

Portland has been and continues to be a leader in the combined global effort to mitigate and adapt to climate change. Portland was the first major city in the US to identify and plan for the negative impacts of CO_2 in 1993, require LEED gold certification for municipally-owned buildings, and is a national leader in bike and mass transit. Yet for all these leadership positions, Portland and its Climate Action Plan (CAP) lack a weatherization component.

Energy efficiency (coined by Amory Levins as "negawatts") is viewed as a key strategy for both mitigation (less energy generation for heating) and adaptation (homes better resistant to extreme heat) at the federal, state, and local level. Energy efficiency in buildings already occupies a core component of the Portland CAP, particularly as concerns municipally-owned, commercial, or multi-family residential structures. In the U.S., most home weatherization efforts have been targeted at low-income households primarily as a function of the federally funded Weatherization Assistance Program (WAP). Energy efficiency is an inexpensive way to reduce CO₂ emissions, yet the challenge for cities is that the population that could benefit from weatherization programs is diffuse and economically diverse. Federal incentives exist for lowincome housing while high-income housing can often afford to invest in technologies that have a long-term payoff. The gulf in the current weatherization policy landscape lies in the vast space of middle-income homeowners.

The landscape of potential homes to be targeted by future iterations of the Portland CAP is large, varied, and unwieldy for a one-size-fits-all policy design. In this report, we provide GIS maps and analysis of relevant variables that could be used to identify and prioritize homes for future weatherization efforts.

We conducted a **pilot study** measuring heat loss from homes with a distribution of size (square footage) and year built across four sites in SE Portland. These results, while certainly specific to a particular set of neighborhoods, are generally consistent with the distribution of single family homes in Portland – particularly in terms of build year. We find evidence that targeting **older** homes in Portland might have the largest desirable effect on energy efficiency improvements.

Based on our empirical evidence, we cannot make a clear recommendation on whether targeting **larger** homes would be advantageous. In this case, the data is complicated by the fact

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that larger homes are also generally higher-value homes. We do not see a clear trend in energy loss (as measured by thermal imaging) with square footage, perhaps as a result of differing building materials. Certainly more energy must be expended to warm a larger home, and we do observe a qualitative match in the census tracts with larger than average gas usage also being those with larger average square footages. However, we motivate a focus on **middle-income** homes not based on this physical data, but rather on a perceived gap between assistance programs on the low-income side and ability to spend in anticipation of longer-term gains on the higher-income side.

We conclude with recommendations with regard to which homes should be targeted and



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In the wake of the 1973 oil crisis, the federal Weatherization Assistance Program (WAP) was created under Title IV of the Energy Conservation and Production Act of 1976.¹ Its purpose was to save imported oil and cut heating bills for low-income households, and it emphasized low cost emergency and temporary measures such as covering windows with plastic sheets and caulking and weather-stripping windows and doors. The 1990s show a trend towards more cost effective measures, most notably auditing homes to comprehensively analyze the best approach for each individual structure.

Today, about 20-

It is worth noting that weatherization measures have their roots in cost effectiveness even before climate change was an issue in the public consciousness, the federal government recognized its monetary benefits.

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low cost materials),³ the establishment of standards in Boulder and Denver targeting new homes and remodels, Seattle's low-cost loans (tailored for low-come houses),⁴ and endless, more ambiguous and vague language concerning partnering with the private sector (Denver) and educational materials (also Denver).

Boston's CAP was updated and released in 2011 by Mayor Menino.⁵ Its description on its page of the official website of the city of Boston reflects a particular emphasis on the economic benefits of climate change action, citing solid waste and produce net savings of over \$2 billion by 2020 through lower energy bills as well as the jobs resulting from "demand for energy and climate related services." Another emphasis, unique to Boston's building efficiency measures, is a

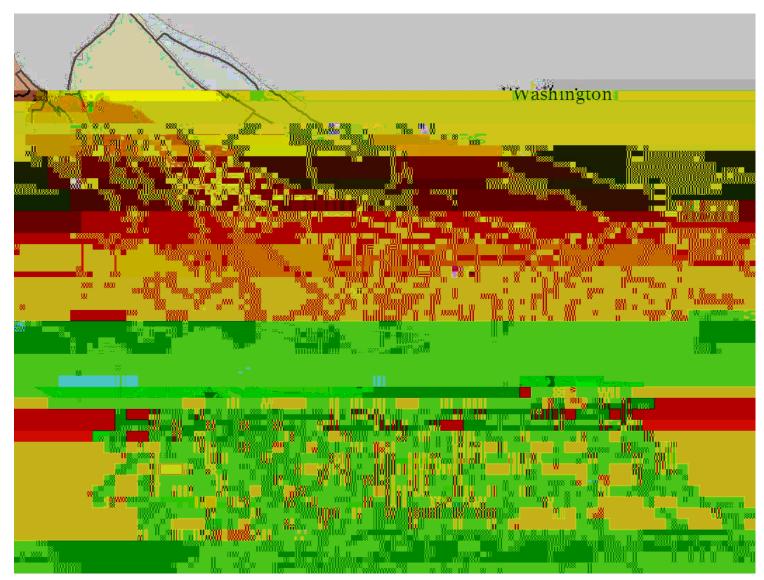


Figure 1. Gas use by census block in Portland city. Data are symbolized as number of single-family houses above median gas use (darker color represents more homes above median gas use) by census block, normalized by number of single-family homes in each census block. Data: City of Portland, Bureau of Planning and Sustainability. Box indicates area of study for this report.

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Figure 2. Map of SE Portland with zoomed in regions showing sampled houses layered onto gas/electric data

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Figure 4. Correlation plot of !T from the maximum wall temperature with respect to house age.

Figure 5. Correlation plot of !T from the front door temperature with respect to house size.

In addition, thermography data was collected from a single house both before and after windows were reinsulated and reset. Figure 6 shows before and after IR images of this house which is typical in size and value to our mean home.

We teamed with Lewis & Clark College's Digital Field Scholarship program for this study. As a result, the complete "digital field notebook" from this pilot IR thermometry

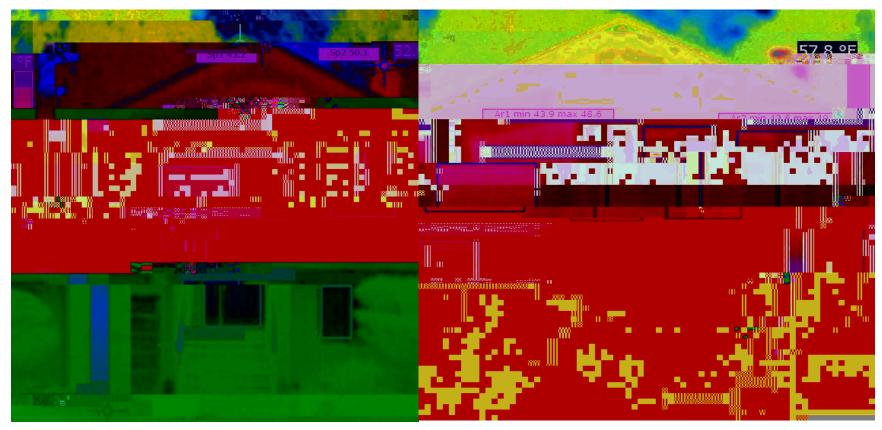


Figure 6. IR images taken of a single home before and after implementation of weatherization improvements. The left image is prior to weatherization actions; the right image is post-weatherization. The two windows in the upper right hand corner of the image were weatherized; the result is a reduced heat loss differential between the siding of the home and the windows.

with high gas use, weatherization will be an attractive option not only because of the "green" value, but because of the increases in home value and the decrease in utility bills.

renovation together. By reframing the focus of the weatherization project from individual homes to city-wide and global, those who can easily pay for higher gas use may recognize the inherent value in weatherization for lowering resource use. This "group mentality" reestablishes the importance of gas use as a proportion of total expenditure on an inramissty

their tenants is necessary. This should be relatively easy to implement, however, since the energy savings experienced by tenants would be net neutral (and eventually net positive) if they paid the difference to landlords until the initial cost of installation is completely paid off (after which tenants reap the benefits of lower energy bills once their rent is lowered to its initial value).

An effective and perhaps overlooked venue of information dissemination (that can effectively inform households of the benefits to weatherization) is the act of canvassing. This can be done door to door, at events like farmers markets and festivals, and at storefronts. We propose what seems like an obvious tactic because experience at Green Mountain Energy has shown us that this will be an extremely effective way of getting residents of Portland on board with the weatherization program. The model used by Green Mountain Energy was very successful in getting PGE customers to pay *more* to have a higher percentage of renewable energy going to the grid (a benefit from which they never profited). We are therefore confident that canvassing efforts to inform people of a program that is *directly profitable to them*, requires no effort, and reduces fossil fuel consumption, will be effective.

The implementation mechanism utilized by Green Mountain was simple. A canvasser would either go door to door or set up tables at festivals, farmers markets, and storefronts. The canvasser's job would be to get attention with lines like "do you want to improve your home value and reduce your electricity bills with Portland's building efficiency program?" Interested recipients would fill out a short form involving their name, phone number, and address, which is entered into a database. Given the success of Green Mountain in getting customers to sign on to a program that was a direct cost to them, it is likely that these sort of information disseminating efforts would be wildly effective for the city of Portland in getting residents to agree to weatherization.

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Note: the text below was taken / adapted from the DOE EERE program website and these cities' published online Climate Action Plans (websites cited above in the report body).

U.S. Department of Energy (DOE) Energy Efficiency and Renewable Energy (EERE) Weatherization and Intergovernmental Program (WIP) http://www1.eere.energy.gov/wip/wap_apply.html

estimated 20-30 million U.S. families eligible for program

- ! Criteria for eligibility state dependant but:
 - automatically eligible if receive Supplemental Security Income (people who are low-income and old or disabled) or Aid to Families with Dependent Children*. "Low-income" is described as income within the 200% poverty threshold, which is to say househould income is 0-2 times some defined "poverty" level of income. Some states may alternatively use 60% of the median state resident income as a poverty benchmark.
 - "States often prefer: age > 60 years, families with one or more members with a disability, families with children

Process:

- ! Call local agency
- ! Fill out application form/provide proof of income for the previous year/go through an interview process
- ! If the agency determines you are eligible they place you on a waiting list
- ! Eventually a state-sponsored energy consulting firm will audit your home and recommend an action plan stressing costing-effectiveness, if said plan is approved by the homeowner then they will weatherize your house

Interesting facts:

- ! Started in 1976
- ! The average weatherization cost per home is \$6500. On average the program increases home values by \$14,300
- Program open to: renters (with written landlord permission), owners, single-family homes, multi-family complexes, mobile homes
- ! Available resources subject to fluctuations as Congress decides funding for the program on a yearly basis
- ! Applications for the program and direct allocation of aid to individuals is managed by State and local governments. Guidelines in the U.S. constitution discourage the federal government from providing aid directly to individuals
- 1989 marks the Oregon legislatures' first carbon reduction goal. In 1993 Portland became the first local government in the U.S. to adopt a greenhouse gas-reduction plan.

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Seattle, but an exception is made for non-Seattle residents who are still customers of Seattle City Light (Seattle's public energy utility).

- ! The application process involves-
 - " Mailing a completed application form along with documentation of all income sources for the past three months to the City of Seattle- Office of Housing.
 - " After a period of 1-2 weeks in which your application is processed and approved, you will receive a call to schedule an energy audit of your home

Additionally, the "Renew Boston" program draws on municipal resources to "develop measures and partnerships that assist Boston residents, businesses, and institutions in taking full advantage of the utility programs."

13 community-based organizations (as of Fall 2010), under this program, have been working to connect Boston households with no-cost weatherization services. Renew Boston's weatherization component focuses on households whose income is between 60 to 120 percent of the median.

Two-thirds of the 2020 goal for GHG reductions from buildings Energy-efficiency retrofits of existing buildings. However, Boston's climate action has an eye to the future, stating that "Better energy performance in new buildings is essential in looking beyond

Hard copies and an electronic version of this mock-up brochure will be provided with our report. Many of these images are taken from CleanEnergyWorksOregon.org, so this should be seen as a sample only.

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