

ECA and Heat Pumps for Urban Heat

Mikel Saralegui | Environmental Studies | mikels@sas.upenn.edu | Mentored by Dr. Kristin Field

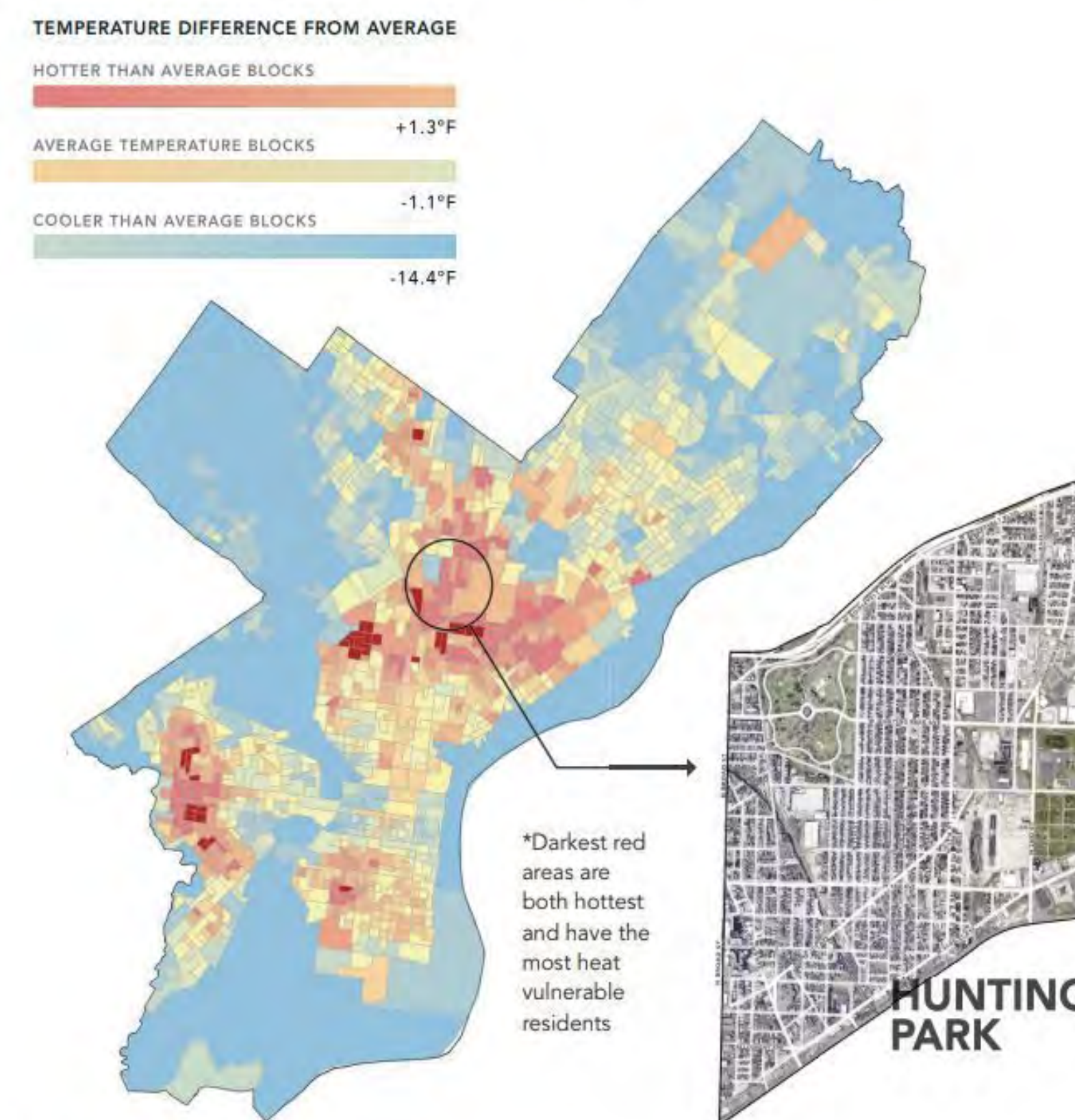
Philadelphia, like other urban cities in the US, has been experiencing increasing amounts of record temperatures. In 2022, Philadelphia experienced a 10-year record temperature of 99 deg F, leading to the death of 5 people across a hot week in July. This is because Philadelphia is an Urban Heat Island, trapping heat through concrete and asphalt, raising peak temperatures by 2-5 deg F.

My Internship at ECA

- The Energy Coordinating Agency (ECA) provides HVAC and weatherization services to low-income communities across Philadelphia
- ECA also trains citizens to receive certifications for weatherization practices to become technicians
- ECA receives yearly grants from the Interstate Renewable Energy Council (IREC), which need to be outlined in the IREC Annual Report



FIG. 2 MAP OF HEAT EXPOSURE AND MOST HEAT VULNERABLE CENSUS BLOCKS IN PHILADELPHIA



Heat Pump Tax Credit

- To use the heat pump tax credit on your taxes, you need to file an IRS Form 5695 with the point-of-purchase heat pump price
- In Philadelphia, due to the compact nature of the city, most heat pump installations will heat and cool using an air-based system, versus water or geothermal
- Air heat pump installations average from \$4000-\$8000, which currently one can reduce by a maximum of \$2000 through the IRA heat pump tax credit

Congress and Heat Pumps

- My idea was to transfer this tax credit to the heat pump installation business, to make the point-of-purchase price directly cheaper
- I went through 4 congressional offices trying to find the transferability of heat pumps, requesting both a Congressional Inquiry (a review of legislation), and a request for help from a federal agency
- The result from these congressional offices was that the credits were not transferable from homeowners to businesses
- This means that in the meantime, homeowners have to wait until tax season to redeem their tax credits

ECA's Heat Pump Process

- ECA manages to install heat pumps at no cost to homeowners at the poverty line through a grant from congressman Dwight Evans
- This grant enables a 3 year program in which ECA students work with seasoned HVAC contractors to install 65 heat pumps across 2 years
- Students perform a checkup on these heat pumps and search for jobs in the 3rd year, developing both the community's workforce and infrastructure



HOW MUCH DOES A ZONED COMFORT SYSTEM COST?

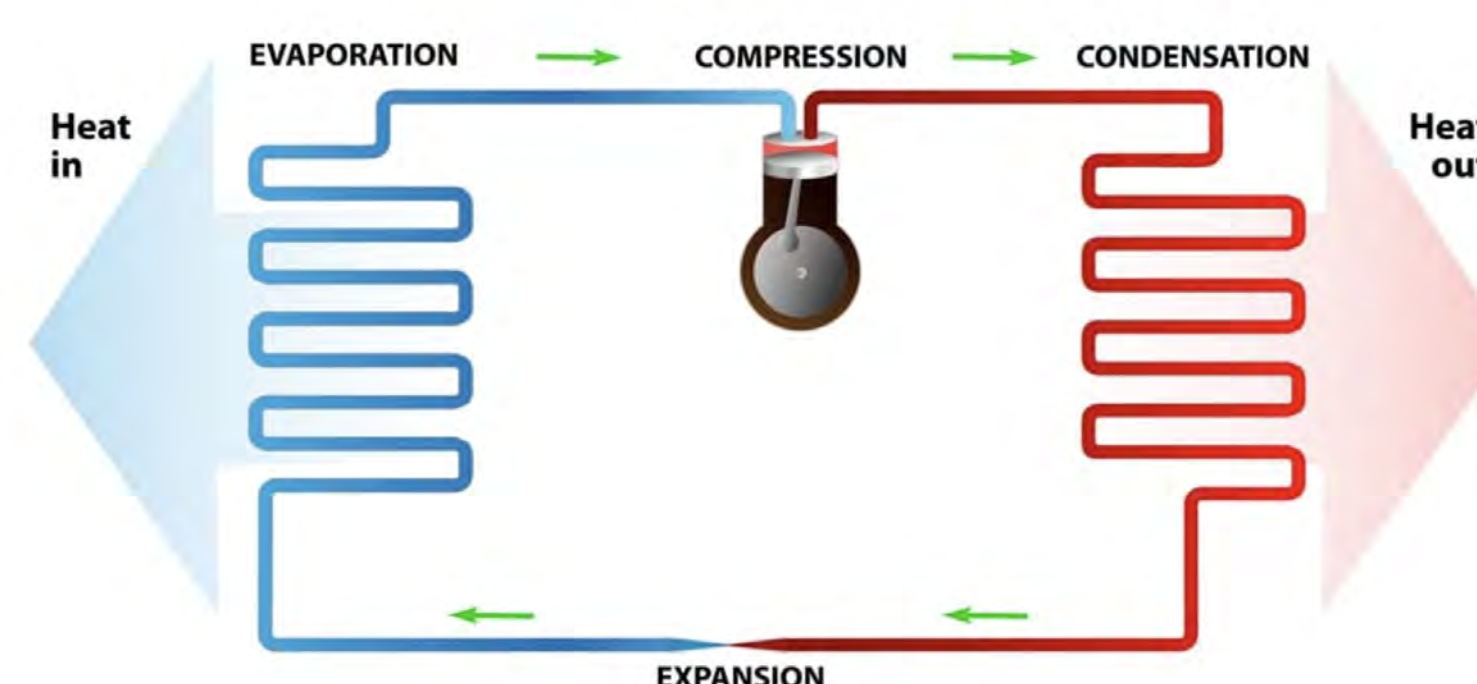
SINGLE-ZONE DUCTLESS	MULTI-ZONE DUCTLESS/DUCTED	MULTI-ZONE DUCTED
\$5,995	\$14,250	\$15,750
SYSTEM SUMMARY	SYSTEM SUMMARY	SYSTEM SUMMARY
SINGLE ROOM ONE UNIT OUTDOOR UNIT TOTAL BTUs = 12,000 REFRIGERANT LINE = 50 FEET	MULTI-ROOM THREE UNITS OUTDOOR UNIT TOTAL BTUs = 30,000 REFRIGERANT LINE = 150 FEET	MULTI-ROOM TWO UNITS OUTDOOR UNIT TOTAL BTUs = 30,000 REFRIGERANT LINE = 100 FEET

Pros and Cons of Heat Pumps

- Pros**
- Ability to both heat and cool the home with one system
 - Much more energy efficient than A/C or gas boilers (175-300%)
 - Minimal Upkeep - only need to be checked 1-2 times a year
- Cons**
- Initial Price can be more expensive than window A/Cs or gas boilers (avg. \$4000-8000)
 - Does not do well in climates that frequently go below freezing
 - Cannot function without electricity



How does a heat pump work?



Sustainable Heating & Cooling

The following helps you utilize the Heat Pump Tax Credits and rebates available in the Inflation Reduction Act of 2023. These incentives compound the \$900 a year saved through the efficiency of electric heat pumps. At the moment, there are two options for owners looking to buy heat pumps:

Option 1: Use the Heat Pump Tax Credit

To take advantage of the heat pump tax credit available through the Inflation Reduction Act, you'll need to complete IRS Form 5695. This form outlines the expenses associated with your heat pump installation.

When you submit this form during the tax season, you could potentially lower your income tax obligation by 30% of the heat pump's initial cost, up to a maximum of \$2000 in tax credits.

It's important to note that you'll initially need to cover the full expense of installing the heat pump system. The tax credit can then be claimed in April when the tax season arrives.

Option 2: Wait for the Heat Pump Rebate

Through the High-Efficiency Electric Home Rebate Act (HEEHRA), low-income and moderate-income homeowners* will be able to claim up to \$8000 in heat pump instant rebates.

While the rebate is not out yet (expected early 2024), you can take proactive steps to check whether your home's electrical system can handle a heat pump installation. If your home has a 100-amp electrical panel, you will need to update your panel to a 200-amp system instead. HEEHRA also offers an electrical panel rebate of up to \$4500 (also expected early 2024).

*Low-income households are defined as earning less than 80 percent of the median family income in their area. Moderate-income households earn 80 to 150 percent of their area's median income for families.

Why Heat Pumps?

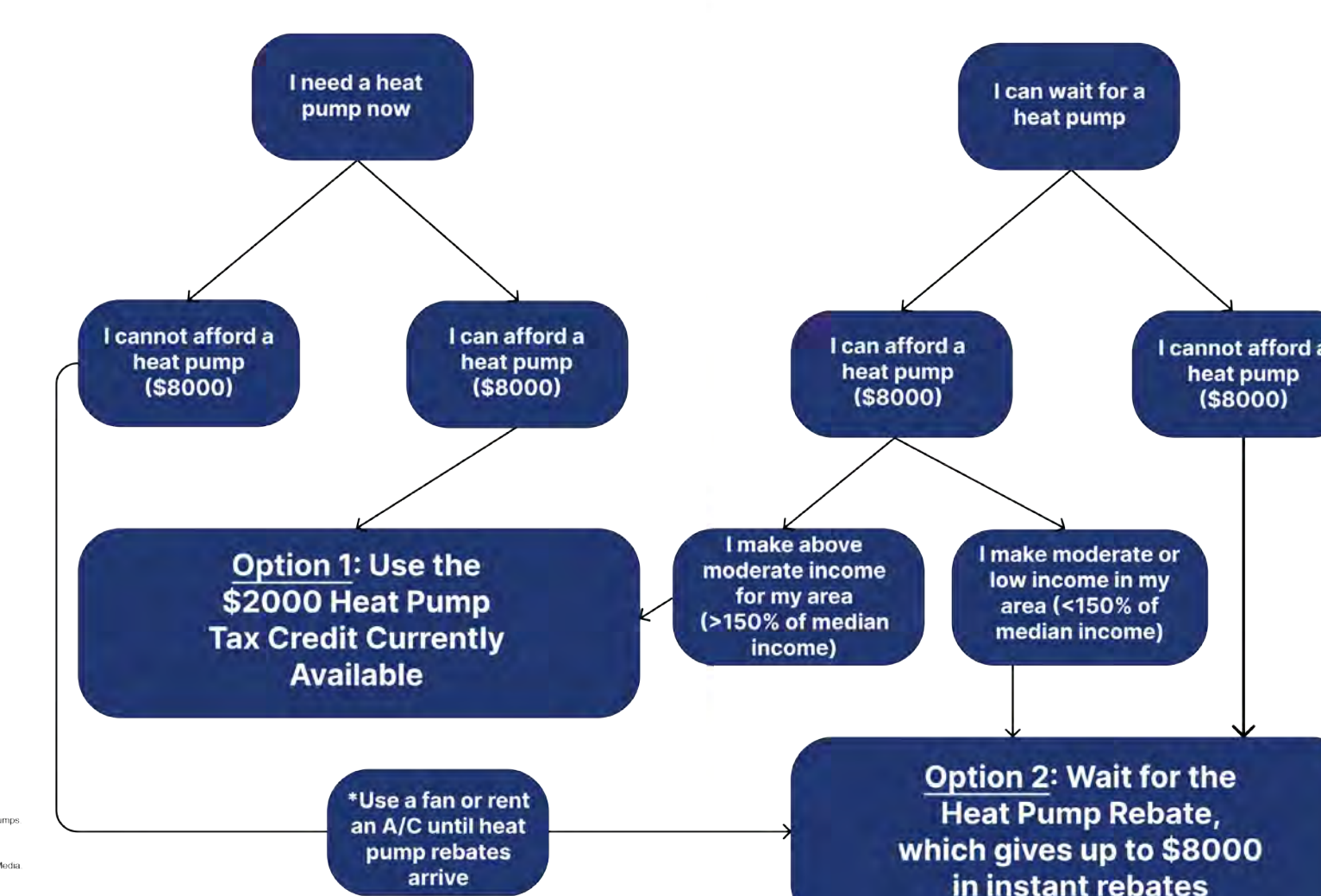
Heat pumps are electric devices capable of transferring heat from a warm source to a cold source to provide heating. This process can be reversed to also provide cooling, eliminating the need for both A/C and a boiler. A single room heat pump costs between \$4000-\$8000 depending on sq. footage, and can heat and cool multiple rooms through the installation of air handling units across a home.

- Heat pumps have the ability to both heat and cool homes with one system
- 2-4x more energy efficient than A/C and gas boilers (saves avg. \$900/year)
- Minimal Upkeep - only need to be checked 1-2 times a year

Single Zone Ductless Heat Pump: \$5,995

Tax Credit or Rebate?

This is a decision tree outlining whether to use the current heat pump tax credit or to wait for the future heat pump rebate, coming in early 2024. More info can be found on page 1.



Inflation Reduction Act

- In late 2022, Biden passed the Inflation Reduction Act, reviewing and renewing many tax laws, particularly in the renewable energy sector
- These changes not only allowed for more affordable installations of renewable energy infrastructure such as solar and wind, but also for home appliances that reduce one's carbon footprint
- This is where I got the inspiration to perform research on the IRA's heat pump tax credit, which gives either back either 30% or up to \$2000 in initial costs of the heat pump

Adapting to Extreme Heat in Philadelphia to Increase Human Vitality

Environmental Innovations Initiative
UNIVERSITY OF PENNSYLVANIA

Penn Engineering
UNIVERSITY OF PENNSYLVANIA

I would like to thank my Mentor Kristin Field for her counseling of my time at ECA, and Andrew Huemmler for connecting me to this research project. I would also like to thank my bosses Walter Yakobosky and Lisa Padilla for providing me the time and tools to engage and understand ECA's green training program, as well as being eager to explain ECA's LIHEAP and heat pump programs.

- Pros and Cons of Window A/C and Heat Pumps: <https://www.forbes.com/home-improvement/hvac/heat-pump-vs-air-conditioner/>
- Dwight Evans' Congressional Office Website: <https://evans.house.gov/contact/offices>
- IRS Form 5695 Link: <https://www.irs.gov/forms-pubs/about-form-5695>
- Heat-Related Deaths in Philadelphia: <https://why.org/articles/philadelphia-confirms-4-heat-related-deaths/>
- Urban Heat Island Info: <https://education.nationalgeographic.org/resource/urban-heat-island/#:~:text=1%2F3%20of%20the%20city's%20area%20is%20made%20of%20concrete%20and%20asphalt,area%20of%20the%20city%20is%20made%20of%20concrete%20and%20asphalt>
- Philadelphia Poverty Line Info: https://www.pewtrusts.org/-/media/assets/2017/11/pri_philadelphias_poor.pdf

Mentor: Dr. Kristin Field, Director of Education, Penn NSF NRT Soft AE Program

Acknowledgements: Walter Yakobosky, Acting Director of Training at Energy Coordinating Agency

References: <https://www.irs.gov/forms-pubs/about-form-5695>, <https://www.eia.gov/energyexplained/urban-heat-islands/urban-heat-islands.php>, https://www.pewtrusts.org/-/media/assets/2017/11/pri_philadelphias_poor.pdf