



*Better Buildings Residential Network
Peer Exchange Call Series*

*New DOE-Funded Research Looks at Homeowner Motivations
and Barriers to Electrify*

January 26, 2023

Agenda and Ground Rules

- Moderator
 - **Jonathan Cohen**, Better Buildings Residential Network, DOE Residential Buildings Integration Program (RBI)
- Agenda Review and Ground Rules
- Residential Network Overview and Upcoming Call Schedule
- Opening Poll
- Featured Speakers
 - **Chrissi Antonopoulos**, Pacific Northwest National Laboratory (PNNL)
 - **Liz Kelley**, Illume Advising
 - **Julie Roth**, Office of Sustainability and Innovations, City of Ann, Arbor, Michigan
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media, social media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- *2/9: Right-Sizing Equipment Vs. Wrong-Sizing – How Not to Waste Energy*
- *2/23: The Deep Retrofit Warranty – A Game Changer?*

Peer Exchange Call summaries are posted on the Better Buildings [website](#) a few weeks after the call



Chrissi Antonopoulos
Pacific Northwest National Laboratory (PNNL)



DOE's Home Occupant Decision and Behavior Study: Occupant Data for Advancing Residential Decarbonization

Chrissi Antonopoulos, Senior Building Scientist
DOE Peer Exchange Call, January 26, 2023



PNNL is operated by Battelle for the U.S. Department of Energy



Project Overview

U.S. Department of Energy (DOE) Building Technology Office (BTO) is funding research to investigate how residents make home energy decisions and to explore whether those decisions help meet decarbonization goals.

Research Questions:

1. What are the motivations and key decision points for energy-related home renovations and upgrades?
2. How do different residential stakeholders decide to buy and use key technologies relevant for residential electrification?

Project Team

- The PNNL team led the study design, research execution, analysis and findings.
- Illume Advising conducted household interviews and collaborated on study findings.
- Study design and execution was informed by an international advisory committee, comprised of over 25 experts in the field.



Chrissi Antonopoulos, PhD,
Building Scientist



Saurabh Biswas, PhD,
Social Scientist



Tracy Fuentes, PhD,
Ecologist



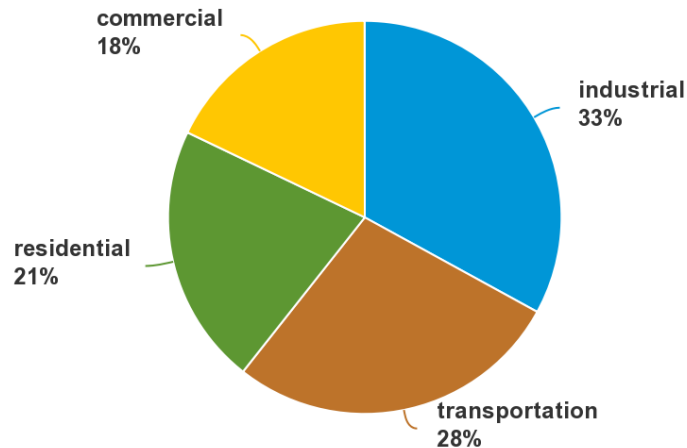
Adrienne Rackley,
Economist

ILLUME

Why is Decarbonization Important?

Share of total U.S. energy consumption by end-use sectors, 2021

Total = 97.33 quadrillion British thermal units



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 2.1, April 2022, preliminary data



Note: Sum of individual percentages may not equal 100 because of independent rounding.

- Residential buildings account for 22% of primary energy consumption in the United States.
- Fossil-fuel combustion in buildings leads to roughly 30% of total greenhouse gas emissions.
- 68% of existing housing stock in the United States was built before energy codes were enacted, resulting in underperforming (by current standards), energy intense buildings.

Decarbonizing our Homes

Objectives:

- Building energy efficiency.
- Electrification of end use appliances/equipment.
- Integration of renewables, energy storage and “smart” energy technologies for demand control.
- Low-carbon material selection.

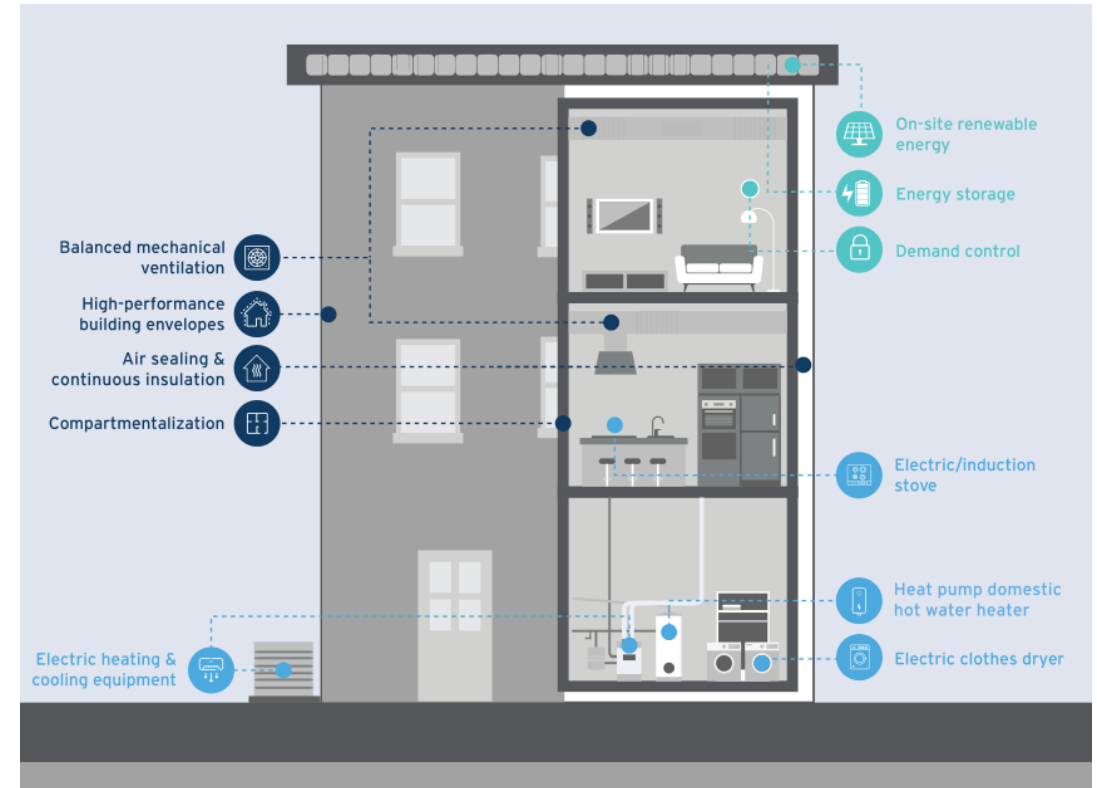


Figure Source: Rocky Mountain Institute <https://rmi.org/insight/decarbonizing-homes/>

Values, Perceptions and Decision Making

The Challenge:

- Household behavior and technology adoption patterns are difficult to predict.
- Even with incentives, many energy-efficient technologies and home upgrades have had slow uptake.

Typology	Intervention	Examples
Stick	Regulation Prohibiting Behavior	Ban on natural gas installations in new home construction
	Regulation Requiring Behavior	Building codes requiring high levels of energy efficiency
Carrot	Reward for Discouraging Behavior	Utility rate system tiered to actual energy use
	Reward for Engaging in Behavior	Subsidy for installing energy efficient appliances
Sermon	Provide Information About Energy Conservation	Utility information campaigns
	Provide Feedback About Household Energy Use	Utility inserts, smart meters

Typology from Vedung (1998); Harrison (1998) and Pacheco-Vega (2020) are examples of how typology applies to environmental regulation and governance

Project Activities

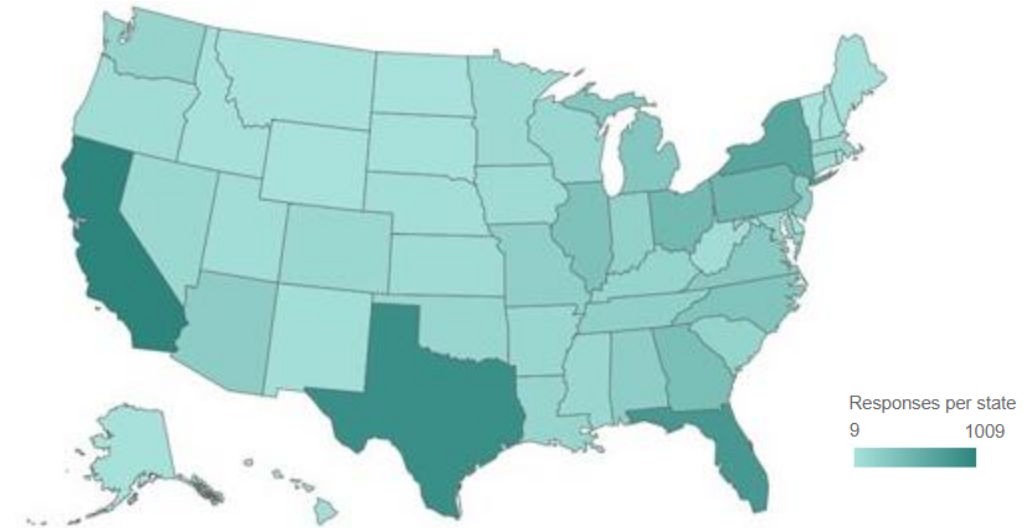
- **HVAC manufacturer outreach** to learn about customer discovery and marketing.
- **Review literature** to identify previous study findings.
- Develop research protocols, sampling strategy, participant criteria, analytical methods and gain Institutional Review Board (IRB) approval.
- Conduct in-depth, semi-structured **interviews** with 150 households to better understand purchasing decisions, use patterns and energy efficiency perceptions and behavior. Interviews conducted by Illume Advising
- Execute national-scale **survey** to 10,000 homeowners and renters, using questions developed from interview outcomes.
- Synthesize results from interviews and survey to inform decarbonization strategies.
- Work with an **external advisory board**, comprised of experts in the field to inform methods and research protocol.

Survey Release and Targets

- Survey was released on August 12th, and closed on October 17th 2022.
- Available in English and Spanish.
- 10,000 responses distributed evenly across the country.
- Race/ethnicity criteria was set to match the US Census.
- 70% homeowners, 30% renters, also matching US Census.
- Partial responses not counted.
- Survey recruitment and data collection conducted by Qualtrics.

Survey Respondent Demographics

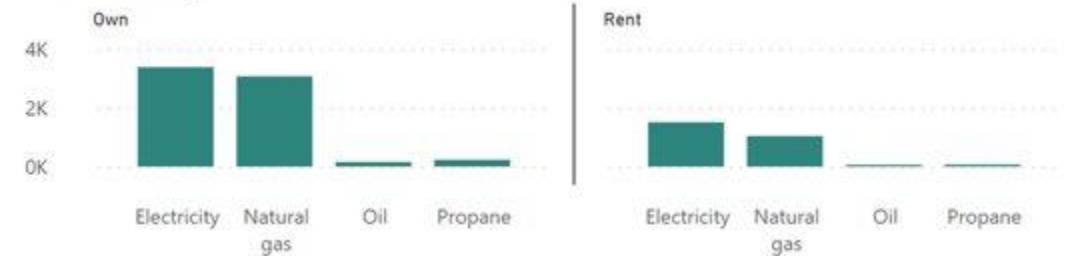
- 9,926 total survey responses, after data cleaning.
- 80% of respondents live in single-family homes.
- 71% homeowners, 29% renters.
- Average respondent age was 46-55.
- Average HH income was between \$60k-\$75k/year.
- Homeowners live in larger homes than renters.



Heating Fuel



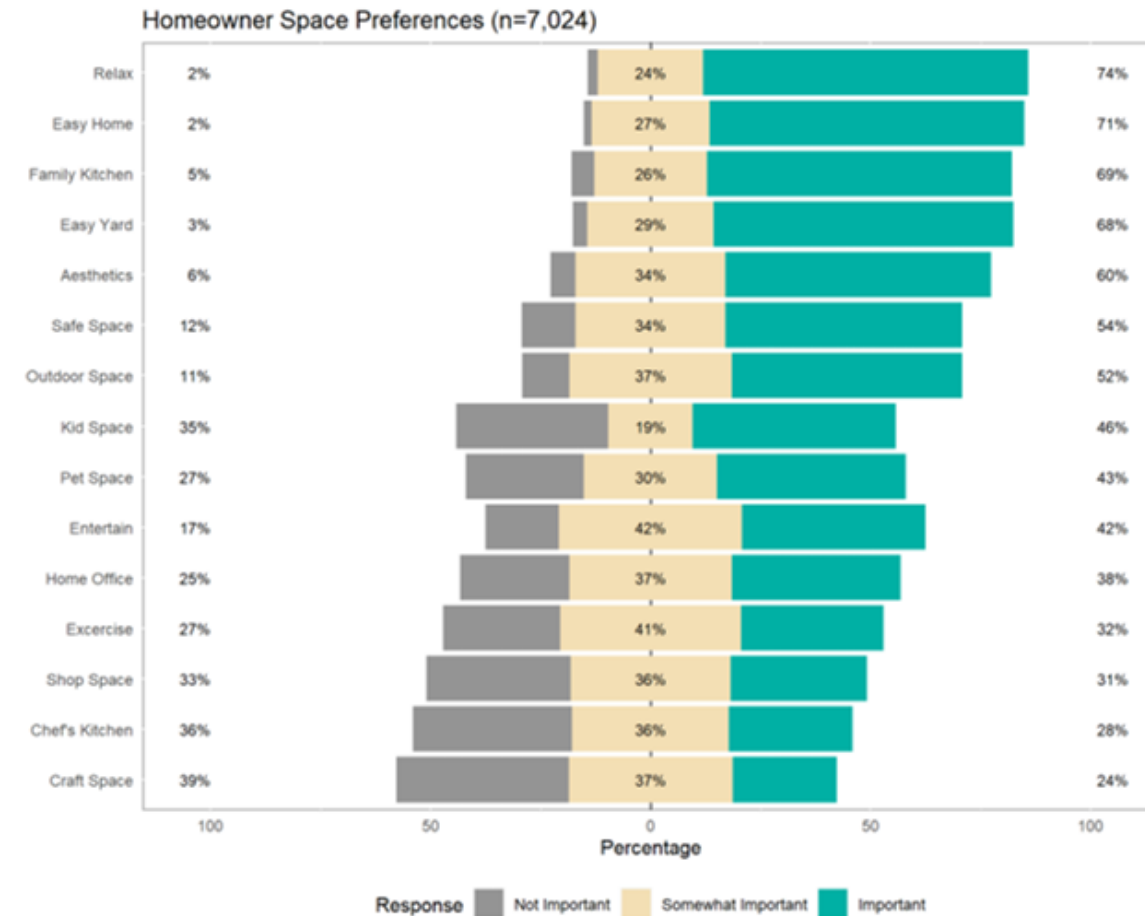
Water Heating Fuel



Preferences for an Ideal Household Environment

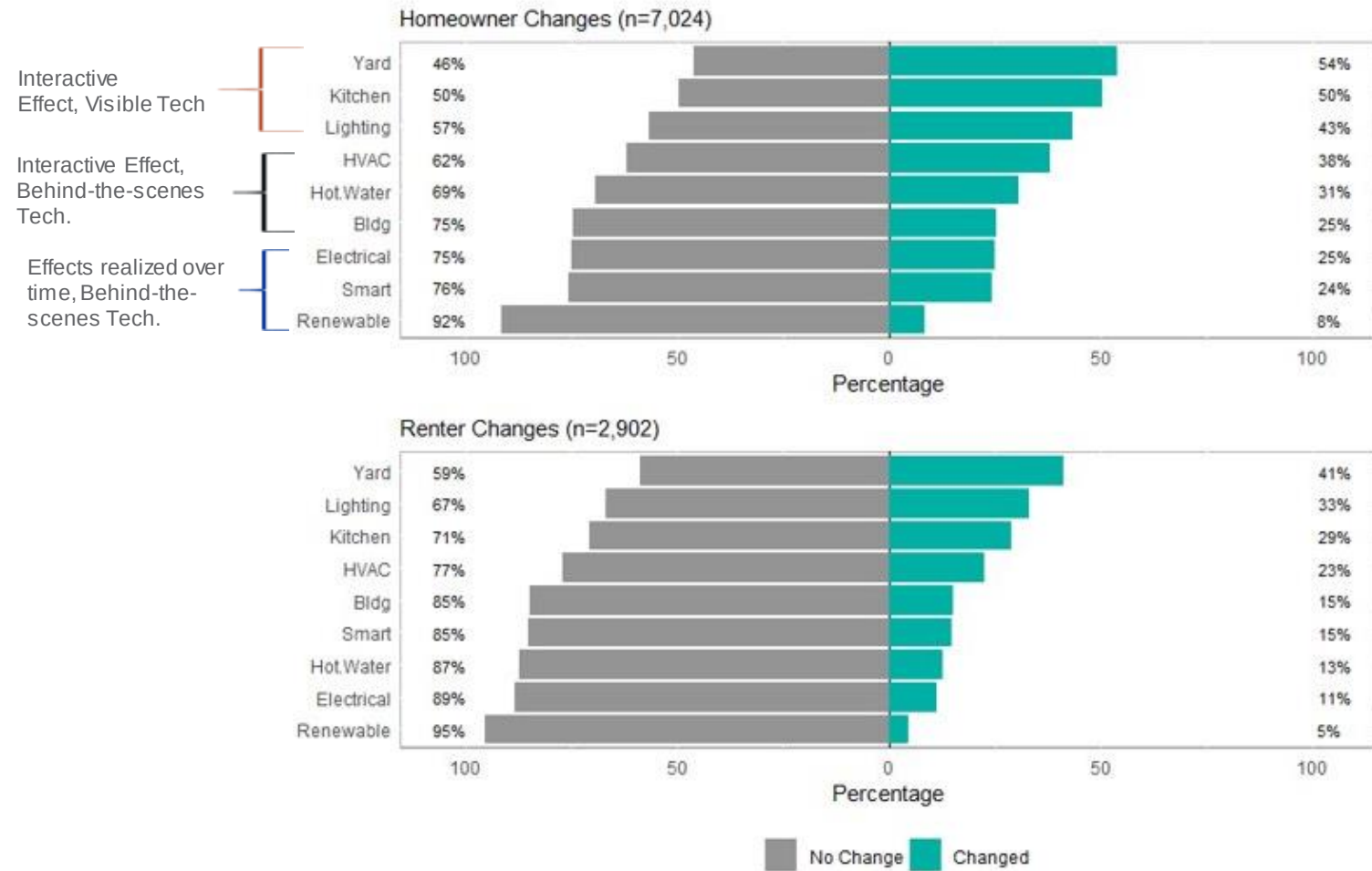
We asked what considerations most influence decision-making:

- **Most important:** A place to relax and a home/yard that is easy to care for (74%, 71%).
- **Important:** A family kitchen (69%).
- **Important:** Homeowners highly value the look of their home (60%).
- **Noted:** Safety and access to outdoor space were noted by about half of respondents. More renters' indicated safety was important (61% vs 54%, $p < 0.0001$)



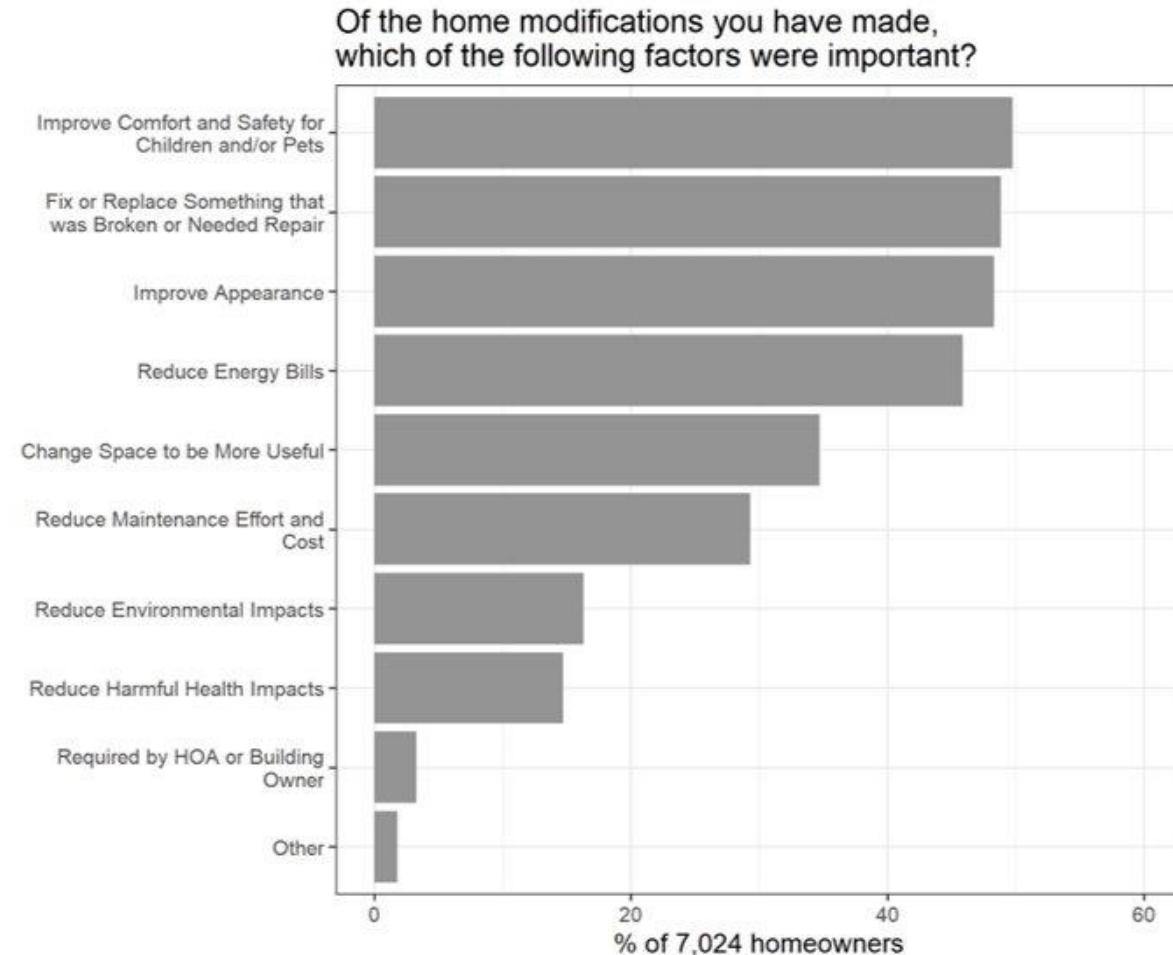
Upgrades and Changes

- More renters and homeowners changed visible, interactive technologies than “behind-the scene” technologies.
- Overall, homeowners are more likely to make changes than renters.



When are Upgrades Made? Motivations for Change

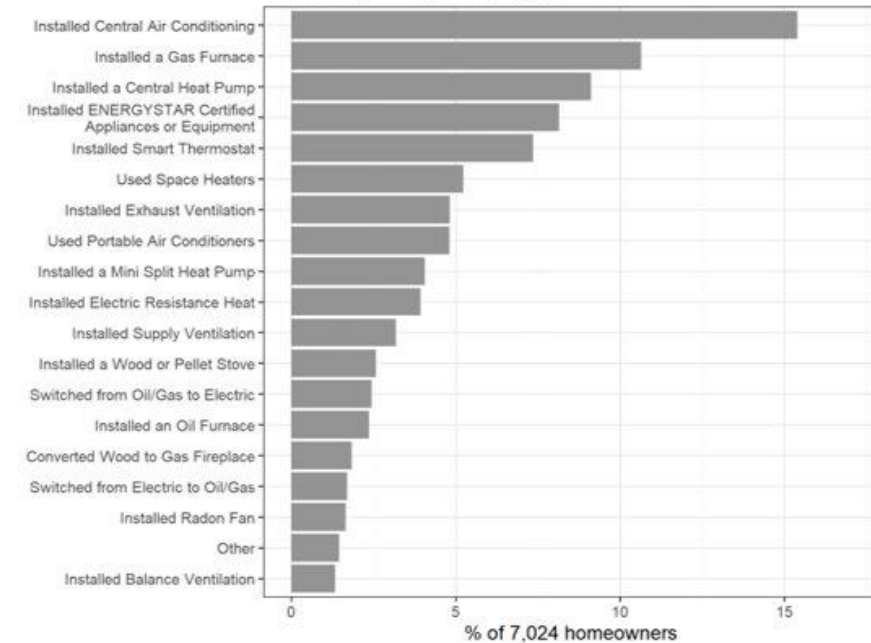
- Comfort/safety for pets/children is the biggest motivator for homeowners and renters.
- Repairing/replacing something broken is second for both homeowners and renters.
- Improving appearance and reducing energy bills are about equally as important.
- Reducing environmental impacts is less important.



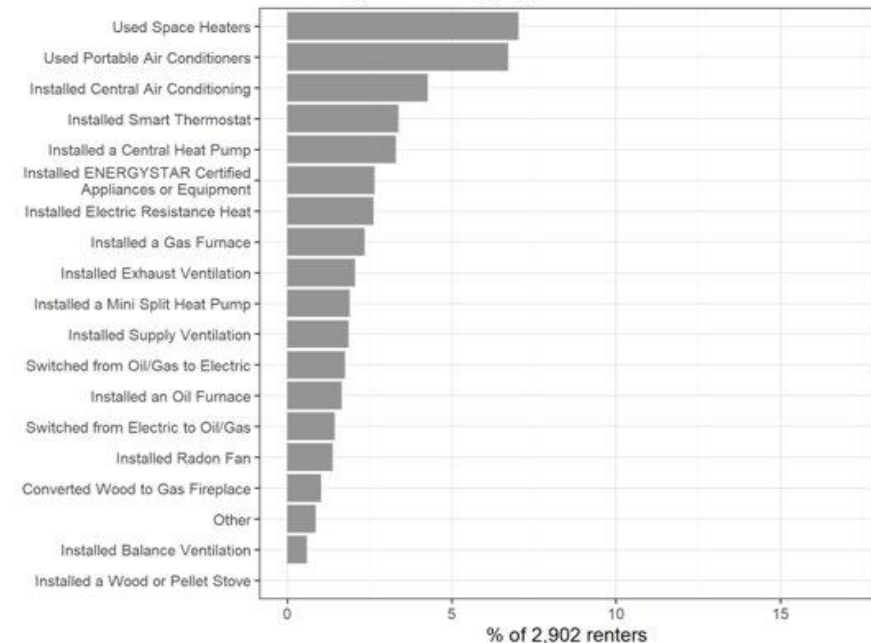
Behind-the-Scenes Tech: HVAC

- Fewer changes to HVAC for both groups (38% owners, 23% renters).
- Energy efficiency was noted as the most important consideration for HVAC and hot water technology decisions (63% for both groups).
- Renters depend on portable heating/cooling, which tends to be inefficient.
- Central air conditioning and gas furnaces dominate homeowner HVAC changes.
- Central heat pumps installed by 8% of homeowners.

What Types of Modification Did You Make to Heating and Cooling Appliances?



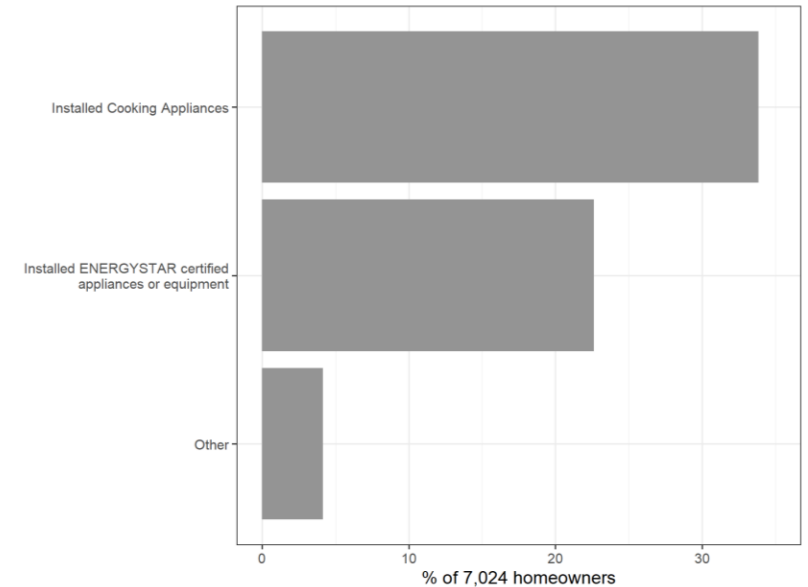
What Types of Modification Did You Make to Heating and Cooling Appliances?



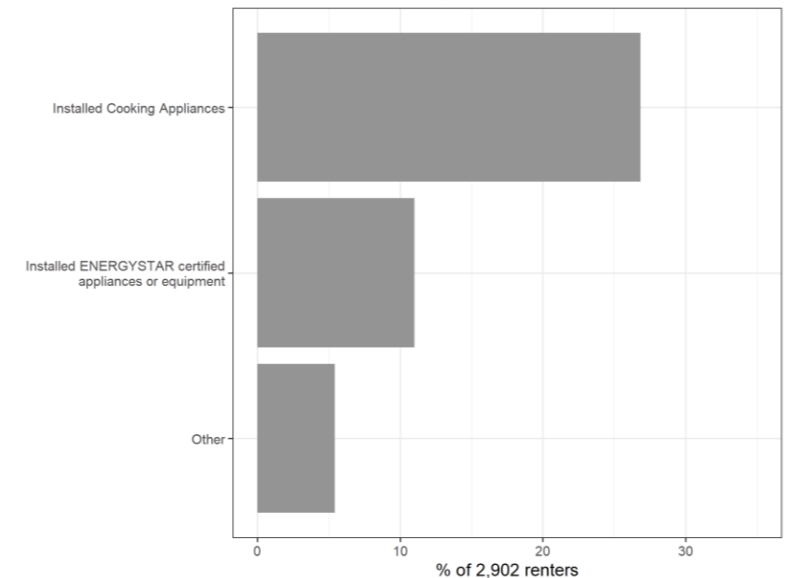
Many People Make Changes to their Kitchen

- 50% of homeowners and 29% of renters have made changes in the kitchen.
- New stoves were installed by 34% of homeowners and 19% of renters.
 - Good place to initially focus electrification programs!
- Availability in big box stores was noted by both homeowners (45%) and renters (40%) as the top influencing factor supporting their decision-making processes.

What Types of Modifications Did You Make to Kitchen or Kitchen Appliances?



What Types of Modifications Did You Make to Kitchen or Kitchen Appliances?



Big Picture Differences Between Homeowners and Renters?

Homeowners

- Installing central AC #1 HVAC change (16%).
- Installed a new roof (8%) and windows (8%) as #1 envelope upgrades.
- Energy efficiency most important consideration when making HVAC/WH decisions.
- More than 15% of homeowners have upgraded their electrical panel.

Renters

- Bought space heaters or portable AC (7%, 6%) as #1 HVAC change.
- Air-sealed (6%) and installed window attachments (5%) as #1 envelope upgrades.
- Energy efficiency most important consideration when making HVAC/WH decisions.

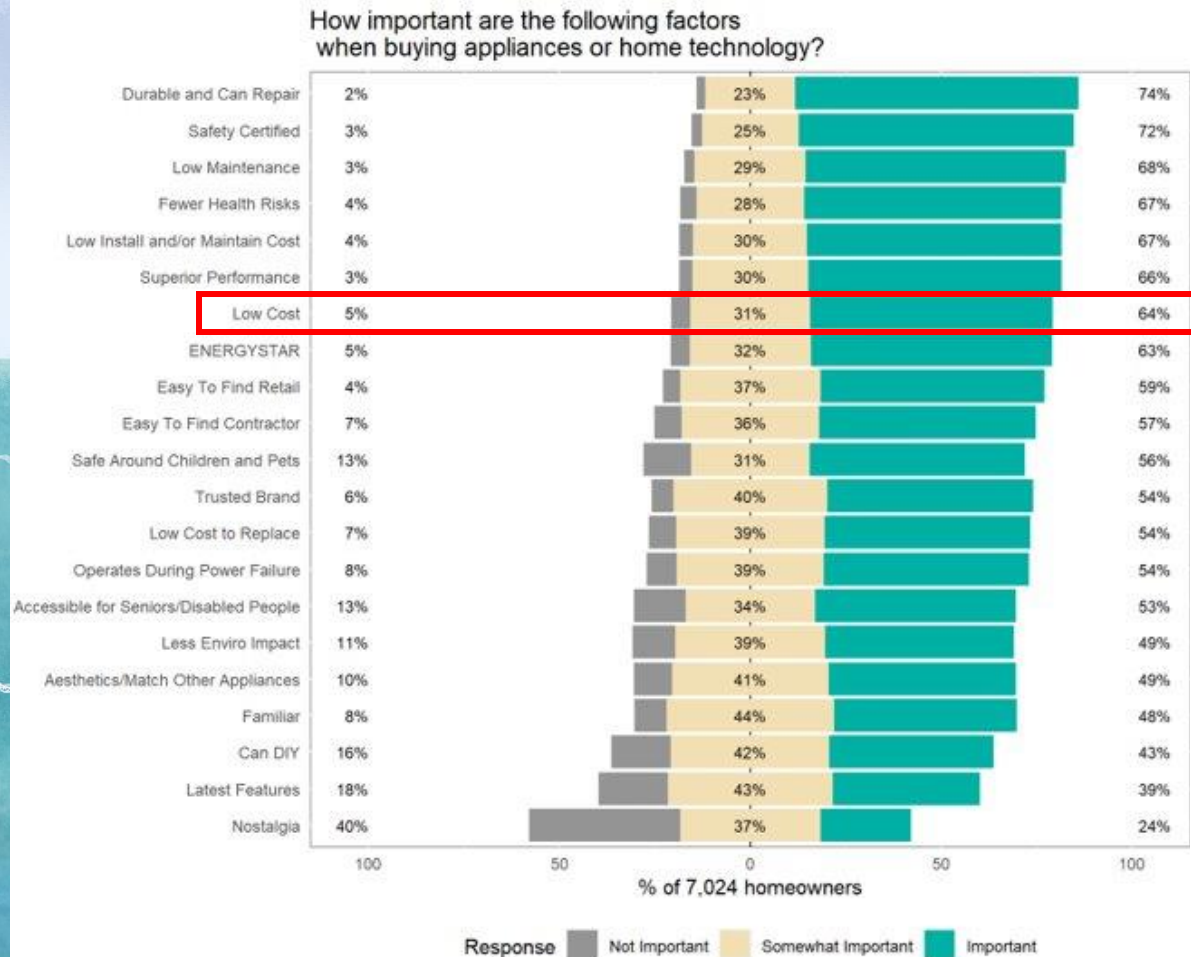
Not All Decisions are Based on Cost

When purchasing appliances and home technologies:

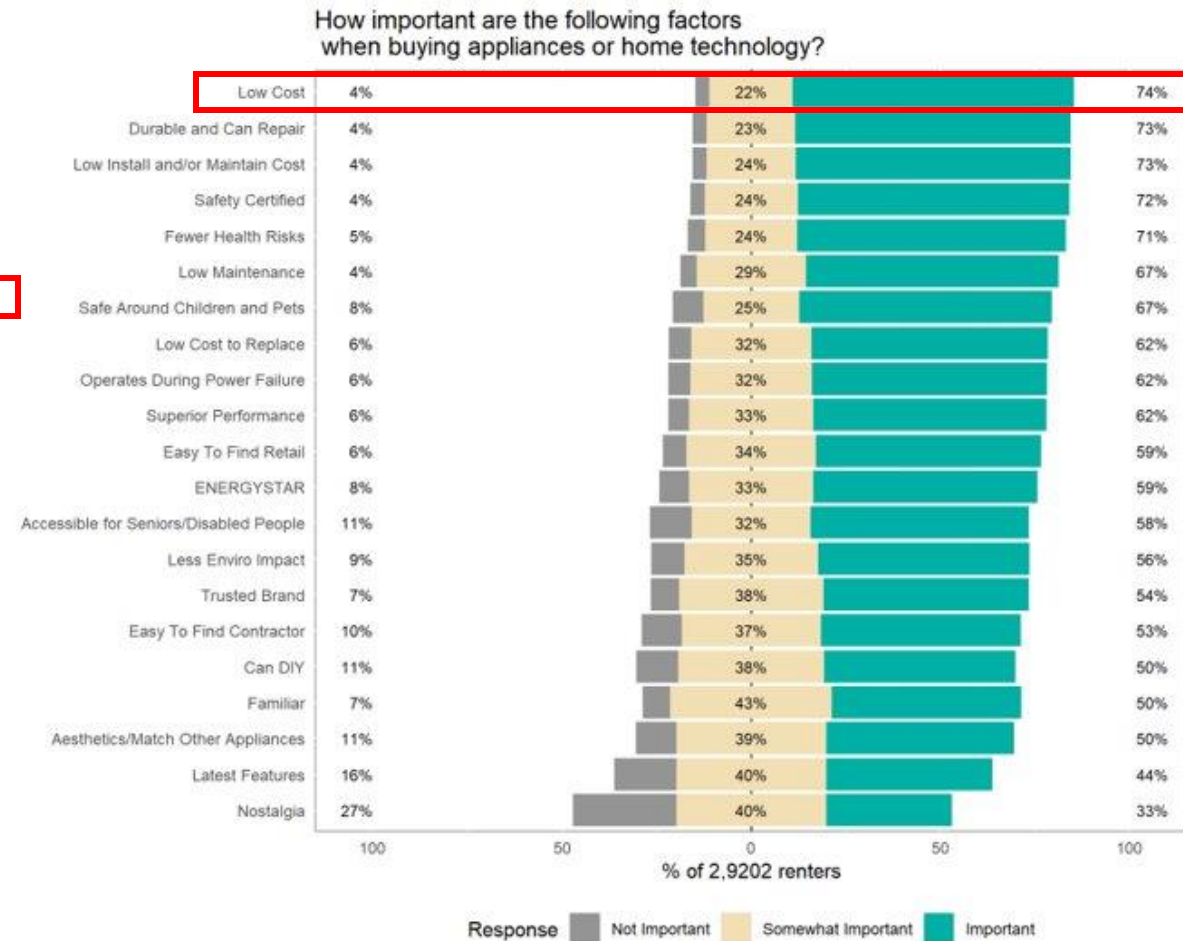
- Cost is the most important factor for renters, but not homeowners.
- For homeowners, health and safety for occupants and pets is more important than cost.
- Durability, repairability and low-maintenance are highly valued by both homeowners and renters.
- Tech with the latest features, or those with high nostalgia, are not highly valued by homeowners or renters.

General Factors that Influence Selecting Appliances or Home Energy Technology

Homeowners



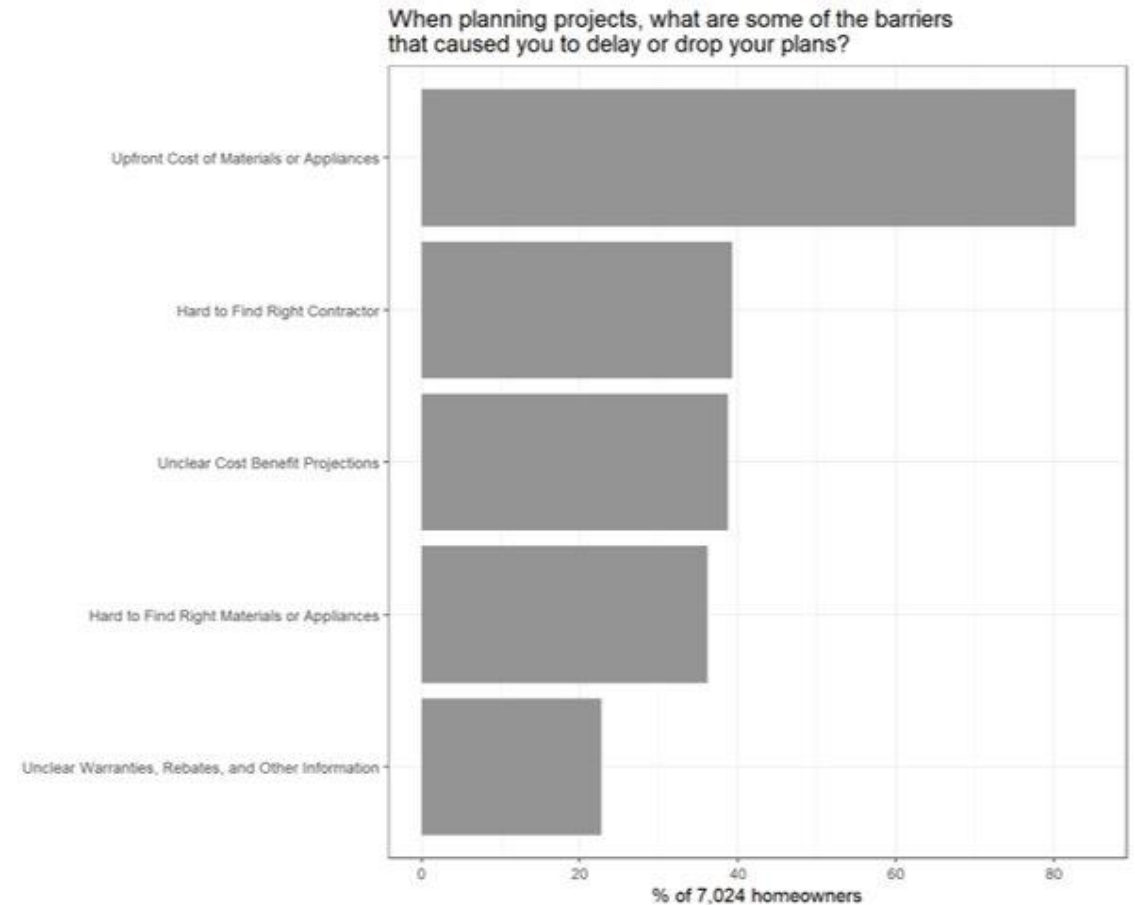
Renters



• Welch's Modified Two-Sample t-Test $p < 0.0001$

Role of the Contractor

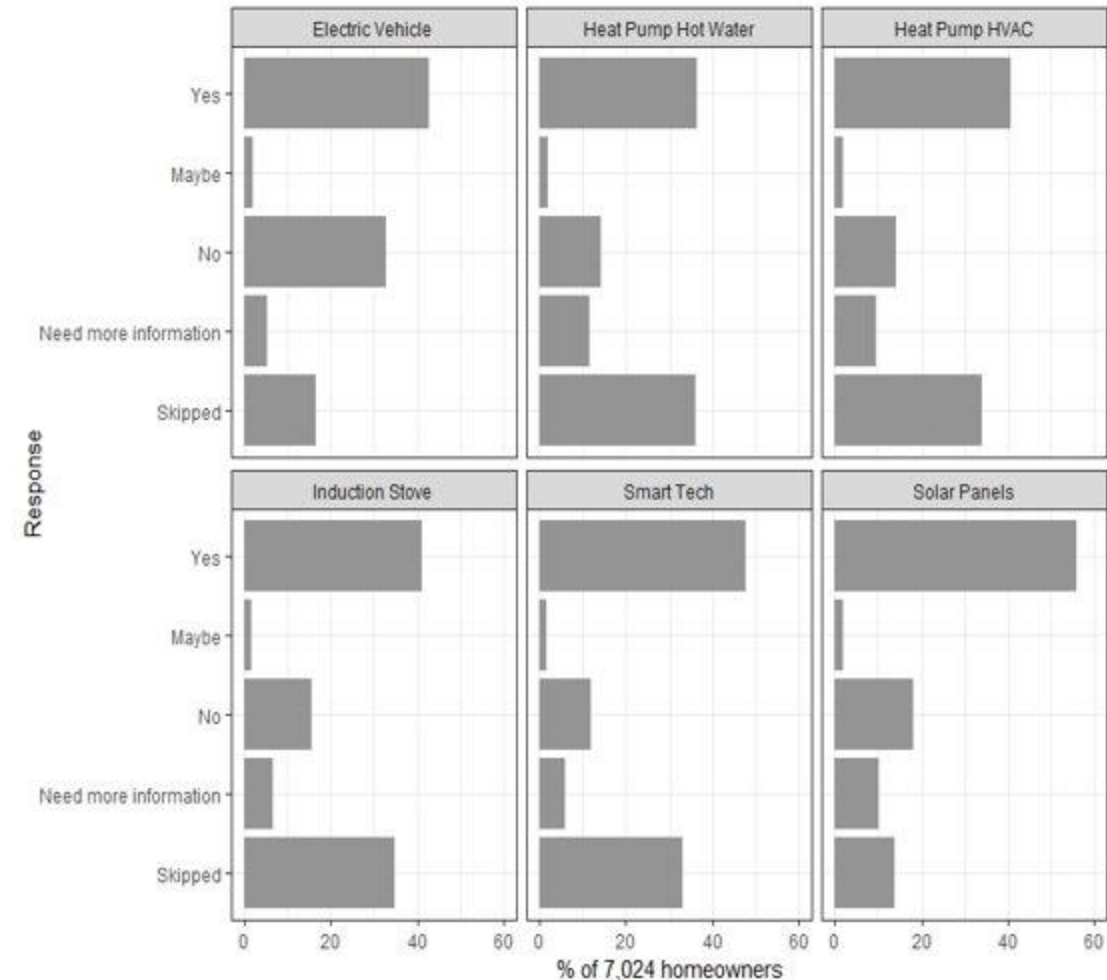
- In addition to upfront cost, contractors have significant influence in the decision-making process, especially for homeowners.
- 40% of homeowners who dropped project plans noted that they couldn't find the right contractor for the job.
- 25% of homeowners noted that a recommendation from a trusted contractor helped them make an upgrade decision.



Willingness to Purchase Decarbonization-Friendly Technology

- Homeowners and renters alike show willingness to invest in electric technologies, even emerging tech. if prices are affordable.
 - Renters' willingness hinges on rents remaining stable.
- 40% of homeowners said they would be willing to install a heat pump (HP).
 - Only 8% of homeowners and 3% of renters have installed HPs.
 - Big opportunity!
- 55% of homeowners would be willing to install solar.
- Contractors and other influencers play a big role in translating willingness into action.

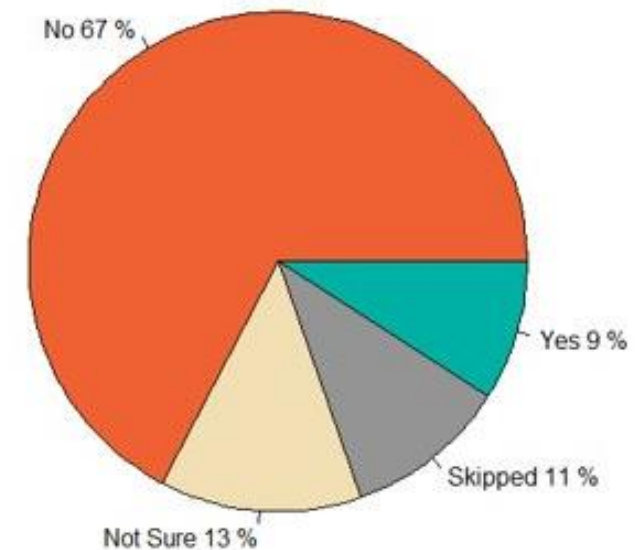
"If affordable, would you be willing to invest in the following technologies?"



Role of Programs

- Most homeowners and renters are not participating in home energy upgrade programs (~67%).
- Of the homeowners that have participated in programs, 71% indicate that the program helped them make the planned upgrade.
- Big opportunity for IRA or other well-executed programs to enhance decarbonization technology in residences.

Participation in Home Energy Program (% of 7,024 homeowners)



Big Take-Aways

- Visible, interactive technologies/attributes are more likely to be changed than behind-the-scenes tech. or those with impacts that are realized over time.
- Messaging around improving comfort and safety for children/pets more effective than a focus on environmental benefits.
- Renters and homeowners value their kitchens highly and are likely to make different decisions specific to how they value a particular room/space.
- Cost is *not* the #1 driver for most decisions, but it's more of a consideration for renters than homeowners.
- Contractors have an influence on decisions. They also can positively and negatively impact occupant's tech experience.
- Homeowners and renters are willing to adopt decarbonization tech., but very few have done so to-date.

Thank You!

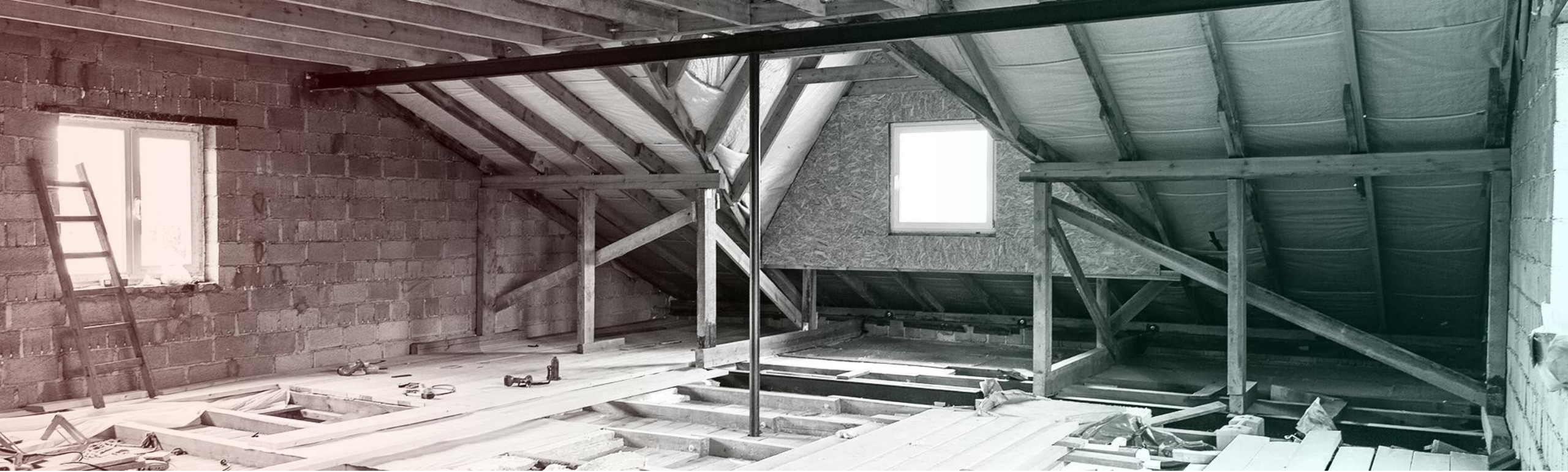
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Liz Kelley
Illume Advising

ILLUME



Pacific Northwest National Laboratory

Advancing Energy Efficiency Behaviors Findings
Webinar

ILLUME Advising
January 26, 2023

Agenda

RESEARCH OVERVIEW

DECISION-MAKING FACTORS

KEY FINDINGS AND RECOMMENDATIONS



Research Overview

Research Focus and Goal

Our research focused on **motivations** and **decision points** for home occupants (owners, renters) as they approached all home projects, including both **energy and non-energy upgrades**, ranging from small maintenance fixes through larger remodeling projects. Our goal is to provide insights that will help industry stakeholders frame **outreach** and **interaction** with home occupants on the topic of **electrification**. Specifically, our research aimed to answer the following questions:

PRIMARY RESEARCH QUESTIONS

How do home occupants make purchasing and renovation decisions that may or may not impact the carbon impact/energy efficiency of their homes? How do these decisions differ across various community and demographic groups?

What are the purchasing decisions and usage patterns for water heaters, HVAC systems, smart thermostats, smart control panels, and smart home energy management systems (SHEMS) writ large?

How can human-centered research inform program design and interventions that will equip communities, companies, and individuals to catalyze deeper energy transitions in the residential sector?

Research Summary

In Spring 2022, the ILLUME team, sponsored by PNNL and DOE, conducted 121 online in-depth interviews with homeowners and renters across four states – Arizona, Georgia, Illinois, and Massachusetts.

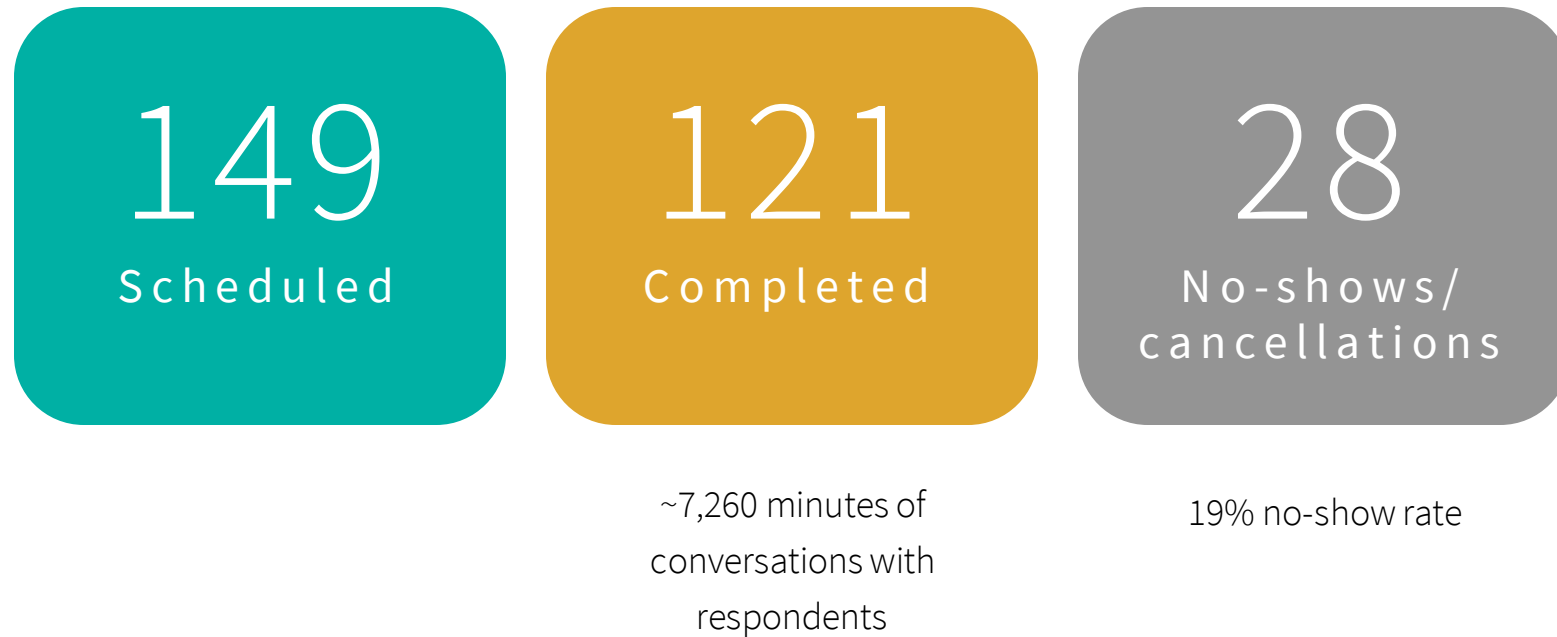
These hour-long interviews explored topics including:

- Home attitudes and preferences
- Approach to home maintenance and finances
- Decisions about energy and non-energy related home projects
- Attitudes towards energy systems and energy bills
- Familiarity and attitudes towards concepts including electrification, decarbonization, and sustainability



Interviews Completed

Overall, the team spoke with 30 people in AZ, 31 in GA, 30 in IL, and 30 in MA.



Respondent Demographics

Total = 121



Home Ownership

Own	84
Rent	37



Race/ Ethnicity

Asian, Native Hawaiian, or Pacific Islander	9
Black or African American	35
Hispanic, Latino, or Spanish	28
Native American, American Indian, or Alaskan Native	7
Non-Hispanic White or Euro-American	55



Age

18 – 24	2
25 – 39	43
40 – 64	60
65+	16



Education

Some high school, HS diploma, or GED	30
Associate Degree	23
Bachelor's degree	39
Graduate or professional degree	29



Income

Less than \$50,000	36
\$50,000 - \$99,999	54
\$100,000 or more	31



Decision-making Factors

Home Upgrade Decision Making Framework

Attitudes Towards Home

- Why did respondents choose their home
- Favorite and least favorite parts of their home
- Rooms or features they focus on

Orientation Towards Home Maintenance

- Regular maintenance vs. emergency maintenance
- Respondent feelings of empowerment/disempowerment
- Prior experience with home cleaning/maintenance
- Life stage

Change-making Resources

- Knowledge (available tech, how to make upgrades, how to use post-installation)
- Access to experts (contractors, online resources, friends/family)
- Agency over their space (e.g. rent vs. own)
- Access to technologies/materials
- Financial
- Time



Home Decision Making

Building/Room Characteristics

- Existing equipment/infrastructure
- Equipment requirements
- Space

Influence of Others

- Influence of others in household
- Influence of experts
- Influence of broader social networks

Type of Upgrade

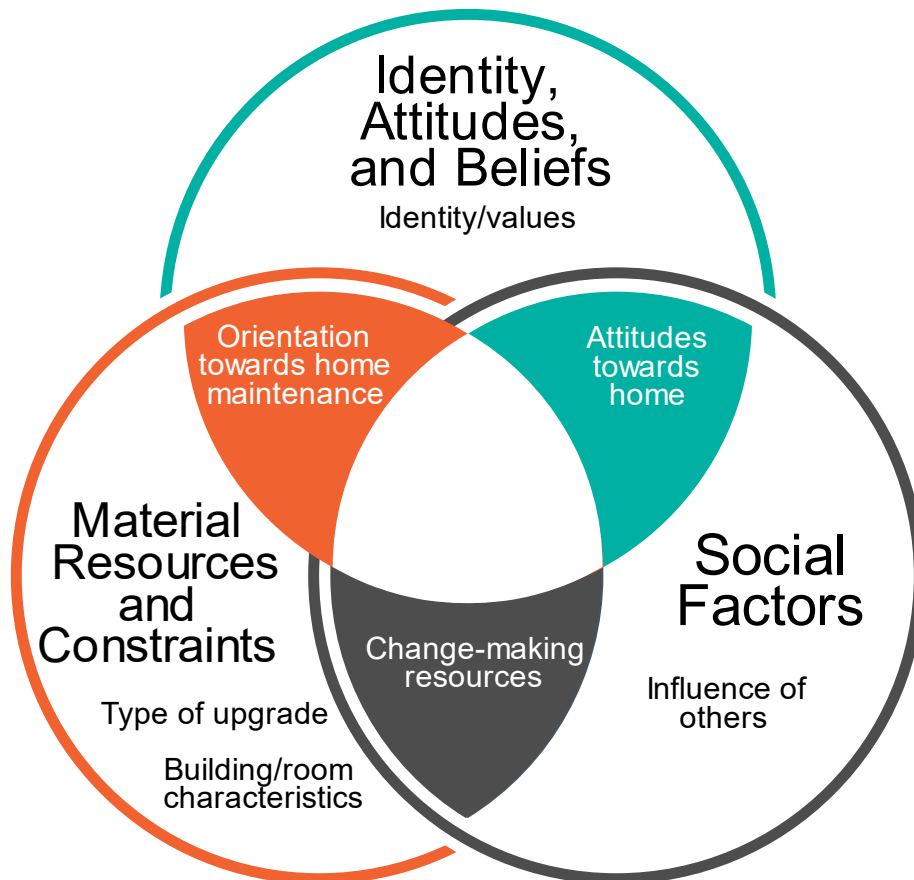
- Contractor vs. DIY
- Level of technicality
- How visible/invisible

Identity/Values

- Respondent self-perception in relation to home/technologies
- Respondent values and priorities

Interactions between these factors

Different decision-making factors are often deeply interconnected and interact to influence home occupant's decision-making.



Identity, attitudes, and beliefs include elements of decision-making related to values and personal identity, which may shape attitudes towards the home and different equipment and features of the home

Social factors include the influence of others and signal the important impact of other people, including family, friends, neighbors, and the broader community, on an individual or household's decision-making.

Material resources and constraints include those elements of decision-making that are constrained or shaped by the specifics of the building and room, the material and time resources of the decision-maker, as well as the specifics of the potential upgrade.



Key Findings and Recommendations

Ability to choose impacts emotion around home choices

Finding:

Home occupants tended to **prioritize more visible and more frequently used spaces** and equipment for upgrades and associated these upgrades with **feelings of joy and empowerment**.

By contrast, respondents tended to associate feelings of **stress, disempowerment, and frustration** with replacing less visible upgrades as these were typically only maintained or replaced when **something broke** or when there was a significant **health, safety, comfort, or functionality issue**.

Recommendation:

More visible or more used equipment, such as stoves, electric vehicles, or electric lawn equipment **may be a means to raise awareness of some of the energy and non-energy benefits of electrification**, as respondents are more likely to prioritize these upgrades and associate these types of equipment with positive feelings of joy and empowerment.





Diamond

- **Homeowner**
- **Central Georgia**
- **Late-30s**

Diamond has a long list of upgrades she would like to make. However, six months ago, a large storm flooded her basement, which triggered her severe mold allergy. Her home insurance denied her claim and she had to save to make repairs, putting other projects on hold.

Diamond wants energy efficient windows, both to increase the potential resale value of the home, and to bring her energy costs down. She says, *“I just want them to be efficient for weathering so that the light bill will go down... I just want to keep my house up to par. So when I pay it off or sell it, we have no problem with it because we maintained everything and anything that is an issue with inspection or anything it's minute.”*

Decision Making Factors for Diamond

Attitudes toward the home: Diamond has a large home to accommodate the indoor and outdoor lifestyle that her family of 8 desires.

Orientation toward home maintenance: Regular maintenance is a priority for Diamond. But, she has experienced a setback in this due to an unexpected flood in the basement.

Change-making resources: Diamond is budget conscious.

Building/room characteristics: Diamond has a long list of functional and aesthetic upgrades that she would like to do, including the installation of energy efficient windows.

Influence of others: She looks to Pinterest for project ideas, and she consults with trusted contacts, including her uncle, on appliances.

Type of upgrade: Her primary focus is repairing a flooded basement, and repairing malfunctioning appliances.

Identity and values: Diamond spends nearly all of her time at home. Her approaches to energy efficiency are shaped by her experiences as a mother to a non-verbal autistic child.

Attitudes about home maintenance vary

Finding:

Attitudes towards home maintenance are shaped both by **identity, attitudes, and values, as well as material and resource constraints** and will impact the degree to which respondents are interested in information about things like electrification, efficiency, and smart devices.

“We’re a Latino family who always have to be together. You dine together at a certain time, and believe it or not, that is where everyone hangs out. Even if they have a room, even if they have their own desk area, they want to be together. They want to talk to you about how their day went. And ideally, it’s the main area where everybody hangs out. So, the bigger the space of the first floor is, the better. That’s I think what we’re working on as far as a family. We like to be together.”

–Respondent No. 6, Illinois

Recommendation:

The differing priorities, attitudes, and approaches that home occupants take to their home maintenance highlights the importance of **promoting electrification technologies through both customer- and contractor-facing channels.**

Additionally, it is important to design informational resources both for those customers who want minimal information, as well as for those who would like to do a deeper dive.

Renter Disempowerment impacts opportunity

Finding:

Many renters expressed **concerns about asking for too much from their landlord** or maintenance person, citing concerns about **rent increases**, being perceived as too high **maintenance**, and the time and hassle required for them to get their landlord's attention.

Recommendation:

Tools such as **building codes and incentives targeted at building owners** may be more effective means of promoting electrification in the small multifamily sector. Implementation of these tools should consider how to **protect tenants, so renters are not priced out of their homes** as a result of implementation of these upgrades.

"I guess I'm scared that if I ask the landlord for money for [work I did in the apartment], he might raise the rent on us knowing that the unit is now more valuable.[...] I don't think they're going to mind, but I also don't want them to know that we're improving the place and then [increase the rent]."

*-Respondent No. 1,
Massachusetts*



Angela

- **Renter**
- **Tucson**
- **Late-30s**

Angela has lived in her townhome in Tucson for 3 years. She has a difficult relationship with her landlord who previously refused to replace a broken dryer, telling Angela to dry her clothes in the Arizona sun. Angela now would like to fix a broken shower and address other plumbing issues, but no longer trusts her landlord to address these issues.

She says, *“We need a licensed plumber to come and get that fixed. And that's just a money issue. This, the outside really is just a time issue. And we know we have to get it done soon because during the summer, we're not going to do it. It's just way too hot out there to get anything done.”*

Decision Making Factors for Angela

Attitudes toward the home: Angela rents a townhome and dislikes her landlord who she feels is negligent and intrusive.

Orientation toward home maintenance: Angela prioritizes emergency maintenance, and regular cleaning.

Change-making resources: Angela is on a limited budget, and with two kids and a work-from-home job, finds she has little time to do the work she would like to do. She and her husband need to complete essential repairs themselves because their landlord doesn't always complete requested repairs.

Building/room characteristics: The home is old and needs repairs, but she dislikes and distrusts her landlord.

Influence of others: She talks with her husband, and has her husband talk with the landlord.

Type of upgrade: Angela needs structural and functional upgrades, and also has an eye towards beautifying the outdoor space.

Identity and values: A full-time mom and a full-time worker, Angela feels pressed for time. The gender and class-privilege of her landlord affects her relationship with him.

Home occupants are more likely to research simple, more visible projects

Finding:

Respondents were more likely to want to **do their own research** when pursuing upgrades that were **simpler and more visible** and for projects with longer timelines.

Recommendation:

Visible or highly used upgrades, such as stoves or even electric vehicles, may be a means **to familiarize respondents with electrification technologies** and the concept of electrification. Respondents' **reliance on social networks** emphasizes the importance of promoting electrification technologies **frequently and through multiple channels** (including non-utility and non-manufacturer channels) to become part of the public consciousness.

It's like sunny 360 days of the year. Why doesn't everybody have solar energy? And so, like I've entertained that a couple of times [...] And it's just like, you know what? Until the value proposition really is motivating to make that shift, forget it. And then I think there's a little bit of ... we have family here we have my parents, [my wife]'s parents, cousins, friends, et cetera. I don't think any of them have solar panels because they've each kind of gone through this very same process that I have. And they've said, you know what? This is not worth it. They're ugly and this is not worth it. And so, I think there's a little bit of that influence as well

-Respondent No. 32, Arizona



Jen

- **Homeowner**
- **Chicago**
- **Late-30s**

This is the first home that Jen has owned, and she has been remodeling it to suit her and her family's needs. Jen says aesthetics are her top priority, and she is also laser-focused on energy efficiency.

Jen says that *“after I got in here and now the newness has worn off of it, now it's like, okay, it's time to make this look more presentable and nicer. I just want it to look nicer so that it's something that I'm not ashamed of. Just look like what other people's houses look like. And then too, energy wise, the furnace was not working properly.”*

Decision Making Factors for Jen

Attitudes toward the home: Jen prioritizes work that creates a safe, expansive, and comfortable space for her and her children.

Orientation toward home maintenance: Jen has been doing emergency maintenance but is building towards a situation where she can also do preventative maintenance.

Change-making resources: Time and money are major constraints, but she is discerning and knowledgeable about her project resources.

Building/room characteristics: The home is old and lacks adequate heating.

Influence of others: Jen spends a lot of time researching online, and she uses online community groups, conversations with professionals to determine her projects.

Type of upgrade: Jen would like to focus on the visible, but the condition of her home has meant that she needs to focus on the structural. She uses contractors for this.

Identity and values: As a domestic violence survivor, safety, comfort, and family networks shape her approach to her home.



Eric

- **Homeowner**
- **Chicago**
- **Early-40s**

Eric wants to upgrade the kitchen and the bathrooms. He would like to remodel the kitchen first, but supply-chain issues and problems with contractors has made him refocus his energies into the bathrooms. He has had many problems with contractors, and so he now plans to do some of the work himself.

He says *“since I’m doing it myself, I can just take my time, make sure I have all the supplies stocked in my house before I start the project, because that’s the last thing I want to do is start it halfway and just pause there. But that means getting the tile, getting to grout, getting a vanity, having all that, maybe asking friends, well, one or two friends, if they’re available to help out on a weekend as a weekend project.”*

Decision Making Factors for Eric

Attitudes toward the home: Eric sold his condo in the Chicago area and needed to a comfortable condo with an open concept, professional kitchen, and space to work from home.

Orientation toward home maintenance: Eric is comfortable with regular maintenance and upgrades but hesitates because of supply chain issues.

Change-making resources: Eric is comfortable with doing his own research, and previous experiences with contractors has made research a priority for him.

Building/room characteristics: He is happy with his place, but like would like to make updates to some “dated” features in the kitchen and bathrooms.

Influence of others: Eric has had negative experience with contractors, and that has led him to refocus his energies on the bathroom instead of the kitchen.

Type of upgrade: He wants to make aesthetic changes, but functionality and reliability are the top of his priority list.

Identity and values: Eric is frugal and does not like to waste.

Contractors are important in recommending equipment and in education

Finding:

For less visible and more complex upgrades, such as HVAC and water heater replacements, **contractors are vital not only in recommending equipment** to respondents and installing it, but also **educating respondents to use the new equipment installed** in their home.

Recommendation :

It is important not only **to train contractors to sell and properly install electrification technologies**, but also to **explain to respondents what equipment has been installed and how to optimally operate it**, especially in conjunction with an existing system.



Energy bills are often mysterious or seen as out of people's control

Finding:

Respondents are **unlikely to connect their purchases** to their **energy bill** unless they see a **sustained increase (or decrease)** in their bill **over a period of multiple months**.

Visible appliances may be more top-of-mind for people as they think about their energy usage, compared with HVAC or water heating.

"I absolutely don't [have control]. Absolutely don't. Nope. I just... I don't know what's really going to change it drastically. You know what I mean? Like what's okay. If I come home and I don't turn that TV on, is it really going to make a difference on my bill?"

– Respondent No. 34, Illinois

Recommendation:

For those upgrades that will substantially impact the home occupants' bills, such as insulation, HVAC, and water heating upgrades, it is **important to clearly communicate the bill impacts of electrification to home occupants**.



David

- **Renter**
- **Boston**
- **Late-20s**

David and his wife have lived in their apartment about three years. The apartment, though old, is conveniently located and affordable. David and his wife are meticulous with their financial management and do what they can to keep their costs contained. They want to buy a home in the area but are nervous about whether they will be able to save enough.

He and his wife have focused on the aesthetics of the house. He says, “*we can actually [make surface-level changes], while changing the way the entire electricity, the circuitry or whatever it is, works in the whole house – it’s probably a much bigger, more unlikely job [to do] rather than putting some veneers on the cabinets.*”

Decision Making Factors for David

Attitudes toward the home: David and his wife decided to rent this place because of the price point and the location. Their landlord is non-responsive and so they do the work they want to do on it.

Orientation toward home maintenance: They feel they have autonomy to make renovation decisions, though they do so semi-secretly, often without the landlord’s knowledge.

Change-making resources: David and his wife coordinate work with a handyman who services the building.

Building/room characteristics: The building is old and neglected, and they do the work that they can control. They think they need new plumbing and wiring, but don’t think it will get done.

Influence of others: David and his wife do things semi-secretly, but with the help of the building’s handyman.

Type of upgrade: They do cosmetic, visible upgrades that they hope the landlord will not oppose.

Identity and values: As a young graduate student, David is extra cautious about expenses. He does not want to do anything that will raise his rent.

Questions?

WE'VE GOT ANSWERS

Contact



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*Office Sustainability & Innovations,
City of Ann Arbor, Michigan*

Engaging Around Electrification in Ann Arbor

Julie Roth

Senior Energy Analyst

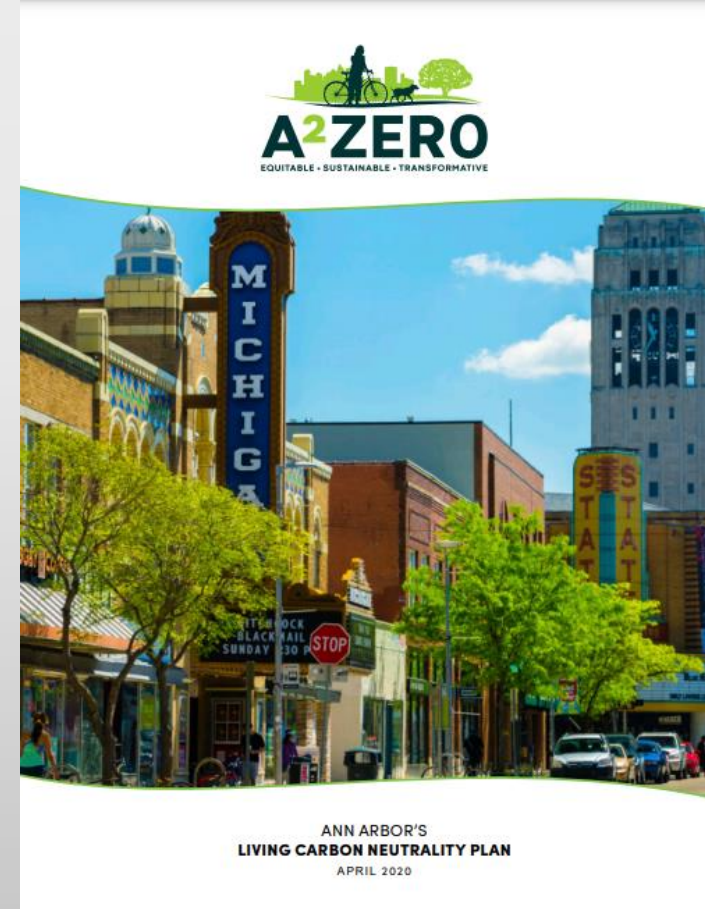
Office of Sustainability and Innovations,

City of Ann Arbor

Jroth@a2gov.org

Climate Action

- In late 2019, A2 City Council declared a Climate Emergency
- 5 months later, presented with a plan to achieve a just transition to carbon neutrality by 2030, they unanimously adopted A²ZERO.



A²ZERO: A Community Action Plan

- 100% renewable energy
- Electrification
- Energy efficiency
- 50% reduction vehicular-miles traveled
- Develop circular economy
- Improve resilience
- Cross-cutting measures



History of engaging the public



- “Power Hours”
 - In-person or zoom meetings with information about all things Energy
 - EE resources, solar, financing, incentives and programs
- Limitations:
 - No immediate action facilitation
 - Limited outreach, engaging the same folks
 - Big goals, urgent timeline
 - EE is not “sexy”



Solarize Ann Arbor

- Group-buy program with RESIDENTS choosing installer and inviting friends – extending City’s outreach
- Discounts based on volume
- Learning with and from peers
- Expand learning to ENERGY as a whole – EE and electrification
- City as project coordinator, maintaining group cohesion and quality control



HI NEIGHBOR,



You're invited to join my Ann Arbor Solarize group buy!

Join us to learn about solar, ask questions, and have the option of joining our group buy to get discounts on solar for your home!

WHEN:

WHERE:



**SIGN UP BY
SCANNING THIS
QR CODE, OR
LEARN MORE AT:**

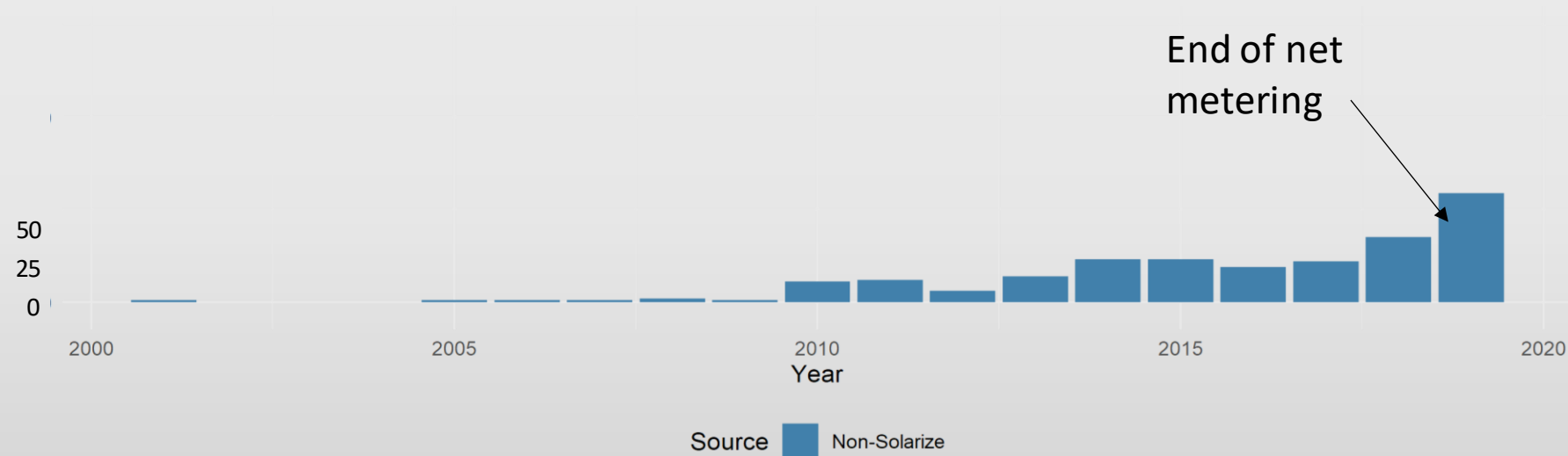
WWW.A2GOV.ORG/SOLARIZE

Easy Button

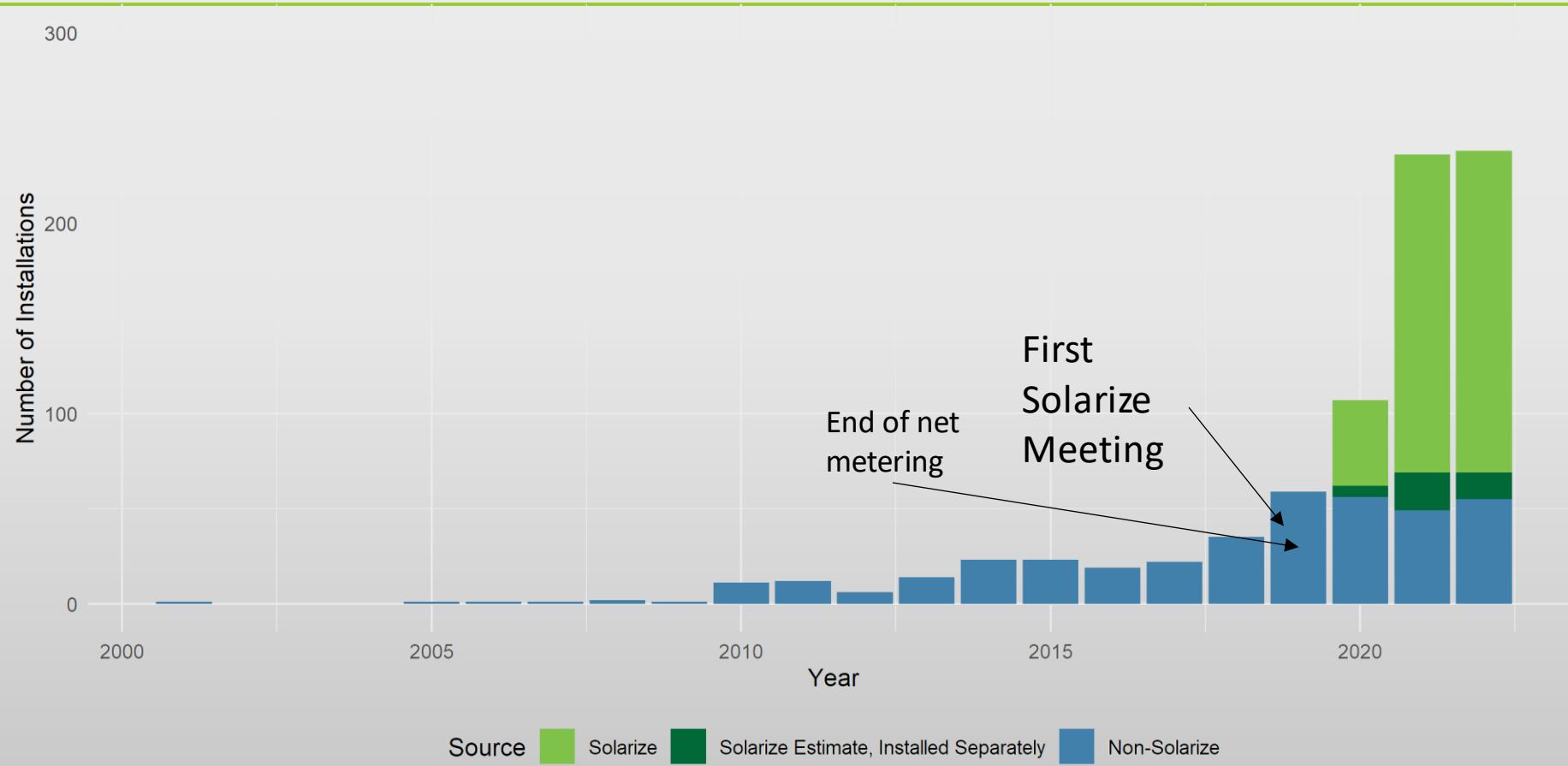
- Easy Action Item DURING the meeting: “Email if you would like an estimate to consider joining the group buy.”



Annual Installations: Pre-Solarize



Annual Installations: After Solarize



Moving into Electrification

Lessons Learned

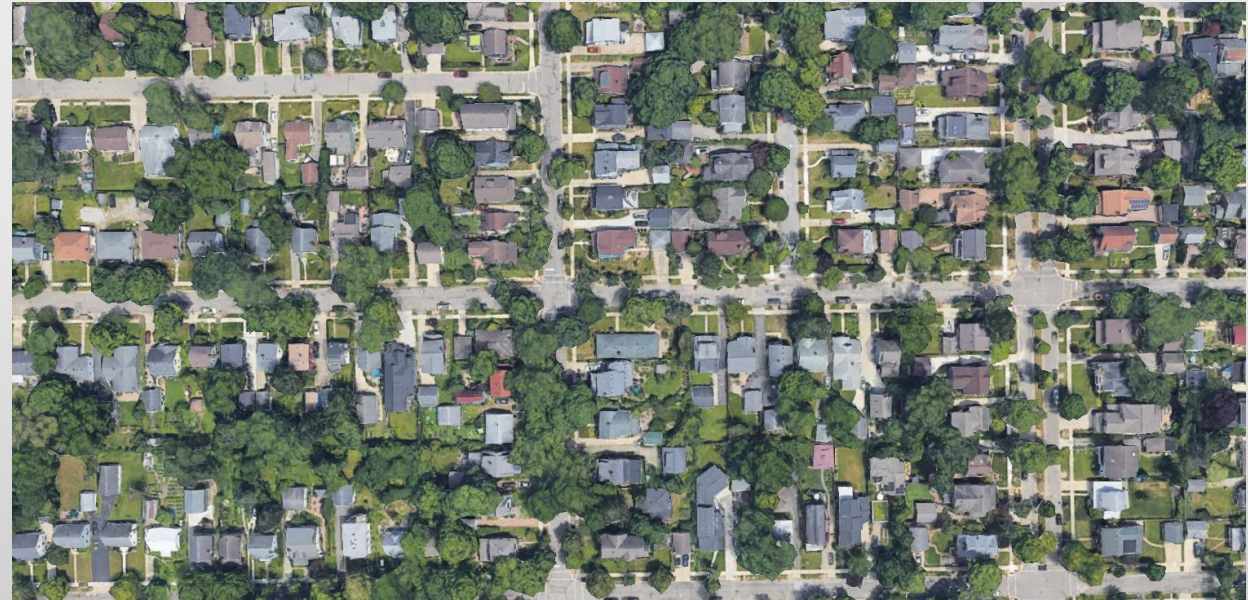
- Residents WANT to be a part of the solution
- Make it easy to take action
- Peer-to-peer learning and engagement increases trust and community-building
- Adoption can become viral, accelerating dynamic norms
- Solarize created a whole cohort of enthusiastic “energy ambassadors” with nowhere to go

New Challenges

- Electrification is complicated!
- EE is boring
- Both are crucial

Barriers to an Electrify Campaign

- HVAC fuel-switching is complicated in MI
 - Technology only recently adequate for cold-climate HPs
- Contractor network is minimal
 - Installers working on outdated information, successful current business models
- Higher up-front costs
- Increased operational costs
- Older building stock
 - Need weatherization
 - Need electrical upgrades
- Limited supply chain
- Large knowledge gap in general public
- Renter/landlord split incentives



Step One: Contractor Network

- Worked with our green bank Michigan Saves to establish an Electrification Badge Program for MI Saves affiliated contractors
 - Small grant from State of MI (EGLE)
 - Peer assistance from CEE
- Contractors (HVAC, solar, plumbers, auditors) take 5 online modules and pass tests to earn their badge
- Residents can search for badged contractors at the MI Saves site

 Residential Homes Commercial Buildings Contractor Center Find Your Contractor			
		www.trustedhvacolutions.com 13.68 miles away	
Heinanen Engineering Inc	• Heating, Ventilation, and Air Conditioning (HVAC) • Water Heaters • Heat Pumps/Mini-splits	Contact Heinanen Engineering Inc 350 S Lafayette St, South Lyon, MI 48178-1814 248-486-6100 www.heinanenengineering.com 16.63 miles away	 5 23 Reviews
Ecotelligent Homes LLC 	• Heating, Ventilation, and Air Conditioning (HVAC) • Solar Photovoltaic (PV) • Geothermal • Air Sealing/Weatherization • Insulation • Duct Sealing • Water Heaters • Energy Audits • Heat Pumps/Mini-splits • Electrification	Contact Ecotelligent Homes LLC 24730 Crestview Ct, Farmington Hills, MI 48335 248-291-7815 www.EcotelligentHomes.com 25.93 miles away	 4.8 25 Reviews
Expert Heating & Cooling 	• Heating, Ventilation, and Air Conditioning (HVAC) • Heat Pumps/Mini-splits	Contact Expert Heating & Cooling 24400 Northline Rd, Taylor, MI 48180-4588 734-676-4488 expertheatcool.com 29.6 miles away	 5 22 Reviews
Absotemp Climate Control, Inc.	• Heating, Ventilation, and Air Conditioning (HVAC) • Water Heaters • Heat Pumps/Mini-splits	Contact Absotemp Climate Control, Inc. 1036 Benstein Rd Suite 101, Commerce Township, MI 48390-2913 248-960-3100 absotemp.com 26.09 miles away	 5 4 Reviews

Step Two: Address Complexity – Ann Arbor Energy Concierge Pilot

- OSI, EcoWorks and Elevate
- Free to residents
- Concierge assistance for owners, renters, market rate, LMI, MFH
- Energy audits, project selection, remediation and weatherization, panel upgrades, electrification, contractor connections, clearinghouse for incentives and rebates

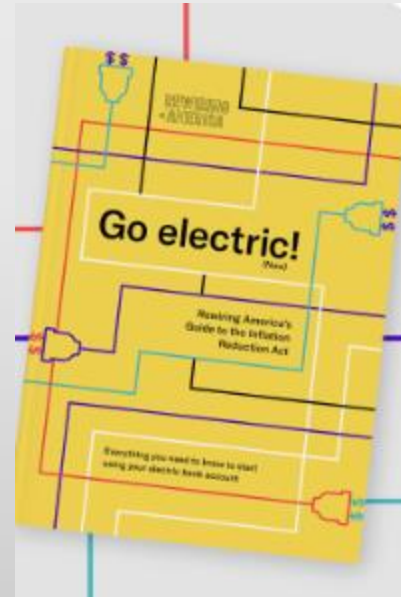
- Roadmap to Electrification



Program modeled after I Heart My Home in CT

Step Three: Reduce Costs

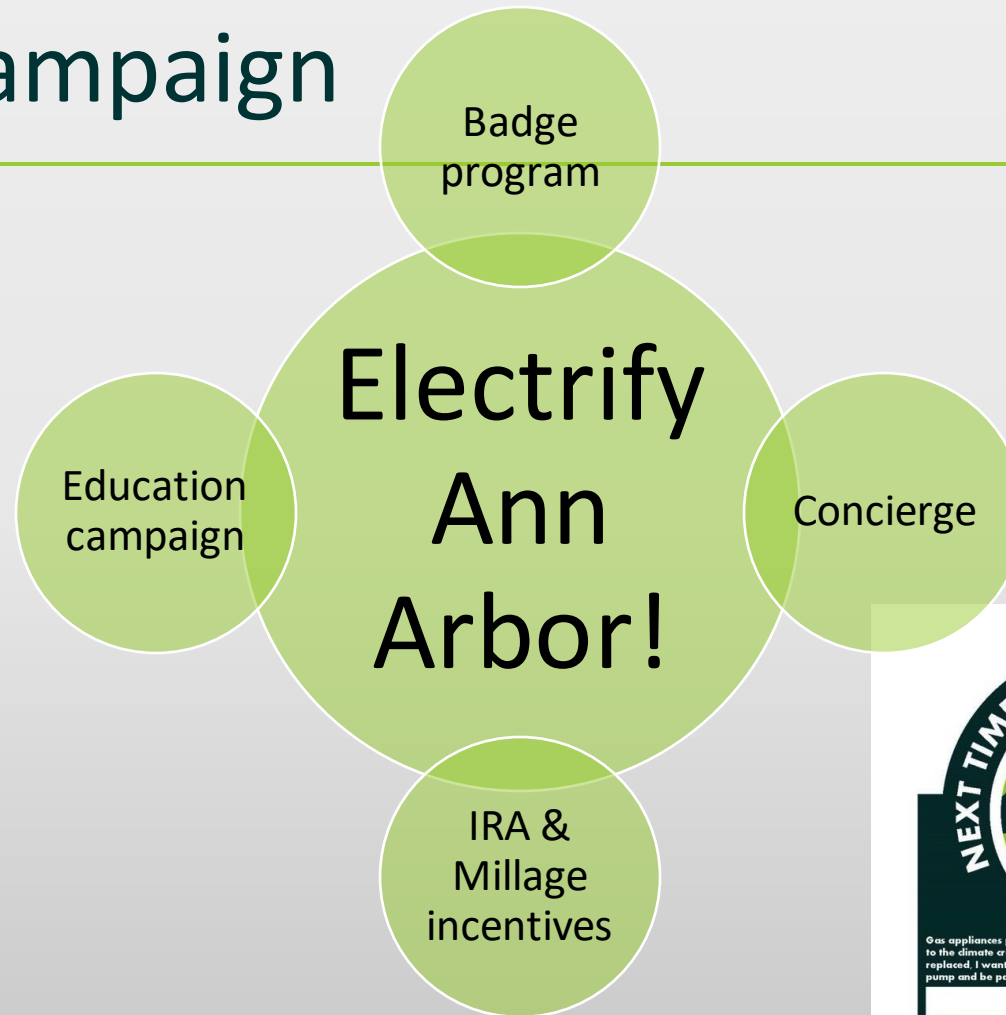
- IRA tax credits and rebates
- Ann Arbor Climate Millage rebates
- MI Saves financing



Michigan Saves®
The Nation's First Nonprofit Green Bank

Step Four: Electrify Ann Arbor Campaign

- Building blocks enable envisioning of community-wide campaign to lower barriers and incentivize fuel-switching and energy efficiency at scale
- Use Lessons Learned from Solarize in design
 - ACTION Item: create a roadmap; contact the concierge
 - Easy button: concierge, central hub
 - Peer to peer engagement: peer network, community-generated outreach and meetings



PS: Another “gateway”

- PNNL Research (people love their kitchens!)
- New headlines regarding the health impacts of gas stoves
- Another potential gateway to discussing energy, health, climate and electrification

 City of Ann Arbor
Office of Sustainability and Innovations

THE CASE FOR ELECTRIC APPLIANCES

Many homes in our community have gas stoves and appliances. When gas burns, it releases harmful pollutants. Chronic exposure to these increases the risk of disease, including: respiratory illnesses, cardiovascular disease, learning deficits, and cognitive impacts. Children living in homes with a gas stove have a 42% higher risk of experiencing asthma symptoms, with 28% of exposed children developing asthma.

The solution: replace gas appliances with induction stoves and other electric devices.



How does induction work?

Induction cooktops create an electromagnetic field that transfers heat to the pot, directly heating the pot without producing heat on the cooktop. To make sure your metal pots are compatible with induction, perform the magnet test. If a magnet sticks to the bottom of your pot, your pot will work on an induction stovetop.



Benefits of electrification of your kitchen:

- No gas fumes, fire, or excessive heat is emitted during use, so it is a safe alternative.
- Induction stove tops heat up more quickly, boiling water in less than two minutes, and are highly efficient.

Induction stovetops can be installed in place of gas stoves, or a plug in plate can be used as a cheaper option. Any reduction of gas stove usage is beneficial, including electric tea kettles, crock-pots, or other alternatives.



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 City of Ann Arbor
Office of Sustainability and Innovations

The hidden danger of gas stoves.

Indoor air quality is much worse than outdoor air quality. It is a public health issue, and one we are largely unaware of. One of the major contributors to poor indoor air quality is the burning of natural gas within a home. Many homes contain appliances that inefficiently burn gas, causing fumes to be released and breathed in by those living there. Fumes are usually not well ventilated to the outdoors, as hoods are often not properly used or installed in homes. These pollutants remain in the home, leading to increased levels of respiratory illness, asthma, cardiovascular disease, learning deficits, and reduced cognitive ability. Children living in homes with a gas stove have a 42% higher risk of experiencing asthma symptoms, with 28% of exposed children developing asthma.

HOW TO REDUCE EXPOSURE TO GAS IN YOUR HOME:

- Replace your gas stove with an electric or induction version, or purchase a cheaper, plug in induction plate.
- If cost is a barrier, ensure that your gas appliance are properly ventilated to the outdoors. Always use the hood and the back burners (even when boiling water) to limit your exposure.
- If you do not have proper ventilation, cook with the windows open, and reduce time the stove/oven is operating.



WHAT GREATER ACTION CAN BE TAKEN:

- This information can be used to inform policy changes to improve air quality
- Beneficial electrification, ensuring that all communities and households have the ability to electrify their homes through education and funding opportunities, should be a public health priority.

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Thank you!

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APRIL
11-13
2023



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Better Buildings, Better Plants
SUMMIT

Learn more: betterbuildingsolutioncenter.energy.gov/summit

U.S. DEPARTMENT OF
ENERGY

Buildings UP

The Buildings Upgrade Prize

AMERICAN
MADE
U.S. DEPARTMENT OF ENERGY

Building capacity to transform U.S. buildings into energy-efficient and clean energy-ready homes, commercial spaces, and communities

Upgrading existing buildings to efficiently run on clean energy will help address climate change. This means transitioning **residential and commercial buildings** to efficient electric equipment, such as **heat pumps and heat pump water heaters**, and ensuring comfort with measures such as **insulation and air sealing**.

Teams participating in **Buildings UP** will develop innovative plans to leverage the billions of dollars through the Bipartisan Infrastructure Law, the Inflation Reduction Act, utility rebate programs, and many other funding sources available and capitalize on this unprecedented opportunity to improve our homes, businesses, and communities.

Buildings UP will award more than **\$22 million** in cash prizes and expert technical assistance to bring winning ideas to life.



www.heroX.com/buildingsUP

Form Your Team and Submit Your Application by July 2023!

- Community-based organizations
- Local governments
- Utilities
- Non-profit organizations
- For-profit energy efficiency companies
- and more!

Multi-stakeholder teams are encouraged

Application support available for new and under-resourced teams

Follow Buildings UP on HeroX for prize info and updates
Questions: buildingsUP@nrel.gov

Buildings UP | U.S. Department of Energy

Explore the Residential Program Guide

Resources to help improve your program and reach energy efficiency targets:

- [Handbooks](#) - explain *why* and *how* to implement specific stages of a program.
- [Quick Answers](#) - provide answers and resources for common questions.
- [Proven Practices](#) posts - include lessons learned, examples, and helpful tips from successful programs.
- [Technology Solutions](#) **NEW!** - present resources on advanced technologies, **HVAC & Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.
- [Health + Home Performance Infographic](#) **NEW!** – spark homeowner conversations.



<https://rpssc.energy.gov>

Health + Home Performance Infographic



DOE's new Health + Home Performance Infographic reveals the link between efficiency and health – something everyone cares about. Efficiency programs and contractors can use the question-and-answer format to discover a homeowner's needs.

The infographic is ideal for the “kitchen table” conversations where people decide what to do – and who they want to do it. It also has links for homeowners to find a qualified contractor if they do not already have one.

[Download](#) this infographic from DOE's Better Buildings Residential Network.

Looking for photos to help tell your energy efficiency story? Visit our image libraries:
<https://www.energy.gov/eere/better-buildings-residential-network/articles/image-libraries>

Thank You!

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Please send any follow-up questions
or future call topic ideas to:
bbresidentialnetwork@ee.doe.gov