



Advancing Residential Decarbonization: A User-Centered Approach to Understanding Occupant Values, Perceptions, and Motivations for Electrification

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





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



Kieren McCord, PhD,
Analyst



Research Questions



What are households' motivations and key decision points for energy-related home renovations and upgrades?



How do different residents decide to buy and use key technologies relevant to residential decarbonization/electrification?

Research Approach

- HVAC manufacturer outreach to learn about customer discovery and marketing
- Literature review to identify previous study findings and approaches
- Semi-structured interviews of owner-occupied and renter households in four U.S. climate zones
 - n=121
 - Interview results informed survey
- National survey of owner-occupied and renter households
 - n=10,000 (9,919 after data cleaning and validation)
 - Largest-scale energy behavior study ever conducted in the U.S.
- Qualitative and quantitative analysis of results

Interview Dataset

121

Number of Interviews

Average Respondent Age

46.6

Average Household Composition

0.7

Residents 17 or younger

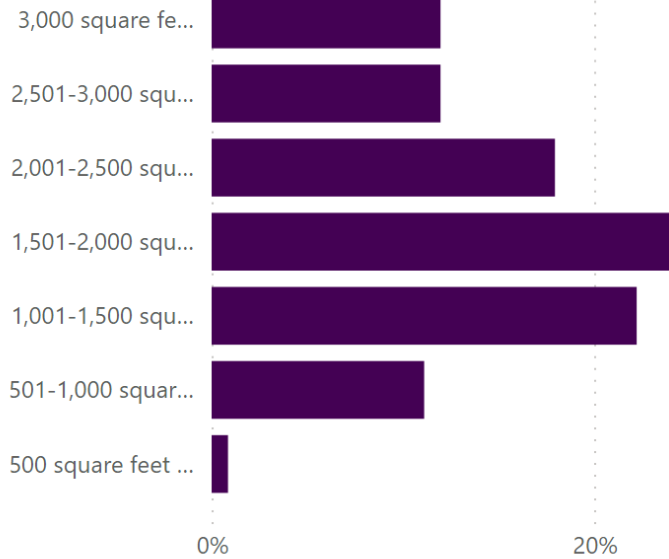
2.2

Residents 18-64

0.4

Residents 65 or older

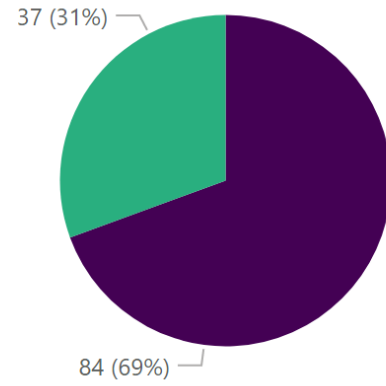
Square Footage



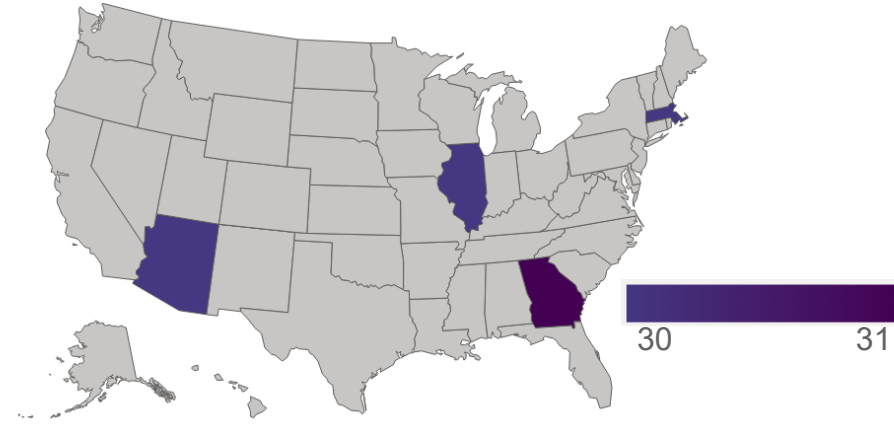
Rent or Own

Own

Rent



Respondents by State



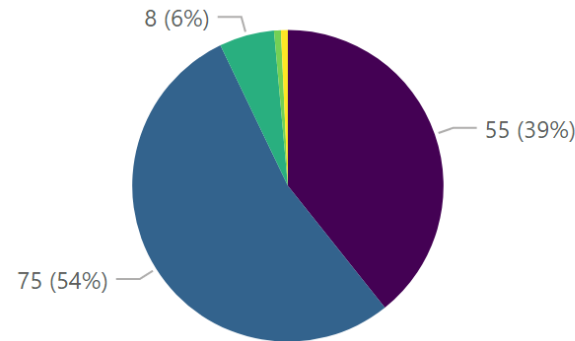
Building Type

Apartment (4 or more units in building) Condo or co-op Duplex, triplex, or townhouse Single family detached home



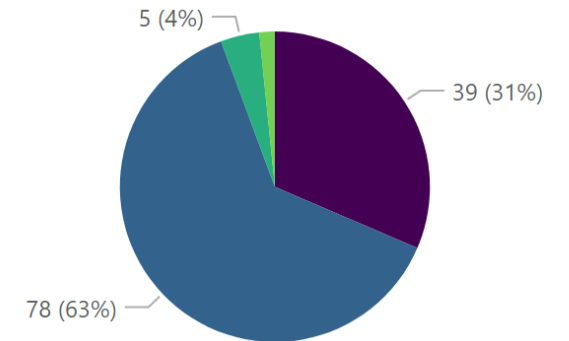
Heating Fuel

Electricity Gas Oil Propane Other



Water Heating Fuel

Electricity Gas Oil Propane Other



Interview Results

Examples of factors eliciting joy and frustration

Joy in the ability to invest in the spaces and experiences that are meaningful

“Well, I would say the fact that I really, I do enjoy crafting. I just really wanted to get a room set up that I felt like was mine and that if I start a craft project that it’s not in the main living area of the house. I like to keep things, especially in the common areas of the home, very tidy. So I like the idea of having it in a room where I could leave it out if the project wasn’t finished.”

Frustration when uncertainties and external actors reduce control over project

“First off the guy came out. He goes, “I’ll be back this day” and I was like, “Okay.” It was ten days later, but he said it was coming back. And then the next thing you know, I get a text from them stating that, “Oh, we had to cancel and we’re going...” I was like, “No, you’re not canceling.” And they kept doing it and doing it. I can’t keep taking days off of work or asking family members to come to my home.”

Survey Dataset

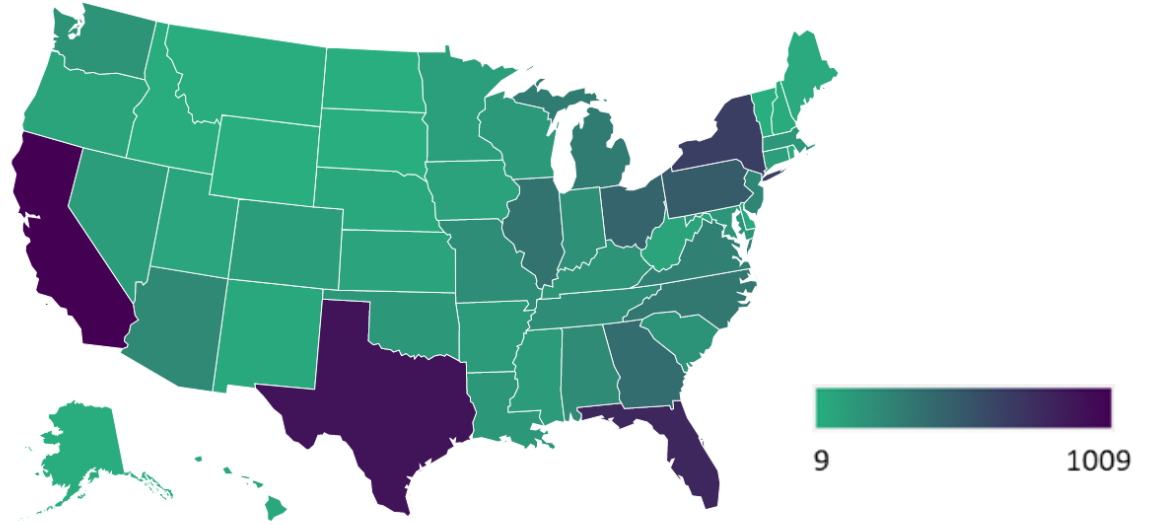
9919

Number of Responses

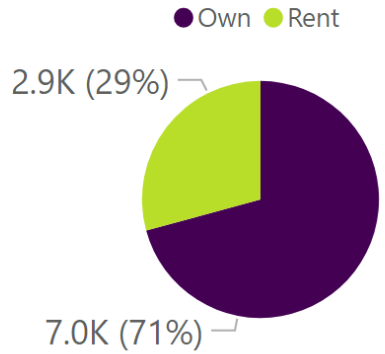
Average Household Composition

- 0.7 Children Under 18
- 1.8 Adults 18-64
- 0.3 Adults 65+

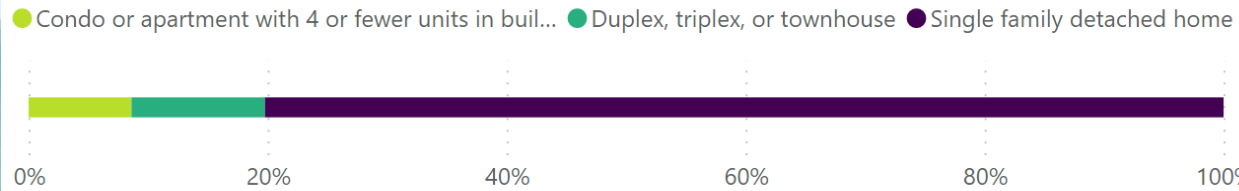
Respondents by State



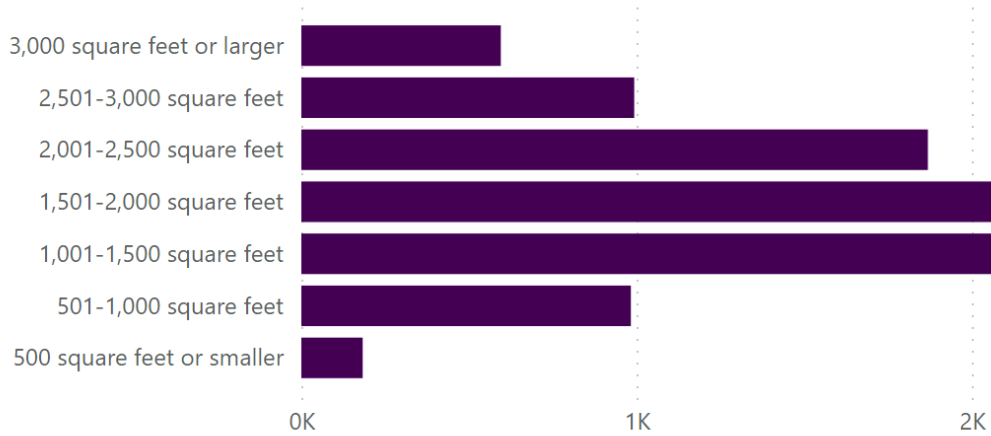
Rent or Own



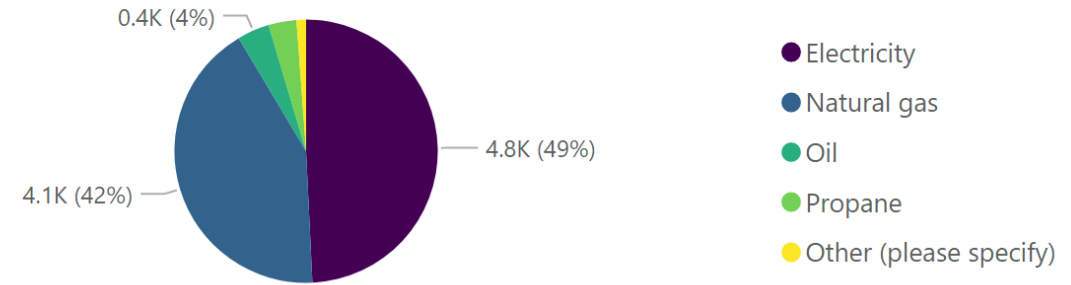
Structure Type



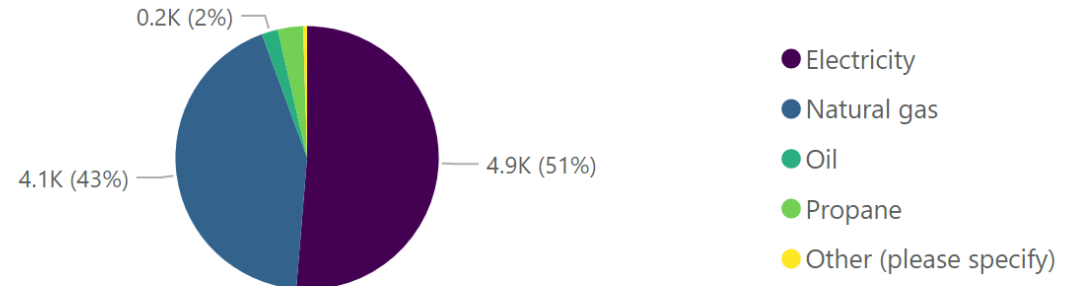
Square Footage



Heating Fuel

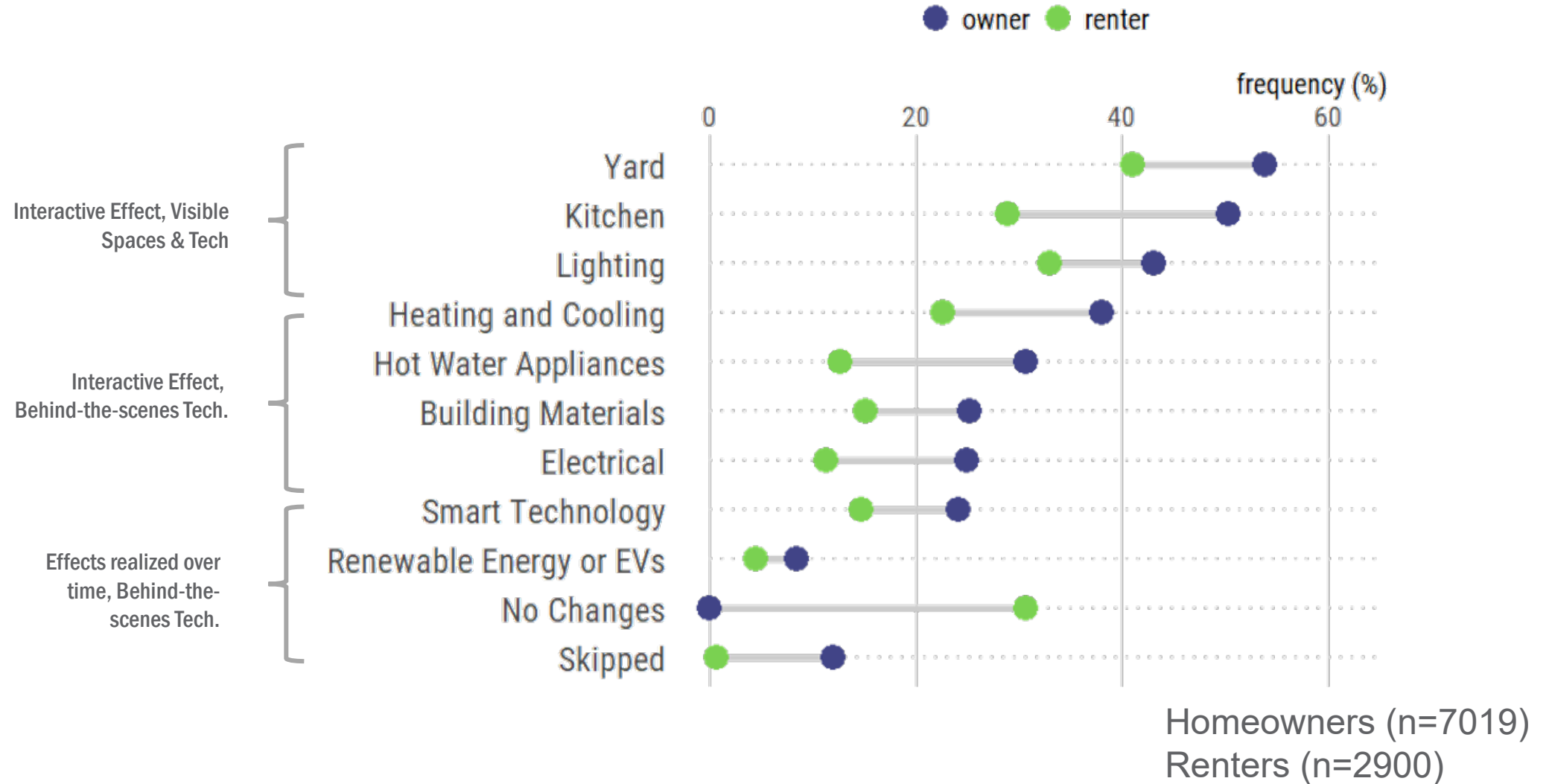


Water Heating Fuel



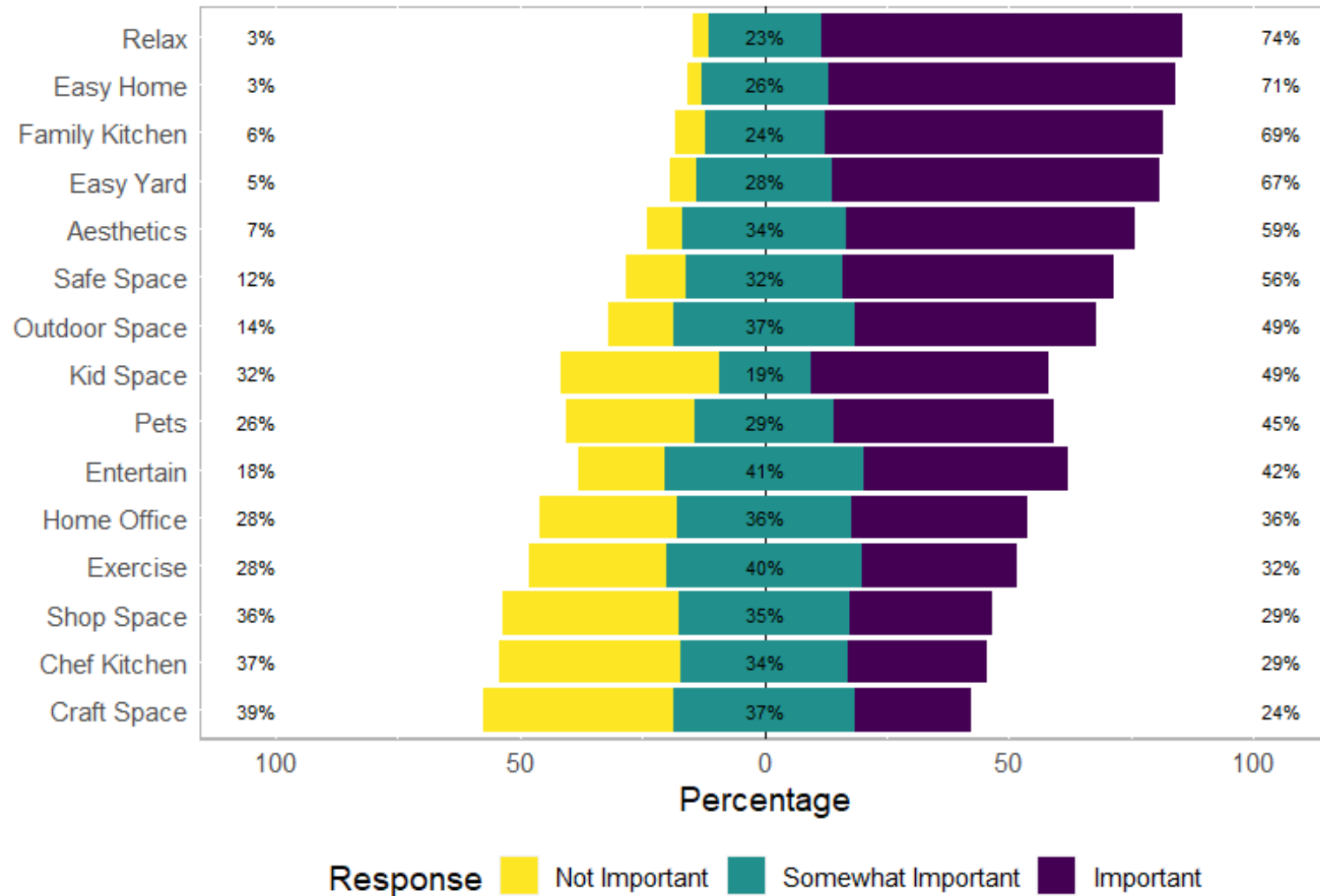
Survey Results

Frequency of Home Modifications



Survey Results

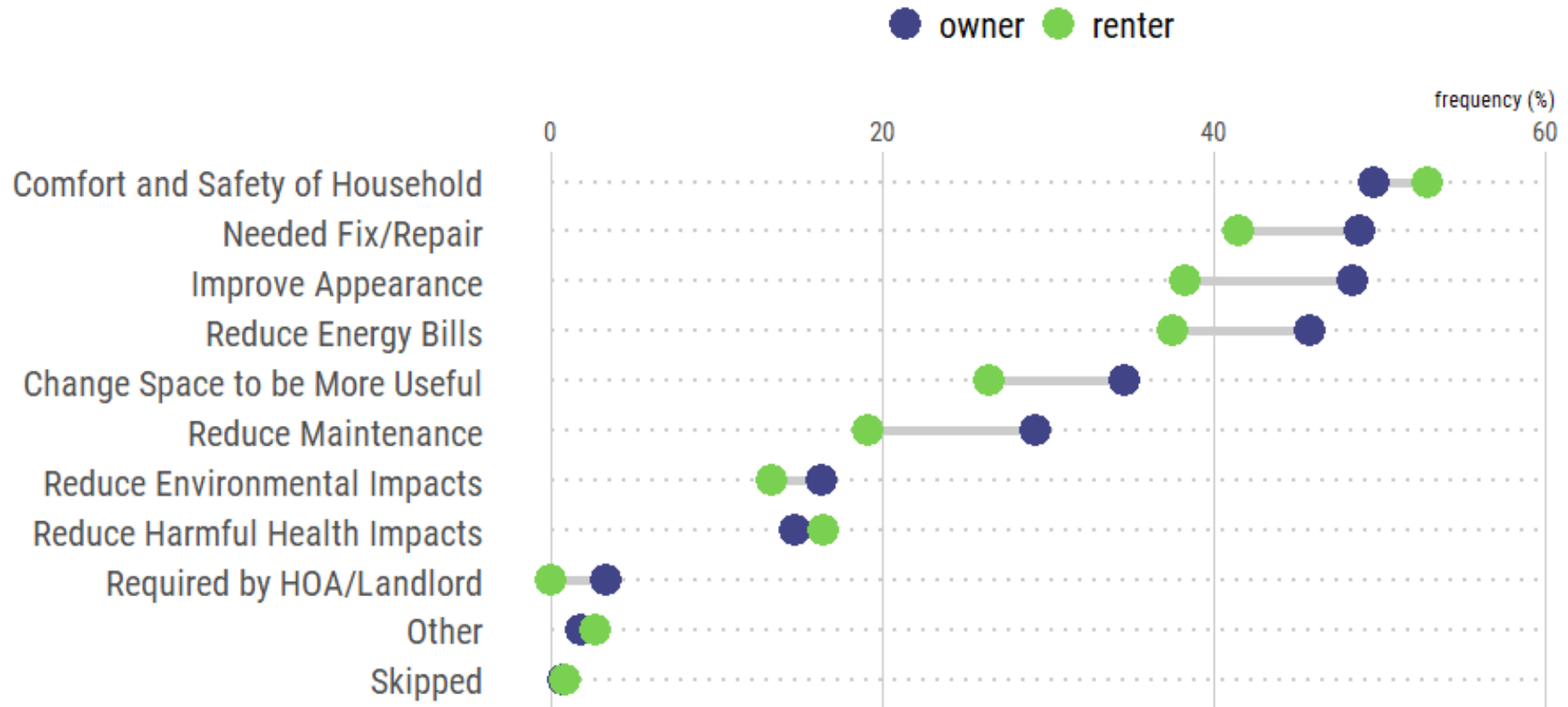
Resident Space Preferences



n=9919

Survey Results

Factors Influencing Home Modifications



Homeowners (n=7019)
Renters (n=2900)

Big Takeaways

- Visible, interactive technologies/attributes are more likely to be changed than behind-the-scenes technology or those with impacts that are realized over time.
- Messaging around improving comfort and safety for children/pets is more effective than a focus on environmental or health impacts.
- 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 the occupant's technology experience.
- Homeowners and renters are willing to adopt decarbonization technology, but few have done so to date.

Thank You!

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