

Nothing For Us Without Us: Affordability Covenants for Energy Efficiency Retrofit Programs

Hal T. Nelson, Ph.D, Portland State University

Alex Brey, Portland State University

Paul Ahrns, Portland State University

ABSTRACT

The need for equitable energy-efficiency retrofit programs stems from the three intersecting crises of energy affordability, climate change, and housing affordability. While energy-efficiency measures offer benefits to both landlords and tenants, a split incentive discourages either from actively pursuing them. Subsidy or incentive programs have the potential to correct this market failure but come with some risks for tenants. As demand for energy-efficiency rises, retrofitting will increasingly command a market premium. There is a possibility that lower income residents would be priced out of energy efficient housing before ever realizing the promised benefits of lower utility bills

One common solution is to utilize an affordability covenant, but evidence is lacking on landlords' interest in such programs. This analysis presents the results of a March 2022 survey of multifamily property owners in Portland, OR. To the authors knowledge, it provides the first empirical estimates of landlord willingness-to-accept rent covenants. A double dichotomous choice experiment methodology was employed, and participants were presented a hypothetical program offer of variable duration between 1 and 19 years. Roughly 70 percent of offers were accepted. Concern for tenant satisfaction, landlords' beliefs and values, and property value appreciation were cited most frequently as motivation for program participation.

Logistic regression reveals about an 80 percent probability of acceptance of a program with a 1 year affordability covenant. Landlords who actively manage multiple smaller properties appear to have the greatest familiarity with energy efficiency technology. Analysis also reveals interest in electrification for climate protection is weak among owners of naturally occurring affordable housing. These findings drive important implications for program design and future research.

Introduction

Across the nation countless families struggle to pay for energy, and often must forgo necessities such as food and education in order to pay for home heating or cooling (Nelson and Gebbia, 2018). Analysis from the American Council for an Energy-Efficient Economy found that in 2017 a staggering 25 percent of households paid at least 6 percent of their income for energy, with 13 percent of all households paying at least 10 percent of income (Drehobl, 2020, ii). This burden falls disproportionately on historically marginalized communities. Black families face a median energy burden 43 percent higher than non-Hispanic white families, while the difference is 20 percent between Hispanic families and non-Hispanic white families (p. iii).

The increasing impacts of climate change are likely to increase energy demands. In June 2021, the Portland, OR temperature record was broken three days in a row settling on a high of 116 degrees Fahrenheit and resulting in the deaths of at least 54 residents due to hyperthermia

(Multnomah County, 2021). Additionally, according to a New York Times analysis of Global Historical Climate Network data, 8.3 percent of weather stations across the country set all-time heat records with many records broken by double digits (Karra and Wallace 2022). Since 1900, the Northwest region has warmed by nearly 2 degrees Fahrenheit and depending on the path of global emission reduction, Oregon is projected to warm by an additional 4-9 degrees Fahrenheit (Mote et al., 2019). Over the contiguous US, the average annual temperature has increased 1.8 degrees Fahrenheit since 1901 and temperatures are projected to rise by an additional 2.3-11.0 degrees Fahrenheit depending on the global greenhouse gas emission reductions achieved (USGCRP, 2018). This increase in temperature and the frequency of heat waves will increase demand for air conditioning and result in increased energy use and likely greenhouse gas emissions.

Another crisis that intersects with energy burden and climate change is housing affordability. Gentrification, and the displacement of vulnerable residents has become one of the most critical issues facing Portland and other urban areas. In 2017, the city identified almost 34,000 households at risk of being displaced (Armstrong, Bump, and Kobel 2018, 5). These households are low-income renters paying more than 30% of their income on rent and living in areas that are currently gentrifying.

Residential building energy efficiency programs thus are likely to have both positive and negative impacts on vulnerable residents. On one hand, energy efficiency (EE) retrofit programs reduce carbon emissions and have the potential to reduce inequitable energy burdens. However, these same programs direct large investments into residential buildings; likely increasing rents that cause displacement. In an effort to mitigate displacement, some existing residential EE programs require participating landlords to sign covenants that limit their ability to increase future rents for a period of years. Yet, as an industry, know nothing about the impacts or effects of these covenants. This study aims to improve equity-focused EE program design by addressing a gap in our understanding of landlord motivations and their willingness to participate in an EE program with rent covenants.

This analysis focuses on naturally occurring affordable housing (NOAH) properties. While there is not one generally agreed upon definition of NOAH, these are MF properties whose landlords do not receive government subsidies, and that have a large percent of low-income residents as a share of total residents. We are interested in NOAH properties for multiple reasons. First, residents in NOAH properties are especially vulnerable to gentrification and displacement. Rents in NOAH properties, almost by definition, are lower than other properties. Second, NOAH properties make up the vast majority of low-income MF properties. One study of over 60,000 MF properties in California (a state that has arguably built more public housing than most other jurisdictions) indicated that only 3.3% of MF properties were non-NOAH and received some public subsidies (Nelson, et al, 2022). Finally, NOAH properties are less energy efficient, are more likely to have tenant metered electricity accounts, and are smaller and older than higher income properties (Nelson, et al, 2022). These factors increase the scale and urgency of needed EE programs for NOAH properties.

Literature Review: Affordability Covenants and Existing Programs

We begin with a review of literature on gentrification, displacement, and affordability covenants. In her textbook chapter, “Preventing Gentrification-Induced Displacement in the U.S.” Miriam Zuk provides a comprehensive overview of gentrification and displacement theory. While the two terms are often used interchangeably, gentrification technically refers to “the

influx of middle- and upper-class people into low-income neighborhoods” (Zuk, 2019, p. 302). Displacement, on the other hand, denotes the departure of long-time residents from a neighborhood. It can be driven by low property values and disinvestment, or it can be driven by reinvestment and rising property values (Zuk, 2019, p. 302-303). Displacement and gentrification may occur together, but often appear separately as well.

There are two major existing housing affordability policies worth examining for lessons: the Low Income Housing Tax Credit (LIHTC) and rent control. LIHTC is an example of a successful program that offers a financial incentive, in the form of tradeable tax credits, in exchange for affordability restrictions. This Federal program has been in operation since 1986 and funds both development and preservation of existing properties. Projects are locked into 30 years of affordability, with potential for states and local governments to impose additional duration. Unfortunately, the LIHTC program’s impact on displacement is less clear, due to its partial focus on new development and due to the lack of academic research.

Rent control programs are another useful comparison. In “The Effects of Rent Control Expansion on Tenants, Landlords, and Inequality: Evidence from San Francisco,” Diamond, McQuade and Qian discuss how the 1994 expansion of rent control policy to a new subset of properties in San Francisco impacted tenants and property owners. This policy applies to buildings with 5 or more units that were occupied prior to 1979 (Diamond et al., 2019). Annual allowable rent increases, as determined by a local board, have averaged 2.08 percent between 1983 and 2023 (Resident Rent Stabilization and Arbitration Board, 2021).

Diamond et al. make several important points about rent controls. The first is that the policy resulted in significant reductions displacement, especially for people of color. In percentage points, those reductions were: 2.8 for white people, 10.7 for Black people, 10.1 for Hispanic people, and 6.4 for Asian people (Diamond et al., 2019, p. 3376). On the other hand, the authors identified significant risks of landlords exiting the rental market entirely. Units covered by the policy change showed an 8 percentage point increase in likelihood of condominium conversion. A condominium conversion is one of the ways for landlords under rent control regulation to exit the rental market completely thus reducing the supply of affordable housing available to renters. Developers of new rental units are also discouraged by rent controls as it limits the potential profitability of their projects. Additionally, the policy expansion resulted in a 15 percentage point decrease in the number of tenants living in buildings impacted by the policy change (Diamond et al., 2019, p. 3368). Therefore, one of the results of rent control policies is a reduction in the supply of affordable units. Furthermore, rent control reduces the incentive for landlords to invest in rent controlled properties since they are unable to recoup that investment through higher rents.

Existing Programs with Affordability Covenants

Next, several existing energy efficiency retrofit programs containing some type of affordability restriction will be discussed. *Figure 1* details how several programs define affordability, along with the size of incentive offered. The U.S. Department of Energy’s Weatherization Assistance Program requires that, “for a reasonable period of time after weatherization the residents will not be subjected to rent increases unless those increases are demonstrably related to matters other than the weatherization” (U.S. Department of Energy, 2016). Unfortunately, this requirement is fairly weak as no specific provisions are made for enforcement. As illustrated in the figure below, several state-level programs include stronger

affordability requirements. Both of California’s programs, as well as Oregon’s Multifamily Energy Program require of duration of 10 years and define affordability in terms of resident income. The California Energy Savings Assistance – Multifamily Whole Building program is unique in requiring 50 percent of actual tenants to be income qualified, as opposed to simply requiring units to be affordable to residents at a given income level.

Table 1: Overview of Several Existing EE Retrofit Programs and Covenants

Program	Payee	Incentives Offered	Affordability Duration	Affordability Definition
CA Low-Income Weatherization Program	Property Owner	\$3,000/\$4,500 per MT CO2e reduction (Owner Paid Energy/Tenant Paid Energy)	10 years. If under rent control, increases approved by local board	66 percent of residents at <=80 percent AMI
CA Energy Savings Assistance – Multifamily Whole Building	Property Owner	Variable from no-cost up to 50 percent property owner co-pay	10 years	50 percent of tenants CARE income qualified (\$34,840 for a 1-2 person household)
Oregon Multifamily Energy Program	Property Owner	\$0.80-\$1.00 per kWh savings (tiered at 20%, 25% and 30% improvement)	10 years	50 percent of residents at <=80 percent AMI
DOE Weatherization Assistance ¹	Resident	No cost	“Reasonable period of time” - Up to implementers to enforce	200 percent Federal Poverty Level

A program’s size of incentive and definition of affordability will significantly impact program participation and outcomes for tenants. Source: (California Low Income Weatherization Program 2018; 2020; 2022; California Public Utilities Commission 2021a; 2021b; 2021c; Oregon Housing and Community Services 2019; 2022; U.S. Department of Energy 2016)

Landlord Decision Making on EE Retrofits

An accurate understanding of the factors influencing property owners’ willingness to accept affordability restrictions will be critical for designing a successful program with strong anti-displacement protections. In “Systematic Review: Landlords’ Willingness to Retrofit Energy Efficiency Improvement,” Lang et al. summarize literature about what motivates landlords to pursue energy efficiency upgrades. Using a meta-summary methodology, the researchers systematically sought out relevant literature and categorized findings from the 16 studies selected (Lang et al., 2021, p. 5).

Their results describe factors related to willingness to renovate (WTR) cited in the literature and how frequently those factors were cited. The researchers identified factors cited as increasing WTR within the categories of financial concerns, tenant concerns, values and beliefs, sociodemographic factors and government factors. While many factors were cited just once in the literature, a handful of factors were referenced with greater frequency. The following list

¹ Implementation of Federal program varies by state.

summarizes the authors' findings, and illustrates those factors along with the number of times that each was referenced:

Increase WTR	Decrease WTR
• Increased property resale value - 6 • Presence of subsidy or incentive programs - 3 • Regard for tenant's welfare - 5 • Demand for EE among tenants - 4	• Financial concerns - 9 • Split incentive - 4 • Other priorities - 7 • Belief that government programs are hard to access - 4 • Property's current condition - 3 • Lack of time - 3

Source: (Lang et al. 2021, 8-9)

A 2017 paper by Walls et al. provides additional understanding of the mechanisms by which energy efficiency yields financial benefits for property owners. Between 2005 and 2011, Energy Star certification was associated with a 2 percent sale premium in Durham-Raleigh-Chapel Hill, NC and in Portland, OR. Local certification schemes were associated with even greater premiums: 4 percent relative to non-certified homes in Portland and 8-9 percent in Austin, TX. In fact, capitalization often exceeds reasonable energy savings (Walls et al., 2017, 105).

That investments in more efficient equipment, new windows, or building envelopes should lead to increased property values should not be too controversial. However, some or all of this increased property value is likely to be capitalized into rents (barring rent or other covenants). Landlords' capital investments need to generate a return large enough to meet their return on investment or to offset the opportunity costs of the investment. Retrofits to areas with common meters will reduce utility bills and generate a return for that portion of the investment, but investments to rental units with tenant-metered energy will not. Landlords must then raise rents in order to meet their return on investment.

To summarize briefly, this review illustrates that energy efficiency retrofits are likely to increase property values, and have the potential to drive gentrification and displacement. If it is true that NOAH is often rented at below market rates, then such properties are at especially high risk of rent increases and subsequent displacement. Existing policies employ affordability covenants, but it remains unknown how to obtain both significant landlord participation as well as tenant protection. Despite this limitation, research into landlord decision making indicates that financial concerns, tenant concerns, and values and beliefs are high decision priorities.

Data and Methods

In order to learn about the preferences of NOAH landlords, a survey of multi-family property owners in the Portland, OR area was conducted in March of 2022 to gain insights into their energy-efficiency knowledge and preferences. Demographic and property data were collected along with qualitative data to explore potential correlations. A link to the survey is located in the Appendix.

A set of 500 multifamily property owners in Multnomah County was identified based on assessor data. Since we are mainly interested in NOAH properties, we screened the property data for owners of appropriately sized multifamily properties. We did not have information on

monthly rent or tenant income, so we could not screen on those attributes. A field of roughly 8,400 registered multifamily properties was reduced to 500 by constraining building square footage. A range of 3,500 and 4,680 improved square feet was selected to better target the typical building profile of naturally occurring affordable housing (NOAH) in the Portland region. Assuming an average unit size of 700 square feet, this restricts the sample to properties of about 5-20 units. Property owners were sent a letter via U.S. mail directing them to an online survey and were offered a \$5 incentive. Of the 500 individuals contacted, 100 responded to the survey and about 80 completed it.

The survey was split into four main sections: property information, WTA, energy use and knowledge, and demographics. This specific sequence was chosen to avoid response bias from question priming. An investment period question provides a seed value for the number of years that landlords would consider for a rent restriction covenant in the subsequent WTA estimation. Respondents were presented the following question, with p defined as a random integer between 1 and their investment period:

Suppose there were a program called the "Portland Multifamily Energy Efficiency Retrofit Program." This program gives property owners free building energy efficiency retrofits. Depending on the needs of your property, the retrofit could include:

- *New cookstoves*
- *Clothes washers and dryers*
- *Insulation*
- *Heating, ventilating and air conditioning equipment*

In order to get the free retrofit, property owners would be required to limit future rent increases to no more than the annual inflation rate. Annual inflation has been about 2.9% over the last two years. Would you be willing to sign an agreement to limit future rent increases to 2.9% if it was for a duration of p years?

A double dichotomous choice experiment methodology was employed to provide additional information. A negative response was followed up with an offer of half as many years (.5p) and an affirmative response was followed up with an offer twice as large (2p). Respondents who rejected the offer twice were asked about their reasons for rejecting the offer. Energy and demographic questions provide additional control information, including: ownership tenure, type of income, property manager utilization, heating and cooling appliances, and familiarity with existing energy efficiency incentives (full appendix at back). Several questions provide additional explanatory detail by inquiring into perceived benefits, need, and obstacles related to energy efficiency retrofitting.

Data

Tables 2 shows a basic overview of demographic details, property characteristics, and familiarity with energy-efficiency. While the goal was to properties between 5 and 20 units, this sample leans towards smaller properties with a mean of 4.9 units. This is consistent with the national study of rental housing such as HUD (2018) that shows that about half of rental properties are 1-4 units. Most Portland properties in the sample are not managed professionally which is consistent with national data.

Table 2: Summary Statistics

	Mean	SD	Min	Max	Notes
Willingness to Accept	0.71	0.45	0	1	0=Reject 1= Accept
<i>P</i> Years	4.12	3.60	1	19	Years of rent restriction in WTA question
EE Knowledge	.42	.49	0	1	0=Not & slightly familiar, 1=Moderately & Very & Extremely Familiar
Electrification Importance	.52	.50	0	1	0=Not at all & not very important, 1= important & extremely important
Unit Count	4.88	5.62	1	49	
Unit Size	3.06	0.71	1	4	1=Studio, 4=Three bedroom
Square Footage	3.21	1.68	1	7	1=Less than 500 sqft, 4= More than 2,500 sqft
Years Owned	3.47	0.76	2	4	2=1-5 years, 4=More than 10 years
Investment Period	7.37	5.74	1	30	
Properties Owned	2.06	1.10	1	5	1=None, 5= More than 6
Employ Property Mgr.	1.38	0.49	1	2	1=No, 2=Yes
Individual Meters	1.87	0.33	1	2	1=No, 2=Yes
Year Built	2.75	2.28	1	8	1=Before 1950, 8=2010 or after
Average Rent	1.63	.54	8.00	3.500	Rent in \$1,000 per month
Gas Heat	0.59	0.49	0	1	0 = No gas heat present 1= Gas
Air Conditioning	0.49	0.50	0	1	0= No AC, 1= Window and/or central AC and/or heat pump
NonNOAH	4.12	3.45	.85	16.80	Average rent * Year built

Because many of the questions in the survey were ordinal, Table 3 presents the Mode for selected landlord demographic variables. The sample is overwhelmingly white, largely over the age of 55, and consists mostly of registered Democrats. There is also a strong skew towards properties that have been owned for more than 10 years.

Table 3: Demographic Profile

Variable	Mode
Age	65-74
Race	White
Language	English
Gender	Male
Education	Professional degree
Political Party	Democratic Party
Years Owned	More than 10 years

Methods

The research question about landlord WTA requires modeling a dichotomous choice: the landlord rejects (0) or accepts (1) the rent restriction for *p* years posited in the survey. A logistic regression model is appropriate to estimate the 0/1 landlord decision function. The regression utilizes the inverse of the general logistic function to estimate the odds of each choice. A vector

of explanatory variables, including p , are linearly combined to predict the dichotomous choice. The definition of the logit function is:

Where $p(x)$ = the Probability of Accept
$$\ln\left(\frac{p(x)}{1-p(x)}\right) \quad \text{Eq. 1}$$

The same logistic regression is used to explain landlord knowledge about EE programs as well as preferences about electrification. The ordinal survey questions were combined as described in Table 8 to result in dichotomous outcomes. This was done in part to increase the available degrees of freedom available for the regressions by not having to estimate equations for ordinal outcomes. Logistic and ordinal regression utilize Maximum Likelihood Estimation which require a minimum of ~100 observations typically (Long and Freese, 2014). Our sample has about 80 usable observations which informed our decision to combine ordinal responses for landlord knowledge and the importance of electrification.

Results

The main research question for this paper is about landlords' willingness to accept rent restrictions in return for public funding for EE at their properties. Table 4 illustrates that a majority of respondents, roughly 70%, choose to participate in the proposed energy efficiency program when the duration of restriction is below their investment period.

As described previously, the offer posed in the question is a function of the respondent's investment period, reported in a previous question. Offers were calculated based on participants' self-reported investment period and had a mean value of 4.1 years and a median of 3 years. The offer represents the hypothetical duration of rent restrictions in years, represented by the variable p . It is derived from the respondent's response regarding investment period y , calculated as a random number between 1 and y .

Table 4: Responses to question: "...Would you be willing to sign an agreement to limit future rent increases to 2.9% if it was for a duration of p years?"

	Reject	Accept	Total
Offer of Less than 4.1 Years	16	43	59
Offer of More than 4.1 Years	7	14	21
Total	23	57	80

Initial offers for the WTA question were imposed by the investment period with offers of less than 5 years being made most frequently. A fair number of respondents also accepted the follow up offer: 28 of 57 accepted an offer twice as long.

A negative response to the initial and follow up offers prompted an open-ended question inquiring into reasons for not participating in the program at all. Approximately 17 of 80 completed responses (21%) indicated that they would not agree to any rent restrictions. The most common explanation was "I don't want to sign any agreements regarding my property." Some respondents chose to provide open-ended text. Responses indicated some degree of political frustration, "liberal dreams don't need to infringe on my market values," and "it is just another way for the city to be involved in your investments." Several respondents indicated that the proposed allowable rent increase would not keep pace with property taxes and insurance. Others indicated a preference for performing retrofits personally, that retrofits had already been completed, an intent to sell the property, as well as concern over inflation.

Data on the perceived benefits of EE retrofits, described in Table 5 below, offers some additional insights into the causal factors for WTA decision making. Consistent with the findings from the Lang et al (2021), tenant satisfaction, landlords' beliefs and values, and property value appreciation are cited most frequently. Recall that 93 percent of respondents reported tenant electricity-metered properties, implying that “lower utility bills” may be largely perceived only for common area EE measures in this sample. Text responses in the Other category were already having EE technologies, wanting to lower carbon emissions, and reducing global warming

Table 5: Response to question, “In what ways do you think your property would benefit from an energy efficiency retrofit?”

Variable	Count
Lower utility bills	56
Alignment with values and beliefs	50
Greater tenant satisfaction	48
Increased property value	43
Reduced turnover	14
Ability to charge higher rent	13
Would not benefit	8
Other	5
I Don't Know	3

Respondents expressed broad interest across a range of EE measures, as illustrated in Table 6. A follow up question prompted respondents to rank selected measures illustrated similarly broad interest, especially in windows, heating, cooling, and insulation. EE program designers should notice how low EV chargers rank in importance.

Table 6: Response to question, “Which energy efficiency measures do you think are most appropriate for this property?”

Variable	Count
Improved heating system	38
Improved A/C system	32
Improved water heating	32
Windows	30
New cookstoves	28
Wall and attic insulation	27
New refrigerators	26
Lighting	17
Electric vehicle charging	14
Other	6

Table 7 lists the factors respondents cited as decreasing their interest in EE retrofit measures. The data corroborates Lang et al's (2021) findings that financial concerns are a top concern. More surprising is the fact that disruption to tenants is cited almost an equal number of times. This is additional evidence that tenant concerns are highly salient for property owners. Typed responses in the other category also referenced different financial concerns, along with administrative challenges.

Table 7: Response to question, “What factors would decrease the likelihood that you would pursue energy efficiency retrofit measures?”

Variable	Count
Lack of financing	31
Too much disruption for tenants	28
No benefit because tenant pays utilities	18
I have already upgraded the appliances	15
I have other priorities	14
Other	12
Condition of property does not warrant	10

The logistic regression results are presented in Table 8. The coefficients in the three models are presented as odds ratios where values less than one represents a reduction in the odds of an outcome =1, and coefficient values greater than one predicts an increase in the odds of that outcome. Recall that odds are slightly different from probabilities (which are the ratio between an outcome and all possible outcomes) and represent the ratio of an outcome to another outcome. For example, 1:1 odds (even odds) are the same as a 50% probability (1/2), but 1:10 odds are equivalent to a 9.1% probability (1/11).

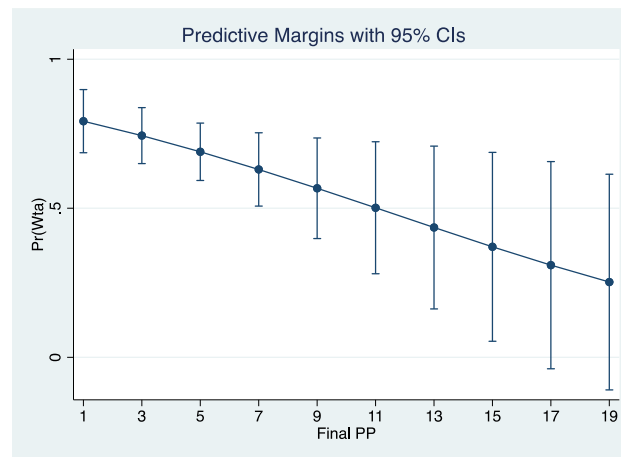
The variable Pyears in Model 1 of Table 8 shows the average effect of an increase of one year in the length of the rent restriction predicts a 15% (1.00-.844) decrease in the odds of landlords WTA for the covenant. The only other variable that is even weakly statistically significant in predicting WTA is the square footage of the average unit size (SquareFootage) of the properties.

Table 8: Logistic Regression Results

	(1)	(2)	(3)
VARIABLES	WTA	EEKnow	ElectImport
Pyears	0.844**		
UnitCount	1.018	0.749**	1.058
UnitSize	1.564	0.390	2.052
SquareFootage	0.592*	0.766	0.487**
YearsOwned	1.144	1.291	1.658
PropertiesOwned	0.973	2.159**	0.762
EmployPM	0.316	0.167**	1.552
IndividualMeter	0.814	9.081**	0.0957*
YearBuilt	1.029	0.698	0.196**
AverageRent	5.670	1.808	3.254
GasHeat	0.372	0.272*	1.662
Cool01	1.682	1.032	0.598
NonNOAH	0.814	1.149	2.205*
Constant	6.704	2.046	4.505
Observations	75	75	74
*** p<0.01, ** p<0.05, * p<0.1			

More resolution on the Pyears variable can be found in Figure 1. The vertical axis shows the predicted probability of agreeing to the rent covenant at determined values of P (years) on the horizontal axis. Controlling for all the other variables, the model predicts about an 80% probability of agreement for a rent covenant of 1 year. Probabilities decline, but the 95% confidence intervals of the predicted probabilities get wide due to few observations in the long duration years and several respondents who said yes to those covenants. Nonetheless, there are statistically significant differences between 1 year agreements versus 18 & 19 year agreements since their 95% confidence intervals do not overlap. Further explanations of those outliers are included the Discussion section below.

Figure 1: Effects of Pyears on WTA



Model 2 in Table 8 attempts to explain the predictors of landlords' stated EE knowledge from the question: "How much would you say you know about energy efficient technologies for your property? Some examples of this for your home might be heat pump water heaters and induction cookstoves." Recall that the ordinal responses to this question were condensed into two outcomes: 0=Not familiar & slightly familiar, 1=Moderately & Very & Extremely Familiar. About 42% of respondents fell into the first category and 58% in the second. Table 8 shows an increase in the number of units at the property predicts a 21% decrease in the odds of Moderate to Extreme familiarity with EE technologies. Absentee landlords who hire a property manager have 83% lower odds of scoring well on EE knowledge. Owning more properties more than doubles the odds of higher EE knowledge. Surprisingly, owners of tenant metered electricity properties have nine times higher odds of better EE knowledge. Since 93% of the surveyed owners have tenant meters, this may indicate a stark lack of knowledge by the master-metered group. In sum, this analysis shows that landlords who actively manage multiple smaller properties are in the sweet spot for existing knowledge about EE technologies.

Model 3 in Table 8 simulates the effects of the covariates on landlords' stated preferences about the importance of electrification. The question asks, "How important to you is building electrification for climate protection? This would replace gas ranges with electric induction units and switch out natural gas furnaces with electric heat pumps. The ordinal responses were recoded into 0=Not at all & not very important, 1=important & extremely important. Model three shows that larger unit size, tenant metered electricity, and older properties are less likely to agree that electrification is important.

Figure 2: Importance of Rent & Year Built on Electrification Importance

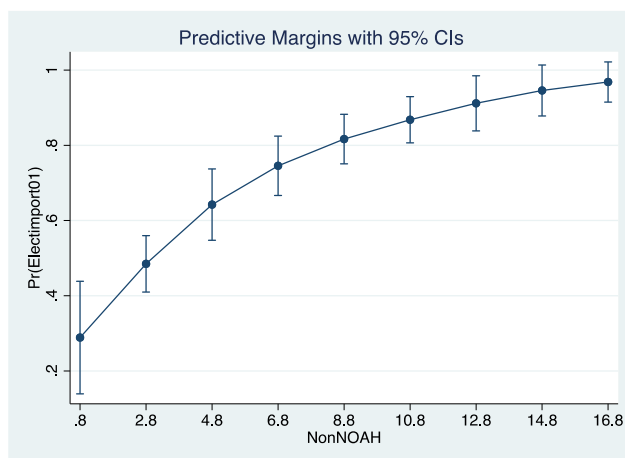


Figure 2 shows the effects of average rent*year built on predicted probabilities of stating electrification is important or extremely important. Higher values of the NonNOAH variable on the horizontal axis are associated with higher rents and newer properties. The owners of the oldest and lowest rent properties have only about a 30% probability of higher stated importance (vertical axis). In contrast, new and higher rent properties have probabilities exceeding 90%. This analysis shows that electrification marketing and outreach materials to what is typically considered the NOAH building segment should probably not highlight building electrification, but rather lower electricity bills, tenant satisfaction, and improved property values (Table 5).

Discussion

This analysis shows the first empirical estimates, that we are aware of, for landlord WTA to accept rent covenants. However, there are some limitations to this analysis. The impact of Covid-19 is a potential confounding variable for the WTA analysis (Table 4 and Model 1 in Table 8). As one respondent explained via email, “I entered 0% on annual rent increases. I typically have rent increases but not in the last 3 years during the pandemic. I belong to RHAO [Rental Housing Association of Oregon] and most landlords say the same. Some private (non-corporate) landlords even lowered rents or offered discounts to help out tenants.” Thus, there is a risk that other respondents interpreted the question similarly and that the survey does not totally reflect valid landlord preferences. The comment also raises the question of pandemic-related changes in landlord attitudes. If landlords voluntarily limited rent increases during the pandemic, there is some risk that their perceptions of fairness or effectiveness will have influenced their survey responses.

Another potentially limiting factor of the data is a small sample of about 75-80 landlords. There is a strong bias towards highly-educated, older, Democrats. While this breakdown may be appropriate for Portland, and potentially for other left-leaning locales, it might limit the generalizability of findings to other areas.

The results outlined above have several important implications for EE retrofit program design. Property owners are highly motivated by financial concerns, tenant concerns, and their values and beliefs generally. Those same motivations should be used in program marketing to increase the perceived value of the program. Nearly half of properties lacked cooling, and

landlords expressed strong interest in measures for cooling (Table 6). This would be an ideal measure to recruit landlords into a comprehensive retrofit program that include heat pumps for electrification. A large proportion of properties were built prior to 1950, which would likely indicate a lack of wall and attic insulation. This would be another ideal measure for prioritization based on interest from property owners. The marketing and outreach materials for NOAH property owners would likely be more effective if it focused on energy savings and tenant satisfaction rather than electrification for climate protection (Figure 2).

These results can potentially inform the design of future rent covenants. While existing EE programs in OR/CA mandate 10 year rent restrictions (Table 1), this is 3 years longer than the average investment period in our sample. Figure 1 shows that in the Portland sample, a 10 year restriction predicts only a 50% acceptance rate. Also consider that about 20% of landlords in our survey were not willing to sign ANY agreement about their property. The implication of these findings is that mandatory rent covenants longer than 5 years will most likely result in many landlords not enrolling in the EE retrofit program. If the primary programmatic goal is carbon reduction, a shorter covenant duration will likely achieve greater benefit. On the other hand, for NOAH properties at high risk of gentrification, a policy which brings half of them under fairly strong anti-displacement protection could be a worthwhile tradeoff. The DOE's Weatherization Assistance Program design might be the worst of both worlds: 1) including the rent covenant likely scares away a substantial portion of potential property owners from the program, combined with its 2) optional enforcement and "a reasonable period of time" attributes means that the covenant most likely does little to prevent future rent increases and subsequent displacement.

In addition to an expanded geographical scope of data collection, future research should investigate if there are any difference in landlords' WTA preferences if the rent restriction only covers existing tenants and not new tenants. It's not clear from the available literature how well existing covenants have been implemented and enforced (if at all), and having to track tenant turnover would certainly increase the administrative burden of implementation. This feature could also give landlords incentives to evict or force out vulnerable existing tenants in order to increase rental revenue.

These findings present the EE industry with a "wicked problem". EE retrofits are proven tools for climate change mitigation, improving household resilience to global weirding, and can reduce low-income and BIPOC household energy burdens. Our research confirms industry knowledge that the largest barrier to EE retrofits is a lack of financing; and public funding of EE programs can help reduce that barrier. But the law of social physics tells us that EE retrofits get capitalized into rents. All else being equal, this will result in increased rental burdens and displacement of vulnerable residents. Affordability covenants are an imperfect tool to mitigate displacement and should be viewed as one tool in toolbox. Local governments can offer property tax abatements to engage landlords. They can also develop programs to increase household income to reduce rental burdens. Other ideas and suggestions are welcome

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Appendices

Pairwise Correlation Table

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) WTA	1.000															
(2) Pyears	-0.158*	1.000														
(3) EEKnow01	-0.098*	0.162*	1.000													
(4) ElectImport01	0.255*	0.070	0.098*	1.000												
(5) UnitCount	-0.022	-0.131*	-0.101*	-0.076	1.000											
(6) UnitSize	-0.005	0.135*	-0.047	0.030	-0.243*	1.000										
(7) SquareFootage	-0.054	0.055	-0.054	-0.007	-0.266*	0.655*	1.000									
(8) YearsOwned	0.070	-0.095*	0.026	0.130*	-0.009	0.006	-0.018	1.000								
(9) PropertiesOwned	-0.065	-0.162*	0.084*	-0.157*	0.544*	-0.185*	-0.218*	-0.173*	1.000							
(10) EmployPM	-0.175*	-0.147*	-0.165*	-0.112*	0.241*	-0.260*	-0.193*	-0.092*	0.360*	1.000						
(11) IndividualMeter	0.007	-0.215*	0.173*	-0.140*	-0.004	0.126*	0.178*	0.084*	0.057	0.228*	1.000					
(12) YearBuilt	-0.264*	-0.011	-0.074	-0.289*	-0.008	0.085*	-0.068	-0.207*	0.215*	0.234*	-0.044	1.000				
(13) AverageRent	0.112*	0.049	0.035	0.243*	-0.441*	0.581*	0.714*	-0.066	-0.190*	-0.180*	0.144*	-0.223*	1.000			
(14) GasHeat	-0.018	0.070	-0.077	0.244*	-0.135*	-0.036	0.011	0.067	-0.164*	-0.182*	-0.004	-0.333*	0.210*	1.000		
(15) Cool01	0.077	0.135*	0.080*	-0.067	-0.032	0.040	0.092*	-0.060	-0.047	-0.203*	0.150*	-0.088*	0.111*	0.175*	1.000	
(16) NonNOAH	-0.211*	0.002	-0.056	-0.212*	-0.059	0.266*	0.163*	-0.219*	0.211*	0.171*	0.014	0.936*	0.041	-0.314*	0.011	1.000

* $p \leq .05$

Survey Instrument

https://www.dropbox.com/s/5a5ochdipisluxf/Portland_Landlord_Survey_Instrument_Export.docx?dl=0