Homeowner Decisions for Fire Resilience and Sustainability in Post-Wildfire Rebuilt Housing

Purpose

Post-disaster recovery can be an opportune time for communities to incorporate their ideals of disaster resilience and sustainability into rebuilt homes and neighborhoods. However, when rebuilding, homeowners need to make many decisions about their homes while also dealing with constraints; for example, they often need to rebuild expediently and cost-efficiently in the face of resource constraints. The incorporation of fire resilience and energy and embodied carbon reduction measures by homeowners in the design and construction of rebuilt homes will influence rebuilt communities for years to come. However, the post-disaster decision-making process by homeowners on incorporating resilience and sustainability measures has not been well studied. Homeowner decision-making may be influenced by jurisdictional decisions, building contractors, insurance, neighbors, and other homeowners who are rebuilding. There is a need to characterize the factors and organizations influencing homeowner decisions, and the tradeoffs homeowners make in the process to determine what influences their ultimate decisions. To this end, we ask:

- What decisions are homeowners making regarding the incorporation of fire resilience and energy efficiency in their rebuilt homes?
- How and why did they make these decisions? What factors or organizations were influential in these decisions?

The answers to these questions will add to the body of knowledge on disaster recovery and climate change adaptation by exposing challenges and opportunities for more sustainable and resilient disaster reconstruction.

Brief Research Methodology and Approach

We investigated these questions in the aftermath of the 2021 Marshall Fire in Boulder, CO, in which over 1,000 homes were lost in suburban neighborhoods, and a diverse array of contractors, from small custom builders to large-scale production builders, were hired to rebuild lost homes. Data from surveys conducted after the fire indicated that homeowners highly prioritized resilience and sustainability; however, we do not know the impact of these priorities on decisions.

Homeowner interviews: We conducted semi-structured interviews with 34 homeowners rebuilding homes post-fire. Each interview lasted approximately 1 hour. We asked homeowners about their rebuilding decisions, including their priorities, challenges, and decision-making processes for the incorporation of sustainability and resiliency into the design and construction of their homes. For those homeowners who did not mention fire resilience or sustainability in response to these questions, we asked specifically if they were

incorporating these measures into their rebuild and why or why not. Some of the questions we asked included, "*As you have had to make decisions, have you experienced conflict or tradeoffs that you need to make between your various priorities*?", "*Has your perception of wildfire risk affected any of your rebuilding decisions?*", and "*How and why did you go about selecting your builder*?".

Home builder interviews: Recognizing the influence of home builders on homeowner's building decisions, we also interviewed 16 contractors involved in the rebuilding to gain further insight into homeowner decisions for resilience and sustainability. We asked contractors about decision-making in the home building process, including how the disaster rebuilding process differed from traditional home building and how energy efficiency and disaster resilience were being incorporated into homes. Some of the questions we asked included, "*What aspects of sustainability are homeowners interested in adopting and why?*", "*What tradeoffs do homeowners grapple with for the design of their house*?", and "*What recommendations are you making to homeowners*?".

Data processing and analysis: We transcribed the interviews and are deductively coding the transcripts for decisions around sustainability and fire resilience. Deductive codes, which are themes determined ahead of time, include tradeoffs, cost, expediency, and choice of builder, among others. For example, the following quote describing a homeowner's choice of production builder was coded for builder decision, energy efficiency, fire resilience, cost, and tradeoff. Here they discussed hiring a contractor who met their cost constraints while incorporating most, but not all, of their desired energy and resiliency goals:

"It took some time to go by [to] *become increasingly comfortable with, okay, this is not exactly what I wanted, it's not perfect, but it's close enough, and it's landing in a budget…. I feel like my decision to go with* [my builder]*, especially with the electric and with the fact that there are so many other things built into the house that…increases the percentage of it being fire resilient, that I was able to become comfortable with that* [the decision to hire the contractor] *over time."* This homeowner hired a production builder to build a fully electric house (no gas) and explored other resilience features.

We are also inductively coding emergent themes related to or affecting decisions for sustainability and fire resilience. Inductive codes, which are themes that emerge during interviews or analysis, include the influence of homeowner groups and builders, mental states, and reasoning patterns. For example, the following quote describing one homeowner's decision to rebuild an energy-efficient home is inductively coded to mental states of trauma and uncertainty, and the reasoning pattern "act of trust":

"I was trying to make decisions based on what was smartest in a traumatic situation. It's not always [possible] to make smart decisions in those moments, but it was the financial aspects... even though it's going to be a struggle to get to a final product, I think I have the resources and also the help of what's out there as far as rebates and incentives and I think I'll be able to do it. And it's going to, in the long run, be the best decision.... And so I'm stepping into it and stepping off the ledge and hoping it works."

All codes were analyzed for frequency and overlap to answer the research questions. Most interviews took place before decisions were finalized. To trace decision-making over time, we are currently obtaining homeowner decisions through follow-up interviews and building permit data, including data on energy code adoption and inclusion of fire-resistant features.

Ethical considerations: We recognize the traumatic nature of this event, including both the initial destruction and the lasting challenges of recovery. All data for this study was collected following IRB approval with the goal of limiting potential harm and providing the maximum benefit to participants. Some homeowner interviewees described the interview process as either therapeutic or providing a valuable opportunity for reflection.

Preliminary Key Findings

We found that homeowners were influenced by resource constraints, namely cost and schedule constraints due to insurance. Additionally, homeowners were influenced by jurisdictional code adoptions and opt-outs for rebuilds and builders.

Resource Constraints

Resources, or the lack of resources, influenced or constrained all decisions in the rebuilding process. It was also the primary source of stress for homeowners, which involved tremendous uncertainty and requiring time and patience to sort through the uncertainty. During this process, many homeowners learned that they were underinsured and received initial estimates of insurance proceeds that were well below the amount needed to rebuild. There was also widespread uncertainty about if and what additional insurance proceeds might be forthcoming. Both the underinsurance and uncertainty in total proceeds led homeowners to be more cost-conservative in their decision-making for their home design. This cost-conservatism affected the adoption of fire resilience and energy efficiency measures directly and indirectly through their choice of builder. For instance, one

homeowner described how this influenced what they could rebuild despite their desires to rebuild otherwise:

"We were aiming to do a fully non-combustible house, in other words, build without any combustible components... However, as we moved along in our project, it looks more and more like that would be a $1,000,000 rebuild project, which is more than we want to spend because… we're only committed to getting about 540,000 or 520,000 from insurance."

Additionally, homeowners were time-constrained from dealing with their insurance, resettling in a new temporary home, and dealing with the emotional toll of loss. As a result, they had less time to devote to educating themselves on design priorities, such as fire resilience and energy efficiency. As such, they were not able to evaluate different options that may increase the homes' resiliency or energy efficiency or increase the affordability of different options. This negatively impacted their "coping appraisal" process, which includes evaluating their ability to adopt an action and their belief in the action's effectiveness. High homeowner ratings for these aspects of "coping appraisal" are important for the adoption of protective actions such as fire resilience in a home rebuild [1].

Jurisdictional influence

Jurisdictional building codes provide regulations for minimum standards of what must be built. This regulatory influence was hugely influential in what homeowners designed and built. In Colorado, building code requirements are determined by the local jurisdiction. Homes were lost within three jurisdictions: the Town of Superior, the City of Louisville, and Unincorporated Boulder County. Shortly before the fire, Superior and Louisville adopted new building codes that would increase energy efficiency requirements. The uncertainty of these new code requirements, whether insurance would pay for the latest energy code, and underinsurance, prompted resident concerns over escalating costs. In turn, this prompted many homeowners to collectively appeal to the jurisdictions to allow opt-outs for fire rebuilds or to change building code requirements. In Ellery et al. [2], our team examined jurisdictions' decisions and factors influencing this process.

Ultimately, Louisville allowed homeowners to opt-out of the latest energy code and made fire sprinklers optional; Superior adopted a WUI code for certain neighborhoods, but also allowed homeowners rebuilding post-fire to opt out of this code, which the vast majority did; and Boulder County, who had adopted energy efficiency and fire resiliency codes years before, maintained their code requirements even for the fire rebuilds. While jurisdictions appealed to resident concerns to rebuild their communities, they also posted information to

reduce uncertainty on the adoption of the latest energy codes and held public forums to educate the public.

Builder influence

We found that homeowners often deferred decision-making to the contractors they hired. In addition to deferring to the experts due to a lack of experience, they also deferred to contractors to make decisions that would speed the process. In part, deference to experts was done to reduce stress during a very traumatic time.

However, many of the builders lacked experience in building for fire resilience and sustainability measures. Their lack of experience caused uncertainty and inflated cost estimates. Further, given their lack of experience, some homeowners perceived these measures as unorthodox or new to the industry, and did not want their builder incorporating unproven measures. In particular, fire resilience measures are not conventionally pursued outside of forested regions in Colorado. One homeowner described this predicament when discussing whether builders were equipped to build to the 2021 code:

"[for my builder to] *build a house to* [the] *2021* [energy] *code, he would be finding his way... He knows to be like, okay, I can… figure it out…. But they're also not going to turn down a $100,000 job. They'll just be like ya ya ya, I can do that... Me as a homeowner, I'm like, I ain't your guinea pig, I want this to be in your wheelhouse, not your first or second rodeo*."

The role of builder influence was further affected by homeowners choosing builders that aligned with their priorities, e.g., some homeowners prioritized selection of a builder that they felt might be able to make the new energy code work.

Potential Implications

Post-disaster is an opportune time to 'rebuild better'. Yet, there is a dearth of information that aids and inhibits these goals. We are addressing this need by characterizing decisions homeowners made for resiliency and sustainability measures when rebuilding their homes post-fire and the factors and organizations influencing these decisions. Further, we plan to offer suggestions about incorporating common decisions and information resources into pre-disaster plans to aid homeowners facing rebuilding to help reduce uncertainty in the decision-making process and ideally enable progress towards reducing the carbon footprint required post-disaster and aid global progress in climate related goals.

Limitations

The study's main limitation is that it is confined to a single event, and it is difficult to quantify the degree to which our findings are context specific. Additionally, while we did our best to interview a representative sample of homeowners, recruitment was largely conducted through snowball sampling which can lead to limited representativeness and sample bias. In ongoing work, we are ensuring representativeness of interviewees in terms of sustainability and resilience decisions, choice of builder, age, sex, ethnicity, and neighborhood/subdivision of the lost home.

References

[1]Botzen, W. J. W., H. Kunreuther, J. Czajkowski, and H. de Moel. 2019. "Adoption of Individual Flood Damage Mitigation Measures in New York City: An Extension of Protection Motivation Theory." *Risk Analysis*, 39 (10): 2143–2159. https://doi.org/10.1111/risa.13318.)

[2] Ellery, M., Javernick-Will, A., Liel, A., and Dickinson, K. (2023). "Jurisdictional decision-making about building codes for resiliency and sustainability post-fire". Environmental Research Infrastructure and Sustainability, 3(4) 045004.