Navigating Climate Risks in Affordable Housing: Strategies for Equitable Risk Assessment

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ABSTRACT

Extreme weather and temperature-related risks pose a growing challenge in the affordable housing sector, particularly for those serving vulnerable populations, such as seniors and low-income individuals. This escalating risk has triggered a surge in insurance premiums and raised concerns about how to assess and combat climate risks for property owners. This issue has also permeated policy development, as evidenced by the inclusion of FEMA's National Risk Index (NRI) in the Green Resilient Retrofit Program (GRRP) to allocate funds to qualifying census tracts.

Given the increasing integration of climate risk into funding allocation decisions, it becomes imperative to ensure that the communities most vulnerable to these risks benefit the most. While tools like the NRI and EDF's Climate Vulnerability Index (CVI) aid in understanding climate risks compared to other regions, individually, they may not be enough for devising building-level policies and programs. For example, even though increasing temperatures are seen across the country, areas with comparatively lower increases might be seen as lower risk in the NRI, potentially downplaying the actual risks they face. Underestimating and downplaying climate risk can result in inadequate adoption of critical solutions, such as energy-efficient HVAC systems and building envelopes.

This paper is not an absolute risk assessment; it provides a guiding methodology for identifying and prioritizing climate risk. It leverages data and insights from multifamily affordable housing providers' portfolios and compares findings across two climate risk assessment tools: FEMA's NRI and EDF's CVI. The paper will exemplify how best to utilize climate risk assessment tools within a portfolio and provide key takeaways on how to incorporate climate risk in program design to ensure equitable access to funding and opportunities.

Introduction

The ten warmest years in recorded history have occurred during the last decade (NOAA 2023). The summer of 2023 was the hottest season in Earth's recorded history (Fox, Keck, and Richmond 2023). The increasing temperatures are a result of global climate change, and communities worldwide have seen a growing number of extreme temperatures, rising sea levels, natural disasters, and severe impacts on human health (NOAA 2023). In the winter of 2023, over 425,000 Austin, Texas, residents were without power for a week due to a widespread winter ice storm that brought about freezing rain and fallen trees (Buchele 2023). In June/July 2022, a heat wave with temperatures nearing or breaking heat records impacted areas of the Pacific Northwest, where 800 people, many of whom were older and lived alone, died (Boone 2022). The COVID-19 pandemic, beginning in 2020, exacerbated the lack of support and slowed response time to these natural disasters as people could not easily leave their homes for heating

or cooling centers. There are compounding numbers of similar experiences, including lost lives and an increasing cost of damage done to communities worldwide.

To combat the impacts of global climate change, energy efficiency has shown to be one of the easiest and most cost-effective ways to reduce energy and utility costs for consumers; it has also shown to be a vital component in achieving net-zero emissions of carbon dioxide through decarbonization (Office of Energy Efficiency & Renewable Energy n.d.). Energy efficiency can act as both an adaptation and mitigation strategy against global climate change and the extreme temperatures it brings; it is needed to ensure that buildings maintain comfortable living environments, build resilience against daily stressors like rolling power outages, and costs remain affordable to heat and cool when faced with extreme temperatures.

Many multi-family affordable housing developers are committed to advancing resident-centered policies and solutions that fight back against the effects of climate change and create sustainable, resilient, and low-carbon affordable homes. This is particularly true for the members of the Stewards of Affordable Housing (SAHF), a collaborative of twelve mission-driven, multi-state nonprofit affordable housing developers. The SAHF member portfolio comprises over 1,950 properties (approximately 149,000 affordable rental homes) nationwide. SAHF and its members are leaders in the affordable housing sector for building and operating energy and water efficient housing. Beginning in 2013, SAHF members committed to the Big Reach[1]- a collaborative initiative of SAHF, its 12 members, and its partners to achieve a 20% reduction in energy and water consumption across SAHF member portfolios by 2020- which goals were met and exceeded.

SAHF member efforts are not limited to the scope of energy efficiency. SAHF members are increasingly looking at ways to protect their portfolio of properties from the impacts of climate change. In the summer of 2020, before any notable climate risk assessment tools were released, SAHF created Climate Risk Reports for its members, identifying individual risk scores for five natural hazards: flood, hurricane, wildfire, extreme heat, and extreme cold. SAHF created scores from data sourced from publicly available federal databases. SAHF assessed how member properties performed and what risks they faced across their portfolios. In the assessment, SAHF found that approximately half of the member properties faced at least one high risk, and the most common risk was extreme temperature. As the SAHF member portfolio is geographically broad, it is fair to assume that it is not unique and that many other affordable housing portfolios are likely to face similar risks.

Since the SAHF Climate Risk Reports were created, new data and climate risk assessment tools have become available. Further interest and funding opportunities exist for multifamily affordable housing stakeholders to make decisions using federally or nationally established climate assessment methodologies (i.e., The Department of Housing and Urban Development's (HUD) Green and Resilient Retrofit Program, or GRRP). The Biden Administration has prioritized addressing climate risk through the Inflation Reduction Act and the prioritization of environmental justice in the Justice 40 Initiative. At the state level, clean energy commitments that impact multifamily homes are becoming more widely adopted through state-level affordable housing policy (in-state Qualified Action Plans (QAP)) and local and statewide building performance standards.

Climate risk is expected to be a determining factor by which limited federal, state, and local decarbonization funding resources will be distributed. For these reasons, climate risk

[1] The official Big Reach report can be read at www.sahfnet.org/resources/big-reach-report

assessment tools must be properly vetted and continuously reviewed if they are to be used as a determining factor for funding. This is to ensure that climate risk assessment tools properly account for risks that decarbonization mitigates, like extreme temperatures, and are not replicating historic systemic issues, like redlining[2]. These climate risk assessment tools must also be reviewed to ensure that they provide information to housing developers and stakeholders to make informed decisions for the well-being of their properties and those living there, especially since housing providers have limited resources to address all of the resident's diverse and complex needs and priorities.

This paper leverages data and insights from affordable housing provider's portfolios across three free national climate risk assessment tools: the Federal Emergency Management Agency (FEMA) National Risk Index (NRI) and the Environmental Defense Fund (EDF) Climate Vulnerability Index (CVI). This paper will provide an overview and assessment of the climate risk tools, as the NRI and CVI give a historical perspective on climate data. Furthermore, the paper will demonstrate the significance of evaluating risk across multifamily property owner's portfolios and offer recommendations to incorporate climate risk across program design to ensure equitable access to funding and opportunities.

Overview of Climate Risk Assessment Tools Based on Historic Data

FEMA National Risk Index (NRI)

Built by FEMA, the NRI is a dataset and online tool first released in October 2020 and updated in 2021 and March 2023. The tool includes scores on 18 natural hazards[3] that United States communities are at the most risk for, and a composite risk score is calculated at the county and census tract levels (FEMA n.d.). The NRI was developed initially to support federal, state, and local planners and emergency managers in understanding natural hazard risk and to develop more climate-responsive policies, programs, and practices. It was recently referenced in the HUD Green and Resilient Retrofit Program (GRRP) Comprehensive funding notice, where each property application requires a Climate Hazard Risk Score based on the NRI; awards prioritize higher scores (HUD 2023). The NRI is also the basis for Enterprise's Portfolio Protect (Enterprise Community Partners 2022). Figure 1 illustrates the scoring formula.

[2] Redlining, as defined by HUD (n.d.), is "discrimination based on location is often referred to as redlining because historically, some lending institutions were found to have maps with red lines delineating neighborhoods within which they would not do business."

[3] Avalanche, Coastal Flooding, Cold Wave, Drought, Earthquake, Hail, Heat Wave, Hurricane, Ice Storm, Landslide, Lightning, Riverine Flooding, Strong Wind, Tornado, Tsunami, Volcanic Activity, Wildfire, and Winter Weather

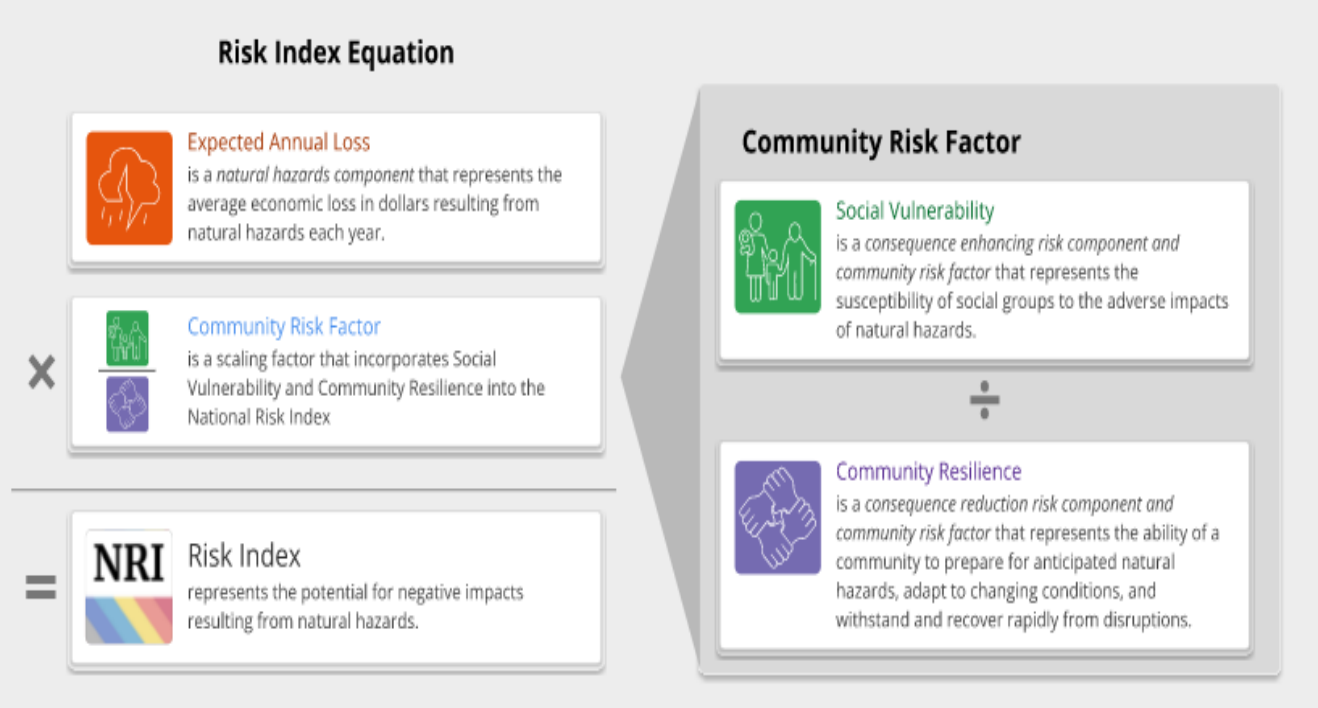

Figure 1. FEMA NRI Risk Index Equation. The formula is calculated using the main components of a hazard: Expected Annual Loss and Community Risk Factor (Social Vulnerability and Community Resilience). *Source*: FEMA n.d.

Figure 2 illustrates the FEMA NRI Climate Risk map user experience. Once searching for a county or address, the equation will output:

- Values: Representative value of the average economic loss from natural hazards each year.
- Scores: National percentile ranking of the community's Expected Annual Loss compared to all other communities at the same level (county or census tract).
- Ratings: Qualitative representation of a community's exposure to individual hazards or overall risk based on its score.
- Ratings include very low, moderately low, moderate, moderately high, and very high
- For the purpose of analysis by SAHF, the FEMA NRI ratings qualitative scores have been converted to a numerical score:
    - Very Low =1
    - Relatively Low = 2
    - Relatively Moderate = 3
    - Relatively High = 4
    - Very High = 5

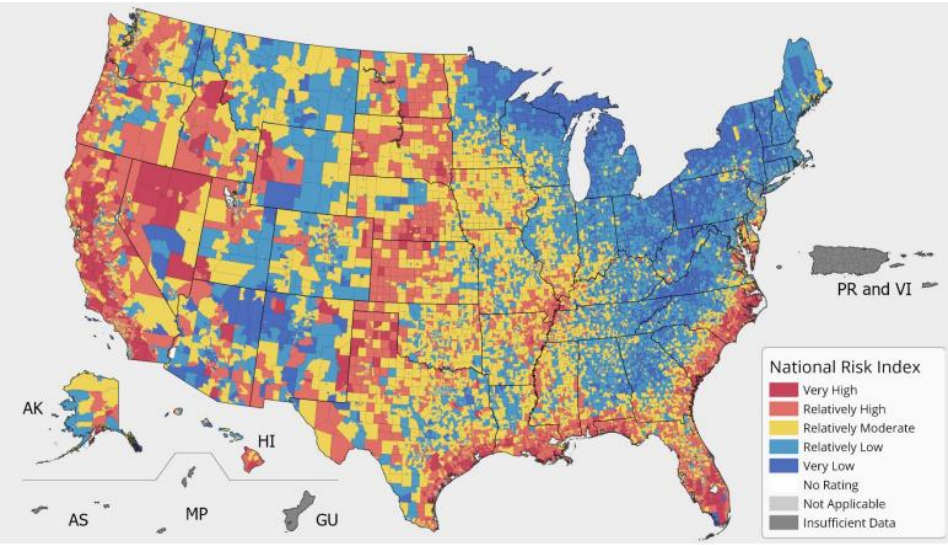

Figure 2. FEMA NRI Risk Index Map. The map shows the varying levels of climate risk across the U.S. *Source*: FEMA 2024.

EDF Climate Vulnerability Index (CVI)

The Climate Vulnerability Index (CVI), developed in partnership between the Environmental Defense Fund and Texas A&M University, was released in 2023. The score combines environmental, social, economic, and infrastructure effects on neighborhood-level stability. Using 184 indicators, the CVI ranks more than 70,000 census tracts to identify communities that face the greatest challenges from the impacts of climate change. The CVI is intended for use by policymakers to build resilience and understand the risks that leave people vulnerable across the country. Tool developers hope that data from the CVI will inform equity-focused funding from recent legislation.

Lewis et al. (2023) state that the CVI is calculated across two themes, Baseline Vulnerabilities and Climate Change risks, which have been divided into categories and further aggregated into indicators, as displayed in Figure 3.

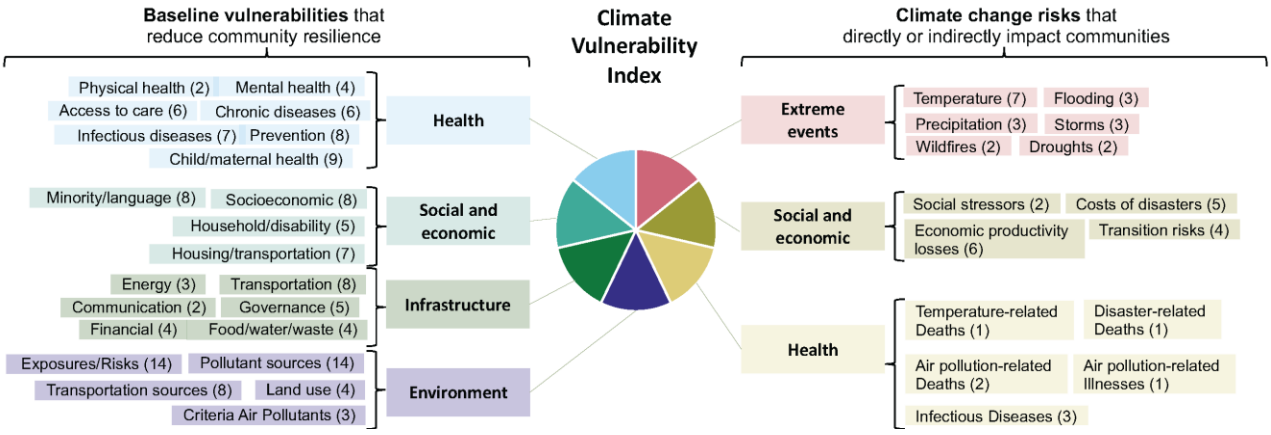

Figure 3. EDF CVI Vulnerability Index formula. Vulnerability and risk categories (n=7) and components (n=37) were used to create the U.S. Climate Vulnerability Index.

Users can explore the data by state, census, county, zip code, address, or Environmental Protection Agency (EPA) region. Darker colors indicate a higher vulnerability. Figure 4 presents the EDF CVI Index. The report will give more details about a location's climate vulnerability index, allowing the user to view different indicators. Details include:

- Indicator Spotlight to view the spread and concentration of a selected indicator's risk.
- Top Drivers to view which sub-indicators are the driving vulnerability for a selected indicator
- Ratings: Qualitative representation of a community's exposure to risk based on its score.
    - Ratings include highest vulnerability, higher vulnerability, average vulnerability, lower vulnerability, lowest vulnerability
- For the purpose of analysis by SAHF, the EDF CVI qualitative ratings have been converted to a numerical score:
    - Lowest Vulnerability = 1
    - Lower Vulnerability = 2
    - Average Vulnerability = 3
    - Higher Vulnerability = 4
    - Highest vulnerability = 5

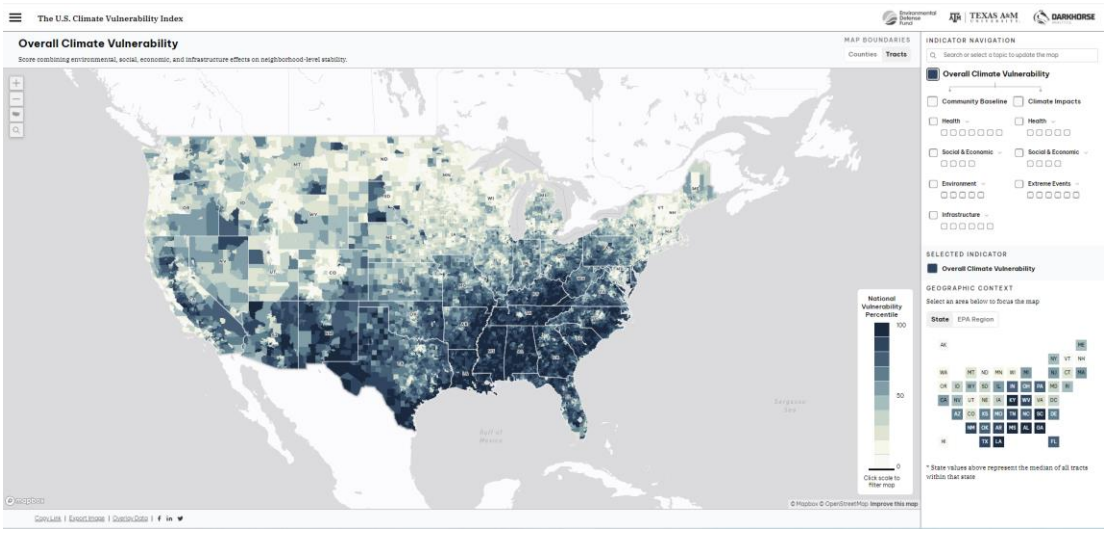

Figure 4. EDF CVI Vulnerability Index Map. The map shows the severity of an indicator, which may be selected in the Indicator Navigation Tree (Top Right) across the U.S. Darker colors represent a higher climate vulnerability. Climate Vulnerability Index.

Assessment of each Climate Risk Assessment Tool

It is important to note that this paper does not review a comprehensive list of all available climate risk assessment tools. However, these Climate Risk Assessment tools were most frequently referenced in conversations with key stakeholders when SAHF pursued an update to the 2020 SAHF Climate Risk analysis. These climate risk tools also appear closely aligned with the original SAHF Climate Risk Reports in 2020. As new climate risk assessment tools become available, the following assessment can be used to determine applicability to decarbonization policies and programs and multifamily housing portfolios.

To conduct a comparative analysis, SAHF looked at multiple factors to determine which climate risk assessment tool is most appropriate for affordable housing organizations and stakeholders working to develop decarbonization policies and programs for affordable housing. Ultimately, SAHF is looking for a tool or series that identifies the risk to properties and the people residing in the communities. These factors included:

- The intention or baseline orientation of the climate risk assessment tool
- The number of climate risk factors included, and in particular, the number of factors associated with extreme temperatures
- The time period projected in the tool
- The number of socioeconomic indicators in its source data; the social qualities that reflect a community's reaction to a natural hazard
- The number of natural hazards resiliency indicators; the physical attributes of a community that determine its ability to withstand or respond to the impacts of natural hazards.

Table 1 assesses the considerations of each climate risk assessment tool based on the above factors.

Table 1. Description of each Climate Risk Assessment Tool

	Tool Baseline Orientation	Number of Climate Indicators	Extreme Temperature Factors Historic Data	Number of Social Factors	Number of Resilience to Natural Hazards Factors
FEMA NRI	Potential Economic Impact from Natural Hazards	18 (4 related to extreme temperatures)[4]	National Weather Service data (2005 – 2022)	16[5]	49[6]
EDF CVI	Potential Community Impact from Natural Hazards	37 (2 related to extreme temperature)[7]	FEMA NRI and Peer-Reviewed Research article[8]	139[9]	45[10]

Description of the FEMA NRI and EDF CVI. Source: Zuzak et al. (2023); Lewis et al. (2023)

[4] SAHF categorized Heat Waves, Cold Waves, Winter Weather, and Ice Storms as relevant extreme temperature factors where energy efficiency and other decarbonization strategies could mitigate impacts.
[5] The NRI utilizes the CDC/ATSDR Social Vulnerability as its source data provider; 16 socio-economic indicators
[6] The NRI utilizes the HVRI BRIC dataset as its community resilience source data provider; 49 community resilience indicators
[7] SAHF categorized Temperature and Storms as relevant extreme temperature factors where energy efficiency and other decarbonization strategies could mitigate impacts.
[8] Iturbide M. et al. Repository supporting the implementation of FAIR principles in the IPCC-WG1 Atlas. (2021).
[9] 139 Baseline Indicators, see Figure 3
[10] 45 Baseline Indicators, see Figure 3

Description of Climate Risk Assessment Tools

The usage of each climate risk assessment tool is dependent on the user's intent. Both tools are open-source and free. Both the NRI and the CVI rank their climate factors as a percentile at either the county or national level, and information can be viewed at the census level, allowing for more clarity on community-level impacts. The CVI tool has the greatest number of indicators, specifically 184- which may be most beneficial for users with a specific question related to the impact on people and community. However, the NRI utilizes a greater number of indicators related to extreme temperature and focuses on the impact on the property and economic loss of space. In summary, both tools have merits but utilize different methodologies.

Climate Risk Assessment Tools: Property Level Comparisons

The following tables present data collected from the NRI and the CVI. Both tables compare a U.S. County and census tract within the SAHF portfolio: Washington DC, Wayne County, Michigan, and Alameda County, California. The following properties are located also in HUD Qualified Census Tracts (QCTs) and EPA Climate and Economic Justice Screening (CEJST) Disadvantaged Communities[11]. Each column yields the overall risk rating for the designated geography. The NRI and CVI qualitative scores were converted to numerical scores, ensuring ratings for individual locations can be referenced and compared between the NRI and CVI.

Table 2. Three Census Tracts within the SAHF Portfolio

	Overall Risk Rating		Heat-Related Risk Rating	
Location	FEMA NRI	EDF CVI	FEMA NRI Heat Risk	EDF CVI Temperature-Related Deaths
Washington DC - Census Tract 11001007804	Relatively Low (score = 2)	Higher Vulnerability (score = 4)	Relatively Moderate (score = 3)	Higher Vulnerability (score = 4)
Wayne County - Census Tract 26163530900	Relatively Low (score = 2)	Higher Vulnerability (score = 4)	Relatively Moderate (score = 3)	Lower Vulnerability (score = 2)
Alameda County - Census Tract 06001402500	Relatively Moderate (score = 3)	Lower Vulnerability (score = 2)	Relatively Low (score = 2)	Average Vulnerability (score = 3)

Climate Risk Assessments for three census tracts across the SAHF portfolio. The scoring has been converted to a numerical score. *Source*: FEMA 2024; EDF n.d.

[11] EPA Climate and Economic Justice Screening (CEJST) Tool is found at www.screeningtool.geoplatform.gov/en/#3/33.47/-97.5

Table 3. Three Counties within the SAHF Portfolio

	Overall Risk Rating		Heat-Related Risk Rating	
Location	FEMA NRI	EDF CVI	FEMA NRI Heat Risk	EDF CVI Temperature-Related Deaths
Washington DC - County	Relatively Moderate (score = 3)	Lower Vulnerability (score = 2)	Relatively Moderate (score = 3)	Higher Vulnerability (score = 4)
Wayne County, Michigan	Relatively High (score = 4)	Higher Vulnerability (score = 4)	Relatively High (score = 4)	Lower Vulnerability (score = 2)
Alameda County, California	Very High (score = 5)	Lower Vulnerability (score = 2)	Relatively Moderate (score = 3)	Average Vulnerability (score = 3)

Climate Risk Assessments for three census tracts across the SAHF portfolio. The scoring has been converted to a numerical score. *Source*: FEMA 2024; EDF n.d.

Analysis

Initially, SAHF intended to use the FEMA NRI to analyze the SAHF portfolio in the second iteration of the SAHF Climate Risk Reports. However, it quickly became apparent that while the tool provides valuable information, it may not be appropriate as the only source for analyzing the portfolio. SAHF also found similar issues when reviewing the EDF CVI tool—it should not be used as the only source for climate risks in future reports.

County and Census Tract Differences

The first discrepancy discovered when reviewing the climate risk assessment tools was the difference between the census tract and county level risk. Currently, for the NRI and the CVI, there are instances where the same tool presents different overall risk ratings when viewed at the county and census tract levels. In several cases, including the three examples of properties above, SAHF discovered that the county overall risk rating and heat-related risk, see Table 3, trended higher than the census tract risks, see Table 2. While this may seem appropriate due to changes in geographic scale from county to census tract, it isn't very clear to the user. This is especially confusing for indicators such as heat, where risk should be relatively static regardless of the geographic boundaries used.

There is greater consistency using the CVI. Alameda County and Wayne County and their census tracts remain the same across Table 2 and Table 3. However, the climate risk rating for Washington, DC, is higher at the census tract level than at the county level when using the CVI. The heat-related risk rating at the county and census tract levels remained the same across all three geographies when using the CVI.

Climate Risk Differences

There are instances where the NRI and CVI have a similar overall risk rating. This is exemplified in Table 3 at the census tract level for Wayne County, which reports an overall risk rating score of 4 when using either the NRI or CVI. However, there are several instances where overall risk rating scores are slightly contrasting or drastically different. The greatest score

difference is in Table 3 for Alameda County, where the NRI reports a score of 5, while the CVI reports a score of 2 for the overall risk rating. These differences are both expected and unsurprising: while the two tools have overlapping data sets, they utilize different methodologies.

As for the heat risk ratings, there are instances where both climate risk assessment tools report the same rating. This is exemplified in Alameda County, where the NRI Heat Wave Rating has a score of 3, and the CVI Temperature Related Death indicator also has a score of 3. Again, there are several instances where climate risk rating scores are slightly contrasting or drastically different. The greatest difference in scores for the climate risk rating is in Wayne County, where the NRI Heat Wave indicator reports a score of 4, while the CVI Temperature-Related Deaths indicator reports a score of 2.

These differences may be due to the underlying goals of each tool. The basis of the NRI is focused on economic loss, and it could prioritize risk in census tracts with higher property values and greater potential for loss due to climate hazards. The NRI utilizes a social vulnerability index to account for community and population-related factors. However, this does not appear to completely counterbalance the reality of undervalued properties in Black Indigenous People of Color (BIPOC) and low-income communities due to historic systemic redlining. If the tool did, there would likely be more alignment with other mapping tools, like EPA CEJST and HUD QCT methodologies. The CVI, with more than 100 social factor indicators, is more likely to account for community impact but has only 11 factors regarding economic losses and may undervalue the impact on properties.

Significance of Evaluating Risk for Affordable Housing Providers

Both climate risk assessment tools can be used to identify the climate and heat risks that communities face. However, the tools differ more than they are similar. Not only do they present differing levels of climate risk between census and county levels, but they also present different overall climate and heat risk ratings, which will likely confuse users about which tool is more accurate to meet their needs and understand their risks. In this case, affordable housing organizations must understand how to prioritize the climate risks to their properties and the residents in their communities. Neither tool serves as a one-size-fits-all solution.

Ultimately, SAHF determined that both tools provide valuable climate risk information but must be utilized to better understand the impacts on the multifamily properties owned and managed by SAHF members and residents in these communities. Since both tools provide risk ratings that can easily be converted to a numerical score, SAHF can place all member properties on a 10-point scale. A property with the lowest risk rating categories for both tools would receive a score of 2, whereas a score of 10 would represent a property that falls into the highest risk category for both the NRI and the CVI. This will allow SAHF members to quickly assess where their portfolio faces a higher risk to the property and residents.

Regarding geography, SAHF believes that it is still appropriate for the SAHF portfolio to utilize the narrowest geography available, specifically the census tract level, but to use information from both tools and compare trends to county-level data, especially for temperature-related risks. This review also underscores that program administrators and policymakers may want to consider the differences between county and census levels and their impact on specific communities as they prioritize resources.

A large discrepancy in climate risk assessment tools can significantly impact funding distribution for buildings in the multi-family sector. When stressors from climate change impact communities, it is often the most vulnerable and historically disenfranchised populations that receive the hardest impact. As exemplified in the 2022 Heat Wave Pacific Northwest, it was the independent elderly populations that were hit the hardest, many of whom lost their lives. Multifamily affordable property owners and developers do not have the disposable funds to conduct in-depth climate risk assessments independently. Yet, there is no substitute for property-level risk assessments. Therefore, it is critical that programs and policies ensure that the climate risk tools and processes used are equitable.

Key Takeaways

Ultimately, there is no easy or direct translation from the current state of climate risk assessment tools to identifying the programs, policies, or practices that support low-income communities in the energy sector. All climate risk assessment tools are valid, but they measure the impacts on different variables (i.e., people, property, etc.) and utilize data sources for different time periods (i.e., historic and future). Addressing energy efficiency is both a building and community effort. SAHF and multifamily affordable housers care about energy efficiency because they connect to the people in the building. The NRI on its own is not enough to develop climate mitigation strategies. When building programs that serve low-income populations, the NRI must be combined with other climate risk assessment tools, such as the CVI, for the affordable housing sector.

The following recommendations will help to ensure equitable access to funding and opportunities when evaluating risk across affordable housing portfolios:

- Consider that different inputs went into developing climate risk assessment tools. All three tools utilized varying amounts of data and different indicators in their analysis, which may explain variability in scoring by location (i.e., census or county level).
    - This variation indicates that affordable housing organizations focused on both properties (including the potential economic losses) and people (residents who live in these communities) cannot use one tool over another.
    - These tools can and will be considered together for the SAHF member portfolio. By combining multiple well-researched but differently oriented tools, SAHF members can begin to understand where and what type of risk is present at their properties.
- The hazards brought about by global climate change are only increasing; therefore, community-level responses and programs should be accurate and exact. For many users, the solution is not to identify where the highest risk is at a national level but where it is within their portfolios or geography. Using only historical percentile rankings may fail to account for neighborhood-level differences appropriately.
- Individual climate risk assessment tools can inform programmatic mitigation and adaptation strategies to combat natural hazards. However, they cannot be the only deciding factor.
    - To ensure equitable access to funding and opportunities, energy efficiency and affordable housing experts need to think about programming that uses climate risk factors as thresholds or incentives rather than mandatory inclusion.

    - Prioritizing equity within the climate risk assessment tools will help developers ensure an equitable and impactful allocation of resources.
- Experts should try to understand the resiliency and energy efficiency needed for a particular community when developing programming and pursuing funding. Programs must be able to assess risk based on the community's present needs.
    - These tools are not a substitute for property-level assessments, especially where the assessments consider resident populations. Instead, climate risk assessment tools should be used in conjunction with property-level data and assessments.

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