HEAT RISK · VALUATION · HOUSING DATA

When the Map Arrives Before the Market

What the Census Bureau's new Local Air Conditioning Estimates reveal about where heat risk concentrates — and why the data has outrun the market that might one day price it.

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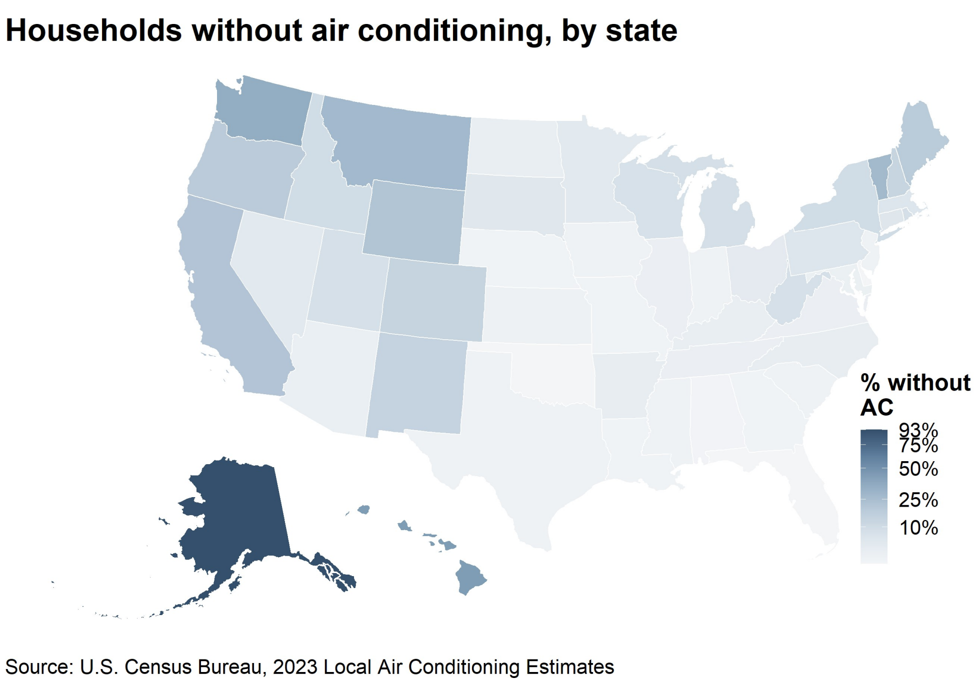
Published: May 24, 2026

On May 19, 2026, the U.S. Census Bureau released a small, quiet dataset with an unglamorous name, the Local Air Conditioning Estimates, or LACE. This data set does exactly what the title promises: they estimate how many homes have air conditioning.[1] It is the kind of release that scrolls past most professionals without a second glance. Air conditioning sounds like a comfort question, not a valuation one. That first impression is worth resisting. It helps answer much deeper questions about how a market is functioning, in essence presenting a shorthand to much more compelling series of characteristics. Table 1 outlines the statewide data from this survey but the data is granular down to the census tract level where the more interesting elements lurk. Figure 1 displays this data on a map, again at the statewide level.

FIGURE 1



Households without air conditioning, by state. Source: U.S. Census Bureau, 2023 Local Air Conditioning Estimates.

TABLE 1

Statewide No-AC Ranking (All 50 States + D.C.)		
Ranks 1–17	**Ranks 18–34**	**Ranks 35–51**
01. Alaska (93.0%)	18. West Virginia (8.2%)	35. Virginia (1.8%)
02. Hawaii (43.4%)	19. Wisconsin (7.7%)	36. Maryland (1.7%)
03. Washington (34.2%)	20. Massachusetts (5.9%)	37. Kansas (1.4%)
04. Vermont (27.2%)	21. Pennsylvania (5.7%)	38. Indiana (1.1%)
05. Montana (27.0%)	22. Connecticut (5.1%)	39. Iowa (1.1%)
06. California (21.4%)	23. South Dakota (4.6%)	40. Mississippi (1.1%)
07. Wyoming (21.1%)	24. Minnesota (3.9%)	41. New Jersey (1.1%)
08. Maine (18.3%)	25. Nevada (3.9%)	42. South Carolina (1.1%)
09. Oregon (18.1%)	26. Ohio (3.6%)	43. Texas (1.0%)
10. New Mexico (14.1%)	27. North Carolina (2.7%)	44. Georgia (0.9%)
11. Colorado (13.4%)	28. Arkansas (2.6%)	45. Louisiana (0.9%)
12. New Hampshire (12.8%)	29. Kentucky (2.2%)	46. Missouri (0.9%)
13. New York (9.8%)	30. North Dakota (2.1%)	47. Nebraska (0.9%)
14. Idaho (9.3%)	31. Arizona (2.0%)	48. Alabama (0.8%)
15. Michigan (8.6%)	32. District of Columbia (1.8%)	49. Delaware (0.5%)
16. Rhode Island (8.4%)	33. Illinois (1.8%)	50. Florida (0.5%)
17. Utah (8.2%)	34. Tennessee (1.8%)	51. Oklahoma (0.5%)

The interesting thing about LACE is not the headline figure that 6.9 percent of American households, roughly 8.8 million homes, lack any form of cooling (see Table 2).[2] It is what that number conceals, where the missing cooling actually concentrates, and what happens when the estimates are read at the resolution an appraiser actually works in. This article begins with what LACE and its companion dataset are and why an air-conditioning figure quietly carries more information than it appears to. It then turns to the empirical findings, drawn from the released file, that bear on valuation: a startling geographic concentration, an enormous within-county heterogeneity that maps onto the way appraisers segment market areas, and a reliability envelope that disciplines how far the estimates can be pushed. Throughout, it argues that heat risk is following the path flood risk traveled, from environmental curiosity to priced financial variable, with one decisive difference. The data layer has arrived ahead of the market machinery. The map is here before the market it might one day describe.

TABLE 2

LACE 2023 Coverage and National Aggregates				
Geography	**Records**	**Occupied HH**	**HH w/o AC**	**% w/o AC**
United States	1	127,482,865	8,807,334	6.9%
States and DC	51	127,482,865	8,807,334	6.9%
Counties	3,144	127,482,865	8,807,334	6.9%
Census tracts	84,095	127,463,219	8,807,020	6.9%

Two Halves of One Picture

The simplest way to hold LACE in mind is as one half of a two-part answer to a single question: who suffers when it gets dangerously hot, and where do they live? The Census Bureau built the two halves to be read together.

The first half is the older of the two. The Community Resilience Estimates for Heat, or CRE for Heat, released in their current experimental form in 2024, measure the *people* side of heat risk. Where the standard Community Resilience Estimates capture the social vulnerability that inhibits community resilience generally, the CRE for Heat narrow that lens to extreme heat, drawing on individual- and household-level information from the American Community Survey (ACS) and the Census Bureau's Population Estimates Program, in collaboration with Arizona State University's Knowledge Exchange for Resilience.[3] In plain terms, they flag the neighborhoods whose residents, by virtue of age, income, disability, isolation, and similar factors, are least equipped to ride out a heat event.

LACE is the second half, and it measures the *housing* side: the share of homes in a place that have cooling. The Census Bureau is explicit that LACE exists because users of the CRE for Heat kept asking for a sharper measure of air-conditioning access as a key indicator of heat vulnerability, and the team extended its modeling framework to deliver one. The two are framed as complements, together offering a fuller picture of heat-related vulnerability than either alone.[4] The combination is the point. A market area can have residents with multiple heat-related resilience risks but relatively high cooling access; it can have widespread cooling but households whose financial hardship or housing-cost burden may limit safe use; or, in the worst case, it can be both socially vulnerable and substantially uncooled. That last overlap is the one planners, public-health officials, emergency managers, and lenders should want to identify before a heat wave identifies it for them.

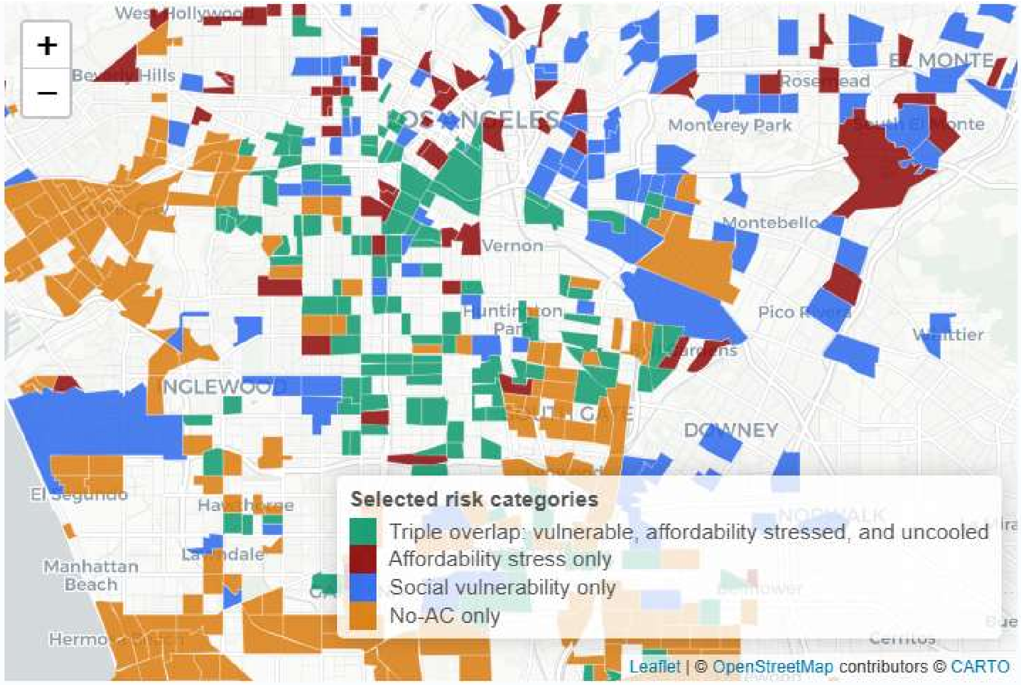
Figure 2 operationalizes the three-part question raised by the article: where are residents socially vulnerable to heat, where are households likely to face affordability stress that could limit safe cooling use, and where is the physical cooling gap greatest? The new LACE file is sufficient for the third element only. It tells us where occupied housing units lack air conditioning. It does not directly tell us whether residents are socially vulnerable or whether they can afford to run the cooling equipment they have.

To perform this type of mapping, I added two layers to the LACE data within my R code file.[5] First, I used the Census Bureau's tract-level CRE for Heat file, which estimates the population share with three or more heat-related resilience risk factors. Second, I used the ACS 5-year and built a conservative cooling-affordability proxy from severe housing cost burden and household poverty. This is not a direct energy-burden measure. It is a tract-level screening proxy for the condition described in the article as households that may have cooling equipment but may not be financially positioned to use it safely during heat events.

The default county is Los Angeles County because it has enough no-AC prevalence, income variation, and cost-burden variation to show all three dimensions in one geography. The thresholds used here are county-relative 75th percentile cutoffs. This is intentional. For market analysis, the first question is often not whether a tract is high by national standards, but whether it is materially different from nearby alternatives in the same competitive or lending geography. For a policy application, change the percentile cutoffs to fixed values or national percentiles.

I was easily able to map out these various elements. The green shaded areas are those where social vulnerability, affordability stress overlap and homes are mostly uncooled. Prior to the LACE data this would have been very challenging to put together.

FIGURE 2



Los Angeles County: overlap of social vulnerability, cooling-affordability stress, and uncooled housing at the tract level. Green tracts show all three conditions together.

Why Do Lenders Care?

A more thorough analysis of why lenders care is pertinent. At the collateral level, homes in low-cooling markets may face future retrofit expectations. If buyers begin treating cooling as a functional requirement after repeated heat events, homes without adequate cooling may suffer diminished marketability, longer exposure periods, or a measurable cost-to-cure issue. At the borrower level, a household that is financially stressed may be more vulnerable to higher utility costs, emergency cooling expenses, temporary relocation, health disruptions, or repair costs during heat events. Those factors can affect delinquency risk even if the house technically has air conditioning.

At the portfolio level, a lender with concentrated exposure in places such as coastal California, the Pacific Northwest, or other high no-AC markets could have a heat-resilience exposure that is not visible in traditional underwriting. The Census Bureau specifically frames LACE and CRE for Heat as tools for identifying communities that may face greater risks during heat events. For lenders, that can translate into climate-risk monitoring, portfolio stress testing, collateral review policy, renovation lending opportunities, and community reinvestment or resilience-finance strategies.

How the Numbers Were Determined and Why That Matters

LACE is not a count. No one tallied the window-units tract by tract. The 2023 estimates are produced by what the Bureau calls cross-survey modeling: a classifier is trained on the 2023 American Housing Survey (AHS), applied to several years of American Community Survey (ACS) microdata to predict the probability that each household has any air conditioning, then calibrated at the census-division level against the AHS benchmark and aggregated up to tract, county, and state.[6] The method borrows the detailed housing questions from one survey and the fine geographic reach of another and fuses them statistically.

Two consequences follow, and both matter for anyone tempted to use the figures in consequential analysis. First, a tract-level LACE value is a modeled estimate carrying uncertainty, not a verified fact carrying none. Second, the Bureau itself labels LACE experimental, meaning it will be refined as methods evolve.[7] That the aggregates roll up cleanly across geographies is reassuring but should not be mistaken for validation: the consistency is a trait of how the product is constructed, since the tract outputs are forced to match a small number of regional benchmarks, not an independent test of accuracy. The honest posture is to treat LACE as context and as a flag, not as a quantity to defend to the decimal.

The underlying idea is not new to LACE. Academic work predating the release had already shown that air-conditioning prevalence varies sharply not just from metro to metro, which was well understood, but block by block *within* cities, which was not.[8] LACE takes that scholarly insight and turns it into a standardized, national, official product.

Why an Air-Conditioning Figure Is Really a Proxy

Whether a home has air conditioning is rarely just a fact about air conditioning. It correlates, all at once, with the age and quality of the housing stock, since older homes are often those never retrofitted; with household income, since cooling costs money to install and to run; with the cost and reliability of the local grid; with regional building norms; and with the health profile of the people inside. A census tract that reads as low-AC on a map is often also an older-housing, lower-income, higher-heat-vulnerability tract. In Los Angeles County for example, the LACE no-AC rate is positively associated with pre-1980 housing stock and CRE Heat vulnerability and negatively associated with median household income. The relationship is not perfect, but it is strong enough to support using the air-conditioning figure as a compact screening signal for broader neighborhood risk.

A single number that is cheap to pull and easy to map quietly compresses a cluster of socioeconomic, housing-quality, infrastructure, and public-health conditions into one readable signal. That is why a heat-vulnerability layer built on it is attractive to municipal planners and, increasingly, to institutional investors thinking about where risk concentrates. The air-conditioning figure is the visible tip; the neighborhood's broader condition is the iceberg beneath.

The Climate Intuition, Inverted

The first surprise in the data is geographic, and it runs against the public mental model. The household most exposed to heat for lack of cooling is not, as intuition suggests, in the rural South. The hot, humid Southeast and the hot, dry Southwest are saturated: Florida, Texas, Louisiana, Mississippi, Georgia, Alabama, and others all show air-conditioning penetration above 98 percent. In those markets the cost approach does not have to ask whether cooling is a value attribute, because effectively every occupied home has it.

The high no-AC rates sit instead along the temperate Pacific Coast and across the northern tier. Alaska is the extreme outlier at roughly 93 percent without cooling, though its estimate was controlled to a separate Residential Energy Consumption Survey benchmark rather than allowed to emerge from the model. Hawaii sits near 43 percent, reflecting a mild year-round climate and a housing stock that historically did not require mechanical cooling. Among the contiguous states, Washington, Oregon, Vermont, Montana, Maine, and Wyoming run between roughly 18 and 34 percent without cooling. What unites them is not climate as commonly imagined but mild summer historical norms that let the housing stock develop without central cooling, paired with construction eras that did not anticipate the heat events of the last decade. It is precisely in Seattle, Portland, San Francisco, Burlington, and Anchorage, not Houston or Atlanta, that the absence of cooling becomes a question the standard appraiser toolkit is poorly adapted to address.

The Concentration Story

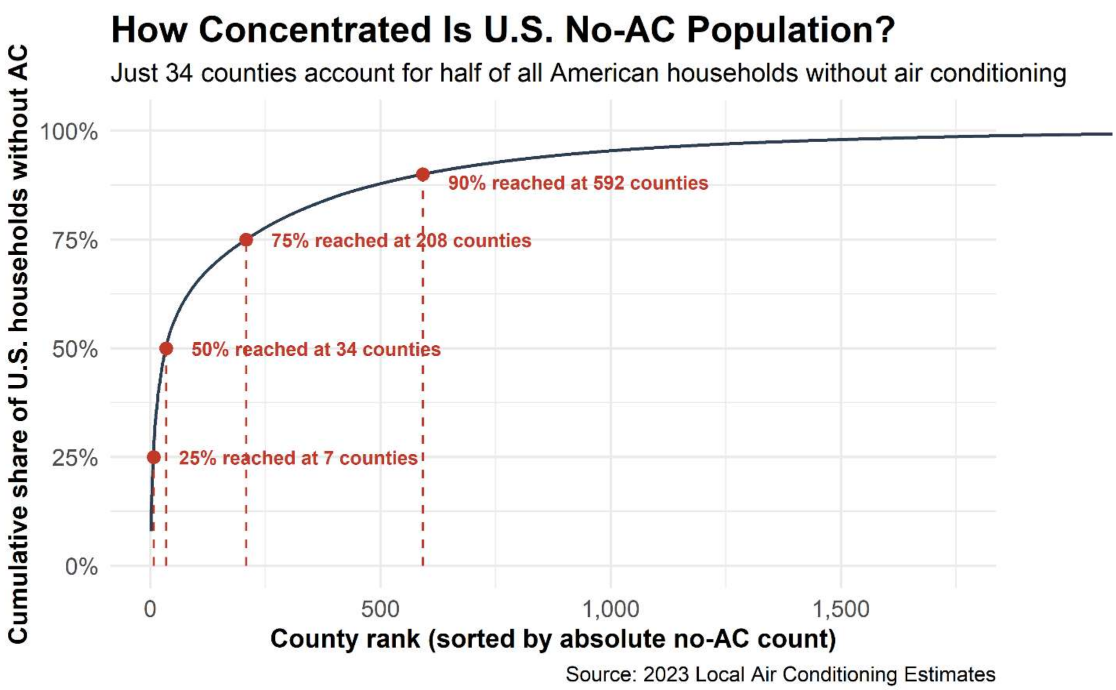
If the first finding is geographic surprise, the second is concentration. The absence of cooling is not merely located in unexpected places; it is concentrated to a degree that reshapes how it should be understood as a risk. Sort the 3,144 counties by the absolute number of households without air conditioning, and the top ten counties contain roughly 32.3 percent of the entire national no-AC population (see Table 3). All ten are on the Pacific Coast. Los Angeles County alone holds about 701,788 households without cooling, more than the entire occupied housing stock of Vermont.

TABLE 3

Top ten counties by total households without air conditioning.

County	Occupied HH	No AC	% no AC	Cum. % of U.S.
1. Los Angeles County, CA	3,390,254	701,788	20.7%	8.0%
2. King County, WA	927,817	435,146	46.9%	12.9%
3. San Diego County, CA	1,159,822	299,246	25.8%	16.3%
4. Alameda County, CA	593,117	251,480	42.4%	19.2%
5. Orange County, CA	1,074,654	243,948	22.7%	21.9%
6. San Francisco County, CA	362,650	237,175	65.4%	24.6%
7. Santa Clara County, CA	654,467	222,509	34.0%	27.2%
8. Pierce County, WA	346,708	154,288	44.5%	28.9%
9. San Mateo County, CA	264,424	153,097	57.9%	30.6%
10. Snohomish County, WA	311,825	149,048	47.8%	32.3%

FIGURE 3



Cumulative concentration of the U.S. no-AC population by county. Source: 2023 Local Air Conditioning Estimates.

The cumulative curve (see Figure 3) makes the point sharply: 34 counties hold half the national no-AC population, about 208 hold three quarters, and about 592 hold ninety percent, leaving the remaining 2,500-plus counties to share the last tenth. This concentration has a direct portfolio reading. A lender holding residential paper concentrated in King County or Alameda County carries a heat-resilience exposure materially different from one with comparable dollars in say Houston or Atlanta. The Houston holdings are fundamentally a property-tax, insurance, and grid-reliability story. The King County portfolio is a structural-retrofitting story that has not been priced in potentially. From a public-targeting perspective the same concentration is a gift: the interventions that would matter most are not diffused evenly across the map but concentrated in places that can be named, mapped, and prioritized.

When the Risk Arrived: A Pacific Northwest Vignette

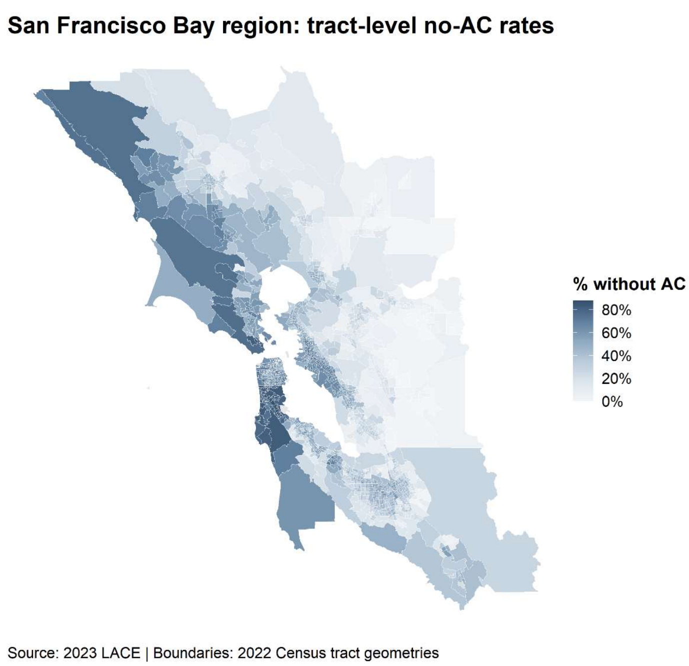
It is worth pausing on what the concentration map looks like once the heat actually arrives, because the Pacific Northwest has already run the experiment. Consider a modest Seattle bungalow, built in 1948, appraised in early 2021 in a King County tract where almost no one had cooling. Its lack of air conditioning was not a defect. It was the neighborhood norm, invisible in the comparable set because every comparable shared it, and a competent appraisal would have made no cooling adjustment at all, correctly. Then, over several days at the end of June 2021, a heat dome settled over the region in what one attribution study characterized as a 1-in-1,000-year event. Portland reached 116°F and Seattle peaked at roughly 108°F, exceeding the prior record by about 5°F, while overnight temperatures stayed high enough that homes without cooling never recovered. The event coincided with an estimated 159 excess injury deaths in Washington State over the three weeks beginning June 25, deaths from drownings, transport accidents, assaults, and suicides that a counterfactual without the heat would not have produced.[9]

The repricing that followed was fast and measurable. Between 2019 and 2021, the share of homes with air conditioning in King, Pierce, and Snohomish counties jumped from 44 percent to 53 percent, with the 2021 figure captured by census takers working in the very summer of the dome; Seattle ceded to San Francisco its long-held title as the least-air-conditioned major metro in America.[10] For the appraiser, the analytic ground shifted under the same physical house. The 1948 bungalow did not change; the meaning of its missing cooling did. What had been a neutral characteristic shared across the comparable set became a point of differentiation within it, as some sales now carried retrofitted mini-splits and heat pumps and others did not. The comparable that closed in May 2021 and the one that closed in August 2021 were drawn from materially different markets, and an appraiser who failed to bracket for cooling capacity in the later period would have mismeasured the subject. This is the uncomfortable lesson the concentration table implies but does not state: in a saturated market the absence of cooling cannot move value because there is no contrast to price, while in a low-cooling market a single heat event can convert that absence from invisible to decisive almost overnight. The LACE map identifies precisely the markets where that conversion is latent and waiting.

California: One State, Two Markets

Nowhere is the within-state heterogeneity starker than California, whose 21 percent statewide no-AC rate averages over what an appraiser would call, at best, a bimodal distribution. San Francisco County sits near 65 percent without cooling; Imperial County, on the Mexican border, below 1 percent. These are not gradations within one market. They are different markets, with different housing stock, different climate regimes, and different value drivers. The temperate coastal strip from Del Norte through Monterey runs above 50 percent without cooling; the Central Valley and desert counties are essentially saturated; the Sierra counties sit in between.

FIGURE 4



San Francisco Bay region: tract-level no-AC rates. Source: 2023 LACE; boundaries 2022 Census tract geometries.

The practical implication for an appraiser is that air-conditioning prevalence is a neighborhood characteristic, not a county characteristic, and the LACE tract estimates can function as a competitive-market signal for the value of cooling capacity. Within a thirty-mile drive in Contra Costa County, no-AC rates fall from above 70 percent on the Bay-facing shoreline to below 5 percent inland around Brentwood and Discovery Bay (see Figure 4). The estimates do not hand the appraiser a dollar adjustment.

Which Kind of Adjustment Is This?

If cooling capacity does begin to change value in these markets, the appraiser still has to decide where in the analysis it belongs, and the honest answer is that it can land in different places depending on the market and the question. The cleanest case is functional obsolescence: a home that lacks cooling in a market where buyers now expect it suffers a potential curable deficiency, measured the conventional way, by the cost to install adequate cooling less any contribution already reflected in the price, provided the cost to cure does not exceed the value it adds. This is the framing that fits a retrofittable single-family home in a warming submarket, and it has the virtue of being something the cost approach already knows how to handle. Where the constraint is the grid's inability to support widespread cooling load, the disadvantage is external, which the sales comparison approach captures only if the comparable set actually brackets the condition. Cooling capacity is functional obsolescence in one tract and an external factor in the next. The LACE estimate is useful precisely because it flags which of those framings the local data should be tested against, not because it decides among them.

What the Model Cannot See: The New Mexico Anomaly

The saturated South has one striking exception that doubles as a caution. New Mexico shows a statewide no-AC rate near 14 percent, but several northern counties exceed 40 percent; Taos County reaches roughly 57 percent and Santa Fe County 38 percent. The northern cluster, including Taos, Mora, Rio Arriba, Colfax, Cibola, Catron, and McKinley, reflects compounding factors the model captures imperfectly: adobe and rammed-earth construction whose thermal mass provides passive cooling, elevations above 6,000 feet that allow whole-house ventilation to work, and a cultural and economic preference for evaporative coolers, which fall outside the AHS definition of air conditioning when reported as swamp coolers. The cross-survey model is informed by climate and geographic variables, the most influential being July wet-bulb globe temperature, U.S. Department of Energy climate zone, coastal-county status, and a state-level benchmark air-conditioning rate, but it cannot see construction method, vernacular building traditions, or substitute technology.[11] Where those deviate from national norms, the prediction deviates from local reality. Northern New Mexico is one such pocket; the high desert of southern Colorado, parts of the Idaho panhandle, and elevation-moderated stretches of Appalachia are others. An out-of-state lender or insurer reading only state-level statistics would badly misread these markets, which is where your local expertise reigns supreme.

The Flood Analogy, and Where It Breaks

Flood risk traveled a now-familiar arc. It began as an environmental concern and became, over years, a financial variable that insurers, lenders, municipalities, and investors priced in. The machinery that made it bite into value was the structure built around it: federal flood maps, a national flood insurance program, premiums tied to elevation, lender requirements in mapped zones, and seller-disclosure rules. Once a hazard has a price tag and a disclosure line, it stops being abstract and starts moving value.

Heat is following the recognition half of that arc but lacks the machinery, and the gap is worth stating bluntly: there is no heat equivalent of the National Flood Insurance Program for homeowners. What exists today is mostly *parametric* insurance, a different instrument that pays a fixed amount when an agreed trigger is met, such as temperature crossing a threshold for a set number of days, and pays nothing otherwise, regardless of whether a specific loss can be proven.[12] Just as important is who these products serve. They are aimed at businesses, workers, and governments, protecting lost wages, retail and utility margins, and municipal budgets, not at protecting a home as an asset.[13] No widespread product says, in effect, your house lost value because the neighborhood became unbearably hot, so here is a check. And the products that exist face structural headwinds: triggers set too low fire too often if extreme heat becomes routine, premiums climb, and coverage becomes unaffordable or unviable, as a government-backed parametric program in Kenya found before discontinuing it after seven years.[14] Even where U.S. regulators such as California's have begun grappling with parametric heat approaches, the framework remains contested and early.[15]

So, the order of arrival is reversed. With flooding, the financial machinery largely came first, and the fine-grained public data filled in around it. With heat, the data infrastructure, LACE and the CRE for Heat, arrived *before* the financial-protection infrastructure. The map has shown up ahead of the market.

A Note on Scope

One limitation should not be glossed over. As released, both datasets concern housing units and the people in them; they are residential by construction, and the findings above carry weight on that footing. The broader thesis, that heat risk is migrating from environmental concern toward priced financial variable, extends naturally to commercial property and to land, where heat bears on operating costs, tenant demand, the economics of outdoor-dependent uses, and the long-run trajectory of whole submarkets. But the present data speak to the residential layer, and the tract findings here should not be read as if they extended to commercial collateral. The wider application is real; it is simply not yet the thing these data can prove.

Conclusion: Alert Patience

LACE is a modest dataset doing an immodest thing. By turning cooling access into an official, tract-level, standardized estimate and pairing it with a measure of social vulnerability to heat, the Census Bureau has assembled the kind of foundational layer that, in another hazard's history, preceded a wholesale repricing of risk. The data already reveal things worth acting on in defined markets: cooling is a neighborhood attribute, not a county one; its absence concentrates in a nameable set of Pacific and northern places; and in those markets it belongs in the appraiser's reasoning about functional adequacy and comparable selection, used with the reliability discipline the estimates demand. What the data do not yet support is a quantified value adjustment read straight off a tract's air-conditioning percentage, because the experimental, modeled estimates carry uncertainty the published margins understate, and because the insurance and disclosure machinery that made flood risk move value does not yet exist for heat. The right stance, then, is alert patience. Treat LACE the way flood-plain maps and wildfire overlays are already treated in their hazard zones: as a routine reference that frames where to look and what to ask, not as a number that ends the inquiry. The map of where Americans lack cooling is now part of the map of where Americans live, and it has earned a place in the working toolkit. It has not yet earned the last word.

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[1] U.S. Census Bureau, *"Census Bureau Releases New Local Estimates of Air Conditioning Access,"* press release, May 19, 2026, https://www.census.gov/newsroom/press-releases/2026/2023-lace.html.

[2] All household counts, percentages, county rankings, reliability bands, and benchmark comparisons reported in this article were computed by the author from the released LACE_23.csv file (U.S. Census Bureau, May 2026). Negative sentinel values for suppressed estimates were converted to missing before aggregation, and water-only tracts (WATER_TRACT = 1) were excluded from tract-level analysis.

[3] U.S. Census Bureau, "Community Resilience Estimates (CRE) for Heat," Experimental Data Products, last revised May 20, 2025, https://www.census.gov/data/experimental-data-products/cre-heat.html. The CRE for Heat are produced in collaboration with Arizona State University's Knowledge Exchange for Resilience.

[4] U.S. Census Bureau, "Local Air Conditioning Estimates," Experimental Data Products, last revised May 19, 2026, https://www.census.gov/data/experimental-data-products/lace.html.

[5] R is an open-source data analysis language designed to help users turn raw data into useful insights. It is widely used for statistics, charts, maps, dashboards, and reproducible reports. Instead of manually editing data one step at a time, R allows the analyst to create a transparent, repeatable workflow that can be checked, updated, and reused.

[6] U.S. Census Bureau, *Cross-Survey Modeling: Fusing Data from Multiple Data Sources to Enhance Multi-Dimensional Measures,* SEHSD Working Paper 2025-05 (Washington, DC: U.S. Census Bureau, 2025), https://www2.census.gov/library/working-papers/2025/demo/sehsd-wp2025-05.pdf.

[7] Census Bureau, "Releases New Local Estimates." The Bureau characterizes LACE as an experimental product that will continue to be evaluated and refined as new methods and needs emerge. https://www2.census.gov/programs-surveys/demo/technical-documentation/lace/2023-LACE-Quick-Guide.pdf.

[8] Yasmin Romitti, Ian Sue Wing, Keith R. Spangler, and Gregory A. Wellenius, "Inequality in the Availability of Residential Air Conditioning across 115 US Metropolitan Areas," *PNAS Nexus* 1, no. 4 (September 24, 2022): pgac210, https://doi.org/10.1093/pnasnexus/pgac210.

[9] Joan A. Casey, Robbie M. Parks, Tim A. Bruckner, Alison Gemmill, and Ralph Catalano, "Excess Injury Mortality in Washington State During the 2021 Heat Wave," *American Journal of Public Health* 113, no. 6 (June 2023): 657–660, https://pmc.ncbi.nlm.nih.gov/articles/PMC10186831/pdf/AJPH.2023.307269.pdf. The Seattle peak of 42°C (≈108°F) and the 1-in-1,000-year characterization are drawn from the rapid attribution analysis cited therein (Philip et al., 2022); the Portland figure of 116°F is from contemporaneous news reporting.

[10] American Housing Survey figures reported by the Census Bureau show that the share of homes with air conditioning in King, Pierce, and Snohomish counties rose from 44 percent in 2019 to 53 percent in 2021, the survey conducted during the summer of the heat dome; over the same period San Francisco displaced Seattle as the least-air-conditioned major metropolitan area in the country. See John Ryan, "Seattle Is Now an Air Conditioning Town," KUOW, May 14, 2024, https://www.kuow.org/stories/seattle-is-now-an-air-conditioning-town.

[11] Wet-bulb globe temperature is a composite heat-stress index used by the military, athletics, and occupational-safety bodies like OSHA. Unlike plain air temperature, it folds in humidity, wind, and radiant heat (direct sun load), via three readings: a dry-bulb thermometer for air temperature, a natural wet-bulb thermometer (a sensor wrapped in a wet wick, which captures evaporative cooling and therefore humidity), and a black globe thermometer that absorbs radiant heat the way a body in sunlight does. It's meant to approximate the actual heat strain on a human body outdoors, which is why it drives "no practice" decisions for football teams and work-rest cycles on job sites.

[12] Howden Group, "Parametric Insurance for Extreme Heat: Protecting People in a Warming World," 2025, https://www.howdengroup.com/uk-en/news-insights/article-name/parametric-insurance-for-extreme-heat-protecting-people-in-a-warming-world; Sonali Gokhale, Aditya Chunekar, and Ritu Parchure, "Parametric Insurance for Extreme Heat: Setting Right Expectations," Prayas (Energy Group), April 8, 2026, https://energy.prayaspune.org/our-work/article-and-blog/parametric-insurance-for-extreme-heat.

[13] Howard Miller, "Inclusive Finance and Extreme Heat: How Small Loans and Parametric Insurance Can Help Vulnerable Populations Manage Through Deadly Heat Waves," Center for Financial Inclusion, April 27, 2023, https://www.centerforfinancialinclusion.org/article/inclusive-finance-and-extreme-heat-how-small-loans-and-parametric-insurance-can-help-vulnerable-populations-manage-through-deadly-heat-waves/.

[14] The Epicenter, "The Frontier of Insurance Innovation: Parametric Heat Insurance," The Epicenter, October 16, 2025, https://www.epicenterinsights.com/the-frontier-of-insurance-innovation-parametric-heat-insurance/.

[15] Scott P. DeVries and Jae Lynn Huckaba, "The Heated Debate over the California Department of Insurance's Heat Community Policy and Parametric Underwriting," Hunton Insurance Recovery Blog, July 2023, https://www.hunton.com/hunton-insurance-recovery-blog/the-heated-debate-over-the-california-department-of-insurances-heat-community-policy-and-parametric-underwriting; Deborah Halberstadt and Rabab Charafeddine, *Neighborhood Protection from Heat,* discussion concept paper, Climate Insurance Working Group, California Department of Insurance, Climate and Sustainability Branch, November 2, 2022, https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Draft-Extreme-Heat-Neighborhood-Protection-Concept-November-2-2022.pdf.