Intersecting Vulnerabilities – Climate Burdens

Housing Costs, Energy Burdens, and Extreme Heat in Washington, D.C.

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Key Findings

Housing costs, utility bills, and extreme heat converge in the same homes and household budgets. The data show overlap—but they also show why one map cannot substitute for another.

- **Rent burden is citywide.** About 84,085 renter households spend at least 30% of income on gross rent; 42,629 spend at least half. A majority—57.9%—live outside the two highest RBII tiers.[1]
- **Energy unaffordability is concentrated.** Among 202 modeled tracts, 71 meet the 6% high-burden threshold and 14 exceed 10%. The severe-burden tracts contain about 5,300 modeled low- and moderate-income renter households.[2]
- **Heat follows a third geography.** The 52 highest-exposure tracts average 15.4% tree cover and 63.7% impervious cover; the remaining tracts average 33.6% and 43.0%, respectively.[3]
- **Forty-seven tracts cross multiple thresholds.** Four cross the housing, energy, and heat thresholds simultaneously: Census Tracts 30, 47.04, 89.03, and 92.04.
- **The burdens are not interchangeable.** Pairwise tract correlations range from -0.08 to 0.11. A housing-only, energy-only, or heat-only screen misses communities visible in the other dimensions.
- **CEPI identifies overlooked climate-energy need.** Eleven tracts score at least 80; only four also meet the high-RBII threshold, and six fall in the lowest relative housing-priority tier.
- **A light-shaded tract is not a no-need tract.** Thresholds organize outreach and verification; they must not become automatic eligibility or denial rules.

CORE POLICY IMPLICATION Use one shared screen to coordinate outreach and investment—while keeping basic affordability, cooling, repair, and anti-displacement protections available citywide.

[1] U.S. Census Bureau, ACS 2020-2024 five-year Table B25070, Gross Rent as a Percentage of Household Income, https://data.census.gov/table/ACSDT5Y2024.B25070.

[2] U.S. Department of Energy, Low-Income Energy Affordability Data (LEAD) Tool and FAQ, 2022 vintage, https://www.energy.gov/cmei/scep/low-income-energy-affordability-data-lead-tool.

[3] D.C. Department of Energy and Environment, Heat Sensitivity-Exposure Index Methodology Report and tract data, 2022, https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/Methodology%20Report_Update%2005.11.22web_0.pdf.

Executive Summary

The problem

Housing affordability is climate infrastructure because rent, electricity, safe cooling, transportation, food, medicine, and emergency expenses all compete for the same household income. Yet housing, energy, and heat assistance remain fragmented across different agencies, data systems, applications, and entry points. Renters also face a structural split incentive: residents often pay the utility bill while owners control insulation, windows, roofs, cooling systems, and major appliances.

What this report does

This report connects three public-data systems at the census-tract level. It measures housing pressure through the Rent Burden Impact Index V.1 (RBII V.1), energy affordability through modeled home-energy burden for renter households at 0% to 80% of area median income, and physical heat exposure through D.C.'s index of afternoon air temperature, lack of tree canopy, and impervious surface. Transparent thresholds and the Climate-Energy Priority Index (CEPI) then show where the burdens overlap and where they diverge.

Why the timing matters

The timing is important. Beginning July 1, 2026, a typical Pepco Standard Offer Service customer using 614 kilowatt-hours per month faces a reported 7.0% total-bill increase, or $9.56.[4] At the same time, D.C. already has strong policy assets—including Solar for All, the D.C. Sustainable Energy Utility, Building Energy Performance Standards, utility discounts, retrofit assistance, and Keep Cool DC.[5]

The central gap is not the absence of programs but the absence of a shared outcome framework. Housing, energy, and heat initiatives should be coordinated around measurable results: lower bills and arrears, fewer shutoffs, safer indoor temperatures, completed repairs, reduced emissions, expanded canopy, and stronger housing retention.

What the evidence shows

The evidence supports a dual strategy. Rent burden is broad enough that basic protections must remain citywide, while energy burden is concentrated enough to support targeted enrollment and bill-affordability work. Heat exposure follows a different geography, requiring building and public-realm interventions beyond conventional housing targeting. The four triple-burden tracts are immediate places for coordinated validation, and the very-high-CEPI tracts show where a housing-only screen would overlook climate-energy need.

ORIGINAL ANALYTICAL CONTRIBUTION RBII V.1, CEPI, and the integrated threshold framework make overlap and mismatch visible with reproducible public data that other U.S. cities can adapt.

[4] D.C. Public Service Commission, Electricity Standard Offer Service Rates and July 1, 2026 customer impacts, https://dcpsc.org/Utility-Information/Electric/Electricity-Standard-Offer-Service-%28SOS%29-Rates.aspx.

[5] D.C. Department of Energy and Environment, Climate Ready DC / Keep Cool DC, Utility Discount Program, and Solar for All, https://doee.dc.gov/climateready; https://doee.dc.gov/udp; https://doee.dc.gov/solarforall.

Introduction: Affordability Is Climate Vulnerability

Public policy often treats housing, energy, and heat as separate sectors. Households do not. Rent and utility bills draw from the same income; building condition shapes both energy use and indoor temperature; and a heat emergency raises electricity demand when residents may be least able to pay. Renters often pay the bill while owners control the improvements that determine comfort and efficiency. A retrofit can lower costs and emissions, but without tenant safeguards it can also create rent pressure or displacement risk.

Three complementary measures

The report uses three complementary measures. Rent burden means gross rent equal to at least 30% of household income, while severe burden begins at 50%.[6] Energy burden is annual home-energy cost divided by household income; this analysis uses 6% as the high-burden threshold and 10% as the severe threshold.[7] Physical heat exposure is D.C.'s composite of afternoon air temperature (50%), lack of tree canopy (25%), and impervious surface (25%). It describes physical exposure rather than complete health risk.[8]

Why no single measure is enough

Each measure answers a different question. RBII shows where housing cost pressure is widespread, severe, numerous, and concentrated. Energy burden identifies where modeled home-energy costs consume a large share of income. The heat index shows where the physical environment intensifies exposure. Their limited correlations are not a defect; they are the reason the measures must remain visible side by side.

How to read the results

Threshold counts and percentile ranks serve different purposes. The overlap screen is easy to interpret because it records whether zero, one, two, or three conditions cross selected cutoffs. CEPI preserves more relative information by ranking energy and heat together. Using both reduces the risk that a hard cutoff hides near-threshold need or that a composite score conceals which condition is driving priority.

These tools must be interpreted carefully. Tract averages are not individual facts, and a low or light-shaded tract is not a no-need tract. The results are intended to guide outreach, verification, program design, and geographic accountability—not to determine a person's eligibility, identity, or health risk.

PLAIN-LANGUAGE RULE "No elevated dimension" means only that a tract did not cross the selected relative thresholds. It does not mean that residents have no need.

[6] U.S. Census Bureau, "Nearly Half of Renter Households Are Cost-Burdened," Sept. 12, 2024, https://www.census.gov/newsroom/press-releases/2024/renter-households-cost-burdened-race.html.
[7] U.S. Department of Energy, LEAD Tool FAQ: energy-burden definition and included costs, https://www.energy.gov/cmei/scep/slsc/low-income-energy-affordability-data-lead-tool-frequently-asked-questions.
[8] D.C. Department of Energy and Environment, Heat Sensitivity-Exposure Index Methodology Report, 2022.

1. Rent Burden Is the Foundation of Climate Vulnerability

RBII V.1 begins from the premise that neither prevalence nor scale is sufficient on its own. A small tract can have a very high burden rate but relatively few affected households, while a larger tract can contain many burdened households even when its rate is more moderate. The index therefore keeps four signals visible—burden rate, severe-burden rate, affected-household count, and burden density—and applies a transparent correction for unusually large tracts.

RBII V.1 component	Weight	Question answered	Planning use
Rent burden rate (30%+)	30%	How widespread is pressure?	Affordability outreach
Severe burden rate (50%+)	30%	How acute is residual-income loss?	Crisis prevention
Rent-burdened households	25%	How many households are affected?	Service capacity
Rent-burden density	15%	How concentrated is place-based need?	Clinics and inspections
Large-tract adjustment	-20% of positive standardized area	Could tract size distort concentration?	Transparent correction

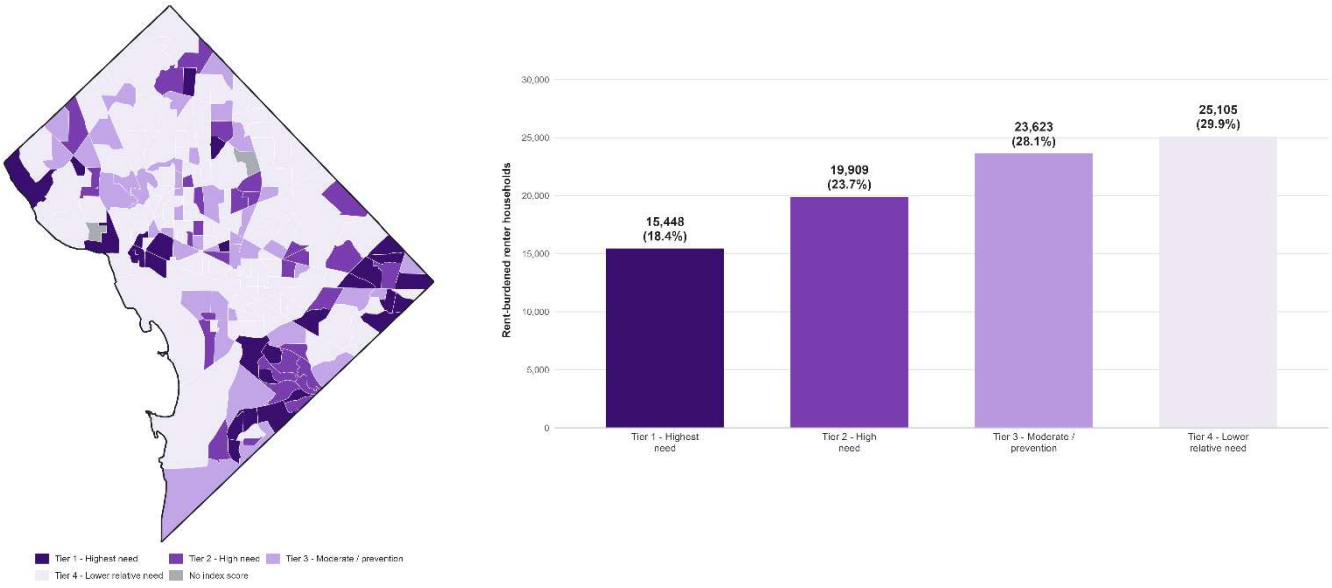

Figure 1 - Darker purple in the map indicates higher relative priority under RBII V.1. Two tracts lack sufficient data for a score; the tiers do not define household eligibility. [9] The bar chart shows that the two highest RBII tiers contain 42.1% of rent-burdened renter households; 57.9% live in Tier 3 and Tier 4 tracts. [10]

[9] Figure source: Author analysis of ACS 2020-2024 Table B25070 and 2024 TIGER/Line census-tract geography, https://www.census.gov/programs-surveys/geography/technical-documentation/complete-technical-documentation/tiger-geo-line.html.

[10] Figure source: Author analysis of U.S. Census Bureau ACS 2020-2024 Table B25070.

Why the component mix matters

The weights intentionally balance rates with scale. The two 30% rate measures keep widespread and severe cost pressure central, while the household-count measure prevents small high-rate tracts from automatically outranking larger places with many affected renters. Density supports place-based delivery, and the area adjustment reduces distortions from unusually large tracts. Because RBII is standardized within D.C., its tiers indicate relative planning priority—not household eligibility or a national benchmark.

What the map and chart show

Tier 1 and Tier 2 contain 35,357 rent-burdened renter households, equal to 42.1% of the citywide total. The typical Tier 1 tract has a 71.8% burden rate and a 46.9% severe-burden rate. Yet Tier 3 and Tier 4 together contain the remaining 57.9% of burdened households, demonstrating that concentrated priority and citywide need coexist.

Geography should therefore determine the intensity and mix of delivery—not access to basic protections. High-RBII areas warrant additional outreach, inspections, legal support, arrearage resolution, and retrofit planning, while citywide protections remain necessary because most burdened households live outside the two highest tiers.

Planning use

In practice, agencies should prioritize outreach where high rates and large affected populations coincide, match service capacity to the number of households rather than the tract rank alone, and use density to plan place-based clinics, inspections, and building-level engagement. Universal protections should remain available everywhere.

[11] Figure source: U.S. Department of Energy, Low-Income Energy Affordability Data Tool, 2022; author calculations.
[12] Figure source: U.S. DOE LEAD Tool, 2022; author calculations.
[13] D.C. Office of the People's Counsel and Synapse Energy Economics, Energy Affordability in Washington, D.C., 2025, https://opc-dc.gov/wp-content/uploads/2025/11/Energy-Affordability-in-DC-Tracking-and-Enhancing-Energy-Affordability-for-District-Residents.pdf.

2. Utility Costs Create a Second Affordability Crisis

Across 202 tracts with DOE LEAD estimates, modeled energy burden averages 5.62% when weighted by approximately 89,383 low- and moderate-income renter households. Seventy-one tracts meet or exceed the 6% high-burden threshold, and 14 meet or exceed the severe 10% threshold. About 37.8% of modeled LMI renters live in tracts between 6% and 10%, while another 5.9% live in tracts at or above 10%.

These estimates should be used as screening evidence rather than precise household determinations. Extreme tract values, especially where modeled household counts are small, require verification with local utility, program, and building-condition data.

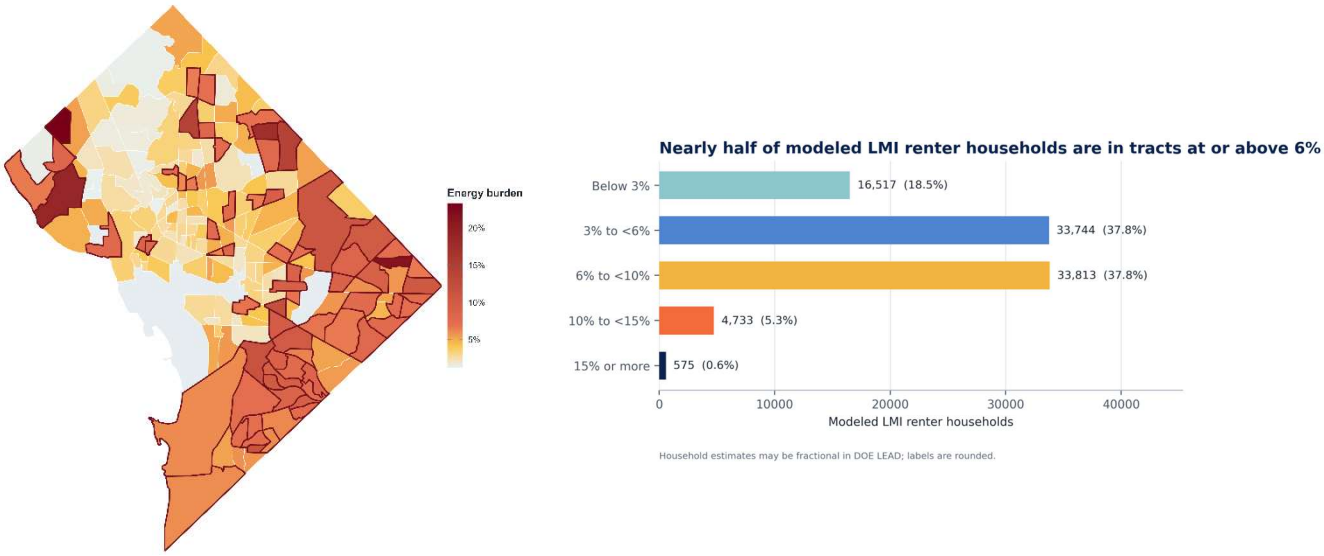

Figure 2. Dark outlines in the map mark tracts at or above the 6% high-energy-burden threshold. Burden is a cost-to-income ratio—not a direct measure of consumption or efficiency.[11] About 37.8% of modeled LMI renter households live in tracts between 6% and 10% burden; another 5.9% live in tracts at or above 10%.[12]

At the tract level, energy burden declines as modeled income rises (correlation -0.62) and increases as modeled annual energy cost rises (correlation 0.67). The policy response must therefore be layered: emergency aid and arrearage management should be paired with income-responsive discounts, efficiency, solar, storage, and verified tenant savings.[13]

[11] Figure source: U.S. Department of Energy, Low-Income Energy Affordability Data Tool, 2022; author calculations.
[12] Figure source: U.S. DOE LEAD Tool, 2022; author calculations.
[13] D.C. Office of the People's Counsel and Synapse Energy Economics, Energy Affordability in Washington, D.C., 2025, https://opc-dc.gov/wp-content/uploads/2025/11/Energy-Affordability-in-DC-Tracking-and-Enhancing-Energy-Affordability-for-District-Residents.pdf.

3. Physical Heat Exposure Follows a Different Geography

Heat exposure is built into the urban landscape through streets, roofs, buildings, trees, and land cover. D.C.'s physical index measures exposure rather than full health risk, intentionally excluding health status, social isolation, homelessness, cooling access, indoor temperature, and power reliability. The highest-exposure quartile includes 52 census tracts and approximately 175,319 residents.

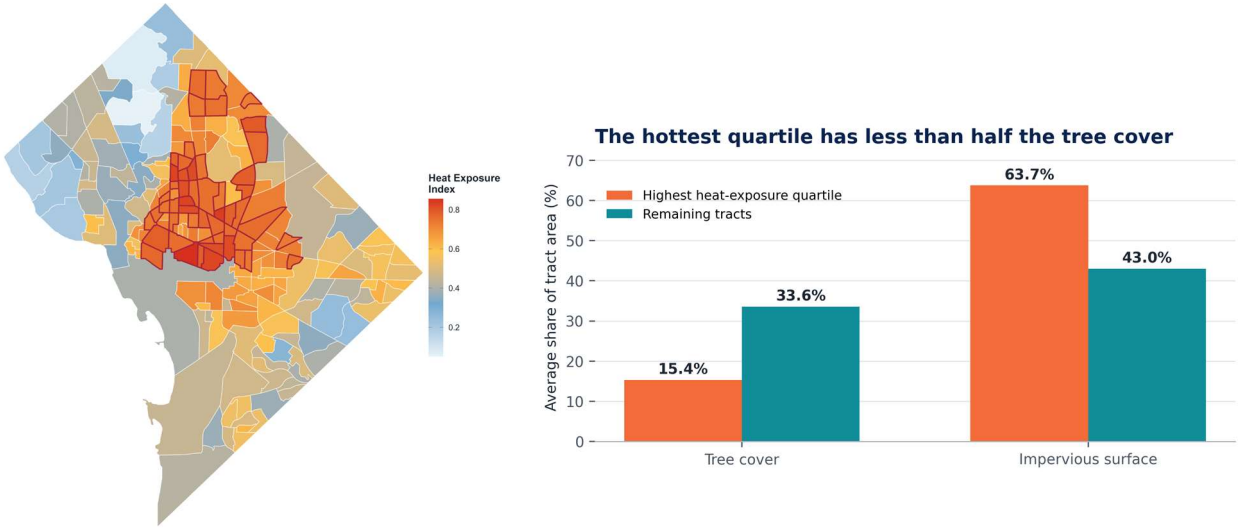

Figure 3. Dark outlines in the map identify the 52 tracts in the highest citywide quartile of physical heat exposure.[14] *Highest-exposure tracts average 15.4% tree cover and 63.7% impervious cover, compared with 33.6% and 43.0% elsewhere.*[15]

Why indoor safety remains distinct

Outdoor exposure does not automatically reveal indoor safety. Poor insulation, inadequate windows, roof conditions, broken equipment, electricity affordability, and power reliability determine whether residents can cool safely. Housing and public-realm interventions must therefore work together: building repairs and utility protections address indoor conditions, while trees, shade, cool surfaces, water access, and safer transit stops reduce neighborhood exposure.[16]

[14] Figure source: D.C. Department of Energy and Environment, Heat Sensitivity-Exposure Index methodology and tract data, 2022.
[15] Figure source: D.C. DOEE physical Heat Exposure Index components, 2022; author calculations.
[16] U.S. Environmental Protection Agency, "What Are Heat Islands?" https://www.epa.gov/heatislands/what-are-heat-islands; U.S. HUD, Responding to Extreme Heat in Public Housing, PIH 2024-20, https://www.hud.gov/sites/dfiles/PIH/documents/PIH%202024-20.pdf.

4. Overlapping Burdens Identify Urgent Places—and Important Gaps

The overlap screen uses three transparent thresholds

The overlap screen applies three transparent thresholds: RBII V.1 at or above 0.50 for housing, modeled LMI renter energy burden at or above 6% for energy, and physical heat exposure in the highest citywide quartile for heat. It counts how many thresholds each tract crosses without concealing the individual components inside a composite score.

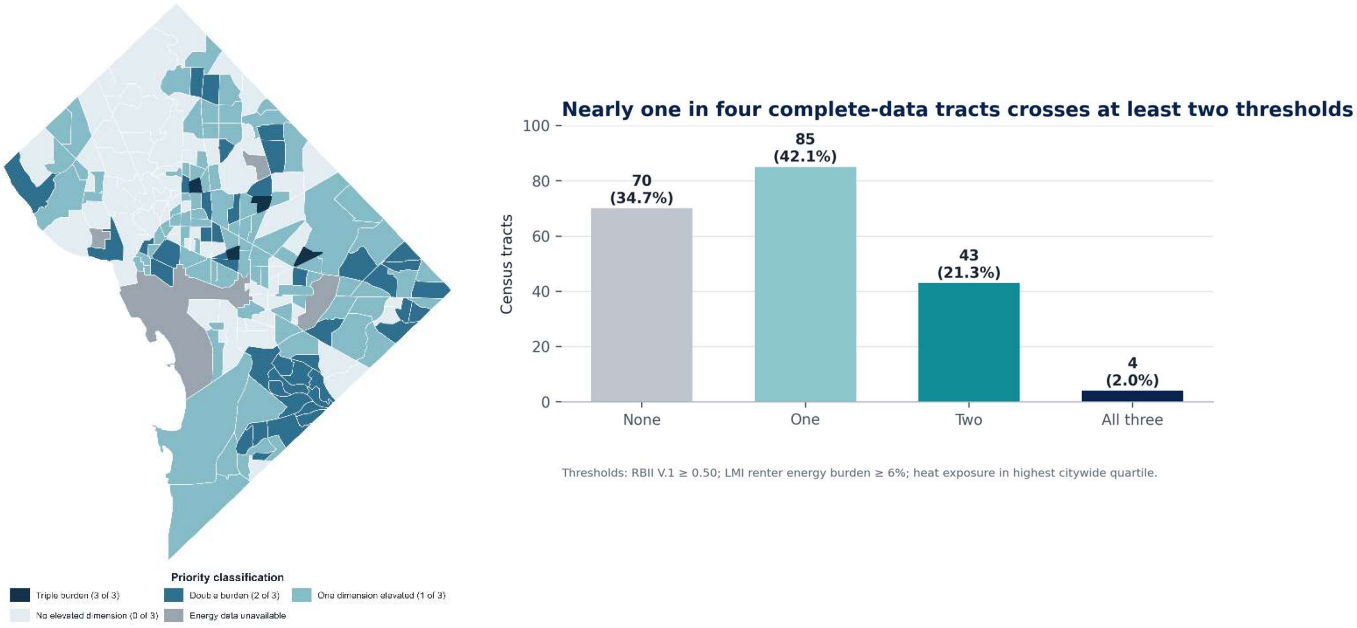

Figure 4. Four tracts cross all three thresholds, 43 cross two, 85 cross one, and 70 cross none. Four tracts lack modeled energy data.[17] Among 202 complete-data tracts, 23.3% cross at least two thresholds and 65.3% cross at least one.[18]

The four triple-burden tracts contain 2,468 rent-burdened households and 3,088 modeled LMI renter households, although these figures come from different source universes and must not be added together. Overlap should guide the intensity and combination of services, but it should never determine whether residents receive basic protection.

[17] Figure source: RBII V.1; U.S. DOE LEAD Tool, 2022; D.C. DOEE Heat Exposure Index, 2022; author calculations.
[18] Figure source: Author calculations using the three component thresholds.

Priority Tract Profiles and the Mismatch Among Burdens

Tract	RBII tier / score	Rent burden	Severe burden	LMI energy burden	Heat exposure
30	Tier 2 / 0.504	49.6% (524 HH)	25.4%	6.53% (585 HH)	0.802
47.04	Tier 1 / 1.687	75.1% (408 HH)	50.8%	8.22% (640 HH)	0.754
89.03	Tier 2 / 0.984	56.1% (678 HH)	35.7%	6.93% (854 HH)	0.733
92.04	Tier 2 / 0.985	61.5% (858 HH)	27.7%	6.45% (1,008 HH)	0.777

These four tracts warrant coordinated resident engagement, building assessment, bill-affordability screening, tenant protection, and heat mitigation. Household counts come from different survey and modeled universes and should not be added across columns.

What distinguishes the four tracts

Among the four tracts, 47.04 shows the most acute housing pressure, with a 75.1% rent-burden rate, a 50.8% severe-burden rate, and the highest RBII score. Tract 92.04 contains the largest affected counts, making service capacity especially important. Tract 30 has the highest heat-exposure score of the group but the lowest housing score, illustrating how heat can elevate priority even when RBII is only slightly above the threshold. Tract 89.03 presents substantial pressure across all three measures. Even triple-burden tracts therefore require differentiated intervention packages.

Different combinations require different interventions

Different burden combinations call for different intervention packages. Housing-plus-energy tracts need bill relief, arrearage prevention, housing stability, legal support, and tenant-protected efficiency. Energy-plus-heat tracts need efficient cooling, distributed energy, weatherization, bill safeguards, and resilience planning. Housing-plus-heat tracts need stabilization, safe cooling, code enforcement, repairs, and public-realm mitigation.

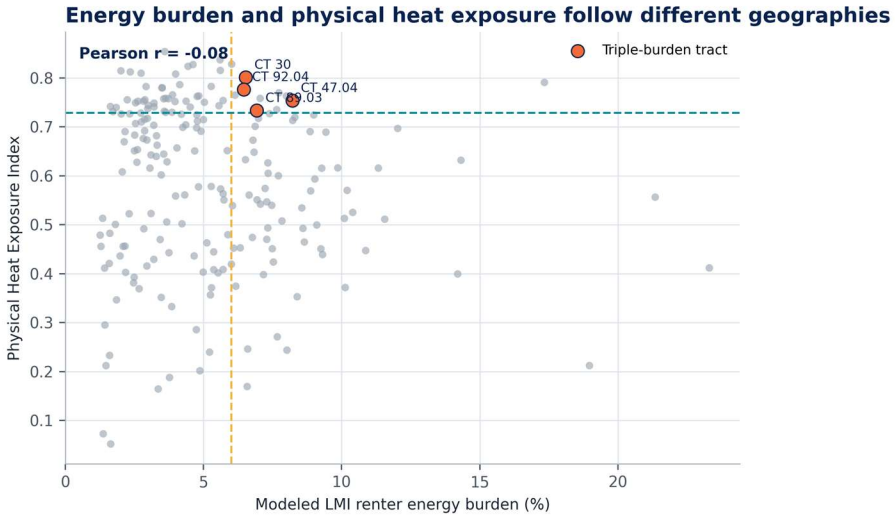

Figure 5. Modeled energy burden and physical heat exposure have a near-zero tract-level relationship (-0.08). The dimensions can compound household hardship without producing similar citywide geographies.[19]

INTERPRETATION Near-zero geographic correlation does not mean that the burdens cannot compound within a household. It means their highest-value tracts do not follow the same citywide pattern.

5. CEPI Finds Places a Housing-Only Screen Can Miss

CEPI gives equal weight to each tract's modeled LMI renter energy-burden percentile and physical heat-exposure percentile. A score of 80 or more is designated very high; this is a transparent planning threshold, not a forecast of individual harm. Eleven tracts meet the threshold, but only four also meet the high-RBII threshold.

What CEPI adds

CEPI does not replace RBII; it answers a narrower question: where do elevated energy burden and physical heat exposure coincide? Equal weighting makes the formula easy to audit and prevents either component from dominating. This is useful for cooling, weatherization, solar, storage, and resilience planning because a tract can rank highly on climate-energy conditions even when it does not cross the housing threshold.

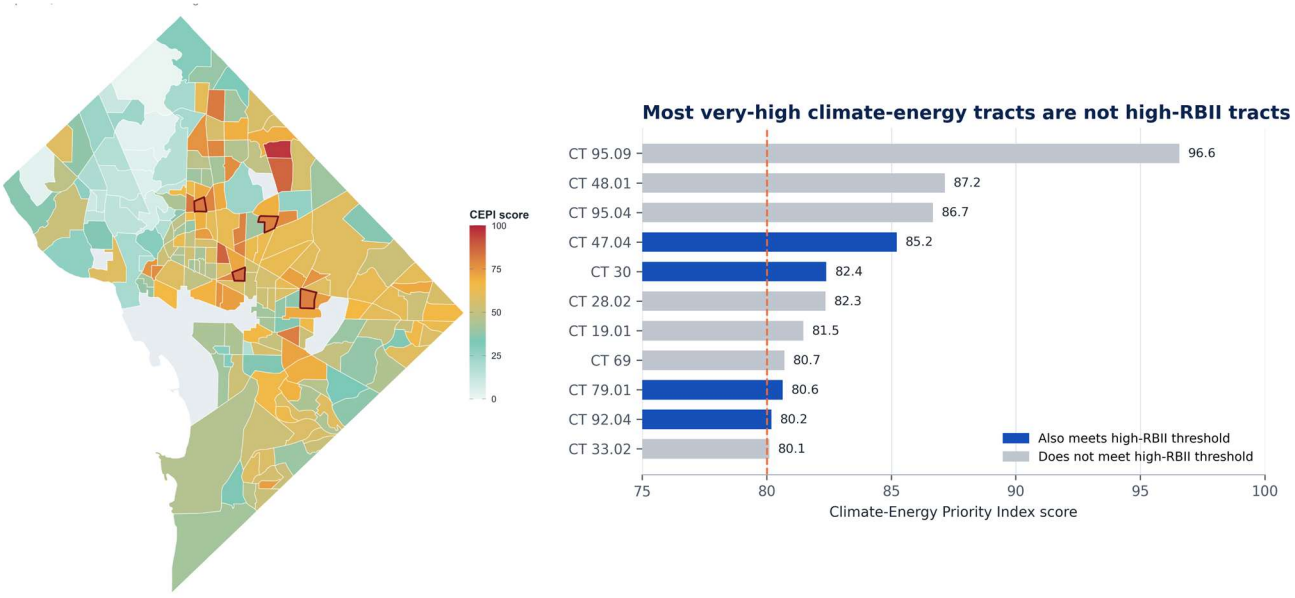

Figure 6. Higher CEPI scores identify tracts that rank highly on both modeled energy burden and physical heat exposure. Outlines identify tracts that also meet the high-RBII threshold.[20] Seven of the 11 very-high-CEPI tracts do not meet the high-RBII threshold; six of those seven are in RBII Tier 4.[21]

Three examples of overlooked climate-energy priority

The mismatch is clearest in three tracts. Census Tract 95.09 has the city's highest CEPI score, 96.57, but falls in RBII Tier 4. Census Tracts 48.01 and 95.04 score 87.15 and 86.67, respectively, and also fall in Tier 4. A climate-energy screen therefore adds information that a housing-only screen would miss.

POLICY VALUE CEPI prevents housing-only screening from overlooking acute energy-and-heat exposure.

[20] Figure source: U.S. DOE LEAD Tool, 2022; D.C. DOEE Heat Exposure Index, 2022; RBII V.1; author calculations.
[21] Figure source: Author calculations.

6. From Maps to Decisions: A Public-Interest Action Framework

The table translates analytical categories into operational choices. It is not a set of mutually exclusive programs; many households need more than one service, and universal access must remain intact. Its purpose is to identify which agencies should coordinate first, what safeguard must accompany the intervention, and which household outcome should be monitored. This keeps targeting tied to public purpose rather than treating a tract score as the outcome itself.

Screening profile	First-line public action	Required safeguard	Outcome to track
Housing + energy + heat	Joint outreach; bill screening; rental inspection; efficient cooling; retrofit and public-realm plan	No displacement; no tract-only eligibility	Bills; indoor heat; repairs; housing retention
Housing + energy	Bill relief; arrearage management; deep efficiency; legal support	Verified tenant savings; preserve affordability	Burden; shutoffs; rent changes
Housing + heat	Safe cooling; code enforcement; shade, roof, window, and tree work	Safety not conditioned on ability to pay	Indoor heat; repair time; displacement
Energy + heat	Weatherization; efficient cooling; solar/storage; cool corridors	Protect renters and master-metered residents	Bills; outages; cooling; canopy
One / none	Targeted referral plus citywide protections and reassessment	Never interpret as no need	Program access; threshold trends

Recommendation 1: Create one shared screen and referral system

D.C. should adopt one shared planning layer that preserves the housing, energy, and heat component values rather than replacing them with an opaque score. The system should support a no-wrong-door referral protocol, disclose where resources are delivered relative to measured need, and give tenant and community representatives a formal role in definitions, update schedules, privacy rules, and permitted uses. Geography may trigger outreach or verification, but it must never become an automated denial rule.

Recommendation 2: Make essential energy affordable by design

D.C. should evaluate an income-responsive discount or percentage-of-income plan; the OPC study describes programs that typically cap bills between 3% and 6% of income.[22] The design must also reach master-metered buildings, households with utilities included in rent, and residents facing arrears, language barriers, shutoff risk, or delayed restoration. Major rate proposals should include an affordability impact statement by income, tenure, and geography.

[22] D.C. Office of the People's Counsel and Synapse Energy Economics, Energy Affordability in Washington, D.C., 2025.

A Six-Part Policy Agenda

Recommendation 3: Retrofit rental housing without displacing renters

Publicly supported rental retrofits should produce measurable tenant savings, prohibit inappropriate cost pass-throughs, preserve affordability, and protect residents against retaliation. Programs must also fund enabling repairs—such as roofs, moisture remediation, wiring, windows, and health-hazard correction—because efficiency equipment cannot perform effectively in unsafe or deteriorated homes.[23]

Recommendation 4: Treat safe cooling as an essential housing service

Safe cooling should be treated as an essential housing service by connecting public-health guidance, housing enforcement, utility protection, and retrofit funding through one coordinated pathway. D.C. should evaluate maximum indoor-temperature rules with funding, technical assistance, enforcement capacity, and a workable phase-in, while expanding trees, shade, cool surfaces, water access, resilience hubs, and safer transit stops.[24]

Recommendation 5: Fund a durable safety net and distributed clean energy

A durable safety net should allow residents to register need and retain a dated place in line even when one funding pool is temporarily exhausted. Agencies should publish processing times and remaining funds, screen residents for related benefits, and expand renter access to solar and storage. Realized savings should be reported by tenure, building type, and geography.[25]

Recommendation 6: Require geographic accountability

Utilities, regulators, and program administrators should report arrears, shutoffs, restorations, enrollment, processing time, and bill impacts at the smallest reliable geography. Rate and investment proposals should show who pays, who benefits, and whether projects reduce household costs or shift them. Privacy suppression should protect individuals without erasing neighborhood-level accountability.

ACCOUNTABILITY STANDARD Judge programs by bills reduced, shutoffs prevented, homes made safer, neighborhoods cooled, emissions avoided, and households able to remain in place.

[23] D.C. Department of Energy and Environment, Home Energy Rebates Consumer Protection Plan, updated Sept. 2025, https://doee.dc.gov/sites/default/files/dc/sites/doee/service_content/attachments/DC%2050121%20HER%20Consumer%20Protection%20Plan_updated%20Sept%202025.pdf.

[24] District Department of Transportation, Cool Corridors Pilot to Fight Urban Heat, July 2026, https://ddot.dc.gov/release/ddot-launches-cool-corridors-pilot-fight-urban-heat-help-keep-neighborhoods-cooler-and.

[25] Public Citizen, Principles for Resilient Homes Grant Programs, June 2026, https://www.citizen.org/wp-content/uploads/Principles-for-Resilient-Homes-Grant-Programs_1.pdf.

7. Implementation Roadmap and Performance Measures

First 100 days: establish the operating system

During the first 100 days, D.C. should convene a cross-agency working group with compensated resident and tenant representatives, adopt shared definitions and privacy rules, publish a transparent update schedule and program crosswalk, establish a no-wrong-door referral protocol, and begin resident-led validation in the four triple-burden tracts and selected very-high-CEPI tracts.

Within one year: test integrated delivery

Within one year, the District should test integrated delivery through multilingual pilots with trusted partners, connected housing-energy-heat case pathways, a common tenant-protection standard for public climate investments, an income-responsive affordability proposal, a privacy-protected dashboard, and an evaluation of indoor-temperature standards.

Within three years: institutionalize and scale

Within three years, D.C. should refresh the indices and delivery data on a predictable schedule, scale coordinated service delivery while preserving citywide access, tie performance incentives to household outcomes, and expand multifamily upgrades, community solar, cooling infrastructure, and independent evaluation.

Sequencing principle

Sequencing is essential. The first phase establishes shared rules and resident governance before technology or scoring systems are scaled. The one-year phase tests whether referrals lead to completed services and whether tenant protections work in practice. The three-year phase should expand only those pathways that demonstrate lower bills, safer homes, and stronger housing retention, with independent review of unintended effects.

Level	Core measures	Why it matters
Household	Energy burden; bill; arrears; shutoff/restoration; rent burden; benefit uptake; housing retention	Tests affordability and stability
Building	Energy use; peak demand; indoor temperature; repair completion; equipment; tenant savings	Tests durable capital benefits
Neighborhood	Canopy; shade; cool surfaces; hub access; heat incidents; outreach coverage	Tests exposure and access
Program	Processing time; denial reason; referrals; repeat documents; tenant-directed dollars	Tests usability and accountability
Equity	Outcomes by income, tenure, language, disability, and geography—with privacy controls	Tests distribution of benefits

8. A Replicable Model for U.S. Cities

The framework has national relevance because ACS rent-burden data, census-tract geography, and DOE energy-burden estimates are available across the United States.[26] Heat measures can be adapted to local conditions using existing heat maps or locally appropriate combinations of temperature, canopy, and impervious surface. The method is modular: publish the components first, count thresholds when agencies need to identify elevated conditions, and use percentiles only when a compact ranking is useful.

Four-step replication protocol

Replication should begin by defining the decision the tool will support—such as outreach, investment, emergency response, regulation, or evaluation. Each source's universe, vintage, geography, missingness, and uncertainty should be documented before data are joined. Housing, energy, and heat components should be published before any composite measure, and priorities should be validated through inspections, program data, outcomes, and resident experience, with revisions made openly.

What replication should avoid

Cities should not copy D.C.'s thresholds without local testing, treat tract averages as individual facts, add variables without a documented purpose and uncertainty assessment, or define success through targeting alone. Performance must ultimately be judged through bills, safety, housing retention, emissions, access, and resident experience.

Minimum replication package

At minimum, a city should publish a tract-level data dictionary, exact formulas and thresholds, source vintages, missing-data flags, and a crosswalk connecting each classification to an action. Sensitivity tests should show how results change under alternative cutoffs or weights. A governance process should also define how updates, corrections, and resident feedback are incorporated. Producing a map alone is not successful replication; the model must improve decisions and accountability.

NATIONAL CONTRIBUTION The method joins three burdens without concealing their differences or weakening universal protections.

[26] U.S. Department of Energy, LEAD Tool Factsheet, July 2024, https://www.energy.gov/sites/default/files/2024-07/lead-tool-factsheet_072624.pdf.

Methods

Unit of analysis and alignment

The analysis covers 206 D.C. census tracts using 2024 TIGER/Line boundaries. Two tracts lack an RBII score, four lack modeled LMI renter energy data, and the overlap and CEPI analyses therefore use a 202-tract complete-data universe.

Dimension	Measure	Elevated threshold	Source / vintage
Housing	RBII V.1: prevalence, severity, number, density, area adjustment	RBII ≥ 0.50	ACS 2020-2024; 2024 TIGER
Energy	Modeled home-energy cost / modeled income for LMI renters	≥ 6%; severe ≥ 10%	U.S. DOE LEAD, 2022
Heat	50% air temperature; 25% lack of canopy; 25% impervious surface	Highest quartile; ≥ 0.729324	D.C. DOEE, 2022
Climate-energy	Equal mean of energy and heat percentile ranks	CEPI ≥ 80	Author calculation

Calculation details

RBII standardizes burden rate (30%), severe-burden rate (30%), logged burdened-household count (25%), and logged density (15%), then subtracts 0.20 times positive standardized land area. Energy burden is modeled annual home-energy cost divided by modeled annual income for renter households at 0% to 80% of area median income. The physical-heat highest-quartile cutoff is 0.729324, while CEPI is the equal average of each tract's energy-burden and heat-exposure percentile ranks; scores of 80 or more are designated very high.

Weighted averages use modeled LMI renter-household counts where stated. Pearson correlations are descriptive rather than causal, and household totals remain within their original source universes; figures from different universes are not added together.

Data joins, missingness, and uncertainty

Tract identifiers were harmonized to 2024 geography before the datasets were joined. Missing component values remain visible in the source tables and are excluded only from calculations requiring complete cases; they are never treated as low burden. Because the data vintages differ, the combined measures are used for screening rather than as simultaneous observations. RBII and CEPI are planning constructs whose results depend on weights, transformations, and cutoffs. Agencies using them for major allocations should test alternatives, review ACS margins of error, verify extreme LEAD values with small modeled populations, and rerun the analysis when updated data become available.

Limitations, Responsible Use, and Conclusion

Six limitations

The analysis is ecological rather than individual: tract averages cannot establish a person's need, eligibility, identity, or health risk. It also joins data from different periods—ACS 2020-2024, 2022 DOE and DOEE estimates, and 2024 tract boundaries—and both ACS estimates and modeled energy values carry uncertainty, especially in tracts with small populations.

Results are also sensitive to the selected weights and thresholds, so agencies should publish alternatives before making major allocations. Physical heat exposure is not complete heat risk because it excludes health, isolation, homelessness, cooling access, indoor temperature, and power reliability. Finally, geographic concentration, overlap, and mismatch do not establish causation or prove program effectiveness.

RESPONSIBLE-USE STANDARD Use the report to coordinate agencies and choose places for verification—not as proof of individual need, causation, or automatic allocation.

Conclusion

D.C.'s next climate-policy stage should connect buildings, household bills, and heat resilience. A transition is not equitable when efficient equipment remains unaffordable, retrofits displace tenants or shift costs onto them, or outdoor heat investments ignore unsafe indoor temperatures.

The tract analysis identifies four triple-burden tracts, 43 double-burden tracts, and 11 very-high-CEPI tracts that a housing-only screen does not fully capture. At the same time, the evidence supports universal protections because most rent-burdened households live outside the two highest RBII tiers.

FINAL TAKEAWAY The best climate policy is not only low-carbon. It is affordable, protective, measurable, and designed around the people who live with its consequences.

Acknowledgments and author contributions

This report was researched and written by Mahin Rahman Tawrat & Craig Holman, Ph.D. Tawrat developed RBII V.1, CEPI, the integrated threshold framework, the tract-level analysis, and all derived figures and tables. The work draws on public data and methodology from the U.S. Census Bureau, U.S. Department of Energy, D.C. Department of Energy and Environment, D.C. Public Service Commission, D.C. Office of the People's Counsel, and the numbered source notes at the foot of each page.

Appendix A. Very-High Climate-Energy Priority Index Tracts

Tract	CEPI	LMI energy burden	Heat exposure	RBII tier	High RBII?
95.09	96.57	17.34%	0.791	Tier 4	No
48.01	87.15	7.73%	0.770	Tier 4	No
95.04	86.67	8.00%	0.763	Tier 4	No
47.04	85.22	8.22%	0.754	Tier 1	Yes
30	82.39	6.53%	0.802	Tier 2	Yes
28.02	82.35	6.02%	0.828	Tier 3	No
19.01	81.46	7.05%	0.758	Tier 4	No
69	80.70	12.03%	0.697	Tier 4	No
79.01	80.63	8.99%	0.724	Tier 2	Yes
92.04	80.18	6.45%	0.777	Tier 2	Yes
33.02	80.10	5.60%	0.837	Tier 4	No

CEPI ≥ 80 is the report's very-high threshold. Seven of 11 tracts do not meet RBII V.1 ≥ 0.50; six of those seven are in RBII Tier 4.

How to read the table

The table should be read by component, not by CEPI rank alone. The RBII columns show whether housing priority reinforces the climate-energy signal. A "No" in the final column does not mean low housing need; it only means the tract falls below the report's 0.50 high-RBII threshold.

Data products accompanying the analysis

The accompanying data products include the RBII V.1 tract table with its component measures and large-tract adjustment; the LMI renter energy-burden table with modeled households, income, costs, and threshold status; the physical heat-exposure table with population, canopy, impervious surface, air temperature, and index values; the integrated priority-area table with threshold classifications and missing-data status; and the CEPI table with percentile ranks, combined scores, RBII status, and formula.

Appendix B. Tracts With Severe Modeled LMI Renter Energy Burden

Tract	Energy burden	Modeled LMI renter HH	Avg. annual income	Avg. annual energy cost
10.03	23.31%	48	$6,474	$1,509
78.09	21.35%	492	$10,780	$2,301
8.04	18.97%	9	$6,562	$1,245
95.09	17.34%	26	$12,081	$2,095
20.02	14.32%	88	$21,171	$3,032
95.03	14.20%	57	$27,420	$3,895
69	12.03%	111	$17,645	$2,123
74.01	11.56%	521	$17,264	$1,996
98.02	11.33%	354	$20,023	$2,270
111	10.87%	581	$16,225	$1,763
78.08	10.39%	617	$24,174	$2,513
76.01	10.20%	1,049	$22,919	$2,338
96.01	10.13%	501	$28,965	$2,934
74.06	10.10%	853	$21,029	$2,123

Severe burden is defined here as modeled home-energy cost equal to at least 10% of modeled annual household income. Small modeled household counts make some extreme estimates less stable. Use the table to prioritize verification—not as an automatic allocation list.

How to use the appendix

The appendix should be used to prioritize verification rather than automatic allocation. Extreme estimates should be checked against local utility, program, and building-condition data; outreach should focus on households rather than treating every resident of a high-burden tract as identical; bill assistance should be paired with weatherization, repairs, efficient cooling, solar, storage, and tenant protections; and outcomes should be tracked through bills, arrears, shutoffs, restoration time, indoor safety, and housing retention.

Data priorities for future updates

Future editions would be stronger with privacy-protected utility arrears, shutoff, restoration, indoor-temperature, cooling-equipment, repair, and realized-savings data by tenure and geography. These measures would allow the screening framework to be tested against observed outcomes rather than exposure and modeled burden alone.

VERIFICATION STANDARD Use severe tract estimates to organize local review of bills, arrears, shutoff risk, building condition, cooling access, and program enrollment—not as automatic household determinations.