No Off Switch: Energy Affordability in a System Without Household Agency

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How Many People Have Ever Felt Like This After Getting an Energy Bill?

To cope with high bills people may do some version of this:

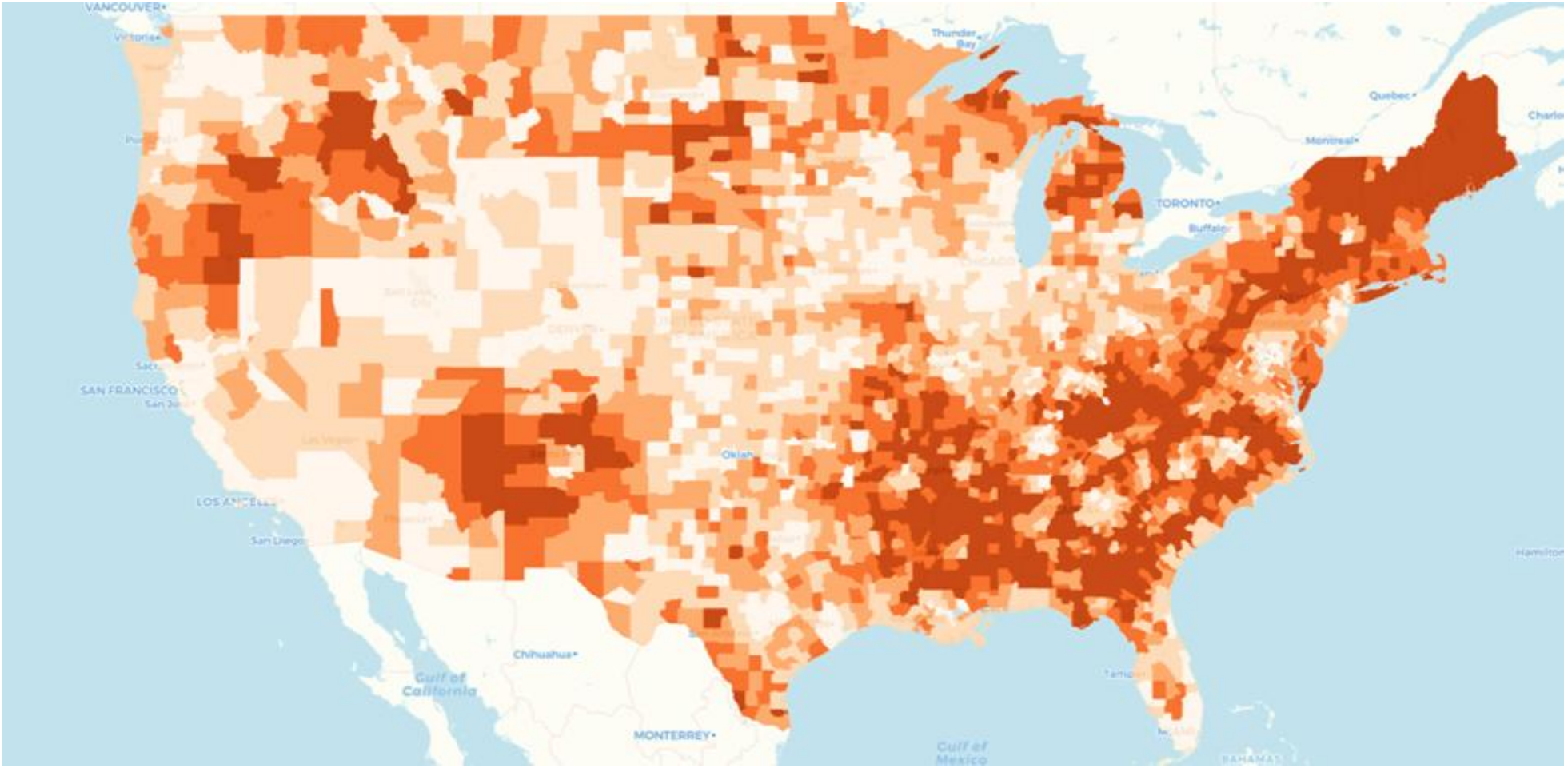
How Many People Have Experienced Pipes Freezing in your Home because you (or someone you know) was trying to save money on the heating bills?

2022 Christmas cold snap led to the entire duplex losing access to water

That's me ☹

(My tenant trying to save money on bills led to big consequences)

Energy poverty discussions dominated by Energy Burden



Energy burdens (at the county level) for LMI (low and moderate-income) households. The lightest color in the choropleth scale is <6% of annual income spent on housing energy bills, and the darkest is >19%.

https://blog.ucsusa.org/joseph-daniel/how-to-make-energy-burden-less-bad

Do you know the percent of income you spend on your energy bills?

- If most people don’t know their energy burden…why does that metric dominate research and analyses?
- It’s easy to calculate
- Many equate affordable with low bills, but this misses health and safety of indoor environments.

Low Energy Bills ≠ Affordable

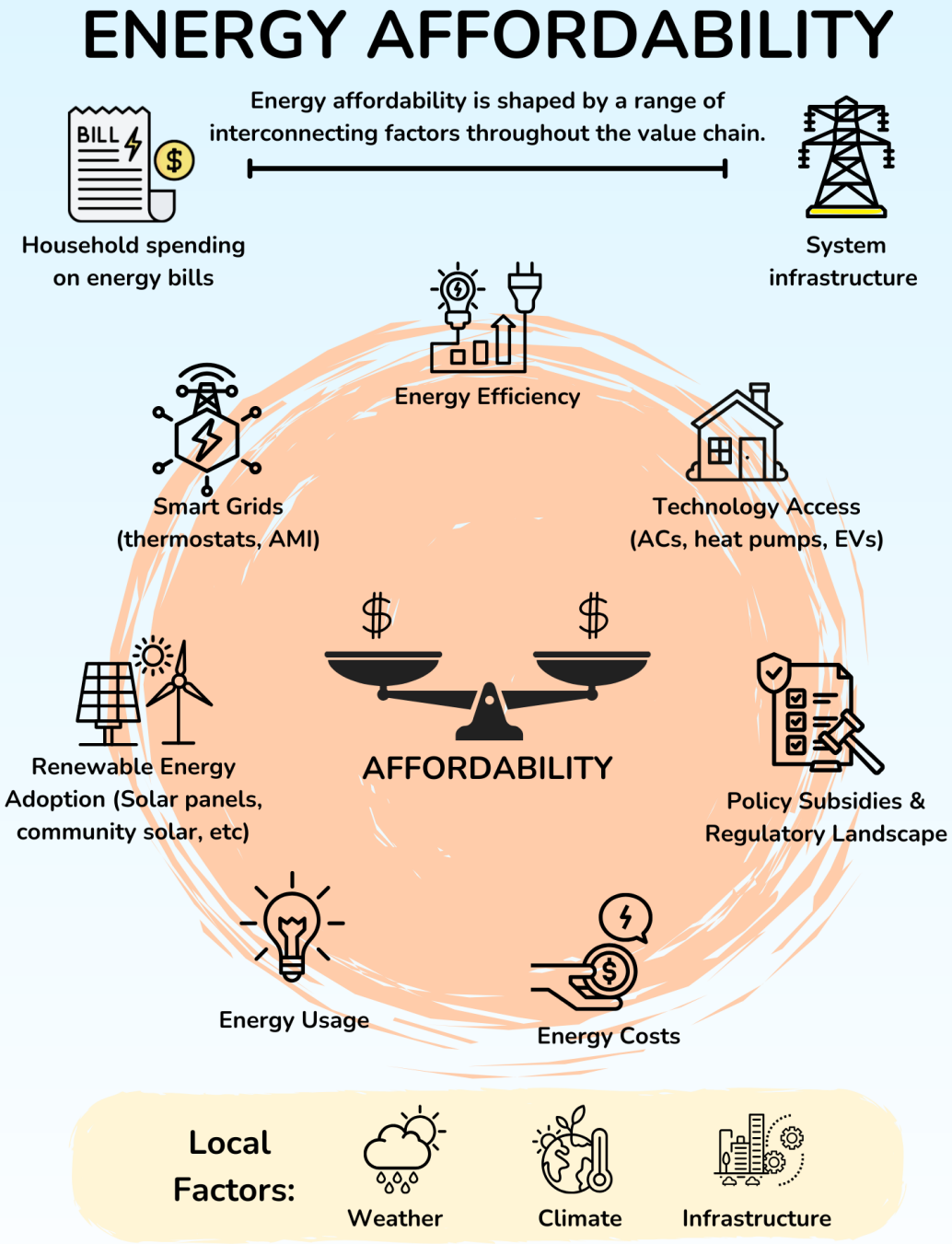
Energy Affordability Definition

Energy affordability is the ability of households to access reliable and sufficient energy services without compromising their financial well-being.

It encompasses energy costs, energy usage, efficiency, access to modern energy technologies, and the influence of policies and rate structures.

More comprehensive definition in the near-term recommendations (MA IRWG)

https://www.mass.gov/doc/defining-energy-affordability/download/



How Much Would You Be Willing To Pay for 345 kWh of electricity?

My husband said $5

Students said $2 - $30

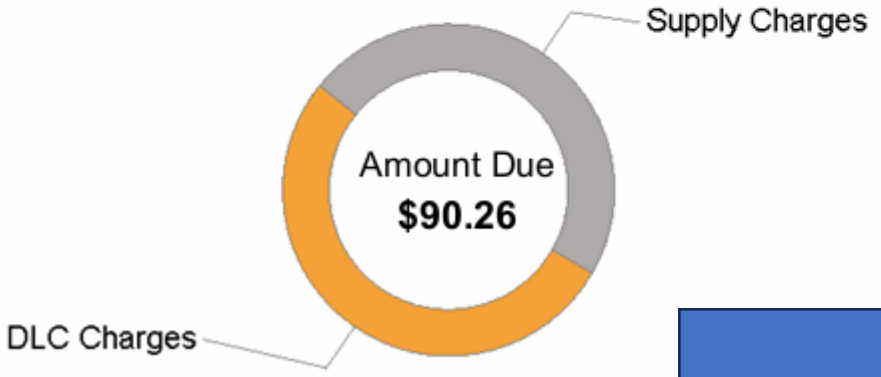
DUQUESNE LIGHT CO.

[redacted]@gmail.com

Account # [redacted]

Due Date	Amount Due
11/12/2025	$90.26

Bill Summary



Bill ID: [redacted] **Date Prepared: 10/22/2025**

Previous Account Balance	$127.37
Payment(s) Received as of 10/14/2025	-$127.37
Balance Forward	**$0.00**
DLC Charges	$47.39
Supply Charges	$42.87
AMOUNT DUE BY 11/12/2025	**$90.26**

But what did that $90 get me?

Message Center

Looking for ways to save on your bills? Visit our website or use the DLC Mobile app to review your home's energy usage and find tips to save. We also have easy to use tools, rebates, incentives and a store of energy-efficient products. Get started today by visiting **DuquesneLight.com/home-energy-center**.

Duquesne Light Company partners with Dollar Energy Fund to provide assistance to customers who struggle to pay their electric bill. If you would like to support the Dollar Energy Fund and your neighbors in need, make a tax deductible monthly pledge at **DuquesneLight.com/dollar**.

Usage Comparison Chart

Period	Total kWh Usage	Avg Daily kWh Usage	# of Days	Avg Daily Temp (F)
Current Month	345	12	29	61
Last Month	511	17	30	69
Same Month Last Year	329	11	29	62

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Since the summer and winter are not the same height I am probably not heating my entire home with electricity.

But since summer and spring not same height, you could guess I have AC.

Usage Comparison Chart

Period	Total kWh Usage	Avg Daily kWh Usage	# of Days	Avg Daily Temp (F)
Current Month	345	12	29	61
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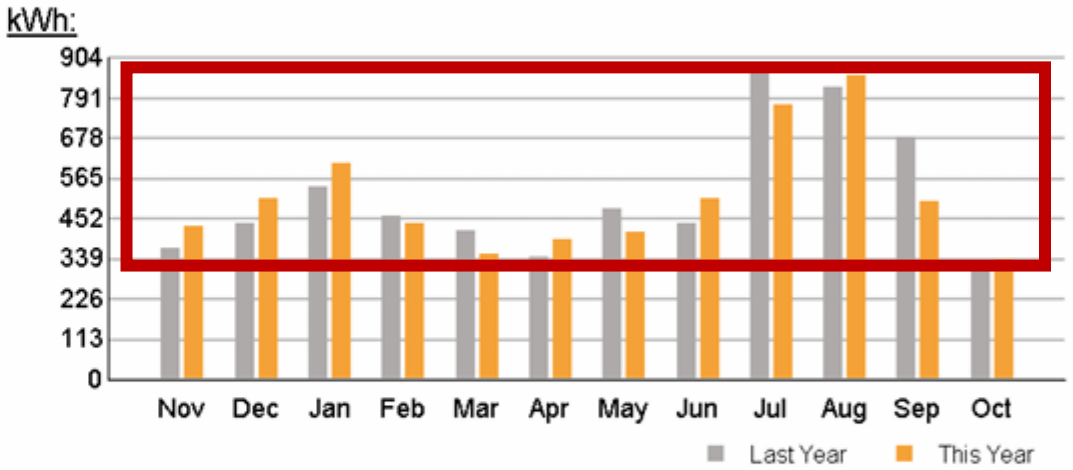
Same Month Last Year	329	11	29	62



Average Monthly Usage for the last 12 months: 520 kWh
Total Annual Usage for the last 12 months: 6238 kWh

BI_EBILL_20251022PRD.xml

Online: www.DuquesneLight.com **Phone:** 888-393-7100 *Billing and meter reading details on page 3*

Please return this portion with your payment. Please enclose check facing forward.
Make payment payable to Duquesne Light Company in US Currency.

A late charge of 1.25% may be assessed after 2025-11-12

Due Date	Amount Due
11/12/2025	$90.26

General Information

Visit us online or call to learn about payment options, or for a copy of our rate schedules. For questions about your bill, please contact us before the bill due date.

Online: www.DuquesneLight.com

Phone: 888-393-7100 **TTY Users:** 711

Mail: Dept 6-1
411 7th Ave Ste 3
Pittsburgh, PA 15219-1942

Billing and Service Options

Sign up online for any of the following services:

- **Phone:** 888-393-7100 **TTY Users:** 711
- **Budget Billing** - Levels out payments across the year
- **Start/Stop Service** - If you're moving and need to have your service turned on or off, you must call Customer Service at 888-393-7100 or visit our website
- **Double Notice Protection** - Sends a payment reminder to you and a person you designate

Dollar Energy Fund

Give to Dollar Energy Fund to help people in our community without heat or light. There are several easy ways to donate and your gift is tax deductible.

Text: Make a one-time donation of $5 by texting POWER to 50000

Online: Visit www.DuquesneLight.com and select "Payment Options" from the Account & Billing menu

Phone: 888-393-7100

Understanding Your Bill

- **Customer Charge** – A monthly basic service charge that includes costs for meter reading, customer billing, service equipment, and other expenses. These expenses are incurred even in months when customers do not use electricity.
- **Distribution Charges** – Basic service charges for delivering electricity over a distribution system to the home or business from the transmission system.
- **Distribution System Improvement Charge (DSIC)** – A charge for company investment to improve service quality and increase safety by repairing, improving, or replacing eligible infrastructure used to deliver electricity.
- **DLC Charges** – Services necessary for the physical delivery of electricity service, such as supply, including default service, transmissions and distribution.
- **Kilowatt-Hour (kWh)** – The basic unit of electric energy for which most customers are charged. It equals the amount of electricity used by 10, 100-watt light bulbs left on for one hour.
- **Meter Reading** – An actual (Act) reading is a reading taken from the meter. An estimated (Est) reading is used when no actual reading is available and is based on past electric usage.
- **Non-Basic Service Charges** – Any category of service not related to basic service.
- **Smart Meter Charge** – Charges for advanced metering technology and related infrastructure that will provide the ability for features such as two-way communication and interval usage data.
- **Supply Charges** – Basic service charges for generation supply to retail customers.
- **Transmission Charges** – Basic service charges for the cost of transporting electricity over high voltage wires from the generator to the distribution system.

Account Detail

[redacted] Supplier Agreement ID: [redacted]

Meter Reading Usage Information

Meter Number		[redacted]
Present	10/22/2025 Act	42,945.6520
Prior		60
Difference		60
Your Mete		1
Total kWh		60

Current Bill Details

DLC Rate	RS-Residential Service	
Price to Compare	$0.1243 / kWh	
DLC Charges		**$47.39**
Customer Charge		$13.00
Distribution	344.8860 kWh@ $0.099869	$34.44
DSIC Surcharge	0.02%	$0.01
Pennsylvania Tax Adjustment		-$0.06
Supply Charges		**$42.87**
Supply	344.8860 kWh@ $0.097093	$33.49
Transmission	344.8860 kWh@ $0.027187	$9.38

Total kWh Used	**344.8860**
Service Charges	**$90.26**

Shopping and Supplier Information

When shopping for electricity with an Electric Generation Supplier, please provide the following information:

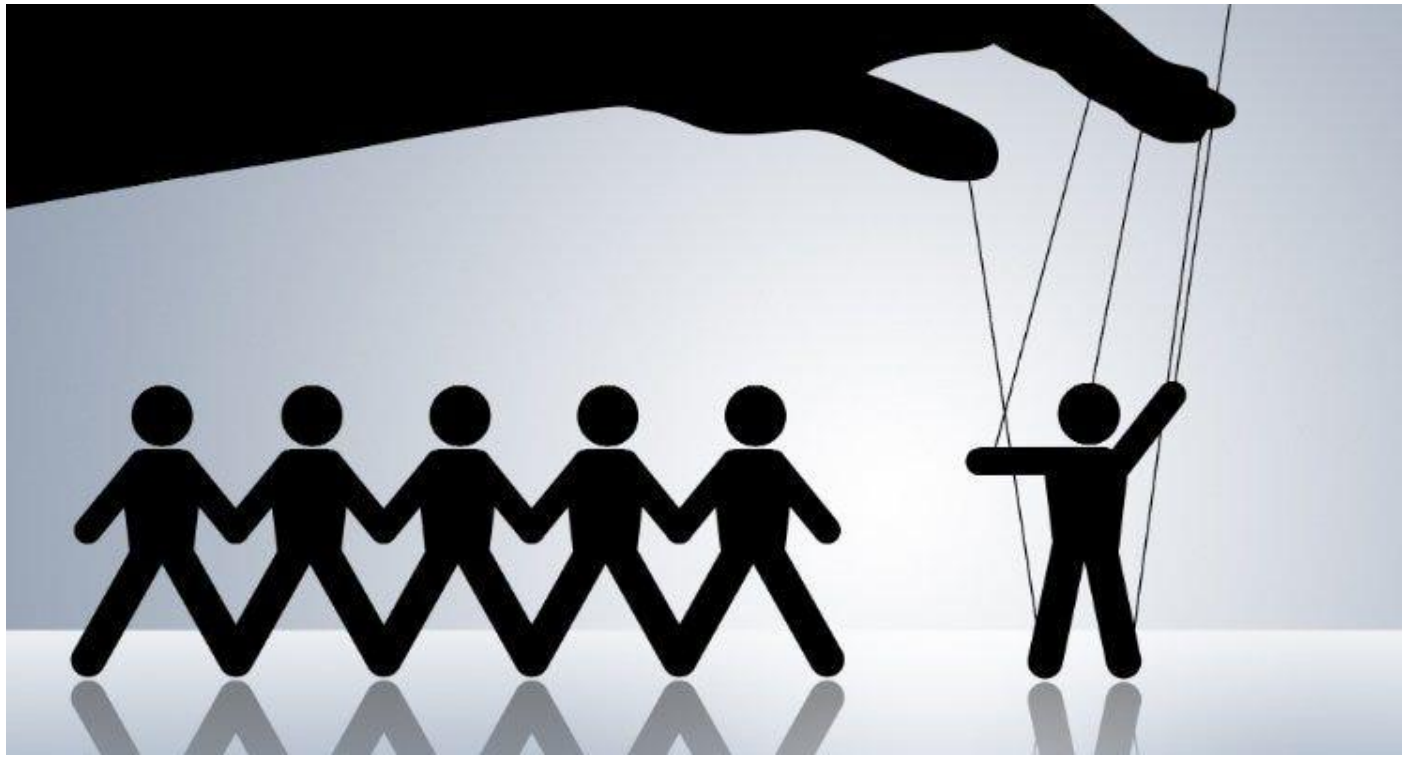
Supplier Agreement ID: 8628173655

Rate Schedule: RS-Residential Service

And All of That Was For Electricity….
in My Gas Heated Home…
Meaning I didn’t even Pay for Heat Yet.

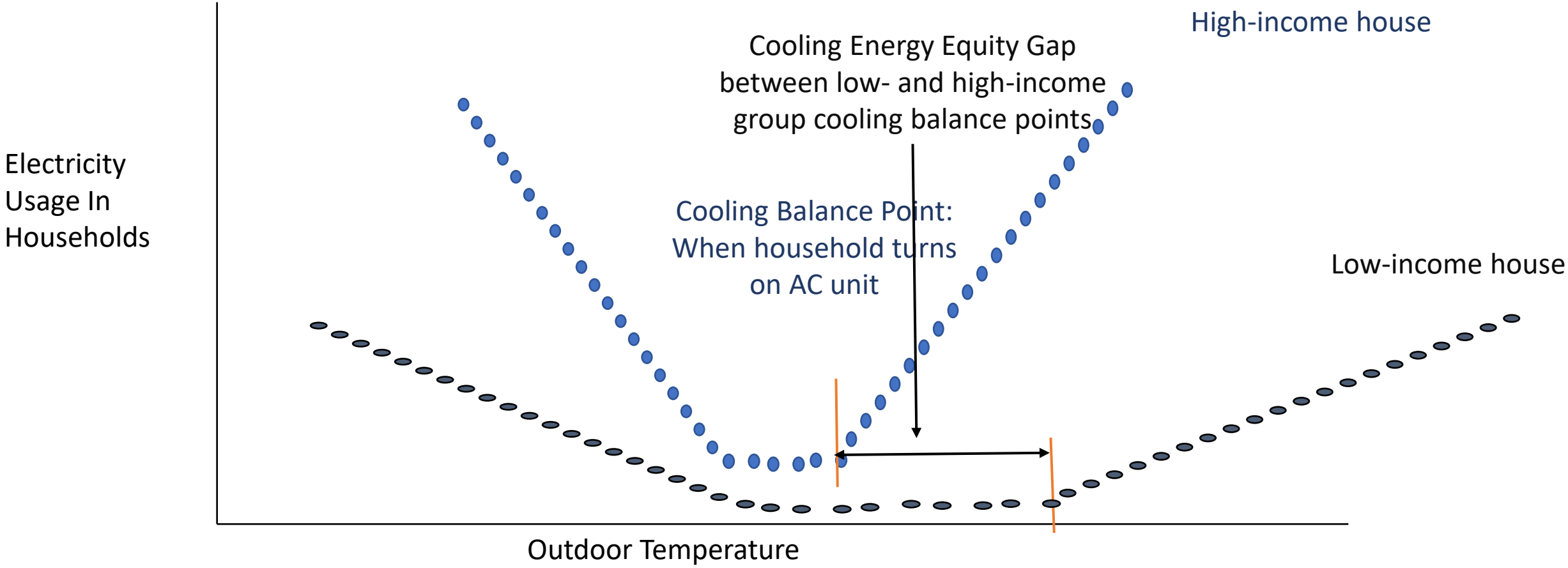
Affordability challenges are rooted in the lack of agency.

- With food and medicine people can choose different brands or quality levels, but with electricity and gas you need services to live in modern society.



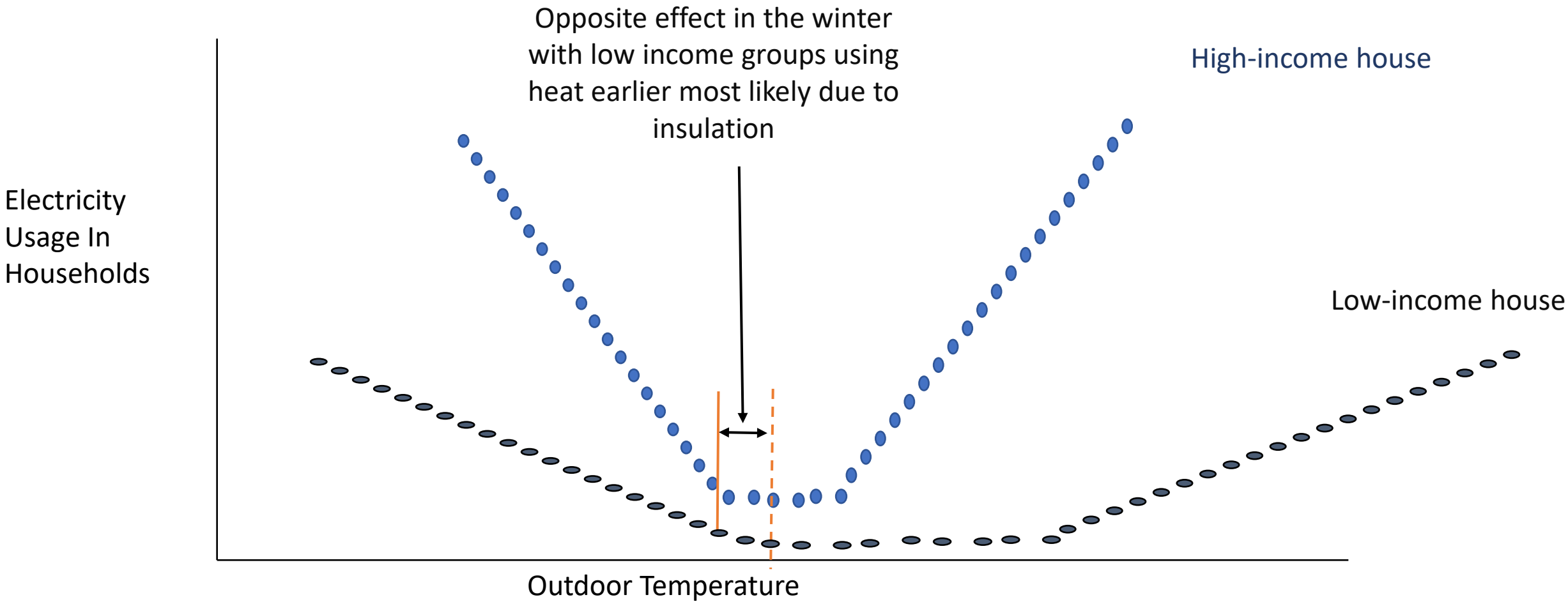

44% of Americans have found themselves in an argument over the thermostat
°F
°C
AROUND THE CLOCK SERVICE
MOONLIGHT MECHANICAL
THE LEGEND IN HEATING AND AIR
580-512-2014

Energy Equity Gap and Energy Limiting Behavior



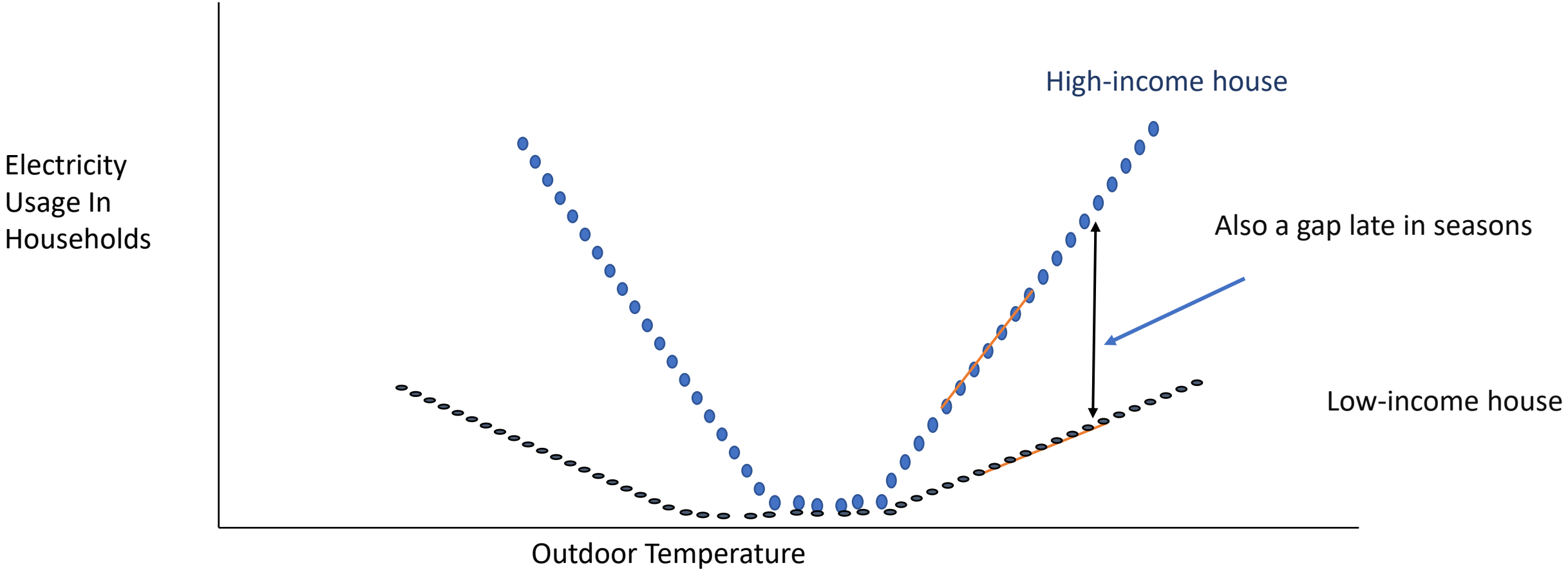
(Cong et al 2022 in Nature Communications and Huang et al (2023))

Energy Equity Gap and Energy Limiting Behavior



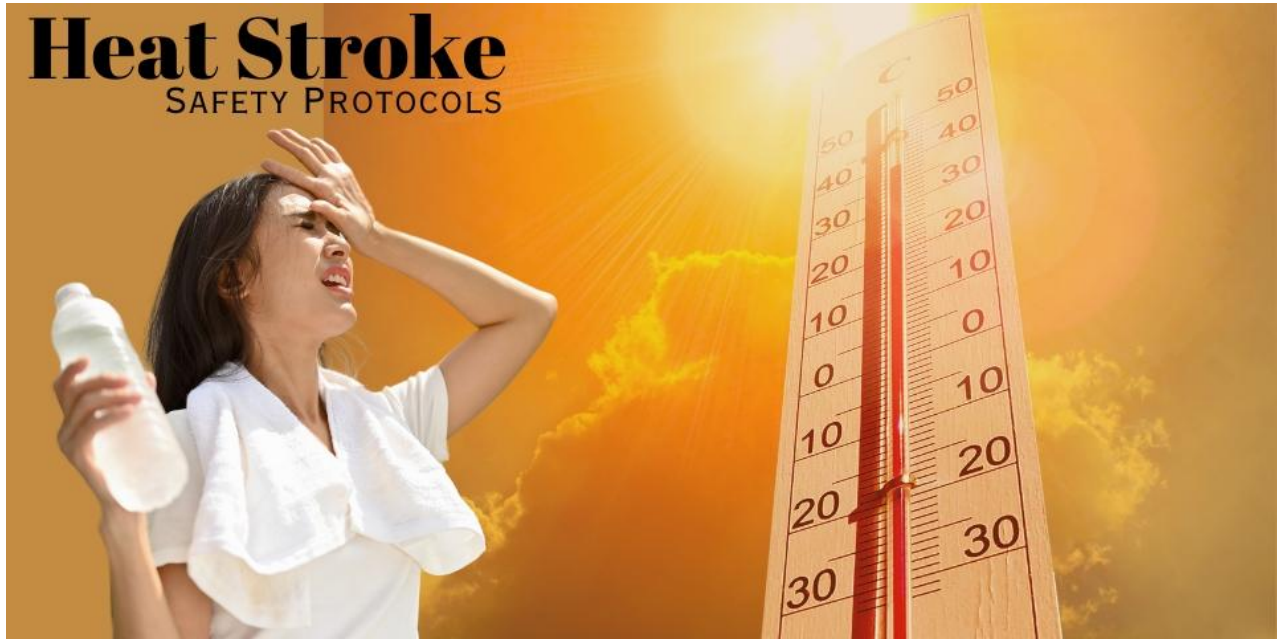
(Cong et al 2022 in Nature Communications and Huang et at (2023))

Slope Gap = Extreme Energy Limiting Behavior



(Kwon et al 2023)

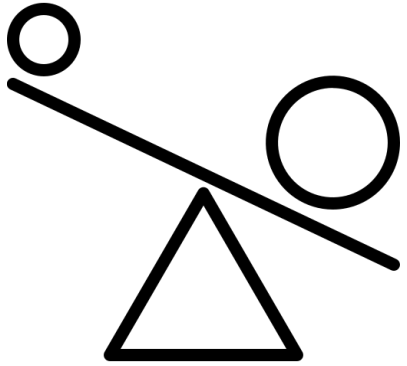
What are key periods for investigating when energy limiting behavior can impact health?



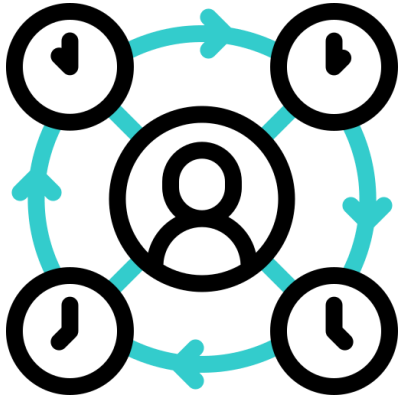
Implications of energy limiting behaviors

- Delaying system use may reflect financial constraints, concerns about bills, or coping behaviors (layering clothing, using fans).
- While these actions reduce immediate costs, they can increase health risks (cold stress, heat stress) and create a “catch-up effect” when systems are finally turned on (i.e., operating inefficiently to improve the thermal load of the home).

Financial Constraints



Coping Behaviors



Catch-up effect

Health Impacts

Two Types of Limiting

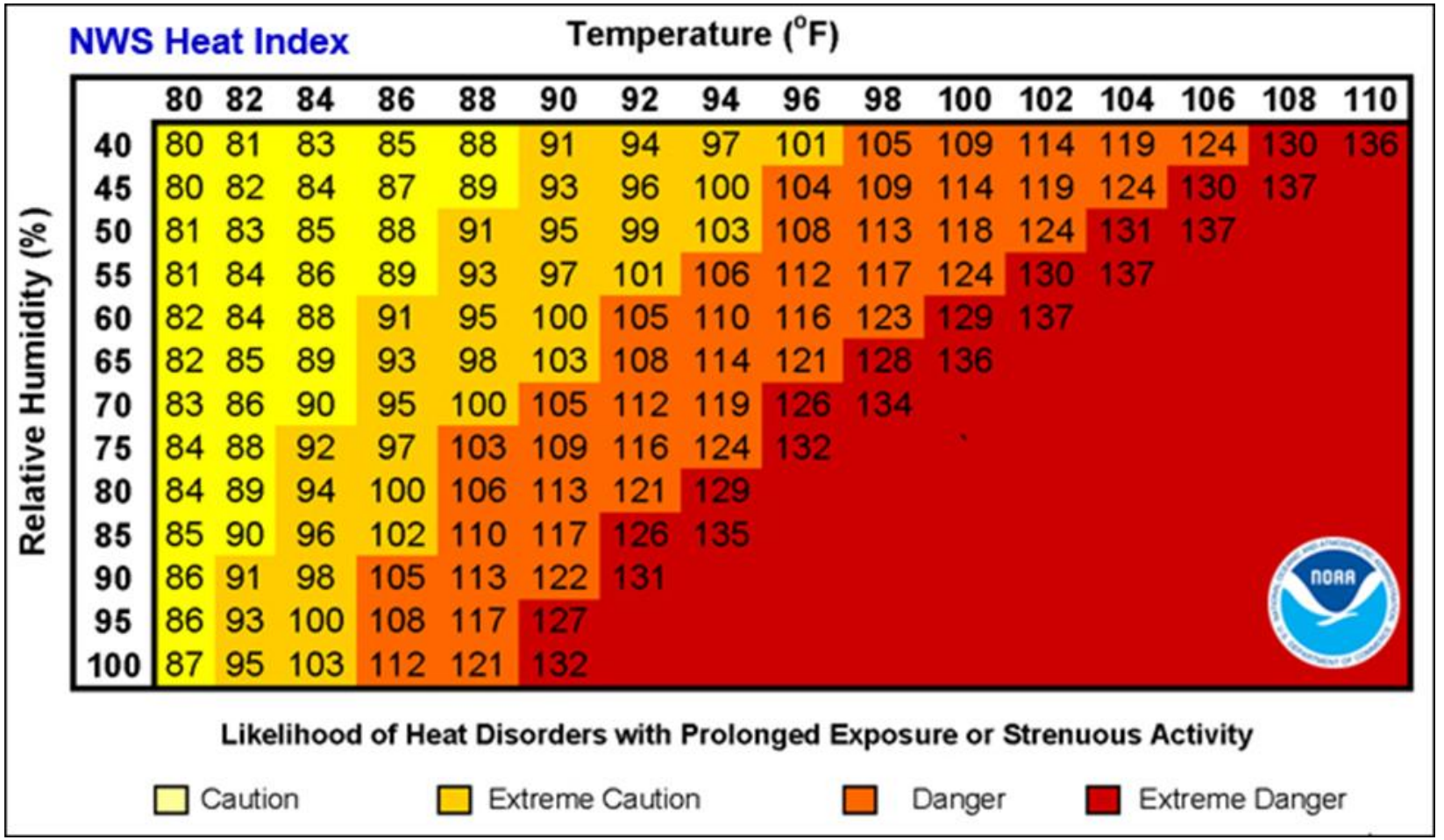
Late-Season Limiting (Using Balance Points)	**Extreme-Temperature Limiting (Using Slopes)**
•Definition: Delay turning on heating/cooling well past typical comfort thresholds. •Implications: • Financial strain or coping behaviors (e.g., supplementing central heat with plug-in space heaters) • Risks: cold stress, heat stress, catch-up use	•Definition: Little/no energy usage during the hottest or coldest days. •Implications: • Lacking equipment (e.g., broken AC), or rationing (e.g., using oven to heat home instead of central system) • Risks: serious health & safety concerns

Late-Season Limiting

- **Definition:** Households that wait unusually long into the season before turning on their heating or cooling systems.

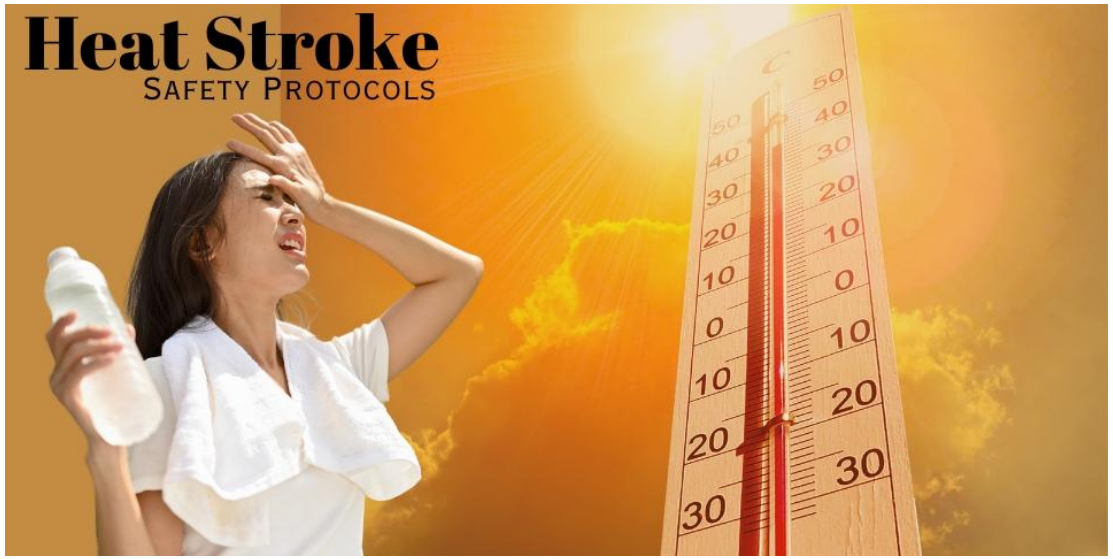
Heating	**Cooling**
•**Low/No Limiting-** Households that begin heating before average outdoor temperatures reach 50°F •**Moderate Limiting -** Households that begin heating when average temperatures are between 50°F and 38°F •**High Limiting–** Households that begin heating below and average temperature of 38°F	•**Low/No Limiting-**Households that begin cooling when average temperatures are less than 68°F •**Moderate Limiting-** Households that begin cooling when average temperatures are between 68°F and 75°F •**High Limiting-** Households that begin cooling when average outdoor temperatures are greater than 75°F

Heat-Risk Signals Based on National Weather Service

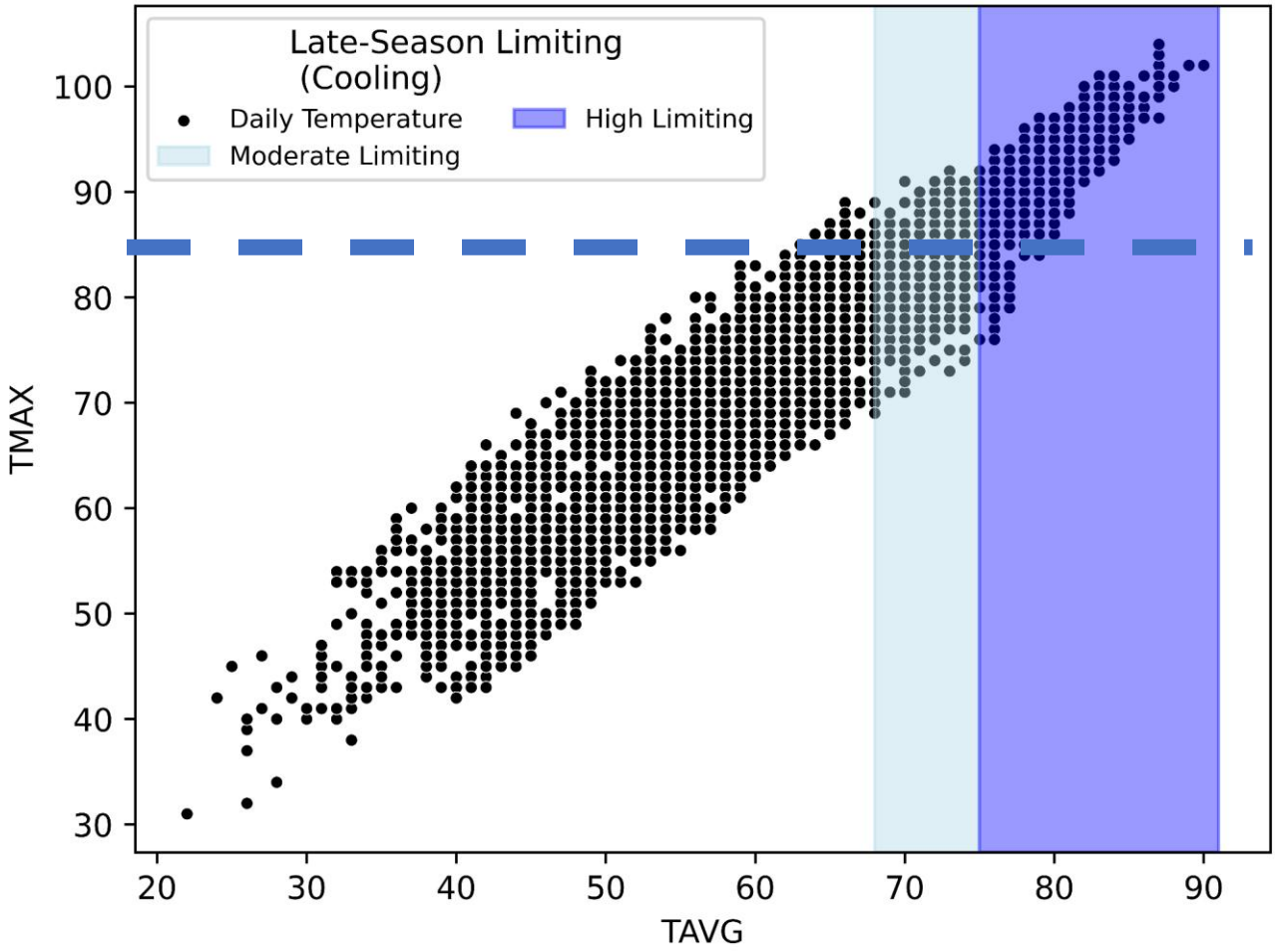


Temperature Thresholds for Cooling Season

These are households who forgo cooling until late in the summer (e.g., waiting a while to plug in window air conditioner units)

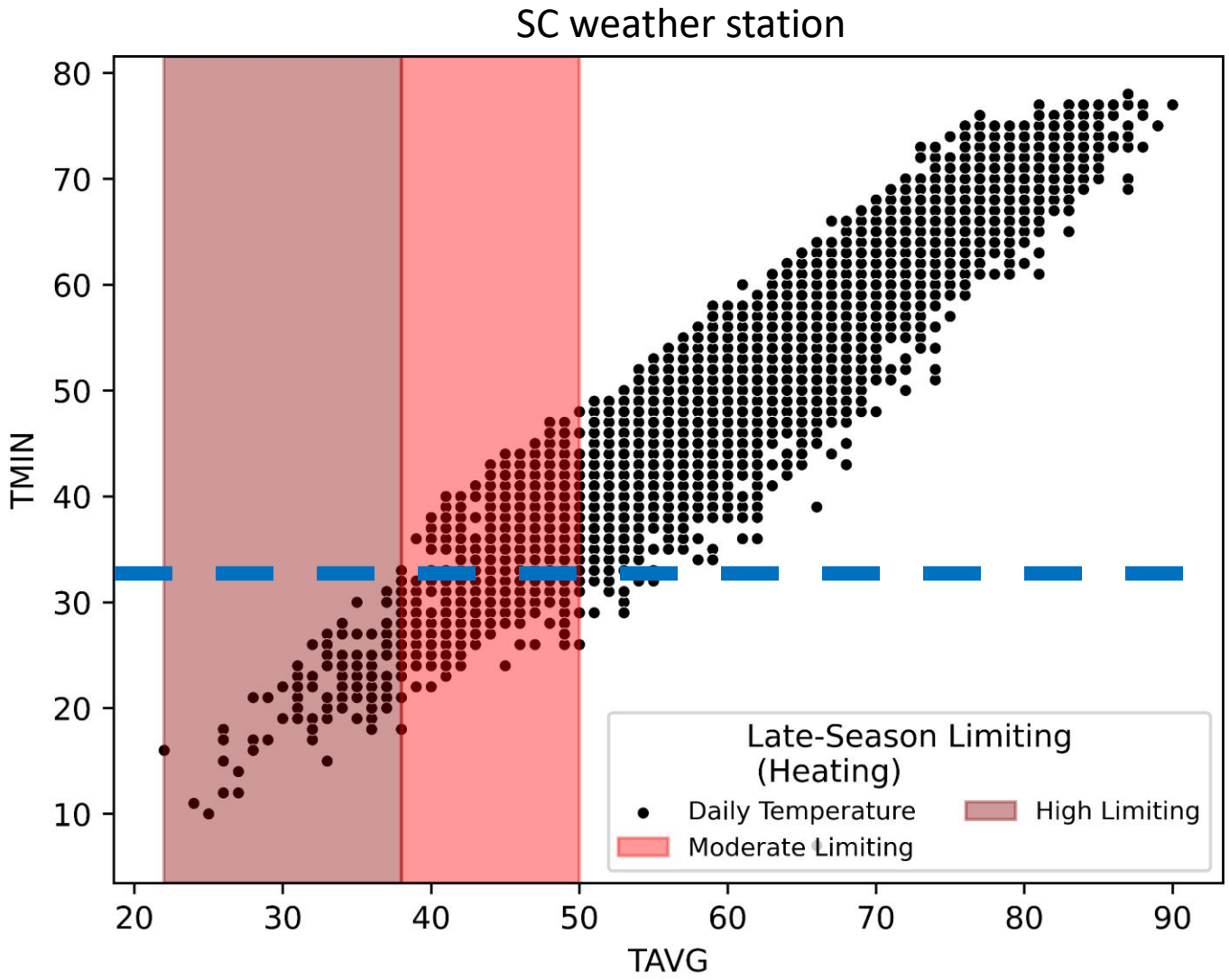


SC weather station

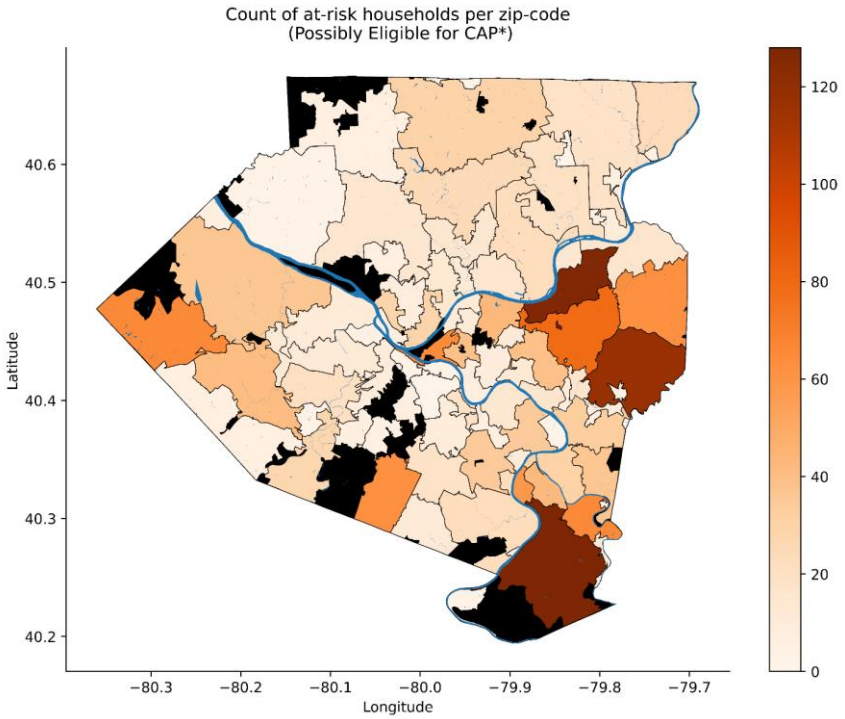


Temperature Thresholds for Heating Season

These can be households who are waiting late in winter season to turn on heat, or pull out space heaters



Our energy pilot has indicated that we are finding at-risk homes

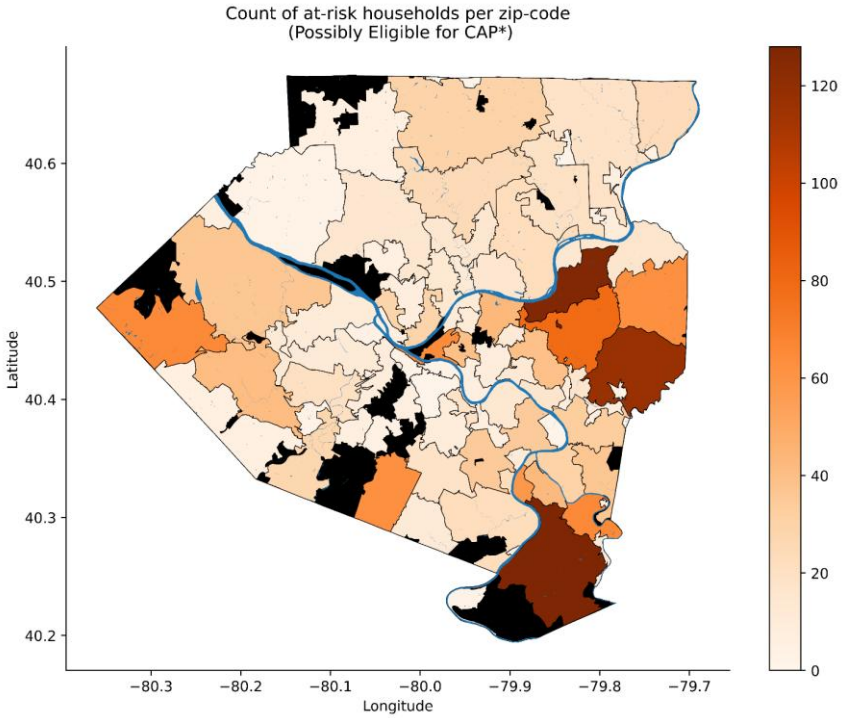


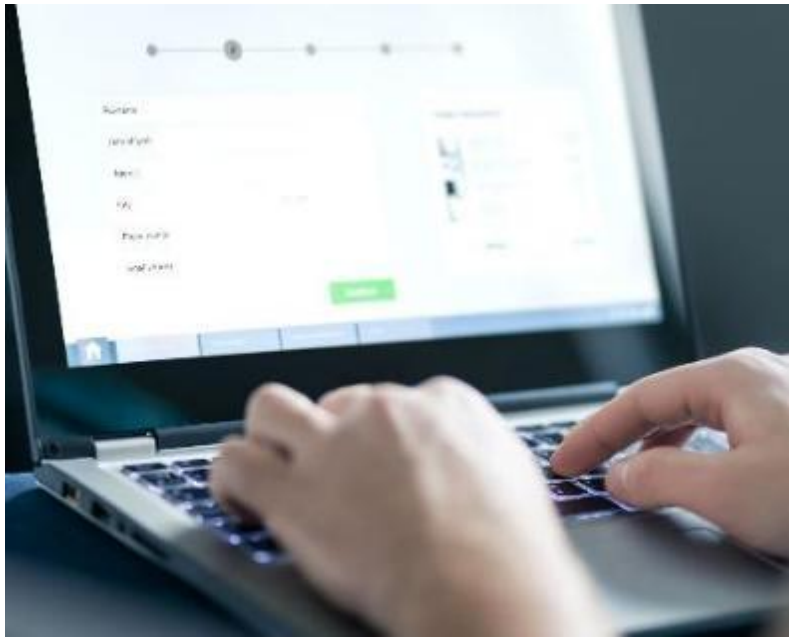
Out of **62,000 households**, we identified the 2,000 that had the most critical need.

- Identified households with a high energy burden or energy wallet share (percent of income spent on bill is greater than 6%) *
- Identified households that use so little heat they put themselves at pipe freeze risk.

*Note that a 2-4% electricity burden is a recommended target range. See MA Docket 24-15 and their low income energy burden targets.

Our energy pilot has indicated that we are finding at-risk homes





Out of **62,000 households**, we identified the 2,000 that had the most critical need.

We used **targeted marketing** to conduct outreach via digital channels (e.g., email)

The results – more than **doubled** customers enrolled in Customer Assistant Program for the tracked household group.

This works because we create distinct affordability at-risk **personas**.

Energy Deficit

Energy-limiting behavior early in the cooling/heating seasons.

Needs **energy-efficient appliances**.

Financial Deficit

Household spends high amount on their energy bills.

Needs **bill assistance.**

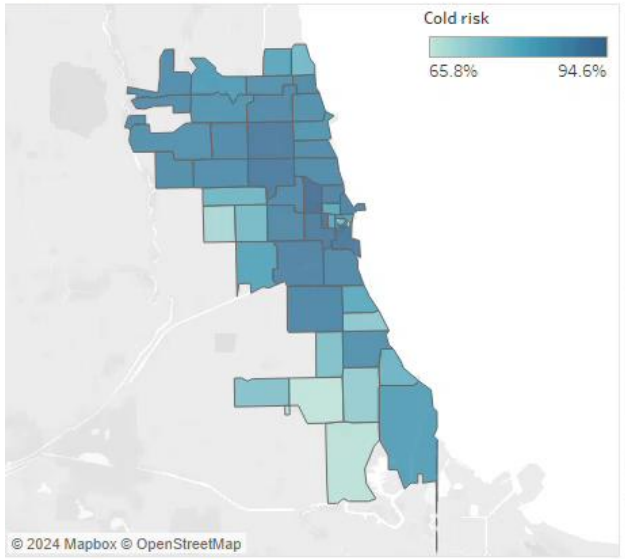
Infrastructure Deficit

Energy-limiting behavior throughout the cooling/heating seasons.

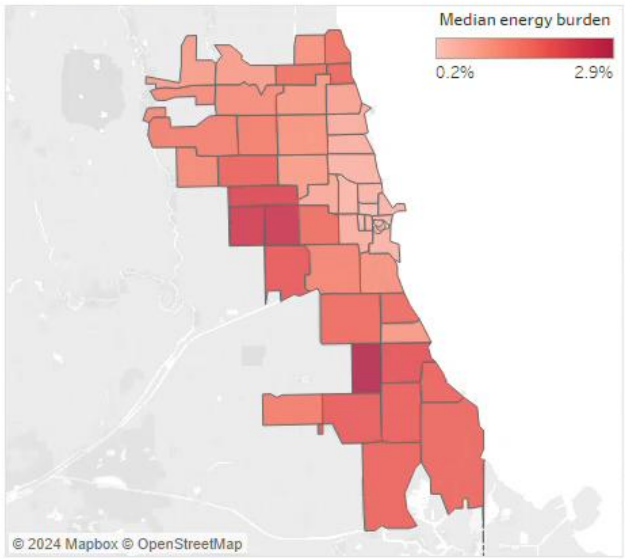
Needs **weatherization**, and/or **efficient appliances**.

We use a customer classification **dashboard** to help us categorize.

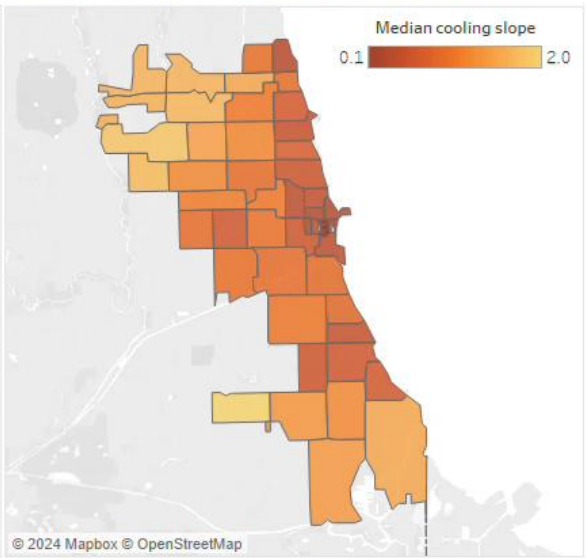
Zip codes to target to reduce cold risk



Energy burden



High risk regions lacking air conditioners



Accounts waiting till it's too cold to start heating

Hidden for Privacy

Accounts	
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
1001811	30
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1001811	30
1001811	30
1001811	30
1001811	30

Accounts with high energy burden

Hidden for Privacy

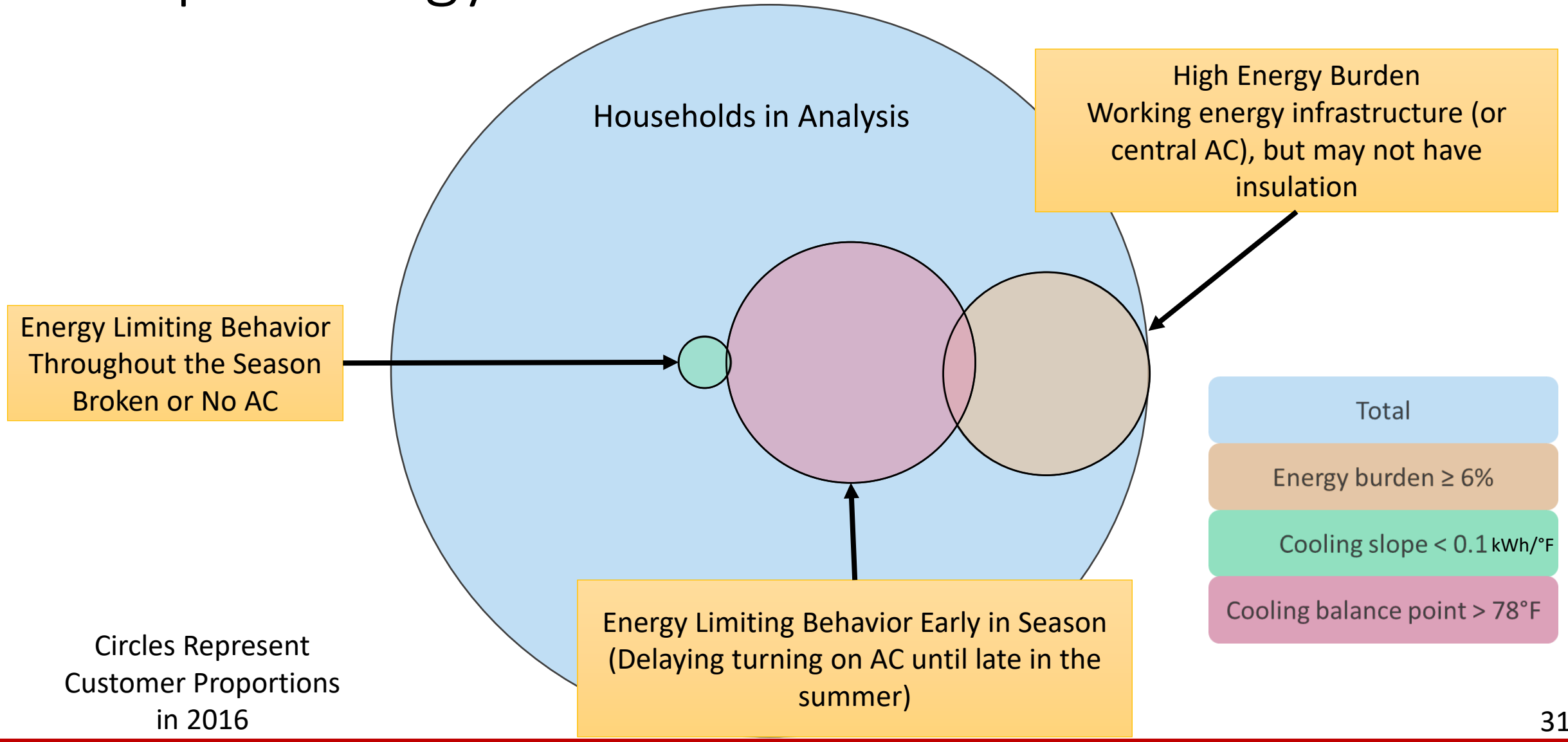
Account	
100190	16.9%
100185	16.5%
100189	14.6%
100185	14.2%
100190	14.2%
100184	14.0%
100189	13.7%
100183	13.7%
100184	13.6%
100182	13.4%
100186	13.3%
100183	12.9%
100182	12.4%
100188	12.4%
100181	12.4%
100190	12.2%
100185	12.1%

Low income households to target with cooling upgrades

Hidden for Privacy

Account	
100183	0.000
100189	0.000
100184	0.000
100190	0.000
100184	0.001
100182	0.001
100185	0.001
100189	0.001
100185	0.001
100190	0.002
100190	0.002
100182	0.003
100181	0.003
100182	0.003
100188	0.003
100187	0.003

Multiple Energy Insecurities



Circles Represent Customer Proportions in 2016

Integrated metrics into a heat pump analysis for the Salt River Project (SRP) region.

Does this technology allow people to be more cool in their homes during the summer while saving money?

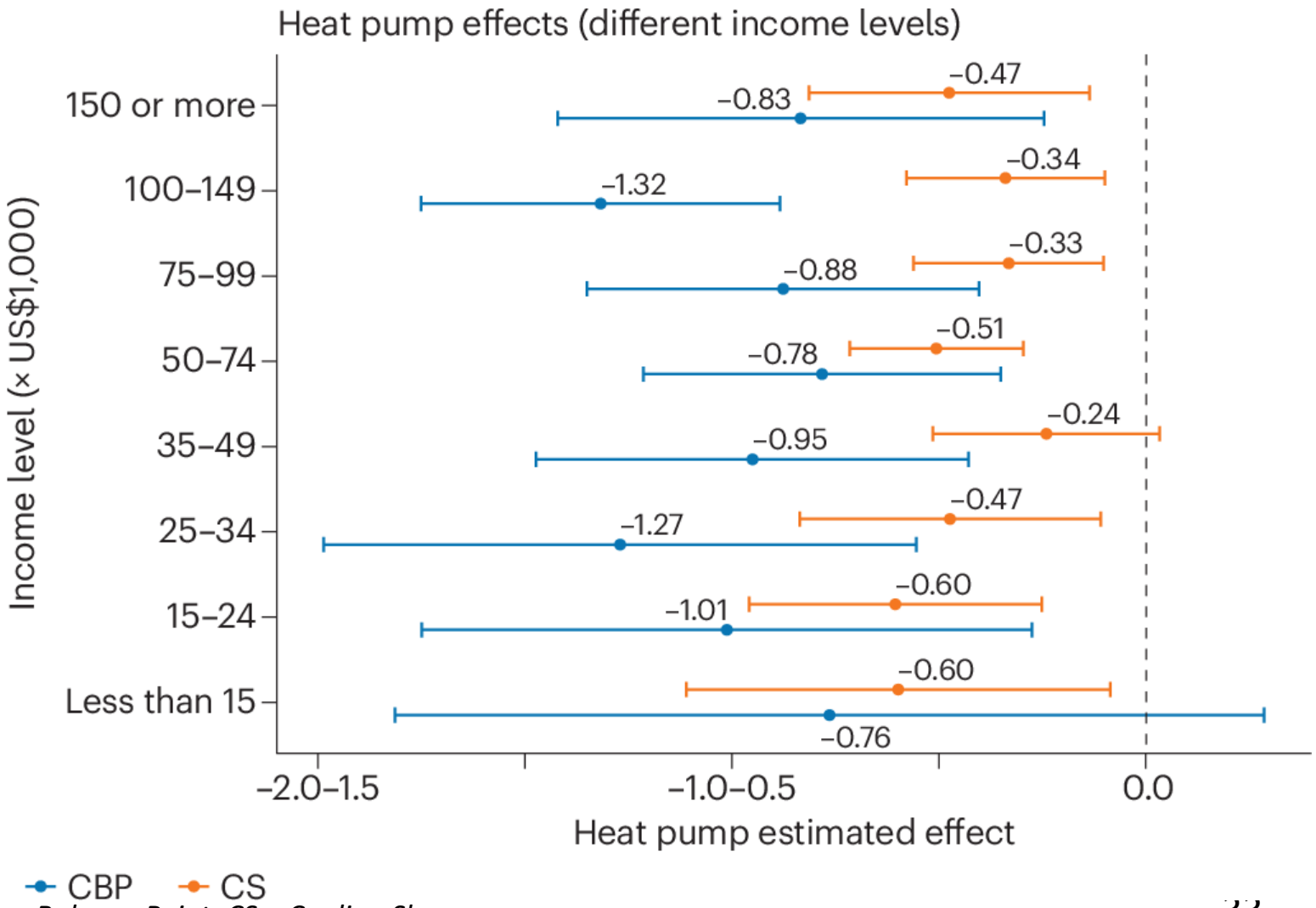
Incorporated these metrics into a heat pump analysis for SRP region in Arizona and found heat pumps deliver comfort + savings equitably across most income levels.

More negative cooling slopes signals earlier cooling activation or lower electricity use per °C rise.

Comfort Gains: Heat pumps lowered cooling balance points by **0.76–1.32 °C** across income groups — showing **consistent comfort benefits** and promoting **energy equity**.

Efficiency Gains: Improved cooling efficiency for nearly all income groups, saving about **0.45 kWh/day per °C** increase in temperature.

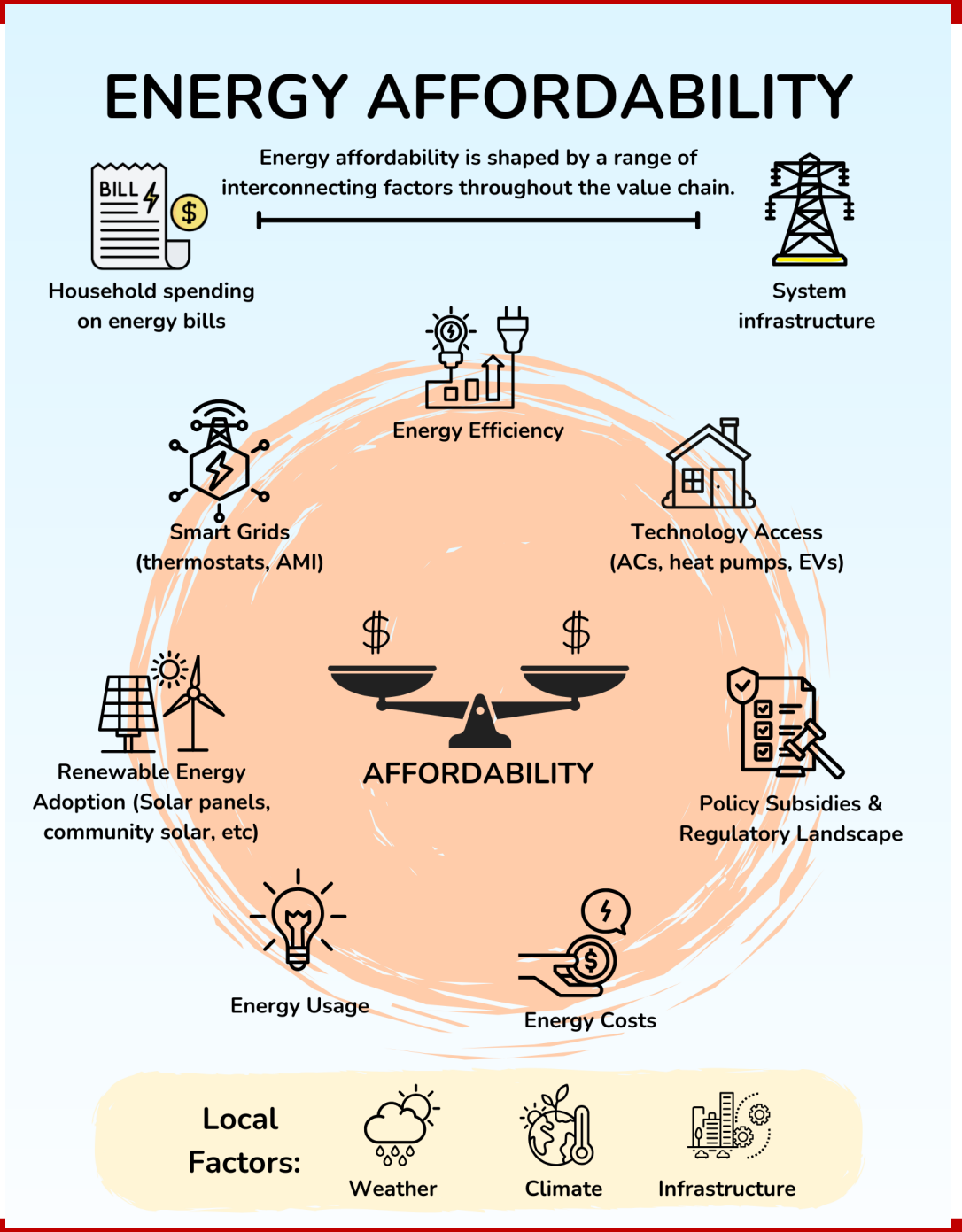
Source: (Ye et al., 2025). "Heat pumps can help alleviate residential energy insecurity in the USA:" https://www.nature.com/articles/s41560-025-01840-7



CBP = Cooling Balance Point; CS = Cooling Slope

A big part of the solution

- Integrate energy justice as a measure of energy transition success
- We need to move beyond income-based measures to holistically understand the multiple facets of energy affordability
- States and energy advocates need to push for the adoption of comprehensive definitions of energy affordability



The SPICE Team

Contact and Acknowledgements

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  - Website: www.PeoplesEnergyAnalytics.com
  - BlueSky: @Destenie

Peoples Energy Analytics

- Affordability Definition: *https://www.mass.gov/doc/defining-energy-affordability/download/*
- Ye, X., Qiu, Y. L., Nock, D., & Xing, B. (2025). Heat pumps can help alleviate residential energy insecurity in the USA: Energy equity. Nature Energy, 10(9), 1056-1057. https://www.nature.com/articles/s41560-025-01840-7
- Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. Energy Policy, 182, 113748.
- Kwon, M., Cong, S., Nock, D., Huang, L., Qiu, Y. L., & Xing, B. (2023). Forgone summertime comfort as a function of avoided electricity use. Energy Policy, 183, 113813.
- Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. Nature communications, 13(1), 2456.

Dr. Destenie Nock

Dr. Destenie Nock is an Associate Professor of Engineering and Public Policy and Civil and Environmental Engineering at Carnegie Mellon University. Dr. Nock is a leader in energy justice, environmental justice, sustainable energy transitions, and the energy-poverty-climate change nexus. She has pioneered new measures of energy poverty to help utility companies identify vulnerable populations and energy deficits (i.e., energy limiting behavior and forgone thermal comfort).

Dr. Nock is the Chief Executive Officer of Peoples Energy Analytics, a data driven company which uses energy analytics to identify energy poverty in vulnerable households. Dr. Nock received her PhD in Industrial Engineering and Operations Research from the University of Massachusetts Amherst, and two BS degrees in Electrical Engineering and Applied Mathematics from North Carolina A&T State University.