Green Warriors 2024: South Dallas Weatherization Pilot Final Impact Report

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Industrial, Manufacturing & Systems Engineering
University of Texas at Arlington (UTA)

Agenda

- About Me & An Energy Background
- Background & The Problem
- Program Design & Partners
- Data & Methodology
- Results & Key Findings
- Workforce Development
- Impact, ROI & Next Steps

Key Takeaway:
Targeted weatherization in South Dallas's most energy-burdened homes reduces bills, increases useful energy services, trains community workers, and gives the City data to scale.

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About Me &
An Energy Background

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Erick C. Jones Jr., Ph.D., P.E.
Assistant Professor, IMSE, REE
University of Texas at Arlington

- Born in Houston, raised in San Antonio, live in Fort Worth; Modern Texan Southerner
- Avid Traveler: Traveled all six habitable continents with only a backpack
- Enthusiastic Competitor: Sports, Board, Card, and Yard Games,
- Cosmopolitan Hobbyist: Drones, Vehicles, Photography
- Cultural Sampler: Museums, Opera, Theatre, Film, Music, Food
- Operations Research and Industrial Engineering, PhD; University of Texas at Austin
- Chemical and Petroleum (minor) Engineering, B.S. Texas A&M University
- 3 years in Oil and Gas and HVAC; Professional Engineer

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Why Texas? What is a UTA?

The energy and critical-mineral system I model is the one outside my window.

THE UNIVERSITY OF TEXAS AT ARLINGTON

TEXAS · ENERGY

#1

in U.S. energy and electricity production

13% of U.S. electricity · 43% of U.S. oil
#1 in wind AND utility solar

TEXAS · ECONOMY

57

Fortune 500 headquarters — more than any state

$2.9T economy — 8th in the world ahead of Canada, Russia & Italy
#1 in total exports

DALLAS – FORT WORTH

8.5M

4th-largest U.S. metro — bigger than 38 states

24 Fortune 500 HQs · AT&T, McKesson, American and Southwest Airlines, Caterpillar

UT ARLINGTON · R1 Institution

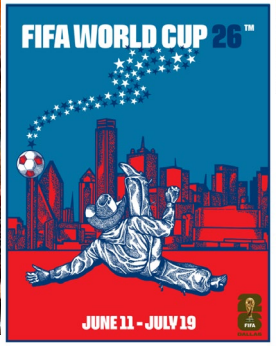
42,000

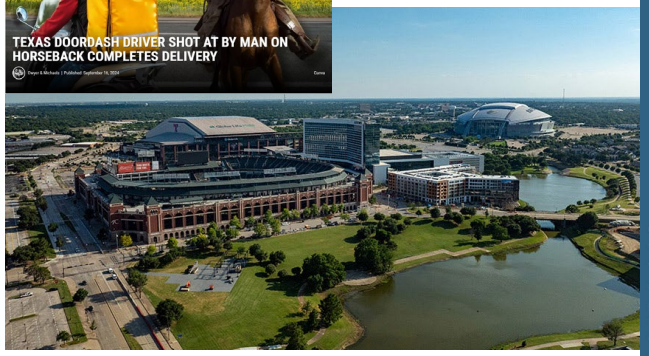
12x Wheelchair Basketball Champions
10 colleges/schools | 180 degrees

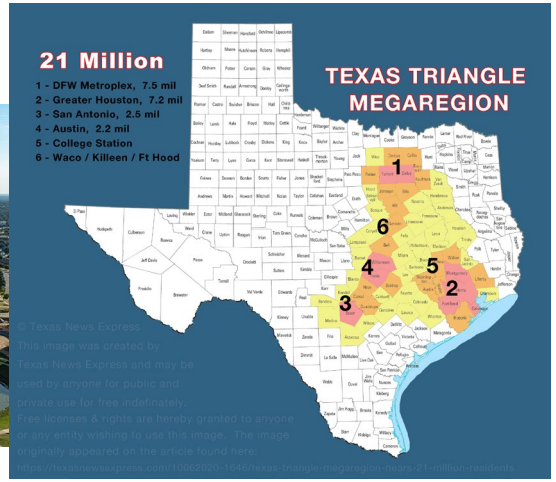
Only IE, CM, and Arch program in North Texas
#1 BS Nursing program in Texas, top public US

WHERE TEXAS RANKS AMONG THE 50 STATES

1	Electricity Produced	Oil & Natural Gas	Wind + Utility Solar	Refining Capacity	Total U.S. Exports	Fortune 500 HQs
2	Population	State GDP	Land Area	Manufacturing	Battery Storage	Registered EVs







Sources: U.S. EIA · U.S. Census Bureau 2025 estimates · Fortune 500 (2026) · UTA Office of Research & Innovation. [Photos: Arlington EDC, Texas Monthly].

Research, Teaching, and Service

Advance innovation to drive sustainable resource abundance that elevates the human condition; here and among the stars.

300+ students taught, 100+ supervised
$100+ M Sponsored Research, ~$1M as PI
50+ publications, 16 classes, 2 books

METHODS
Classic Engineering & Industrial Systems

Courses
- Probability and Statistics (IE 3301)
- Engineering Economics (IE 2308)
- Deterministic Operations Research (IE 3315)
- Stochastic Operations Research (IE 4315)
- Graduate Operations Research (IE 5301)

Projects
- Screwworm Trap Analytics (USDA)
- Naloxone RFID Tracking (Amneal)
- AI and Sustainable Infrastructure (NSF RET)
- Sidewalk Repair Program (Dallas)

APPLICATION
Energy & Critical Mineral Systems

Courses
- Energy Systems Modeling (REE 4301)
- Critical Mineral Supply Chain Modeling (IE 6301)

Projects
- Engineering for One Planet, EOP, Institutionalization Grant (Lemelson)
- Land Based Electrical Testing (ONR)
- HESM Workforce Training (ONR)
- Green Warriors Weatherization (Dallas)
- Unconventional Critical Minerals and REE

PEOPLE
Supervision & University Service

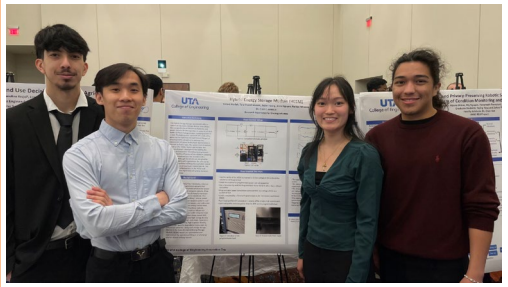
People Supervised:

4 PhD Students | 10 MS RAs & Fellows | 10 REUs | 100+ MS & OPTs Volunteers

- INFORMS Student Chapter Advisor
- NSBE Student Chapter Advisor
- GEM Fellowship University Rep
- Admission and Scholarship Committee
- Faculty Search and Hiring Committees

PROFESSION
External Service & Recognition

- IISE Energy Systems Director
- Tellimus/Green+ Board Member
- NATTBATT Track and Trace Committee
- Powerhouse Texas EPAC (2023-25)
- Green Careers Texas Board (2022-26)
- INFORMS ENRE Cluster Chair (2024-24)
- TEPRI Academic Advisor (2024-25)
- IEEE PES Taskforce (2022-24)
- DOE FACES Fellow (2024)
- BPC Energy and Climate Cohort (2024)







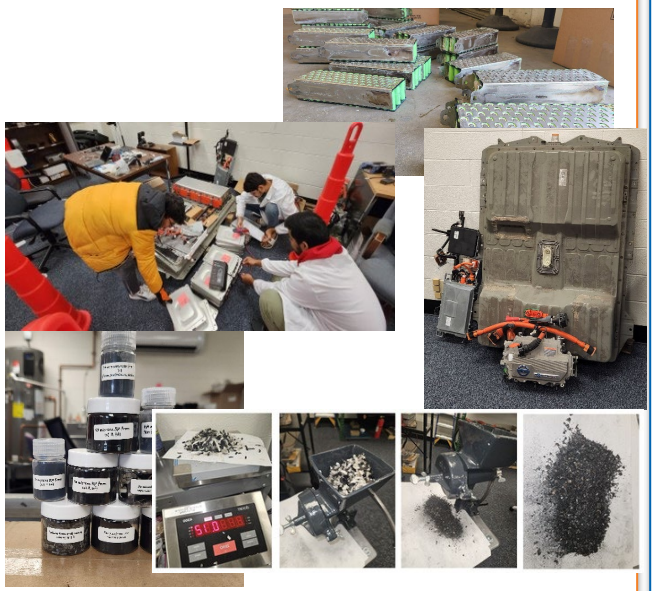
Research Areas

Mission: *Build the Integrated Infrastructure of the Future: Physical, Digital, Institutional*

SEAR LAB
Sustainable and Efficient Allocation of Resources

PHYSICAL INFRASTRUCTURE
Energy & Critical Mineral Systems

- 500+ kWh of recovered EV batteries
- Commercial Quality Lithium-Ion Batteries
- Electrical, Chemical and Powder Analysis
- Material Reduction: Shred, Grind, Sieve
- Reuse cells, 3D print, Recover metal
- Microgrid w/ Repurposed EV LIBs and Solar
- 3R-BET: Remanufacturing, Repurposing, Recycling; Battery and Energy Technologies



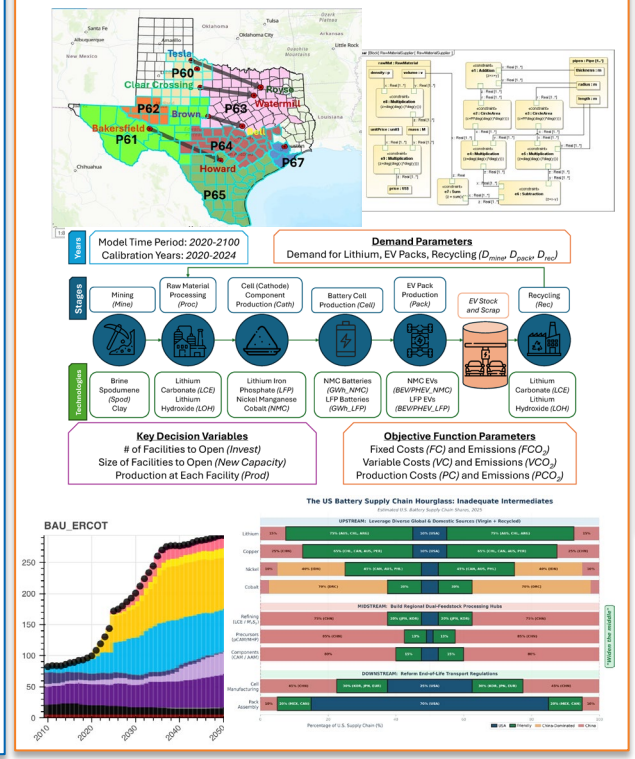
PHYSICAL → DIGITAL
RFID-Enabled Digital Twins

- Radio Frequency Identification (RFID)
- RFID Equipment and Software
- Real Time Location System (RTLS)
- Blockchain
- Solar-powered Energy Emulation
- Circular Conveyor System, Robotic Arm
- Operational Hospital Beds w/ RFID

DIGITAL INFRASTRUCTURE
Computational Modeling & Analytics

- Trustworthy Decision Making
- Composed Surrogate Optimization
- Systems Modeling, Data Analytics
- Optimization, AI/ML, DOE, MBSE, DES, ABM
- Supply Chain & (Reverse) Logistics

Cited in IPCC AR6, Working Group III



INSTITUTIONAL INFRASTRUCTURE
Efficient Rule-Making & Enforcement

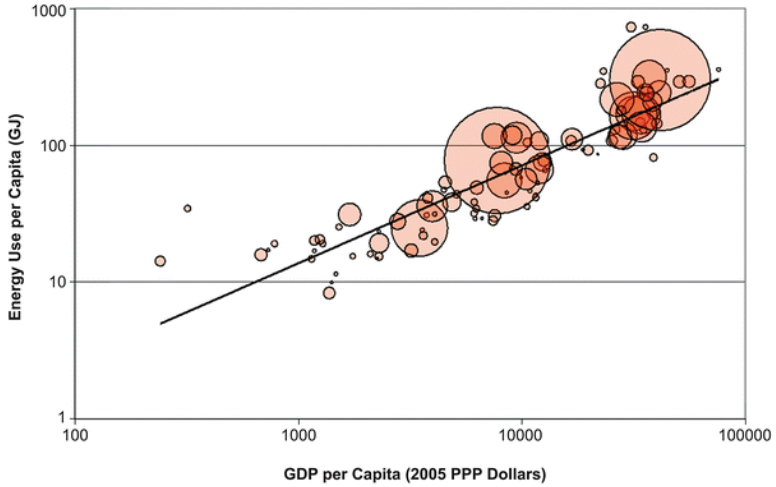
- Organization Structure
- Democratizing Analytics
- Non-partisan Policy
- Community Analytics
- Person-scale Impacts

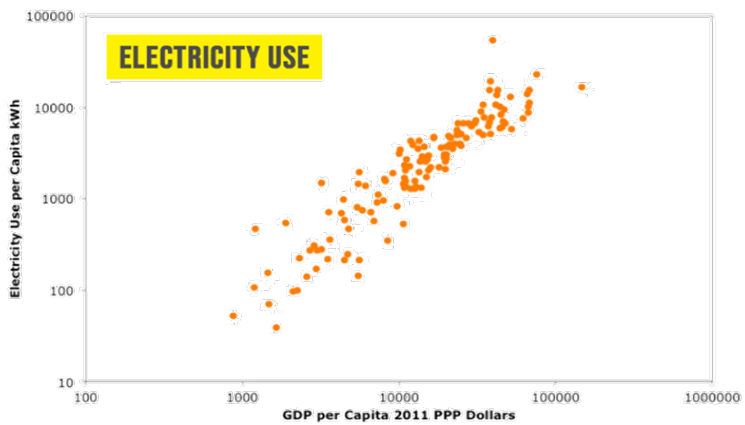
IN THE NEWS
Green Warriors Weatherization S. Dallas

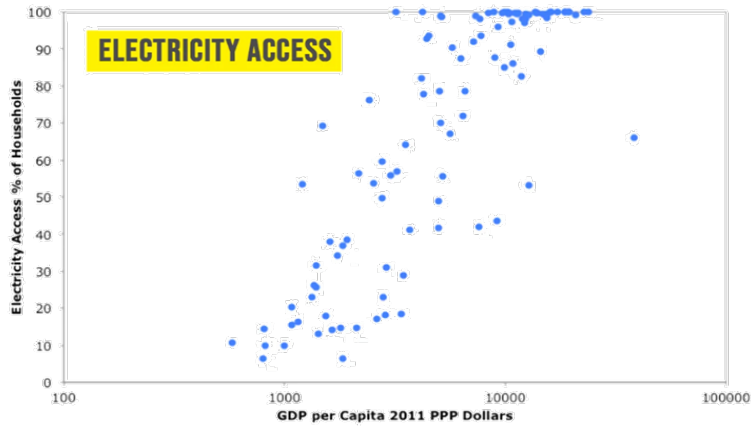
- WFAA-TV (ABC), July 2026
- The Dallas Morning News, June 2026

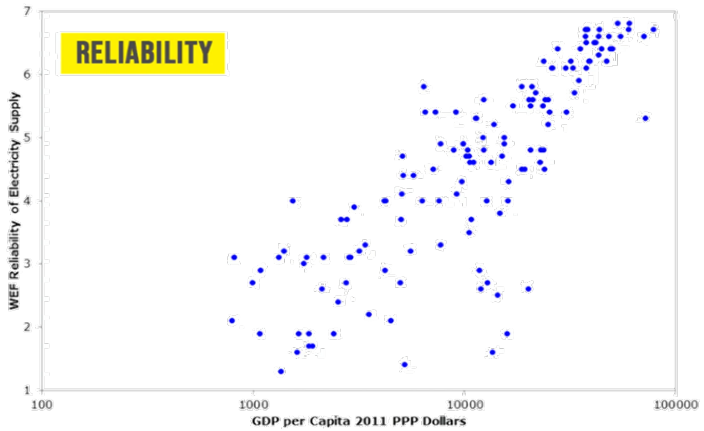
Director: Erick C. Jones Jr., Ph.D., P.E. | erick.jones@uta.edu | https://searlab.uta.edu/

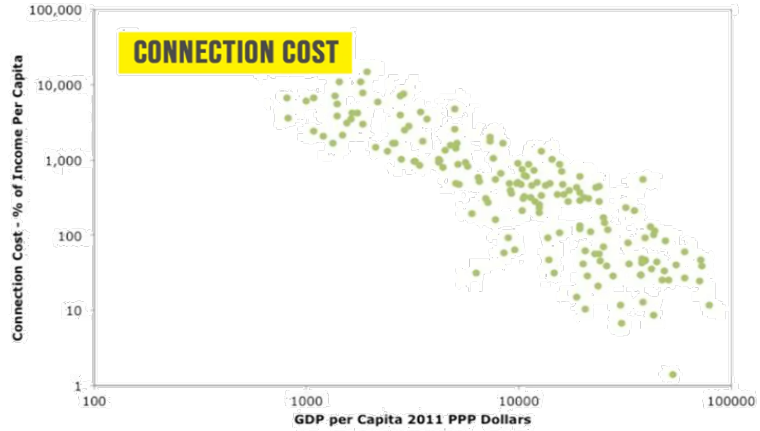
Relationship Between Energy and GDP











"The Impact of Electricity on Economic Development: A Macroeconomic Perspective" David I. Stern, Paul J. Burke & Stephan B. Bruns.

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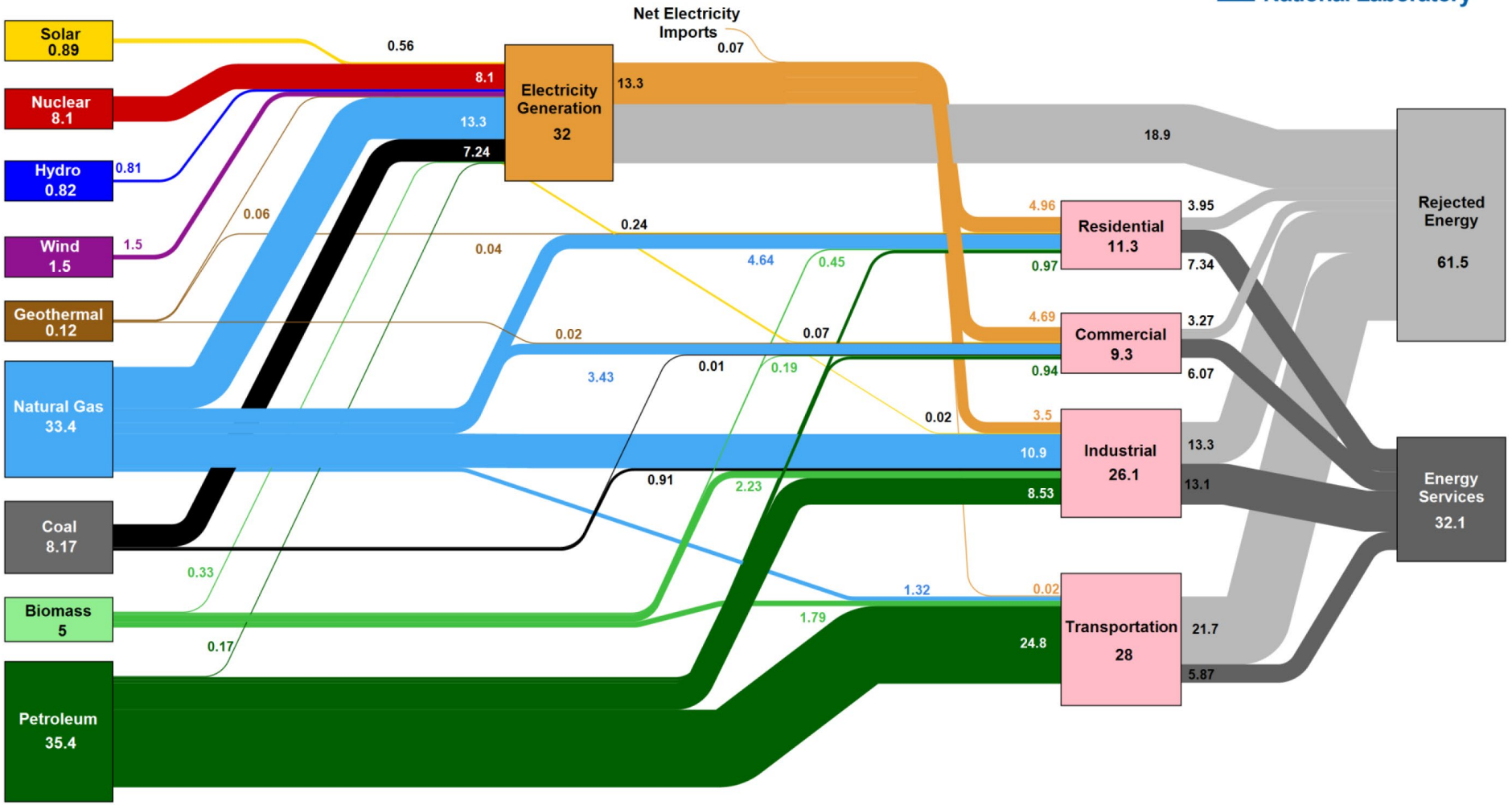
Estimated U.S. Energy Consumption in 2023: 93.6 Quads

Lawrence Livermore National Laboratory



Source: LLNL October, 2024. Data is based on DOE/EIA SEDS (2024). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 49% for the industrial sector, and, 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

10^{15} BTU = Quad
3412 BTU = 1 kWh
3519 BTU / car VMT
10^{4} kWh / US house
10^{4} PMT / house
10^{8} homes / Quad
10^{11} PMT / Quad

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The Energy Material System vs. The Fossil Fuel System

2050: The energy materials system vs. **2022: The fossil fuel system**

Up to **13 billion tonnes** of waste rock produced from all energy transition materials (stored on-site)

0.3 billion tonnes of materials in clean energy technologies

This is around the same amount of waste rock currently produced by all copper mining.

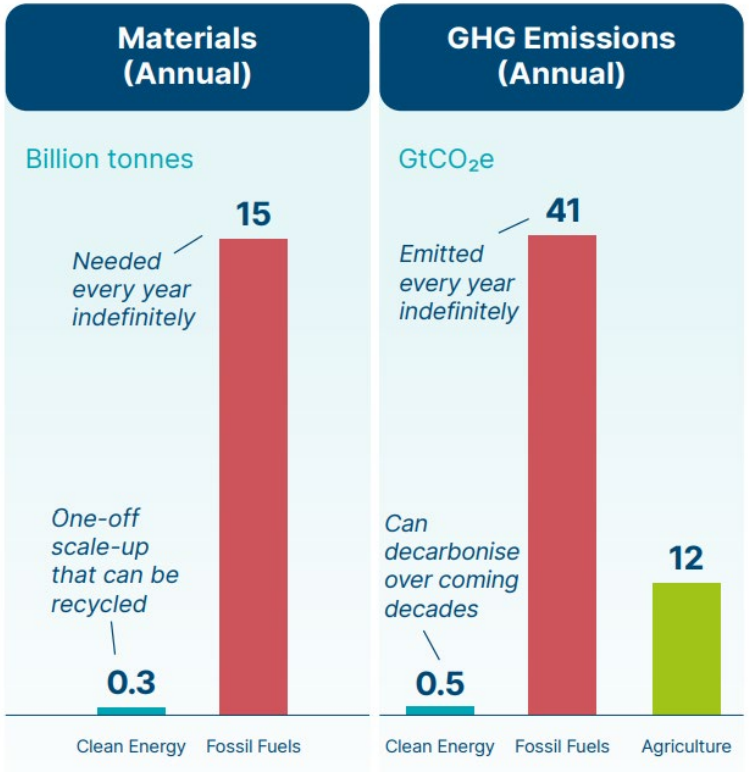
5 billion tonnes of oil

8 billion tonnes of coal

3 billion tonnes of gas

15 billion tonnes of fossil fuels (30% of which is internationally traded)

2 billion tonnes of waste rock and tailings from coal mining



SEAR LAB
Sustainable and Equitable Allocation of Resources Lab

UTA THE UNIVERSITY OF TEXAS AT ARLINGTON

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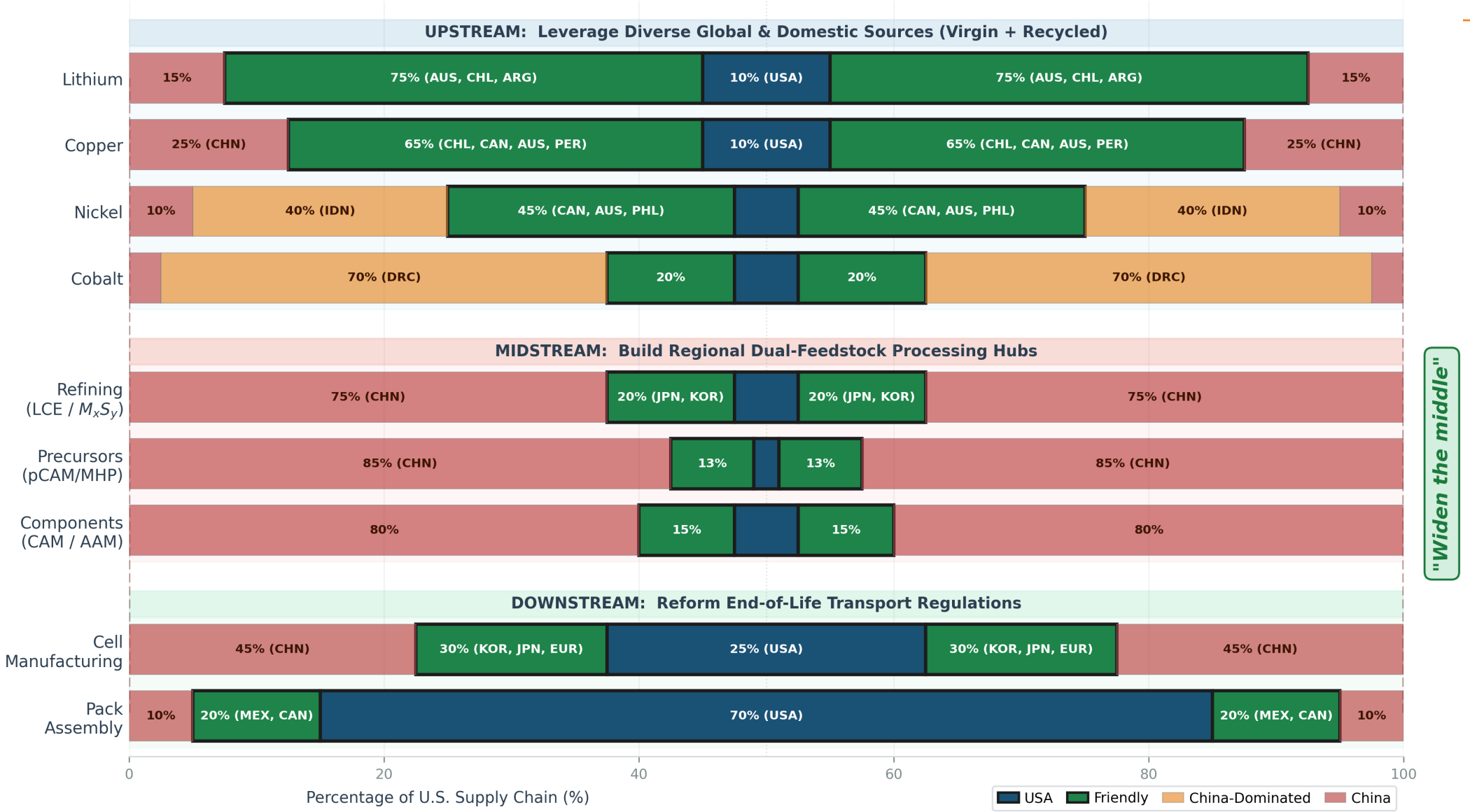
The US Battery Supply Chain Hourglass: Inadequate Intermediates

Estimated U.S. Battery Supply Chain Shares, 2025



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Background & The Problem

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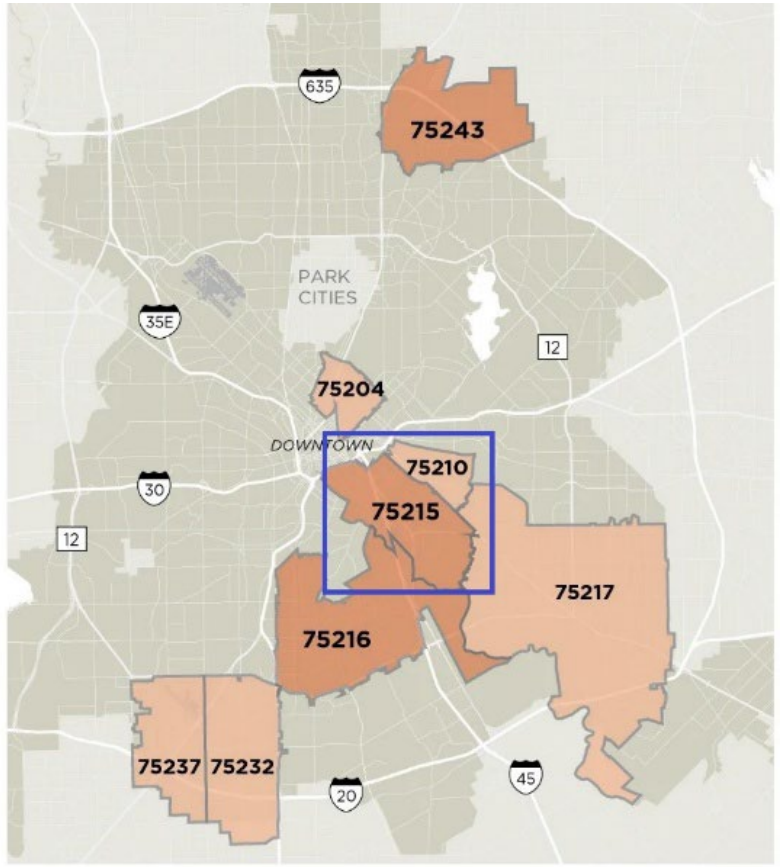
Energy Burden Reality: Who Lives Here?

- Zip codes 75210 and 75215 — the two lowest-income zip codes in Dallas
- Over 50% of households live below the federal poverty level (vs. 15.5% statewide)
- Residents spend 40–60% of monthly income on housing costs
- All homes are located in Justice 40 census tracts exceeding 5+ Disadvantaged Community criteria
- Homes are predominantly pre-1965 construction, under 1,100 sq ft, with no functional attic insulation
- Residents are overwhelmingly senior citizens (65+) earning under $24,010/year
- Per-square-foot energy spending is ~50% above the Dallas average — significant waste from building envelope failures
- Despite above-average per-sq-ft costs, total consumption is below average — residents are curtailing use to manage bills



SOURCE: *Dallas Morning News* research Laurie Joseph/Staff Artist

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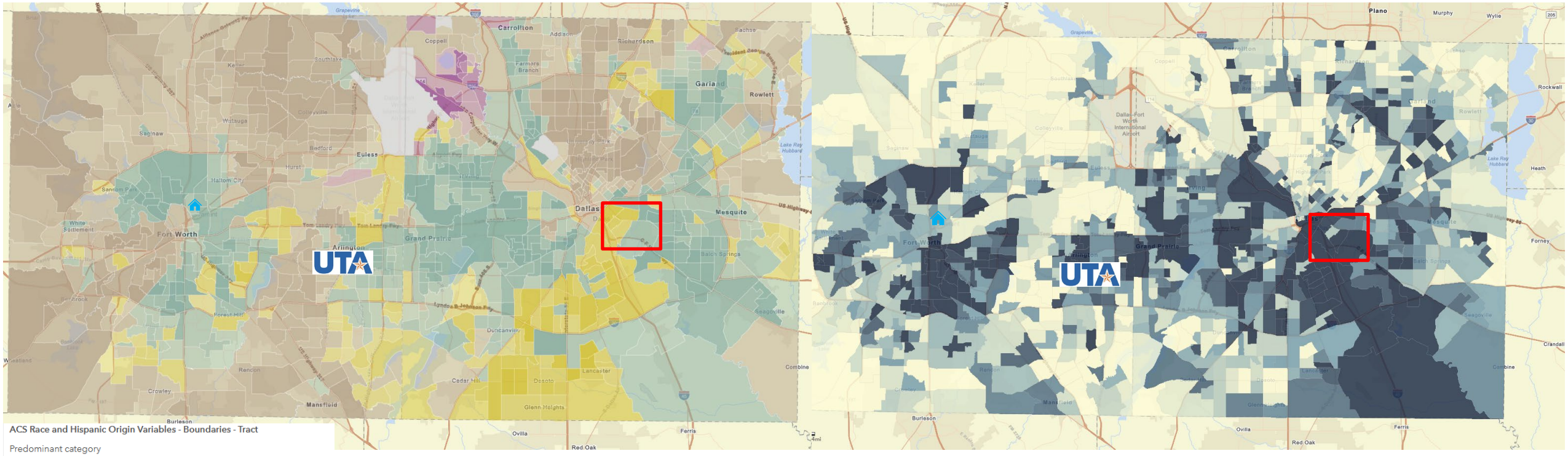
DFW Spatial Socioeconomics



ACS Race and Hispanic Origin Variables - Boundaries - Tract

Predominant category

- White alone, not Hispanic or Latino
- Hispanic or Latino
- Black or African American alone, not Hispanic or Latino
- Asian alone, not Hispanic or Latino
- American Indian and Alaska Native alone, not Hispanic or Latino
- Two or more races, not Hispanic or Latino
- Native Hawaiian and other Pacific Islander alone, not Hispanic or Latino
- Some other race alone, not Hispanic or Latino
- Tie/No Value

Strength of predominance

- > 85
- < 15

Dallas (Dallas County): 1.3M, 9th largest city

ACS Poverty Status Variables - Boundaries - Tract

Percent of Population whose income in the past 12 months is below poverty level

- > 22
- 13
- < 4

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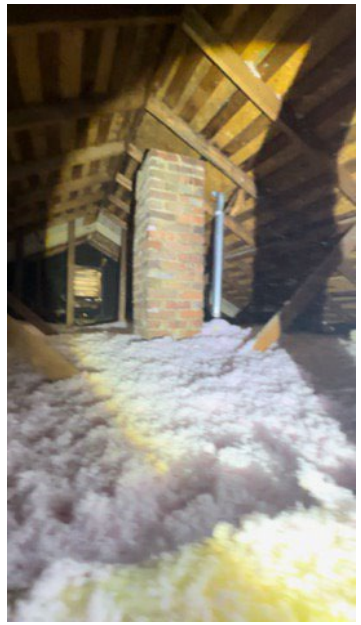
Home Conditions



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Why Existing Programs Don't Reach These Homes

- **WAP (Weatherization Assistance Program) disqualifications:**
  - Health & safety deferrals: mold, foundation sagging, rotting wood
  - Failed HVAC, electrical, or plumbing systems — must be fixed before weatherization
  - Roofing deficiencies that prevent attic work
- **Dallas County Health & Human Services defers ~10% of WAP applicants annually**
- **Financial barriers compound the gap:**
  - Median credit scores below 600 in these zip codes — loans are not an option
  - Residents largely unaware that weatherization assistance exists
- These homes need targeted interventions before standard programs can reach them

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Program Design & Partners

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Program Goals: Four Objectives

- **1. Lower Energy Bills**
  - Reduce monthly electricity costs for residents in the most disadvantaged census tracts
- **2. Prove the Concept**
  - Demonstrate that targeted weatherization works in homes WAP cannot currently reach
- **3. Create Living-Wage Work**
  - Build a community-based weatherization workforce for neighborhood residents
- **4. Provide the City with Data to Scale**
  - Deliver granular, temperature-contextualized evidence to support program expansion
- Whether savings show up as lower bills OR increased comfort, the program delivers value

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The Interventions: $3,750 per Home

- **Total investment: $26,250 across 7 homes ($3,750 each)**
- **1. Attic Insulation — $2,850/home**
  - Blown-in insulation to replace worn-out or nonexistent attic insulation
  - Primary driver of heating and cooling savings
- **2. Air Sealing — $750/home**
  - Caulking of doors and windows to reduce air leakage
- **3. LED Lighting — $150/home**
  - Replacement of incandescent bulbs with LED equivalents
- Expected efficiency improvement: 10–40% reduction in energy waste
- Value delivered as EITHER savings OR comfort — both represent program success (rebound effect is a feature, not a flaw)

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Partners & Collaborators

- **City of Dallas — Office of Environmental Quality & Sustainability (OEQS)**
  - Rosaerlinda Cisneros (current lead); relationship active since 2021 across leadership transitions
- **Southern Dallas Progress CDC**
  - James McGee & Stacy Rosenthal — community outreach, resident recruitment
- **Green Warriors**
  - Lance Smith & Robert Jenkins — performed all weatherization work
- **Green Careers Texas**
  - Tracy Wallace — workforce training coordination
- **St. Philip's School & Community Center**
  - Nicole Raphiel — community engagement and resident connections
- **UTA SEAR Lab**
  - Erick C. Jones Jr., PhD — data analysis, reporting, and program evaluation

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Data & Methodology

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Data & Methodology

- **Pre-Intervention Utility Bills:**
  - Monthly electricity and gas bills for all 7 homes, January 2023 – August 2024
  - Cost per kWh ranged $0.18–$0.28; modal rate of $0.22/kWh used for all savings estimates
- **Post-Intervention Smart Meter Data:**
  - 15-minute interval data for all 7 homes, late 2023 – April 2026
  - Aggregated to daily and monthly totals; smart meter data prioritized where overlap exists
- **Year-Over-Year Comparison Window:**
  - January–September 2024 vs. January–September 2025 (primary savings metric)
- **Outlier Treatment:**
  - Home 3: 78% reduction — consistent with vacancy, reported separately
  - Home 5: 18% increase — under investigation, reported separately
  - All statistics presented with and without outlier homes
- Temperature data from National Weather Service DFW to contextualize weather effects

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Results & Key Findings

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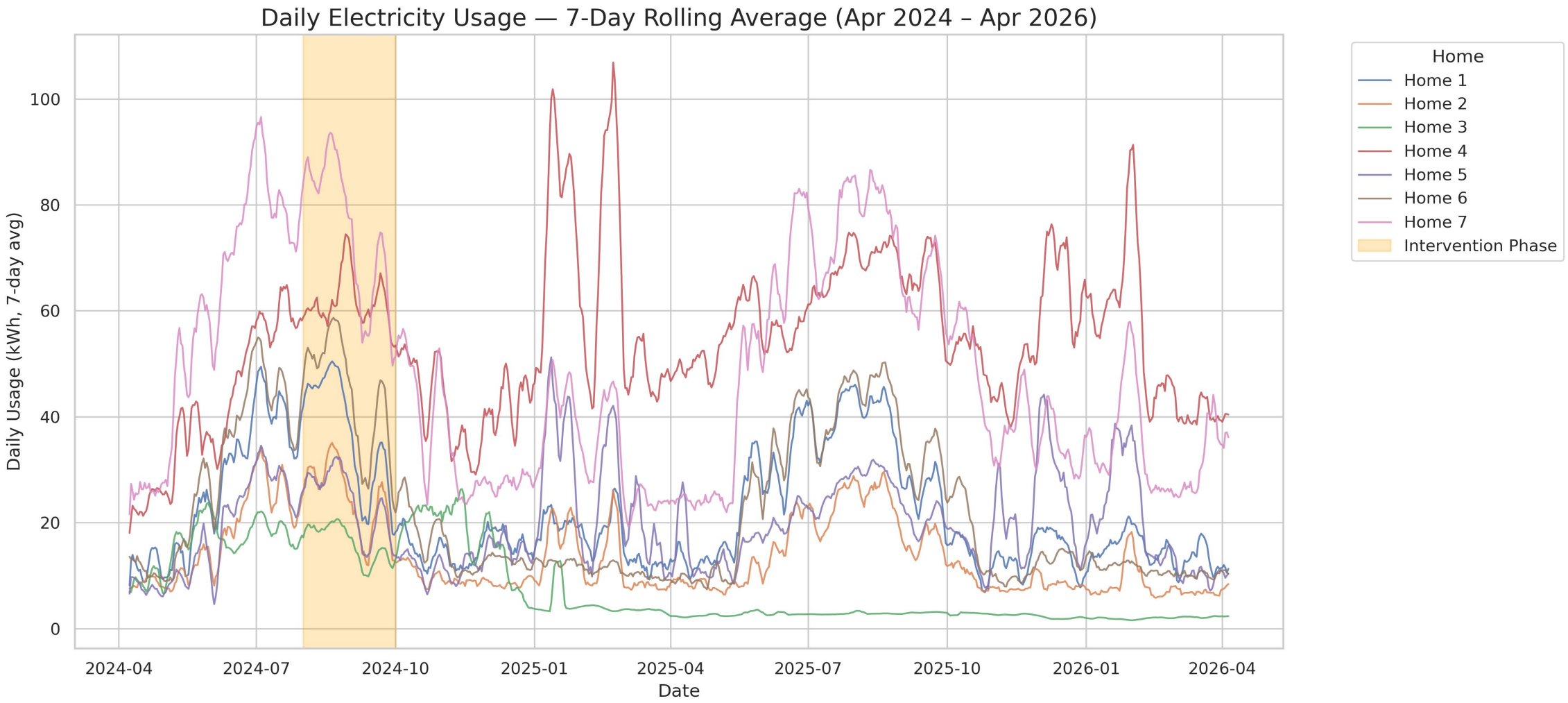
Daily Electricity Usage Trends



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Headline Findings

- 10.0% program-level energy reduction (Jan–Sep 2024 vs. 2025, all 7 homes)
- 7.3% reduction excluding the two outlier homes (Home 3 & Home 5)
- ~$225/home/year average estimated savings for the 5 non-outlier homes
- Home 4 led with 13.4% reduction — estimated $780/year savings, payback under 5 years
- These estimates are conservative: Dallas was ~2°F cooler in 2025 than 2024 — savings occurred despite naturally lower demand
- **The rebound effect is a positive sign:**
  - Several homes used MORE energy post-weatherization, especially in summer
  - This reflects residents accessing comfort (AC, heating) they previously could not afford to run
  - More energy services per dollar = real improvement in quality of life and safety
- All 5 non-outlier homes showed net positive results; no home was made worse by the intervention

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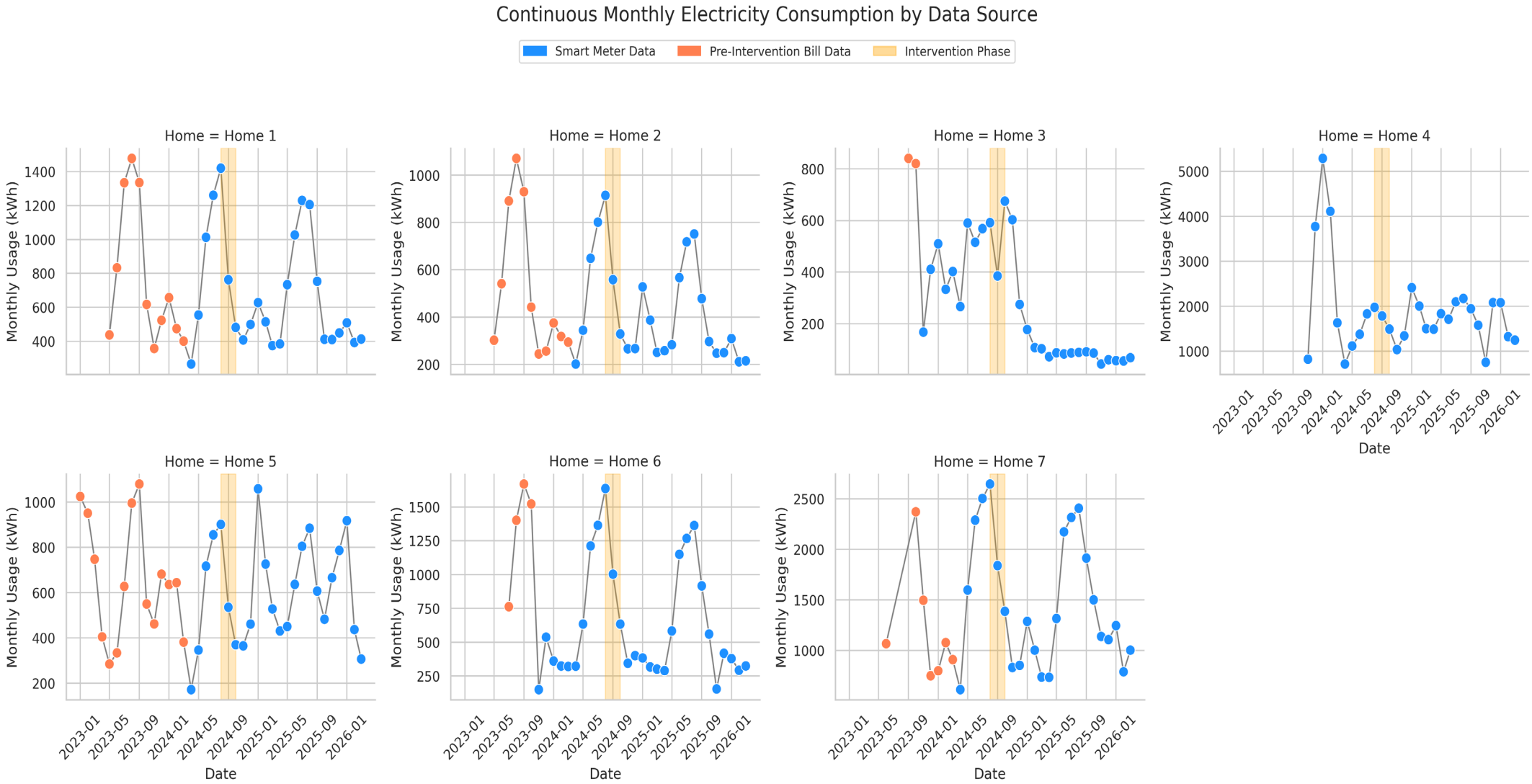
Continuous Monthly Timeline



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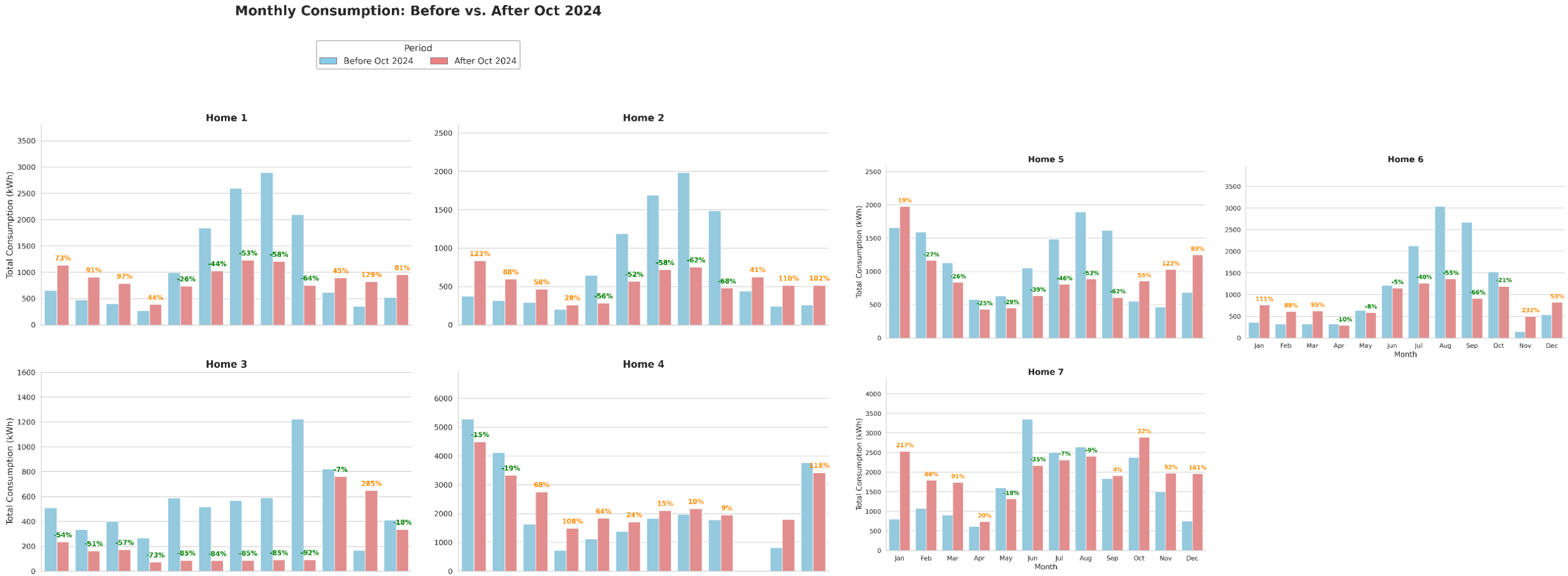
Household Monthly Consumption



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Home-by-Home Results

- Home 1 — +0.6% (Essentially flat)
  - 819 sq ft, lowest pre-intervention consumption; already relatively efficient
- Home 2 — −5.3% overall | Summer −14%, Winter +15%
  - Clear seasonal pattern: resident now heating the home more effectively in winter
- Home 4 — −13.4% (Star Performer) | 2,658 kWh saved | $780/year
  - Highest consumer in pilot; Winter −38%, Summer +24% rebound; payback <5 years
- Home 6 — −8.4% (Most Balanced) | Summer −10%, Winter −11%
  - Improvements across both seasons without significant behavioral rebound
- Home 7 — −2.7% | Summer −9%, Winter +27%
  - 14,281 kWh baseline; strong winter rebound = resident now heating home effectively
- Home 3 (Outlier) — −78%: Usage dropped to near-zero — likely vacant
- Home 5 (Outlier) — +18%: Increase despite milder weather — under investigation

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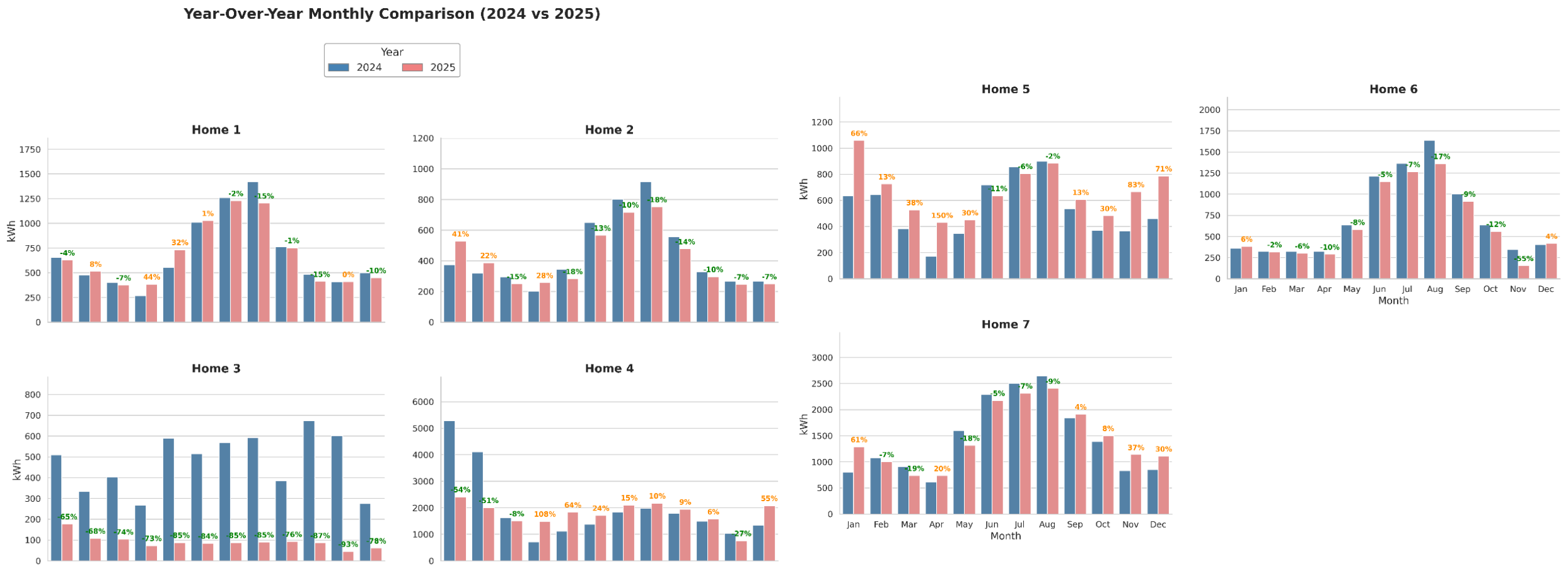
Year-Over-Year Monthly Comparison



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Seasonal Patterns: Winter Savings, Summer Rebound

- **Winter (Nov–Feb) Analysis:**
  - Insulation gains are most visible in winter heating reductions
  - Home 4: −38% winter; Home 6: −11% winter; Home 2: +15% (heating more effectively)
- **Summer (May–Aug) Analysis:**
  - Summer changes reveal the rebound effect — residents using AC they previously avoided
  - Home 4: +24% summer; Home 7: Summer −9% efficiency gain
- **Key insight from the seasonal comparison chart:**
  - Homes with winter reductions + summer increases = classic weatherization success
  - Improved envelope made heating and cooling effective for the first time
  - The "lost" summer savings represent gained comfort and health safety — a benefit, not a cost
- Program-level: net reduction holds in both seasons for non-outlier group
- Winter confirmed as the primary driver of measured energy savings

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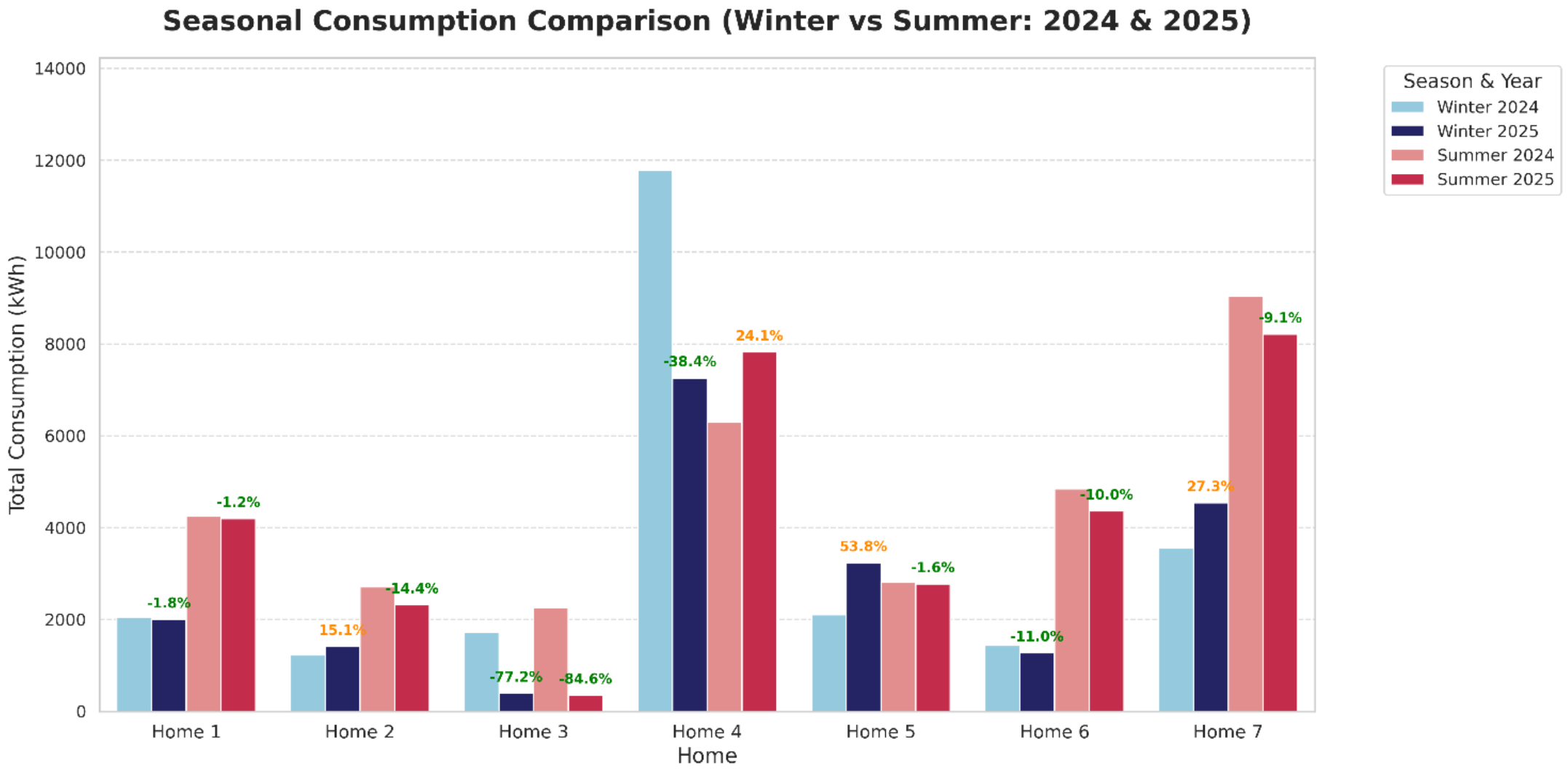
Seasonal Consumption Comparison



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The Rebound Effect: A Positive Outcome

- **What is the rebound effect?**
  - Post-weatherization energy use increases when improved efficiency enables residents to consume more
- **Why it happened here (and why it's good):**
  - Before: Poor insulation meant AC ran constantly but cooled ineffectively — residents rationally avoided it
  - After: Insulation made cooling effective; residents could actually cool their homes in Dallas summers
  - Result: Higher kWh, but dramatically better comfort, health outcomes, and indoor safety
- **What the rebound effect means for program value:**
  - Energy burden reduction is real even when bills don't drop — residents get more per kWh
  - A pre-weatherization dollar might buy 30 min of cooling; now it buys hours of climate control
  - Risk of weather-related hospitalization (heat stroke, hypothermia) is reduced
- **Research context:**
  - The rebound effect is well-documented in energy efficiency literature
  - It represents improved quality of life, not efficiency failure

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Temperature Context: Why Savings Are Conservative

- **Dallas 2025 was ~2°F cooler than 2024 in both winter and summer:**
  - February 2025 was 8.4°F cooler than February 2024
  - August 2025 was 3.4°F cooler than August 2024
  - Winter avg: 52.1°F (2025) vs. 54.0°F (2024); Summer avg: 81.9°F (2025) vs. 83.9°F (2024)
- **This matters for interpreting results:**
  - Homes showing reductions achieved them with naturally lower heating/cooling demand — savings are understated
  - Homes showing increases (like Home 5) did so despite milder weather — increases are behavioral, not weather-driven
- **Conservative estimate framing:**
  - Had 2025 matched 2024 temperatures, measured savings would be larger
  - The 7–10% program reduction likely understates the true weatherization impact
  - Future analyses should use temperature-normalized (HDD/CDD) methods
- Energy usage vs. temperature overlay confirms strong correlation and visible weatherization gap

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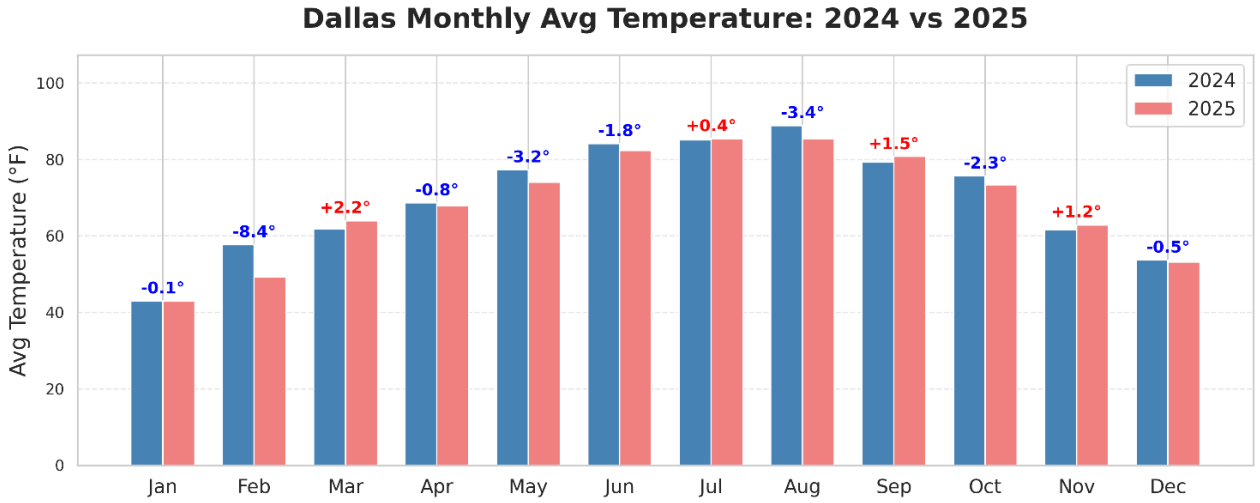
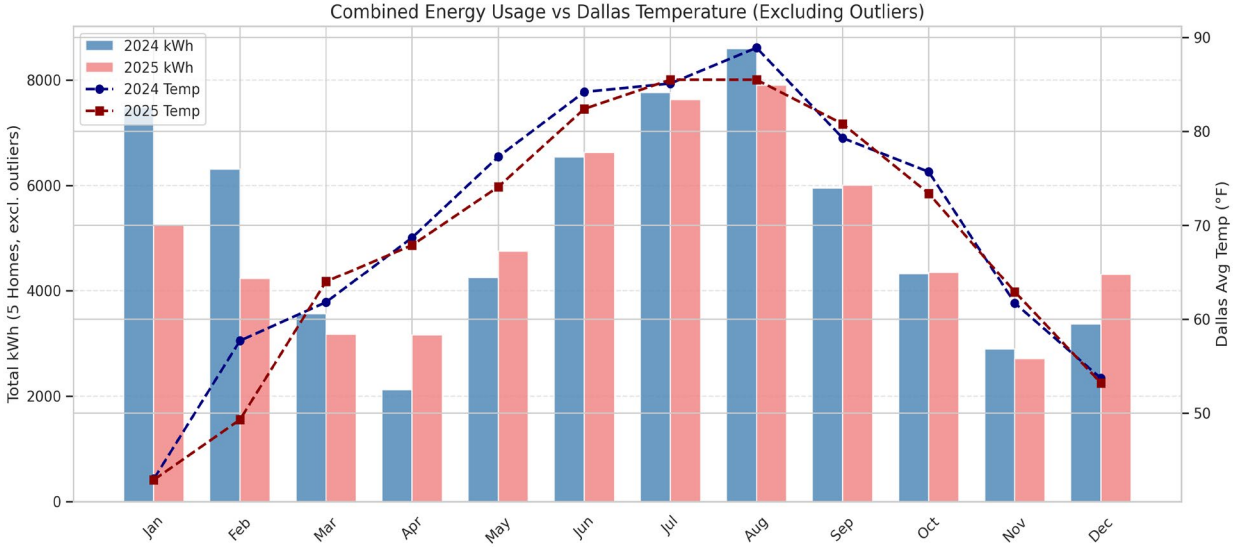
Temperature Context





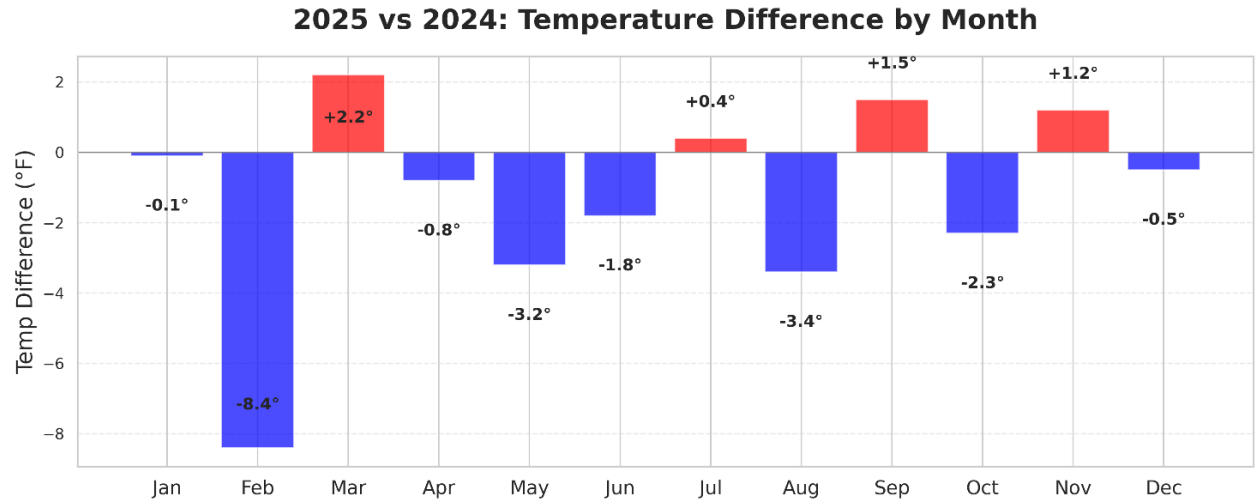


Table 1: Seasonal Average Temperature (°F)

Season	2024 Avg °F	2025 Avg °F	Difference
Summer (May–Aug)	83.9	81.9	-2.0°F (cooler)
Winter (Nov–Feb)	54.0	52.1	-2.0°F (cooler)

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Home 4 Spotlight: Maximum ROI

- **Profile:**
  - 1,065 sq ft | Built 1964 | All-electric (no gas service)
  - Senior citizen (65+), Black Non-Hispanic; avg electricity bill $205/month pre-intervention
  - 1.18 kWh/sq ft — highest in the pilot and well above the Texas average of 0.50
- **Results (Jan–Sep comparison):**
  - 19,840 kWh (2024) → 17,183 kWh (2025) = 2,658 kWh reduction
  - 13.4% overall reduction | Winter: −38% | Summer: +24% (rebound)
  - Estimated annual savings: $780/year at $0.22/kWh
- **Return on Investment:**
  - Intervention cost: $3,750 | Payback period: under 5 years
  - Strongest ROI in the pilot — demonstrates that targeting high-burden homes maximizes program efficiency
- **Key lesson:**
  - The highest-consuming home had the most room to improve
  - Prioritizing high-burden / high-consumption households in future expansions will maximize impact per dollar

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Final Numbers

Table 2: Jan–Sep Consumption Comparison (2024 vs. 2025)

Home	kWh 2024	kWh 2025	Change	% Change	Est. Annual Savings
Home 1	6,810	6,851	+41	+0.6%	-$12
Home 2	4,456	4,220	-236	-5.3%	+$69
Home 3*	4,165	906	-3,259	-78.3%	+$956
Home 4	19,840	17,183	-2,658	-13.4%	+$780
Home 5*	5,191	6,129	+937	+18.1%	-$275
Home 6	7,179	6,574	-605	-8.4%	+$177
Home 7	14,281	13,895	-386	-2.7%	+$113

** Outlier homes. Savings at $0.22/kWh (modal observed rate), annualized from 9-month comparison.*

Table 3: Program-Level Summary

Metric	All 7 Homes	5 Homes (excl. outliers)
Total kWh 2024 (Jan–Sep)	61,922	52,566
Total kWh 2025 (Jan–Sep)	55,756	48,722
Overall Change	-10.0%	-7.3%
Avg Est. Annual Savings/Home	$258	$225

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Workforce Development

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Green Warriors at Work

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Green Warriors Training

- **Training Program:**
  - Energy Smart Academy's free Weatherization: Building Science Principles Course
  - Hosted by the City of Dallas Green Job Skills program (greenjobskills.com)
  - Self-paced online learning; Green Warriors then applied skills directly in the pilot homes
- **What they learned:**
  - Building envelope science — how heat moves through walls, attics, and windows
  - Insulation types, installation methods, and quality standards
  - Air sealing techniques for doors, windows, and penetrations
  - Energy auditing basics and identifying efficiency opportunities
- **What they did:**
  - Lance Smith and Robert Jenkins performed all weatherization work on the 7 pilot homes
  - Applied classroom learning to real homes in their own community
  - Documented work with before-and-after photos for each home
- This hands-on model produces workers with theory AND practice — immediately employable

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Program Impact & Equity: Solving Two Problems at Once

- **This pilot solves two community problems simultaneously:**
  - Home efficiency + Living-wage workforce pipeline = compounded community investment
- **Energy burden reduction:**
  - Residents receive more effective energy services per dollar spent
  - Health and safety improved — safer indoor temperatures without financial hardship
- **Workforce equity:**
  - WAP contractors face persistent labor shortages — Green Warriors fill that pipeline
  - Would-be contractors cannot gain experience without opportunities like this pilot
  - Community-grown workforce serves their own neighbors; investment stays local
- **Equity alignment:**
  - Targets Justice 40 tracts with the highest energy burdens
  - Reaches homes that existing WAP programs cannot serve due to health/safety deferrals
  - Addresses systemic disparities in energy affordability and home efficiency
- If scaled: trains a new generation of energy workers while making neighbors more comfortable

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Impact, ROI & Next Steps

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ROI & Payback Analysis

- **Intervention cost: $3,750/home ($26,250 total for 7 homes)**
- **Estimated annual savings (non-outlier homes at $0.22/kWh):**
  - Home 1: −$12/year (flat; already efficient)
  - Home 2: +$69/year | Payback ~54 years (comfort gains outweigh bill savings)
  - Home 4: +$780/year | Payback under 5 years — STRONGEST ROI
  - Home 6: +$177/year | Payback ~21 years
  - Home 7: +$113/year | Payback ~33 years
- **Program average: ~$225/home/year for non-outlier homes**
- **These estimates are conservative because:**
  - 2025 was ~2°F cooler — savings are understated relative to a normal year
  - Payback calculations exclude avoided health costs, rising energy prices, and comfort value
  - Rebound effect delivers value not captured in kWh savings
- For high-consumption targeting (like Home 4), the program is self-amortizing in under 5 years

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Recommendations & Next Steps

- **Expand the program:**
  - Prioritize high-consumption homes in 75210 and 75215 for maximum ROI
  - Use these results to justify scaling to additional Justice 40 tracts across Dallas
- **Continue data collection:**
  - Maintain smart meter monitoring through 2026–2027 for multi-season validation
  - Investigate Home 5 (site visit needed) and confirm Home 3 occupancy status
  - Incorporate temperature normalization (HDD/CDD) for more precise impact isolation
- **Collect resident survey data:**
  - Document changes in comfort, thermostat behavior, and perceived energy burden
  - Substantiate the rebound effect with resident testimony on quality-of-life improvements
- **Scale Green Warriors training:**
  - Expand workforce pipeline in parallel with home weatherization
  - Build local capacity to supply WAP contractors and clean energy firms
- **Explore rate shopping:**
  - Residents pay $0.18–$0.28/kWh; rate optimization could compound savings beyond weatherization

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Acknowledgments & Questions

Key Takeaway:
Targeted weatherization in South Dallas's most energy-burdened homes reduces bills, increases useful energy services, trains community workers, and gives the City data to scale.

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Thank You!

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