



Scaling Low-Income Energy Efficiency Program Delivery

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TVA's Mission

An aerial photograph of a vast valley filled with a thick layer of white clouds, creating a sea of clouds effect. The sun is rising in the upper right corner, casting a warm glow and long shadows across the landscape. The sky is a clear, pale blue. The foreground shows dark, silhouetted hills and valleys.

**To serve the people
of the Tennessee Valley
to make life better.**

Energy | Environment | Economic Development



Tennessee Valley Authority's Extreme Energy Makeovers (EEM)

- TVA-funded initiative to address energy affordability needs of limited-income families in seven communities
- Targeted 25% electric energy savings at no cost to participants
- Homes \geq 20 years old
- Maximum spend of \$10.00 per square foot
- Community and participant education and outreach required



Key outcomes of EEM projects in total include:

3,476
RETROFITS

17M
KWH SAVED

17000000



Average of

36%

ENERGY SAVINGS
per home

Projected annual average of

\$492

ELECTRIC BILL SAVINGS
per household



EEM improvements made to

4.3M

SQUARE FEET
of conditioned space

average of

4

EEM MEASURES
installed per household



Low-Income Program Expansion Strategy



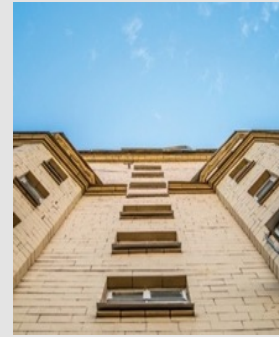
Home Uplift



WAPez



Home Energy Workshops



Community Power Challenge

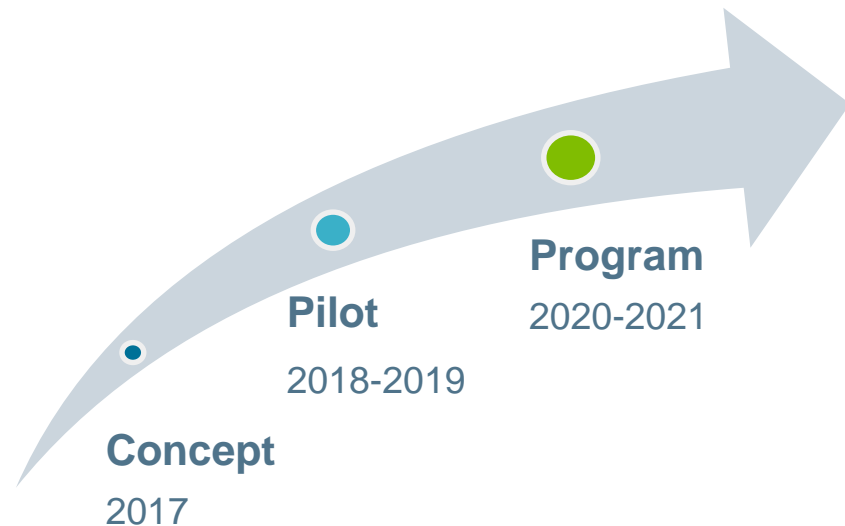
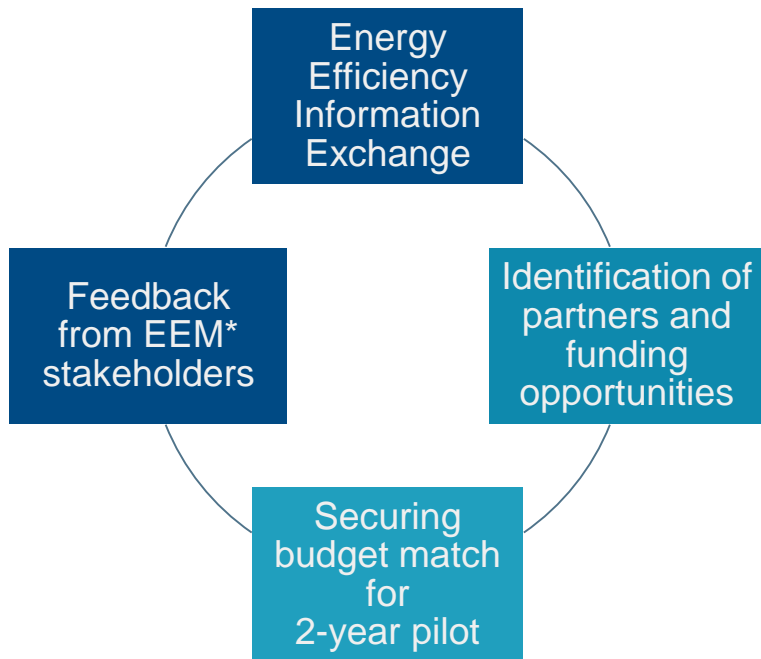


Building Futures Minority Workforce

Supporting home energy upgrades for families with limited means

Exploring ways to meet community needs through education & outreach

Home Uplift Development



*Extreme Energy Makeover (TVA EPA Project 2015-2017)

Home Uplift Stats (as of May 2019)

55.7 years

Average Age
of Home

1,059

Homes
Completed

1,205 ft²

Average Square
Feet per Home

\$7,892

Average Cost
per Home*



HVAC System



Duct System



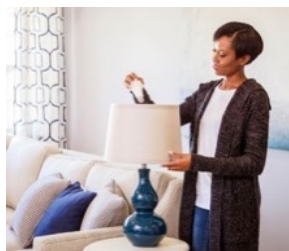
**Attic & Wall
Insulation**



Windows & Doors



Water Heating



Lighting



Air Sealing



Refrigerators

*Installations only

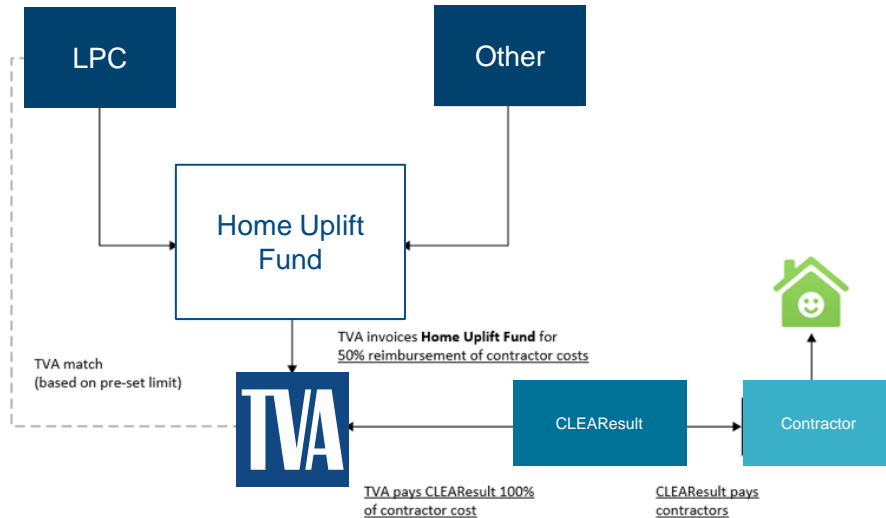


Community-Driven Funding Model

- LPC Round Up Programs
- LPC Charitable Contributions (de minimis limits)
- City Governments
- Local Housing Authority
- State Energy Offices
- Competitive Grants (FHLB)
- Federal Grants (HUD, CDGB)
- Foundations
- Corporations
- Local Non-profits

Home Uplift Fund

Funding Model



Benefits of Approach

- Eliminates multiple grant disbursement processes
- Provides method to collect LPC and 3rd party funding for Home Uplift projects
- Simplifies external billing process to recover matched funding
- Aligns strategic objectives of grants



501c3 Non-Profit Partner

TVA to partner with Community Development Financing Institution (CDFI) to manage funds and act as 501c3 designee for grant applications

Role

- Accept contributions and maintain account balances from LPCs and 3rd parties
- Service accounts within Home Uplift Fund
- Compliance reporting
- Provide TVA administrator monthly account balances to authorize work
- Remit Home Uplift funds to TVA per monthly invoice

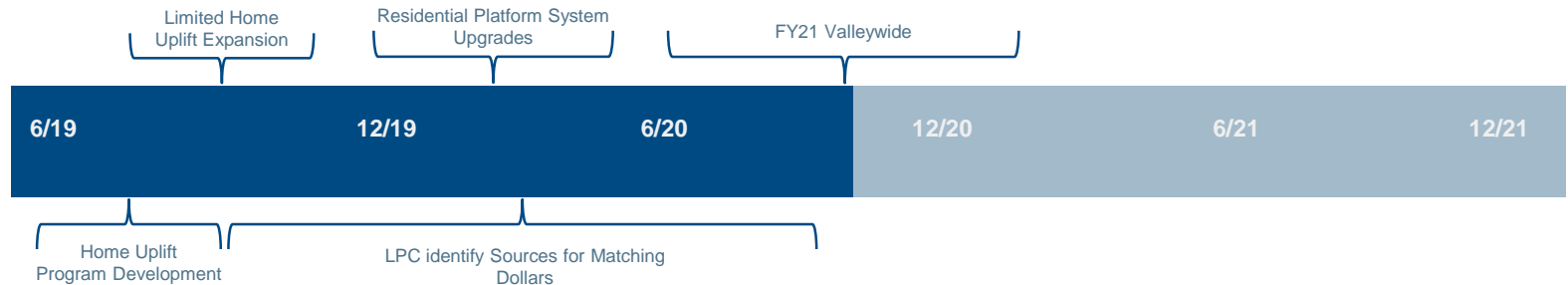
Home Uplift Timeline

Next Steps

October Complete Home Uplift Fund Setup, Update LPC Home Uplift Agreements and Finalize LPC Contributions Process

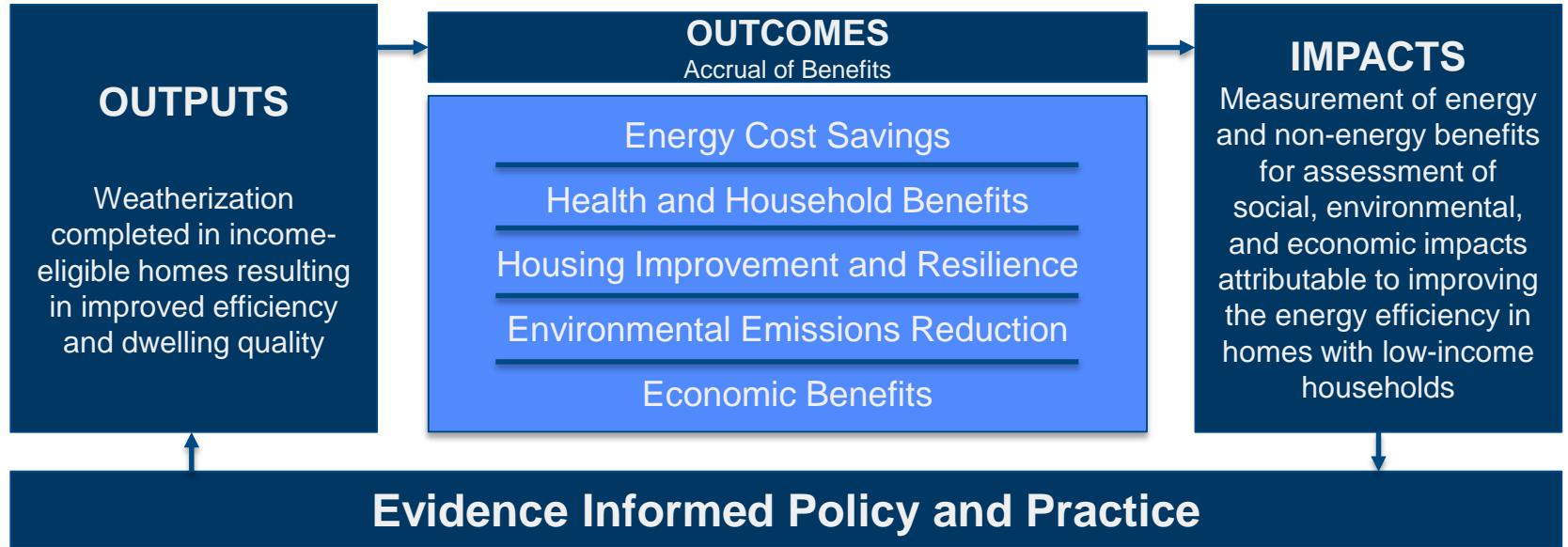
FY20 Program available to all LPCs

FY21 Full implementation with funds allocated to all LPCs



Non-Energy Impacts Evaluation

Improving Energy Efficiency of Housing Conceptual Framework



Research Acknowledgements

Sponsors

- Tennessee Valley Authority &
- Robert Wood Johnson Foundation

Key Team Members

- Three³ – Bruce Tonn, Erin Rose, Beth Hawkins, Michaela Marincic
- University of Tennessee, Center for Applied Research and Evaluation – Linda Daugherty, Amy Melton

Contributors

- Tennessee Valley Authority
- Weatherization Agency (Knoxville-Knox County CAC)
- Utilities (Memphis Light, Gas and Water; Knoxville Utility Board; EPB (Chattanooga); Nashville Electric Service; 4-County Electric Power Association)
- Huntsville Housing Authority
- CLEARresult

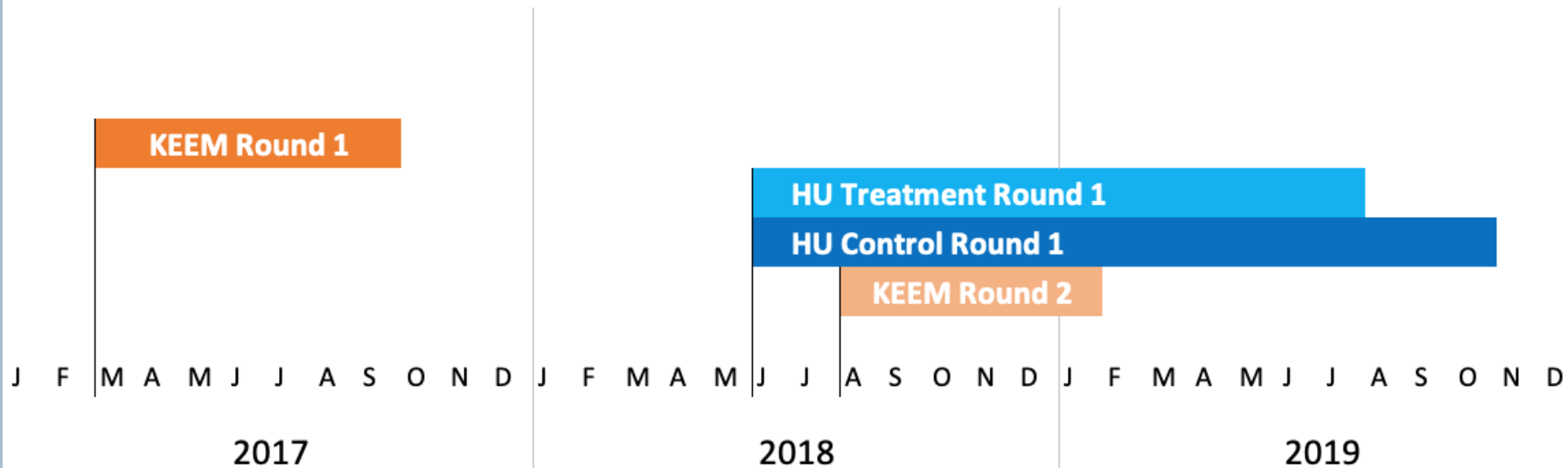
Outline

- Project Overviews
 - Knoxville Extreme Energy Makeover (KEEM)
 - Home Uplift Initiative (HU)
- KEEM Results + Comparability with Home Uplift
- Home Uplift Baseline Characteristics
 - Demographics
 - Thermal Stress
 - Asthma
 - Budget Issues
- HU Qualitative Evaluation: Data With a Soul (DWaS)

Approach to Health Benefits Research

- Surveys
 - Administer comprehensive survey on health and home conditions, budget issues and demographics to the following groups
 - T – homes weatherized during study
 - C – homes not slated for weatherization
 - CwT – homes that were weatherized one year prior to study*
 - Typically by phone; some residents request a paper form
 - Provide gift cards as incentives
- Measures Installed
 - CO monitors
 - Ranges of measures that reduce fire risk
- Data With A Soul (DWaS)**
 - Up-close and personal stories

Research Timeline



Project Overviews

| Project | Sponsor | Location | Home Types | Sample Sizes: CwT/ T/ C | | | Status |
|---------|---------|-------------------|------------|----------------------------|-------|-------|-----------|
| KEEM | RWJF | Knoxville, TN | SF | 197 | 99 | 152 | Complete* |
| HU | TVA | TN, KY, MS, AL | SF, MH | -- | 701** | 183** | Ongoing |

* HU data and KEEM data may be merged to increase sample sizes for KEEM analysis specifically.

** Sample sizes are not final but reflect the sample used for preliminary analysis in this presentation.

KEEM Demographics

| Variable/Group (N Pre-Wx, N Post-Wx) | Comparison (197/141) | Treatment (99/79) | Control (152/100) |
|---|-------------------------|----------------------|----------------------|
| Respondent Gender: Female | 73%/75% | 76%/77% | 79%/79% |
| Respondent Age | 58/60 | 54/56 | 56/59 |
| Average Household Size | 2.03/2.04 | 2.04/2.08 | 2.16/2.11 |
| Black or African American | 45%/47% | 29%/34% | 27%/25% |
| Respondent Employed | 35%/33% | 34%/35% | 38%/35% |
| Respondent Retired | 31%/33% | 20%/23% | 26%/31% |
| Respondent Married | 20%/17% | 25%/24% | 26%/31% |
| Respondent Education: GED or below | 50%/51% | 42%/39% | 58%/57% |

KEEM Results

| Variable | Treatment | | Control | | Diff. | Sig. |
|---|-----------|------|---------|------|-------|------|
| | Pre | Post | Pre | Post | | |
| Home too drafty (% Yes) | 43% | 15% | 31% | 25% | -22% | .023 |
| Have mold in home (% Yes) | 41% | 24% | 33% | 37% | -21% | .039 |
| Kept home at unhealthy temperatures (% Yes) | 55% | 14% | 42% | 27% | -26% | .007 |
| Mildew odor (% Yes) | 38% | 26% | 37% | 38% | -13% | .176 |
| Bad physical health days past month | 12.5 | 11.3 | 12.1 | 12.3 | -1.4 | .182 |
| Bad mental health days past month | 9.9 | 6.4 | 7.4 | 7.6 | -3.7 | .144 |
| Days past month very healthy and full of energy | 10.5 | 14.3 | 12.0 | 12.5 | +3.3 | .184 |
| Bad/worse headaches (% Yes) | 36% | 17% | 31% | 25% | -13% | .117 |
| Hard to pay energy bills (% Yes) | 73% | 51% | 60% | 64% | -26% | .013 |
| Food assistance (% Yes) | 47% | 49% | 49% | 35% | +16% | .116 |

Comparing KEEM and Home Uplift

| Home and Health Conditions | KEEM | HU |
|--|------|-----|
| Respondent Gender: Female (%) | 76% | 82% |
| Respondent Age | 56 | 60 |
| Black or African American (%) | 35% | 76% |
| Respondent Retired (%) | 27% | 40% |
| Respondent Education: GED or below | 51% | 52% |
| How often home too drafty? (all to some of the time) | 83% | 72% |
| How infested is home with cockroaches, other insects, and spiders? (extremely to somewhat) | 34% | 20% |
| Have seen mold in home? (% yes) | 39% | 30% |
| Asthma Rates | 15% | 14% |
| Number of days previous month physical health not good | 10.9 | 8.5 |
| Number of days previous month mental health not good | 8.9 | 5.3 |

Home Uplift Baseline Characteristics

Respondent Demographics

| Variable/Research Group (N = Number of Respondents) | Treatment (n=701) | Control (n=183) |
|--|----------------------|--------------------|
| Gender: Female | 81.6% | 82.5% |
| Age (mean) | 62 | 55 |
| Black or African American | 76.6% | 73.8% |
| White | 21.7% | 18.0% |
| Employed (respondent) | 25.8% | 33.3% |
| Retired (primary wage earner) | 43.1% | 25.7% |
| Unable to work (primary wage earner) | 24.8% | 27.3% |
| Respondent is in school | 1.9% | 3.8% |
| High school diploma/GED only | 33.7% | 33.9% |
| College degree(s) | 23.0% | 21.3% |

Thermal Stress – Cold

| Survey Item/Group | Treatment (n=701) | Control (n=183) |
|--|----------------------|--------------------|
| Someone in the household visited the following care setting because home was too cold (in past 12 months): | | |
| Went to Hospital = yes | 1.1% | 1.6% |
| # of times visited | 1.8 | 2.3 |
| Visited Emergency Department = yes | 2.4% | 1.6% |
| # of times visited | 1.6 | 1.3 |
| Outpatient Clinic/Doctor's Office = yes | 4.1% | 4.9% |
| # of times visited | 1.9 | 2.6 |
| Did any of the medical emergencies happen during a natural disaster or power outage? | 2.6% | 1.8% |

Thermal Stress – Hot

| Survey Item/Group | Treatment (n=701) | Control (n=183) |
|--|----------------------|--------------------|
| Someone in the household visited the following care setting because home was too hot (in past 12 months): | | |
| Went to Hospital = yes | 0.4% | 0.5% |
| # of times visited | 1.0 | 1.0 |
| Visited Emergency Department = yes | 1.4% | 1.1% |
| # of times visited | 1.2 | 1.0 |
| Outpatient Clinic/Doctor's Office = yes | 2.6% | 2.2% |
| # of times visited | 1.9 | 3.3 |
| Did any of the medical emergencies happen during a natural disaster or power outage? | 3.5% | 0 |

Asthma

| Survey Item/Group | Treatment (n=697) | Control (n=182) |
|---|----------------------|--------------------|
| Lifetime Asthma: Main Respondents | 18.1% | 26.8% |
| Current Asthma: Main Respondents | 13.3% | 22.5% |
| Asthma Subsample Results | Treatment (n=148) | Control (n=65) |
| Number of asthma 'flare-ups' in past 3 months | 4.0 | 5.1 |
| Stayed overnight in the hospital because of asthma (in past 12 months) | 5.5% | 8.5% |
| Visited the emergency room because of asthma (in past 12 months) | 12.4% | 23.7% |
| Visited an urgent care center because of asthma (in past 12 months) | 9.0% | 20.3% |

Trade-offs: Food Security and Health Care

| Survey Item/Group | Treatment (n=701) | Control (n=183) |
|--|----------------------|--------------------|
| <i>Over the past 12 months...</i> | | |
| Did not purchase food in order to pay energy bills (every month or every other month) | 9.8% | 13.1% |
| Did not pay energy bills in order to purchase food (every month or every other month) | 3.1% | 6.0% |
| In past 4 weeks, respondent or household member went an entire day and night without eating anything because there was not enough food | 8.0% | 11.5% |
| Difficulty paying medical bills | 31.7% | 31.1% |
| Household members needed prescription medicines but didn't get them because couldn't afford them | 29.0% | 30.1% |

HU Evaluation Data With a Soul

to be captured through a
series of microfilms

Overall Well-being/QoL

A general Quality of Life theme that expresses hardship/human suffering related to energy inefficient housing and the potential life-changing benefits of weatherization programs. This theme also captures the importance of formal and informal supports necessary to maintain energy security.

Affordability and Trade-Offs

This theme highlights extreme cases of energy poverty/burden and trade-offs that households are often forced to make between energy bills, food, medications/healthcare, travel and socializing. It also emphasizes psychosocial stress related to energy insecurity in the forms of disconnections and seeking energy assistance while on a fixed or low-income.

Housing IEQ and Health

Observations related to specific indoor environmental quality issues that correlate to health, such as mold and moisture issues evidenced to impact respiratory health (e.g., pediatric asthma); Trip and fall hazards; Pest management; Benefits of air exchange/fresh air and reduced dust.

Benefits of Thermal Comfort

Covers a range of benefits associated with medical diagnoses (e.g., arthritis), sleep, general thermal comfort for all elderly persons and children, and health and safety issues (e.g., fires) related to the use of secondary heat sources.

Data With a Soul Microfilm Candidates

Overall Well-being/QoL

- Her old furnace did not work, and space heaters “do not keep your house that warm.”
- Her water heater had gone out at the same time as her heat, so it was “like a downhill trip for a while.”
- Was tired all the time. “If you’re mentally tired, it affects your whole body.” Now that she has wx, “It feels luxurious! I feel like I’m rich.”
- “[Wx] changed my life; I don’t have to be miserable now.”
- “It changes your outlook too; you don’t feel so overwhelmed by your circumstances.”

Affordability and Trade-Offs

- They get ‘disconnected’ as much as every 3-4 months. The light bill averages around \$250-300 and gets as high as \$500 in winter.
- Saving money on the light bill would help them pay for prescriptions and transportation to and from the doctor’s office. They are on a fixed income and raising two grandkids currently with two already out of the house, and they receive no form of support from either the parents or their in-laws, so they have to provide everything for the kids from school supplies to clothes to food and healthcare.
- Worried about a fire from the space heaters.

Housing IEQ and Health

- Trip and fall hazards from uneven floors and bad back.
- Concerned about the rats and about potential lead in pipes and paint.
- No vapor barrier. House has mold and moisture issues.
- She has a number of health issues, and her grandchildren are always sick, coughing, and in respiratory distress.

Benefits of Thermal Comfort

- He had no central heat or air before wx and would use space heaters and window A/C units. Sometimes he would drive an hour to his family’s farmhouse just to be warm.
- The house feels like home now. “[The weatherization] is a blessing, especially this time of year [in winter].”
- Soon after the work, he noticed the air feeling fresher, which helps with his breathing problems.
- He had only praise for the program and said it was the first program that’s done what it said it would do, “and that means a lot down here.”

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