Better Buildings®
U.S. DEPARTMENT OF ENERGY

*Better Buildings Residential Network*
*Peer Exchange Call Series*

# *Deep Retrofits – How Deep Can You Go with the Inflation Reduction Act?*

*October 12, 2023*

U.S. DEPARTMENT OF ENERGY

# Agenda and Ground Rules

- Moderator
  - **Jonathan Cohen,** Better Buildings Residential Network, U.S. DOE Residential Buildings Integration Program (RBI)
- Agenda Review and Ground Rules
- Residential Network Overview and Upcoming Call Schedule
- Opening Poll
- Featured Speakers
  - **John (Jack) Mayernik,** National Renewable Energy Laboratory (NREL)
  - **Jennifer Amann,** American Council for an Energy-Efficient Economy (ACEEE)
  - **Adam Stenftenagel,** Radiant Labs, Snugg Home
- Open Discussion
- Closing Poll and Announcements

**Ground Rules:**

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

*The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.*

# Join the Network

**Member Benefits:**

- Recognition in media, social media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

**Commitment:**

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

**Upcoming Calls (2nd & 4th Thursdays):**

- *10/26: Transition: Office to Multi-Family Building Conversions and Efficiency*
- *11/09: Residential Storage – An Essential Piece of the Climate Puzzle*

*Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call*

**Jennifer Amann**
***ACEEE***

# Increasing Deep Retrofits & Electrification with IRA Funding

Jennifer Amann, ACEEE

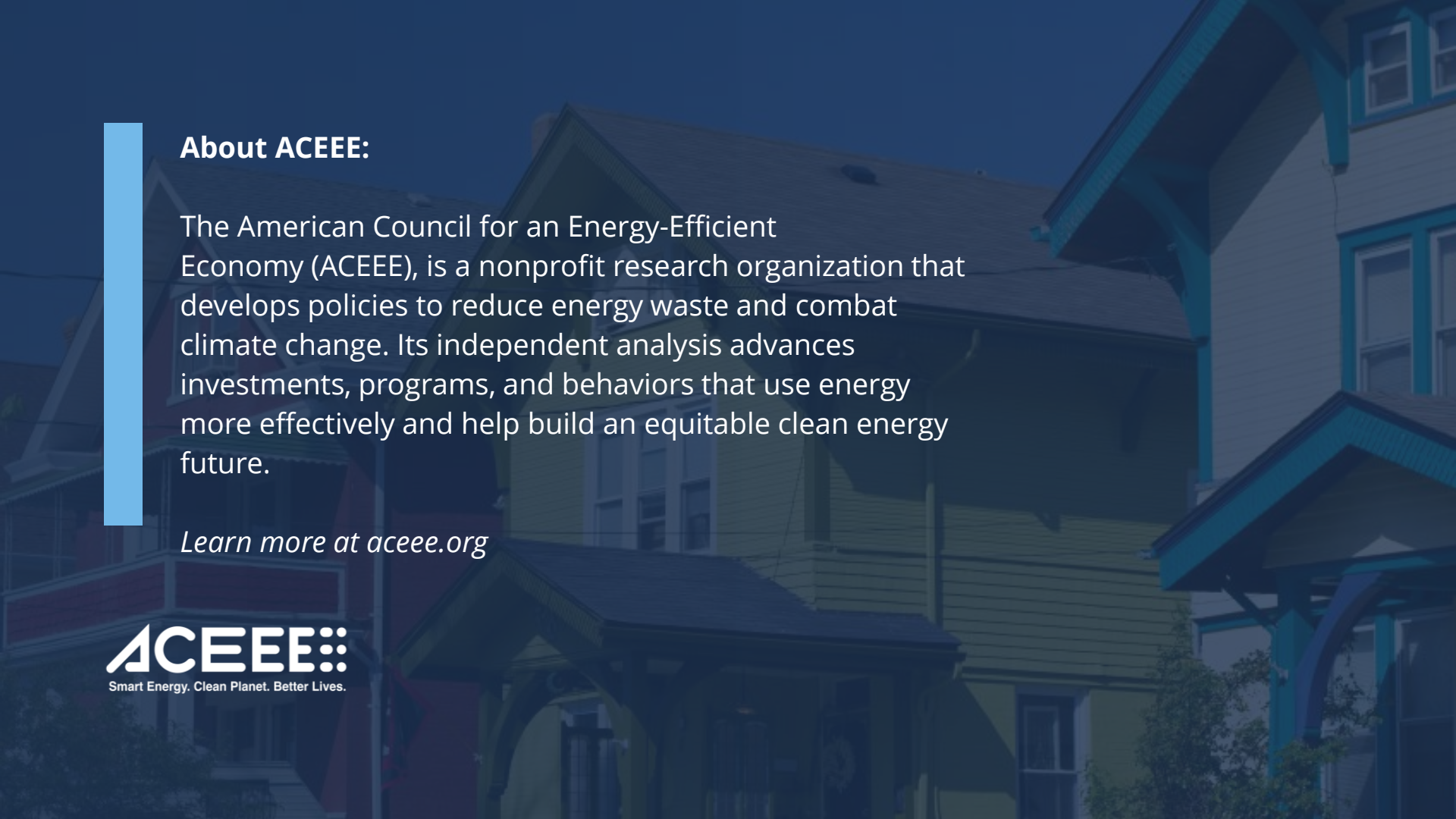
Better Buildings Residential Network

Peer Exchange webinar

October 12, 2023

ACEEE

Smart Energy. Clean Planet. Better Lives.



## About ACEEE:

The American Council for an Energy-Efficient Economy (ACEEE), is a nonprofit research organization that develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

*Learn more at aceee.org*

ACEEE

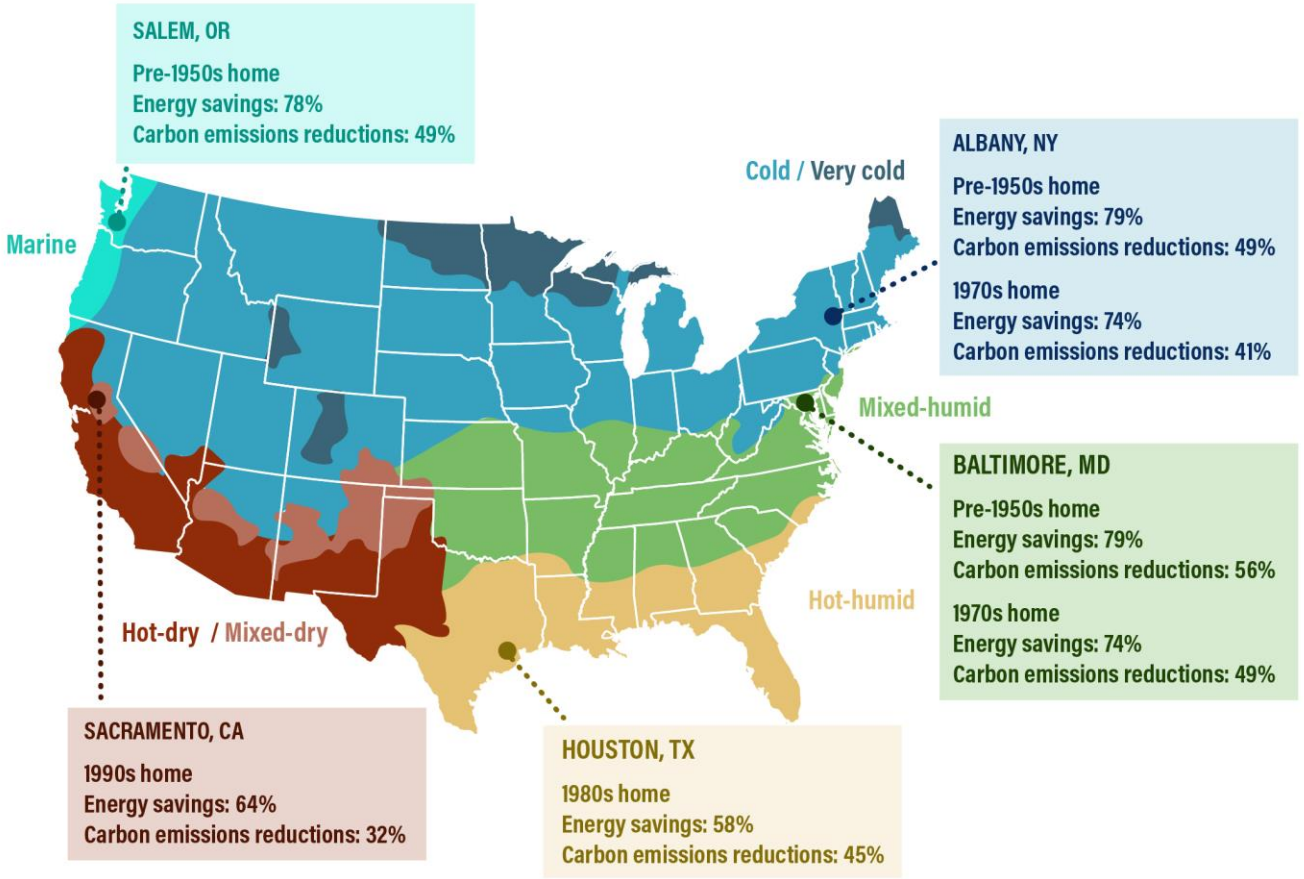
Smart Energy. Clean Planet. Better Lives.

A robust package of retrofit measures can cut a home's energy use by 58% to 79% and its carbon emissions by 32% to 56% depending on the home's age and regional climate.

Costs range from $35k to $57k

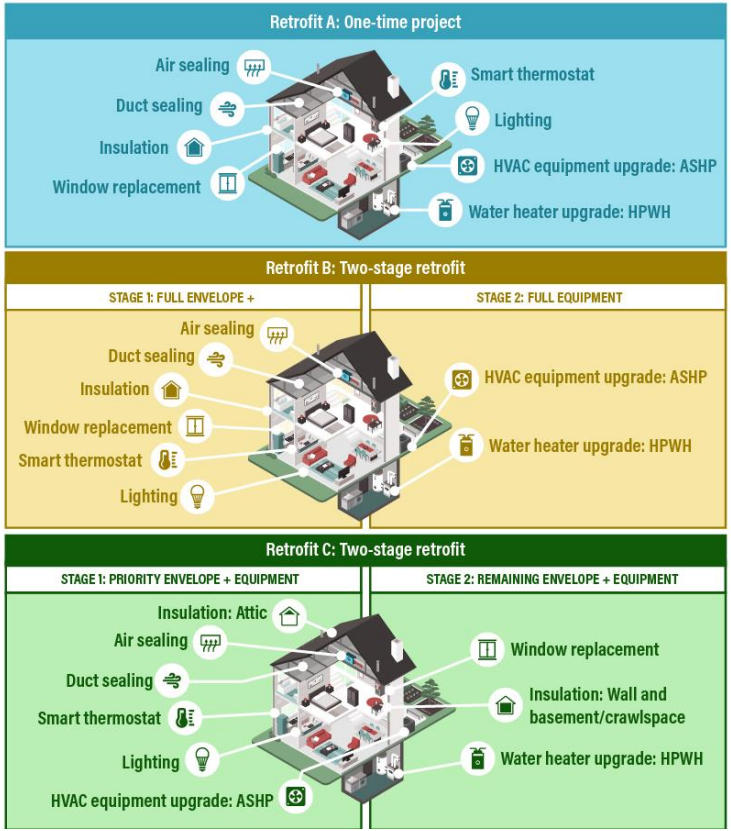
How do we increase consumer interest and participation?

## Deep Retrofits' Energy and Carbon Savings (by climate zone)



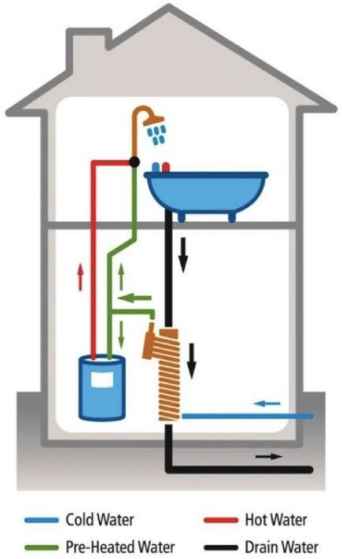

Adapted from the Department of Energy's Building America Climate Zone Map

# Breaking retrofit packages into stages can help customers manage costs and better meet their needs




- Retrofit B: prioritizes envelope upgrades in the first phase. Older homes in the heating-dominant cold, mixed-humid, and marine climate regions benefit the most from comprehensive envelope upgrades, which account for most energy savings.
- Retrofit C: combines some envelope efficiency measures with priority equipment replacement. This approach may be especially appealing to customers in the hot-humid and hot-dry regions, which have milder winters and newer housing stock.
- IRA funding can support staging
  - Home efficiency rebates + 25C tax credits
  - Home electrification and appliance rebates
  - Supplemental financing when needed

Drain water heat recovery




Cellular Shades

Storm Windows

Air cleaners

Video streaming devices


# Ongoing role for existing efficiency programs

- Support participation above and beyond IRA
- Incentivize measures that offer lower cost, less disruption, and greater consumer amenity
  - Alternatives measures that reduce heating, cooling, and water heating loads
  - Supplemental measures to reduce other end-use categories
- Offer financing options
- Market transformation activities

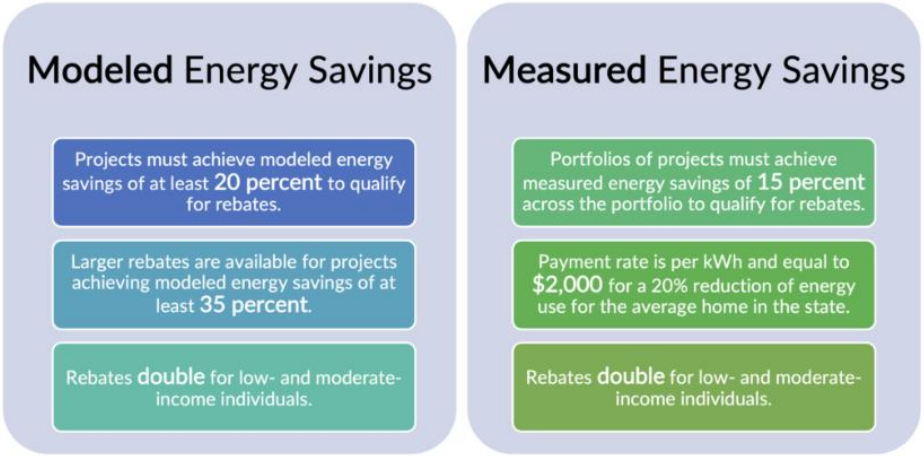
# Financial analysis

Three finance scenarios analyzed for 10- and 20-year repayment at 0%, **2.5%**, and 5% to determine upfront capital/incentive required.

- **Cash-flow neutral:**
- 10-yr: $30k-$47k (65-88% project cost)
- 20-yr: $17k-$42k (38-78% project cost)
- **Monthly added cost of $75:**
- 10-yr: $22k-$39k (48-73% project cost)
- 20-yr: $3.5k-$28k (8-52% project cost)
- **Monthly added cost of $150:**
- 10-yr: $14k-$31k (31-58% project cost)
- 20-yr: $0k-$14k (0-25% project cost)

| Climate | Project cost | Pre-retrofit costs ($/month) | | Post-retrofit costs ($/month) | | Savings ($/month) |
|---|---|---|---|---|---|---|
| | | Electric | Gas | Electric | Gas | |
| Cold, pre-1950s | **$ 53,223** | $ 112.47 | $ 203.83 | $ 187.04 | $ 17.69 | **$ 111.56** |
| Cold, 1970 | **$ 53,657** | $ 131.21 | $ 150.29 | $ 194.49 | $ 17.69 | **$ 69.32** |
| Mixed-humid, pre-1950s | **$ 46,569** | $ 135.21 | $ 172.07 | $ 125.50 | $ 13.16 | **$ 168.61** |
| Mixed-humid, 1970 | **$ 56,748** | $ 121.54 | $ 141.57 | $ 125.95 | $ 13.16 | **$ 124.01** |
| Hot-humid | **$ 45,159** | $ 143.34 | $ 43.98 | $ 95.43 | $ 16.00 | **$ 75.88** |
| Hot-dry | **$ 42,582** | $ 146.70 | $ 71.82 | $ 158.03 | $ 8.37 | **$ 52.12** |
| Marine | **$ 50,683** | $ 66.47 | $ 133.05 | $ 96.12 | $ 7.59 | **$ 95.81** |

## Home Efficiency Rebates + 25c tax credits




Rebates of $2,000 to $4,000 depending on savings
Double to $4,000 to $8,000 for LMI households

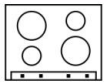
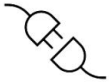
| Improvement | % of cost | Maximum credit | Efficiency criteria |
|---|---|---|---|
| Home energy audits* | 30% | Up to $150 | Auditor certification requirements to be determined by DOE |
| Heat pumps | 30% | Up to $2,000 per year | Based on CEE Tiers |
| Heat pump water heaters | 30% | Up to $2,000 per year | Based on CEE Tiers |
| Central air conditioners* | 30% | Up to $600 | Based on CEE Tiers |
| Natural gas, propane, or oil furnaces, boilers, or water heaters* | 30% | Up to $600 | Based on CEE Tiers |
| Biomass stoves or boilers | 30% | Up to $2,000 per year | Thermal efficiency of at least 75% |
| Electric panel or circuit upgrades for new electric equipment* | 30% | Up to $600 | 200 amps or more |
| Insulation materials* | 30% | Up to $600 | Based on 2021 IECC |
| Windows and skylights* | 30% | Up to $600 | ENERGY STAR Most Efficient |
| Exterior doors* | 30% | Up to $500 (max of $250 for each door) | ENERGY STAR |

*Subject to combined cap of $1,200 per year

$1,200 per year cap (excluding HP and HPWH)
$2,000 for HP
$2,000 for HPWH (or 30% of cost)

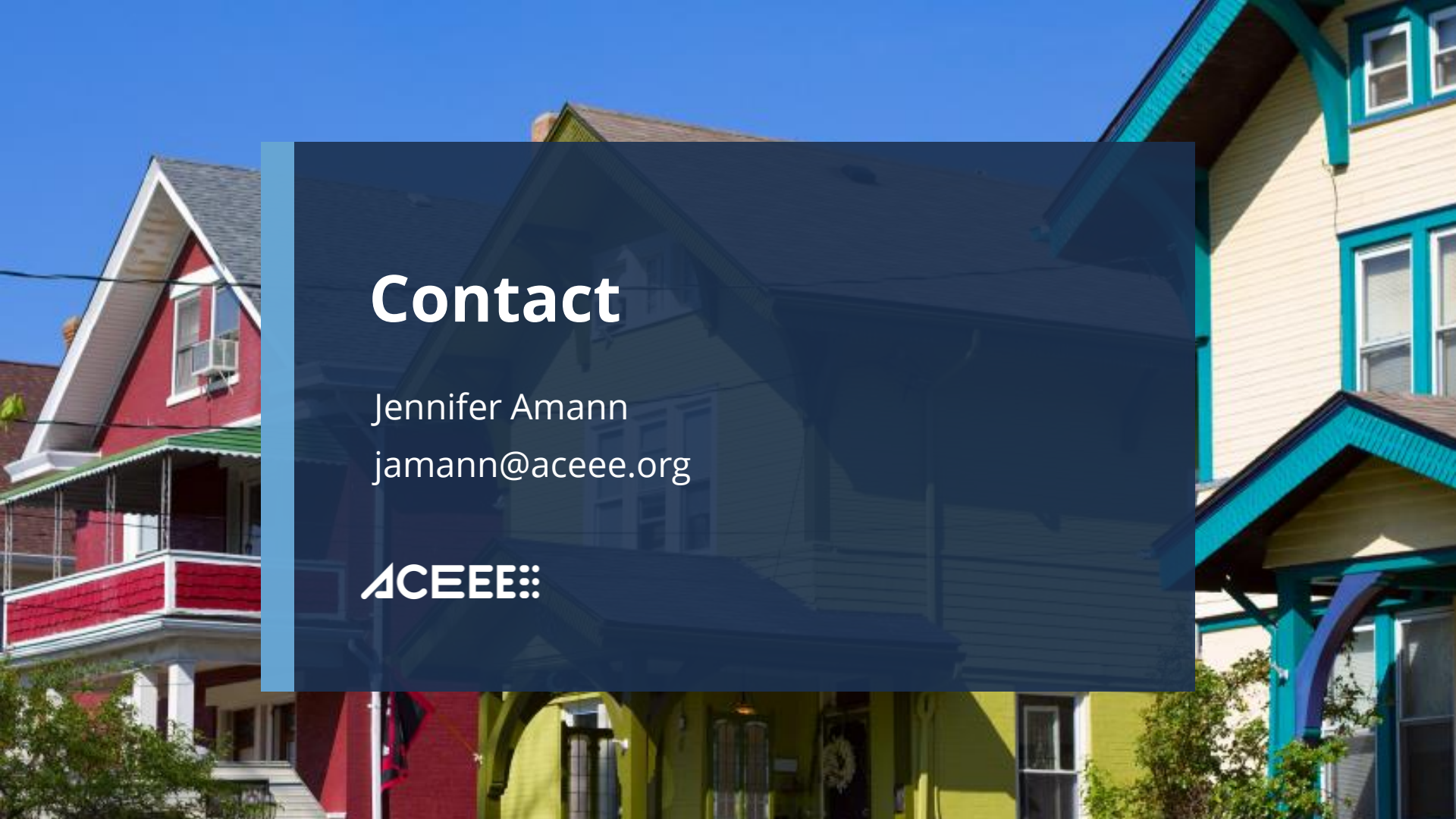
## Home electrification and appliance rebates

- Up to $14,000 in rebates for low- and moderate-income households
- Prescriptive, point-of-sale rebates
- Supports transition to all-electric homes
- Incentives for contractor participation

| | Appliance | Rebate Amount (Maximum) |
|---|---|---|
|  | Heat Pump (for space heating and cooling) | $8,000 |
|  | Electric Stove, Cooktop, Range, or Oven, or Clothes Dryer | $840 |
|  | Heat Pump Water Heater | $1,750 |
|  | Electric Wiring | $2,500 |
|  | Electric Load Service Center (Breaker Box) | $4,000 |
|  | Insulation, Air Sealing, and Ventilation | $1,600 |

## Recommendations

- Standardized (yet flexible) retrofit measure packages
- Staged retrofits to meet customer and program needs
  - Need mechanisms to keep consumer engaged and provide staged financing
  - Leverage remodeling and other projects/transactions
- Consider challenges and opportunities for electrification
- Expand the range of measures and delivery mechanisms
  - Multiple trades, retail, utility marketplaces, direct install, behavioral
- Funding packages that support customers and contractors with mix of incentives and financing
- Fed $$ makes things better, but gaps remain – still need state and private solutions to meet the need



# Contact

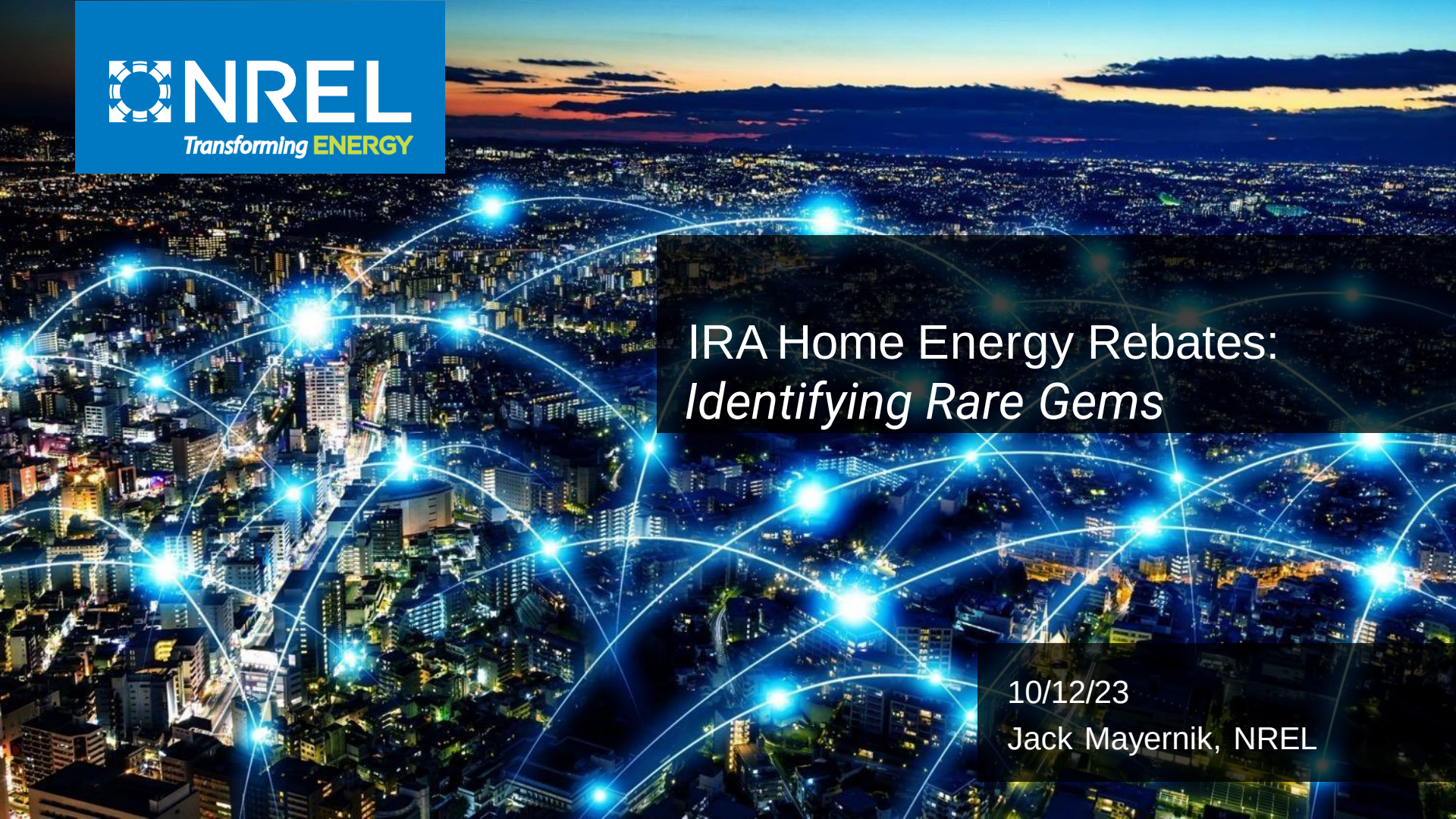
Jennifer Amann
jamann@aceee.org

ACEEE

# Upcoming conferences

| | | |
|---|---|---|
| Energy Efficiency as a Resource | October 16–18, 2023 | Philadelphia, PA |
| Behavior, Energy & Climate Change (BECC) | November 12–15, 2023 | Sacramento, CA |
| 2024 Hot Water Forum & Hot Air Forum | March 12– 4, 2024 | Location TBD |
| 2024 Summer Study on Energy Efficiency in Buildings | August 4–9, 2024 | Pacific Grove, CA |

**John (Jack) Mayernik**
***NREL***



# IRA Home Energy Rebates: *Identifying Rare Gems*

10/12/23

Jack Mayernik, NREL

# Inflation Reduction Act Home Energy Rebates Programs

- **50121 – HOMES**
  - No income cap
  - Rebates are based on energy savings
  - LMI households are eligible for larger rebates
- **50122 – HEEAR**
  - Only households making less than 150% AMI are eligible
  - Rebates based on equipment installed (must be electric)
  - LMI households are eligible for larger rebates

# Size of the Program

- **Assumptions to Estimate National Impact**
  - Max Rebate per HH (cost to government for rebates)
    - HOMES: $8,200
    - HEEAR: $14,500
  - Max Households Total (cost to government for rebates)
    - HOMES: $2,000
    - HEEAR: $1,340

| | Maximize Rebate Value for Each Household | Maximize the Total Number of Households Receiving Rebates |
|---|---|---|
| **Est. Homes Receiving Rebates** | 640,000 | 4,100,000 |

# What are the potential impacts?

# Key Disclaimers on IRA Home Energy Rebate Analysis

- **Microsegments** – We are looking at average outcomes for households with similar characteristics, outcomes for individual household will vary.
- **Equipment Cost** – Are national averages and do not reflect local market conditions such as labor rates.
- **Utility Rates –** Analysis was done with state average volumetric utility rates.
- **Heat Pumps –** Sized for cooling loads, this may understate the energy savings potential for these upgrades, particularly in heating dominated climates. Additionally, the measures implemented represent bounding performance levels.

Additional Details on Disclaimers in Appendix

# What are the Objectives?

Different States have different priorities and IRA provides significant flexibility for achieving secondary policy objectives.

| Metric | Objective |
|---|---|
| Emissions Reduction | High emissions reduction |
| Utility Bill Savings | Significant reductions in bills |
| Energy Savings | Substantial energy savings |
| Low-Income HH Served | High level (at *least* 40%) |
| Electrification | Significant share of households electrified |
| Indoor Air Quality | Meaningful improvement in IAQ |
| Service Additions | Improve comfort (e.g. add AC) |
| Households Served | High number of households |

# What are the Objectives?

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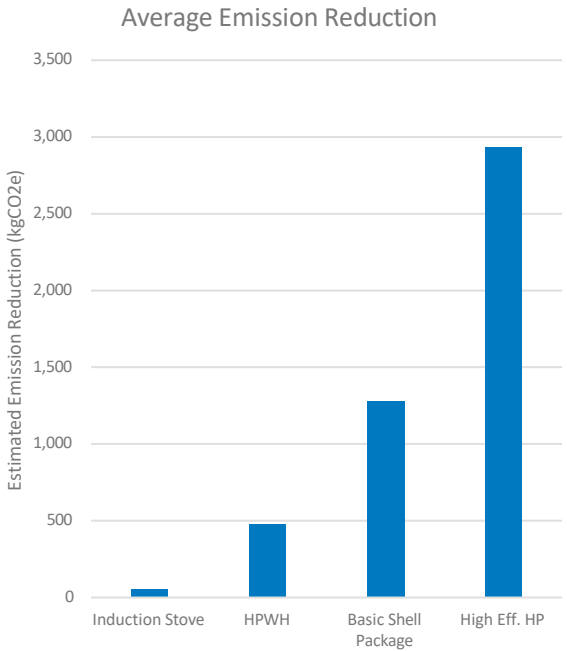
# Average Impacts

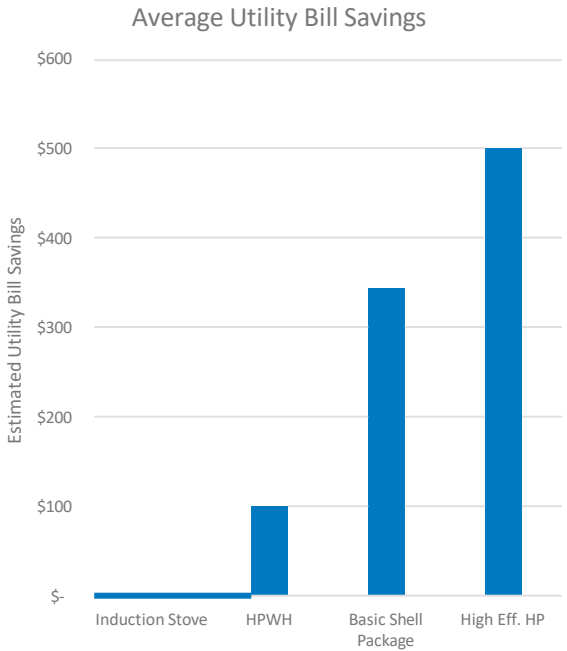
**Measures**

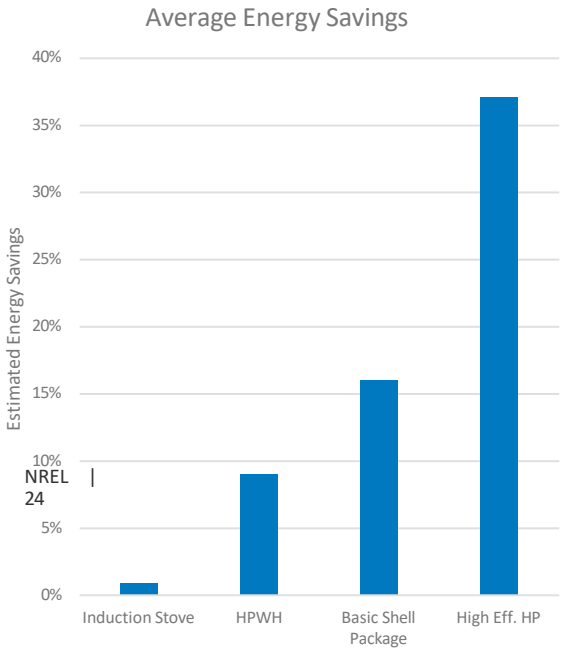
- Induction Stove
- HPWH
- Basic Shell Package
- High Eff. HP

**Metrics**

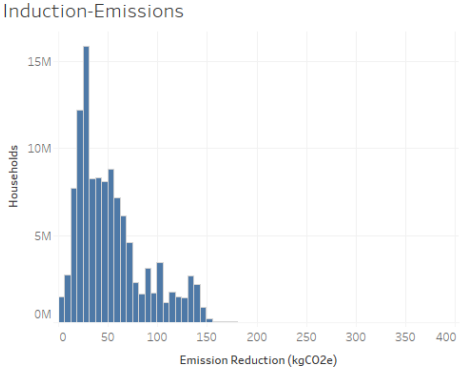
- Emissions Savings
- Utility Bill Savings
- Energy Savings

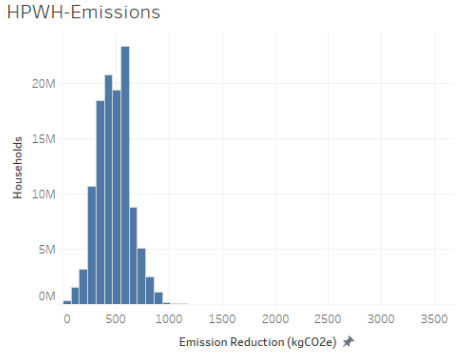


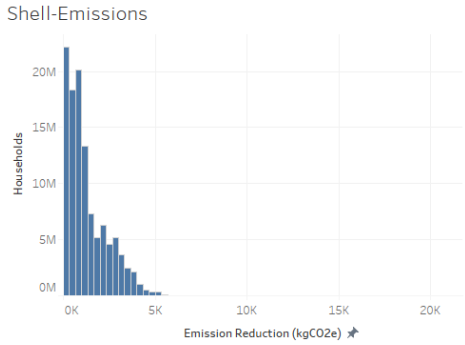



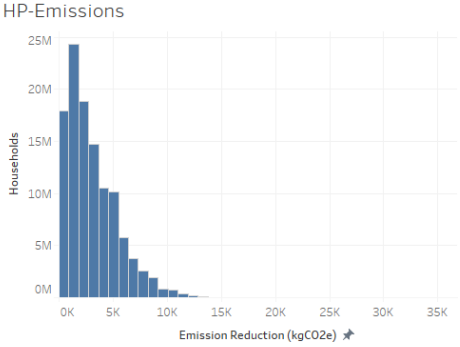



# Range of Impacts Emissions



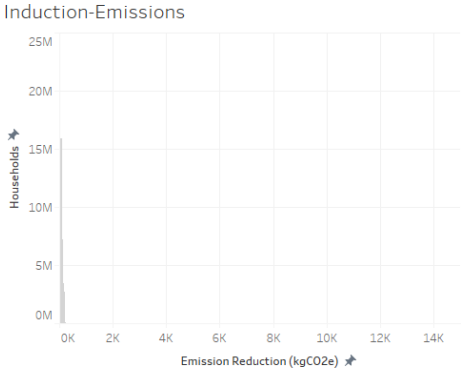



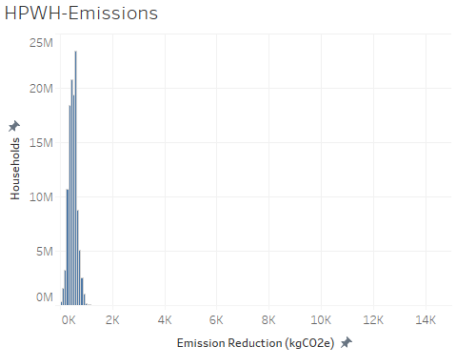



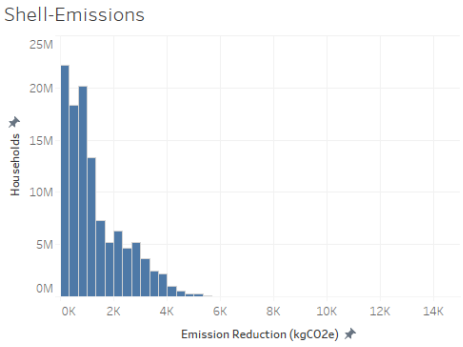

- Please Note:
  - Different shapes
  - Axis Values

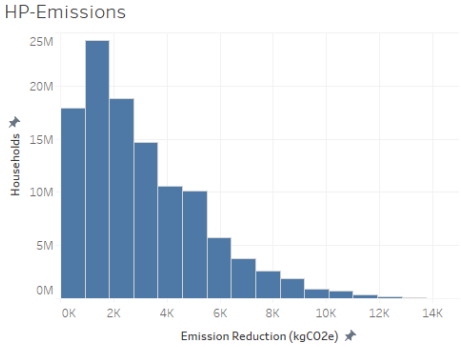
What happens if we put them on the same scale?

# Range of Impacts Emissions



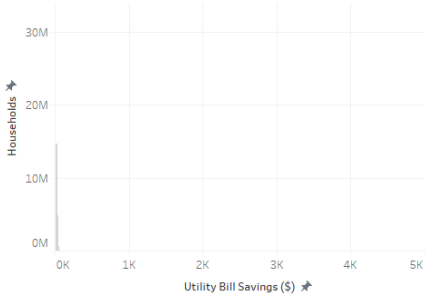

The impact of Induction Cooking and HPWH are minimal compared with the potential impact of building shell and a high efficiency heat-pump.

What happens if we put them on the same scale?

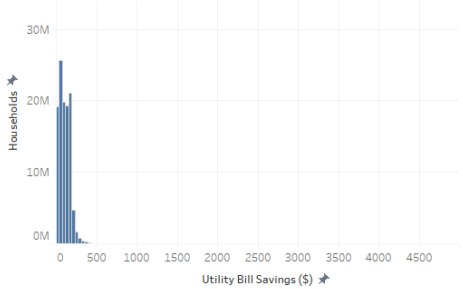
# Range of Impacts – Bill and Energy

## Utility Bill

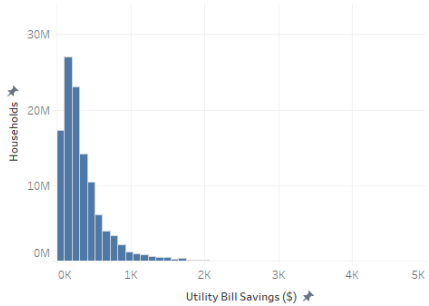
Induction-Bill



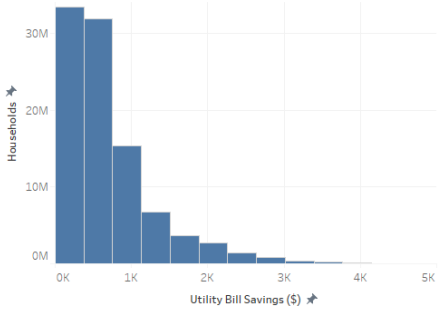

HPWH-Bill




Shell-Bill

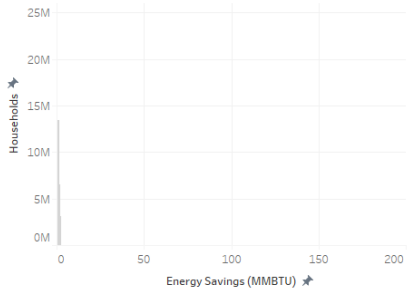



HP-Bill

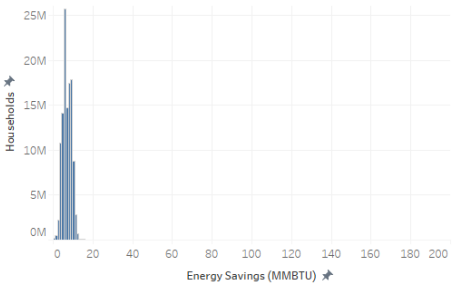



## Energy Savings

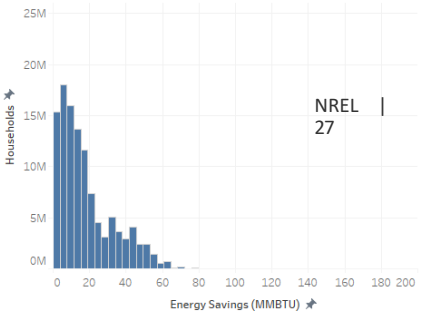
Induction-Energy



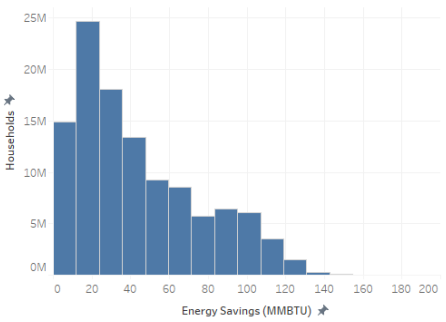

HPWH-Energy




Shell-Energy




HP-Energy






Not for publication

# How Can We Identify Rare Gems?

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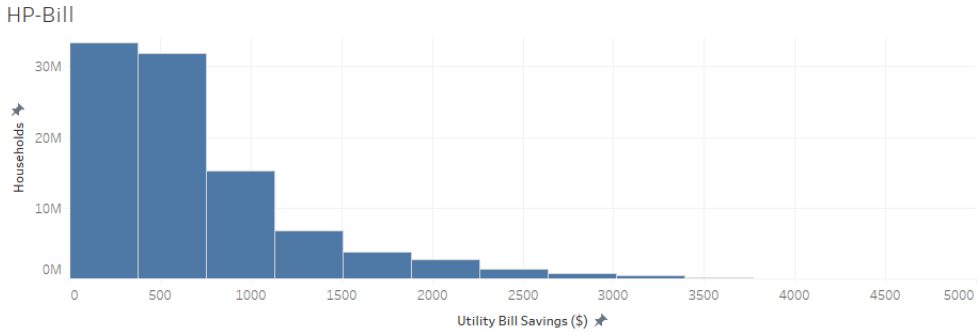
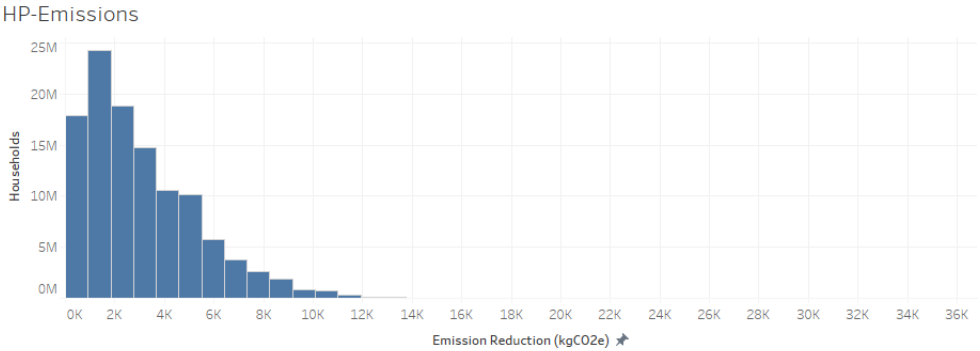
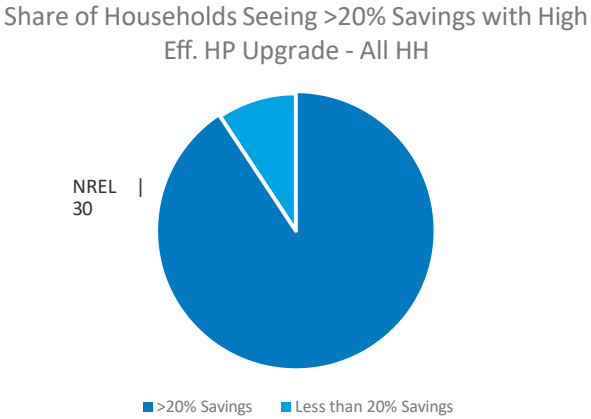
# One Measure Example: High Eff. HP



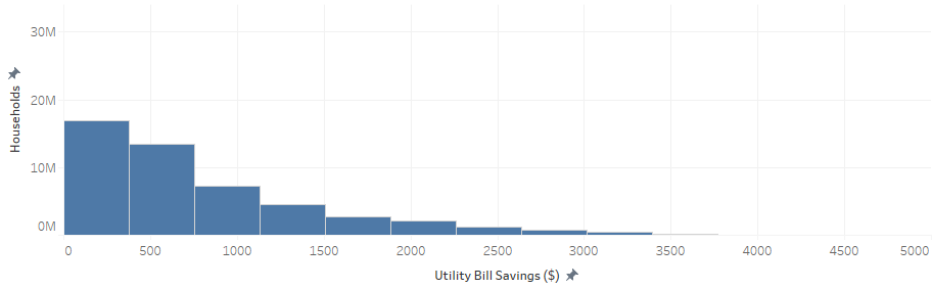




- **Selection**
  - All Households
- **TOTAL Households in Selection**
  - ~117 Million Households
  - 91% of these households save at least 20% with this upgrade
- **Average Emissions per Household**
  - 2,900 $kgCO_2e$ Annually
- **Average Bill per Household**
  - $510

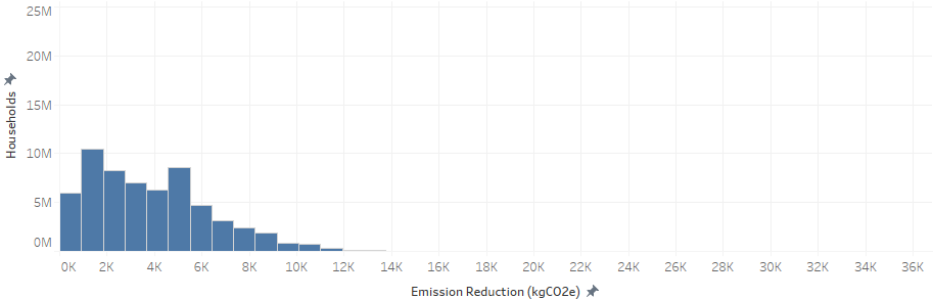


# Exploring Each in Turn: Vintage

HP-Bill

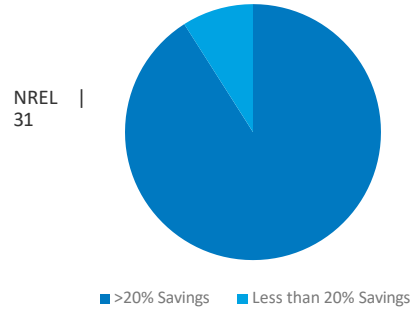



HP-Emissions



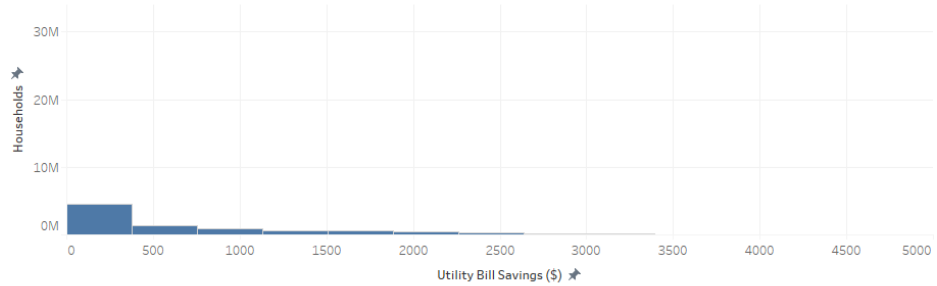

- **Selection**
  - Households that were built before 1980
- **TOTAL Households in Selection**
  - ~63 Million Households
  - 91% of these households save at least 20% with this upgrade
- **Average Emissions per Household**
  - 3,700 $kgCO_2e$ Annually
- **Average Bill per Household**
  - $540

Share of Households Seeing >20% Savings with High Eff. HP Upgrade - Households Built Pre-1980

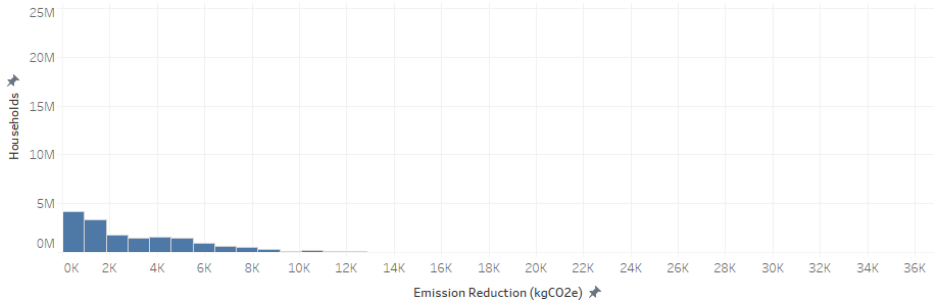


# Exploring Each in Turn: Air Conditioning

HP-Bill

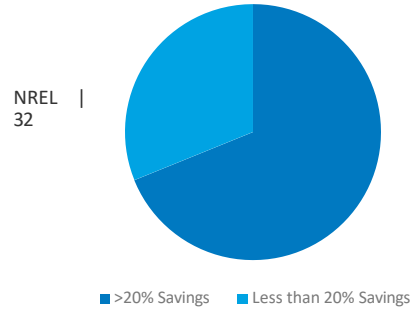



HP-Emissions



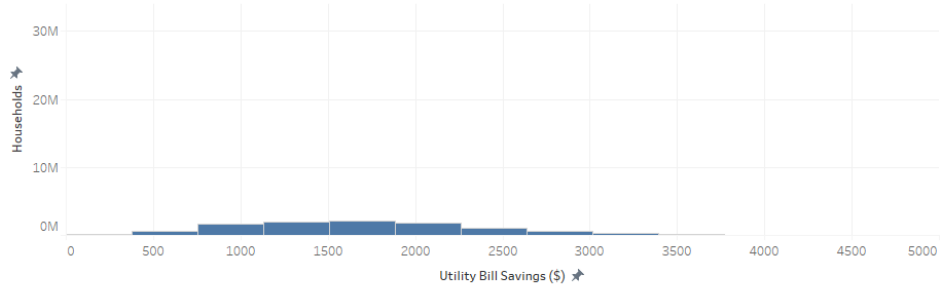

- **Selection**
  - All Households without air conditioning
- **TOTAL Households in Selection**
  - ~19 Million Households
  - 69% of these households save at least 20% with this upgrade
- **Average Emissions per Household**
  - 2,700 $kgCO_2e$ Annually
- **Average Bill per Household**
  - $190

Share of Households Seeing >20% Savings with High Eff. HP Upgrade - Households with No AC

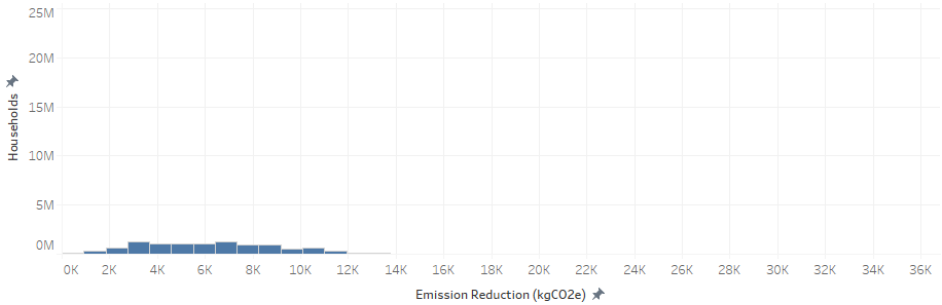


# Exploring Each in Turn: Fuel

HP-Bill

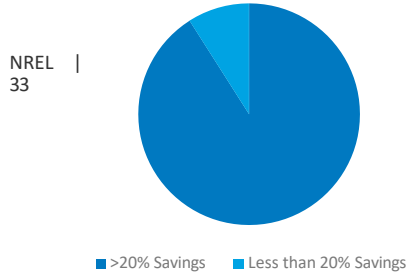



HP-Emissions



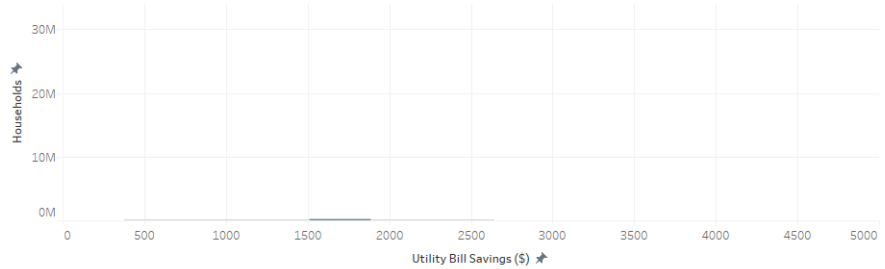

- **Selection**
  - Households that heat with fuel oil or propane
- **TOTAL Households**
  - ~10.5 Million Households
  - 99% of these households save at least 20% with this upgrade
- **Average Emissions per Households**
  - 6,300 $kgCO_2e$ Annually
- **Average Bill per Households**
  - $1,710

Share of Households Seeing >20% Savings with High Eff. HP Upgrade - Households Heating with Fuel Oil or Propane

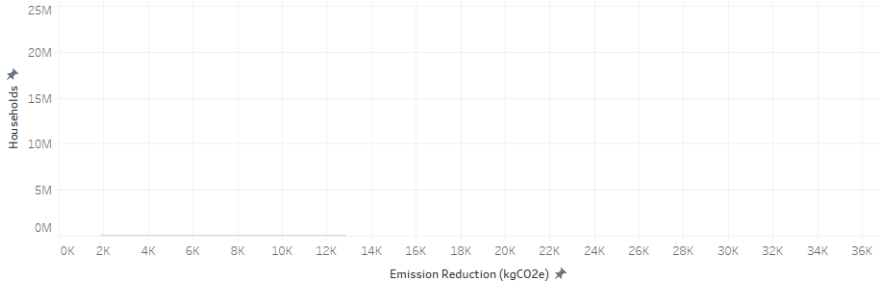


# Bringing it all Together

HP-Bill

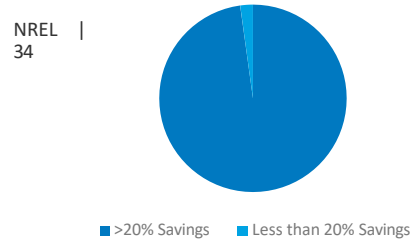



HP-Emissions

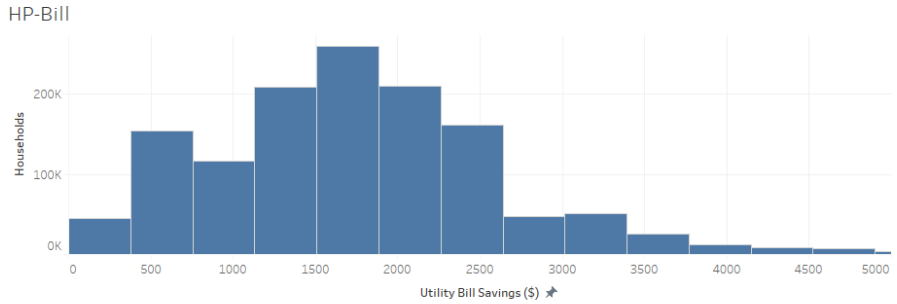


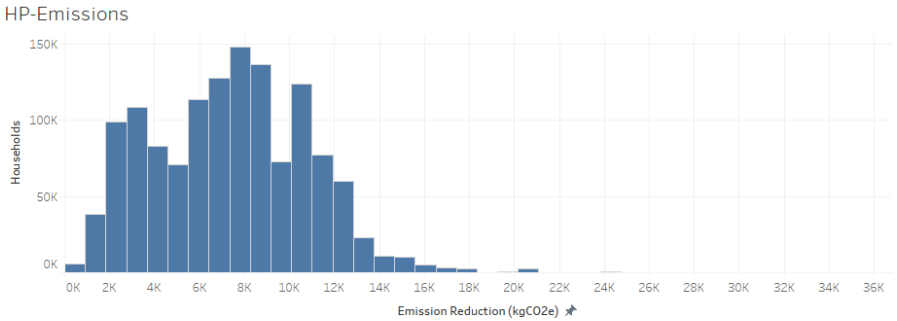

- **Selection**
  - Households that were built before 1980, heat with fuel oil or propane, and do not currently have air conditioning.
- **TOTAL Households in Selection**
  - ~1.3 million
  - 98% of these households save at least 20% with this upgrade
- **Average Emissions per Household**
  - 7,400 $kgCO_2e$ Annually
- **Average Bill per Household**
  - $1,750

Share of Households Seeing >20% Savings with High Eff. HP Upgrade - Households Built Pre-1980, that Heat with Fuel Oil or Propane, and Do Not Have AC



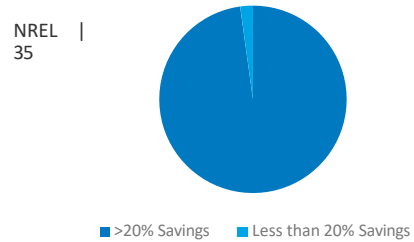
# Bringing it all Together




- **Selection**
  - Households that were built before 1980, heat with fuel oil or propane, and do not currently have air conditioning
- **TOTAL Households**
  - ~1.3 million
  - 98% of these households save at least 20% with this upgrade
- **Average Emissions per Households**
  - 7,400 $kgCO_2e$ Annually
- **Average Bill per Households**
  - $1,750

Share of Households Seeing >20% Savings with High Eff. HP Upgrade - Households Built Pre-1980, that Heat with Fuel Oil or Propane, and Do Not Have AC



# Average Across Segments (High Eff. HP)

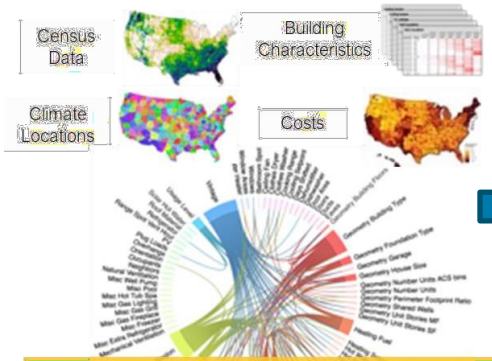
| | Annual Emission Reduction ($kgCO_2e$) | Annual Utility Bill Savings ($) | Total Households in Segment | Share of Households with >20% Energy Savings |
|---|---|---|---|---|
| **All Households (HH)** | 2,900 | $510 | 116,719,000 | 0.91 |
| **HH Built Before 1980** | 3,700 | $540 | 63,105,000 | 0.91 |
| **HH with No AC** | 2,700 | $190 | 18,838,000 | 0.69 |
| **Heat with Fuel Oil or Propane** | 6,300 | $1,710 | 10,533,000 | 0.99 |
| **Built Before 1980, No AC, Heats with FO or Propane** | 7,400 | $1,750 | 1,327,000 | 0.98 |

# What’s the potential impact of focusing our efforts?

# IRA Home Energy Rebate Scenario Tool

ResStock

Large public and private datasets




ResStock: 1000s of probability distributions for 100 parameters structured in a dependency tree

## IRA Home Energy Rebate Scenario Tool

- Modeling of Program Design
- Equipment Cost (REMDB)
- Consumer Choice Modeling
- Policy Preferences Adjustment Factors
- Power Sector Evolution (Cambium)

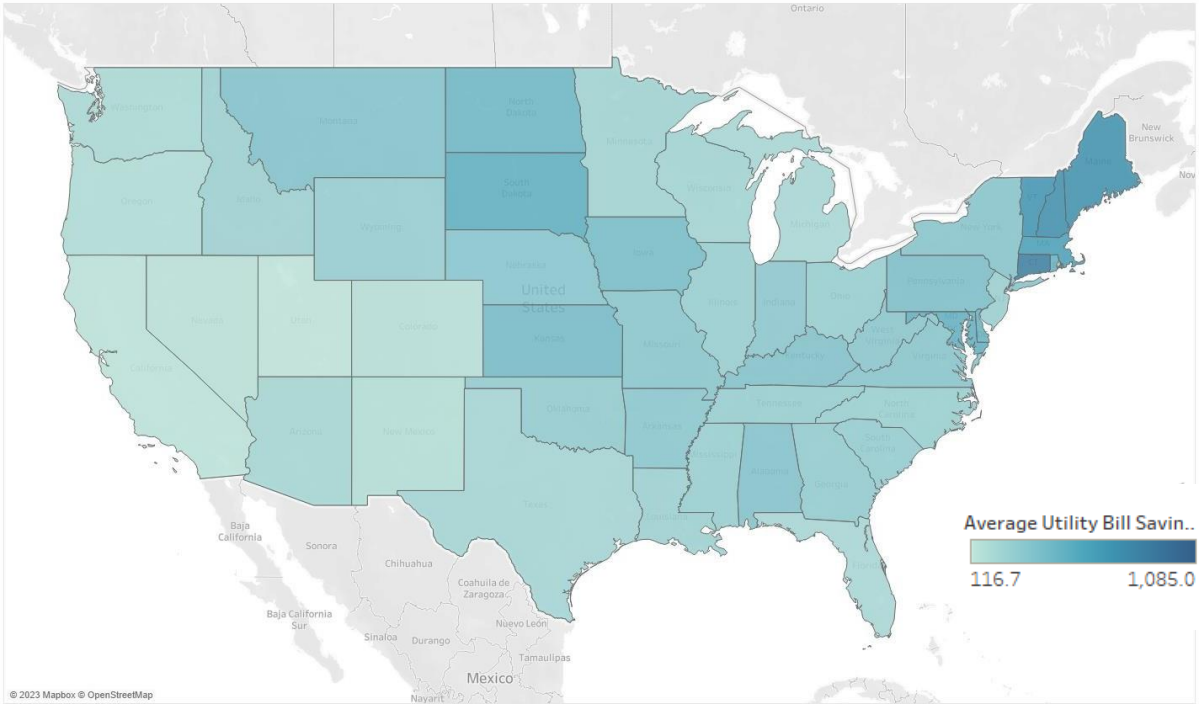
## Outputs

- Utility Bill Savings
- Emissions Reductions
- Average Rebate Amount
- Households Upgraded
- Types of Upgrades
- Cost to Consumers
- Homes Electrified
- And More!

# Reference Scenario

- Purchasing Decisions Driven by:
  - Cost to Consumer
  - Bill Savings
  - Payback Period

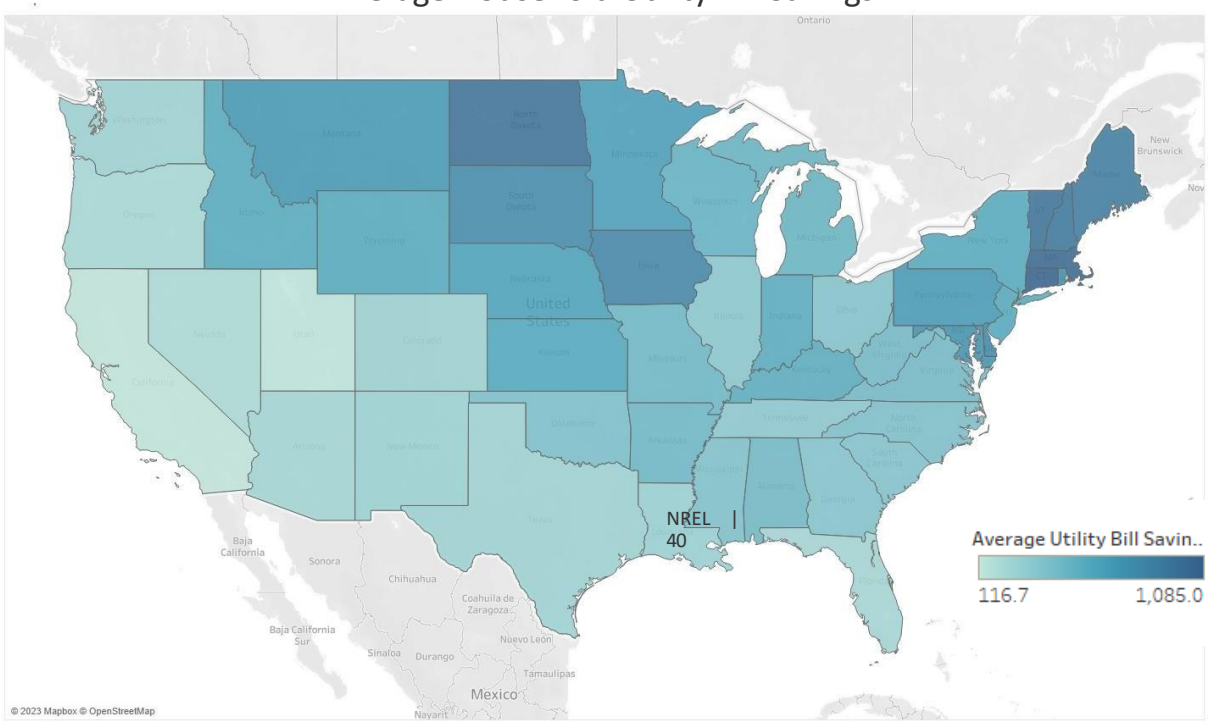
Average Household Utility Bill Savings



# Focused Scenario

- Additional Adoption by Households:
  - Heating with Fuel Oil or Propane
  - Built before 1980
  - Do not currently have air conditioning

Average Household Utility Bill Savings



# Summary Comparison

| | Reference | Targeted |
|---|---|---|
| Total Households Receiving Rebates | 927,000 | 908,000 |
| Total Emission Reduction (Annual) | 2.6 MMT | 3.0 MMT |
| Total Utility Bill Savings (Annual) | $279 million | $384 million |
| Average Utility Bill Savings (Annual) | $300 | $420 |
| Number of Households Adding AC | 73,000 | 198,000 |
| Number of Households Electrified | 436,000 | 460,000 |

# Conclusions

- IRA Home Energy Rebates programs have the potential for significant impacts
- There are a wide range of benefits from these energy efficiency upgrades
- Targeting upgrades can substantially increase their impact

# Appendix

# Disclaimers for IRA Scenario Tool

- **Outputs should be thought of as guidelines showing the reasonable outcomes rather than projections of what will happen**
- Not all packages are simulated in every house, for example if a home already has a heat-pump then the minimum-efficiency heat pump package would exclude that house from the analysis
- Package cost data, while calculated in ResStock at the household level, is analyzed at the microsegment level likely obscuring some variations in the per household costs
- Utility rates are handled at the state level whenever possible however for some fuels regional or even national averages are used; it should also be noted that no TOU rates were considered in this analysis
- Bill savings analysis will differ from published EUSS derived results because of changes in utility rates
- All packages simulated were part of the End-Use Savings Shapes (EUSS) Res Round 1 analysis. Assumptions about technologies are available in this slide deck - https://www.nrel.gov/docs/fy23osti/84931.pdf
- Scenarios are driven by the measures included in the tool. While covering many of the technologies included in IRA, exact performance levels for IRA program eligibility are not included in this dataset.
- Heat pumps were sized for cooling load, meaning that in cold climates they are likely undersized increasing the reliance of these households on supplemental (less efficient) heat – making bill impacts look less favorable than if sized for heating
- Heat pumps are assumed to be installed and operate perfectly; imperfect refrigerant charge and imperfect air flow can reduce performance.

**Link to Technical Report**

**Adam Stenftenagel**

***Radiant Labs***

***Snugg Home***

# Deep Energy Retrofits & IRA Residential Rebates

## Bundling, Braiding, & Financing

**Adam Stenftenagel**
**CEO - Radiant Labs & Snugg Home**
**adam@snugghome.com**
**adam@radiantlabs.co**


RADIANT LABS

Snugg Pro

# Ft.  Myers, FL

RADIANT LABS

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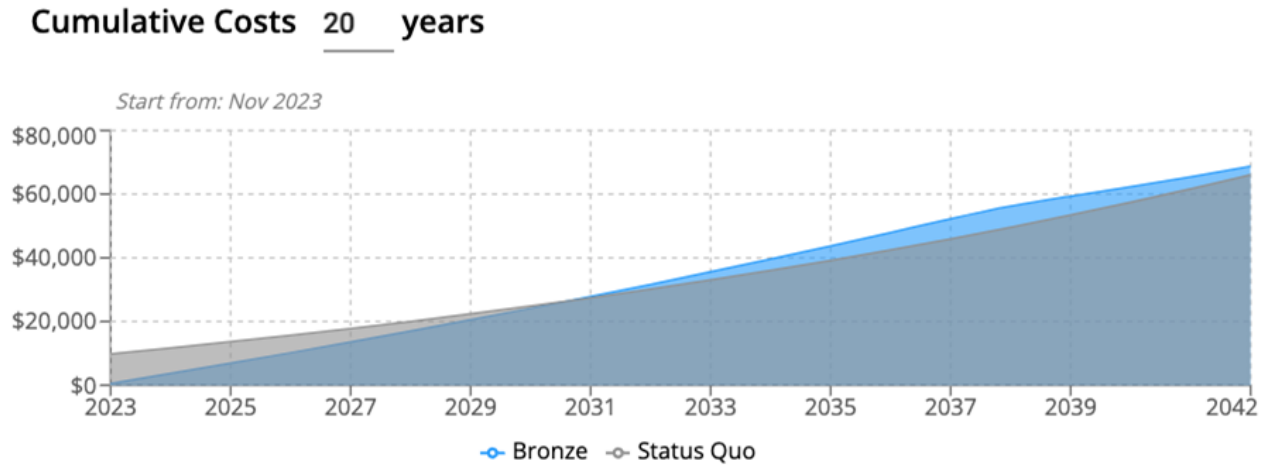
# Ft. Myers

1999 • All Electric • Slab on Grade • 1900 sqft

## Heat Pump • HP Water Heater

**$150 Utility Rebate**
**$2000 Tax Credit**
**7.5% / 15 yr Loan**




**$56,533** on annual energy bills + **$9,550** on unexpected replacements = **$66,083** Total

Business as usual

**$41,951** on energy bills + **$26,776** on Bronze package replacements financing (including interest payments) = **$68,727** Total

Engaging the roadmap

**$-2,644**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

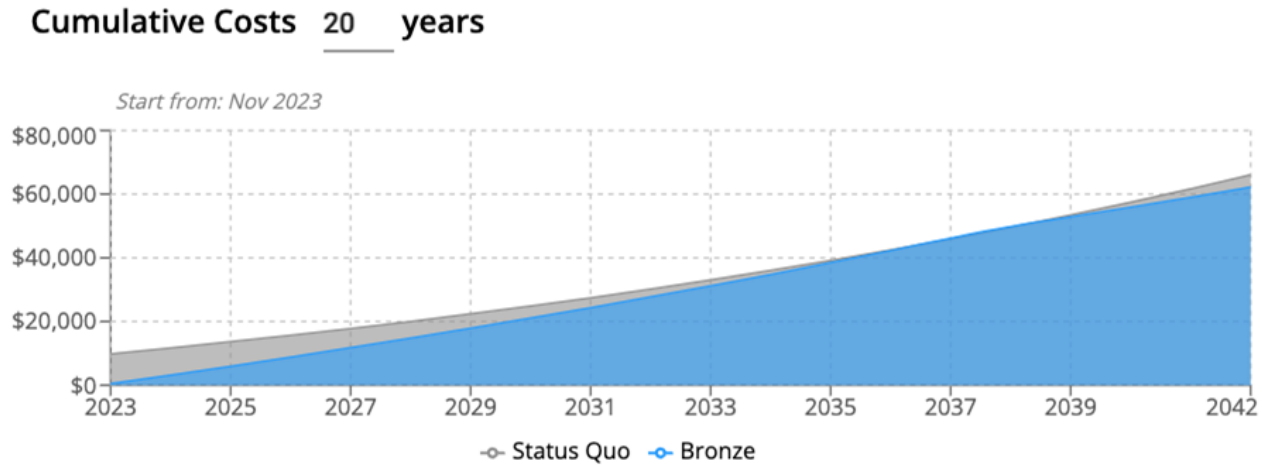
*Assumes a 5% energy escalation rate*

# Ft. Myers

1999 • All Electric • Slab on Grade • 1900 sqft

## Heat Pump • HP Water Heater

**$150 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**7.5% / 15 yr Loan**




**$56,533** on annual energy bills + **$9,550** on unexpected replacements = **$66,083** Total

Business as usual

**$41,951** on energy bills + **$20,305** on Bronze package replacements financing (including interest payments) = **$62,256** Total

Engaging the roadmap

**$3,828**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

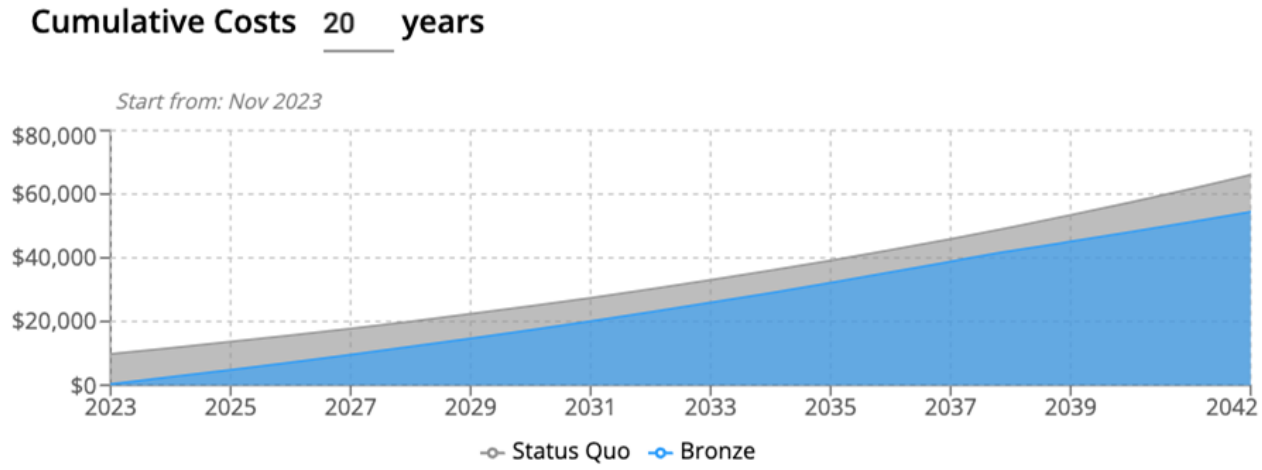
*Assumes a 5% energy escalation rate*

# Ft. Myers

1999 • All Electric • Slab on Grade • 1900 sqft

## Heat Pump • HP Water Heater

**$150 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**0% / 15 yr On Bill Loan**




**$56,533** on annual energy bills + **$9,550** on unexpected replacements = **$66,083** Total

Business as usual

**$41,951** on energy bills + **$12,550** on Bronze package replacements financing (including interest payments) = **$54,501** Total

Engaging the roadmap

**$11,582**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

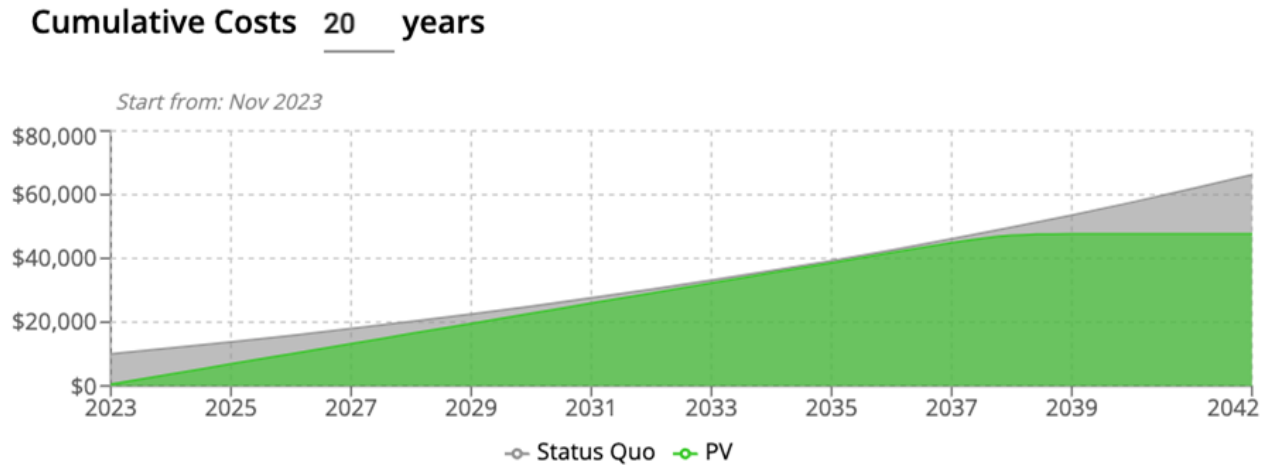
*Assumes a 5% energy escalation rate*

# Ft. Myers

1999 • All Electric • Slab on Grade • 1900 sqft

## Heat Pump • HP Water Heater • PV

**$150 Utility Rebate**
**$2000 Tax Credit**
**30% ITC on PV**
**7.5% / 15 yr Loan**




**$56,533** on annual energy bills + **$9,700** on unexpected replacements = **$66,233** Total

Business as usual

**$0** on energy bills + **$47,650** on PV package replacements financing (including interest payments) = **$47,650** Total

Engaging the roadmap

**$18,583**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

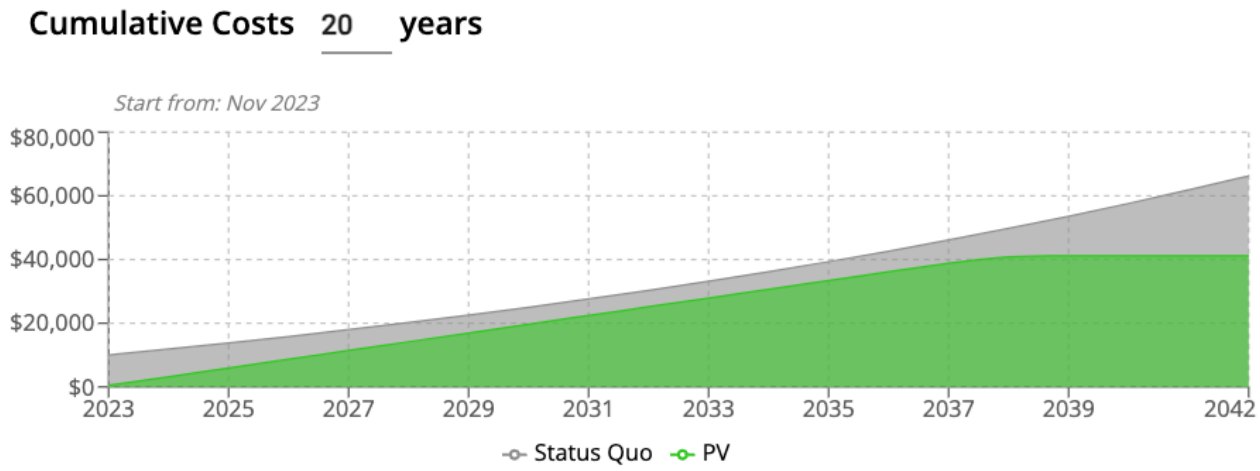
*Assumes a 5% energy escalation rate*

# Ft. Myers

1999 • All Electric • Slab on Grade • 1900 sqft

## Heat Pump • HP Water Heater • PV

**$150 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**30% ITC on PV**
**7.5% / 15 yr Loan**




**$56,533** on annual energy bills + **$9,700** on unexpected replacements = **$66,233** Total

Business as usual

**$0** on energy bills + **$41,179** on PV package replacements financing (including interest payments) = **$41,179** Total

Engaging the roadmap

**$25,055**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

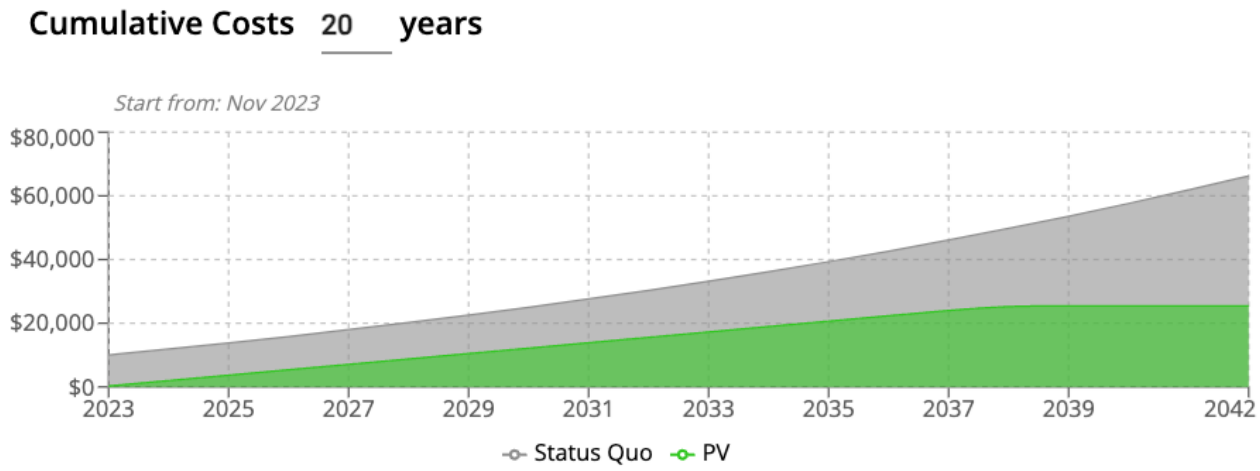
*Assumes a 5% energy escalation rate*

# Ft. Myers

1999 • All Electric • Slab on Grade • 1900 sqft

## Heat Pump • HP Water Heater • PV

**$150 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**30% ITC on PV**
**0% / 15 yr On Bill Loan**




**$56,533** on annual energy bills + **$9,700** on unexpected replacements = **$66,233** Total

Business as usual

**$0** on energy bills + **$25,452** on PV package replacements financing (including interest payments) = **$25,452** Total

Engaging the roadmap

**$40,781**
**Total 20 yr Savings**

Engaging the roadmap

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Snugg Pro

*Assumes a 5% energy escalation rate*

# Denver, CO

RADIANT LABS

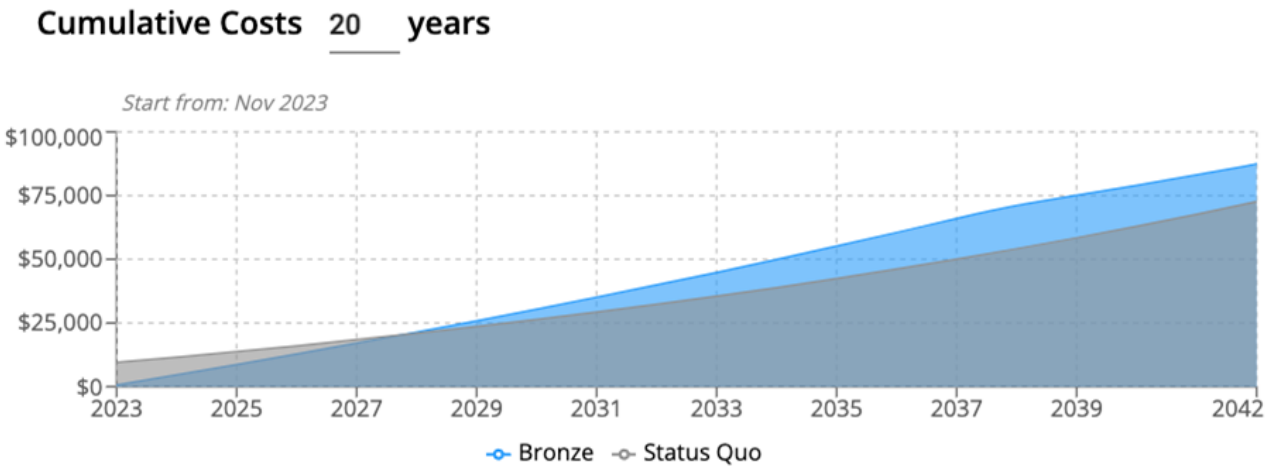
Snugg Pro

# Denver

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop

**$3400 Utility Rebate**
**$2000 Tax Credit**
**7.5% / 15 yr Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$54,892** on energy bills + **$32,520** on Bronze package replacements financing (including interest payments) = **$87,412** Total

Engaging the roadmap

**$-14,763**
**Total 20 yr Savings**

Engaging the roadmap

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*Assumes a 5% energy escalation rate*

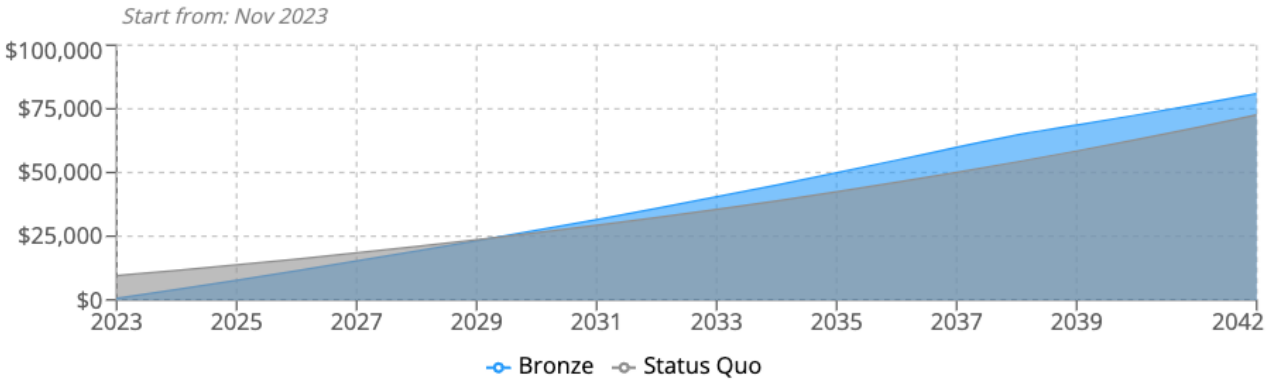
# Denver

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**7.5% / 15 yr Loan**

Cumulative Costs 20 years




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$54,892** on energy bills + **$26,048** on Bronze package replacements financing (including interest payments) = **$80,940** Total

Engaging the roadmap

**$-8,291**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

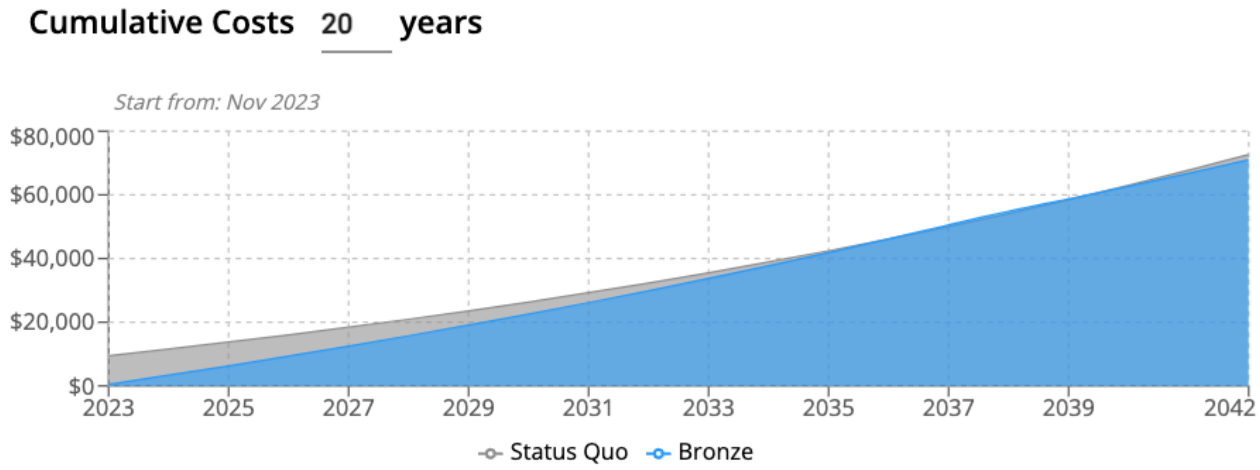
*Assumes a 5% energy escalation rate*

# Denver

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**0% / 15 yr On Bill Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$54,892** on energy bills + **$16,100** on Bronze package replacements financing (including interest payments) = **$70,992** Total

Engaging the roadmap

**$1,657**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

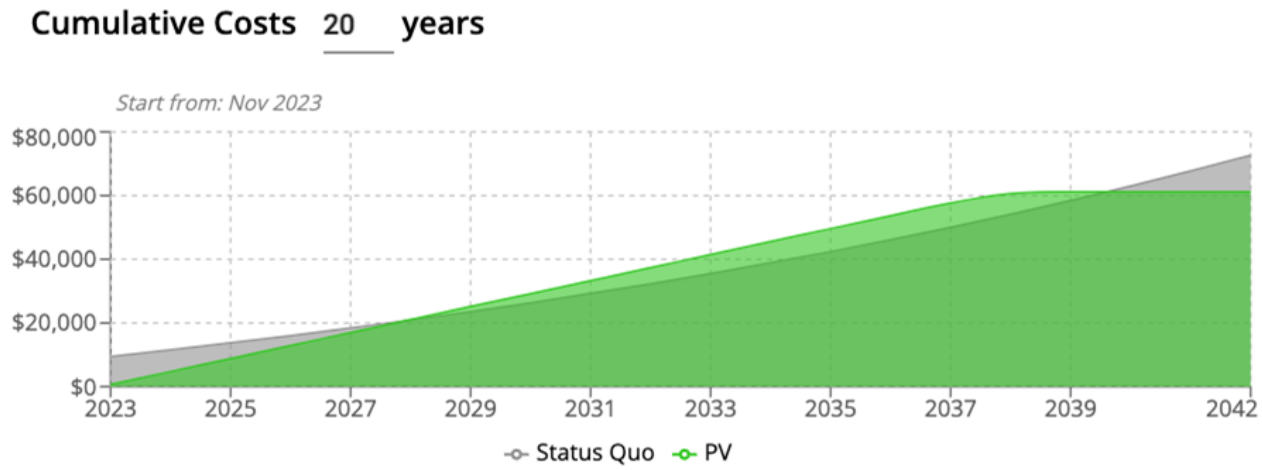
*Assumes a 5% energy escalation rate*

# Denver

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop • PV

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**30% ITC on PV**
**7.5% / 15 yr Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$0** on energy bills + **$61,202** on PV package replacements financing (including interest payments) = **$61,202** Total

Engaging the roadmap

**$11,448**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

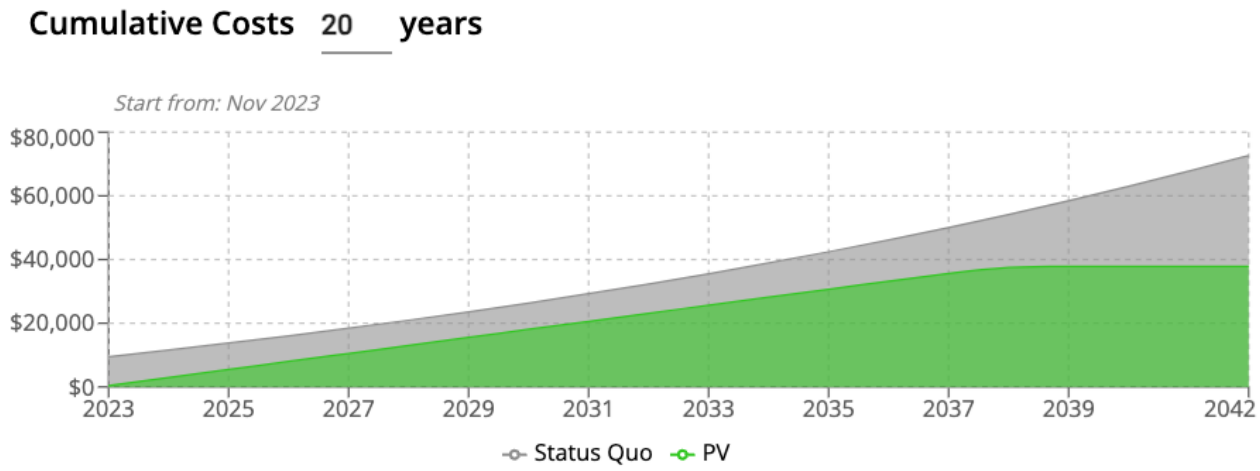
*Assumes a 5% energy escalation rate*

# Denver

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop • PV

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**30% ITC on PV**
**0% / 15 yr On Bill Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$0** on energy bills + **$37,828** on PV package replacements financing (including interest payments) = **$37,828** Total

Engaging the roadmap

**$34,821**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

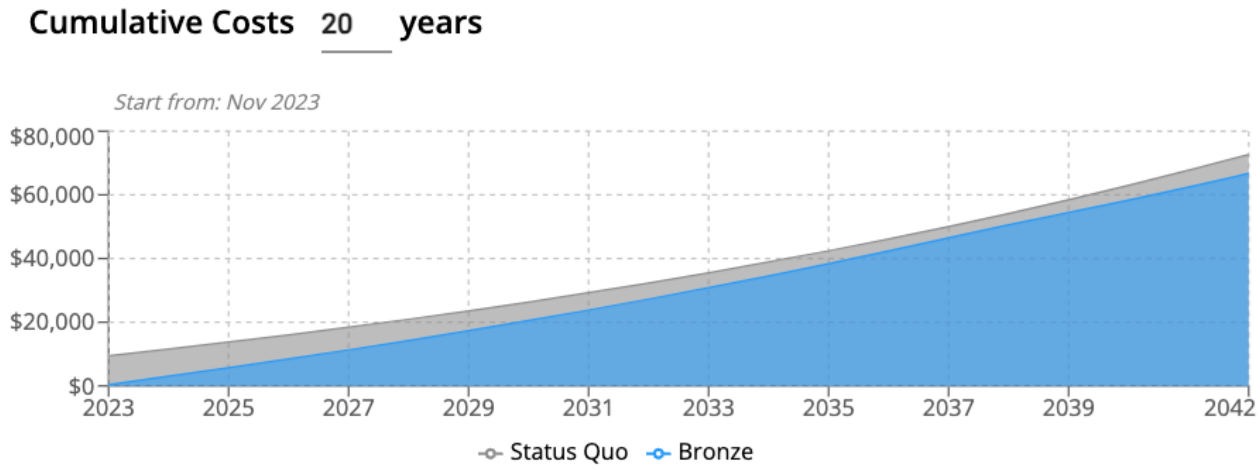
*Assumes a 5% energy escalation rate*

# Denver - 150% AMI

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$12790 HEEHR Rebate**
**7.5% / 15 yr Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$54,892** on energy bills + **$11,827** on Bronze package replacements financing (including interest payments) = **$66,719** Total

Engaging the roadmap

**$5,930**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

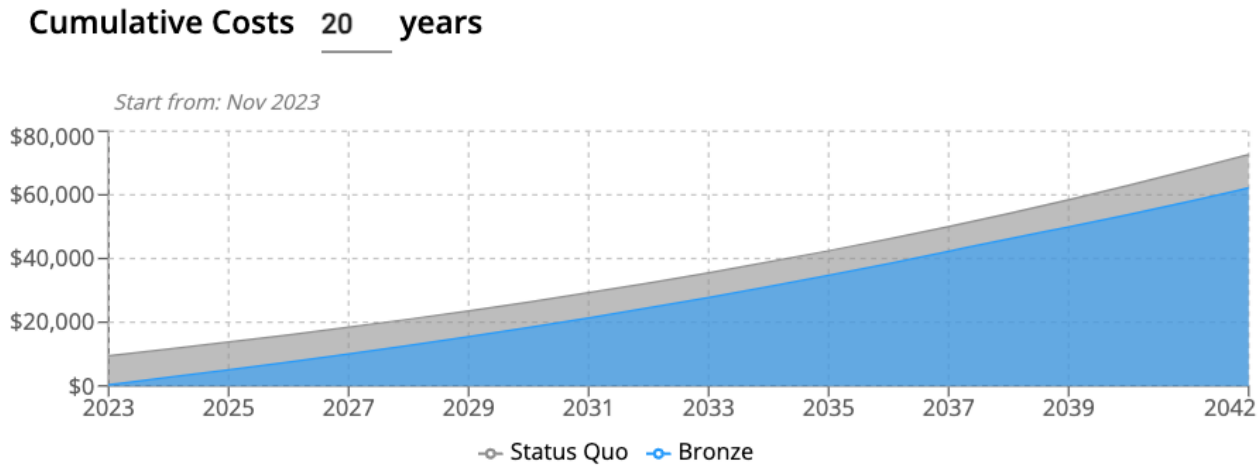
*Assumes a 5% energy escalation rate*

# Denver - 150% AMI

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$12790 HEEHR Rebate**
**0% / 15 yr On Bill Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$54,892** on energy bills + **$7,310** on Bronze package replacements financing (including interest payments) = **$62,202** Total

Engaging the roadmap

**$10,447**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

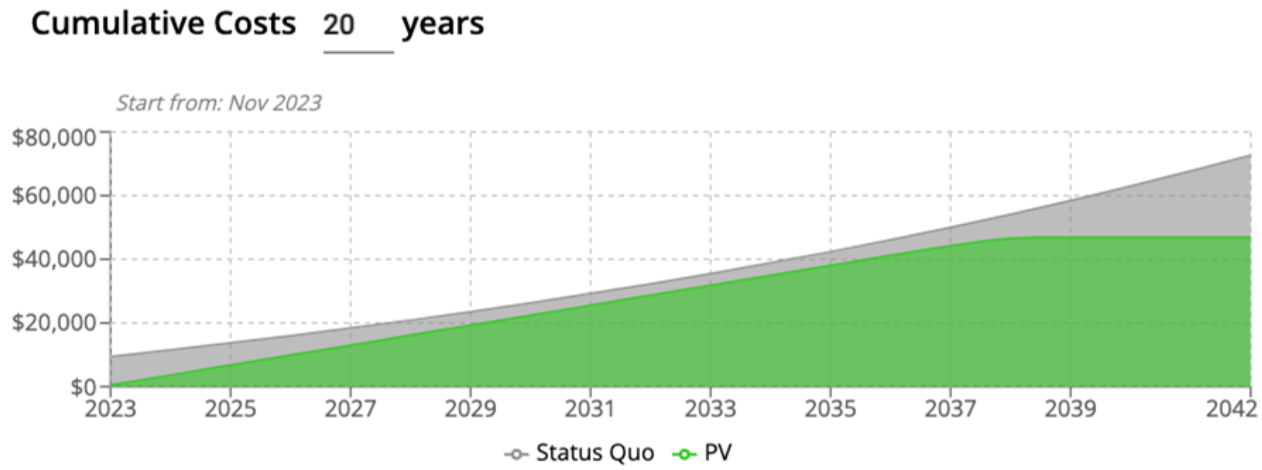
*Assumes a 5% energy escalation rate*

# Denver - 150% AMI

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop • PV

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$12790 HEEHR Rebate**
**30% ITC on PV**
**7.5% / 15 yr Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$0** on energy bills + **$46,980** on PV package replacements financing (including interest payments) = **$46,980** Total

Engaging the roadmap

**$25,669**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

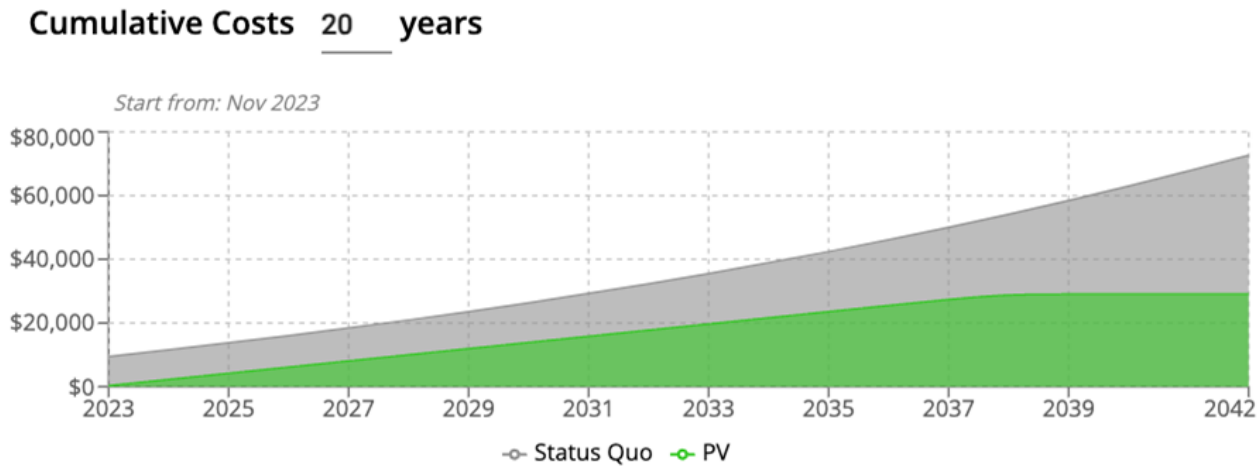
*Assumes a 5% energy escalation rate*

# Denver - 150% AMI

1965 • Gas Heat • Crawlspace • 1925 sqft

## Attic • Air Sealing • Condition Crawl
## Heat Pump • DHW • Induction Cooktop • PV

**$3400 Utility Rebate**
**$2000 Tax Credit**
**$12790 HEEHR Rebate**
**30% ITC on PV**
**0% / 15 yr On Bill Loan**




**$63,499** on annual energy bills + **$9,150** on unexpected replacements = **$72,649** Total

Business as usual

**$0** on energy bills + **$29,038** on PV package replacements financing (including interest payments) = **$29,038** Total

Engaging the roadmap

**$43,611**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

*Assumes a 5% energy escalation rate*

# Rochester, NY

RADIANT LABS

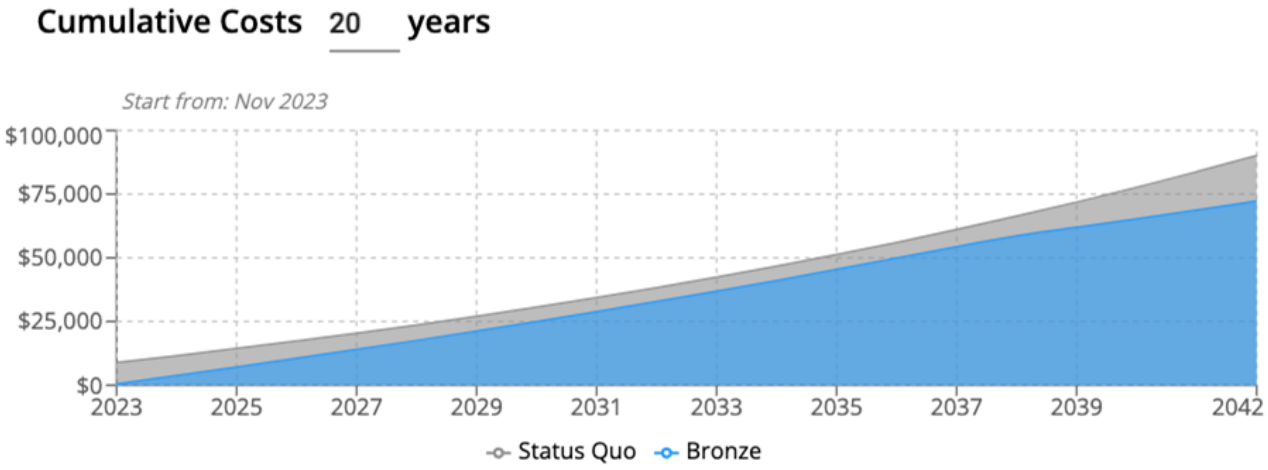
Snugg Pro

# Rochester

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop

**$5400 Utility Rebate**
**$2000 Tax Credit**
**7.5% / 15 yr Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$46,131** on energy bills + **$26,210** on Bronze package replacements financing (including interest payments) = **$72,340** Total

Engaging the roadmap

**$17,801**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

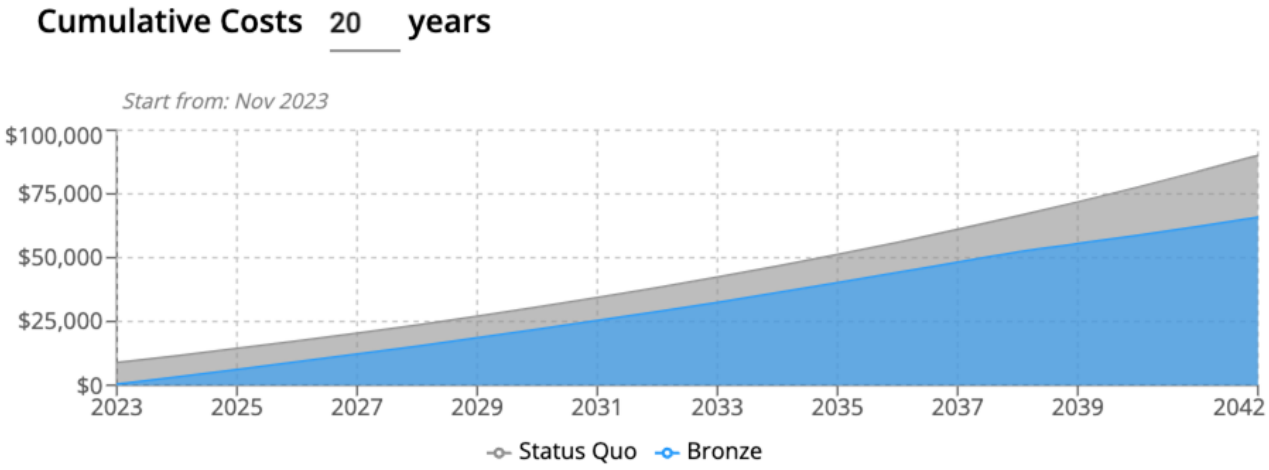
*Assumes a 5% energy escalation rate*

# Rochester

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop

**$5400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**7.5% / 15 yr Loan**




| $81,642 on annual energy bills | + | $8,500 on unexpected replacements | = | $90,142 Total |
|---|---|---|---|---|

Business as usual

| $46,131 on energy bills | + | $19,738 on Bronze package replacements financing (including interest payments) | = | $65,869 Total |
|---|---|---|---|---|

Engaging the roadmap

**$24,273**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

*Assumes a 5% energy escalation rate*

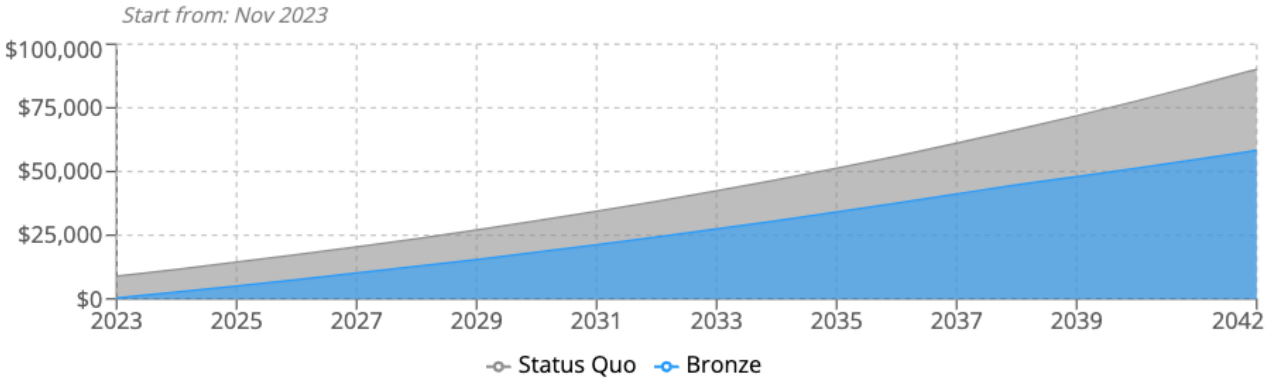
# Rochester

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop

**$5400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**0% / 15 yr On Bill Loan**

Cumulative Costs 20 years




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$46,131** on energy bills + **$12,200** on Bronze package replacements financing (including interest payments) = **$58,331** Total

Engaging the roadmap

**$31,811**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

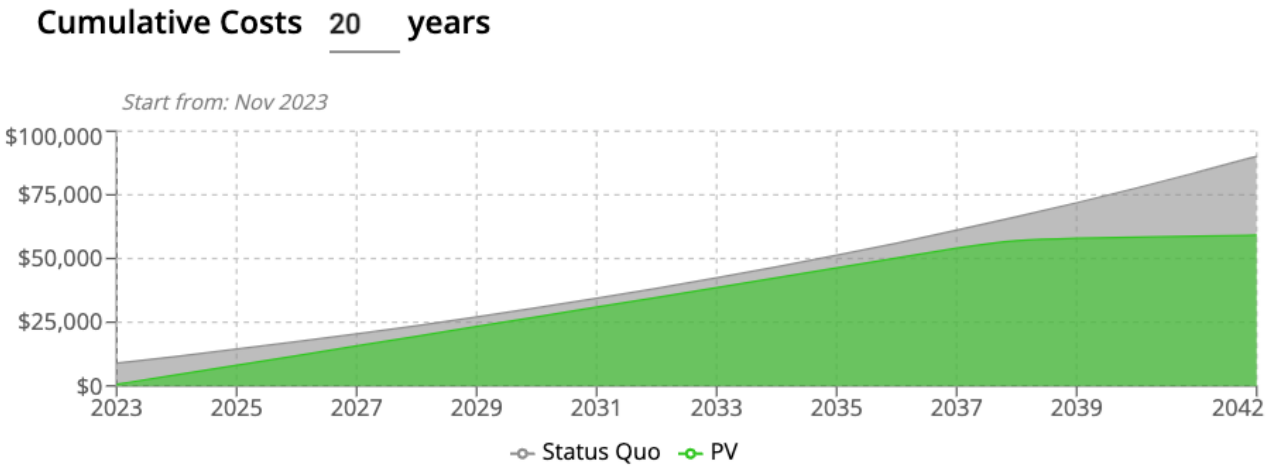
*Assumes a 5% energy escalation rate*

# Rochester

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop • PV

**$5400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**30% ITC on PV**
**7.5% / 15 yr Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$5,773** on energy bills + **$53,431** on PV package replacements financing (including interest payments) = **$59,204** Total

Engaging the roadmap

**$30,938**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

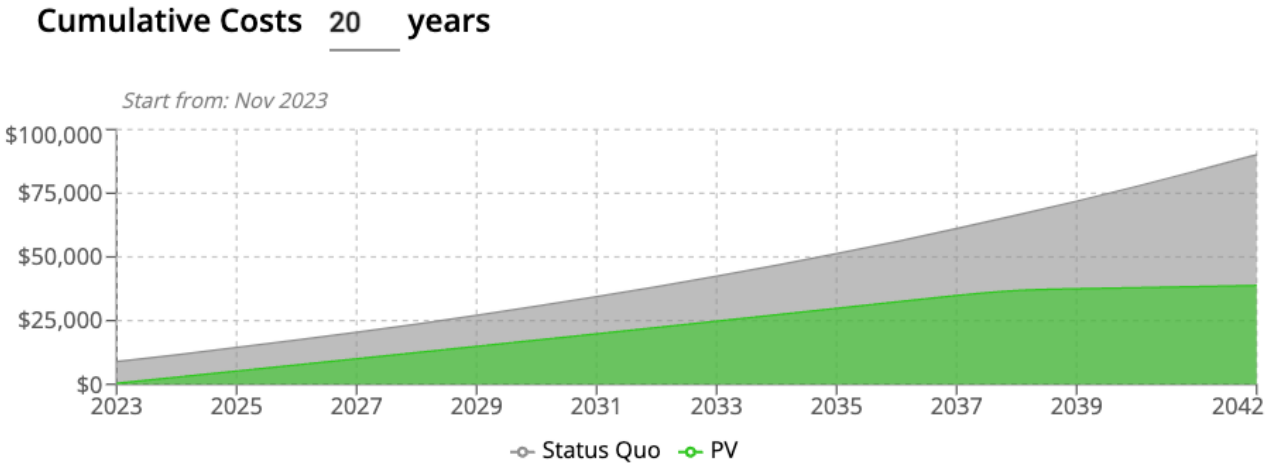
*Assumes a 5% energy escalation rate*

# Rochester

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop • PV

**$5400 Utility Rebate**
**$2000 Tax Credit**
**$4000 HOMES Rebate**
**30% ITC on PV**
**0% / 15 yr On Bill Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$5,773** on energy bills + **$33,025** on PV package replacements financing (including interest payments) = **$38,798** Total

Engaging the roadmap

**$51,344**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

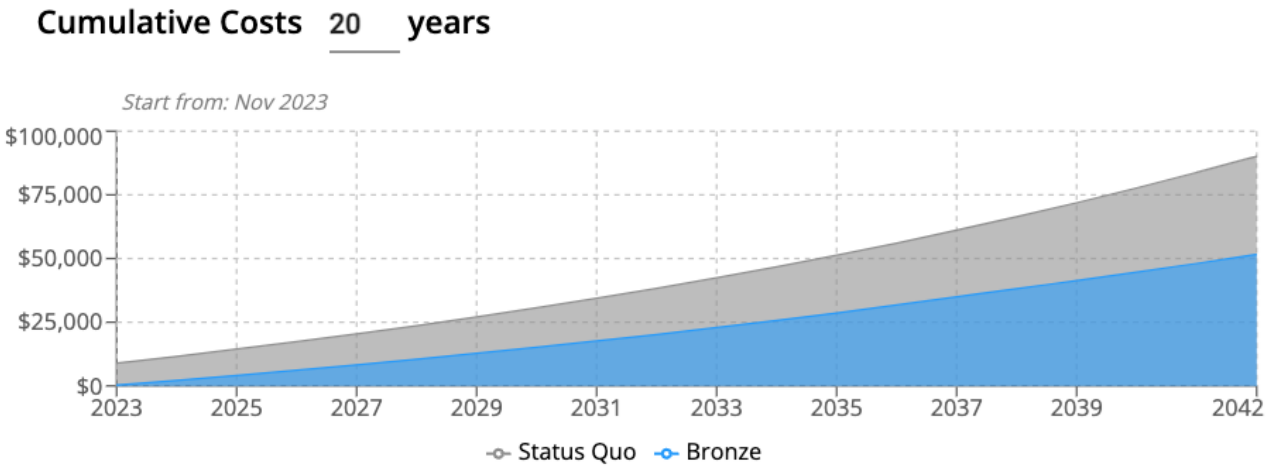
*Assumes a 5% energy escalation rate*

# Rochester - 150% AMI

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop

**$5,400 Utility Rebate**
**$2,000 Tax Credit**
**$12,790 HEEHR Rebate**
**7.5% / 15 yr Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$46,131** on energy bills + **$5,517** on Bronze package replacements financing (including interest payments) = **$51,648** Total

Engaging the roadmap

**$38,494**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

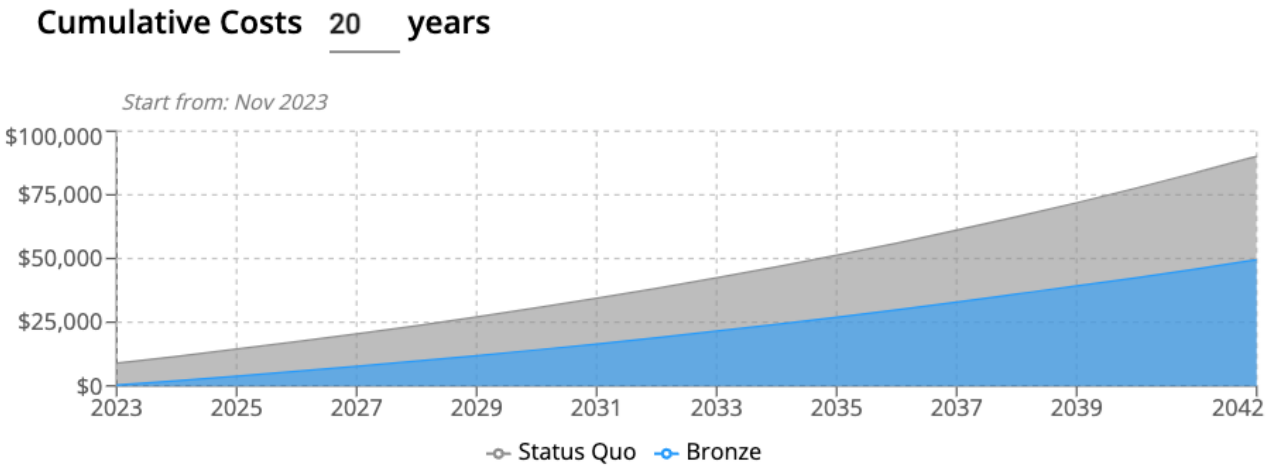
*Assumes a 5% energy escalation rate*

# Rochester - 150% AMI

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop

**$5,400 Utility Rebate**
**$2,000 Tax Credit**
**$12,790 HEEHR Rebate**
**0% / 15 yr On Bill Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$46,131** on energy bills + **$3,410** on Bronze package replacements financing (including interest payments) = **$49,541** Total

Engaging the roadmap

**$40,601**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

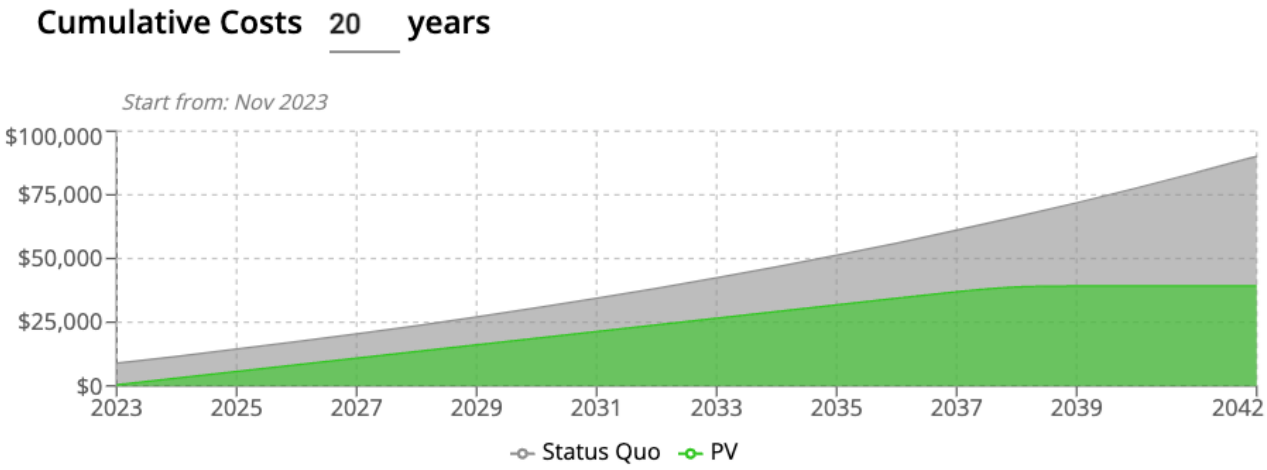
*Assumes a 5% energy escalation rate*

# Rochester - 150% AMI

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop • PV

**$5,400 Utility Rebate**
**$2,000 Tax Credit**
**$12,790 HEEHR Rebate**
**30% ITC on PV**
**7.5% / 15 yr Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$0** on energy bills + **$39,210** on PV package replacements financing (including interest payments) = **$39,210** Total

Engaging the roadmap

**$50,932**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

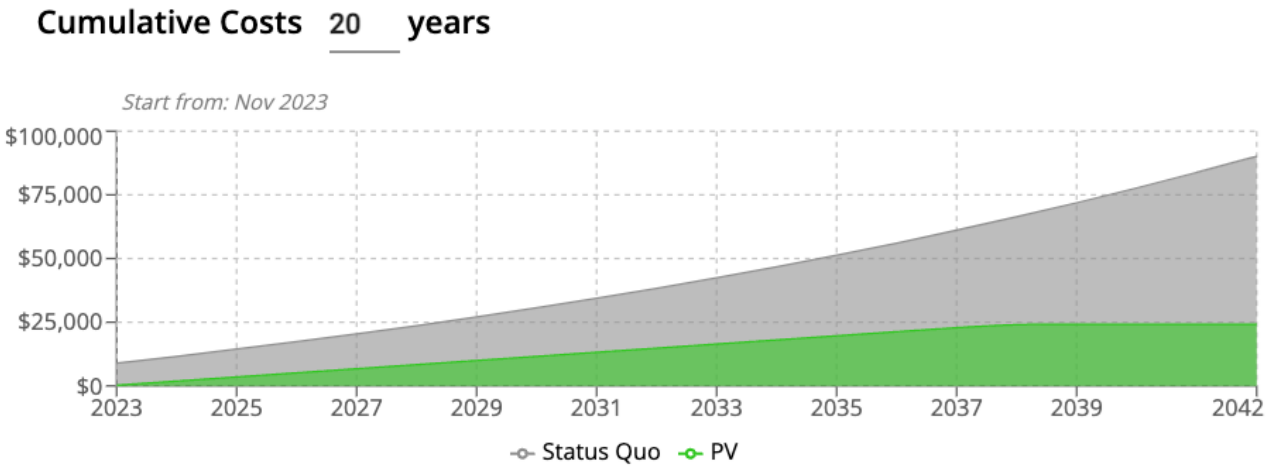
*Assumes a 5% energy escalation rate*

# Rochester - 150% AMI

1915 • Gas Heat • Basement • 1650 sqft

## Attic • Air Sealing • Rim Joist
## Heat Pump • HP DHW • Induction Cooktop • PV

**$5,400 Utility Rebate**
**$2,000 Tax Credit**
**$12,790 HEEHR Rebate**
**30% ITC on PV**
**0% / 15 yr On Bill Loan**




**$81,642** on annual energy bills + **$8,500** on unexpected replacements = **$90,142** Total

Business as usual

**$0** on energy bills + **$24,235** on PV package replacements financing (including interest payments) = **$24,235** Total

Engaging the roadmap

**$65,907**
**Total 20 yr Savings**

Engaging the roadmap

RADIANT LABS

Snugg Pro

*Assumes a 5% energy escalation rate*

# Bulk Modeling

RADIANT LABS

San Francisco Modeling

MODELING_DYNAMIC · 103,425 of 505,553

Filter set: Basic (2)

Save *

Add Chart

## EASF RESI


## Upgrade ID

Column value: SANFRAN005

MODELING_DYNAMIC/PACKAGE_ID

## # Natural Gas Price

$ / therm

1 — 2.30 — 5

## # Rebate Amount

$

0 — 0 — 30000

## # Interest Rate

Use as whole number (for example 7.9% enter 7.90)

0 — 7.5 — 20

## # Num of Payments

# of payments on the loan (loan term in years * 12)

12 — 180 — 360

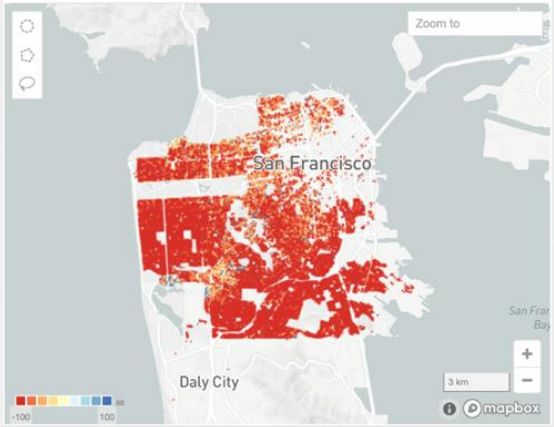
## # Status Quo Replacement Factor

Adjustment Factor for Status Quo Replacement Co...

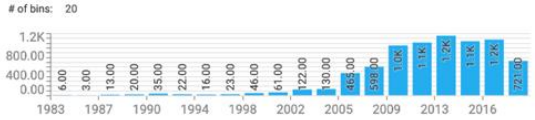
0 — 0 — 2

Cash Flow View | Payback View

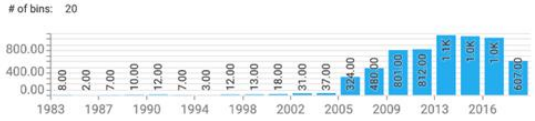
## Offset PV Monthly Cash Flow



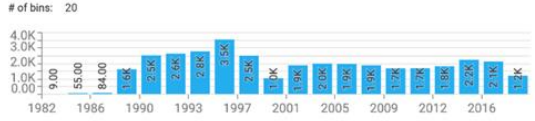

## Gas Furnace Permits



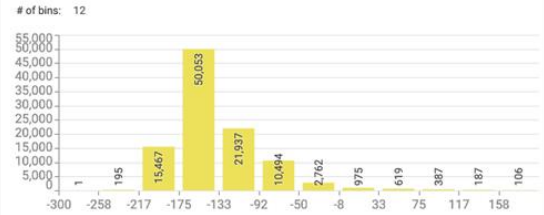

## Water Heater Permits



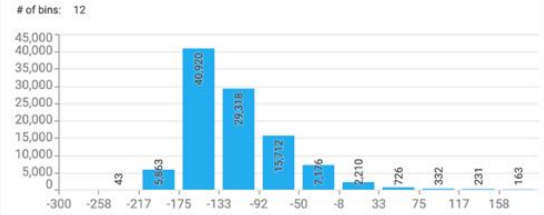

## Roof Permits



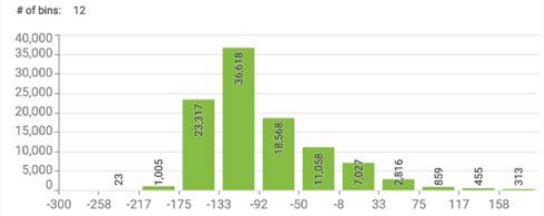

## No PV Monthly Cashflow




## Offset PV Monthly Cashflow




## NetZero PV Monthly Cashflow




## No PV # Cashflow +

2,307

## No PV % Cash Flow +

2%

## Offset PV # Cashflow +

3,732

## Offset PV % Cash Flow +

3%

## NetZero PV # Cashflow +

11,028

## Netzero PV % Cash Flow +

10%

## Avg Unit Area (sqft)

1,804

## Median Year Built

1930

## Total Assessed Value ($)

76B

## Owner Occupancy %

60%

# Records by CENSUS LIMITED ENGLISH as PERCENT

# Records by CENSUS WITHOUT INTERNET as PERCE...

RADIANT LABS

MARKET FACTORS - Adam Demo

COMMON_SCHEMA · 2,997,196 of 8,466,122

Filter set: Default Filter Set (2)

Saved | Add Chart

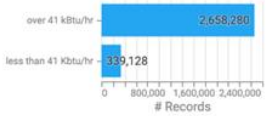
UPGRADE_ID

Column value: NYSERDA001

US_NY_NEW_YORK_STATE_COMMON_AND_M...

## Disadvantaged Community


## Peak Heating Load Threshold




## Property Use

SINGLE FAMILY 2,996,383

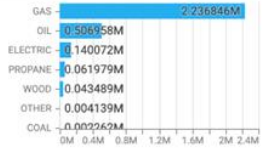
MULTI-FAMILY 447

COMMERCIAL/INDUSTRIAL/GOVERNMENT 37

MOBILE HOME 200

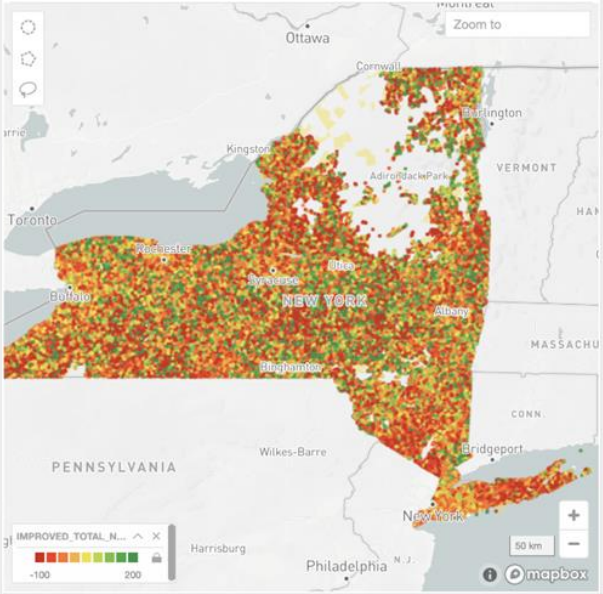
0.0 1.0M 2.0M

## Heating Fuel

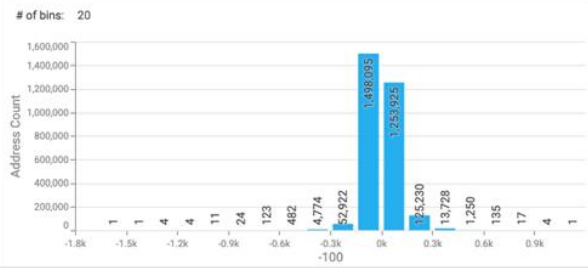



NY State

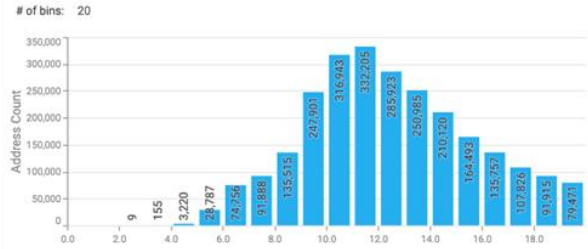
## Cash Flow with Disadvantaged Community Overlay




## Monthly Cash Flow




## Payback (Years)




## # Addresses

2,997,408

## # Cash Flow +

1,557,461

## % Cash Flow +

51%

## Avg Incremental Cost

$30,575

## Avg Area (sqft)

1,803

## Total Incremental Cost

92B

## Median Year Built

1955

## Owner Occupancy %

## # Rebate Amount

0 — 0 — 30000

## # Loan Interest Rate

Use as whole number (for example 7.9% enter 7.90)

0 — 1.9 — 20

## # Loan Payments

12 — 180.00 — 360

## # Installation Cost Adjustment

.5 — 1.25 — 2

## # Natural Gas cost/therm

.5 — 2.1 — 5

## # Fuel Oil cost/gallon

1.00 — 4 — 8

## # Electricity cost/kWh

0.04 — 0.14 — 0.50

## # Status Quo Replacement Cost Factor

0 — 0 — 2

# Smart Tools for Efficient HVAC Performance (STEP) Campaign

Pacific Northwest NATIONAL LABORATORY

STEP CAMPAIGN

Scan this QR code to visit our website

Contact: christian.valoria@pnnl.gov

The STEP Campaign aims to increase adoption of smart diagnostic tools to streamline HVAC system performance testing and troubleshooting, reducing energy-wasting faults and improving occupant comfort.

## To join the STEP Campaign, visit: bit.ly/3DFmEaE

### HVAC Contractors and Technicians

- Reduce callbacks, improve consistency and quality, streamline processes
- Find out where to get training on smart diagnostic tools
- Be recognized for successful adoption of smart diagnostic tools!

### Utilities and Program Implementers

- Streamline quality installation and quality maintenance programs
- Improve engagement with your contractors
- Be recognized for programs that utilize smart diagnostic tools!

### HVAC Training Organizations

- Offer qualified training on System Performance with smart diagnostic tools
- Promote your training events
- Be recognized for providing training!

### Weatherization Organizations

- Ensure your ASHP/CAC installations are operating at optimized efficiency
- Develop pilot with PNNL team
- Be recognized!

ORGANIZING PARTNERS

ACCA · BUILDING PERFORMANCE ASSOCIATION · CEE Working Together, Advancing Efficiency · HVAC Excellence · NATE · neea · U.S. DEPARTMENT OF ENERGY

# Explore the Residential Program Guide

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.
- Health + Home Performance Infographic – spark homeowner conversations.


https://rpsc.energy.gov

# Health + Home Performance Infographic


DOE's Health + Home Performance Infographic reveals the link between efficiency and health – something everyone cares about. Efficiency programs and contractors can use the question-and-answer format to discover a homeowner's needs.

The infographic is ideal for the "kitchen table" conversations where people decide what to do – and who they want to do it. It also has links for homeowners to find a qualified contractor if they do not already have one.

Download this infographic from DOE's Better Buildings Residential Network.

Looking for photos to help tell your energy efficiency story? Visit our image libraries: https://www.energy.gov/eere/better-buildings-residential-network/articles/image-libraries

# Thank You!

**Follow us to plug into the latest Better Buildings news and updates!**

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**Office of Energy Efficiency and Renewable Energy Facebook**

**Please send any follow-up questions or future call topic ideas to:**
bbresidentialnetwork@ee.doe.gov