

Technical Appendix – Methodology for Greenhouse Gas Reduction Estimates for CPRG Implementation Grant Application

Las Vegas-Henderson-Paradise Metropolitan Statistical Area

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Introduction

This appendix is a supplement to the Las Vegas-Henderson-Paradise Metropolitan Statistical Area Implementation Grants General Competition application under the Environmental Protection Agency's (EPA) Climate Pollution Reduction Grant Program (CPRG). This appendix details methodologies, data, sources, assumptions, and results of quantitative assessments performed in support of the All-In Home and Building Improvement Hub measure quantifications of estimated greenhouse gas (GHG) emissions reductions.

Measure Description

The All-In Home and Building Improvement Hub will establish a one-stop shop for home and building improvements that enhance indoor air quality and comfort, increase water and energy efficiency, and reduce utility bills. It will provide residents and businesses with the technical assistance, financial resources, and contractors needed to do the work. This action is meant to drive energy and emissions reductions in two ways that were quantified separately.

Direct impacts include reductions in household energy use that result from installation of energy conservation measures implemented directly with CPRG funds in income-qualifying households.

Indirect impacts are those that result from investments in energy conservation that are induced across Clark County from education and support services available through the Hub to help all residents and businesses navigate the complex landscape of incentives for home energy and other health related improvements.

Analysis Approach

Potential benefits estimated for the All-In Home and Building Improvement Hub are dependent on several key assumptions. Unlike discrete infrastructure projects, the potential reach and subsequent impact of the Hub will be determined by factors such as the total amount awarded, program implementation costs, and details of program design.

GHG Reduction potential and other benefits were estimated from a series of connected calculations:

- 1) Estimate the number of homes that could be upgraded with the requested funding amount.
- 2) Estimate the number of households that could be indirectly supported by the Hub, inducing action through education and other support.
- 3) Estimate the energy impacts of 'measure packages' applied across participating households.
- 4) Estimate reductions in GHGs for each year's reduction in energy use, accounting for changes to grid carbon intensity expected over the short term (2025-2030) and long term (2025-2050)
- 5) Sum annual reductions for cumulative reductions projected for 2025-2030 and 2025-2050.

Tools and Models

The following section summarizes tools used in the analysis to support this grant application.

NREL ResStock End Use Savings Shapes (EUSS)

The primary source of data for energy use reduction potential used is the National Renewable Energy Lab (NREL) ResStock, End Use Savings Shapes (EUSS), Typical Meteorological Year (TMY) datasets for the

state of Nevada¹. This resource contains the results of building energy models testing common measure packages in a comprehensive set of model input parameters describing the US residential building stock in great detail. The EUSS dataset allows for developing reduction estimates that capture how the weather of Southern Nevada impacts the effectiveness of energy conservation measures across a range of home typologies and conditions that are likely to exist in the field. The EUSS dataset provides several pre-defined measure packages for varying levels of weatherization/building envelope measures and electrification (Table 1). This impact analysis is based on the average energy impact for select measure packages, which produce net energy savings estimates for each retrofit type.

Table 1. NREL ResStock EUSS Measure Package Descriptions

ResStock EUSS Measure Package	Description
Package 1: Basic Enclosure	<ul style="list-style-type: none"> - Attic floor insulation - General air sealing - Duct sealing - Drill-and-fill insulation
Package 2: Enhanced Enclosure	<ul style="list-style-type: none"> - Measure Package 1 - Foundation wall insulation and rim joint insulation - Seal vented crawlspaces - Insulate finished attics and cathedral ceilings
Package 4: Heat Pumps, High-Efficiency, Electric Backup	<ul style="list-style-type: none"> - Centrally ducted variable speed heat pump - Ductless variable speed mini-split - Backup heat provided by electric resistance
Package 8: Whole-Home Electrification, High Efficiency	<ul style="list-style-type: none"> - No enclosure measures - High-efficiency heat pump (Measure Package 4) - Heat pump water heater - Ventless heat pump dryer - Electric oven and induction range
Package 9: Whole-Home Electrification, High Efficiency + Basic Enclosure	<ul style="list-style-type: none"> - Measure Packages 1 & 8
Package 10: Whole-Home Electrification, High Efficiency + Enhanced Enclosure	<ul style="list-style-type: none"> - Measure Packages 2 & 8

With a substantial number of model runs representing many possible combinations of conditions, the EUSS dataset is believed to be a better estimate of likely outcomes of home energy efficiency measures. It provides higher confidence than other single point estimates available in the literature or % based changes to energy use.

One limitation faced in applying this tool was the tradeoffs between looking at targeted groups identifiable in the data set, such as low-income households, with the need to keep large numbers of model households to derive generalizable results.

NREL Cambium Model

The NREL Cambium Model² provided scenarios for projected emissions intensity of grid supplied electricity applied in future-year GHG reduction estimates. While Cambium provides a range of grid

¹ National Renewable Energy Laboratory. ResStock End Use Savings Shapes 2022.1 Release TMY3.

<https://resstock.nrel.gov/datasets>

² Gagnon, Pieter; Cowiestoll, Brady; Schwarz, Marty (2023): Cambium 2022 Data. National Renewable Energy Laboratory.

<https://scenarioviewer.nrel.gov>

carbon intensity scenarios for this analysis, the “Mid-Case with 95% Decarbonization by 2050” was selected as the primary scenario to be modeled as it aligns best with the outcomes for economy wide GHG reductions sought by the Inflation Reduction Act. The Cambium Model provides outputs using grid regions that align with other analyses performed under CPRG. One limitation of Cambium is that it does not provide a continuous year-over-year projection of factors, requiring some interpolation between years.

Calculation Steps

The first step in estimating reduction potential is to evaluate how far requested funding levels could reach if applied in Clark County.

Estimating Program Reach

The target award level for this program is \$499,999,236. Following development of the program implementation budget, it is assumed that nearly 20% of funding (\$99,990,014) would go towards various support activities including overall administration of the Hub. The remaining 80% of funds (\$400,009,222) would be reserved specifically for offsetting all costs associated with home energy retrofits and beneficial electrification in low-income households.

The analysis to support this application narrative was performed iteratively testing the impact of different combinations of energy savings potential and likely retrofit costs. The analysis demonstrated that by focusing on lower-cost measures, such as weatherization as opposed to full home decarbonization, the potential number of homes reached with implementation funds changed significantly.

Further, the overall intent of this program is to braid program benefits with as many additional sources of funding available. However, it is recognized that there are limitations on combining funding from multiple Inflation Reduction Act grant programs, notably The Home Electrification and Appliance Rebates³ and Home Efficiency Rebates Programs⁴ from the US Department of Energy. In a review of likely benefits from those programs, it appeared that a larger gap may exist for supporting comprehensive weatherization activities than for appliances and equipment, which provides some guidance for cost effective targeting. Note that energy savings and GHG reductions calculated here for the impact of CPRG do not include savings that would occur from households taking advantage of other IRA grant programs even though doing so will be encouraged for additional measures not covered by the Hub.

Estimating the number of households that can be reached with \$400,009,222 requires an estimate of the costs of different retrofit packages. For this analysis estimated costs of each package were developed from a compilation of installed costs, cataloged by Lawrence Berkeley National Labs⁵, to best match with the components of each of the ResStock Measure Packages. Total households potentially reached by the program was determined by dividing \$400,009,222 across prioritized shares of measures and their costs after local utility administered rebates were accounted for.

³ U.S. Department of Energy. Home Electrification and Appliance Rebates. <https://www.energy.gov/scep/home-electrification-and-appliance-rebates>

⁴ U.S. Department of Energy. Home Efficiency Rebates. <https://www.energy.gov/scep/home-efficiency-rebates>

⁵ Less, et al. Lawrence Berkeley National Labs. August 2021. The Cost of Decarbonization and Energy Upgrade Retrofits for US Homes. doi:10.20357/B7FP4D. https://eta-publications.lbl.gov/sites/default/files/final_walker_-_the_cost_of_decarbonization_and_energy.pdf

Table 2. Final Retrofit Package Costs per Household

ResStock EUSS Measure Package	Initial Cost per Retrofit ⁶	Available Utility Rebate Value ⁷
Package 2: Enhanced Enclosure	\$16,950	\$400 for weatherization
Package 4: Heat Pumps, High-Efficiency, Electric Backup	\$15,069	\$3,400 for SEER 19+ Rated model
Package 9: Whole-Home Electrification, High Efficiency + Basic Enclosure Package	\$36,741	\$400 for weatherization, \$3,400 for SEER 19+ Rated model, \$600 combined incentives for water heater and washer/dryer
Package 10: Whole-Home Electrification, High Efficiency + Enhanced Enclosure Package	\$49,708	

Direct Program Participation

The share of implementation funds allocated to each type of retrofit was assumed to be 72% for weatherization and 28% for standard weatherization + whole home electrification. This split allowed some support for full decarbonization of a targeted share of homes while extending the program's reach with lower-cost weatherization support, which has lower available rebates. The percentages applied reflect the relative proportion of households in Clark County identified through the Climate and Economic Justice Screening Tool (CEJST) as below 200% of the FPL. Note that this split does not imply how income criteria would be used but represents a reasonable split for funds reserved for those households with the greatest need.

With \$400,009,222 of funding reserved to offset costs for direct install retrofit projects, approximately 20,844 homes could receive direct support for implementation of energy conservation measures (Table 3).

Table 3. Households Impacted by Direct Funding

Package Type	Final Cost per Household	Share of Program Funding	Target Households
Enhanced Envelope (EUSS Package 2)	\$16,550	72%	17,402
Whole Home Electrification + Conventional Envelope (EUSS Package 9)	\$32,541	28%	3,442

Indirect Program Participation

While the Hub will provide targeted direct assistance to low-income and disadvantaged communities to offset home improvement costs; resources to help all residents and building owners navigate the many potential incentives offered by other federal programs as well as local utility incentives is expected to create an uptick in the overall level of investment in energy retrofits above the current rate.

The “one-stop-shop” approach to energy rebate programs has proven to be effective at driving additional adoption of energy conservation measures than just the availability of rebates. The estimated magnitude of these effects is based on the use of a “net-to-gross ratio”, which balances free ridership

⁶ Less, et al. Lawrence Berkeley National Labs. August 2021. The Cost of Decarbonization and Energy Upgrade Retrofits for US Homes. doi:10.20357/B7FP4D. https://eta-publications.lbl.gov/sites/default/files/final_walker_-_the_cost_of_decarbonization_and_energy.pdf

⁷ NVEnergy. Home Energy Saver Rebates. <https://www.nvenergy.com/save-with-powershift/home-energy-saver> Accessed 3/6/2024.

against spillover and other market effects induced by the program.⁸ This analysis uses the net-to-gross ratio of 1.21, reported in the Market Effects Analysis of the US Department of Energy Better Buildings Neighborhood Program,⁹ which follows a similar model as the intended program design of the Hub.

The net-to-gross ratio of 1.21 was applied to an estimated current market for home energy savings projects within Clark County of \$261,568,492 per year. This value was derived from the total spending on home improvements within the Las Vegas – Henderson – Paradise MSA (\$1.8 billion / year) by the national share of home improvement spending on energy efficiency projects (15%).¹⁰ The subsequent impact is a \$54,929,383 net market annual increase in spending.

The mix of energy conservation measures for indirect households is assumed to take advantage of all project types as these selections would be more of a function of household preferences than Hub administrative decisions to maximize cost effectiveness. However, the education resources of the Hub should guide spending to the high-impact but cost-effective whole home electrification + conventional weatherization package (EUSS Package 9). The final share of spending is summarized in Table 4.

Under these participation splits – and assuming that the Hub increases market spending by \$54,929,383 applied to the relative costs of different packages, approximately 2,802 additional households will implement energy conservation measures every year, resulting in the additional retrofits detailed in Table 4. This level of increased activity is modeled to continue annually as the program is expected to become self-sustaining by the end of the CPRG implementation funding cycle.

Table 4. Annual Households Impacted by Indirect Assistance

Package Type	Estimate Share of Market Spending	Number of Participating Households
Enhanced Envelope (EUSS Package 2)	25%	830
High Efficiency Heat Pump (EUSS Package 4)	25%	1,177
Whole Home Electrification + Conventional Envelope (EUSS Package 9)	40%	675
Whole Home Electrification + Enhanced Envelope (EUSS Package 10)	10%	121

Household Energy Savings Potential

The energy impact of building energy retrofits is based on estimates obtained from the NREL ResStock EUSS datasets for the state of Nevada.¹¹ This resource provides the most comprehensive set of energy conservation measure performance values across a range of real-world circumstances that could be matched to mix of homes in Clark County. The measure packages included in this assessment are detailed in Table 1. Datasets for each measure package analyzed were filtered to only those that

⁸ Violette and Rathbun. National Renewable Energy Lab. September 2014. “Estimating Net Savings: Common Practices. Uniform Methods Project, Chapter 17”. <https://www.energy.gov/sites/prod/files/2015/01/f19/UMPCChapter17-Estimating-Net-Savings.pdf>

⁹ U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. June 2015. “Market Effects of the Better Buildings Neighborhood Program Final Evaluation Volume 5”. <https://www.energy.gov/eere/analysis/articles/market-effects-better-buildings-neighborhood-program-final-evaluation-volume>

¹⁰ Joint Center for Housing Studies of Harvard University. 2023. “Improving America’s Housing”. Excel Data Tables A-4 & A-5. <https://www.jchs.harvard.edu/improving-americas-housing-2023>

¹¹ National Renewable Energy Laboratory. ResStock End Use Savings Shapes 2022.1 Release TMY3. <https://resstock.nrel.gov/datasets>

matched input variables selected to best reflect the homes that would be likely candidates for retrofit support. These include:

- In Clark County, Nevada; to account for local weather conditions.
- Single-family detached or single-family attached buildings; to avoid mixing savings estimates from multi-unit apartment complexes with different equipment and performance characteristics.
- Use natural gas for heating fuel; to avoid mixing savings from all-electric baseline homes.
- Central AC is present; to avoid diluting energy savings of efficiency measures with impacts of adding air condition where it did not previously exist.
- Excluding buildings with ducted heat pump heating types; to avoid diluting energy savings with low impacts to homes already equipped with high efficiency heat pumps.

These filters resulted in a dataset of 1,335 combinations of other home characteristic inputs and model results. It is worth noting that these filters will exclude model homes with characteristics that likely do exist in Clark County, however a key aspect of the concierge service is to ensure that funded energy conservation measures are only going into the homes where the existing conditions would lead to energy savings as a result of the retrofit.

Reference Scenario

While not explicitly modeled under a business-as-usual forecast, the approach utilizing the ResStock EUSS datasets implies a reference scenario defined by homes continuing to operate according to their baseline (pre-retrofit) efficiency. Savings estimates for each of the retrofit packages were obtained by matching baseline energy use to post-retrofit energy use by building model IDs. Thus, savings are estimated for each of the EUSS Measure Packages in each of the 1,335 model homes in the dataset relative to its baseline performance.

Uncertainty in Savings Estimates

Although this action is intended to primarily target low-income households, the average savings values used in this analysis reflect the mean savings across all households matching the filters specified above. Early iterations of the analysis explored different savings levels by Federal Poverty Level (“FPL”) classifications included in each model input values. Separating savings by income resulted in relatively low numbers of observations within each set, particularly the low-income divisions of interest. The ResStock EUSS Technical Documentation recommends using annual results that include 1,000 models or more.¹² Since there were only 161 records between the 0-100% and 100-150% FPL, a decision was made to utilize the complete sample size of 1,335 modeled home records. Using a larger sample size reduced the standard deviation for savings estimate by an average of 8% across all measure packages. These improvements increased the confidence in use of the average savings values from across the complete dataset.

Multiple attempts were made at assessing uncertainty utilizing the filtered EUSS dataset. Minimum and maximum values from across the set of modeled homes were applied in full impact calculations as well as ranges developed by adding and subtracting the standard deviation from the mean savings all model results. Unfortunately, due to the characteristics of the data set, the results of these exercises did not

¹² National Renewable Energy Laboratory. ResStock EUSS Technical Documentation https://oedi-data-lake.s3.amazonaws.com/nrel-pds-building-stock/end-use-load-profiles-for-us-building-stock/2022/EUSS_ResRound1_Technical_Documentation.pdf

yield meaningful insights for uncertainty. The boundaries provided by both approaches did not result in scenarios that would be likely in real world conditions, as it is highly unlikely that anywhere near all homes impacted by the project would perform at either the high or low end of the savings estimates.

With a large sample size of 1,335 homes, the average savings rates for each measure package should be representative of the expected outcomes of implementing different measure packages. Final savings estimates for each are summarized in Table 5. Results for the impacts of uncertainty assessments using the approach of average savings +/- one standard deviation are included in the estimate of total GHG reduction potential.

Table 5. Average Energy Reduction Potential of ResStock Measure Packages for 1,335 model homes

ResStock Measure Package	Annual Electricity Savings per Household (kWh)	Annual Gas Savings per Household (therms)
Package 2: Enhanced Enclosure	1,130	64
Package 4: Heat Pumps, High-Efficiency, Electric Backup	2,194	211
Package 9: Whole-Home Electrification, High Efficiency + Basic Enclosure Package	2,439	352
Package 10: Whole-Home Electrification, High Efficiency + Enhanced Enclosure Package	2,498	352

Applying Measure Package Savings Estimates

Raw outputs from ResStock reported savings in kWh for all energy types and gas results were converted to therms. Energy savings for each fuel type were normalized to terms of savings per square foot based on the ResStock input building area, “in_sqft” field for each 1,335 model homes, allowing them to be applied to a generic Clark County household to estimate program savings.

The estimated average annual energy savings per households for each measure package (Table 5) was calculated by applying the average savings per square foot by the average household size of 1,974 square feet, derived from the Clark County Property Tax Assessor Database.

Program Ramp-Up

It is recognized that some time will be needed to get up to speed. An assumed ramp-up schedule was devised to spread program activities as even as possible across the period. With momentum gained in the pilot program supported through EECBG funding, the Hub aims to upgrade 2,084 homes in calendar year 2025, 10% of the 5-year target. The annual rate of projects completed will ramp up and peak during program years 2027 and 2028, and then begin to close out prior to the end of 2029, allowing for additional time for final project evaluations. The ramp up schedule and associated changes are provided in Table 6.

Table 6. Estimated Ramp-Up Schedule for Direct Program Support

	2025	2026	2027	2028	2029
Share of Target Reached Each Year	10%	20%	25%	25%	20%
Calendar Year Upgrades Made	2,084	4,169	5,211	5,211	4,169
Year-End Cumulative Upgrades	2,084	6,253	11,464	16,675	20,844

Indirect Impacts Ramp Up

It is expected that the indirect impacts of the program will ramp up to their full impact much more quickly as they are driven primarily by information availability and other light-touch services than what is required for arranging direct installation of measures. This analysis assumes 10% of the indirect impact potential is reached in year 1, 50% in year 2, and 100% every year thereafter. Unlike direct-impact households, it is expected that The Hub will at a minimum continue to exist as an information resource and continue to drive home energy above the current market rate. The cumulative reductions of these homes are included in the estimates for 2050 reduction potential as a representation of the transformative impact The Hub is expected to bring to the region.

Energy Use Reductions

Target households for each measure package were multiplied by the ramp-up schedules for direct installations and indirect support, respectively, to determine the number of households retrofitted in each year. The average energy reduction potential of the ResStock measure packages were applied to the annual target households to estimate incremental use savings. These incremental savings were aggregated such that annual reductions for each calendar year incorporate the total energy use reductions that resulted from all prior year retrofits.

Water Energy Savings

In addition to energy savings, direct installation recipients will get a full complement of water saving rebates provided by the Southern Nevada Water Authority (SNWA). By 2030, individual retrofit savings estimates provided by SNWA will add up to 152 million gallons of water saved annually.

Table 7. Water Conservation Measure Savings

Retrofit Type	gal/home/year	% of homes Applicable
Water Main Leak Replacement	6,570	2.5%
Indoor Savings for Appliance Retrofits	18,907	100%
Outdoor Water Savings from WSL	17,410	100%

Water savings are expected to translate to energy savings in the water distribution system. Using an SNWA internal benchmark of 6.76 MWh / Million Gallons, cumulative power savings could total 6,168 MWh. This would result in an additional 2030 cumulative GHG savings of 1,014. Note that additional water savings are not modeled beyond this date due to uncertainty around future water energy intensity.

Accounting for Cleaner Electricity

Forward looking projections for grid carbon intensity were obtained from the National Renewable Energy Laboratory's (NREL) 2022 Cambium Model.¹³ While there are many available scenarios to choose from, this analysis selected the "Mid-Case 95% Decarbonization Scenario". Cambium Model exports provide projected emissions factors for target years through 2050 (Table 8). Under this scenario, the projected carbon intensity of electricity in the AZNM eGRID region is 115.5 kg CO₂ per MWh in 2030 and 12.8 kg CO₂ per MWh in 2050. A linear decrease was assumed to estimate emissions factors for interim years

¹³ Gagnon, Pieter; Cowiestoll, Brady; Schwarz, Marty (2023): Cambium 2022 Data. National Renewable Energy Laboratory. <https://scenarioviewer.nrel.gov>

between those provided by Cambium. Annual emissions factors were applied to estimated changes in electricity use to avoid overestimating GHG reduction potential.

Table 8. Cambium Model Electricity Emissions Factors

	2024	2026	2028	2030	2035	2040	2045	2050
kg CO ₂ per MWh	246.6	212.7	148.4	115.5	66.6	48.8	41.3	12.8

GHG Reductions

Annual electricity savings were multiplied by the respective Cambium Model projected emissions factor to determine CO₂ annual emissions savings from electricity use. Annual natural gas savings were multiplied by standard EPA emissions factors¹⁴ for CO₂, CH₄, and N₂O to determine emissions savings from natural gas use. The Global Warming Potentials (GWP) from the IPCC Fifth Assessment Report (AR5)¹⁵ were applied to CH₄ and N₂O to estimate total emissions savings in MTCO₂e.

Annual GHG reductions for each calendar year incorporate the total energy use reductions that result from all prior year retrofits delivered through the program. Cumulative GHG reductions achieved through 2030 represent a sum of each year's annual reduction for the program period. Annual reductions and cumulative reductions are included in Table 9 and Table 10, respectively. Additional details for 2050 cumulative reductions can be found in the attached calculation workbook.

Table 9. Annual GHG Reductions (MTCO₂e / Year)

Participant Type	Energy Source	2025	2026	2027	2028	2029	2030
Direct Installation	Electricity	644	1,790	2,786	3,331	3,702	3,241
	Natural Gas	1,239	3,717	6,815	9,913	12,392	12,392
Indirect Support	Electricity	126	698	1,580	2,110	2,597	2,905
	Natural Gas	309	1,854	4,945	8,035	11,126	14,217
Water Energy Savings	Electricity	118	219	232	191	136	119

*Note totals may not sum perfectly due to rounding

Table 10. Cumulative GHG Reductions (MTCO₂e)

Participant Type	Energy Source	2025	2026	2027	2028	2029	2030
Direct Installations	Electricity	644	2,435	5,221	8,553	12,255	15,496
	Natural Gas	1,239	4,956	11,772	21,685	34,076	46,468
Indirect Support	Electricity	126	823	2,403	4,513	7,110	10,016
	Natural Gas	309	2,163	7,108	15,144	26,270	40,487
Water Energy Savings	Electricity	118	337	56	759	895	1,014
Total							113,480

*Note totals may not sum perfectly due to rounding

¹⁴ U.S. Environmental Protection Agency (EPA). Emission Factors for Greenhouse Gas Inventories (2021). https://www.epa.gov/system/files/documents/2023-04/emission-factors_sept2021.pdf

¹⁵ Intergovernmental Panel on Climate Change (2014). IPCC Fifth Assessment Report (AR5).

Cost Effectiveness

Total 2030 cumulative GHG reduction of 113,480 MTCO₂e was divided by \$499,999,236 to arrive at a cost effectiveness estimate of \$4,406/MTCO₂e reduced.

Uncertainty Results

The results of uncertainty estimates using +/- one standard deviation in energy savings from the EUSS data set result in 2030 cumulative savings ranging from 11,325 to 220,739 MTCO₂e, and 2050 cumulative savings from 212,394 to 2,510,853 MTCO₂e

Permanence

When assessing the future impact of energy conservation measures, it is common to incorporate considerations for the effective useful life of each energy conservation measure. The focus of the Hub will be weatherization measures and improvements to heating, ventilation, and air conditioning ("HVAC") systems, which have effective useful lives which are longer than the 2025-2030 horizon and all savings are expected to remain intact by 2030.

The changes made in typical home energy retrofit projects have an effective useful life of the equipment or weatherization measures resulting in diminishing future savings.

- For fuel switching measures, it is unlikely that customers will revert back to combustion-based space conditioning, water heating, and cooking. Impacts are assumed permanent.
- Assumption that the impacts for weatherization will last 30 years and the impacts for heat pumps and other equipment is 12 years.¹⁶
- Savings adjustments to account for effective useful life were estimated from the performance of a heat pump operating in a highly insulated home as opposed to the pre-weatherization condition of the home. This value was determined by sampling EUSS Package 4 impacts within homes that were already fully electric and with high levels of insulation and other weatherization features.

Applying the impact of effective useful life followed methods utilized in other analysis using EUSS datasets, with some simplification for the sake of spreadsheet modeling. For equipment related savings, 1/2 of the savings were removed in the first year of its effective useful life and the remaining savings removed in the following year.

These adjustments begin in 2037, 12 years after the implementation of measures in 2025. For the discrete electrification actions that occur from direct impacts, the end result is nearly half of the aggregate electricity savings from Package 9 improvements are subtracted from long term savings.

Adjustments for effective useful life are more significant among the indirect program beneficiaries that continue to install energy conservation measures beyond 2025. By 2041, 12 years after the maximum level of implementation is reached, 2.2 million kWh are subtracted from each year's annual savings as older equipment wears out from 12 years prior.

¹⁶ Mayernick and Stenger. National Renewable Energy Laboratory. "Overview of the Inflation Reduction Act of 2022 (IRA) Home Energy Rebate Tool. Table 3. <https://www.nrel.gov/docs/fy23osti/86700.pdf>