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Ameren Illinois ENERGY STAR® Retail Products Platform

2021 Evaluation

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Table of Contents

1. Introduction	1
2. Evaluation Background	2
2.1 Market Transformation.....	2
2.2 ESRPP Pilot Description	2
3. Methodology.....	5
3.1 General Approach.....	5
3.2 Natural Market Baseline	5
3.3 Unit Energy Savings.....	6
3.4 Non-Participating Retailers.....	6
3.5 Other Program Savings.....	7
4. Results.....	8
4.1 Performance in 2021.....	8
4.2 Natural Market Baseline	9
4.2.1 Data and Data Cleaning.....	10
4.2.2 Statistical Forecast.....	10
4.2.3 Model Adjustments	11
4.2.4 Final Natural Market Baseline Forecast.....	14
4.3 Market Share Net of Natural Market Baseline.....	14
4.4 2021 Savings Calculation	15
4.4.1 Unit Energy Savings.....	16

Table of Tables

Table 1. ESRPP Intervention Strategies	3
Table 2. Qualifying Unit Definitions and Incentives	9
Table 3. Projected DOE Federal Standard and ENERGY STAR Specification Updates by Product Type.....	12
Table 4. Baseline Modification Theories and Adjustments	13
Table 5. Market Share Difference Between Forecasted and Actual Program Sales	15
Table 6. Non-Program Sales by Product Subtype	16
Table 7. Non-Program Sales Secondary Sources	16
Table 8. Unit Energy Assumptions	17
Table 9. 2021 ESRPP Program Savings (MWh).....	17

Table of Figures

Figure 1. Evaluation Period Sales, by Product and Subtype.....	8
Figure 2. Evaluation Period Qualifying Units by Product and Subtype	9
Figure 3. Market Share of Qualified Refrigerator Sales: Program Sales and Final NMB Forecast.....	14
Figure 4. Market Share of Qualified Clothes Washer Sales: Program Sales and Final NMB Forecast.....	14

1. Introduction

This document presents background, methodology, and results of the 2021 Ameren Illinois Company (AIC) ENERGY STAR® Retail Products Platform (ESRPP) evaluation.¹

The ESRPP is a national-level, long-term, Market Transformation (MT) program that consists of a menu of intervention strategies targeting specific product categories aimed at decreasing residential plug loads. AIC began sponsoring the ESRPP in April 2021—that is, AIC joined a growing list of utilities that pay incentives for efficient appliances sold by participating retailers in their service territories. In 2021, the ESRPP was implemented by the Northwest Energy Efficiency Alliance (NEEA) and Resource Innovations on behalf of AIC. The ESRPP team implemented the Program in AIC’s service territory with the goal of transforming the markets for several appliances, which is consistent with the guiding theory behind MT programs. Notably, the ESRPP Program is the first in the state evaluated under the *Illinois Technical Reference Manual (IL-TRM) Attachment C: Framework for Counting Market Transformation Savings in Illinois* (heretofore referred to as Attachment C).²

The ESRPP Program is long-term in nature, such that we would expect impacts to be realized over a longer time frame than typical resource acquisition programs. That said, in this document we provide near-term estimates of program savings that occurred during the nine months of active participation in 2021, between April 1, 2021, and December 31, 2021 (the “evaluation period”). Note that AIC claimed no savings for the ESRPP Program in 2021 and the estimates provided in this memo are for informational purposes only.

Moving forward, AIC has decided to discontinue sponsoring the ESRPP Program. If AIC should want to revisit sponsoring the program in the future, it may be beneficial to conduct additional research with market actors to better understand savings potential. We include suggestions in the Model Adjustments section for additional data collection strategies that may help provide critical insight into how the market responds to changes in Department of Energy (DOE) Federal standards (“standards”) and ENERGY STAR specifications (“specifications”), which will likely play an integral role in future program savings.

¹ All product or company names that may be mentioned in this publication are tradenames, trademarks, or registered trademarks of their respective owners.

² 2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0. Attachment C: Framework for Counting Market Transformation Savings in Illinois: September 25, 2020. Effective January 1, 2021.

2. Evaluation Background

2.1 Market Transformation

“Market transformation is the strategic process of intervening in a market to create lasting change that results in the accelerated adoption of energy efficient products, services and practices.”³

The resource acquisition (RA) paradigm has dominated the Demand Side Management (DSM) industry for several decades. In an RA program, the program implementer affects the decision-making and behaviors of individual actors (i.e., program participants), causing them to take actions that save energy compared to the actions they would have taken had it not been for the program intervention. Theoretically, MT programs involve shifting away from focusing on individuals and instead aim higher, by changing the structure and function of an entire market.^{4,5} By doing so, MT programs have the potential to provide massive benefits to society because the market dynamics the program influenced, in turn influence the actions of a much broader pool of market actors. The reach of MT programs would likely be cost prohibitive to replicate under a RA paradigm.

Nevertheless, there are significant barriers faced by the energy efficiency industry that prevent MT programs from being a more commonly used intervention for reducing energy use.⁶ Some of the particularly challenging barriers are that, in contrast to RA programs, MT programs are generally more complex to design and implement because they are aimed at affecting dynamic markets with an array of actors, the timeframe under which MT programs operate is generally longer term, savings/impacts will be harder to measure, claims of attribution will be more complicated and uncertain, and processes and protocols for assessing cost-effectiveness will need to change.

2.2 ESRPP Pilot Description

ESRPP is a national-level, long-term MT program.⁷ The overall goal of ESRPP is to decrease energy use associated with residential plug loads by transforming the market for several different appliance product categories. Over the evaluation period, AIC’s ESRPP Program included two product categories: (1) refrigerators and (2) top-load washing machines.⁸

In addition to AIC, the current participating *Program Sponsors*,⁹ by state, include:¹⁰

³ Ibid. p. 1.

⁴ See Attachment C for a more detailed discussion of the distinctions between MT and RA.

⁵ For a review of best practices for designing and implementing market transformation initiatives, see Keating, Ken. (2014) *Guidance on Designing and Implementing Energy Efficiency Market Transformation Initiatives*. White paper written for the California Public Utilities Commission, San Francisco.

⁶ Prah, R. & Schlegel, J. (1994). *DSM Resource Acquisition and Market Transformation: Two Inconsistent Policy Objectives?* Prepared for 1994 ACEEE Summer Study.

⁷ The expectation had been that ESRPP would be at least a 10-year program, resulting in the ESRPP logic model being presented as such. AIC has since discontinued their participation in the program.

⁸ The product categories included in the program can vary based on the market conditions for the various products in a Program Sponsor’s service territory. Factors such as expected purchase rates, available program budget, and cost-effectiveness also come into play. Product categories offered in other jurisdictions, but not (yet) included in Illinois, include freezers, clothes dryers, room air conditioners, and advanced thermostats.

⁹ *Program Sponsors* are the organizations that offer the ESRPP Program to retailers in their jurisdiction. Program Sponsors can be individually owned utilities (e.g., ComEd, AIC, PG&E), municipal utilities (e.g., SMUD), or regional bodies (e.g., NEEA).

¹⁰ Consolidated Edison (Con Edison) in New York and Xcel Energy in Colorado have also participated; however, both are currently inactive.

- **California:** Pacific Gas and Electric Company (PG&E), Sacramento Municipal Utility District (SMUD)
- **Connecticut:** Energize Connecticut, Eversource, United Illuminating (UI)
- **Illinois:** Commonwealth Edison (ComEd)
- **Maryland/Washington, D.C.:** Baltimore Gas and Electric (BGE), Delmarva Power, Potomac Edison, Potomac Electric Power Company (PEPCO), Southern Maryland Electric Cooperative (SMECO)
- **Minnesota:** Xcel Energy
- **New York:** Consolidated Edison (Con Edison), New York State Electric and Gas Corporation (NYSEG), Rochester Gas and Electric Corporation (RG&E)
- **Vermont:** Efficiency Vermont
- **Washington, Oregon, Idaho, and Montana:** Northwest Energy Efficiency Alliance (NEEA)

Current national participating *retailers* include:¹¹

- The Home Depot
- Best Buy
- Lowe’s
- Nationwide

Strategies are used to affect energy efficiency in a particular product market. Currently the program includes the six strategies shown in Table 1.¹²

Table 1. ESRPP Intervention Strategies

Strategy	Description	Desired Outcomes
Midstream Incentives	Program Sponsors provide incentives to retailers for sales of products meeting initiative-defined efficiency criteria	Retailers favor efficient products in stocking assortments and promotional decisions, increasing efficient market share and provide full category sales data to Program Sponsors
Emerging Technology Advocacy	<i>Program Implementers</i> work with manufacturers, retailers, and other industry stakeholders to promote the development and availability of efficient products	Efficient technologies become more widely available and are incorporated into a wider range of products
Measurement and Compliance Advocacy	ESRPP engages with the DOE, Environmental Protection Agency (EPA), and others to advocate for test procedures and reporting requirements that accurately reflect real-world energy use and differentiate efficient products	Test procedures and the DOE Federal Standards and ENERGY STAR specifications that rely on them accurately reflect real-world energy use and differentiate efficient products
Specification Advancement	<i>Program Implementers</i> engage with EPA and others to advocate for more stringent voluntary efficiency specifications	Product specifications recognize the most efficient products and motivate manufacturers to increase efficiency

¹¹ Note that Program Sponsors can also work with local or regional retailers.

¹² Lieb, N. & Van Clock, J. (2019). *Retail Product Portfolio Evaluation—Final Report*. Prepared for NEEA, Dated July 11, 2019.

Strategy	Description	Desired Outcomes
Standards	<i>Program Implementers</i> engage in DOE and other minimum efficiency standard revisions processes to advocate for more stringent standards	Stringent standards eliminate the least efficient product(s) from the market, increasing the share of efficient options
Tracking	When direct market intervention is deemed unwarranted for a product, passively track the market	<i>Program Implementers</i> are informed and prepared to quickly shift strategies when/if appropriate market conditions present themselves

Source: Adapted from Lieb and Van Clock (2019).

3. Methodology

3.1 General Approach

The general approach we followed for computing energy savings for the ESRPP builds on NEEA's proposed approach of comparing actual market shares of program-qualified models over a given period of time to the forecasted natural market baseline (NMB) shares. To fairly capture and represent the market-transformative nature of the ESRPP, we developed separate estimates for participating and non-participating retailers to reflect that the ESRPP may be affecting the participating and non-participating portions of the market differently, particularly in the near-term. As an initial position, we assumed the market share and the natural market baseline of non-participating retailers is equivalent to that of participating retailers.¹³ The evaluation team suggests that, in future years, the development and estimation of the market share of non-participating retailers and natural market baseline for both participating and non-participating retailers rely on an assessment of the program theory and logic model coupled with input from an expert panel.

In general terms, for each product category, Equation 1 shows how our team estimated net savings from the pilot in 2021. We discuss our approach to calculating each of these inputs in subsections below.

Equation 1. ESRPP Savings

$$ESRPP \text{ kWh Saved} = kWh \text{ Saved}_p + kWh \text{ Saved}_{NP} - OPS$$

$$kWh \text{ Saved}_p = PS \text{ Units} \times MSNB \times UES$$

$$kWh \text{ Saved}_{NP} = NPS \text{ Units} \times MSNB \times UES$$

Where:

P, NP = Indicator for Participating Retailer vs. Non-Participating Retailer Groups

$PS \text{ Units}$ = Total Unit Sales, by Participating Retailers

$NPS \text{ Units}$ = Total Unit Sales, by Non-Participating Retailers

$MSNB$ = $MS - NMB$

UES = Savings (in kWh) per unit

MS = Actual Market Share

NMB = Modeled Natural Market Baseline

OPS = Savings claimed through other programs

3.2 Natural Market Baseline

We estimated the Market Share Net of Baseline (MSNB) by subtracting the NMB from the actual market share (MS). Actual MS for participating retailers is available through analysis of participating retailer sales data, and we assume the non-participating market share is equivalent. The key component of the calculation lies in estimating the NMB, as this estimate involves many complex and subjective decisions to be made by evaluators.

¹³ Over time, we expect to see non-participating retailers experience an increase in the market share of qualifying equipment because of competitive pressure (as they attempt to match prices offered by participating retailers to maintain sales) as well as due to the program's influence on standards, specifications, and retailer stocking decisions.

The process we developed to estimate the NMB for each product type includes statistical modeling, incorporation of secondary data, and application of expert judgement. We expect the NMB will require iteration over the lifetime of the evaluation as revised secondary data and new primary data become available to update and revise key assumptions.

Conceptually, the NMB represents a projection of the state of the market in the absence of the AIC ESRPP Program. The NMB is a counterfactual forecast representing what we think the market within AIC's service territory would look like at a given point in time if AIC *had not* sponsored the ESRPP. As actual sales data become available, this forecast will serve as the point of comparison that will allow evaluators to estimate the savings attributable to the program intervention.

Note that this effort is closely and inherently tied to attribution. We support application of theory-based evaluation and a preponderance of evidence (POE) approach to draw conclusions about whether and to what degree changes in the market can be attributed to the Program. The results of the statistical modeling should be one of many inputs into this POE approach. As discussed in Attachment C, there is a great degree of uncertainty associated with estimating attribution for MT initiatives, like the ESRPP. As such, decision-making related to ESRPP attribution will benefit from a defined approach that will allow for transparency for all stakeholders involved.

We support using structured expert judgement panels to develop a better understanding of attribution. The end goal of each of these proposed panels would be to come to consensus on any revisions to the NMB, potentially separating the forecast between participating and non-participating retailers. Each targeted product category would require its own panel.

We did not convene a panel for this evaluation thus no additional adjustments were made to the NMB to account for program attribution.

3.3 Unit Energy Savings

Opinion Dynamics applied the appropriate *Illinois Technical Reference Manual Version 9.0* (IL-TRM) unit energy savings values (or algorithms), where applicable. We relied on savings assumptions and algorithms in section 5.1.6 of the IL-TRM to define unit energy savings for refrigerators, and 5.1.2 for clothes washers. Granular subcategories were combined and averaged to merge with program tracking data.

3.4 Non-Participating Retailers

As a MT program, the ESRPP is designed to impact structural elements of the marketplace for each supported product category. Impacts are not constrained to only participating retailers, as market dynamics, in addition to accelerated DOE Federal efficiency standards and revised test procedures, may, at some point, result in changes to the market share of energy-efficient equipment across all retailers in the marketplace. Therefore, we include all units of a product category sold in AIC's territory. Units are classified by participating vs. non-participating retailers, estimated through analysis of participating retailer sales data and/or national shipment data. To estimate non-participating retailer sales, we followed an approach similar to that used by NEEA, accounting for all investor-owned and public utilities in the state of Illinois and allocating based on customer count.¹⁴

¹⁴ In addition to AIC, ComEd, MidAmerican Energy Co., and Mt. Carmel Public Utility Co., which are currently included in NEEA's estimates, other municipal utilities (notably City Water Light and Power) were accounted for in this calculation.

Equation 2 shows the calculation of non-participating retailer program-qualified sales. The Results section below provides input assumptions and citations as well as the final resulting count of non-participating retailer sales by product subtype.

Equation 2. Non-Participating Retailer Sales

$$NPS_{x,y} = \left(NS_x \times \frac{(HH_{IL} \times S_{IL})}{(HH_{US} \times S_{US})} \times \frac{ResC_{AIC}}{ResC_{IL}} \times \frac{PU_{x,y}}{PU_x} \right) - PS_{x,y}$$

Where:

$NPS_{x,y}$ = Non-participating retailer sales of product type x and product subtype y in Illinois

NS_x = National shipments of product category x

HH = Number of total households in IL and the US

S = Saturation of product type x in households in Illinois and US

$ResC$ = Number of residential electric customers in AIC's service territory and IL overall

PU = Program units of product type x and product subtype y. Program units include all units in the tracking data, both historical and during the program year

PS = Program sales are program units sold during the evaluation period, April 2021 through December 2021, of product type x and product subtype y

3.5 Other Program Savings

As a final step, we removed all verified net savings AIC claimed associated with qualifying units incentivized through their residential Retail Product Initiative and other resource acquisition programs incenting these measures within the evaluation period to avoid double counting energy savings. In 2021, this only included the Retail Products Initiative.

4. Results

4.1 Performance in 2021

In 2021, four national retailers participated in AIC’s ESRPP Program: Best Buy, Home Depot, Lowes, and Nationwide (an aggregator representing smaller, local retailers). During the evaluation period, participating retailers sold over 57,000 refrigerators and over 46,000 clothes washers in total within AIC’s service territory.¹⁵ The most common subtypes of refrigerators sold were top-freezer refrigerators and bottom-freezer refrigerators, while top-loading clothes washers were by far the most common clothes washer subtype (Figure 1).

Figure 1. Evaluation Period Sales, by Product and Subtype



Source: Evaluation team analysis of program tracking data

Through the ESRPP, AIC provides incentives for qualifying refrigerators and washers sold by participating retailers in their service territory (Table 2). During the evaluation period, qualifying units included ENERGY STAR Most Efficient and Emerging Tech Award refrigerators and ENERGY STAR and ENERGY STAR Most Efficient top-loading clothes washers.

¹⁵ Total counts include both program-qualified and not qualified sales.

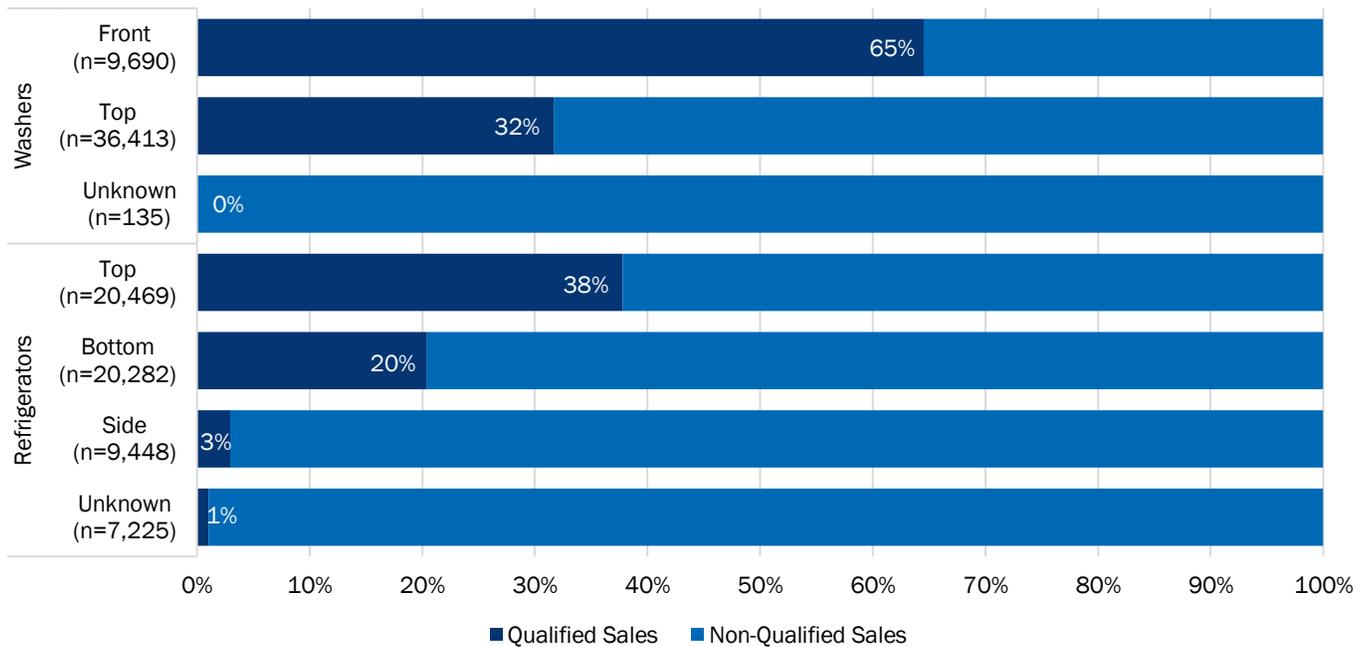
Table 2. Qualifying Unit Definitions and Incentives

Product	Tier	Incentive	Definition
Refrigerators	Basic	\$8	ENERGY STAR Most Efficient v5.0
Refrigerators	Advanced	\$8	Emerging Tech Award v5.0
Washers	Basic	\$8	ENERGY STAR - Top Loaders v8.0
Washers	Advanced	\$8	ENERGY STAR Most Efficient v8.0

Source: NEEA via ESRPP web portal

Over the evaluation period, 21% of the refrigerators sold by participating retailers in AIC’s service territory were qualified units, although this percentage ranged from 3% for side-freezer refrigerators to 38% of top-freezer refrigerators. Almost two-fifths (38%) of clothes washers sold were qualified units, although this varied by subtype (65% for front-loading washers compared to only 32% for top-loading washers) (Figure 2).

Figure 2. Evaluation Period Qualifying Units by Product and Subtype



Source: Evaluation team analysis of program tracking data

4.2 Natural Market Baseline

The evaluation team developed a preliminary NMB for each product type through initial data ingestion and cleaning, preliminary statistical modeling, and incorporation of secondary research and data into out-of-model adjustments. We discuss each step below.

4.2.1 Data and Data Cleaning

The evaluation team relied on two primary data sets to develop the NMB: program tracking data provided by participating retailers via NEEA (i.e., full category sales data) and national sales data purchased from the Association of Home Appliance Manufacturers (AHAM).

ESRPP Program Sponsors are provided full category sales data from participating retailers covering the product types supported in their service territory for the evaluation period and two calendar years of historical data. This database (“program tracking data”) served as the basis for calculating actual market share and played an integral role in developing the NMB because it provided insight into both monthly distributions of sales and the historical relationship between time, total product sales, and market share.

The evaluation team relied on national sales data purchased from AHAM to estimate the NMB. AHAM’s national sales data is the best available source to estimate total unit sales,¹⁶ representing approximately 98% of overall US shipments of major appliances, including both foreign and domestic manufacturing, as well as online sales. The dataset was also used to estimate non-participating retailer sales (discussed further in the 2021 Savings Calculation section).

To develop the NMB forecast for market share of qualified program sales, the evaluation team first completed preliminary cleaning of historical tracking data. We identified misalignments in program tracking data, where some of the same model numbers were categorized as both “qualified” and “unqualified” sales, where no clear differences existed. To account for this misalignment, we began by consistently applying the “qualified” status to all refrigerator product types that met the program qualifying efficiency levels during the evaluation period (i.e., “basic” defined as ENERGY STAR Most Efficient [ESME] and “advanced” defined as Emerging Tech Award [ETA]). Next, we manually recoded ETA model numbers as “qualified” in historical data.

4.2.2 Statistical Forecast

The preliminary statistical forecast provides a starting point developing the NMB. In this step, we leverage historical program tracking data and national level appliance shipments trends to forecast monthly product subtype sales by qualified status through 2030. Due to the limited historical data available, particularly for program sales for which only 2020 data was available, any statistical forecast will be inherently uncertain and imprecise, and will only capture specific trends and relationships present and detectable in the historical data. Given these limitations, we would anticipate using these data, along with additional sales data as they become available to aid in developing a preliminary statistical forecast in any future evaluations of the ESRPP.

We developed an initial statistical forecast by:

- Forecasting annual sales growth rates for refrigerators and washers based on national AHAM sales data from 2009–2020.
- Applying this average annual growth rate to program sales in 2020 to estimate program sales for 2021–2030.
- Allocating forecasted annual sales to months based on monthly sales patterns, derived from historical program tracking data.
- Developing a relationship between the proportion of sales in a month that are qualifying, and total sales (and date) based on program sales in the pre-period for participating retailers. Then, we leverage

¹⁶ Sum of national sales for both participating and non-participating retailers.

this relationship to disaggregate forecasted program sales by month into qualifying and non-qualifying sales. This relationship is estimated through a beta regression using Stata software.¹⁷

- Applying an average distribution of product subtypes (for washers, this is top and front loading, and for refrigerators it is top, bottom, and side freezer) by qualified status to disaggregate forecasted monthly sales into subtypes. The average distributions by subtype are based on program sales in the pre-period.

4.2.3 Model Adjustments

Given the lack of sufficient historical data and inherent limitations of a statistical forecast, the evaluation team conducted a thorough review of secondary research to identify general trends and discrete events important to forecasting the NMB that were unavoidably excluded from the statistical forecast.

These adjustments represent starting points that may be periodically reviewed and adjusted as the program matures and revised secondary data or new primary data becomes available. In the end, how the market responds to changes in standards and ENERGY STAR specifications are empirical questions. It will be important to provide expert judgment panels with sufficient primary and jurisdiction-specific data to refine these estimates. We suggest data collection such as:

- Survey with participating retailers in AIC's service territory. This would help us to characterize stocking and assortment practices of retailers, responses to new standards and specifications, and how they promote the sales of program qualifying units, their satisfaction with the program, and gaps they see in the program's design.
- In-depth interviews with manufacturers, distributors, and if possible, DOE representatives or other stakeholders with experience in the standards and specification settings process to solicit feedback on (1) future standard and specification changes; and (2) opportunities for future increases in efficiency (and the expected timelines) for refrigerators and clothes washers (and subtypes).

The evaluation team's secondary research focused on predicting when new standards and ENERGY STAR specifications would take effect (and how these events would impact the market share of qualifying program sales) and identifying general trends in equipment efficiency.

One primary consideration was the impact on the market share of qualified program sales following ENERGY STAR specification revisions. In our forecast, we assume an initial drop of twenty percent (relative to the preliminary statistical forecast) to occur in the market share of qualified sales following the first ENERGY STAR specification revision within our forecast timeline, which we anticipate will take place in 2023 for both products. Additionally, we expect to see another five percent decrease in the market share of qualified sales for the corresponding product type when subsequent ENERGY STAR specifications take place. Based on historical cadence of new standards and ENERGY STAR specifications we estimated when we expect ENERGY STAR specification revisions to occur across our forecast for each product type (Table 3).

Immediately preceding enactment of stricter ENERGY STAR specifications, we assume consumers will purchase products they originally set out to buy prior to the release of new ENERGY STAR specifications, rather than selecting a different, presumably more expensive unit at the time of purchase that meets the new ENERGY STAR guidelines (i.e., consumer preferences are, in the short-term, mostly independent of ENERGY STAR certifications at a given efficiency/price level).

¹⁷ A beta regression is a generalized linear model which assumes a beta distribution of responses. This model is inherently flexible yet restricts responses to between 0 and 1, non-inclusive. See Ferrari SLP, Cribari-Neto F (2004). "Beta Regression for Modelling Rates and Proportions." *Journal of Applied Statistics*, 31(7), 799-815.

Current ENERGY STAR specifications for residential refrigerators are based on a percentage difference in efficiency level above standards rather than a set metric as used for clothes washers;¹⁸ meaning ENERGY STAR specifications will automatically adjust when standards change. Therefore, even in the absence of a revised ENERGY STAR specification, when a new standard becomes effective the absolute efficiency level criteria for ENERGY STAR certification increases. Nonetheless, we assume specifications themselves will be revised twice over the forecast period, and standards will not be revised without concurrent revisions to specifications.

Table 3. Projected DOE Federal Standard and ENERGY STAR Specification Updates by Product Type

Date	Product	Impact of Specification Adjustment
4/1/2023	Refrigerators and clothes washers	20% decrease in qualified sales
6/1/2025	Clothes washers	5% decrease in qualified sales
8/1/2027	Refrigerators	5% decrease in qualified sales
7/1/2028	Clothes washers	5% decrease in qualified sales

Our secondary research also highlighted the need for separate naturally occurring trends in the market share of each clothes washer subtype. For clothes washers, increased efficiency is primarily achieved through increasing capacity of the clothes washer basin and given the current size of products, the biggest opportunity to expand capacity involves increasing the product's height. Due to their design, top-loading clothes washers have greater leeway for increasing a unit's height than front-loading clothes washers; therefore, we expect top-loading clothes washers to experience greater gains in efficiency at a faster pace than front-loading clothes washers. To account for this, we implemented an overall five percent increase in the market share of qualified program sales for top-loading clothes washers (relative to the initial statistical forecast).

Table 4 provides a summary of the results of our secondary research, the baseline modifications we applied to the preliminary forecast, and the impact on evaluation period savings.

¹⁸ ENERGY STAR®. (2007). "ENERGY STAR® Program Requirements for Residential Refrigerators and/or Freezers: Partner Commitments." Last Accessed: April 8, 2022.

https://www.energystar.gov/sites/default/files/Refrigerators_and_Freezers_Program_Requirements_V5.1.pdf

Table 4. Baseline Modification Theories and Adjustments

Modification Driver	Theory Behind Modification	Impact on 2021 Savings	Forecast Adjustment
Overall Trend	Front-loading clothes washers typically have been larger than top loading washers, but due to the need to increase depth in order to increase capacity, this is likely to change. For this reason, top-loading clothes washers have a greater leeway for increasing capacity moving forward by increasing the unit's height. Thus, since increasing capacity is a primary method of increasing efficiency it is likely that top-loading washers will see higher efficiency increases at a faster pace moving forward. ¹⁹	We assumed a negative impact on 2021 program savings due to this trend, causing a minor decrease in savings.	5% increase in forecast overall; muted impact of new specifications
Federal Standards and ENERGY STAR Specifications	The market will likely observe a short-term dip in qualified sales directly following ENERGY STAR specification revisions as retailers prepare to replace previously qualified units and restock with units meeting new specification requirements.	Due to there being no new standards announced or specification revisions over the 2019–2020 timeframe from which the data was used to forecast 2021 savings, we assumed this trend had no impact on program savings.	See Table 3
Federal Standards and ENERGY STAR Specifications	Qualified market shares for refrigerators will likely decrease following a new Federal Standard prior to a new ENERGY STAR specification since current specifications are in place as percentage points in efficiency level above the standard's baseline rather than set efficiency level values.	Due to there being no new standards announced or specification revisions over the 2019–2020 timeframe from which the data was used to forecast 2021 savings, we assumed this trend had no impact on program savings.	See Table 3
ENERGY STAR Tier Market Share	Top-mounted freezer refrigerators will likely achieve a high ESME market share compared to other configuration types due to the only ESME requirement for this configuration being that the unit meets basic ENERGY STAR requirements. Thus, with the current specification requirements, we can assume the same ENERGY STAR and ESME market shares for top-mount freezer units.	Due to AIC having only paid incentives on the ESME and ETA tiers and no specification revisions having occurred over the 2019–2020 timeframe used to forecast 2021 savings, no adjustment was made for top-mount freezer refrigerators in the 2021 forecast resulting in no impact on program savings.	Program only claims ESME or higher (i.e., ETA) for savings. No adjustments.

¹⁹ Apex Analytics. 2019. "Retail Product Portfolio Evaluation: Clothes Washers Product Guidance Memo." NEEA. July 11, 2019.

4.2.4 Final Natural Market Baseline Forecast

The final NMB is presented below, with actual market share for context. Figure 3 and Figure 4 display the actual and forecasted market share of qualified program sales for refrigerators and clothes washers, respectively. The highlighted area in each figure defines the nine-month program period in 2021. As noted, we expect small dips to occur in the market share of qualified products when new ENERGY STAR specifications are implemented (see Figure 3 for expected timing of specifications across forecast).

Figure 3. Market Share of Qualified Refrigerator Sales: Program Sales and Final NMB Forecast

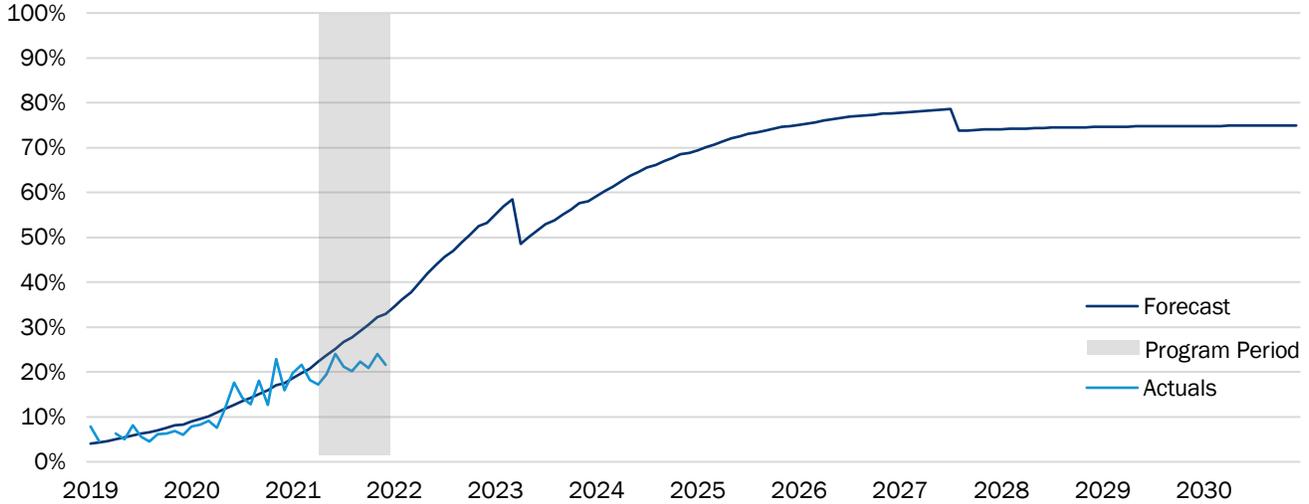
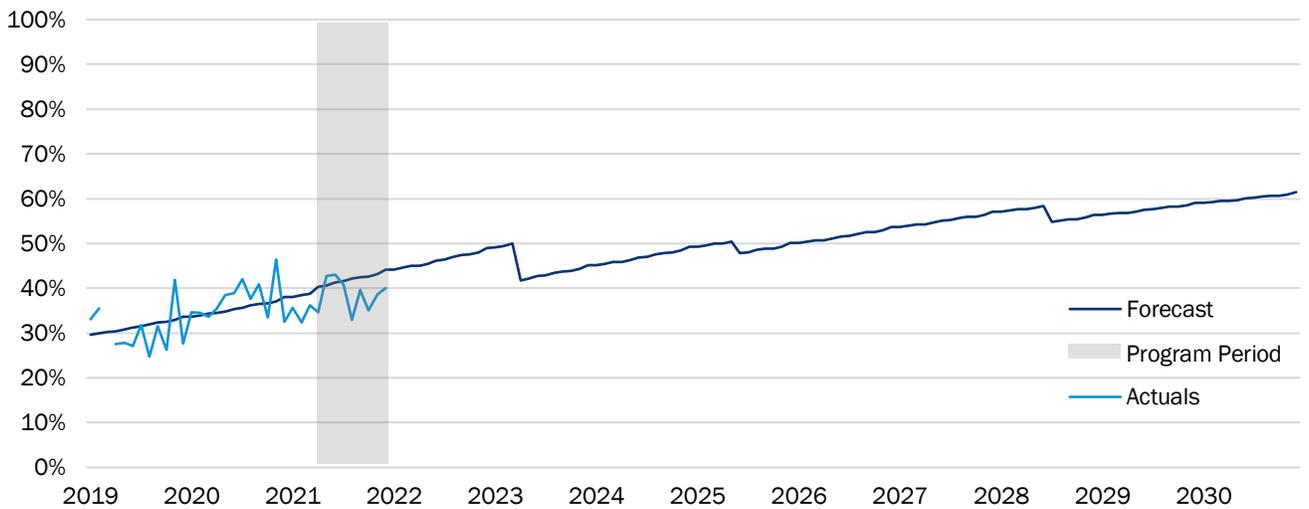


Figure 4. Market Share of Qualified Clothes Washer Sales: Program Sales and Final NMB Forecast



4.3 Market Share Net of Natural Market Baseline

The market share net of the NMB represents the differences in sales based on the market share of qualified products between our final forecast and actual market share, by product type. This represents the final “lift” in market share attributable to program intervention. Top-mount refrigerators (-5%) and top-loading clothes washers (-5%) represent the largest differences between actual sales and our forecast, suggesting the

program caused a decrease in market share of 5% over the evaluation period. While *decreases in market share are* inconsistent with the program theory, this result highlights the inherent uncertainty in this calculation.

Uncertainty stems both from the quantitative uncertainty of the statistical forecast, but also includes other sources of uncertainty, such as the AHAM forecast of annual growth for washers and refrigerators, the shares of annual sales in the AIC service territory, and the monthly pattern of sales. It is virtually impossible to quantify this overall uncertainty in a statistical sense; however, given these various assumptions and data sources. Despite this uncertainty, to conclude that the Program has not yet caused measurable changes in the markets for high-efficiency refrigerators or top-loading clothes washers is plausible. This is likely due to the fact that the program period was only nine months, which gave the participating retailers little opportunity to change their stocking and assortments, product placements, and advertising for program-qualified units. Given this, measurable changes among non-participating retailers is equally unlikely. Additionally, the short duration of the program period did not provide the necessary length of time to allow this intervention design to be successful; thus there was no expectation that the program would achieve energy savings for this evaluation period.

Looking forward, one might also explore other specifications of the beta regression, potentially including the monthly consumer price index or some other metric of macro-economic performance. More broadly, future research may explore alternative models altogether, such as Holt-Winters. We should also note that while this evaluation did include estimation of a long-term NMB, for the purpose of estimating savings we only rely on the expression of this baseline forecast over the evaluation period.

Table 5 provides the market share net of NMB results by product subtype.

Table 5. Market Share Difference Between Forecasted and Actual Program Sales

Product	Product Type	Market Share Net of Market Natural Baseline
Refrigerators	Top	-5%
Refrigerators	Side	1%
Refrigerators	Bottom	2%
Washers	Top	-5%

4.4 2021 Savings Calculation

The evaluation team calculated energy savings achieved in the evaluation period using the calculation framework described above. First, we estimated non-program sales, then translated the MSNB from a market share to an absolute number of units. Finally, we converted the number of units to energy savings using the UES.

Table 6 shows the calculation of non-participating retailer sales during the program period, according to the process outlined in the Methodology section. Table 7 provides the sources for all inputs not drawn from program tracking data.

Table 6. Non-Program Sales by Product Subtype

Product	Product Type	NPS	NS	HH-IL×Saturation-IL/ HH-US× Saturation-US	ResC-AIC/ ResC-IL	PU_Class/ PU_Category	PS_Class
		(f)=(a) × (b) × (c) × (d)-(e)	(a)	(b)	(c)	(d)	(e)
Refrigerators	Top	10,246	9,726,300	3.81%	20%	42%	20,469
Refrigerators	Side	4,355	9,726,300	3.81%	20%	19%	9,448
Refrigerators	Bottom	8,887	9,726,300	3.81%	20%	40%	20,282
Washers	Top	17,312	8,541,000	3.95%	20%	80%	36,413

Table 7. Non-Program Sales Secondary Sources

Variable	Source
NS	Association of Home Appliance Manufacturers: Factory Shipment Reports. 2021. Last accessed 4/19/2022.
HH IL	US Census Bureau's Annual American Community Survey: 2020 Population and Housing State Data. https://www.census.gov/library/visualizations/interactive/2020-population-and-housing-state-data.html . Last accessed 4/19/2022.
Saturation_IL	US Census Bureau's Annual American Community Survey. Steven Ruggles, Sarah Flood, Sophia Foster, Ronald Goeken, Jose Pacas, Megan Schouweiler and Matthew Sobek. IPUMS USA: Version 11.0. Minneapolis, MN: IPUMS, 2021. US Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457A and EIA-457C of the 2015 Residential Energy Consumption Survey.
Saturation_US	US Census Bureau's Annual American Community Survey. Steven Ruggles, Sarah Flood, Sophia Foster, Ronald Goeken, Jose Pacas, Megan Schouweiler and Matthew Sobek. IPUMS USA: Version 11.0. Minneapolis, MN: IPUMS, 2021. US Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457A and EIA-457C of the 2015 Residential Energy Consumption Survey.
ResC_AIC	Annual Electric Power Industry Report, Form EIA-861 detailed data files: Sales_Ult_Cust_2020.xlsx. https://www.eia.gov/electricity/data/eia861/ . Last accessed 4/19/2022.
ResC_IL	Annual Electric Power Industry Report, Form EIA-861 detailed data files: Sales_Ult_Cust_2020.xlsx. https://www.eia.gov/electricity/data/eia861/ . Last accessed 4/19/2022.
PU_Class	Program tracking data
PU_Category	Program tracking data
PS_Class	Program tracking data

4.4.1 Unit Energy Savings

Given that AIC’s ESRPP Program only provides incentives for ESME or ETA refrigerators, there is a misalignment between basic and advanced definitions used in the IL-TRM and those used in program tracking data. Therefore, we applied the IL-TRM advanced unit energy savings for basic ESRPP refrigerators and calculated

appropriate unit energy savings assumptions for advanced (i.e., ETA) refrigerators. For ETA refrigerators, we assumed unit energy savings of 30% relative to federal baseline assumptions.²⁰

Table 8 provides the final unit energy savings assumptions for each product subtype and tier combination.

Table 8. Unit Energy Assumptions

Product	Category	Tier	UES
Refrigerator	Top	Basic	78.3
Refrigerator	Top	Advanced	156.54
Refrigerator	Bottom	Basic	94.45
Refrigerator	Bottom	Advanced	188.84
Refrigerator	Side	Basic	87.8
Refrigerator	Side	Advanced	175.5
Clothes Washer	Top/Front	Basic	126
Clothes Washer	Top/Front	Advanced	235.8

Source: Evaluation team analysis and IL-TRM V9.0

Total savings over the evaluation period are calculated by multiplying the total increase in sales from Table 5 by unit energy savings in Table 8. As a final step, we remove verified net savings associated with qualifying equipment captured in AIC’s Retail Products Initiative.²¹

Table 9 provides the final savings calculations by product subtype.

Table 9. 2021 ESRPP Program Savings (MWh)

Product	Program Sales	Non-Program Sales	Total Savings (Unadjusted)	AIC Retail Products Program Savings	Final ESRPP Savings
	(a)	(b)	(c)=(a)+(b)	(d)	(e)=(c)-(d)
Refrigerators Total	-25	-17	-42	0	-42
Basic	-55	-28	-83		
Advanced	30	11	41		
Washers Total (Top Loading)	-244	-116	-360	149	-509
Basic	-244	-116	-360		
Advanced	0	0	0		

²⁰ The US EPA recognized refrigerators with Advanced Adaptive Compressors for the 2020–2021 ETA. By definition, winning products must outperform the measured federal minimum standard by 30% OR outperform the federal minimum standard by at least 25% compared to when the compressor is in a fixed-speed mode, when the compressor is in adaptive mode. Source: “2020–2021 Advanced Adaptive Compressors.” ENERGY STAR Emerging Technology Award for Consumers. Last accessed 4/18/2021. https://www.energystar.gov/about/awards/energy_star_emerging_technology_award_consumers/2020_advanced_adaptive_compressors.

²¹ AIC Retail Products Initiative refrigerator savings in 2021 are based on ENERGY STAR designation and includes no Consortium of Energy (CEE) 2 assumptions. Therefore, no adjustments to refrigerators is needed. For washers, the adjustment is based on ex post savings for 2021 for all washers prorated to nine months and adjusted to represent top loading washers only. The configuration adjustment is based on breakdown in ex ante savings between top and front loading washers.

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