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REPORT #E15-316

Television Initiative MPER #4

Prepared by:
Research Into Action, Inc.
PO Box 12312
Portland, OR 97212

Apex Analytics, LLC.
1525 Spruce Street, Suite 200
Boulder, CO 80302

Northwest Energy Efficiency Alliance
PHONE
503-827-8416
FAX
503-827-8437
EMAIL
info@neea.org

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Initiative Description and Background

The Northwest Energy Efficiency Alliance (NEEA) is an alliance of more than 140 Northwest utilities and energy efficiency organizations working to accelerate the innovation and adoption of energy-efficient products, services, and practices in the Northwest.

NEEA's Consumer Electronics Television (TV) Initiative (the Initiative), which launched in 2009 sought to influence the television market in the Northwest. Due to the importance of large, national retailers in the TV market and the national scope of their decisions around product assortments – decisions the Initiative sought to impact – the TV Initiative also had impacts nationally. Table 1 summarizes the Initiative's activities and areas of influence on the TV market at both the regional and national levels.

Table 1. Initiative Activities and Areas of Influence on the TV Market

Level of Influence	Area of Influence	Initiative Activities
National	Retail product assortment	NEEA offered an incentive to participating retailers for each TV sold that met specified efficiency requirements, which NEEA and its partner utilities defined each year. Through these incentives, NEEA sought to influence retail merchants within the TV business unit to select a larger proportion of qualified TV models for inclusion in the set of TV models their stores would display and sell (their product assortment).
	Manufacturer product design	By increasing retailer demand for efficient TVs, NEEA sought to motivate manufacturers to design TVs that are more efficient. The TV Initiative engaged with manufacturers to inform them of specifications and facilitate this outcome.
	ENERGY STAR® specification development	NEEA participated in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR specification revision process, encouraging EPA to adopt stringent ENERGY STAR specifications that would drive increases in TV efficiency
Regional	Sales associate knowledge and attitudes Consumer demand	NEEA primarily used in-store marketing to increase demand for, and sales of, efficient TVs. These in-store activities included placing labels on qualified TVs indicating that they were among the most efficient and informing retail sales staff about the Initiative and the benefits of qualified TVs. NEEA also worked with retailers to include a short promotional video in the loop of video content playing on the display TVs in participating stores.

In 2013, NEEA determined that the TV market had transformed to the point that active intervention was no longer necessary and transitioned the TV Initiative to Long-Term Monitoring and Tracking (LTMT) at the end of the year. Through 2014, NEEA continued to incentivize sales of efficient TVs through a new retailer-facing Initiative, the Retail Products Portfolio (RPP) pilot. With the TV Initiative in LTMT, NEEA will continue to participate in ENERGY STAR specification development and monitor the TV market to identify any technological or market developments that might justify further intervention.

Research Objectives

This evaluation sought to measure the influence of NEEA's efforts in transforming the consumer TV market through the Initiative's activities in both 2012 and 2013. This evaluation sought to catalog both the Initiative's regional influence, including local, in-store activities that can be directly measured and quantified, and its national influence, including Initiative influence on corporate-level retailer behavior.

Evaluation Activities

Three evaluation activities informed the findings presented in this report:

- **In-depth interviews:** Research Into Action and Apex Analytics (the research team) conducted semi-structured phone interviews with three groups of market actors.
  - *Retailers:* The research team interviewed corporate-level staff at all five of the national chain retailers participating in the Initiative, and followed up interviews with written questions when necessary. In addition to sustainability executives, the evaluation team received responses directly from TV merchants at four of the five retailers.
  - *EPA ENERGY STAR Staff:* The research team interviewed an EPA staff member involved in the development and management of the ENERGY STAR TV specification.
  - *NEEA and implementation contractor staff:* The research team interviewed two NEEA staff members involved in managing the Initiative as well as staff of the Initiative's implementation and data management contractors.
- **Quantitative analysis:** The research team analyzed TV sales data that participating retailers provided to the Initiative. The research team also analyzed TV sales data that NEEA purchased from NPD Group, Inc. (NPD), a market research provider, for both the Northwest and a comparison region. From these datasets, the research team used descriptive statistics to explain current market conditions and conducted statistical analyses to explore the presence of, and attempt to quantify, Initiative influence on TV sales.
- **Initiative document review:** To support and provide further depth to findings from in-depth interviews and quantitative analyses, the research team reviewed Initiative documents including the Initiative logic model, Alliance Cost Effectiveness (ACE) Model, Salesforce Database, and publicly available ENERGY STAR and market research documents.

Key Findings

Drawing on analysis conducted for multiple evaluation activities, the research team identified five overarching findings related to the Initiative's influence on the TV market:

- **The Initiative's influence on retailers was strongest early in its implementation.** Both regionally and nationally, evaluation findings suggest the Initiative's influence on the TV market waned as the market shifted and efficiency became less effective in differentiating TV models.
- **The differential between the most efficient TVs and the rest of the market has diminished, but new technologies may alter the landscape.** In 2011, Initiative-qualified TVs drew, on average, 46 W less than non-qualified models. By 2014, the gap between qualified and non-qualified models had shrunk to 10W. Nonetheless, the introduction of ultra-high definition (UHD) and other new technologies may increase the differential between the most efficient TVs and others in coming years.
- **In-store engagement influenced sales of energy efficient TVs.** A comparison of TV sales in the Northwest with a similar region without program activity found higher sales of qualified TVs in the Northwest. Analysis of a marketing experiment NEEA implemented in 2013 confirmed that in-store activities like those NEEA conducted result in increased sales of qualified TVs.
- **Inclusion of a second specification tier may allow the Initiative to influence a broader portion of the market.** Defining two qualification tiers allowed NEEA to reward sales of the most efficient TVs on the market, while also ensuring that qualified models to be available for retailers to assort at all price levels.
- **NEEA's advocacy helped drive more stringent ENERGY STAR specifications.** NEEA has provided consistent and formative feedback on the development of ENERGY STAR TV specifications that has helped EPA ensure the specifications are stringent enough to push the TV market.

Conclusions and Recommendations

Based on the findings of this Market Progress Evaluation Report (MPER), the research team draws the following conclusions and recommendations:

- **Conclusion #1:** The Initiative influenced the TV market at both the national and regional levels.
- **Conclusion #2:** Little opportunity remains for NEEA to intervene in the TV market.
  - **Recommendation:** Future midstream programs should target product categories for which energy savings can provide a meaningful, consumer-facing selling point.
  - **Recommendation:** NEEA should continue to monitor the impact of UHD adoption on TV energy use.

- **Conclusion #3:** In-store engagement is a valuable element of mid-stream programs.
  - **Recommendation:** NEEA should incorporate in-store engagement efforts into future mid-stream programs.
- **Conclusion #4:** A second specification level can help an Initiative influence all parts of the market.
  - **Recommendation:** Future mid-stream efforts should define multiple specification levels for qualified products.

1. Introduction

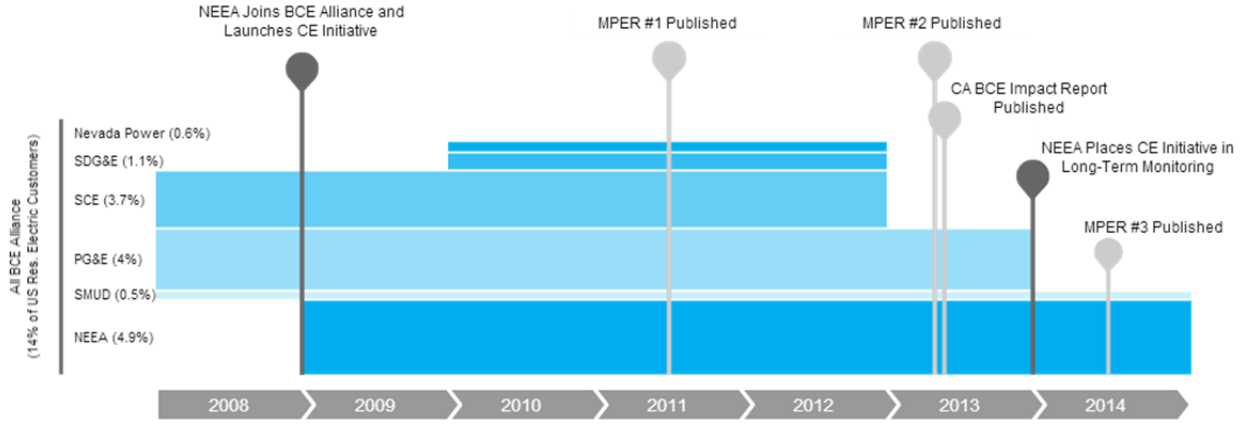
Consumer electronics efficiency programs are vital to reducing electricity demand. In 2013, electronics accounted for about 12% of a typical household's total electricity use, making them as significant an end use category as lighting, appliances, water heating, or air conditioning (Fraunhofer 2014). Although these other residential loads have been the subject of energy efficiency programs for two decades, consumer electronics have only recently come into view as a necessary, but challenging, efficiency target. The number of energy efficiency programs targeting consumer electronics, in particular televisions, has increased in recent years, from a handful in 2008 to 118 educational, incentive, and marketing programs in 2014 with a total budget of around $74 million (ENERGY STAR 2014c).

Northwest Energy Efficiency Alliance (NEEA) launched its Consumer Electronics Television (TV) Initiative (the Initiative) in 2009. NEEA implemented the Initiative in cooperation with a group of other efficiency program administrators in the West, which these funders informally called the "Business and Consumer Electronics (BCE) Alliance." Each member of the BCE Alliance used the same implementation contractor and implemented the same product qualification criteria, but other elements of their implementation differed, including their per-unit incentive payments, total incentive payments, and the point-of-purchase (POP) promotional materials they placed in participating stores.

When NEEA launched the TV Initiative, the BCE Alliance consisted of NEEA, Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and the Sacramento Municipal Utility District (SMUD). In 2010, two additional funding utilities, San Diego Gas & Electric (SDG&E) and Nevada Energy joined the BCE Alliance, for a total of six sponsors in California, Nevada, and the Pacific Northwest. Membership in the BCE Alliance began decreasing when SDG&E and Nevada Energy announced they would not participate in 2013. Membership further decreased when PG&E announced they would not participate in 2014. SMUD continued offering midstream incentives for TVs through 2014. NEEA moved the Initiative into long-term monitoring at the end of 2013, but continued to offer incentives for TVs through its Retail Products Portfolio pilot in 2014.

The BCE Alliance was the largest coordinated energy efficiency program effort to target consumer electronics, reaching approximately 15% of the U.S. electricity residential end-use customers at its height of utility participation (EIA 2013). Figure 1 provides a timeline of each program administrator's entry and exit from the BCE Alliance; the thicknesses of the bars represent the proportion of U.S. electric residential customers each organization represented. NEEA represented the largest proportion of population in the BCE Alliance (comprising 4.9% of U.S. residential electric customers), with PG&E and SCE each representing about 4% of U.S. residential electric customers.

Figure 1. BCE Alliance and Consumer Electronics Initiative Timeline, 2008 to 2014



1.1. Initiative Design and Influence

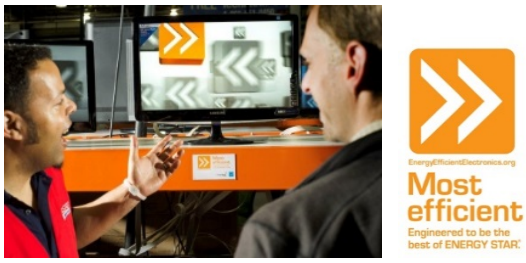
The Initiative employed a "midstream" approach in which television retailers were the program participants. The terms "midstream" or "upstream" are used to describe an efficiency program design that targets a product's supply chain rather than the end user. Although the terms are often used interchangeably, "upstream" typically refers to manufacturers or component suppliers and "midstream" to retailers or distributors.

The initiative employed two major methods to influence sales of qualified televisions: corporate retailer engagement and incentives, and regional in-store activities. At the corporate level, the Initiative engaged with retailers to establish and maintain relationships with corporate staff, provide energy-related information, and offer per-unit incentives for sales of qualified televisions. The Initiative expected these activities to motivate retailers to include more energy efficient televisions in their assortments (the number and type of televisions a retailer makes available in its stores or online) than they would without the Initiative. Because large national retailers like those participating in the Initiative typically make assortment decisions at a national level, any influence the Initiative had on assortment would likely influence TV sales across the U.S.

The incentive amounts NEEA offered retailers for sales of qualified TVs varied somewhat from year-to-year over the course of the TV Initiative. However, because members of the BCE Alliance collaborated to define consistent specification levels, the total amount of incentives participating retailers stood to receive from assorting and selling qualified TVs varied more substantially over time as program administrators joined, and then left, the alliance.

The Initiative also affected television sales regionally, primarily by engaging in in-store activities. These in-store activities included placing POP materials on display models of qualified TVs in participating stores (Figure 2 is an example of the Initiative's POP), playing a promotional video on display TVs in participating stores, and training sales associates. NEEA also carried out marketing campaigns to promote qualified TVs during the course of the Initiative.

Figure 2. Examples point of purchase signs



1.2. Stakeholders and Activities

In addition to NEEA, two organizations played key roles in the implementation of the TV Initiative: Navitas Partners, and Energy Solutions. Navitas managed the Initiative's relationships with retailers and manufacturers and served as the Initiative's point of contact for these industry actors. Energy Solutions served as the Initiative's data management contractor, receiving retailers' monthly submissions of sales data, determining which models qualified for incentives, and reporting the quantity of qualified sales at each retailer to NEEA. Table 2 shows the Initiative's seven key activities and the stakeholders that contribute to them.

Table 2. Initiative Activities and Stakeholders Involved, 2013

	Stakeholder (s) and their Roles		
	NEEA	**Navitas Partners**	**Energy Solutions**
Activity	**Funder**	**Implementer**	**Data Manager**
Develop and manage relationships with retailers and manufacturers	X	X	
Place Initiative point-of-purchase materials at participating retail stores	X	X	
Pay incentives to retailers	X		X
Collect, manage, analyze and report on television sales data		X	X
Participate in industry discussions regarding the energy efficiency of televisions	X		X
Establish annual Initiative specification levels and incentive amounts	X	X	X
Market energy efficient televisions to end users	X		

In order to cover the largest possible proportion of the TV market in the Northwest, the Initiative sought to partner with large, chain retailers. In 2013, the Initiative's retailer participants consisted of six national chains and one buying group that supplies TVs to smaller, independent retailers.

Table 3 lists the Initiative's retailer participants.

Table 3. 2013 Initiative Participants in NEEA Territory

Store/Chain Name	Number of Participating Stores
Best Buy	39
Costco	50
Sam's Club	6
Sears Holdings Corp.	114
Sears	*72*
Kmart	*42*
Target	65
Walmart	106
Nationwide	15
Fry's	2
Total	**397**

1.3. Research Objectives

The current evaluation sought to measure the influence of NEEA's efforts in transforming the consumer television market via the Initiative activities in both 2012 and 2013. Prior evaluations (MPERs 1-3) found mixed results regarding program effects. For example, while Market Progress Evaluation Report (MPER) #1 did not find evidence of any program effects, in both MPER #2 and #3 Research Into Action found evidence of Initiative influence on assortment of qualified televisions, and sales of qualified televisions. Previous MPERs, however, were unable to reliably quantify these impacts due to the complex and proprietary nature of the assortment decision-making process employed by retailers and manufacturers. The experience of the previous MPERs is consistent with the experience of other mid-stream BCE program evaluations, which have attempted to quantify assortment and have generated estimates that are widely divergent, often controversial, and of limited reliability.

This evaluation sought to catalog both the Initiative's regional influence, including local, in-store activities that can be directly measured and quantified, and its national influence, including Initiative influence on corporate-level retailer behavior.

2. Evaluation Activities

Three data collection activities informed the evaluation: in-depth interviews, quantitative analyses of television sales data (both data retailers reported to the Initiative and data NEEA purchased from NPD Group, Inc. (NPD), a market research provider), and a review of Initiative documents. A summary of the activities appears below. The appendices contain additional details, including the interview guides.

- **In-depth Interviews.** Semi-structured phone interviews with electronics industry market players, including retail merchants, retail sustainability executives, U.S. Environmental Protection Agency's (EPA) ENERGY STAR® staff, and Initiative staff.
- **Quantitative Analysis.** Review and analysis of retailer-supplied sales data. Review and analysis of NPD sales data comparing NEEA territory sales data to retailer sales data from a comparable geographic region in the US.
- **Initiative Document Review.** Review of Initiative documents including Initiative logic model, Alliance Cost Effectiveness (ACE) Model, and planning documents. Review of publicly available ENERGY STAR and market research documents.

2.1. In-depth Interviews

In-depth interviews were an important data collection activity for this MPER. These interviews provided a primary source of data on Initiative influence on national level retailer behavior. In order to ensure that these interviews provided the most complete sense of the market possible, Research Into Action and Apex Analytics (the research team) interviewed a diverse population with varying perspectives on the Initiative, including individuals in different positions within retail organizations and staff from all five major retail chains. Table 4 lists the number of in-depth interviewees by population and position.

Table 4. In-Depth Interviewees

Interviewee Type	Completion Goal	Completed Interviews
Participating retailers	5	5
ENERGY STAR Program Manager	1	1
NEEA and Implementation Contractor Staff	2	4
Total	**11**	**12**

The evaluation team conducted the majority of the in-depth interviews by telephone. With respondents' permission, interviewers recorded the interviews and used the recordings to supplement notes taken during the interview. Due to the difficulty in reaching retailer merchants, who are often protected from program evaluation activities, the evaluation team also sent an online survey to retailer merchants. The evaluation team used *Dedoose*, qualitative analysis software, to organize and analyze data from all interviews and surveys. The evaluation team also

analyzed interview data from MPERs #2 and 3 to provide an historical perspective to the Initiative's influence on the energy efficient television market.

2.2. Sales Data Analysis

The evaluation team analyzed sales data from two sources: Initiative supplied sales data and NPD sales data.

Initiative Supplied Sales Data: The evaluation team performed statistical analyses on television sales data collected by the Initiative. Researchers received a database with daily or monthly sales by retail chain and store. Researchers worked with Energy Solutions to identify qualified television models, distinguish online from in-store sales, and gather assortment lists for each year of the Initiative. Researchers cleaned the sales database, used descriptive statistics to explain current market conditions, and conducted statistical analyses to explore the presence of, and attempt to quantify, Initiative influence on television sales. Statistical methods researchers employed included t-tests and analyses of variance (ANOVAs), multiple regression models, and multi-level regression models.

NPD Sales Data: In order to estimate regional impacts from the Initiative, the research team took a market-based approach to estimating program attribution. The evaluation team first selected a comparison region to use as a baseline. The comparison region the evaluation team selected lacked any program administrator-sponsored activity focused on TVs, but was similar to the Northwest in demographic and household makeup. The evaluation team then estimated qualified and non-qualified sales in both NEEA territory and the comparison regions, and statistically compared the proportion of qualified sales between the two regions (NEEA territory and the comparable baseline region).

2.3. Program Data Review

The evaluation team conducted a thorough review of Initiative data to address the research objectives. These activities included: a systematic review of entries in the Initiative's Salesforce database; an examination of public comments submitted in response to proposed ENERGY STAR specifications; and a comparison of findings from previous MPERs (1-3) with data collected for the current evaluation.

3. Findings

This chapter presents findings from the research activities conducted for this MPER. It begins with a characterization of the TV market, focused on the impact of new technologies currently entering the market, reviews the Initiative's logic model, elaborates on five key findings drawn from a synthesis of the various research activities, and reviews the assumptions of the Initiative's ACE Model.

3.1. Market Characterization

TV technologies stabilized somewhat in recent years after a period of rapid change as flat panel displays replaced cathode ray tube TVs and light emitting diode (LED) backlighting became common in liquid crystal display (LCD) TVs. However, TV manufacturers have been developing a range of new technologies, motivated in part by the potential for organic light emitting diode (OLED) displays to enter the market on a larger scale.

OLED displays are an emerging TV display type that has the potential to provide higher quality images in thinner form factors than the LED-lit LCD displays that currently dominate the TV market. In response to the emergence of OLED displays, as well as other factors, TV manufacturers have developed new technologies to improve the performance of their LED LCD displays. The most prominent of these new technologies to date is Ultra-High Definition (UHD) TVs, also called 4K TVs, which have a vertical resolution of at least 2,160 pixels, double that of HD TVs and provide four times as many pixels.

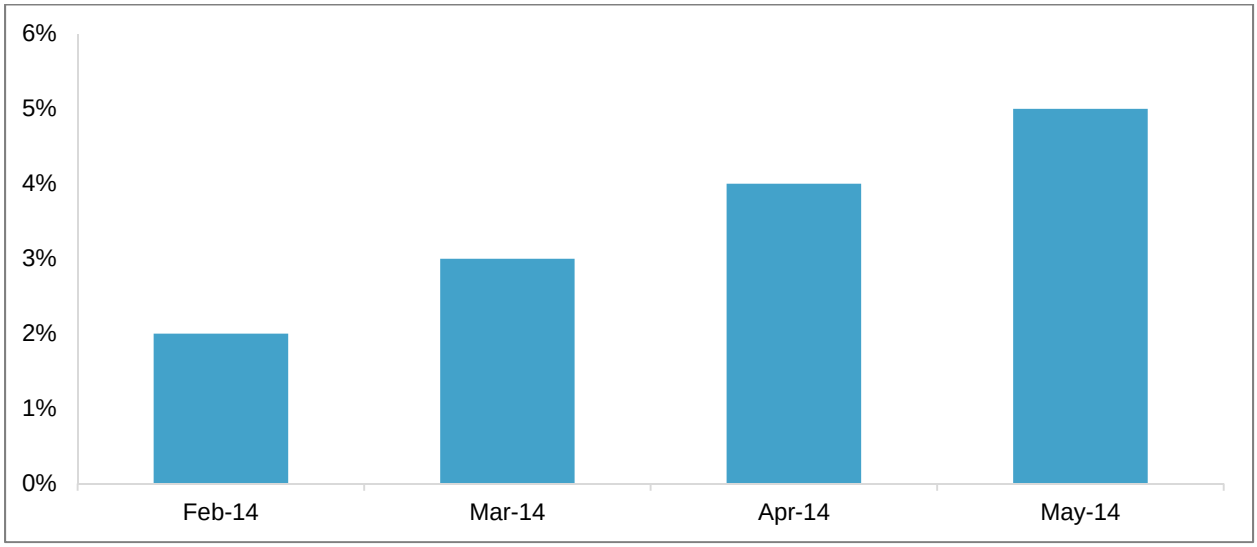
In order to assist NEEA in monitoring trends in the TV market, this section presents findings from a review of TV industry and technology news and market research reports related to the adoption of UHD and other new TV technologies and the implications of those technologies for TV energy use.

3.1.1. Market Characteristics

- **Overall LCD TV shipment forecasts are rising.** LCD TVs experienced slight gains in global shipments in 2013, and an accelerated increase in shipments in 2014. While shipments increased globally, North America was one of the regions with the most substantial gains (DisplaySearch 2014b). Due to this growth, industry analysts increased global shipment forecasts for LCD TVs in the coming years. Industry sources expect continued growth in unit shipments of about 7% in 2014 and similar growth in 2015 (DisplaySearch 2014b).
- **While UHD TVs currently hold a small share of the market, shipments grew steadily in 2014 and analysts expect them to continue to rise.** In 2014, UHD TVs experienced steady growth and their share of the LCD TV market has been increasing. The UHD TV market share increased at least one percentage point each month between February and May 2014 (see Figure 3) (Hong 2014b). In mid-2014, UHD TVs accounted

for 5% of LCD TVs globally, up from 2% in September 2013 (Hong 2014b). Industry sources have raised their estimates for future UHD shipments in the United States and worldwide. In the United States, IHS has raised its UHD shipment forecasts from 2.1 million units to 3.6 million in 2017 and predicts 4.6 million units shipped in 2018. Analysts predict this will account for 13% of total US LCD TV shipments in 2018 (IHS Technology 2013).

Figure 3. UHD TV Percentage Share of Total LCD TV Market (Share Based on Shipments)



Source: IHS Technology 2014

- **Decreased cost and high demand for large TVs contribute to rising UHD TV market share predictions.** Industry sources report that consumer demand for larger screen sizes has resulted in greater demand for UHD TVs because improved resolutions are most noticeable on larger screens (IHS Technology 2013). UHD TV costs have also decreased. Analysts estimated that in 2013, UHD TVs cost on average from four to eight times the cost of other HD LCD TVs. Analysts expect this price differential to decrease, estimating that UHD TVs will cost approximately 2.6 times as much as other HD LCD TVs by 2018 (Bergman 2013). A decrease in forecasted shipping prices also contributes to growth forecasts (Gonzalez-Thayer 2013).

- **The availability of UHD content is likely to increase, and content availability will be an important factor in UHD adoption.** TV manufacturers and content providers have formed a partnership called the UHD Alliance to create standards for content and delivery (Kastrenakes 2015). An initial concern about UHD TVs was that there would be too little content to persuade consumers to upgrade their TVs to UHD (Lendino 2014). The UHD Alliance hopes to ensure there is content, and to set standards, define terminology and design delivery of UHD content, in order to establish a "healthy UHD ecosystem" (Kastrenakes 2015).

3.1.2. Technology Trends

- **While OLED TV technology may provide better image quality than UHD LCD TVs, OLED TVs have been slow to enter the market.** Product reviewers have reported that OLED TVs provide a more realistic image, with more vibrant colors and greater depth, but growth in the OLED market has been slower than expected (Morrison 2012). As a relatively new display technology, OLED TVs require a distinct manufacturing process, which is not as mature as the process for manufacturing LCD displays (Morrison 2013). In particular, manufacturers have faced challenges in manufacturing larger display sizes (Consumer Report News 2013). Both Samsung and LG released OLED models in the past few years, but only LG released updated OLED TVs for 2015, and plans to release an UHD OLED model (Morrison 2014). Samsung has indicated that it intends to continue to pursue OLED technology (Wheatley 2015). OLED TVs are expected to become increasingly available and prices are expected to decline, but at a much slower rate than UHD TVs (Consumer Report News 2013).

- **Delays in the release of OLED TVs have allowed UHD LCD TVs to gain market share** (Gonzalez-Thayer 2013)**.** UHD LCD TVs have been able to come on the market more quickly than OLED TVs because manufacturers can produce them on the same production lines as standard LCD TVs and offer them at lower cost than OLED TVs (Consumer Report News 2013).

- **Industry sources expect significant growth in UHD TVs with quantum dot technology in the next few years, boosting the UHD market further.** In response to the development of OLED technology, LCD TV manufacturers are turning their efforts towards quantum dot technology (DisplaySearch 2015). By placing a film of quantum dots (made up of semiconductor nanocrystals) between the LED backlight and the LCD display panel, TV manufacturers can improve the quality of the light entering the LCD panel (Jukic 2015). As a result, TVs with quantum dot technology can provide more "lifelike" color and improved contrast (Morrison 2013). UHD TVs with quantum dot technology are expected to become available in 2015 and begin with 1.3 million shipments worldwide. This is expected to grow to 18.7 million shipments in 2018 (DisplaySearch 2015).

3.1.3. Energy Use Implications

- **UHD TVs use notably more energy than standard HD TVs.** The increase in resolution required for UHD TVs increases their energy use compared to similar models with HD resolution (Enervee 2014). The UHD TV models listed in the TV dataset EPA used to develop the most recent ENERGY STAR specification (Version 7.0) used, on average, more than three times the on mode power of HD TVs in the same size categories (see Table 5).

Table 5. Comparison of On Mode Power Draw between HD and UHD LCD TVs

Screen Size Category (In)	Count of Models		Average On Mode Power Draw (W)[1]	
	HD[2]	UHD	HD	UHD
40	227	3	47	149
50	190	24	69	234
60	89	9	79	270
70	27	12	96	346

Source: ENERGY STAR (September 2, 2014). TV Specification Version 7.0, Draft 2 EPA Dataset. Received from *https://www.energystar.gov/sites/default/files/Draft2V7_TVs_EPADataset_0.xls*

[1] On mode power in default mode as shipped.

[2] Models with 1080p native vertical resolution.

The ENERGY STAR Version 7.0 specification, which takes effect on October 30, 2015, provides an on mode power allowance for UHD TVs that is 50% greater than the on mode power allowance for other types of TVs (ENERGY STAR 2014a). Nonetheless, in comments on the specification, one manufacturer stated that this requirement would be difficult to meet. According to this manufacturer, UHD TVs typically use "twice as much power" as similar non-UHD TVs, and, while this manufacturer expects efficiency improvements, they do not expect the differential between the two to fall even to 50% (ENERGY STAR 2014b).

- **The energy use implications of other emerging TV technologies are not clear.** As noted above, analysts expect the prevalence of TVs with quantum dot technology to increase. Some manufacturers claim that quantum dots could make TVs more efficient by providing increased brightness for the same power, but energy usage data on TV models with quantum dot technology is not yet publicly available. The energy use of OLED TVs relative to LCD TVs is also unclear. While some sources predict OLED TVs will use less energy than LCD TVs because they do not require a backlight, the little data currently available does not support this claim. The ENERGY STAR dataset included two HD OLED TVs, both in the 50 inch size group and both with 3D capability. These models drew an average of 88W of on mode power in their default mode as shipped, compared to 60W for 50 inch HD LCD TVs with 3D capability (Morrison 2015; Matheson 2015; ENERGY STAR 2014d).

3.2. Logic Model Review

At the end of 2013, NEEA transitioned the TV Initiative to Long-Term Monitoring and Tracking (LTMT). This transition follows NEEA's assessment that the market has transformed to the point that active intervention is no longer necessary to drive adoption of efficient TVs. In LTMT, NEEA will continue to monitor the TV market to identify any technological or market developments that could reverse recent efficiency gains and might justify future intervention. NEEA will also continue to participate in the process of setting efficiency standards for TVs,

both through voluntary initiatives like ENERGY STAR and mandatory standards like those that recently took effect in Oregon.[1] In LTMT, the Initiative will no longer take actions to directly influence market actors, like paying retailers incentives and maintaining in-store marketing efforts.

Because it is no longer actively intervening in the market, a transition to LTMT implies a shift in an Initiative's activities. In reviewing the logic model for this MPER, Research Into Action sought to ensure that the model accurately reflects the TV Initiative's activities under LTMT. The logic model the evaluation team reviewed reflected some activities the Initiative undertook prior to its transition to LTMT, which will no longer be performed. For example, under LTMT, the Initiative will not establish annual specifications and incentive amounts or engage with retailers to present the program. The logic model review largely focuses on removing activities the Initiative is no longer conducting as well as their associated outputs and outcomes from the logic model and updating those activities the Initiative will continue to conduct.

Figure 4 shows the logic model displayed in the Transition Complete Milestone Document and Figure 5 shows the updated logic model based on the review for this MPER. Appendix G provides additional detail and rationale for each recommended change.

[1] Along with California and Connecticut, Oregon recently established energy efficiency standards for TVs. Oregon standards came into effect at the beginning of 2014 and largely parallels the ENERGY STAR Version 4.0 TV specification. (The Appliance Standards Awareness Project)

Figure 4. TV Initiative Logic Model from June 30, 2014 Transition Complete Milestone Document

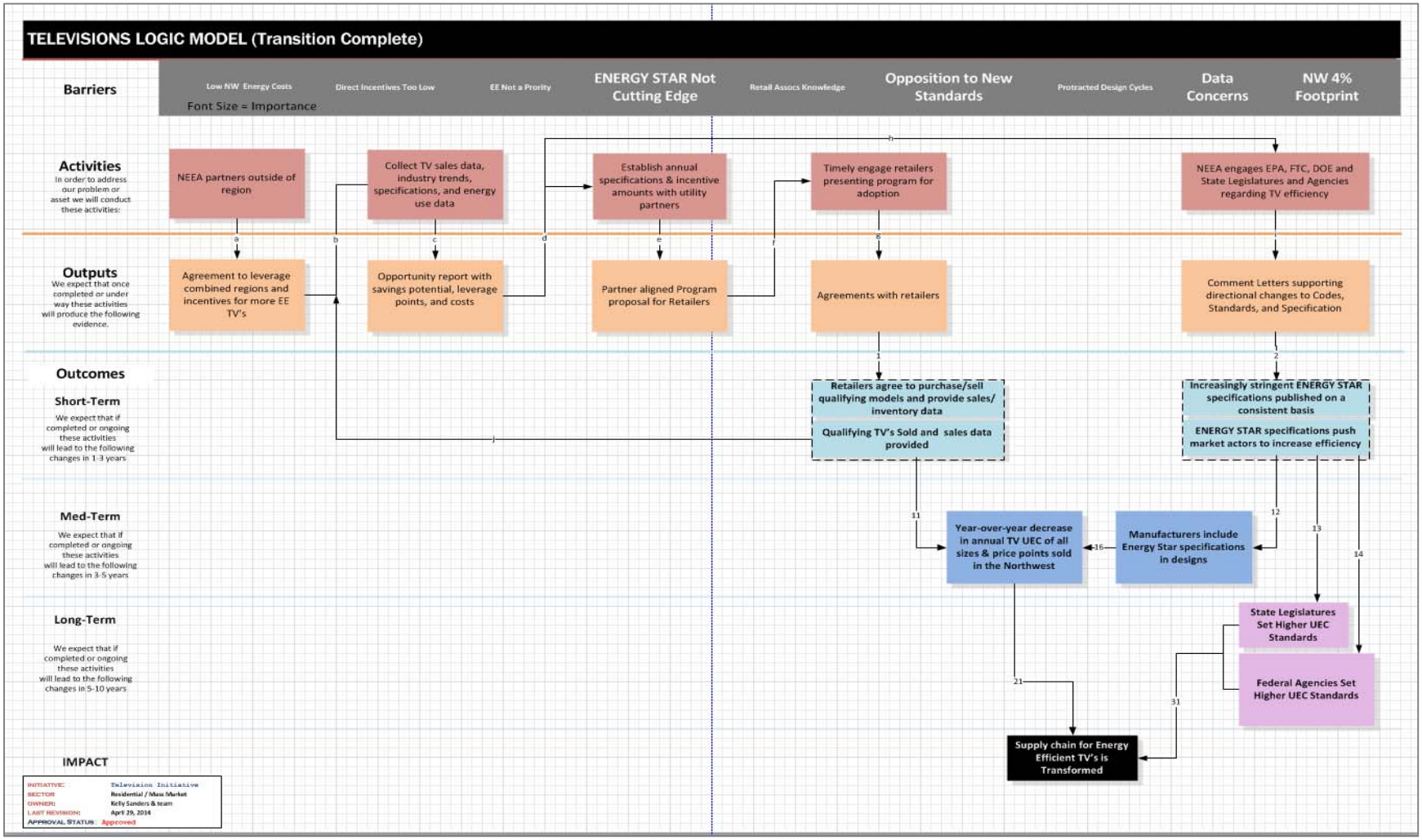
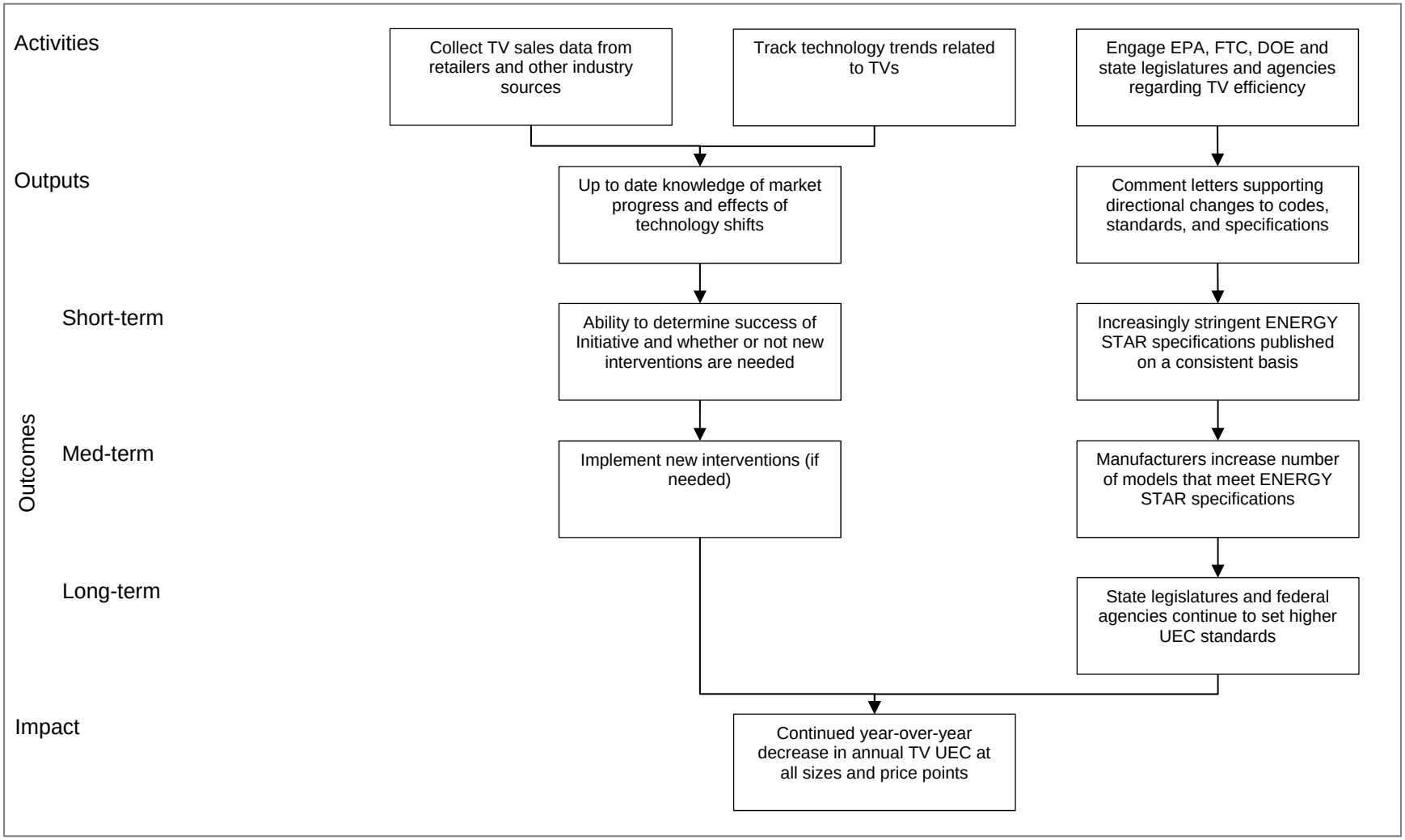


Figure 5. Revised Logic Model



3.3. Initiative Influence and Key Changes in Market

This section presents five overarching findings related to the Initiative's influence on the TV market that the research team has identified. Each key finding draws on analysis conducted for multiple evaluation activities, including the analyses of retailer-reported sales data, NPD market data for the Northwest and a comparison region, in-depth interviews, and reviews of Initiative and industry documents.

3.3.1. Key Finding #1: The Initiative's influence on retailers was strongest early in its implementation

The Initiative's activities sought to influence the TV market at both the national and regional levels since the initiative's inception in 2009. By offering incentives for sales of qualified TVs, the Initiative sought to motivate retailers to increase the proportion of efficient TVs in their assortment. The Initiative also anticipated that retailers' increased demand for efficient TVs would motivate manufacturers to increase the efficiency of the TVs they design. To the extent the Initiative achieved these goals, it would have an influence on the TV market nationally since large chain retailers make their assortment decisions at a national level, and manufacturers design models for national or international markets.[2]

The Initiative also carried out activities designed to have a regional influence. Most prominently, these activities included in-store engagement efforts, including tags identifying qualified TVs, a video promoting qualified TVs that played on the display TVs in participating stores, and information on the Initiative that field services staff would deliver during regular store visits. Data collected for this MPER and past MPERs indicate that the Initiative influenced retailers at both a national and a regional level, but the incremental gains in efficiency the Initiative has brought about each year have likely declined as the TV market has evolved since 2011.

[2] TV Initiative MPERs #1 and #2 confirmed that these decisions are made at a national level.

3.3.1.1. National Level Influence

Retail TV merchants and sustainability staff have consistently reported that the Initiative's incentives were one of many elements they consider in their assortment decisions and that incentives could motivate them to assort a more efficient TV over a less efficient one that was similar in other ways. For example, in an interview for this MPER, one retail TV merchant said the incentive would factor into an assortment decision "if it was a tiebreaker-type situation. There are a lot of feature sets to consider…if all else was equal, then yes, [the incentives] would be a consideration." A sustainability executive at another retailer explained that, by influencing the profitability of a particular model, Initiative incentives might motivate merchants to "assort it more prominently." These statements are consistent with retailers' statements in interviews for past MPERs regarding the role of the Initiative in their assortment decisions:

- "If a manufacturer says our [model] doesn't meet [the Initiative specification], and another vendor has the latest certification, it influences us. It's not a check-off on a sheet where we won't buy without it."
- "Probably the consumer would feel, as we do, that if it's a toss-up between two products, we're going to go the direction of the more energy efficient product."
- "If [the merchants] could look at three televisions and all things are equal between them…but maybe one is more energy efficient, maybe we assort that one over the less efficient one."
- "[Merchants] want to be made aware of what products meet what energy efficiency standards when they look and bring products into the assortment. That doesn't mean that energy efficiency is the number one or the driving factor on what makes it into the assortment, but it does mean that it's a consideration."

Nonetheless, interviews for this MPER begin to show a shift away from consideration of Initiative incentives in TV assortment decisions for some retailers. Merchants from two retailers stated that they did not consider Initiative incentives in their 2013 assortment decisions. A merchant from a third retailer stated that, while they were new to the position and had not been involved in assortment decisions under the Initiative, regional programs would be unlikely to cover enough of the market to influence national assortment decisions.

A review of interview findings from past MPERs provides additional context to this shift in attitudes, suggesting that the Initiative had the greatest influence on retailers' TV assortments early in its implementation. In a 2012 interview conducted for MPER #2, one retail TV merchant said "The lineup of TVs that we sell has already evolved into one that is very energy efficient…When we started the program years ago, we did make buying decisions based on the qualifications of the most efficient products – limiting plasmas and choosing plasmas that are more efficient than others. We have already evolved the lineup to reflect that." Another retailer similarly noted that when the TV Initiative launched, program incentives were "at the height of their value for program participants. It was a significant economic driver for both retailers and manufacturers."

3.3.1.2. Regional-Level Influence

Like its influence on national assortment decisions, the influence of the Initiative's regional efforts appear to have been strongest earlier in its implementation. A comparison of TV sales data between the NEEA region and a demographically similar area without programs seeking to increase sales of efficient TVs found that, in 2012, sales of efficient TVs in the Northwest were between 6% and 8% greater than in the comparison region. In 2013, the regional lift in sales between the Northwest and the comparison region decreased to between 2% and 3%.

Because retailers do not vary their assortments by region, this decrease in Initiative influence likely does not directly reflect changes in the Initiative's influence on assortment decisions. Instead, it is more likely to reflect shifts in both NEEA's and retailers' efforts to promote efficient TVs. As noted in Key Finding #3, the Initiative's in-store outreach efforts had an effect on sales of qualified TVs, and the Initiative's regional influence would reflect any decrease in those efforts in 2013 relative to 2012. Mystery shopping visits conducted for MPER #3 also found that retail sales associates were significantly less likely to mention energy efficiency unprompted when discussing TVs with customers in 2013 than they were in 2012.

3.3.1.3. Reasons for Decreased Engagement

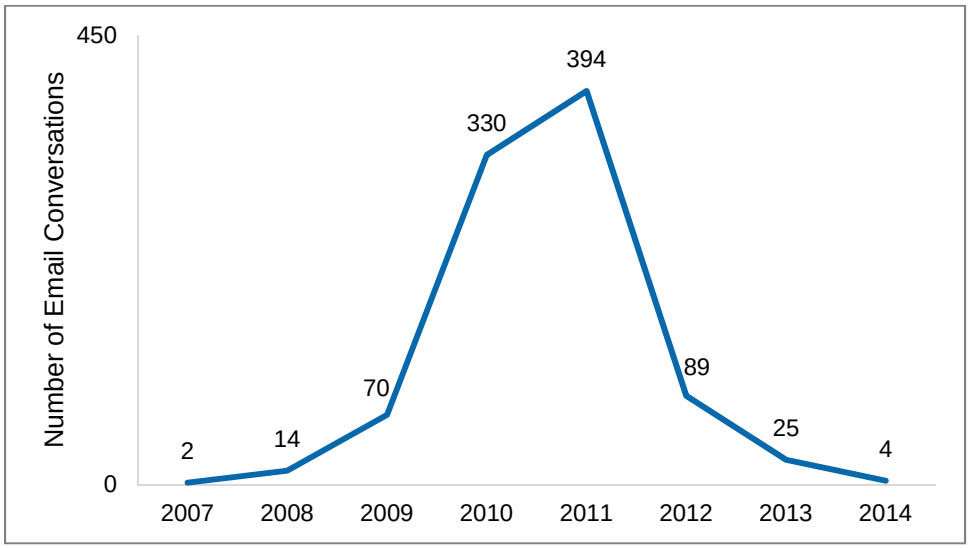
Interview findings suggest three factors that probably contributed to retailers' reduced engagement later in the Initiative: staff turnover among retail merchants, decreases in the proportion of the market covered by incentive programs, and changes in the TV market.

Staff Turnover

Merchants at four retailers stated they had come to their positions after their companies began participating in the Initiative, with one reporting they had been in the position less than one year. These merchants may be less engaged with the program than those that were involved in their organization's initial decision to participate. For example, one merchant said "It might have been different when the program first started, [now my role is] managing the contract each year when the program changes and then providing the data; that's about all the involvement I have." Sustainability staff at the fifth retailer stated that staff turnover in the consumer electronics business unit had made it difficult to retain TV merchants' attention to the Initiative.

The Salesforce database the Initiative implementer used to track its contact with retailers further suggests that retail staff involved in the Initiative in earlier years had more in-depth contact with the Initiative than those involved later. As Figure 6 shows, the number of email conversations tracked in the database rose quickly through 2010 and 2011, peaking at 394 conversations tracked in 2011. In 2012, the number of email conversations tracked in the database fell by more than 75% and continued to decline through 2013.

Figure 6. Email Conversations Tracked in Implementer's Salesforce Database over Course of TV Initiative



Source: Initiative Implementer's Salesforce Database

Decreases in Market Coverage by Mid-Stream Programs

Collaboration with other program administrators was an important element of NEEA's strategy in the TV Initiative. In addition to streamlining the participation process for retailers who would otherwise have had to manage relationships with multiple efficiency programs, collaboration increased the proportion of a participating retailer's market in which they could earn incentives for sales of qualified TVs.

During our in-depth interviews, retailers reported that both of these benefits were important to the success of the Initiative. According to one TV merchant, incentives like those the Initiative offered would be "meaningful, especially if a program could capture a greater amount of the country, so it's not that I'd have to work with 50 different programs and trying to track each one and put it together; consolidation would make things easier." This merchant later said, "If the program was national, then I'd look to assort the majority of my [TV models] under this program. When these programs are regional, it doesn't add up to a large enough savings to make me switch [TV models] nationally." A sustainability executive at another retailer expressed a similar opinion in an interview for MPER #2, noting that it had become more difficult to capture merchants' attention because incentive levels had decreased.

Through 2012, NEEA implemented the TV Initiative as part of the BCE Alliance, in partnership with all three of California's investor-owned electric utilities, as well as the SMUD and NV Energy. Together, the California and Nevada utilities and the four Northwest states NEEA serves comprise 15% of U.S. residential electric customers. At the end of 2012 however, SDG&E, SCE, and NV Energy stopped offering midstream incentives for efficient TVs. Without those utilities, in 2013 the BCE Alliance's coverage decreased to 9% of residential electric customers in the U.S.

Changes in the TV Market

In interviews for both the current and past MPERs, retailers described considerations related to anticipated consumer demand as central to their assortment decision making. According to one TV merchant, "Usually our assortment is all based on customer demand…what are the customers looking for, what are they asking for, and what are they buying? Let's go get more of that. It all stems around the customer reaction or feedback that we get." While other retailers reported that considerations like supply chain stability and profit margins also factored into their assortment decisions, all stated that they sought to assort models that would generate strong consumer demand. In a 2012 interview, one retailer said, merchants "are trying to predict what TVs customers are going to want to buy, and they are trying to predict that half a year before those TVs even get into the store."

Retailers reported that energy efficiency has the potential to build consumer demand for a particular TV model, if that model's efficiency sets it apart from other options. According to one retailer, "Energy efficiency could [differentiate one TV from another] if we could communicate to the consumer, with this TV you will save X dollars and it's meaningful to them relative to the price point of the TV."

However, as described in Key Finding #2, over the course of the Initiative, TV energy use decreased and the difference between the average energy use of the most efficient and the least efficient models sold narrowed. Retailers reported that these changes made energy efficiency less effective as a differentiating factor in motivating customers to choose particular TV models. In an interview conducted in 2013 for MPER #3, one retailer stated that promoting energy efficient TVs is, "kind of a tough proposition because the main gains in energy consumption have been realized with the industry shifting to LCD TVs." This retailer noted that consumers could see from the Energy Guide label that TVs use relatively little energy and the difference in energy costs between efficient and inefficient models is relatively small.

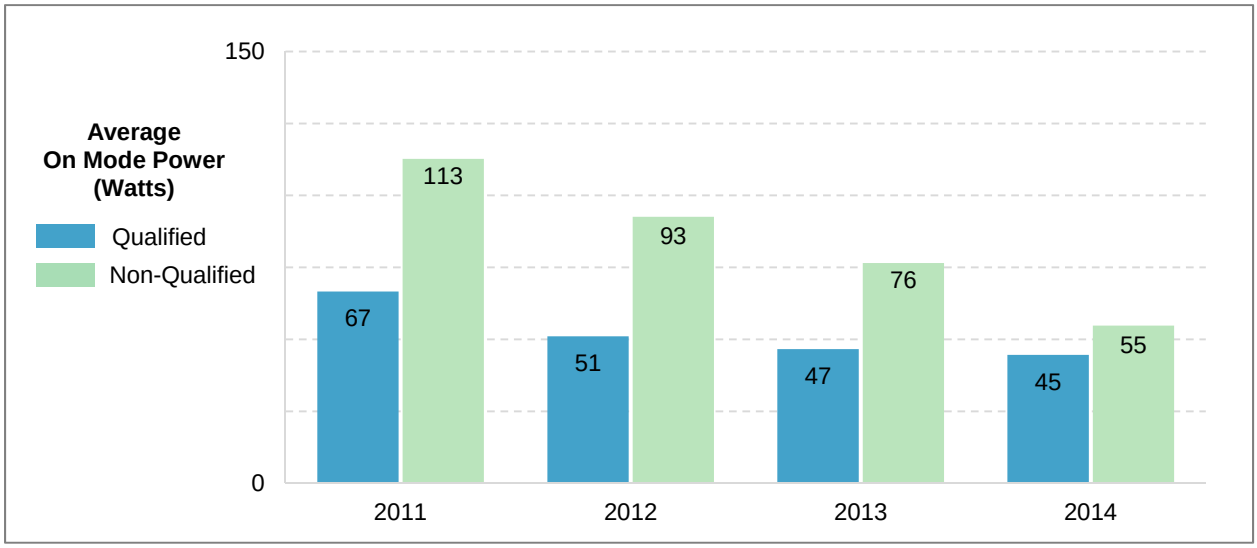
As energy efficiency became less of a differentiator for TVs, merchants' perceptions of the value of a qualified TV over a non-qualified TV likely decreased, altering their assessment of the value proposition the Initiative offered. With a difference in energy use that the retailers viewed as less meaningful to the consumer, a TV's efficiency level was less important in meeting the merchants' goal of assorting models consumers would demand. One TV merchant interviewed for the current MPER said, "At the end of the day, the consumer is the final decision maker. If they continue to purchase, it becomes more relevant for us."

Initiative incentives continued to increase the potential profit margins retailers could earn from sales of qualified models, and for some retailers profit margins weigh more heavily in the assortment decision than others. For example, in an interview for the current MPER, one retailer said, "If the customer says they want it, we will buy it. It's not like we will buy one item because the margin is better. We will buy because the customer will want it."

3.3.2. Key Finding #2: The differential between the most efficient TVs and the rest of the market has diminished, but new technologies may alter the landscape

Over the course of the Initiative, TVs have become notably more efficient, and the gap between the most efficient models and the rest of the market has decreased. Sales data retailers reported to the Initiative show that across all TV sizes, on-mode power use shrunk each year between 2011 and 2014. These reductions are most pronounced among larger models, which have grown in popularity. By 2014, almost all (99%) of TVs sold used 100 watts or less in on-mode. As TVs have become more efficient, the difference in average energy use between TVs that qualified for the TV Initiative and those that did not has decreased (Figure 7). In 2011, qualified TV models were rated at an average of 67 watts while non-qualified models averaged 113 watts (an average difference of 46 watts). This gap shrunk over the next three years to an average difference of 10 watts in 2014, despite a more stringent 2014 specification relative to previous years (discussed further in Key Finding #4, below).

Figure 7. Change in Average On-Mode Power, by Qualification Status



Source: Retailer-reported sales data

This reduction in the difference in energy use between qualified and non-qualified models largely reflects increases in efficiency among non-qualified models. While non-qualified models dramatically dropped in average on mode power use over the four incentive periods studied, average qualified model power use changed less in the last three incentive periods.

This decrease in TV energy consumption is largely a result of the growing prevalence of LED-backlit LCD TVs in the market, which ENERGY STAR has called "the most energy efficient combination of backlighting and panel technology today."[3] LED-backlit TVs made up a small

[3] ENERGY STAR. Television Buying Guidance. Retrieved from: https://www.energystar.gov/products/certified-products/detail/televisions

fraction of the market when the Initiative began in 2009. By 2012, they represented a majority of the TVs available, and by 2014, sales data retailers reported to the Initiative suggest that more than 80% of the TVs sold in the Northwest were LED-backlit LCDs.[4]

While the difference in energy use between efficient TVs and others has decreased in the past few years, new technologies entering the market may increase the energy consumption of some models. UHD TVs, in particular, appear likely to continue to gain market share, and, because they use more energy than HD models, to increase overall TV energy use. It is possible that the adoption of other emerging TV technologies, like OLED displays and quantum dot technologies could offset the increases in TV energy use likely to result from a growing prevalence of UHD TVs. However, it is not yet clear to what extent, if at all, these technologies will reduce TV energy use.

3.3.3. Key Finding #3: In-store engagement influenced sales of energy efficient TVs

As described in Key Finding #1, the Initiative had an influence on sales of energy efficient TVs in the Northwest beyond any influence that resulted from changes in retailers' assortments at the national level. As the results of the experiment NEEA implemented in 2013 to test the influence of video wall promotions and sales associate training demonstrate, these in-store engagement efforts were a key element of the Initiative's regional influence.[5]

Stores at which the Initiative's field services staff provided enhanced training to sales associates or stores that played the Initiative's video on their TV display walls sold about 3.5% more qualified televisions than stores that did not receive either of these interventions. The two interventions in combination had a larger effect, resulting in a nearly 5% increase in the proportion of qualified sales (Table 6). Because the effect of the combined video wall and enhanced training was less than the sum of the two effects individually, the experiment's outcome suggests that the two interventions acted in similar ways to influence sales of efficient TVs, although implementing them together magnified their effect over the effect of either individually.

Table 6. Intervention Effects on Proportion of Qualified Sales

Intervention	Effect on Proportion of Qualified Sales
Video Wall + Enhanced Training	+4.6%
Enhanced Training Only	+3.5%
Video Wall Only	+3.4%

While these findings are consistent with those of prior MPERs, NEEA's use of a designed experiment allows the research team to more confidently isolate the influence of NEEA's interventions from other factors influencing the TV market. In MPER #2, the evaluation team

[4] Ibid.

[5] See Appendix C for more on this experiment.

identified a 3% increase in sales of top-tier qualified TVs at one major retail chain associated with the promotional video. MPER #3 found a 2.6% increase in sales of qualified TVs in October 2012, when the Initiative video played, relative to September 2012, when the video did not play. This influence varied by chain, and may have reflected other promotional activities the Initiative undertook in October 2012. The experimental design NEEA used to implement its in-store engagement activities in 2013 enabled the research team to isolate the effects of each intervention and identify those effects consistently across retail chains.

Retailers value the Initiative's in-store activities and are unlikely to conduct similar efforts to promote efficient TVs on their own. According to one retailer, "We see [field services] as a really significant practice to the long-term success of any program. The more education and awareness that we can make [energy efficiency] top of mind with sales associates, the more they will make it top of mind for their customer base."

Interview findings suggest it is unlikely Initiative incentives would motivate retailers to feature a qualified TV over a less efficient model in their marketing. According to sustainability staff at one retailer, TV merchants "are dealing with millions of dollars for a weekend advertising promotion. We have not had great success breaking through that, making energy efficiency a decision tool for them to do short term marketing efforts." This retailer went on to note that their weekly newspaper inserts do not vary regionally, and so are unlikely to reflect regional efficiency programs.

3.3.4. Key Finding #4: Inclusion of a second specification tier allowed the Initiative to influence a broader portion the market

Throughout the TV Initiative's implementation from 2009 to 2013, NEEA defined two qualification levels each year. The more stringent (first tier) qualification level offered higher incentives for sales of the most efficient TVs on the market and sought to drive retailers and manufacturers to increase TV efficiency. The second tier qualification level offered lower incentives for sales of TVs that met a less stringent standard, which nonetheless exceeded ENERGY STAR requirements. The Initiative typically stepped up its qualification levels each year, making one year's first tier qualification level the second tier level the next year. In 2014, NEEA began offering incentives at only one specification level: the ENERGY STAR Most Efficient (2014) designation.[6] As the TV Initiative's top-tier specification had in previous years, this specification recognized a relatively small set of the most efficient TVs on the market.

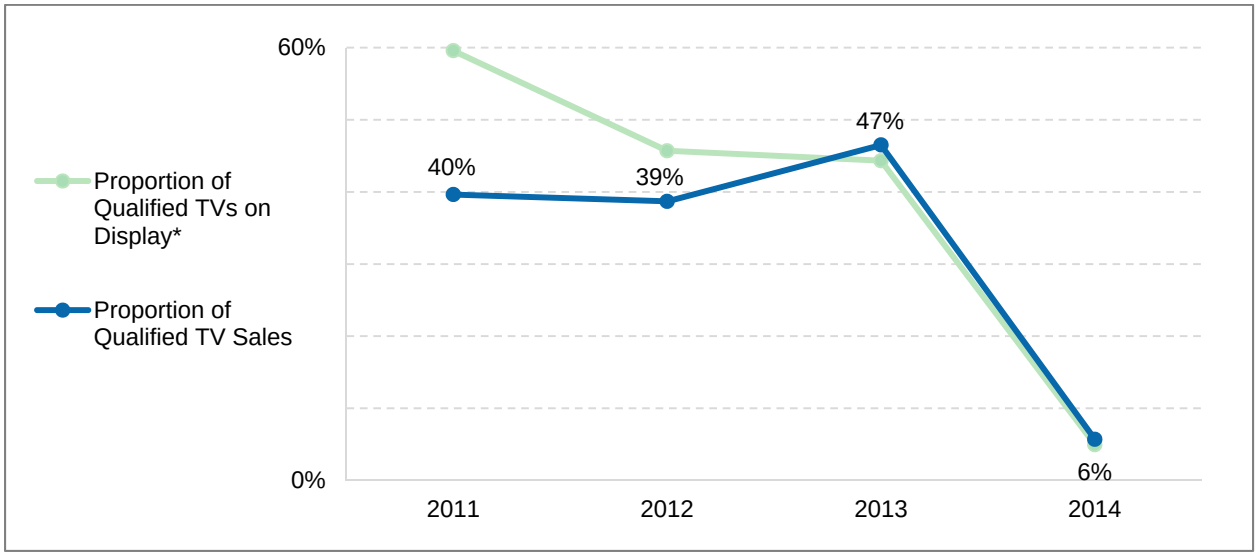
A comparison of retailer-reported sales data from 2014 with previous years suggests four benefits the TV Initiative may have gained from offering a less stringent qualification tier: a higher volume of qualified sales, availability of qualified models at a wider range of price points, an opportunity to engage a broader range of retailers, and greater predictability in incentive levels for retailers and manufacturers.

[6] This change was part of NEEA's transition from the TV Initiative, which entered long term monitoring and tracking at the end of 2013, to the RPP pilot, which launched in 2014.

3.3.4.1. Volume of Qualified Sales

In 2014, the proportion of participating retailers' assortments and sales of qualified TVs decreased sharply relative to their levels in 2013 (Figure 8), and the shift to a single qualification level was likely a contributing factor in this decrease.[7]

Figure 8. Proportion of Qualified TVs on Display and Sold



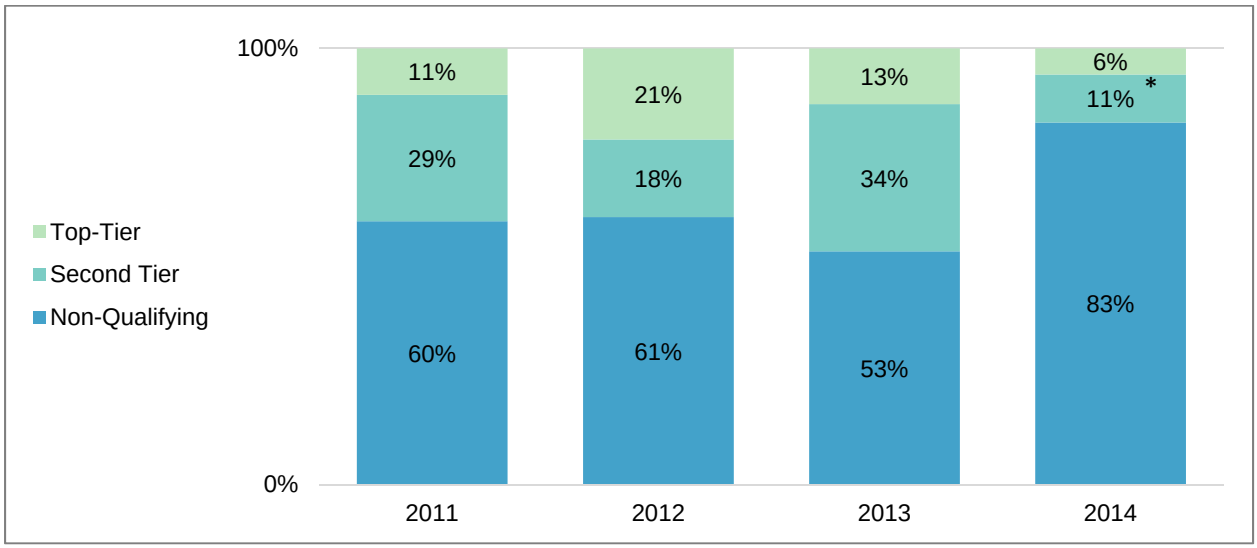
Source: TV sales data participating retailers reported to the Initiative.

* Proportion of qualified TVs on display is calculated by dividing the number of qualified unique models sold in a given year (across all retailers) by the number of all unique models sold.

If NEEA had continued to use a two tiered incentive level approach in 2014, sales data suggest the proportion of qualified TVs sold would have more closely resembled previous years. Assuming NEEA continued its practice of stepping up specification levels (with the top qualification level from 2013 – ENERGY STAR Most Efficient 2013 – as a second tier), qualified TVs overall would have made up 17% of reported sales (Figure 9).

[7] Other factors that may have contributed to the decrease in sales and assortment of qualified models include manufacturers' delays in submitting models for certification under ENERGY STAR Version 6.0, the inclusion of TVs in a similar, but separate initiative Retail Products Portfolio (RPP) as well as delays related to the administrative shift from the TV Initiative to RPP.

Figure 9. Proportion of Reported TV Sales by Incentive Tier



Source: Retailer-reported sales data

* Theoretical second tier based on previous year's top tier. These models did not earn incentives in 2014.

The inclusion of Most Efficient 2013 as a second incentive tier would have nearly tripled the overall proportion of TV sales that qualified for Initiative incentives from 6% under a single tier to 17% if a second tier were included. Nonetheless, inclusion of a second tier would not have brought 2014 qualified TV sales to a level equivalent to previous years. To some extent this may reflect the influence of the Initiative; the inclusion of Most Efficient 2013 as a second tier in 2014 may have further increased sales of these models as the incentives may have motivated retailers to assort and promote more qualified models.

The timing of the specification change and availability of qualified models is likely another factor influencing the lower qualified sales in 2014. While RPP began using Most Efficient 2014 as its qualification level in January 2014, an analysis of the ENERGY STAR qualified products list suggests that nearly three-fourths (73%) of the qualified models available in 2014 entered the market after April 1. Thus, there were few qualified models available to retailers and consequently few qualified sales prior to April 2014. This seasonality of the TV market motivated the Initiative's decision to change qualification criteria for the 2013 incentive period as of April 1, 2013.

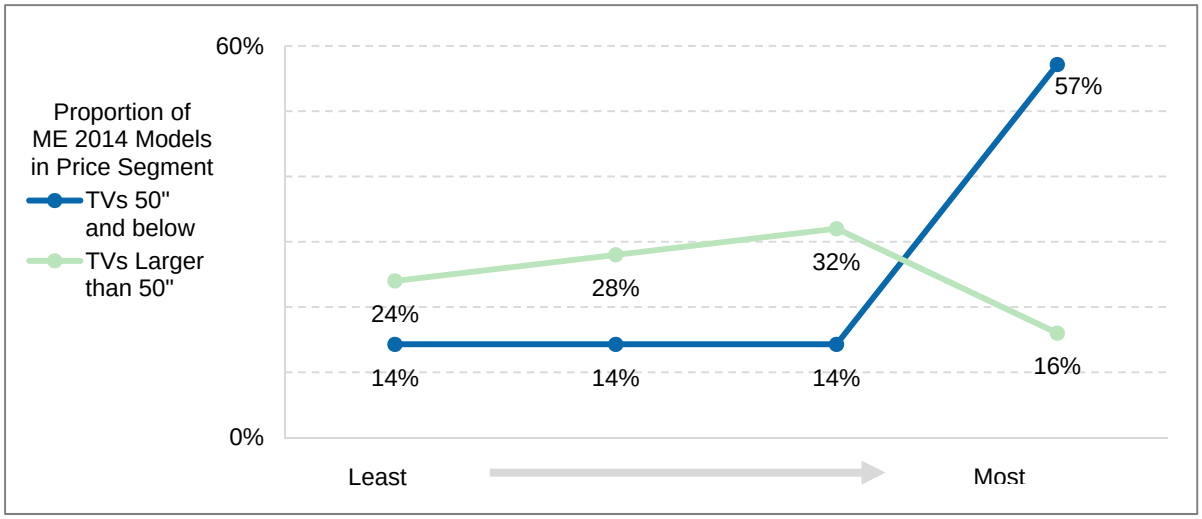
While qualified TVs would have made up a larger proportion of all TV sales if the Initiative had included a second, lower specification level, it is important to set that specification at a level that drives the market. If either a very large proportion or a very small proportion of models qualify for incentives, there will be fewer situations in which retail merchants and consumers have an opportunity to choose between a qualified and a non-qualified model. As a result, there would be less opportunity for the Initiative to influence the market. As discussed below, maintaining an effective balance of qualified products can be important in providing an efficient option for all TV purchases and engaging all types of retailers.

3.3.4.2. Availability across Price Points

TVs meeting the ENERGY STAR Most Efficient designation are likely to be higher-end models. According to one retailer in a 2013 interview, "Most Efficient has been challenging to attract a large mass of customers to. It's the upper crust of the category, so price points are higher." This retailer went on to note that there were not Most Efficient products in all price categories.

An analysis of price data for Most Efficient 2014 models supports this retailer's assertion.[8] A majority of the small and mid-sized (50 inches and below) Most Efficient 2014 TVs that participating retailers carried were among the most expensive TVs in their size category (Figure 10). Large TVs meeting the Most Efficient 2014 designation were distributed more evenly across the range of prices for TVs within their size category, but these large TVs are notably more expensive than small and mid-size models. On average, 55-inch TVs (average price: $1,145) were nearly twice as expensive as 50-inch models (average price: $641). In 2014, models 50 inches and smaller made up 78% of the TV sales retailers reported to NEEA.

Figure 10. Distribution of Most Efficient 2014 TVs by Price Segment



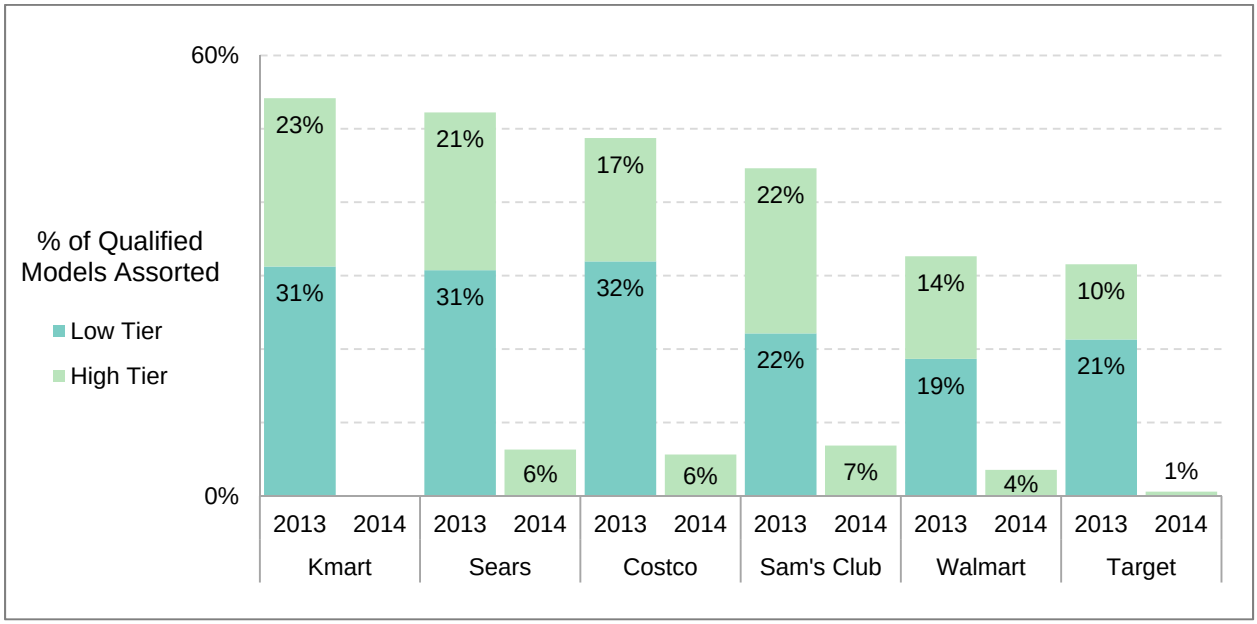
Source: Price data for Most Efficient models from participating retailer websites; comparison price data from Best Buy website as of October 22, 2014. See Footnote 8 on p. 23 for a more detailed description of these data sources.

Models were grouped into quartiles by price within each size category (32", 40", 47", 50", 55", 60", and 65"), and the counts per quartile were then aggregated to obtain overall proportions for TVs 50" and below and TVs larger than 50".

[8] The evaluation team was able to gather price data on 46 of the 50 Most Efficient 2014 models that participating retailers sold in 2014. In collecting these data, we prioritized long term average price data listed on *www.camelbuy.com* and *www.camelcamelcamel.com* and prices listed on archived versions of retailer webpages from 2014. When necessary, we also used current price data or referred to listed "regular prices" for discounted models. The evaluation team collected comparison price data from an archived version of Best Buy's website from October 22, 2014. The comparison dataset includes the top 10-15 models with prices listed in each size category, sorted by top selling models.

The prevalence of high priced models among ENERGY STAR Most Efficient TVs may have reduced some retailers' likelihood of assorting these models. One retailer noted that his company requires products to meet sales volume thresholds in order to remain in the assortment, and higher-end models typically achieve lower sales volumes. Another retailer stated they would be unlikely to assort very high-end TVs "because that's not who [our company's] consumer is. The consumer who is going to [a specialty retailer] is looking for those TVs." Data on retailers' assortments from 2014 are consistent with these statements. Retailers focused on offering lower-cost models, particularly Kmart and Target, offered few, if any, Most Efficient 2014 TVs (Figure 11).

Figure 11. 2013 and 2014 Assortment of Qualified Models by Tier



Source: Retailer-reported sales data

3.3.4.3. Predictability of Incentive Levels

Setting two specification levels each year and stepping up incentive levels by making the previous year's high tier specification the current year's low tier, as NEEA did from 2011 to 2013, allowed retailers to predict the coming year's specification, at least for the low tier.[9] Providing this advance knowledge was important in creating the potential for the Initiative to

[9] Because the ENERGY STAR Version 6.0 specification, which took effect in June 2013, calculated the maximum allowable on-mode power use differently from the prior specification (Version 5.3), the Initiative's low-tier qualification level for 2013 (ENERGY STAR Version 6 + 20%) is not precisely the same as its high tier qualification level for 2012 (ENERGY STAR Version 5 + 35%). Nonetheless, the two specifications arrive at very similar energy use requirements. As of April 28, 2015, the Version 6.0 ENERGY STAR Qualified Products List for TVs contained 800 models that met either the V5+35% or the V6+20% specification. Of those, 89% met both specifications, and the rest were roughly evenly divided with 5% meeting only the V5+35% specification and 6% meeting only the V6+20% specification.

influence TV design by motivating retailers to ask manufacturers to increase the efficiency of their TVs. Historically, the Initiative informed retailers of the coming year's specifications prior to the retailers' meetings with manufacturers in the fall. The TV models manufacturers presented to retail merchants in the fall were in a pre-production phase, with design substantially complete.

Because TV designs are largely complete in the fall, multiple retailers stated they would be unlikely to request that manufacturers increase the efficiency of their TV models during the assortment planning process. Instead, one retailer stated that merchants request specific attributes for the following year's TV models in meetings with manufacturers in the spring – a year before those models were available on the sales floor. According to this retailer, "If there is any desire for a specific utility to affect assortment decisions for TVs, the program measures will need to be determined almost one year in advance. This would allow a merchant to take into account the additional profitability and bring alternate products into their assortment." Defining two incentive tiers and stepping up their stringency from one year to the next could provide retailers with enough advance knowledge of Initiative specifications that they could incorporate those specifications into these early discussions with manufacturers.

3.3.5. Key Finding #5: NEEA's advocacy helped drive more stringent ENERGY STAR specifications.

NEEA has provided ENERGY STAR with consistent and formative feedback during the development of their TV specifications that has helped ENERGY STAR ensure their specifications are stringent enough to push the TV market. This section describes insights into both the influence NEEA has had on recent revisions of the ENERGY STAR specification for TVs and the conditions under which efficiency advocates like NEEA can have the greatest influence on ENERGY STAR specifications.

3.3.5.1. Influence on Recent ENERGY STAR Specifications

EPA ENERGY STAR staff have consistently reported that NEEA's involvement in the specification revision process has helped to maintain the stringency of ENERGY STAR TV specifications. According to EPA staff, NEEA's advocacy has been valuable in countering comments by industry stakeholders seeking specifications that are more lenient. One EPA staff member said, "We go out with a tight proposal with very strict requirements because the TV market moves so quickly. NEEA is one of the stakeholders that support that. Not all of our stakeholders support that; manufacturers definitely don't support that."

NEEA's comments to EPA in the Version 7.0 TV specification revision process, which took place in 2014, demonstrate the type of advocacy the ENERGY STAR staff member described. NEEA and other efficiency advocates argued for more stringent on-mode and standby-active mode power consumption requirements. For example, in comments regarding TV on-mode power requirements, NEEA proposed that the target proportion of models on the market that meet ENERGY STAR's proposed specification (pass rate) should be 10%, whereas some manufacturers supported a 20% pass rate. Based in part on these comments, EPA adopted compromise standards that would capture approximately 16% of the TV models on the market.

EPA also maintained a 3W limit for energy use in standby active low mode, which NEEA and other efficiency advocates supported but some manufacturers opposed.

In the Version 7.0 revision process, NEEA also supported EPA's efforts to incorporate UHD TVs in the ENERGY STAR specification. An EPA staff member stated that this effort has played an important role in reducing the energy consumption of UHD TVs as they enter the market. According to this staff member, "If ENERGY STAR had not stepped in; I think it would have taken a lot longer to bring down the energy consumption of 4K. I think in this case, we really did get ahead of the market." This staff member expects UHD TVs to enter the market at efficiency levels equivalent to HD TVs under the Version 6 specification, while HD TVs will become between 20 and 30% more efficient.[10]

In addition to supporting efforts to incorporate UHD TVs in the ENERY STAR specification, NEEA also helped push to make standards for UHD TVs more stringent. The ENERGY STAR staff member stated that the support EPA receives from efficiency organizations such as NEEA has been important in establishing stringent standards for UHD TVs, saying, "We knew this would be a stretch for manufacturers. We had an 11% pass rate within the 4K models, so it was really important to have the voice of the efficiency community supporting us in that and providing corroborating data – doing the analysis to make sure we were in a good place."

3.3.5.2. Conditions for Greatest Influence

Analysis of NEEA's comments and other program data reveals two conditions under which NEEA can have a particularly strong influence on the market through involvement in the ENERGY STAR specification revision process. First, NEEA's efforts are likely to result in greater overall energy savings when the energy use of a large number of qualified models is very close to the minimum ENERGY STAR requirements. Assuming manufacturers would continue to design these models to meet the ENERGY STAR specification, a slight increase in the stringency of the specification could account for a large reduction in energy use in the region.

To illustrate the influence an increase in the stringency of the ENERGY STAR specification could have on TV energy use in the Northwest, the research team calculated how many TV models sold in 2013 would have been affected by relatively small increases in the stringency of the ENERGY STAR specification. Based on participating retailers' sales data from 2013, an increase in the stringency of the ENERGY STAR specification by 5% would have affected 56 TV models. Assuming manufacturers redesigned those models to meet increased efficiency specifications, the approximately 44,000 units of those models sold in NEEA territory in 2013 would have saved approximately 98,000 kWh (Table 7). This example illustrates the potential impact increases in the stringency of an ENERGY STAR specification could have, particularly on models with energy use values close to the minimum ENERGY STAR specification.

[10] The research team does not have the data to confirm these estimates

Table 7. Modeled Influence of Increased Energy Star Specification Stringency on TV Energy Use, Based on 2013 Regional TV Sales

2013 Initiative Sales Data	Increase in Stringency of On-Mode Requirement By:	
	1%	5%
Models Affected	8	56
Unit Sales Affected	11,781	43,965
Total Annual Energy Usage of Affected Units*	725,026 kWh	3,656,975 kWh
Annual Energy Savings	1,584 kWh	98,163 kWh

* Annual energy usage calculations assume no change in sleep mode power use, and assume TVs are in on-mode for 5.2 hours per day, consistent with NEEA's ACE Model assumptions.

The second condition under which NEEA's involvement in specification development could have a particularly strong influence on the market is during periods of rapidly changing market conditions. When the market changes rapidly, there is more variance in energy use between older and newer models. NEEA's efforts to ensure that EPA uses only the most current data to determine the proportion of models on the market that meet its proposed specification (the pass rate) can be important and help keep the specifications more stringent.

By 2013, year over year changes in TV energy use had slowed, limiting the influence of excluding older models from the database. In the ENERGY STAR Version 7.0 revision process, NEEA was the only stakeholder to suggest that EPA exclude models that entered the market before April 2013 from its dataset, a suggestion EPA incorporated into its analyses in later drafts. In the context of the Version 7.0 TV specification revision, this suggestion had a limited impact; there were relatively few models in the original EPA dataset that entered the market before April 2013, and there was relatively little difference in energy use between models entering the market before April 2013 and those entering the market later. Nonetheless, in a more rapidly changing market, ensuring that only the most recent models are part of the EPA dataset could play a larger role in supporting a more stringent specification.

To illustrate NEEA's potential impact on a changing market, the research team analyzed a dataset made up of models listed on final ENERGY STAR Version 5.3 TV Qualified Products List that entered the market between April 2011 and May 2013. This dataset yields a pass rate of 71% for the Version 6.0 specification. A hypothetical dataset made up only of newer models – those entering the market between April 2012 and May 2013 – yields a pass rate of 82%. The difference between these two pass rates is functionally equivalent to increasing the stringency of the specification by 5%. Thus, in a market with more variance than the 2013 market, ensuring only the newest models are included in the database to calculate pass rates could have a substantial impact on the stringency of ENERGY STAR specifications.

3.4. Review of ACE Model Assumptions

This section summarizes the review of Alliance Cost Effectiveness (ACE) Model Assumptions. The review focuses on the following three key points:

- What is the current installed base (stock) of televisions?

- How is the installed base (stock) of televisions changing?
- Are the assumptions of the model correct?

For a more detailed review of the ACE Model assumptions, see Appendix E.

3.4.1. Current Installed Base Estimates

Two assumptions inform NEEA's estimate of the current installed base of TVs in the Northwest: the number of televisions per household, and the number of households with a television. This section reviews each of these assumptions.

3.4.1.1. Televisions per Household

We recommend using an estimate of an average of 2.1 televisions per household based on data from the Residential Building Stock Assessment (RBSA).[11] Of all available estimates of the number of TVs per household, the RBSA is the most directly focused on the Northwest. RBSA data are also largely consistent with estimates from other regions conducted over the past five years. As RBSA data become less current, NEEA should monitor the findings of other studies that consider whether a TV is plugged in to identify any consistent trends or major changes in the proportion of households with TVs. It may also be beneficial to consider differentiating by household type in calculations based on TVs per household.

3.4.1.2. Households with Televisions

Multiple studies have found that the proportion of households with TVs has remained relatively high and relatively constant over the past few years, with estimates typically between 96% and 98%.[12] In calculating the installed base of televisions, it is important for NEEA to consider whether its estimate of the average number of televisions per household includes households without televisions. If these households are included in the averages, NEEA should base its installed base calculations on the total number of households in the Northwest. According to American Community Survey one-year estimates, in 2013 there were 5,163,133 occupied housing units in NEEA's four-state region (United States Census Bureau/American FactFinder 2013).

[11] The 2.1 TVs per household figure reflects a weighted average of the number of TVs per household reported for each of the housing types included in the RBSA (Ecotope 2011).

[12] All studies cited in Fraunhofer USA Center for Sustainable Energy Systems. "Energy Consumption of Consumer Electronics in U.S. Homes in 2013: Final Report to the Consumer Electronics Association (CEA)." June 2014.

3.4.2. Annual Growth of the Installed Base

The ACE Model's estimate of growth in the installed base is based on assumptions about changes to the two key variables that feed the estimate of the size of the current installed base: growth in housing stock and number of TVs per household.

Growth in housing stock has been minimal, and varied nationally and regionally over the past few years. However, population growth has been consistent, with about a 1% annual increase in the Northwest each year from 2011 to 2013 (see Table 8). This is consistent with NEEA's estimated annualized percent growth of 1.03% over the long term. Due to the complicated nature of forecasting housing stock, we recommend using population growth estimates for calculations estimating the growth in the housing stock, as they are a reasonably good proxy variable.

Table 8. Household Growth

Year	National				Northwest			
	Housing Stock (in Millions	Growth in Housing Stock	Population (in millions)	Growth in population	Housing Stock (in Millions	Growth in Housing Stock	Population (in millions)	Growth in population
2013	116	.28%	316.1	.72%	5.2	.34%	13.4	.99%
2012	116	.85%	313.9	.74%	5.1	.23%	13.3	.94%
2011	115	.37%	311.6	.73%	5.2	-.77%	13.1	.99%

Source: United States Census Bureau. Annual Estimates of the Resident Population and American Community Survey (ACS)

The average number of televisions per household appears to have remained stable in recent years. As a result, changes in population are likely the primary contributor to changes in the installed base.

3.4.3. TV Market Forecasts

The TV Initiative ACE Model assumes a two percent decrease in TV sales annually for 2014-2015, followed by one percent year-over-year growth in total TV sales for 2016-2020. Publicly available market research reports are not sufficiently complete nor targeted to justify changing these assumptions, but new technologies are likely to enter the TV market in the coming years that may impact sales growth. Thus, NEEA should continue to monitor trends in TV sales and adjust assumptions accordingly.

3.4.4. Other Key Assumptions

Research Into Action reviewed other assumptions important to NEEA's estimation of energy savings from adoption of efficient TVs.

3.4.4.1. Replacement Cycle

NEEA's assumption of a 7-year measure life for TVs likely remains valid, although NEEA should monitor changes in measure life as TV technologies shift. NPD DisplaySearch conducts an annual survey of people who have purchased TVs, in part to determine typical replacement cycles. While previous surveys had shown the TV replacement cycle decreasing, the most recent survey showed a somewhat longer replacement cycle, of approximately 8 years (NPD Group 2014). The DisplaySearch study also found that the average age of TVs in homes gradually increased from 2012 to 2014 to just over 5 years (NPD Group 2014).

3.4.4.2. TV Usage

Existing studies do not suggest a compelling reason for NEEA to change its assumption that TVs spend an average of 5.2 hours in on-mode each day. RBSA estimates of average number of hours TVs were on per day ranged from 5.4 hours to 6.8 hours in 2011, depending on housing type. This is in line with 2014 Nielsen estimates of 5.5 hours on per day, but slightly higher than the average hours on per day estimate from the Fraunhofer CE Usage Survey, which estimated an average of 4.4 hours on per day (Nielsen 2014; Fraunhofer 2013).

3.4.4.3. Proportion of Sales to Commercial End Use

NEEA discounts its Northwest TV sales estimates by 11% to account for TV sales for commercial end use. As discussed in the ACE Model review conducted for TV Initiative MPER #2, market research data may be able to distinguish between TV sales through retail channels and sales to large commercial customers. However, for TVs sold at retail, market researchers and retailers themselves cannot distinguish between those bought for residential as opposed to commercial use. Thus, we were unable to find data against which to evaluate this assumption.

4. Conclusions and Recommendations

The research team draws the following conclusions based on the findings of this MPER:

4.1. Conclusion #1: The Initiative influenced the TV market at both the national and regional levels.

NEEA's TV Initiative included both national and regional components: it sought to influence retailers' assortment decisions and manufacturers' design choices at a national level, and increase sales of qualified TVs through in-store engagement at a regional level. In-depth interview findings with TV merchants at participating retailers for this and previous MPERs provide qualitative evidence that the Initiative's incentives had an effect on TV assortments. Assortment decisions are extremely complex and incorporate a large number of factors; nonetheless, retailers have consistently reported that the Initiative's incentives were one of the elements they considered. The Initiative's incentives had the potential to motivate retailers to assort a qualified TV over a less efficient model that was similar in other ways. However, retailers were unable to provide quantitative estimates of the Initiative's influence on their TV assortments.

As discussed further below, the Initiative also helped to increase sales of efficient TVs in the Northwest region. Both comparison region analysis and analysis of NEEA's 2013 marketing experiment provide quantitative estimates of the effect NEEA's regional engagement efforts have had on the TV market.

Finally, through involvement in the specification development process, NEEA contributed to a more stringent ENERGY STAR standard for televisions. As one of the few stakeholders advocating for energy efficiency, NEEA played a key role in countering manufacturers' arguments for more lenient specifications. Data suggests that NEEA provided consistent and formative feedback during the development of ENERGY STAR TV specifications that helped ensure specifications remained stringent enough to push the TV market forward.

4.2. Conclusion #2: Little opportunity remains for NEEA to intervene in the TV market.

Since the Initiative began, the TV market has transformed such that energy efficiency is now standard among new TVs. Average energy use has fallen for TVs across all size categories, and the difference in energy use between Initiative-qualified models and other models has decreased. Even in 2014, when Initiative specifications were particularly stringent, the difference in average energy consumption between qualified models and non-qualified models fell to 10W. In contrast, in 2011, the average difference was 46W.

As the difference in energy use between qualified TVs and non-qualified TVs has fallen, the Initiative's ability to influence retailers to assort and sell TVs that are more qualified has also waned. Retail merchants seek to select models for which there will be strong consumer demand. The Initiative could leverage this motivation when the difference in energy use provided a

compelling reason for consumers to select a qualified model over one that did not meet the Initiative's specifications. At a regional level, larger differences in energy use also allowed sales associates to more effectively use energy efficiency as a selling point for qualified models.

UHD TVs and other new technologies entering the market may begin to widen the gap between the most efficient TVs and the rest of the market in the coming years. UHD TVs use considerably more energy than HD models, and analysts expect their market share to more than double from 5% in 2014 to 13% in 2018. Other new technologies like quantum dot and OLED may also affect TV energy use. However, these are both relatively new technologies, and it is still premature to draw conclusions about their likely future impact on the TV market.

4.2.1. Recommendations

- **Future midstream programs should target product categories for which energy savings can provide a meaningful, consumer-facing selling point.** In these categories, assorting qualified products is likely to appeal to merchants both as a factor that could drive demand and because of the incentive's potential to increase profit margins. In-store engagement efforts are also likely to be more effective for these products.
- **NEEA should continue to monitor the impact of UHD adoption on TV energy use.** Future opportunities to intervene in the TV market may arise if a significant energy use differential emerges between the most and least efficient UHD TVs as they gain a larger share of the market.

4.3. Conclusion #3: In-store engagement is a valuable element of mid-stream programs.

The lift in sales of qualified TVs in the Northwest relative to a demographically similar region without TV program activity is likely a result of NEEA's regional efforts – primarily carried out in participating stores – to promote Initiative-qualified TVs. Results of the marketing experiment NEEA ran in 2013 further support this conclusion. Both in-store videos and enhanced training of sales associates significantly increased sales of qualified TVs, and the combined effect of the two interventions was greater than the effect of either individually. Retailers also valued the Initiative's in-store efforts. They are unlikely to carry out similar promotions on their own given the national nature of their promotional efforts and the large dollar amounts manufacturers offer to promote their products.

An additional benefit of in-store engagement efforts is their evaluability. This evaluation, like previous MPERs, was unable to quantify the Initiative's influence on retailers through national level assortment decisions or on manufacturers' TV designs. In contrast, this is the third MPER that has successfully quantified influence from the Initiative's in-store engagement efforts. While this regional influence does not capture the Initiative's full influence in the market, it is valuable to quantify some concrete changes resulting from the Initiative.

4.3.1. Recommendation

- **NEEA should incorporate in-store engagement efforts into future mid-stream programs.** As the TV Initiative's experience has shown, activities targeting both shoppers and retail sales associates can significantly increase sales of qualified models. These efforts also provide an opportunity to quantify Initiative influence when it may not be possible to do so for other Initiative activities.

4.4. Conclusion #4: A second specification level can help influence a broader swath of the market.

Setting stringent specifications rewards retailers for assorting and selling the most efficient TVs available, but specifications that are too stringent risk losing the opportunity to influence the low end of the market. In 2014, when NEEA adopted a single, stringent qualification level for TVs, a majority of the qualified TVs smaller than 55 inches that retailers offered were among the most expensive models in their size categories. Some retailers targeting more budget-conscious customers assorted few, if any, qualified models. As a result, NEEA likely missed an opportunity to encourage these retailers to assort and sell the most efficient TV models at the price levels the retailers carried. A second, lower specification level provides an opportunity to promote these less expensive models while still encouraging assortment of the most efficient options.

Establishing two specification levels and resetting one year's high level to the next year's low level also increased the predictability of specification levels for market actors. This was particularly important in the Initiative's efforts to influence TV design, since manufacturers design their TV models approximately a year before those models enter the market. Knowing that the current year's high tier specification would become the next year's low tier allowed manufacturers to incorporate that specification into their product design process. Incorporating the Initiative's specification into the design of the upcoming year's models may no longer have been possible when the Initiative formally announced its specifications in the fall. This type of advanced notice of specification levels may be beneficial in other product categories in which there is a lead-time between product design and the time products reach the market. Increased predictability may also help retailers incorporate Initiative incentives into their planning and sales forecasts.

In setting specification levels, it is important for mid-stream programs to achieve a balance that drives the market. Retail TV merchants stated that Initiative incentives acted as a tiebreaker in their decisions between similar models. Ideally, the Initiative would establish specification levels in a way that increases the likelihood that the incentive levels will be in a position to influence these decisions. If too many models, too few models, or an insufficiently diverse range of models meet the specifications, it is less likely that merchants will be in a position to decide between similar models that differ in their Initiative qualification. Thus, there will be less opportunity for the Initiative to influence assortment decisions. In order to strike this type of a balance, NEEA will need to closely monitor the market to track the number and type of products that meet any proposed specifications.

4.4.1. Recommendation

- **Future mid-stream efforts should define multiple specification levels for qualified products.** Initiatives should ensure that their specifications cover efficient options at a variety of price points and provide predictability to market actors in their specification setting. Defining two specification levels – one to recognize the most efficient products on the market and another to capture a wider range of efficient options – is an effective way to meet these goals.

References

Bergman, M. 2013. *Ultra-High-Definition: State of the Industry Summary*. Consumer Electronics Association.

CEA (Consumer Electronics Association). 2014. "Consumer Electronics Industry Revenues to Reach All-Time High in 2014, Projects CEA's Semi-Annual Sales and Forecasts Report." Accessed January 23, 2015, http://www.ce.org/News/News-Releases/Press-Releases/2014/Consumer-Electronics-Industry-Revenues-to-Reach-Al.aspx.

Consumer Reports News. 2013. *Forget 4K Ultra HD TVs: I want an OLED TV*. Retrieved from http://www.consumerreports.org/cro/news/2013/01/forget-4k-ultra-hd-tvs-i-want-an-oled-tv/index.htm

DisplaySearch. 2014a. *Global TV Shipments Rebound, LCD Growth Significantly Improves, According to DisplaySearch.* IHS Online Pressroom. Retrieved from http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/141124_global_tv_shipments_rebound_lcd_growth_significantly_improves.asp.

DisplaySearch. 2014b. *LCD TV Shipment Forecast Revised Upward on Strong Consumer Demand for Larger Sizes, DisplaySearch Reports*. Press release. Retrieved from http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/141231_lcd_tv_shipment_forecast_revised_upward_on_strong_consumer_demand_for_larger_sizes.asp

DisplaySearch. 2014c. *NPD DisplaySearch: Replacement TV Purchase Decisions Driven by Picture and Sound Quality Despite Introduction of New Features.* Retrieved from http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/140611_replacement_tv_purchase_decisions_driven_by_picture_and_sound_quality.asp.

DisplaySearch. 2015. *Explosive Growth Forecast for Quantum Dot LCD TV Technology, DisplaySearch Reports*. Press Release. Retrieved from http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/150106_explosive_growth_forecast_for_quantum_dot_lcd_tv_technology.asp

Ecotope, Inc. 2011. *2011 Residential Building Stock Assessment: Single-Family Characteristics and Energy Use.* Portland, OR: Northwest Energy Efficiency Alliance.

EIA. 2013. *Number of customers – Residential sector by state and utility*. Retrieved from http://www.eia.gov/electricity/data.cfm#sales

ENERGY STAR. 2014a. *Draft 2 Version 7.0 Specification for Televisions.* Retrieved from http://www.energystar.gov/products/spec/televisions_specification_version_7_0_pdf

ENERGY STAR. 2014b. *Draft 2 Version 7.0 Specification for Televisions Comments*. Retrieved from https://www.energystar.gov/sites/default/files/Sharp_Draft2V7TVs_Comments.pdf.

ENERGY STAR. 2014c. *Summary of Consumer Electronics Programs, September 2014 Update*. Retrieved from https://www.energystar.gov/ia/partners/downloads/FINAL_2014_ENERGY_STAR_Summary_of_Consumer_Electronics_Programs.pdf?b114-10b5

ENERGY STAR. 2014d. *TV Specification Version 7.0, Draft 2 EPA Dataset*. Retrieved from https://www.energystar.gov/sites/default/files/Draft2V7_TVs_EPADataset_0.xls

ENERGY STAR. 2014e. *Unit Shipment and Market Penetration Report Calendar Year 2013 Summary.* Retrieved from https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2013_USD_Summary_Report.pdf?5ebf-448e

Enervee. 2014. *4K TVs – Hogh Resolution, Great Picture Quality – But what about Energy Efficiency*. Retrieved from http://blog.enervee.com/2014/06/4k-tvs-high-resolution-great-picture.html

Fraunhofer USA Center for Sustainable Energy Systems. 2014. *Energy Consumption of Consumer Electronics in U.S. Homes in 2013*. Retrieved from http://www.ce.org/CorporateSite/files/e4/e4d65f2d-bbd3-49f5-b3d6-8634268aa055.pdf

Gibbs, S. 2015. "3D TV Was a Bust, but the UHD Alliance Promises 4K Will Be Different," *The Guardian.* Retrieved from http://www.theguardian.com/technology/2015/jan/05/uhd-alliance-4k-video-television-sony-samsung-warner-brothers-disney.

Gonzalez-Thayer. 2013. *IHS Boosts Long-Term UHD LCD TV Forecast—Predicts 4.6 Million Units Shipped in US in 2018*. Press release. Retrieved from http://press.ihs.com/press-release/design-supply-chain/ihs-boosts-long-term-uhd-lcd-tv-forecast%E2%80%94predicts-46-million-units

Hong, J. 2014a. "Global Flat-Panel TV Shipments Enjoy Sound Growth in Q1; South Koreans Top Field," *IHS Technology*, Retrieved from https://technology.ihs.com/503074/global-flat-panel-tv-shipments-enjoy-sound-growth-in-q1-south-koreans-top-field.

Hong, J. 2014b. *Ultra-High-Definition TVs Make Gains but Still Lack Market Penetration*. IHS Technology. Press release. Retrieved from https://technology.ihs.com/506724/ultra-high-definition-tvs-make-gains-but-still-lack-market-penetration

IHS Technology. 2013. *IHS Boosts Long-Term UHD LCD TV Forecast – Predicts 4.6 Million Units Shipped in US in 2018*. Press release. Retrieved from http://press.ihs.com/press-release/design-supply-chain/ihs-boosts-long-term-uhd-lcd-tv-forecast%E2%80%94predicts-46-million-units

Jukic, S. 2015. *Quantum Dots Made Their Debut at CES 2015: Here is How They Work*. Retrieved from http://4k.com/news/quantum-dots-and-how-they-work-in-4k-tvs-5181/

Kastrenakes, J. 2015. *Samsung, Disney, Netflix, and More Team up to Define Ultra HD and How You'll Watch it*. The Verge. Retrieved from http://www.theverge.com/2015/1/5/7493099/uhd-alliance-announced-samsung-disney-netflix-others-standardize-uhd-ces-2015

Lendino, J. 2014. "What is 4K (Ultra HD)." *PC Magazine*. Retrieved from http://www.pcmag.com/article2/0,2817,2412174,00.asp

Lin, L. & Cavanaugh, K. 2014. "Ultra-High-Definition TV Panels Hit 1 Million in Shipments for First Time; South Koreans Make Lower-Cost Panels." *IHS Technology.* Retrieved from https://technology.ihs.com/500499/ultra-high-definition-tv-panels-hit-1-million-in-shipments-for-first-time-south-koreans-make-lower-cost-panels.

Matheson, R. 2015. *Tackling the "Achilles Heel" of OLED Displays*. Retrieved from http://newsoffice.mit.edu/2015/mass-produced-inkjet-printed-oled-displays-0212

Morrison, G. 2013. *What are Quantum Dots, and How Could They You're your Next TV?* Retrieved from http://www.cnet.com/news/what-are-quantum-dots-and-how-could-they-help-your-next-tv/

Morrison, G. 2015. *Quantum Dots: How Nanocrystals can Make LCD TVs Better*. Retrieved from http://www.cnet.com/news/quantum-dots-how-nanocrystals-can-make-lcd-tvs-better/

Morrison, G. 2014. *The state of OLED TV: 2014 and beyond*. Retrieved from http://www.cnet.com/news/the-state-of-oled-tv-2014-and-beyond/

Morrison, G. 2012. *4K TV vs. OLED TV*. Retrieved from http://www.cnet.com/news/4k-tv-vs-oled-tv/

Nielsen. 2014. *The Total Audience Report*.

NPD Group, Inc. 2014. *NPD DisplaySearch: Replacement TV Purchase Decisions Driven by Picture and Sound Quality Despite Introduction of New Features.* Retrieved from *http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/140611_replacement_tv_purchase_decisions_driven_by_picture_and_sound_quality.asp*

United States Census Bureau/American FactFinder. 2013. "Housing Units" *2013 American Community Survey 1-Year Estimates*. U.S. Census Bureau's American Community Survey Office.

Wheatley, M. 2015. *Samsung Not Quitting OLED TV; Files "Super UHD" Trademark*. Retrieved from *http://www.hdtvtest.co.uk/news/super-oled-201503064026.htm*

Appendices

Appendix A. Detailed Methods

This Appendix reports complete methodological details of the analyses used for Market Progress Evaluation Report (MPER) #4.

A.1. Analysis of Initiative TV Sales Data

Energy Solutions, the Consumer Electronics Television (TV) Initiative (the Initiative) contractor responsible for data management, provided the TV sales data for the stores participating in the initiative. The sales data varied by the store's parent retailer and typically included, for each TV sold: model characteristics, date of sale, and place of sale. The data covered TV sales from January 2011 through October 2014. Table 9 lists the stores included in the analysis; the Evaluation Team only analyzed data from stores that contributed enough data for proper statistical analysis. Further, online sales were excluded from the analyses.

Table 9. Data Quality by Retailer or Buying Group*

Retailer/ Buying Group	Years	Full Category (includes non-qualified models)	Sales Time Period
Costco	2011-2014	Yes	Daily
Kmart	2011-2014	Yes	Daily
Sam's Club	2011-2014	Yes	Monthly
Sears	2011-2014	Yes	Daily
Target	2012-2014	Yes	Daily
Walmart	2011-2014	Yes	Monthly

* Five participating retailers did not contribute enough sales data to justify their inclusion and were thus excluded from the analyses.

Incentive qualification specifications changed each "incentive period," with qualification requirements becoming increasingly stringent (in terms of minimum energy efficiency) with each subsequent incentive period. Incentive periods did not always correspond to the calendar year. Accordingly, unless explicitly stated otherwise, reported results represent changes across incentive periods. Table 10 exhibits the program years, the time periods in which they took place, and the tier specifications associated with each.

Table 10. Initiative TV Specifications, 2011-2014

Incentive period	Period	Specification	
		High Tier	Low Tier
2011	January 1, 2011 – December 31, 2011	ENERGY STAR v5 + 20%	ENERGY STAR v5
2012	January 1, 2012 – March 31, 2013	ENERGY STAR v5 + 35%	ENERGY STAR v5 + 20%
2013	April 1, 2013 – December 31, 2013	Most Efficient 2013	ENERGY STAR v6 +20%
2014*	January 1, 2014 – December 31, 2014**	Most Efficient 2014	[none]

* 2014 marked the end of the NEEA TV Initiative and the start of the Retail Products Portfolio (RPP) pilot. RPP sets only one qualification level, while the Initiative defined two tiers in each year.

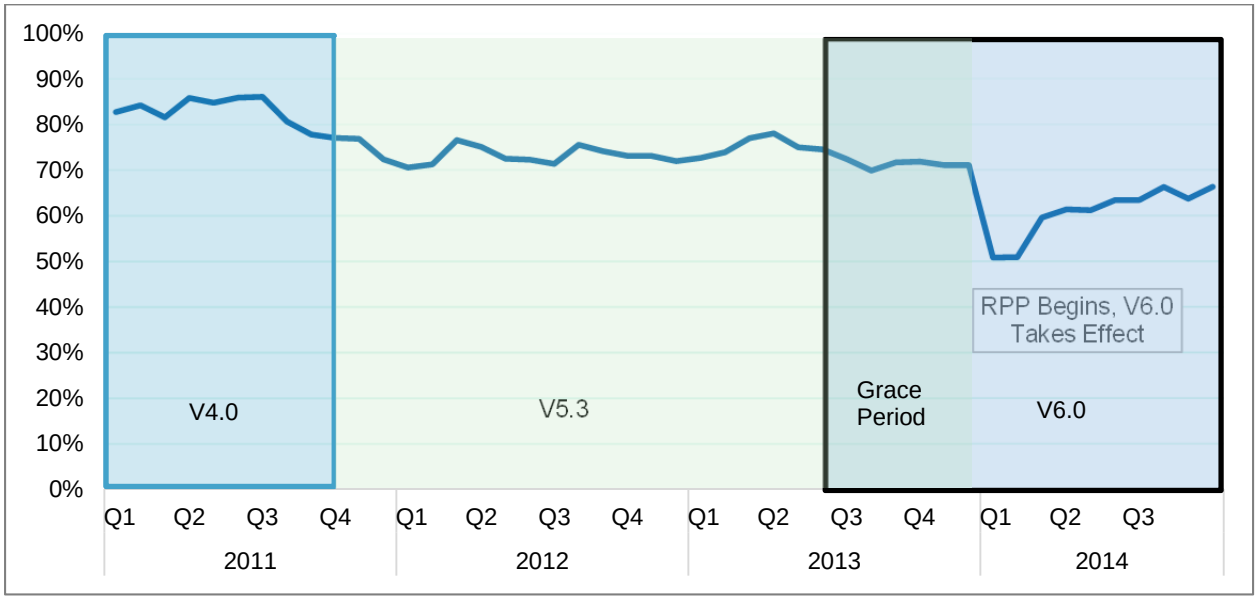
** The research team only had access to TV sales data through October 31, 2014 for this study.

Energy Solutions uses the ENERGY STAR Qualified Products List (QPL) to retrieve the information needed to confirm whether TV models sold by participating retailers qualified for the NEEA incentive. If a model does not appear on the QPL, then no qualification calculations are performed and the model is determined to be ineligible for incentives.[13] The QPL changes with each subsequent ENERGY STAR specification version, and includes all models that were tested and confirmed to meet the new specification requirements. Thus, in order to be placed on the new QPL, manufacturers must retest all TV models offered to ensure their TVs meet the new specification.

Upon the V6.0 effective date (June 1, 2013), the QPL had very few models on it as manufacturers were slow to get their products retested to the V6.0 specification. If NEEA had switched to using the V6.0 QPL for incentive eligibility determination as of the effective date of the new specification, it would have invalidated a large number of models that would otherwise qualify once retested. Ultimately, a grace period was granted for the remaining half of 2013, where both V5.3 and V6.0 QPLs were valid until the end of 2013. Thus, Energy Solutions was able to calculate incentive qualifications for any models that appeared on either QPL during the grace period. And then as of January 1, 2014, only the V6.0 QPL was used to calculate and confirm incentive qualifications; a date that coincided with the roll out of the new RPP pilot. As seen in Figure 12 below, there was a substantial drop in the percent of televisions on display that met the ENERGY STAR specification immediately following the end of the V6.0 grace period. As 2014 progressed, the percent of televisions on display that met ENERGY STAR specifications steadily increased; but as of October 2014, it had still not caught up to pre-V6.0 levels.

[13] Energy Solutions will double check all models with 50 or more submissions to ensure they do not appear on the QPL.

Figure 12. Percentage of Unique TV Models on Display with ENERGY STAR Specification, by ENERGY STAR Specification Version*



* Percentage of unique TV models on display with ENERGY STAR specification is calculated by dividing the number of unique ENERGY STAR-qualified models sold in a given month (across all retailers) by the number of all unique models sold.

A.2. Experimental Design Analysis

A.2.1. Experiment Background

In 2013, Northwest Energy Efficiency Alliance (NEEA) and Research Into Action worked together to design an experiment in which three interventions were deployed at participating retail stores with the goal of increasing sales of qualified televisions:

- Enhanced sales associate training, in which the Initiative's field staff offered retail sales associates a Starbucks gift card to take and discuss a brief quiz on the benefits of Initiative-qualified TVs.
- In-store video wall, in which the retailers agreed to include the Initiative's 30-second promotional video in the loop of video content playing on the TVs on display in their stores. The video typically played approximately four times each hour.
- Enhanced training *and* the in-store video wall

The experiment also included a control group that did not receive any of the three interventions. Table 11 shows the "2x2" experimental design. Research Into Action randomly assigned participating retail stores to one of four groups (Table 11). NEEA implemented the experiment in Q3 and Q4 2013.

Table 11. Experimental Design – Groups by Intervention Type

		Training	
		On	**Off**
Video	**On**	Group 1: Video + Training	Group 2: Video
	Off	Group 3: Training	Group 4: Nothing (Control)

Table 12 lists the retailers included in the analysis and shows the number of stores from each retailer included in each study group.[14]

Table 12. Number of Retailer's Stores Included in Each Study Group

	Study Group			
Retailer	**Video Wall Only**	**Enhanced Training Only**	**Video + Training**	**Control Group (No Interventions)**
Retailer A	12	13	12	13
Retailer B	11	10	10	9
Retailer C	0	0	0	6
Retailer D	9	12	11	16
Retailer E	0	0	0	65
Retailer F	26	26	27	27

A.2.2. Data Sources

The Evaluation Team aggregated Energy Solution monthly and daily sales data for individual stores from the retailers listed in Table 9 to compute the proportion of television sales that qualified under the initiative's incentive criteria and the proportion of qualified televisions on display (or, the assortment) for each store during the study timeframe.[15] Further, online sales were excluded from the analyses.

[14] Target and Sam's Club stores did not receive the experiment's interventions, and are thus included only as control group stores. Inclusion of these stores increases the sample size of the experiment by nearly one-third, increasing the statistical power to detect the experiment's effect. Analyses indicate that inclusion of Target and Sam's Club stores does not bias the control group for two reasons. First, as described below, the effects of the experiment did not differ significantly across retail chains. Second, Target and Sam's Club are similar to other retailers' control stores in regard to the proportion of their sales that met Initiative qualification criteria.

[15] Proportion of qualified televisions on display was calculated individually for each store by dividing the number of qualified unique models sold during the study timeframe by the number of all unique models sold.

A.2.3. Quantitative Methods

The Evaluation Team used multilevel linear modeling (linear mixed modeling) and restricted maximum-likelihood estimation-based linear regression to examine the effect of NEEA's experiment (a video wall and/or advanced sales training) on the proportion of television sales that qualified under the initiative's incentive criteria. Throughout all analyses, the Evaluation Team treated the intervention (video wall display, advanced sales training, and video wall display plus advanced sales training) and control (proportion of assortment that qualified for incentives) independent variables as fixed effects, as the study did not aim to generalize beyond the interventions used in this study or beyond the assortments represented.[16] However, the Evaluation Team hypothesized that this intervention's effect would vary across retailers, and that variation in the outcome (the proportion of qualified television sales) would be a nested-function of the store's retailer. For example, while an intervention may have similar effects across Costco stores, the same intervention may have a different effect in Walmart stores. To test this hypothesis, the Evaluation Team treated the retailer intercept as random (which allows the model to factor in inter-retailer variation in the outcome variable). This linear mixed model revealed that the effect of the experiment was not retailer-dependent, as demonstrated by an insignificant (p = .13) covariance parameter estimate for the random retailer intercept.

Since the proportion of qualified television sales following the intervention was not a nested-function of the store's retailer, subsequent regression techniques did not employ multilevel modeling. However, the Evaluation Team retained the restricted maximum-likelihood estimation employed in the aforementioned multilevel modeling, as it allows for a more fair comparison with the prior multilevel results and is more robust than the ordinary least squares estimation method found in a standard linear regression model.

A.2.4. Detailed Regression Results

First, the Evaluation Team regressed the experimental intervention variable on the proportion of qualified sales. Results from the Type III Tests of Fixed Effects exhibited an insignificant (p=.667) bivariate relationship, demonstrating that the interventions alone did not significantly explain variation in store-level proportions of qualified sales. However, once store-level assortment was controlled for in the model, multivariate regression revealed that the interventions did have an overall significant (p<.001) effect on qualified sales.[17] Table 13 exhibits the Estimates of Fixed Effects output, which demonstrates how each specific intervention (video wall, training, or video wall plus training) effected qualified sales. As demonstrated in the Estimate column in Table 13, training-only and video wall-only interventions resulted in approximately 3.5% increases in qualified sales. The two interventions in combination (see Group 1) had a larger effect, resulting in a nearly 5% increase in the proportion of qualified sales. Because the effect of the combined video wall and enhanced

[16] Further, the interventions are inherently fixed effects, as they represent the exhaustive list of possibilities in this experiment: either the store had a video wall, advanced sales training, both, or no intervention occurred.

[17] Reported p value is from the Type III Tests of Fixed Effects.

training was less than the sum of the two isolated effects, the experiment's outcome suggests that the two interventions interacted with one another.

Table 13. Detailed Regression Results

Parameter	Estimate	Standard Error	Degrees of Freedom	t	P Value	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	-.006822	.019344	310	-.353	.725	-.044885	.031241
Group 1: Video Wall + Training	.046410	.010325	310	4.495	.000	.026095	.066725
Group 2: Video Wall Only	.034189	.010401	310	3.287	.001	.013723	.054655
Group 3: Training Only	.035496	.010243	310	3.465	.001	.015341	.055650
Group 4: Control Group (No Intervention)	0[b]	0	.	.	.	.	.
Store-Level Assortment	1.053712	.048502	310	21.725	.000	.958278	1.149147

a. Dependent Variable: PropQualSold.

b. This parameter is set to zero because it is redundant.

Appendix B. Detailed Quantitative Findings

This appendix summarizes findings from quantitative analyses conducted as part of TV Initiative MPER #4. These analyses seek to characterize the role of Initiative-qualified TVs in the broader TV market and identify the Initiative's impact on the sales of qualified TVs in NEEA territory.[18] These analyses draw on two data sources: TV sales data that participating retailers provided to the Initiative's data management contractor as part of their participation agreements, and market research data on TV shipments to the Northwest and comparison states that NEEA purchased from the NPD Group, Inc. (NPD).[19]

It is important to recognize that the Initiative may have had an impact on the TV market that a geographic comparison cannot capture. Because retailers do not differentiate their TV assortments by region, any impact the Initiative had on national assortment would likely affect the Northwest and the comparison states equally and thus not be reflected in this analysis. Any influence the Initiative had on manufacturers' TV designs would likewise influence the TV market beyond the Northwest and not be reflected a geographic comparison. Nonetheless, a geographic comparison of TV sales can demonstrate the effects of regional efforts to promote efficient TVs, both on the part of NEEA and participating retailers.

This appendix begins with findings from analysis of the Initiative sales data, followed by an analysis comparing TV sales in the Northwest and a set of comparison states based on NPD data.

B.1. Initiative TV Sales Data

This section describes findings from the analysis of TV sales data provided by Energy Solutions, the Initiative contractor responsible for data management. The sales data varied by retailer and typically included, for each TV sold: model characteristics, date of sale, and place of sale. The data covered TV sales from January 2011 through October 2014. Table 14 lists the stores included in the analysis; the Evaluation Team only analyzed data from stores that contributed enough data to allow for a meaningful statistical analysis.[20] Further, online sales were excluded

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[18] In this section, the term "Initiative-qualified TV" refers to any TV for which a participating retailer could earn incentives through the Initiative. Except where otherwise specified, this analysis combines TVs eligible for both of the Initiative's incentive levels in any given year and refers to both as Initiative-qualified TVs. The term "non-qualified TV" refers to any TV not eligible for incentives. A TV may have met current ENERGY STAR requirements but nonetheless be non-qualified if it did not meet the more stringent criteria NEEA and its partner utilities set for incentive qualification. As discussed further in this Appendix, comparison analyses identify differences in TV sales resulting from the Initiative's regional activities, primarily in-store engagement and marketing efforts. These analyses do not capture influence the Initiative had on the TV market nationally, through changes in TV assortments or product design.

[19] The NPD Group's *2013 US Tech Geo Level Monthly Retail Store Level Color Television Report for Kansas and Virginia.*

[20] These analyses exclude five of the Initiative's retail partners, who together comprise 9% of sales of qualified units in the 2011 to 2014 timeframe. Two of these retailers (Brandsource and Vann's) were excluded because

Continued…

from the analyses. Since no significant differences were found between states, all results are reported at the regional level.[21]

Table 14. Retailer Data Included in Analysis of Program Sales Data

Retailer/Buying Group	Years	Full Category (includes non-qualified models)	Sales Time Period
Costco	2011-2014	Yes	Daily
Kmart	2011-2014	Yes	Daily
Sam's Club	2011-2014	Yes	Monthly
Sears	2011-2014	Yes	Daily
Target	2012-2014	Yes	Daily
Walmart	2011-2014	Yes	Monthly

Incentive qualification specifications changed each incentive period, with qualification requirements becoming increasingly stringent (in terms of minimum energy efficiency) with each subsequent incentive period. Incentive periods did not always correspond to the calendar year. Accordingly, unless explicitly stated otherwise, reported results represent changes across incentive periods. Table 15 exhibits the program years, the time periods in which they took place, and the tier specifications associated with each.

Table 15. Initiative TV Specifications, 2011-2014

Incentive period	Period	Specification	
		High Tier	Low Tier
2011	January 1, 2011 – December 31, 2011	ENERGY STAR v5 + 20%	ENERGY STAR v5
2012	January 1, 2012 – March 31, 2013	ENERGY STAR v5 + 35%	ENERGY STAR v5 + 20%
2013	April 1, 2013 – December 31, 2013	Most Efficient 2013	ENERGY STAR v6 +20%
2014*	January 1, 2014 – October 31, 2014**	Most Efficient 2014	[none]

* At the beginning of 2014 NEEA transitioned from the TV Initiative to the Retail Products Portfolio (RPP) pilot. RPP sets only one qualification level, while the Initiative defined two tiers in each year.

** Although the program continued for the full year, the research team only had access to TV sales data through October 31, 2014 for this study.

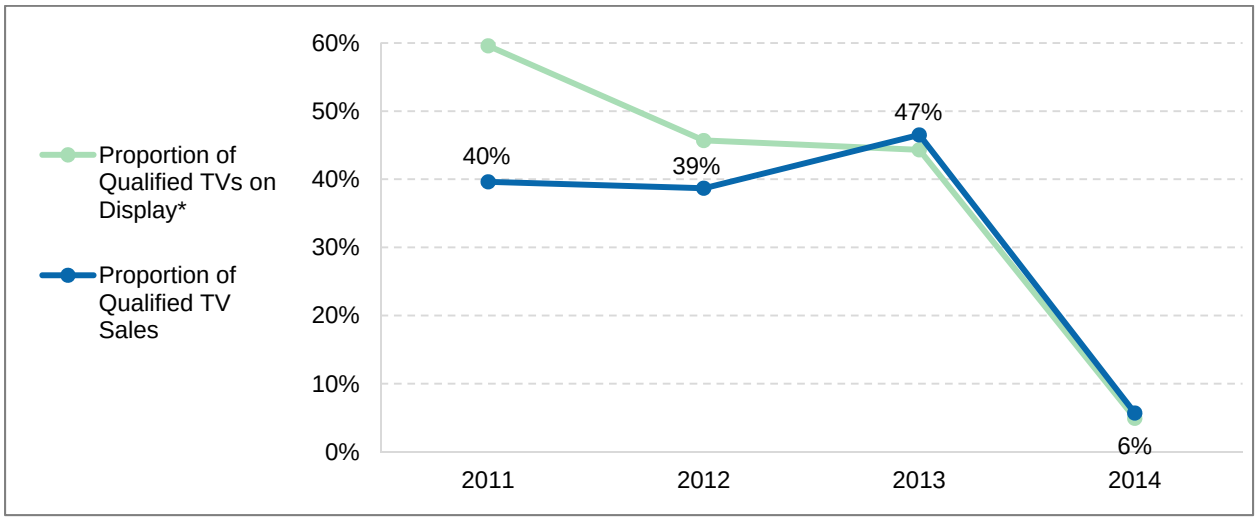
the period of their Initiative participation was limited and they had relatively low sales volume, resulting in too little data on their performance for a meaningful analysis. Three retailers (Best Buy, Fry's Electronics, and Nationwide) did not report full category sales data, instead submitting data only on sales of models the retailer anticipated would qualify for incentives. Without full category sales data, it was not possible to complete a full analysis of this retailer's sales.

[21] Results presented in this report may differ from those presented in previous MPERs. In addition to the process findings presented in Appendix F, this review excluded data on returned units, duplicate incentive applications, online sales, while including sales from models that did not match to the ENERGY STAR qualified products list.

There was a positive relationship between the proportion of qualified TVs on display and the proportion of qualified TVs sold. And while assortment of qualified TVs decreased from 2011 to 2013, sales of qualified TVs reached their highest point in 2013.

Figure 13 exhibits the relationship between proportion of qualified TVs on display and proportion of qualified TVs sold. The linear association shows a positive relationship between assortment and sales, suggesting that an increase in the proportion of qualified TVs on display leads to an increase in the proportion of qualified TVs sold. Both within and across retailers, the proportion of qualified TVs on display and proportion of qualified TVs sold were strongly correlated.[22] Nonetheless, year over year trends between the two variables were not always parallel. For example, despite a decrease in the proportion of qualified units on display, the proportion of qualified TVs sold was virtually unchanged from incentive period (IP) 2011 to 2012. IP 2013 witnessed the greatest proportion of qualified sales (47%) and was the first year in the study timeframe where the proportion of qualified sales exceeded the proportion of qualified TVs on display.

Figure 13. Proportion of Qualified TVs on Display and Sold



* Proportion of qualified TVs on display is calculated by dividing the number of qualified unique models sold in a given year (across all retailers) by the number of all unique models sold.

More stringent qualification requirements are likely a primary cause of the sharp decrease in assortment and sales of qualified TVs in 2014 relative to 2013.

While the TV Initiative had defined two qualification levels each year, the RPP pilot paid incentives only for TVs meeting the Most Efficient 2014 designation. In 2013, the Initiative adopted Most Efficient 2013 as its high qualification tier. Models meeting that designation accounted for 13% of TV sales in 2013, but an additional 34% of sales met the Initiative's lower qualification tier (ENERGY STAR Version 6.0 + 20%), for total qualified sales of 47%. Other

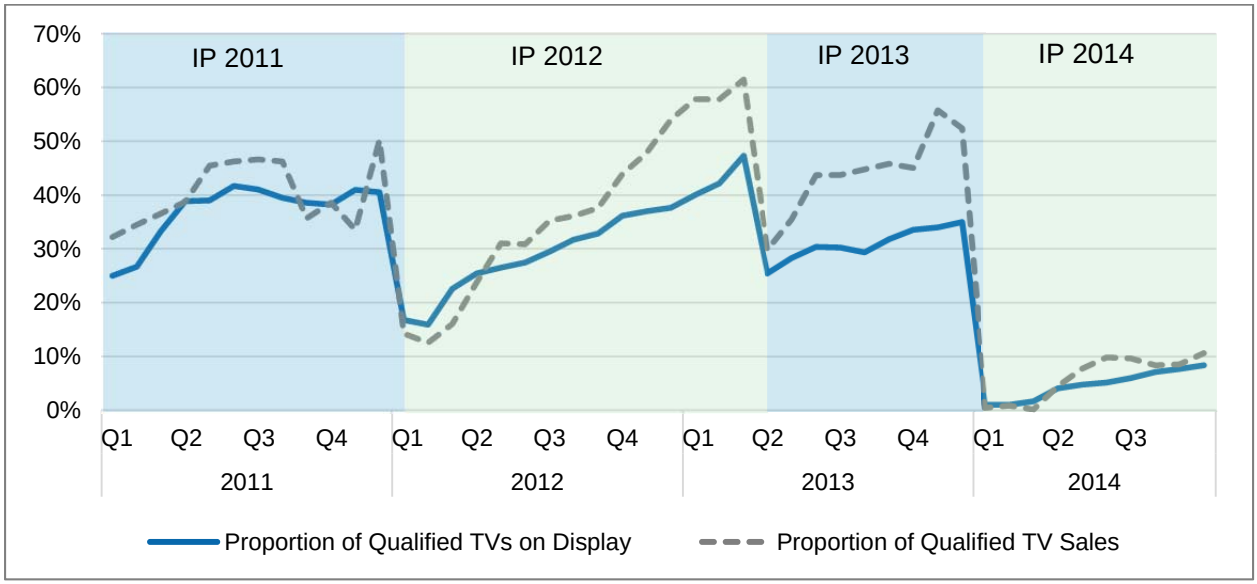
[22] Kmart slightly deviated from this trend, demonstrating somewhat lower correlations when compared to other retailers.

factors may also have contributed to the decrease in qualified sales in 2014, including delays in manufacturers submitting TV models for testing and inclusion on the ENERGY STAR qualified products list, and the transition from the TV Initiative to RPP. Nonetheless, the use of a single, stringent qualification criteria likely accounts for much of the decrease in qualified sales.

Qualified sales drop and then steadily climb in each new incentive period cycle.

Monthly analysis of the proportion of qualified TV sales demonstrates that incentive periods are accompanied by a consistent sales cycle: the proportion of qualified sales in the first month of a new incentive period are considerably lower than that of the previous month (from the previous incentive period), after which the proportion of qualified sales steadily climbs throughout the remainder of the incentive period (Figure 14).

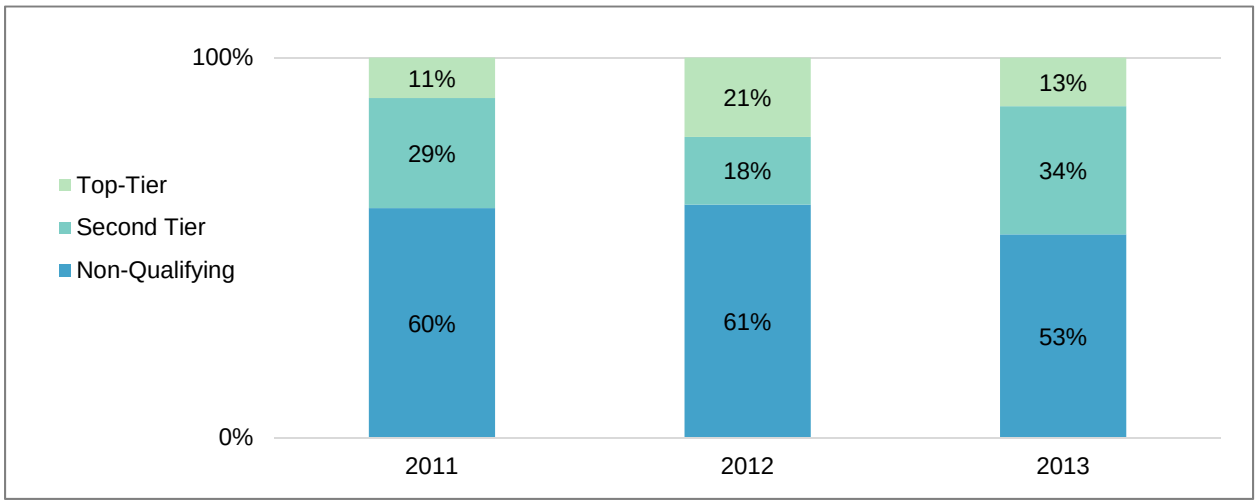
Figure 14. Monthly Proportion of Qualified TVs on Display and Sold



Most TVs sold in 2013 were in the Initiative specification's second tier.

Under the TV Initiative, NEEA specified two efficiency levels each year at which TVs would qualify for incentives. NEEA sought to define these levels such that models qualifying under the first tier, which were eligible for the highest incentive, represented the most efficient TVs available. Requirements to qualify under the second tier were more inclusive, but still typically more stringent than ENERGY STAR (Table 15, above, lists tier qualification criteria for 2011-2014). While the proportion of qualified TV sales was nearly identical in both IP 2011 and IP 2012, the proportion of first-tier sales (as compared to second-tier sales) nearly doubled in IP 2012 (Figure 15). And even though a comparably higher proportion of all sales qualified in IP 2013, the market share of top-tier sales went back down to near IP 2011 levels. The RPP pilot began in IP 2014 and had only one qualification level; thus it is not included in Figure 15.

Figure 15. Proportion of TVs Sold, by Tier



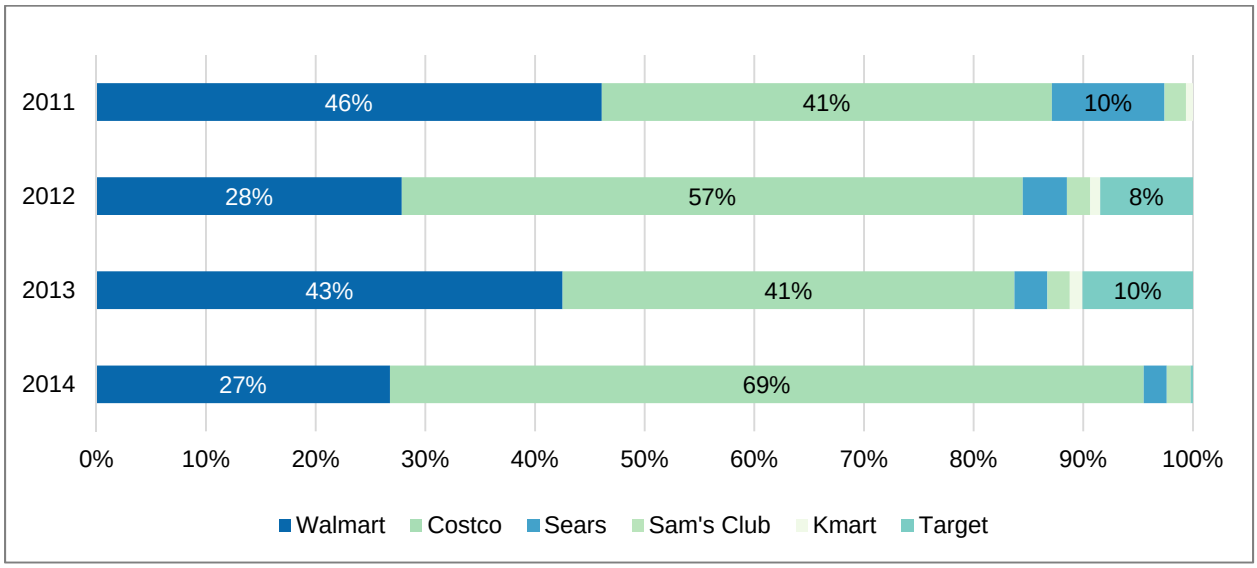
B.1.1. Differences by Retailer

Costco and Walmart consistently sold the most qualified TVs across the study timeframe.

A total of 208,391 qualified TVs were sold in IP 2013 (Figure 16).[23] Costco and Walmart accounted for the bulk of these sales (174,461 qualified units sold, or 84% of all qualified TVs sold). The remaining participating retailers (included in this analysis) sold ten percent or less of all qualified units. This disparity was heightened in 2014's RPP pilot, with Costco and Walmart accounting for 96% of all qualified sales. Kmart did not stock any qualified units in IP 2014.

[23] This number excludes Best Buy's sales, as Best Buy's data was too incomplete to include in the analysis. Best Buy reported an additional 10,313 qualified sales in IP 2014.

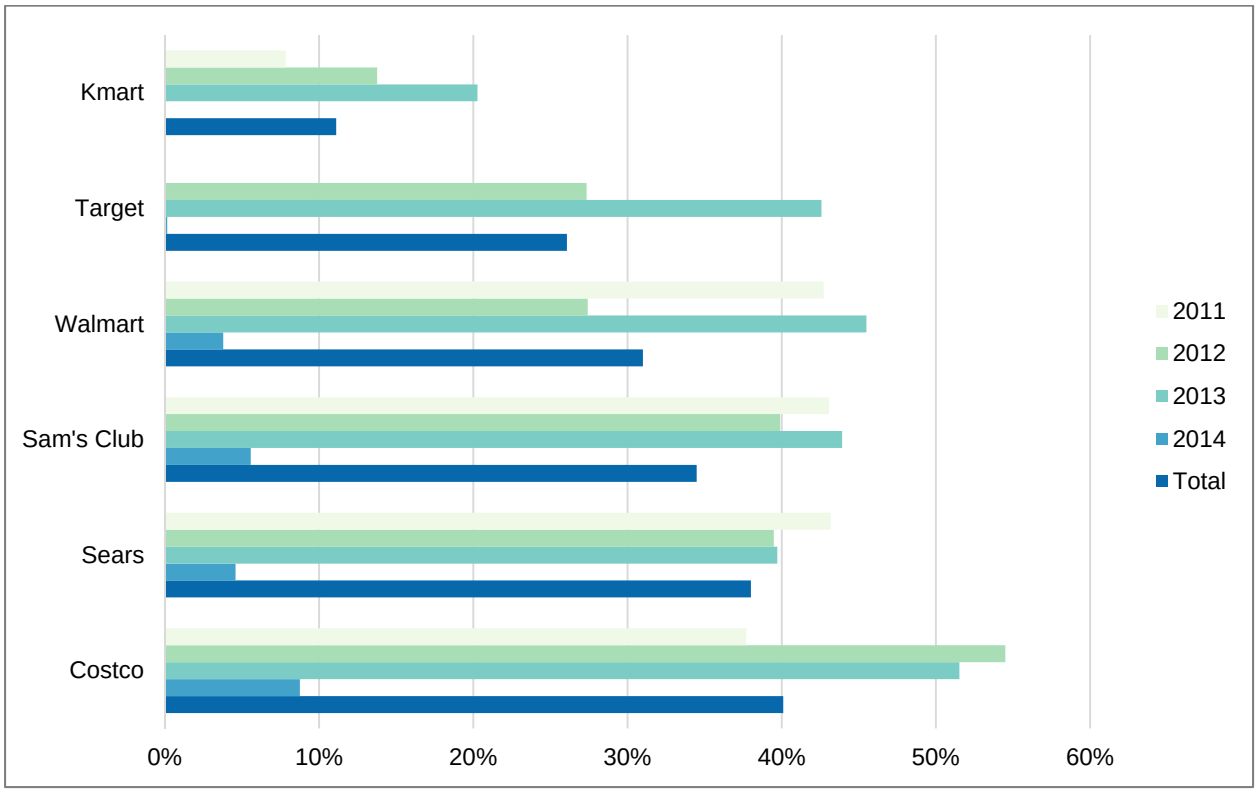
Figure 16. Retailer Proportions of All Qualified TVs Sold, by Incentive Period



Even though Costco and Walmart had the highest volume of qualified sales, most of the other retailers sold comparable proportions of qualified units.

Costco and Walmart sold the vast majority of Initiative-qualified TVs, with each selling more than three times as many qualified TVs as the retailer with the third-highest qualified sales in each of the four years studied (Figure 16). Costco also assorted the largest proportion of qualified TVs among the participating retailers, but the difference in assortment was not as stark as the difference in sales (Figure 17). While an average of 40% of Costco's assortment qualified for Initiative incentives across the four years, an average of 38% of Sears' assortment and 34% of Sam's Club's assortment qualified. Despite its high sales, Walmart ranked fourth among the six participating major retailers in the proportion of its assortment that qualified for incentives. These findings suggest that the high proportions of all qualified models sold in Costco and Walmart stores reflect these retailers' overall sales volume more than differences in assortment across retailers.

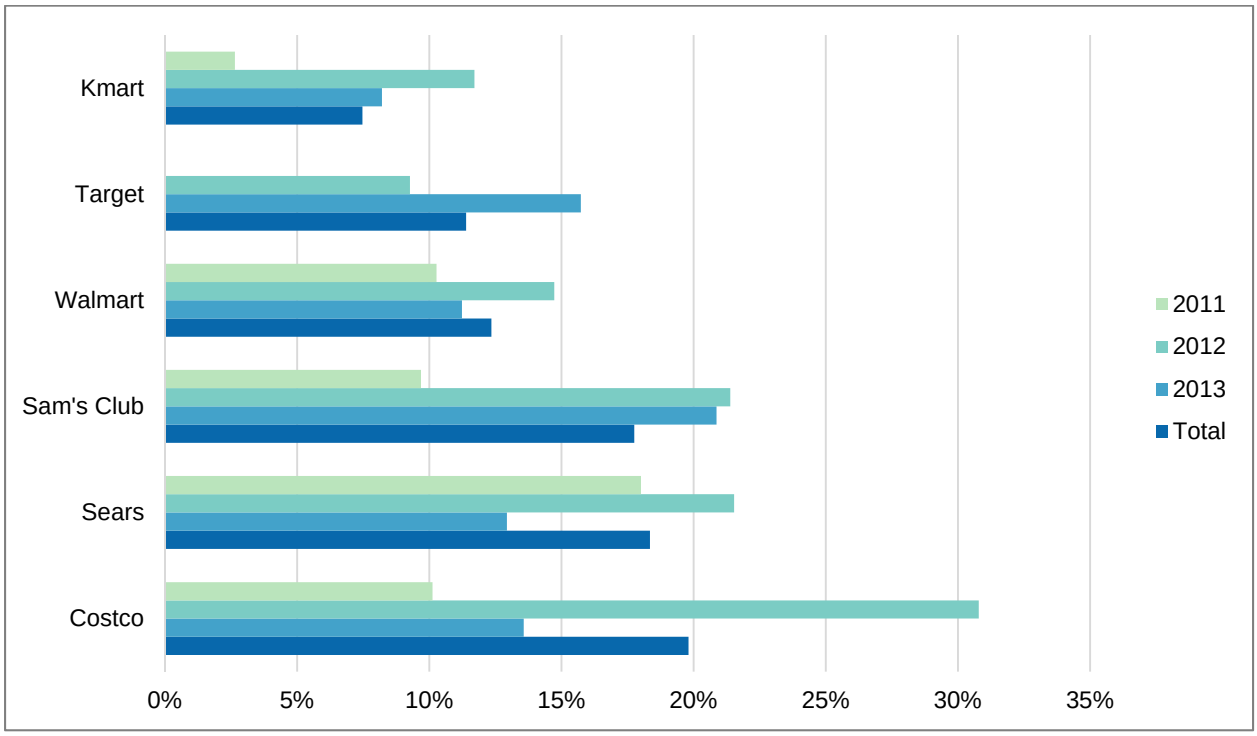
Figure 17. Proportion of Qualified TVs Sold, by Retailer



Costco, Sears, and Sam's Club had the highest proportion of top-tier sales.

Over the four years studied, Costco, Sears, and Sam's Club sold the largest proportion of top-tier TVs (ranging from 18-20%); selling top-tier units at about twice the rate of Kmart, Target, and Walmart (Figure 18). Additional analysis of sales across all retailers revealed that the proportion of qualified sales strongly correlated with proportion of top tier sales (r = .94), demonstrating that retailers that sold a high proportion of qualified TVs overall tended to sell a high proportion of top tier units.

Figure 18. Proportion of Top-Tier TVs Sold, by Retailer

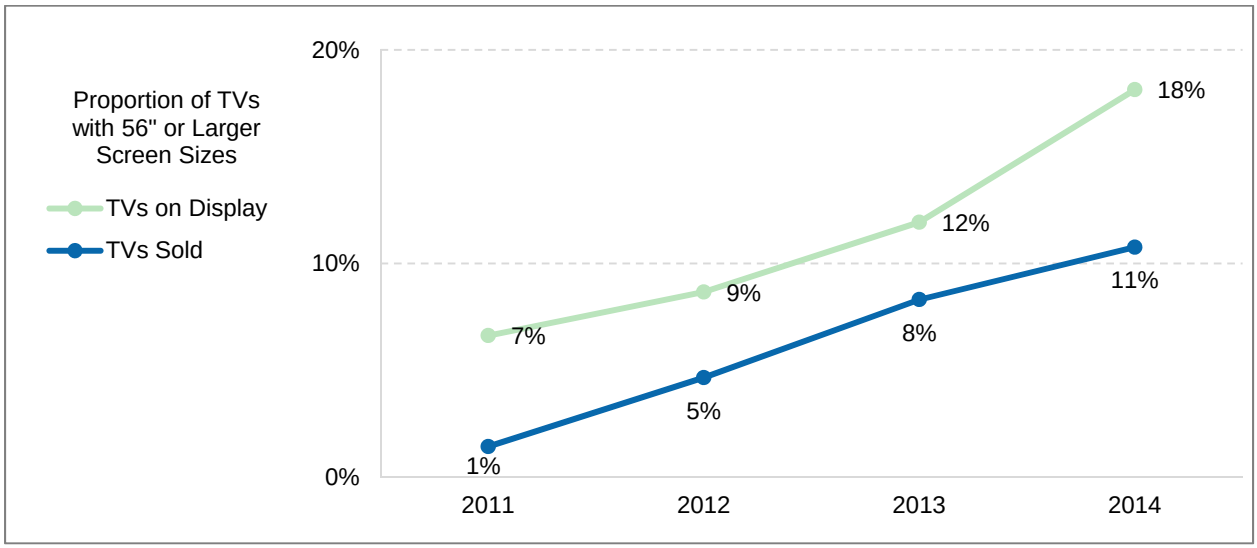


B.1.2. Energy Use of TVs Sold

Large TVs, which use more energy, have become increasingly popular.

While large TVs (with diagonal screen sizes of 56 inches or more) were only one percent of all TVs sold and seven percent of all TVs on display in IP 2011, large TVs accounted for over one-tenth of sales and nearly one-fifth of all units on display by IP 2014. Further analysis demonstrates that screen size is positively correlated with on-mode power use (r = .56); confirming that larger TVs use more power.

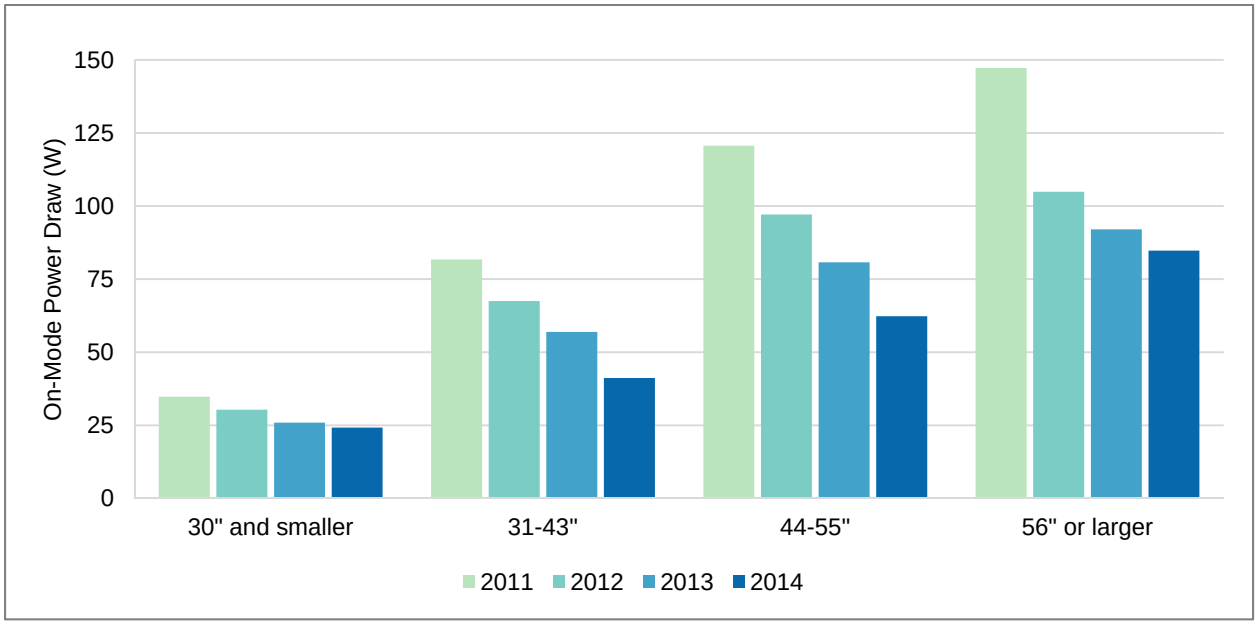
Figure 19. Proportion of Large TVs on Display and Sold



On-mode power in watts decreased across all TV screen sizes from IP 2011 to IP 2014.

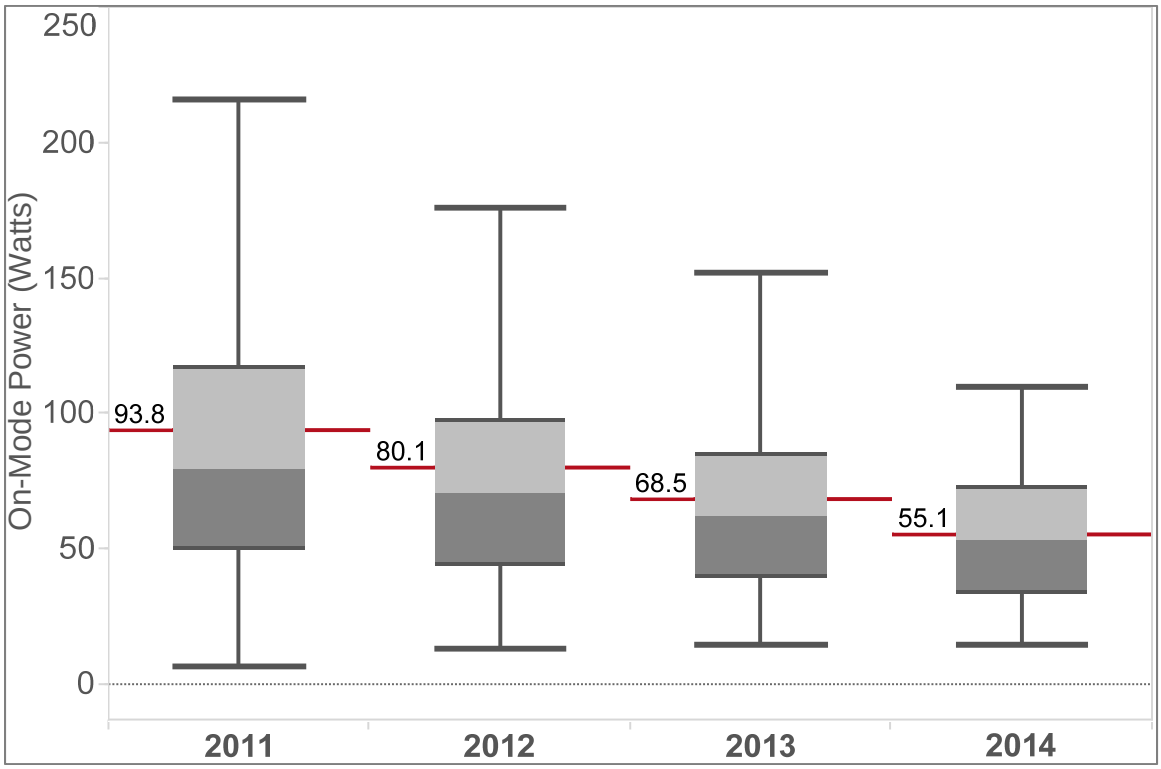
On-mode power use dropped dramatically in all screen sizes across the study timeframe, with TVs larger than 30 inches cutting their on-mode power wattage nearly in half relative to 2011 levels by IP 2014 (Figure 20). While reductions in on-mode power use were quite dramatic among 31 inch and larger models, 30 inch and smaller models exhibited smaller on-mode power decreases across the study timeframe. In IP 2014, 99% of all TVs sold used 100 watts or less while on.

Figure 20. Average On-Mode Power, by Screen Size



Irrespective of screen size, on-mode power use of assorted TVs steadily decreased in each successive incentive period (Figure 21). This boxplot shows both a decrease in typical on-mode power each year (the median and mean are lower each year), as well as a shrinking of the range of on-mode power each year (the size of the shaded boxes and "T" bars are smaller each year).

Figure 21. Distribution of On-Mode Power*

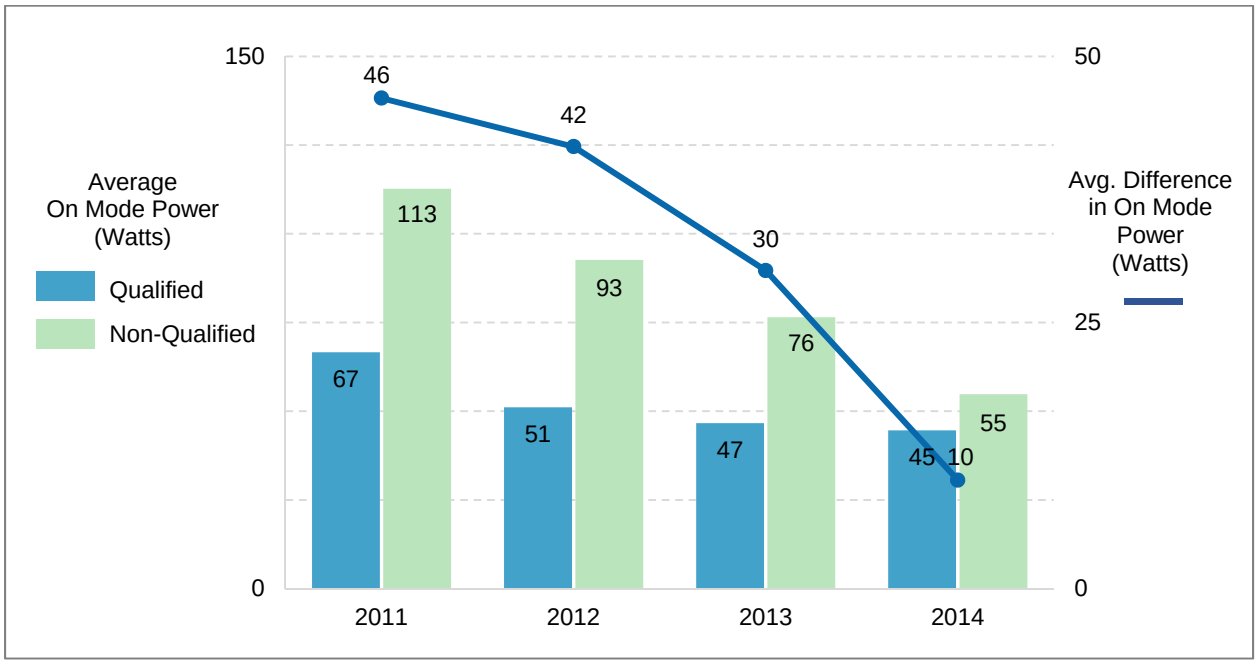


* The boxplot provides a visual representation of on-mode power usage for TVs sold from 2011 to 2014. The "box" (the light and darker grey shaded areas) show the typical on-mode power usage of the data (the middle 50%, with the change-over between dark and grey shaded areas representing the median on-mode power consumption per year, and the red line representing the mean). The "T" bars stemming from the shaded box represent the valid range of on-mode power for each year.

Average on mode power for qualified TVs barely decreased from IP 2012 to IP 2014, while the gap between qualified and non-qualified models in on mode power usage became smaller.

In IP 2011, qualified TV models were rated at an average of 67 watts while non-qualified models averaged 113 watts (demonstrating an average difference of 46 watts). However, this gap shrunk over the course of the study timeframe (with an average difference of 10 watts in IP 2014); while non-qualified models dramatically dropped in average on mode power use over the four incentive periods studied, average qualified model power use changed little in the last three incentive periods (Figure 22).

Figure 22. Change in Average On-Mode Power, by Qualification Status

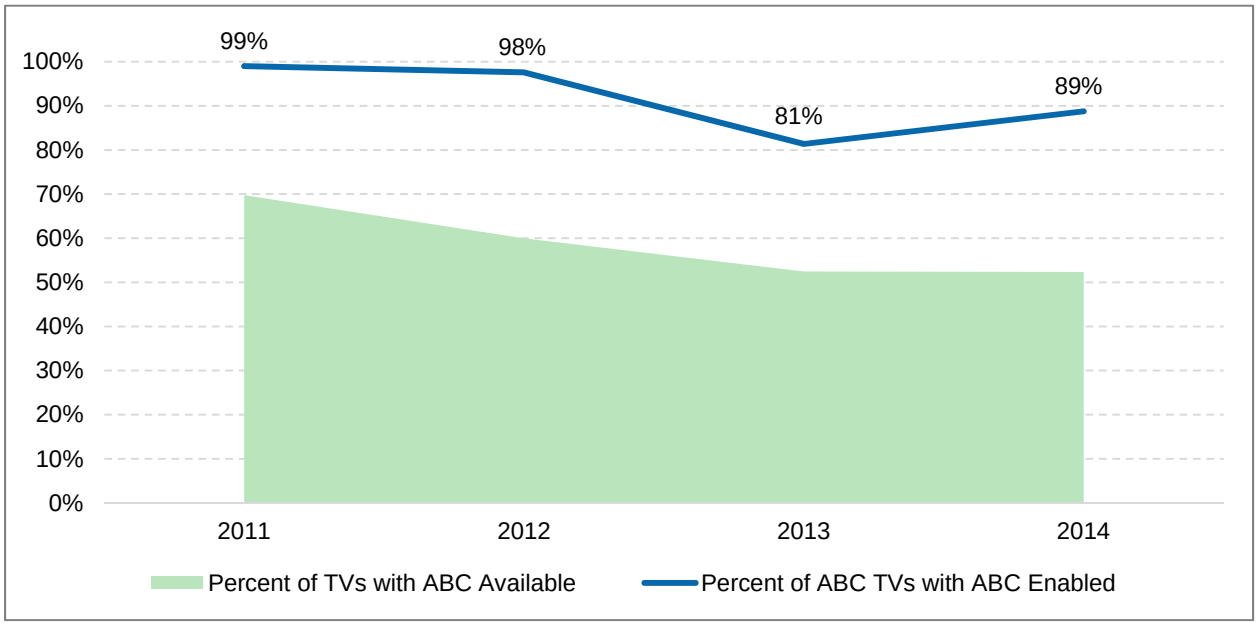


The proportion of TVs sold with automatic brightness control functionality dropped over the study timeframe, but remained constant from IP 2013 to IP 2014. The percent of units sold with these controls enabled by default also dropped, but has begun bouncing back as of IP 2014.

Of the 60% of TV sales in the dataset with auto brightness control (ABC) data, about 60% of all unique TV models in the study timeframe had ABC.[24] From 2011 to 2013 the percent of TVs sold with ABC that had the feature enabled by default declined from 99% to 81%, but then bounced back to 89% in 2014. Similarly, the percent of TVs sold with ABC functionality declined from 2011 to 2013, but stopped dropping after 2013.

[24] Since ABC data was only available for models that matched the ENERGY STAR list, it is likely that reported ABC rates are inaccurate. Thus, if ABC is more prevalent among ENERGY STAR models, then reported ABC rates are artificially high. Further, 6% of unique models with ABC were missing ABC enabled data.

Figure 23. Proportion of TVs Sold with Auto Brightness Control Available and Enabled



B.2. Regional Influence Based on NPD Data

As has been documented in prior MPER studies, estimating the impacts due to market transformation programs is an inherently difficult task, particularly for the NEEA TV Initiative, which does not offer direct incentives to end-use customers. In fact, the program is often invisible to end-use customers, in that many customers may not even be aware that the program exists. In order to quantify the Initiative's regional influence on TV sales, the Evaluation Team utilized a market-based approach consisting of the following steps:

- Develop and select a comparison region; ultimately selecting Virginia and Kansas
- Estimate overall NEEA region qualified (and non-qualified) sales
- Estimate proportional qualified sales differential between NEEA and comparison region
- Estimate program impacts

Step 1: Development and Selection of the Comparison Region

The goal of including a comparison region in this evaluation effort is to represent market dynamics and penetration of high-efficiency TVs (sale of NEEA-qualifying ENERGY STAR units) in locations our team has identified as similar to the NEEA region (Idaho, Washington, Oregon, and Montana), but lack any equivalent program administrator-sponsored activity. The comparison area approach also allows for the estimate of sales "lift" from both participating and non-participating retailers (i.e., participant and non-participant spillover), thus providing a more fully comprehensive analysis of program attribution.

In an effort to identify states with a similar demographic and household makeup as the NEEA region, data from the 2013 American Community Survey (ACS) were used to construct an index of similar states based upon a variety of characteristics. Additionally, data from the 2012 presidential election was incorporated into the selection to account for state-level partisanship. For each measure, states were ranked 1-47 (D.C. included) by comparing NEEA's value for the measure to each individual state's value (i.e. subtracting the individual state value from the NEEA value).[25] Rankings were then aggregated across all measures to create a composite score, resulting in a final ranking of how comparable each state was to NEEA across all measures. The list of variables used to create the composite score are listed in Table 16, and the top 30 states are presented in Table 17.

Table 16. List of Variables Used to Construct the NEEA Comparability Ranking Index

Home Characteristics	Political Partisanship	Demographic Characteristics
Home Ownership	% Voted for Obama (2012)	Median household income
Number of Rooms		Median Age
Year Built		Race
Median home value ($)		Education
Primary Heating Fuel		Employment Status
		Years in Residence

Table 17. Ranking of Top 30 States to NEEA Based on Full Composite Score

Ranking	State	Ranking	State	Ranking	State
1	Colorado	11	Texas	21	Ohio
2	Virginia	12	Tennessee	22	Arkansas
3	North Carolina	13	Alaska	23	Maryland
4	Kansas	14	Illinois	24	Pennsylvania
5	Missouri	15	Utah	25	Florida
6	Wisconsin	16	Delaware	26	South Carolina
7	Minnesota	17	Indiana	27	Kentucky
8	Arizona	18	South Dakota	28	Connecticut
9	Georgia	19	New Mexico	29	New Hampshire
10	Nebraska	20	Wyoming	30	Massachusetts

Virginia (rank = 2) and Kansas (rank = 4) were the top ranking states in the index which lacked any utility-sponsored energy efficient TV rebate or promotional program.[26]

[25] All variables used in the index construction were based on overall state percentages, allowing for percentages between NEEA and a given state to be directly compared.

[26] "DSIRE: Database of State Incentives for Renewables and Efficiency." November 2014. *www.dsireusa.org*

The Team also used the ACS household data to compare the retailer makeup of the NEEA and comparison regions (number of stores normalized per 100,000 households). The two regions have very similar representation of Best Buy and Sears, while Costco was underrepresented in the comparison region and Wal-Mart and Target were both overrepresented in the comparison region (highlighted in boxes in the table below).[27] Also included in Table 18 are the total 2012-2013 qualified sales (based on retailers' reporting to the Initiative) to demonstrate that over two-thirds of the qualified sales were derived from Costco and Walmart.

Table 18. NEEA and Comparison Region Number of Retailer's per 100,000 Households

Retailer/Buying Group	NEEA Region Stores per Household	Comparison Region Stores per Household	Retailer % of Total 2012-2013 Qualified Sales**
Best Buy	0.66	0.60	20%
Costco	**1.01**	**0.44**	**40%**
Sam's Club	0.12	0.58	2%
Sears	1.93	1.84	4%
Target	1.29	1.79	7%
Walmart	**2.07**	**3.82**	**27%**

** The retailer sales percent's reflect the portion of each retailer relative to those retailers listed in this table, and do not include the smaller retailers (which as a group represent less than 3% of sales)

The Team also reviewed Television sales by region (once the NPD Group data became available, see Step 2 below for details regarding the NPD Group data) and normalized the sales by the number of households in each region. As can be seen in Table 19 below, the comparison region showed considerably stronger household TV sales relative to the NEEA region (approximately one out of every five households in the NEEA region purchased a new TV relative to one out of every three households in the comparison region). It is not clear, nor are there any studies the Team has identified that have conclusively shown, if a relationship exists between TV purchasing rates and TV efficiency levels.

Table 19. NEEA and Comparison Region TV Sales per Household

Retailer/Buying Group	NEEA Region TV Sales per Household	Comparison Region TV Sales per Household
TV Sales	0.22	0.33

[27] Since Costco is not included in the NPD data, the underrepresentation in the comparison region does not have any impact on the quantitative analysis, while the underrepresentation of Walmart in the NEEA region could have an impact on the results. Since Walmart shows a lower-than average percentage of qualified unit sales relative to the other retailers, the underrepresentation of Walmart stores in the NEEA region could translate into a higher attribution ratio than if they were closer to parity.

Step 2: Estimate NEEA-Qualified TV Market

This step provided an estimate for the total number of program qualified units sold across the NEEA region (in both partner and non-partner stores). The Evaluation Team utilized two key data sources to estimate the overall market for the program-qualified TVs in the NEEA region:

- NEEA partner sales data. As noted above, Energy Solutions, NEEA's Implementation contractor, collects daily/monthly sales data from the program retail partners. The reporting of sales data with the number of qualified and non-qualified units sold by month is required to remain a partner in the program.[28]

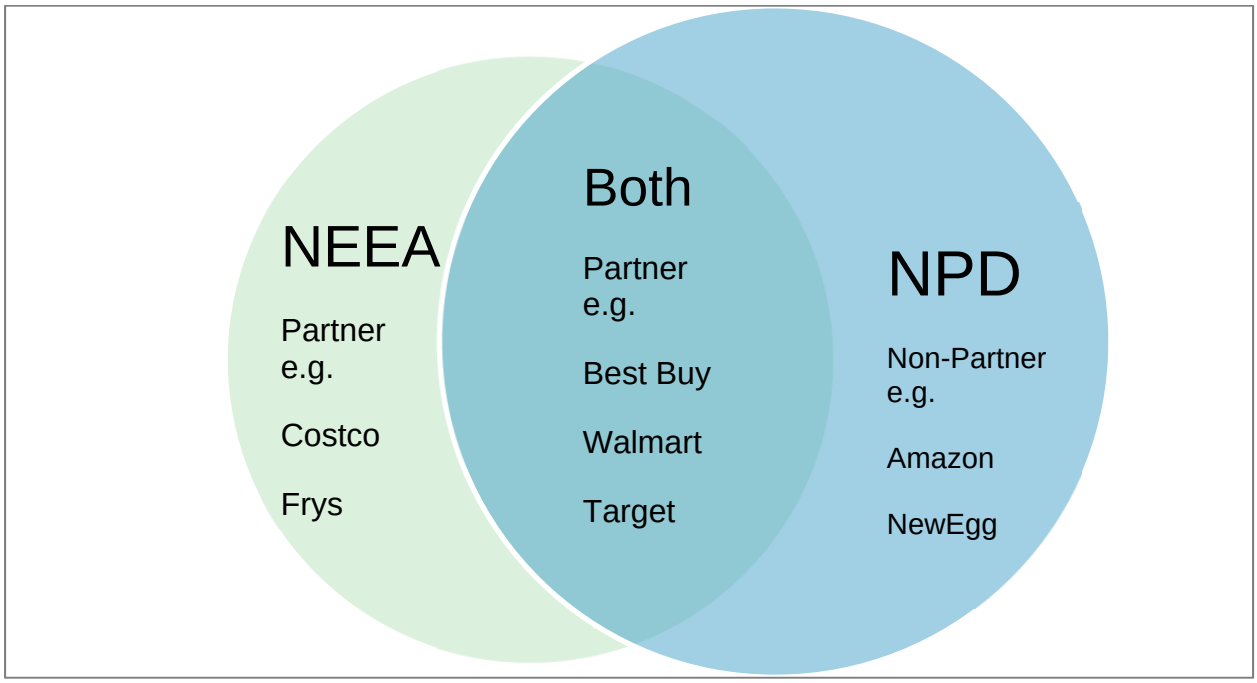
- Qualified and non-qualified state-level annual[29] sales data from the NPD Group (NPD). NPD collects, aggregates, and maintains a database of sales data from its retailer informants (including TV sales). NPD estimates that their data represent approximately 76% of total national TV retailer unit sales.

Since neither data source encompasses the entire NEEA region consumer TV retail market, the first step for estimating the market share is to establish a more comprehensive and inclusive picture of the overall NEEA region qualified TV market. In order to do this, the Team isolated unique retailers present in both datasets and identified those retailers present in one dataset but absent from the other: Costco, Nationwide, and Fry's are represented in the NEEA Energy Solutions data but are not represented in the NPD data, whereas the NPD data includes a number of non-NEEA program retailers present in the NEEA region, including major online electronics retailers (Amazon, NewEgg, Adorama), direct manufacturer retailers (Sony, Samsung), and others (Ritz, JC Penny, BJs). The Team then created three sub-groups of retailers based on the data source: NPD and NEEA Partner retailers (retailers that are NEEA partners and included in the NPD dataset), NPD non-NEEA Partner retailers, and NEEA partner retailers that are not in the NPD data. These groupings are demonstrated below in Figure 24.

[28] Best Buy, however, only provides qualified unit sales and will not share non-qualified unit sales with Energy Solutions. In order to estimate Best Buy's non-qualified unit sales, the Team used the weighted average of a composite of other participating retailers qualified to non-qualified unit sales as a proxy. Note, however, that Costco and a number of smaller retailers were not included in the composite since Costco had considerably higher proportion of qualified sales relative to the other retailers and the smaller retailers deemed less reliable per the market characterization analysis above. Note the selection of the composite retailers selected to approximate the Best Buy total sales does not impact the number of programmable attributable units, only the estimate of total market sales.

[29] Though quarterly or monthly data is available from NPD, the added cost of the data at this resolution exceeded the available budget for this task. Furthermore, due to corporate data sharing agreements, NPD was only able to provide summary (aggregate) sales data that included total sales by state, screen size, and on-mode power consumption.

Figure 24. NEEA Region Retailer Representation (and Overlap) within Each Data Source



The team had originally planned on developing and using two indicators: the first is the market share of program-qualified units from program partners alone, and the second is the market share of program-qualified units across all retailers. The former indicator does not take non-participant spillover into account, while the latter estimate does. Because the program could potentially impact sales of efficient TVs at non-participating retailers, the Team elected to rely solely on the latter approach. The most likely way the program could impact non-partner retailers would be through increased demand met by the manufacturers and the advertising and marketing of the program. The availability of program incentives could lead manufacturers to promote qualified TVs to partner and non-partner retailers, so the non-partner retailers end up assorting the efficient TVs manufacturers are promoting.

Another possible line of influence would be if the Initiative's marketing activities created consumer demand for efficient TVs, and non-partner retailers increased their assortment of efficient TVs in response to that demand. The Initiative's marketing activities were concentrated on the partner retailers and were focused on influencing people at the point of purchase. Market research for previous MPERs suggests energy efficiency is not typically a primary concern when people are deciding what TV to buy. NEEA designed the Initiative's marketing hoping energy efficiency would be a factor that tips the balance when a consumer is choosing between two TVs that are equal in other ways.

To establish the known TV market for the NEEA region, the Team summarized the qualified and non-qualified unit sales from the NEEA-based (Energy Solutions) database and the NPD group

database[30]. Each of the three retailer group totals are displayed below in Table 20. The overall NEEA region TV unit sales in 2013 declined slightly relative to 2012 sales (a 3.1% drop in sales), though the proportion of qualified sales significantly increased (from 25.7% to 39.2%).

Table 20. NEEA Region 2012-2013 (Calendar Year) TV Sales by Data Source

Year	Data Source	NEEA Region Non-Qualified Sales	NEEA Region Low Tier Sales	NEEA Region High Tier Sales	NEEA Region Total Sales	NEEA Region Qualified Proportion
		(A)	(B)	(C)	(D)	(B+C) / D
2012	NPD and NEEA Partner	520,983	78,327	84,432	683,742	23.8%
	NPD non-NEEA Partner	374,449	20,807	32,349	427,605	12.4%
	NEEA partner, not in NPD	146,486	59,758	84,242	290,486	49.6%
	Total	**1,041,918**	**158,892**	**201,023**	**1,401,833**	**25.7%**
2013	NPD and NEEA Partner	294,661	142,792	95,874	533,327	44.8%
	NPD non-NEEA Partner	430,102	86,319	70,924	587,345	26.8%
	NEEA partner, not in NPD	99,998	89,726	46,460	236,184	57.7%
	Total	**824,760**	**318,831**	**213,258**	**1,356,856**	**39.2%**

Table Source: (A, B, C, D) NPD Group and NEEA (Energy Solutions) unit sales data

The Team used several key pieces of information in order to estimate the overall NEEA market for qualified unit sales. First, the team used the largest known estimate for total TV sales, about 1.1 million units for the NEEA region in 2012, which NPD estimates to represent 76% of the market. This level of market coverage would suggest a total of 1.46 million TV sales in the Northwest. Next, the research team added the NEEA supplied retailer sales from retail chains known to be excluded from the NPD sales data to the data on 1.1 million unit sales in the NPD dataset, creating a final, combined estimate of 1.4 million units. The evaluation team estimates that the current estimate of 1.4 million units covers about 96% of sales in NEEA region (1.4 million units out of a total of 1.46 million TVs sold in NEEA territory).[31]

[30] The Team verified and then relied on the Energy Solutions qualification assignments by tier for the NEEA sales data and used the qualification specifications per NEEA program and ENERGY STAR specifications to assign the tiers for the NPD Group data. Since the NPD data was annual, the Team applied the known (Energy Solutions-based) proportion of annual sales occurring in Q1 2013 sales by tier (using the old 2012 qualifying specification and new 2013 specification) to the 2013 annual sales data to derive a more representative tiered sales summary.

[31] To estimate the total overall market, which includes the unknown portion of sales, the team then leveraged the NPD-assumed coverage of the overall Television market. NPD estimates their data to represent 76% of the overall National TV market. Assuming the NPD-based 1.1 million units is therefore 76% of the NEEA market, the research team derived the overall Television market to be approximately 1.46 million units sold in 2012. By adding the known NPD and NEEA supplied retailer sales results in an overall coverage of approximately 96% of estimated NEEA region TV sales

NEEA partner sales (both qualified and non-qualified units) represent approximately 67% of the overall NEEA region TV market (974,228 out of 1.46 million unit sales in 2012). Based on the total known coverage of the NEEA market (1.4 million unit sales in 2012), the 2012 NEEA supplied sales data accounts for 69% of all regional TV sales, and 85% of qualified unit sales; for 2013, the NEEA supplied sales data accounts for 57% of regional TV sales, and 70% of qualified unit sales. These statistics are derived from Table 20 above, which shows NEEA region sales across partner and non-partner retailers (with qualified unit sales in the red highlighted grids).

Step 3: Estimate Regional Proportional Qualified Sales Differential

For this step, the Evaluation Team relied on a simple statistical method to determine whether there is a significant difference in the proportion of qualified unit sales between NEEA and the comparison region. The team used a logistic regression to isolate the impacts of the NEEA-based program on TV sales, whereby the probability (or odds) of qualified purchase in the NEEA region, relative to the comparison region, is the output from the regression. Logistic regression is a generalized linear model (GLM) procedure: it is regressing for the probability of a categorical outcome (in this case qualified versus not-qualified sales). In simplest form, this means that we are considering just one outcome variable and two states of that variable- either 0 (non-qualified) or 1 (qualified).

The probability, or odds ratio, between the NEEA and comparison region is equal to the simple percent difference in proportion of qualified unit sales between the two regions of interest in this study. The advantages of using this approach rather than the percent difference in proportions (of difference of means) is that it displays both the increased probability (in this case, program lift or influence) of a NEEA-based qualifying TV purchase and the statistical significance of the result (confirms that the proportion of qualified purchases between the two populations are indeed statistically different). The equation used for this analysis is demonstrated below:

$$\lambda(\boldsymbol{Qualifiedy_i}) = \boldsymbol{\alpha} + \boldsymbol{\beta}(\boldsymbol{NEEA})\boldsymbol{\varepsilon_i}$$

where:

α is an intercept,

β represents the NEEA versus non-NEEA likelihood of qualified TV purchase,

ε_i is an error term, and

λ is the unit sales weight.

There are two known limitations to this approach. First, the approach does not account for other factors that may influence market share, including energy prices, climate zone, population center distribution (urban/suburban/rural) etc., all of which may be predictors of high-efficiency TV market share. Second, the approach assumes a non-program area that is the theoretical equivalent to NEEA in the absence of program activity, and does not account for the possibility that the efforts in NEEA or other states with active programs may have influenced the sales in the comparison states. While this impact cannot be accurately quantified (there is no way to "undo" the significant program activity that has occurred in both the NEEA region and elsewhere, such as California), it means estimated baseline sales for all states—including the comparison states—

may be overstated. In other words, sales outside the NEEA region—and estimated baseline sales—may have been lower in absence of the NEEA program (i.e., estimates of program impacts inside NEEA are likely to be conservative).

The logistic regressions were run individually for each year and qualifying specification (low versus high efficiency tier). The results of the logistic regression for the 2012 calendar year are shown in Table 21 below. The 2012 year showed some degree of influence, with the NEEA region consumers having a between 6-8% (as indicated in the Odds Ratios found in Table 21 of 105.5% and 107.7%) higher likelihood of purchasing a program qualified unit.

Table 21. 2012 Calendar Year Logistic Regression for NEEA Baseline Sales Estimation

Parameter	Odds Ratio	Std Error	Z	P>[Z]	Lower 95% CI	Upper 95% CI
2012 Low Tier	105.5%	0.479%	11.84	0	104.6%	106.5%
2012 High Tier	107.7%	0.456%	17.59	0	106.9%	108.6%

The results of the logistic regression are all statistically significant, with low standard errors and tight confidence intervals, and confirmation that the proportion of qualified NEEA sales is statistically different (and higher) than the comparison region.

In 2013 program qualification specifications changed after the first quarter – with first quarter based on 2012 specifications and the remainder of 2013 on new 2013 specifications. This change during the course of the year may have influenced the size of the Odds Ratio. The overall 2013 results suggest that the difference in the likelihood of purchasing a program qualified unit between NEEA region and comparison region consumers is smaller than in 2012. Because the Initiative specification changed at the end of Q1 2013, the Team chose to include two model runs – one based on applying the older (2012) based specification standards to the 2013 sales data, and the second applying the newer (2013) based specification standards. This approach was necessary because NPD data were reported on calendar years and thus could not precisely capture the change in specifications at the end of Q1.[32] As was demonstrated in Figure 14, the Team believes that the primary factor influencing the lower influence scores for the secondary specifications in 2013 were due to the newer (2013) based specifications were introduced in Q2 of 2013, and based on general trends of Figure 14, and on anecdotal evidence from retailer interviews, there is always a "ramp-up" period following new specification changes.

[32] As noted previously, annual-based data was the only option based on the available budget for this study. Based on the findings for the varying specifications, the Team believes there would be little benefit from purchasing the sales data on a monthly or quarterly basis. Note that the Team was also not able to acquire pre-program sales given excessive cost for the data, so a difference of differences approach (cross-sectional time series) was not possible.

Table 22. 2013 Calendar Year Logistic Regression for NEEA Baseline Sales Estimation

Parameter	Odds Ratio	Std Error	Z	P>[Z]	Lower 95% CI	Upper 95% CI
2013 Low Tier (2012 Spec)	110.5%	0.585%	18.78	0	109.3%	111.6%
2013 High Tier (2012 Spec)	99.1%	0.351%	-2.6	0.009	98.4%	99.8%
2013 Low Tier (2013 Spec)	99.7%	0.303%	-0.98	0.326	99.1%	100.3%
2013 High Tier (2013 Spec)	102.8%	0.367%	7.84	0	102.1%	103.6%

To estimate the overall 2013 calendar year program influence or odds factor, the Team relied on weighting the odds ratio by the proportion of 2013 annual sales that occurred in the first quarter. Unit sales for the first quarter of 2013 represented 24% of annual sales. Therefore the first two rows of Table 22, which are the older 2012-based specification results of the model receive 24% of the annual weight and the second two rows, which represent the newer 2013-based specification results receive 76% of the annual weight. Since two of the results showed no lift, the Team chose to apply a value of 100% (representing zero lift) as the odds ratio rather than allowing a negative odds ratio to be factored into the weighting.[33] The overall odds ratios used for the 2013 calendar year were 102.5% for the low tier and 102.1% for the high tier – showing that the 2013 calendar year showed significantly less program influence on highly efficient TVs.

Step 4: Estimate Program Impacts

To estimate the total regional impact of the Initiative, the results from each of the previous steps are consolidated and integrated into the final calculation. To represent the units that can be credited to the influence of the NEEA program, the following estimates are used: the program lift from the logistic regression, the total NEEA region qualified TV sales, and the NEEA-program claimed sales (the total units that were qualified, and that retailers received paid incentives towards). The resulting total number of program attributable sales can then be divided by the total claimed NEEA program sales to derive the program influence ratio. All summary statistics are included in Table 23 below, which displays the overall program attributable sales of 37,004 units over the two years.

[33] Since the hypothesis of market lift in this effort would imply NEEA sales greater than Comparison Sales, then the rejection of this hypothesis requires Comparison sales to exceed NEEA, which in the case of "negative lift" or Odds Ratio less than 100%, would translate to 0% lift, or equivalent sales (equaling 100%).

Table 23. NEEA 2012-2013 Program Impacts

Year	NEEA Program Lift	Total NEEA Region Qualified Sales	NEEA Program Attributable Sales	NEEA Claimed Sales	NEEA Program Influence
	(A)	(B)	(A*B)	(C)	(A*B) / (C)
2012 Low Tier	5.5%	158,892	8,766	138,085	6.3%
2012 High Tier	7.7%	201,023	15,529	168,674	9.2%
2013 Low Tier	2.5%	318,837	8,124	232,518	3.5%
2013 High Tier	2.1%	213,258	4,585	142,334	3.2%
Overall 2012-2013 Period			**37,004**	**681,611**	**5.4%**

Table Source: (A) Logistic Regression; (B) NEEA plus NPD sales data, Table 20 (C) NEEA sales data (Energy Solutions)

Unfortunately, there are not many other high efficiency TV market transformation program evaluations available against which to benchmark these findings, though they are in line with a fairly recent evaluation for the New York State Energy Research and Development Authority (NYSERDA) New York Products Program (NYPP). The NYPP offered a similar program for appliances,[34] and the recent evaluation showed approximately 10% lift attributable to the program.

There is also a recent (2013) study in California that evaluated a similar market transformation program involving three of the California electric utilities. The study, titled "Impact Evaluation Report: Business and Consumer Electronics Program (WO34)" (KEMA, 2013) used several approaches to assess market lift and found that "Due to the uncertainty around this point estimate alternate calculations for net-to-gross (NTG) were explored. These alternate approaches yield NTG results that range from 5.8 to 39.3% and are lower than the mean value from the Delphi panel at 43.7%)." Due to the difficulty in establishing a reliable point estimate for market lift, the study concluded that "given the issues surrounding the panel (perceived upward and downward bias, panelist attrition and failure to approach consensus) the uncertainty around the NTG recommendation of 22.3% limits its applicability to the 2010-2012 program cycle. The results also are limited in their application to future programs. The panel focused on the program period from Q1, 2010 through Q3, 2011. Extrapolating the findings from this study to future periods may not be appropriate due to the rapid evolution of TV technology, the expectations for new ENERGY STAR specifications, or both."

[34] NYPP is a mid-stream market transformation program aimed at driving ENERGY STAR sales of efficient appliances, home electronics, and lighting by offering retailer incentives and marketing assistance to increase consumer demand for these products.

Appendix C. Experimental Design Results Analysis

This appendix summarizes findings from experimental design analyses conducted as part of TV Initiative MPER #4. These analyses seek to assess the effect of three in-store interventions that aimed to increase the sales of qualified TVs. These analyses draw on TV sales data that participating retailers provided to Energy Solutions as part of their participation agreements.

The Evaluation Team used advanced regression techniques to examine the effect of NEEA's in-store experiment (a video wall and enhanced sales training) on the proportion of television sales that qualified under the initiative's incentive criteria. The analysis showed all interventions in the experiment (video wall display, advanced sales training, and video wall display plus advanced sales training) resulted in higher proportions of qualified sales than control stores (with no interventions).

C.1. Experiment Background

In 2013, NEEA and Research Into Action worked together to design an experiment in which three interventions were deployed at participating retail stores with the goal of increasing sales of qualified televisions:

- Enhanced sales associate training, in which the Initiative's field staff offered retail sales associates a Starbucks gift card to take and discuss a brief quiz on the benefits of Initiative-qualified TVs.
- In-store video wall, in which the retailers agreed to include the Initiative's 30-second promotional video in the loop of video content playing on the TVs on display in their stores. The video typically played approximately four times each hour.
- Enhanced training *and* the in-store video wall

The experiment also included a control group that did not receive any of the three interventions. Table 24 shows the "2x2" experimental design. Research Into Action randomly assigned participating retail stores to one of four groups (Table 24). NEEA implemented the experiment in Q3 and Q4 2013.

Table 24. Experimental Design – Groups by Intervention Type

		Training	
		On	**Off**
Video	**On**	**Group 1:** Video + Training	**Group 2:** Video
	Off	**Group 3:** Training	**Group 4:** Nothing (Control)

Table 25 lists the retailers included in the analysis and shows the number of stores from each retailer included in each study group.[35]

Table 25. Number of Retailer's Stores Included in Each Study Group

	Study Group			
Retailer	**Video Wall Only**	**Enhanced Training Only**	**Video + Training**	**Control Group (No Interventions)**
Costco	12	13	12	13
Kmart	11	10	10	9
Sam's Club	0	0	0	6
Sears	9	12	11	16
Target	0	0	0	65
Walmart	26	26	27	27

To quantitatively assess the effect of these interventions, the Evaluation Team aggregated Energy Solution sales data for individual stores from the retailers listed in Table 25 to compute the proportion of television sales that qualified under the Initiative's incentive criteria and the proportion of qualified televisions on display for each store during the study timeframe.[36, 37] The Evaluation Team used multilevel linear modeling and linear regression to measure the effect of NEEA's in-store experiment.

C.1.1. Results

All interventions resulted in significant increases in qualified sales. Regression analysis revealed that the experiment had a significant effect on qualified sales; all three interventions resulted in increased proportions of qualified sales when compared to the control group. As seen in Table 26, training-only and video wall-only interventions resulted in approximately 3.5% increases in qualified sales. The two interventions in combination had a larger effect, resulting in a nearly 5% increase in the proportion of qualified sales. Because the effect of the combined video wall and enhanced training was less than the sum of the two isolated effects, the experiment's outcome suggests that the two interventions interacted with one another. This is consistent with findings presented in TV Initiative MPER #3, which suggest that in-store videos

[35] Target and Sam's Club stores did not receive the experiment's interventions, and are thus included only as control group stores. Inclusion of these stores increases the sample size of the experiment by nearly one-third, increasing the statistical power to detect the experiment's effect. Analyses indicate that inclusion of Target and Sam's Club stores does not bias the control group for two reasons. First, as described below, the effects of the experiment did not differ significantly across retail chains. Second, Target and Sam's Club are similar to other retailers' control stores in regard to the proportion of their sales that met Initiative qualification criteria.

[36] Proportion of qualified televisions on display was calculated individually for each store by dividing the number of qualified unique models sold during the study timeframe by the number of all unique models sold.

[37] Online sales were excluded from the analyses.

and point of purchase materials can serve as a "prime" influencing interested consumers and sales associates to prioritize efficiency in their TV selection.

Table 26. Intervention Effects on Proportion of Qualified Sales

Intervention	Effect on Proportion of Qualified Sales
Video Wall + Enhanced Training	+4.6%
Enhanced Training Only	+3.5%
Video Wall Only	+3.4%

This experiment demonstrates that in-store interventions aimed at increasing customer and sales associate awareness of energy efficient television choices can positively impact sales of energy efficient televisions.

In-store intervention effects were consistent across retailers. The Evaluation Team initially hypothesized that the effects of the intervention might vary across retailers. For example, while an intervention may have similar effects across Costco stores, the same intervention may have a different effect in Walmart stores. However, initial analysis revealed that the effect of the experiment was not retailer-dependent, ultimately demonstrating that the interventions had a significant effect on qualified sales at the store level irrespective of the retailer.

Changes in assortment from month to month can blur the effects of in-store interventions. It is common for store-level television assortments to change from month to month. Consistent with findings in the Initiative Impact Findings Memo, bivariate regression analysis confirmed that there is a strong relationship between assortment and sales of qualified televisions in stores included in the experimental design analysis. As a result, in analyzing the outcomes of the experiment, it was important to control for changes in store-level assortment.[38]

[38] When simply testing the association between the interventions and the proportion of qualified sales, regression models exhibit an insignificant relationship; that is, bivariate regression models demonstrate that the experiment was not associated with increased (nor decreased) proportions of qualified sales among intervention groups when compared to the control group. However, once proportion of qualified televisions on display is controlled for in the model, multivariate regression reveals all three interventions resulted in significantly increased proportions of qualified sales when compared to the control group.

Appendix D. MPI Progress Review

This appendix presents findings from data analyzed as part of TV Initiative MPER #4 regarding the Initiative's progress toward its Market Progress Indicators (MPIs), as listed in Table 9.1.1 of the "Transition Complete Milestone Document," dated June 30, 2014. Consistent with NEEA's assessment that the TV market has been transformed, we find that the Initiative has met most of its MPIs.

D.1. MPI #1: Participating retailers sign contracts agreeing to provide sales data: Met

Based on the implementation contractor's (Navitas) Salesforce database, we conclude that contracts were in place to require retailers to provide sales data; the database references the process of signing contracts, retail staff referenced their contracts with the Initiative in in-depth interviews, and all of the participating retailers reported sales data to Energy Solutions.

D.2. MPI #2: Participating retailers provide sales data for all TVs sold at their establishment: Largely met

All but three retailers submitted full category sales data, reflecting all of the TVs sold in their stores within NEEA territory (i.e. TVs that qualified for incentives and those that did not).[39] These retailers submitted sales data only for models staff anticipated might qualify for incentives. In a 2011 email tracked in Navitas' Salesforce database, corporate sustainability staff from the one of these retailers explained their decision not to report full category sales data to Stephanie Fleming, then NEEA's TV Initiative Manager. According to the email, because full category sales data could allow someone to predict the retailer's business performance, the company will not release these data without non-disclosure agreements that prevent state government agencies that are potentially subject to public records requests, like public utilities commissions, from accessing them. In addition, because Energy Solutions (the Initiative's data manager) has advocated for local energy efficiency standards, the retailer does not want to provide Energy Solutions with data they could potentially use to advocate for regulations that the retailer opposes.

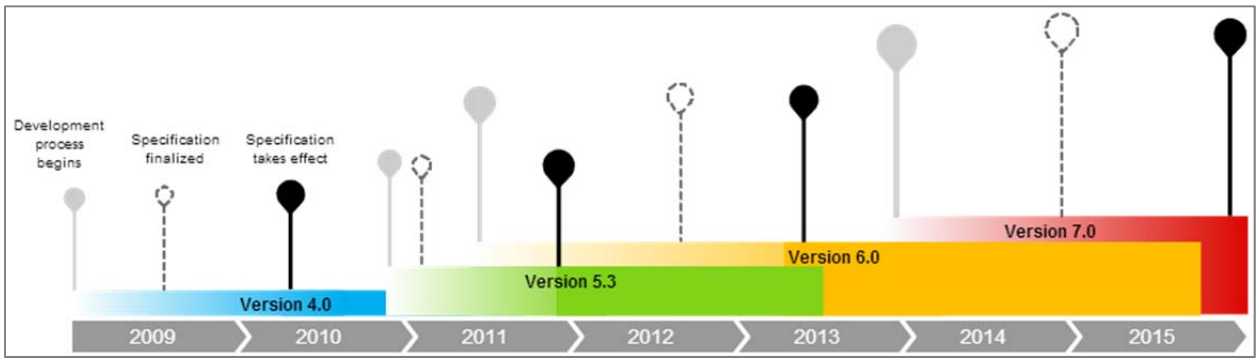
D.3. MPI #3: ENERGY STAR publishes new and more stringent standards on a consistent basis: Met

Since 2010, a new ENERGY STAR specification for TVs has taken effect approximately every two years. Figure 25 illustrates the specification revision processes for the current ENERGY STAR specification (Version 6.0), the upcoming specification (Version 7.0), and the previous two specifications (Versions 4.0 and 5.3). As TV technology changed rapidly in recent years,

[39] Best Buy, Fry's Electronics, and Nationwide did not report full category sales data.

EPA accelerated its revisions of the ENERGY STAR specification for TVs. Notably, the development process for the Version 6.0 specification began before Version 5.3 took effect.

Figure 25. TV ENERGY STAR Specification Development Timeline

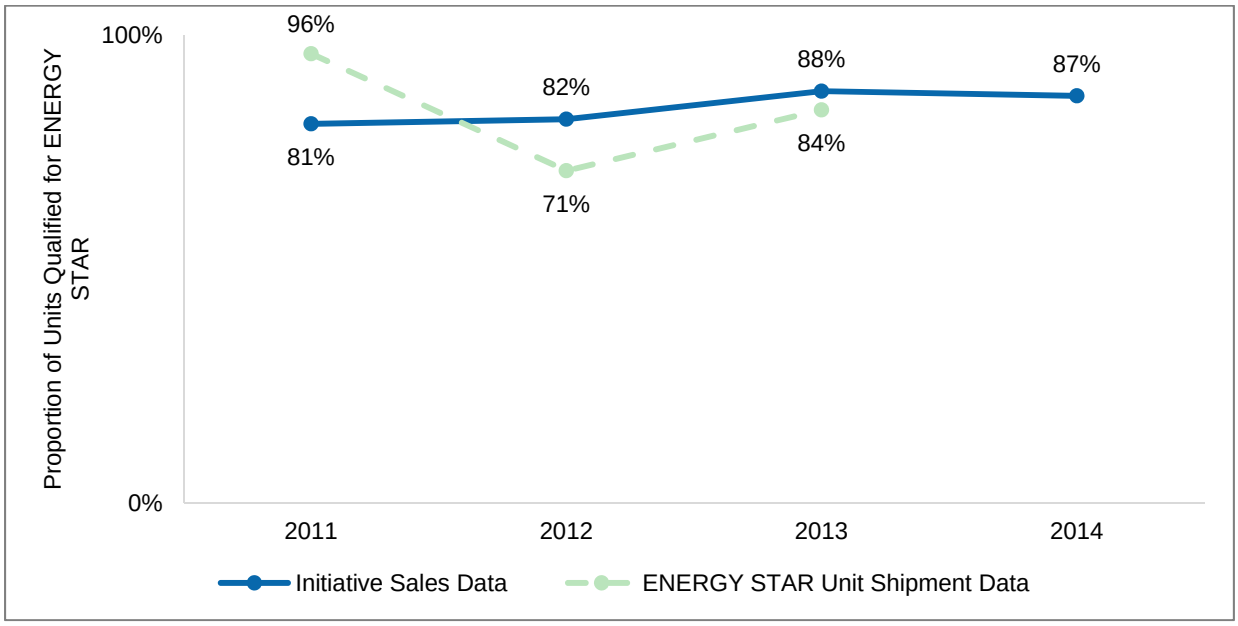


In addition to revisions to the ENERGY STAR specification, in 2012, EPA launched the ENERGY STAR Most Efficient designation for TVs and other products. Through the designation, EPA seeks to recognize the most efficient among ENERGY STAR qualified products, and EPA updates the criteria to earn the designation every year.

D.4. MPI #4: The penetration of ENERGY STAR qualified televisions in the Northwest increases over time: Met

Retailer-reported sales data indicate that penetration of ENERGY STAR qualified televisions in the Northwest increased from 81% in 2011 to 87% in 2014. As Figure 26 illustrates, from 2012 to 2013, both retailer-reported sales data and national ENERGY STAR Unit Shipment Data indicate an increase in penetration of ENERGY STAR qualified TVs. The previous year, ENERGY STAR Unit Shipment Data indicate a notable decrease in penetration, but this decrease reflects the shift from the Version 4.0 specification to the more stringent Version 5.3 requirements in late 2011. Retailer reported sales data suggest a slight decrease in penetration of ENERGY STAR qualified TVs in the Northwest in 2014. National unit shipment data are not yet available for 2014.

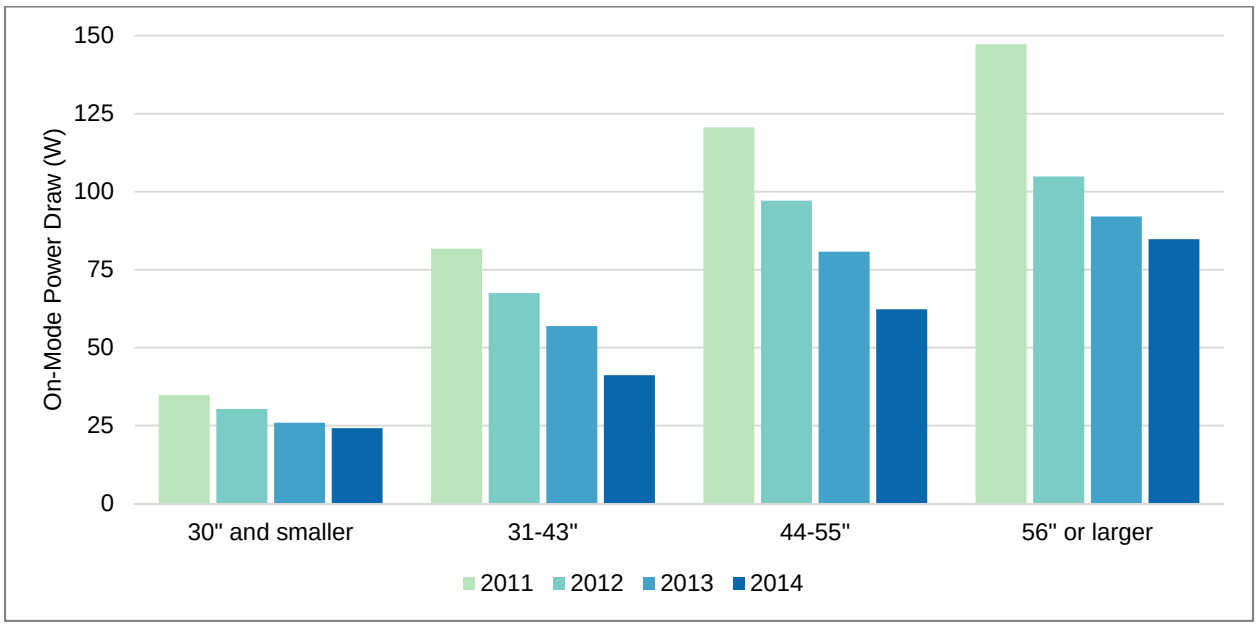
Figure 26. ENERGY STAR Penetration 2011-2014



D.5. MPI #5: Average energy consumption of televisions at all sizes decreases each year: Met

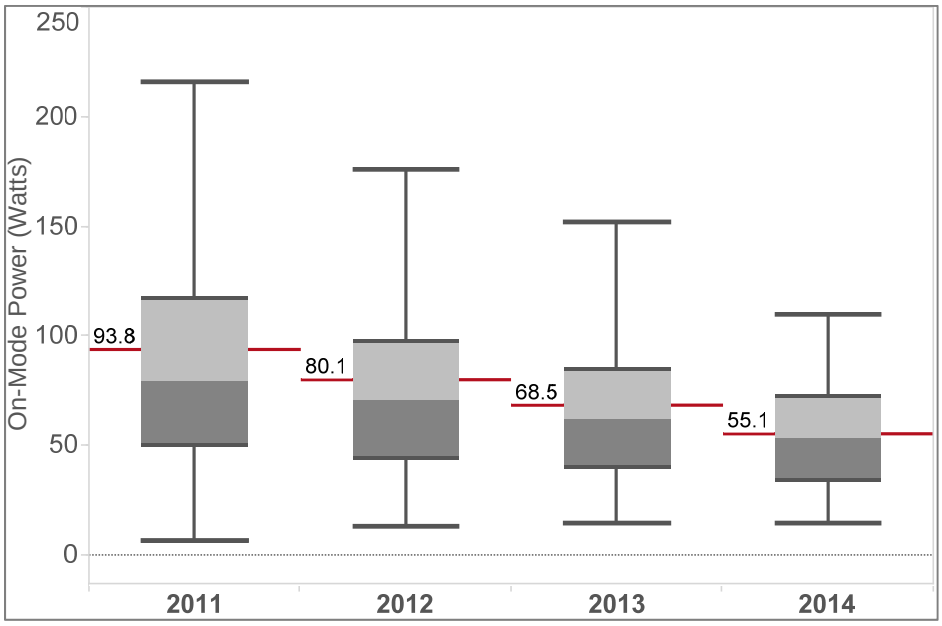
Average on-mode power use steadily decreased in all size categories from 2011 to 2014, and the range in power consumption across size categories narrowed (Figure 27). Over the three years, the largest televisions experienced the most dramatic decreases in energy use. By 2014, 99% of all televisions sold used 100 watts or less in on-mode.

Figure 27. On-mode Power Use by Size Category



Consistent with this decrease in energy consumption within each size category, overall average on-mode power consumption of TVs also continuously decreased from 2011 ($\bar{x}$=93.8) to 2014 ($\bar{x}$=55.1) (Figure 28). Further, the range of on-mode power use shrank in each subsequent year, resulting in substantially less variation by 2014.

Figure 28. Distribution of On-Mode Power Usage*

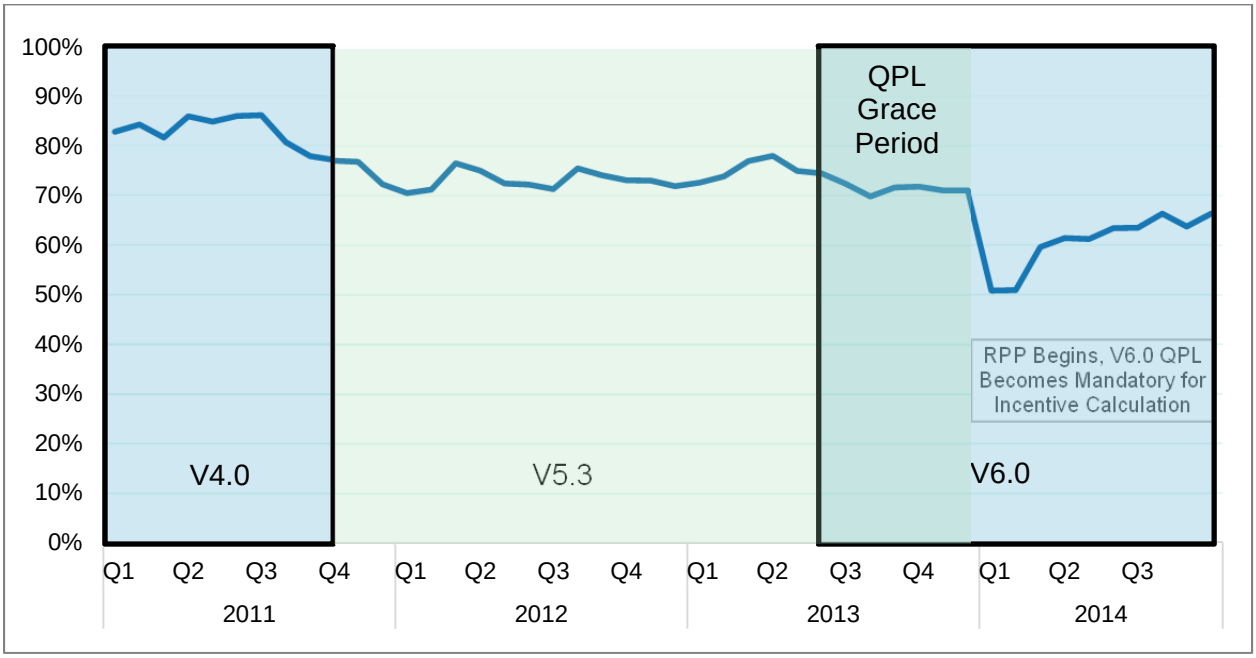


* The boxplot provides a visual representation of on-mode power usage for TVs sold from 2011 to 2014. The "box" (the light and darker grey shaded areas) show the typical on-mode power usage of the data (the middle 50%, with the change-over between dark and grey shaded areas representing the median on-mode power consumption per year, and the red line representing the mean). The "T" bars stemming from the shaded box represent the valid range of on-mode power for each year.

D.6. MPI #6: Percentage of televisions available for sale that meet current ENERGY STAR specifications increases over the cycle: Uncertain

The proportion of TVs in retailers' assortments that met ENERGY STAR specifications decreased immediately following each specification change (Figure 29). However, Initiative sales data indicate that for each of the past three ENERGY STAR specifications, proportions of ENERGY STAR qualified TVs in retailers' assortments have not recovered to the levels they achieved during the previous specification. The proportion of TVs in retailers' assortments that met current ENERGY STAR specifications was approximately 85% under the Version 4.0 specification, fluctuated between 70% and 80% under the Version 5.3 specification, and decreased to approximately 70% in the first few months of the Version 6.0 specification.

Figure 29. Proportion of TVs in Participating Retailers' Product Assortments Meeting Current ENERGY STAR Specifications



The sharp decrease in the proportion of assorted TVs that qualify for the ENERGY STAR Version 6.0 specification between December 2013 and January 2014 reflects a change in the Initiative's process for matching models to the ENERGY STAR Qualified Products List (QPL). Because TV manufacturers were slow to qualify models under the V6.0 specification, which took effect in June 2013, the Initiative continued to qualify models for incentives based on the energy consumption values listed on the V5.3 QPL until the end of 2013.[40] As of January 1, 2014, the Initiative began qualifying models for incentives based solely on the V6.0 QPL. As seen in Figure 29 above, there was a drop in the percent of televisions on display that met the ENERGY STAR specification immediately following the end of the V6.0 grace period.[41] As 2014 progressed, the percent of televisions on display that met ENERGY STAR specifications steadily increased.

[40] Energy Solutions uses the ENERGY STAR QPL to retrieve certain information (such as on-mode power use) needed to confirm whether TV models sold by participating retailers qualified for the NEEA incentive. If a model does not appear on the QPL, then no qualification calculations are performed (as the data needed to calculate qualification is missing) and the model is determined to be ineligible for incentives.

[41] The Evaluation Team used a field from the Energy Solutions TV sales dataset that indicated whether a given model was on the QPL to determine whether the model met ENERGY STAR specifications. Since Energy Solutions was using both V5.3 and V6.0 QPLs during the grace period in the second half of 2013, the Evaluation Team had no way to determine whether models sold in the grace period actually met V6.0. Accordingly, the proportion of models meeting V6.0 specifications during the second half of 2013 is likely inflated and thus the sudden drop in TV models meeting ENERGY STAR specifications in January 2014 is artificial. Instead, this sharp drop likely happened in June 2013 when V6.0 initially took effect.

D.7. MPI #7: States adopt and increase Unit Energy Consumption (UEC) stringency of television standards: Met

The Appliance Standards Awareness Project lists three states that have established energy efficiency standards for TVs: California, Connecticut, and Oregon. California was the first state to establish standards, with its first standard taking effect in 2006. More stringent standards came into effect in California in 2011 and 2013. Oregon and Connecticut's standards both came into effect at the beginning of 2014. The current standards in all three states largely parallel the ENERGY STAR Version 4.0 TV specification.

D.8. MPI #8: DOE adopts and increases UEC stringency of television standards: Not Met

U.S. Department of Energy (DOE) adopted a test procedure for TVs in 2013, but has not adopted any mandatory efficiency standards for TVs.

Appendix E. Detailed ACE Model Review

This appendix provides a detailed summary of Research Into Action's review of ACE Model assumptions. The review focuses on the following three key points:

- What is the current installed base (stock) of televisions?
- How is the installed base (stock) of televisions changing?
- Are the assumptions of the model correct?

E.1. Current Installed Base Estimates

Two assumptions inform NEEA's estimate of the current installed base of TVs in the Northwest: the number of televisions per household, and the number of households with a television. This section reviews each of these assumptions.

E.1.1. Televisions per Household

We recommend using an estimate of an average of 2.1 televisions per household based on data from the Residential Building Stock Assessment (RBSA).[42] Of all available estimates of the number of TVs per household, the RBSA is the most directly focused on the Northwest. RBSA data are also largely consistent with estimates from other regions conducted over the past five years. As RBSA data become less current, NEEA should monitor the findings of other studies that consider whether a TV is plugged in to identify any consistent trends or major changes in the proportion of households with TVs. It may also be beneficial to consider differentiating by household type in calculations based on TVs per household.

The Consumer Electronics Association's (CEA) Annual Household CE Ownership and Market (O&M) Potential study has provided relatively consistent estimates of the number of TVs per household from 2009 to 2013 at about three units per household (see Table 27. The CEA study's estimates are typically somewhat higher than estimates from the Fraunhofer USA Center for Sustainable Energy Systems' CE Usage Survey (also sponsored by CEA), which counts only TVs that were recently plugged in (Fraunhofer 2014). Regional estimates in California and NEEA territory are more consistent with these estimates.

[42] The 2.1 TVs per household figure reflects a weighted average of the number of TVs per household reported for each of the housing types included in the RBSA.

Table 27. TVs per Household

	National[1]				
Year	CE Usage survey	CEA O&M	Nielsen	California	Northwest
2013	2.6	2.9			
2012		2.9		2.5 (CLASS)	
2011		3			2.1 (RBSA)
2010	3.1	3	2.9		
2009	2.4	3	2.9	2.3 (RASS)	2.3 (RECS)[2]

[1] All studies cited in Fraunhofer USA Center for Sustainable Energy Systems. 2014. *Energy Consumption of Consumer Electronics in U.S. Homes in 2013.*

[2] Includes Oregon, Washington, Idaho, Montana, Utah, Wyoming, Alaska, and Hawaii

RBSA data indicate that the number of TVs per household in the Northwest varies by household type, with single family homes having the most TVs on average (2.3), followed by manufactured homes (2.1) and multifamily units (1.5) (Ecotope 2011).

E.1.2. Households with Televisions

In calculating the installed base of televisions, it is important for NEEA to consider whether its estimate of the average number of televisions per household includes households without televisions. If these households are included in the averages, NEEA should base its installed base calculations on the total number of households in the Northwest. According to American Community Survey one-year estimates, in 2013 there were 5,163,133 occupied housing units in NEEA's four-state region.

Multiple studies have found that the proportion of households with TVs has remained relatively high and relatively constant over the past few years, with estimates typically between 96% and 98% (see Table 28).

Table 28. Household Penetration

	National Surveys [a]				
Year	CE Usage Survey	CEA O&M	Nielsen	California	Northwest
2013	96.8%	98.0%	98.0%		
2012		99.0%		98.7% (CLASS)	
2011		96.0%			
2010	99.0%	95.0%	99.1%		
2009	95.8%	99.0%	99.2%	94.1% (RASS)	98.5% (RECS)[b]

[a] All studies cited in Fraunhofer USA Center for Sustainable Energy Systems. 2014. *Energy Consumption of Consumer Electronics in U.S. Homes in 2013.*

[b] Includes Oregon, Washington, Idaho, Montana, Utah, Wyoming, Alaska, and Hawaii

We also compared Nielsen data on the number of TV households in each of the 15 media markets in the Northwest to census data on occupied housing units in the Northwest to estimate the proportion of northwest households with TVs. This approach provided an estimate of 92.9% of Northwest households with TVs. This somewhat smaller estimate relative to the studies listed in Table 28 may reflect inconsistencies between state boundaries and those of media markets.

E.2. Annual Growth of the Installed Base

The ACE Model's estimate of growth in the installed base is based on assumptions about changes to the two key variables that feed the estimate of the size of the current installed base.

E.2.1. Change in Number of Households

Growth in housing stock has been minimal, and varied nationally and regionally over the past few years. However, population growth has been consistent, with about a 1% annual increase in the Northwest each year from 2011 to 2013 (see Table 8). This is consistent with NEEA's estimated annualized percent growth of 1.03% over the long term. Due to the complicated nature of forecasting housing stock, population growth estimates are a reasonably good proxy.

Table 29. Household Growth

	National				Northwest			
Year	**Housing Stock (in Millions**	**Growth in Housing Stock**	**Population (in millions)**	**Growth in population**	**Housing Stock (in Millions**	**Growth in Housing Stock**	**Population (in millions)**	**Growth in population**
2013	116	.28%	316.1	.72%	5.2	.34%	13.4	.99%
2012	116	.85%	313.9	.74%	5.1	.23%	13.3	.94%
2011	115	.37%	311.6	.73%	5.2	-.77%	13.1	.99%

Census Annual Estimates of the Resident Population and ACS

E.2.2. Change in Number of Televisions per Household

The average number of televisions per household appears to have remained stable in recent years. As a result, changes in population are likely the primary contributor to changes in the installed base. Studies do not provide consistent evidence that the number of TVs per household is changing. The CEA Ownership and Market Potential Study is the most consistent source of estimates of TVs per household among the studies reviewed for this memo, with findings available each year from 2009 to 2013. As shown in Table 28, above, the study's estimates of the number of TVs per household remained relatively constant over the 2009 to 2013 period. While other studies showed slight changes in the average number of TVs per household, these changes were not consistent across studies and regions. Thus, the changes may reflect differences in methodology or sampling rather than shifts in the installed base of TVs.

E.3. TV Market Forecasts

The TV Initiative ACE Model assumes a two percent decrease in TV sales annually for 2014-2015, followed by one percent year-over-year growth in total TV sales for 2016-2020. Publicly available market research reports are not sufficiently complete nor targeted to justify changing these assumptions, but new technologies are likely to enter the TV market in the coming years that may impact sales growth. Thus, NEEA should continue to monitor trends in TV sales and adjust assumptions accordingly.

Publicly available reports from market researchers provide contradictory findings regarding TV sales growth in 2014. Research from the Consumer Electronics Association suggests that U.S. TV sales decreased 5% in 2014 below 2013 levels (CEA 2014). In contrast, two other market research groups suggested that TV sales increased in 2014, although publicly available information does not allow for a precise estimate of the extent of growth in the U.S. for the full year. One group reported that global flat panel TV shipments increased 3.3% in Q1 2014 relative to the same period the previous year (Hong 2014a). The other reported a 4% global year-over-year increase in TV shipments in Q3 2014, but stated that shipments had grown less than 1% in the first half of the year (DisplaySearch 2014a). Both reports cited global TV shipment figures, but the second noted that shipment growth in North America contributed to the increases reported for Q3 2014 (DisplaySearch 2014a).

While TV technologies have stabilized over the past few years, analysts expect new technologies to enter the market in the next few years, led by 4K Ultra HD (UHD) technologies. Sales of UHD TVs have grown rapidly, increasing from under 400,000 units per month to more than one million units per month globally in the first three months of 2014. Analysts predict more than 68 million UHD TVs will ship globally by 2018 (Lin and Cavanaugh 2014). Nonetheless, analysts expect adoption of UHD TVs to happen more slowly and be more in line with typical TV replacement cycles than the adoption of HD TVs, which occurred as flat panel TVs were entering the market and many countries were transitioning to digital broadcasting (Gibbs 2015). Overall, analysts expect global TV shipments to increase 12% by 2018(Lin and Cavanaugh 2014). Publicly available market research sources do not provide longer-term projections for U.S. TV market growth specifically.

E.4. Other Key Assumptions

Research Into Action reviewed other assumptions important to NEEA's estimation of energy savings from adoption of efficient TVs.

E.4.1. Replacement Cycle

NEEA's assumption of a 7-year measure life for TVs likely remains valid, although NEEA should monitor changes in measure life as TV technologies shift. NPD DisplaySearch conducts an annual survey of people who have purchased TVs, in part to determine typical replacement cycles. While previous surveys had shown the TV replacement cycle decreasing, the most recent survey showed a somewhat longer replacement cycle, of approximately 8 years (DisplaySearch

2014c). The DisplaySearch study also found that the average age of TVs in homes gradually increased from 2012 to 2014 to just over 5 years (DisplaySearch 2014c).

E.4.2. TV Usage

RBSA estimates of average number of hours TVs were on per day ranged from 5.4 hours to 6.8 hours in 2011, depending on housing type. This is in line with 2014 Nielsen estimates of 5.5 hours on per day, but higher than the average hours on per day estimate from the Fraunhofer CE Usage Survey, which estimated an average of 4.4 hours on per day (Nielsen 2014; Fraunhofer 2014). Based on this range of estimates, NEEA's estimate of 5.2 may be on the low side, but a reasonable estimate for the region.

E.4.3. Proportion of Sales to Commercial End Use

NEEA discounts its Northwest TV sales estimates by 11% to account for TV sales for commercial end use. As discussed in the ACE Model review conducted for TV Initiative MPER #2, market research data may be able to distinguish between TV sales through retail channels and sales to large commercial customers through other channels. However, for TVs sold at retail, market researchers and retailers themselves cannot distinguish between those bought for residential as opposed to commercial use.

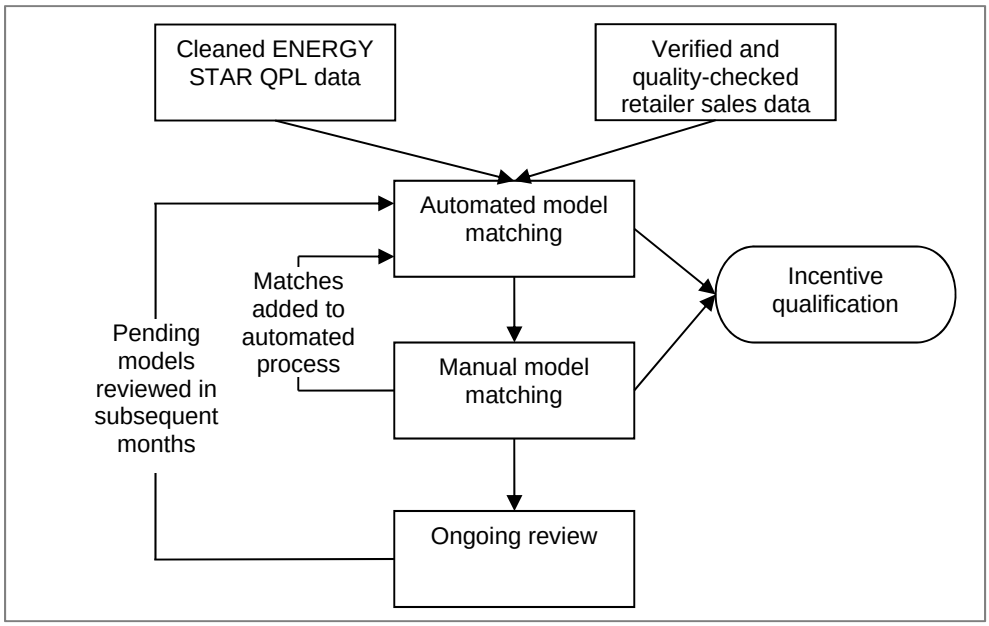
Appendix F. Initiative Data Management Process Review

This memo describes Energy Solutions' process for matching TV models to ENERGY STAR® Qualified Product Lists (QPLs), drawing primarily on an in-depth interview with two members of Energy Solutions staff involved in the process. This memo details: the model matching process in 2013, changes to the program, and sources of uncertainty.

F.1. Model Matching Process

Energy Solutions' model matching process relies on two inputs: ENERGY STAR QPLs, which Energy Solutions staff downloaded quarterly in 2013, and participating retailers' sales data, which the retailers uploaded to Energy Solutions monthly. After receiving the data, Energy Solutions undergoes a multi-step process to identify which models meet the Initiative's incentive levels. Figure 30 summarizes this process and the following sections describe it in detail.

Figure 30. Energy Solutions Model Matching Process



F.1.1. Step 1: ENERGY STAR QPL Data Cleaning

After downloading an ENERGY STAR QPL, Energy Solutions staff would identify duplicate records, ensure that the values on the list were within a reasonable range, the products on the list met the ENERGY STAR specification based on the on-mode power values listed, and identify any records with symbols that would prevent the Energy Solutions database from reading them. Energy Solutions staff would inform EPA Energy Star staff of any inconsistencies in ENERGY STAR data. In the case of duplicate records, Energy Solutions would use the record with the most recent certified date, or whichever record had a higher energy use estimate, if the certification dates were the same. Energy Solutions staff reported that these inconsistencies have

become less common as ENERGY STAR has updated its data reporting systems to include more verification.

F.1.2. Step 2: Sales data Verification and Quality Check

Energy Solutions staff checks the sales data retailers submit to ensure that all the required fields are populated, the formatting is correct, sales are from participating stores within NEEA's territory, and there are no duplicates based on the transaction ID and model number.

F.1.3. Step 3: Automated Model Matching

Energy Solutions attempts to automatically match the models in the retailers' sales data to ENERGY STAR QPLs. Early in the BCE program, Energy Solutions staff worked with TV manufacturers to understand the structure of each manufacturer's model numbers. Based on this research, Energy Solutions allows for some wildcards, differences between upper case and lowercase letters and normalization of hyphens and other symbols in its model matching algorithms. Any models found to meet Initiative criteria based on the automatic matching process are approved for payment.

F.1.4. Step 4: Manual Model Matching

Models that the automated process cannot match to the ENERGY STAR list enter a manual matching queue. Energy Solutions staff seek to match these models by comparing information about the model on retailer websites, manufacturer websites, and the model's Energy Guide label to information on the ENERGY STAR QPL. Once Energy Solutions staff are satisfied a particular model matches the ENERGY STAR QPL, they update the automated matching system so future instances of that model in retailer sales data will match automatically. Energy Solutions staff also document their rationale for concluding that the model reported sold matches the model listed on the ENERGY STAR QPL.

Because this manual model matching process is labor intensive, Energy Solutions prioritizes models with greater sales. In 2013, Energy Solutions came to an agreement with NEEA and other program administrators to set sales of 50 units as a threshold for manually matching a given model. Through this approach, Energy Solutions seeks to match the largest possible volume of units sold.

F.1.5. Step 5: Ongoing Review

Any models not matched to the ENERGY STAR QPL through either the automated or manual process remain in Energy Solutions' database with a status of pending until the end of the program year. Energy Solutions includes these models in its searches each month in case they appear on a future ENERGY STAR QPL. If a model reported in a previous month matches to a subsequent QPL, Energy Solutions authorizes payment of incentives on sales of that model back to the beginning of the program year and updates its reporting. Energy Solutions staff noted that this occurs most often at the beginning of the year, when new TV models may not yet have

completed the ENERGY STAR certification process. Energy Solutions determines that any models not matched to an ENERGY STAR QPL by the end of the program year are not qualified for incentives.

F.2. Challenges in Model Matching

Energy Solutions staff described challenges in the model matching process stemming from both inputs to the process: the model numbers reported in sales data participating retailers submit and the information provided in ENERGY STAR QPLs.

F.2.1. Retailer-Reported Model Numbers

Staff at Navitas, the TV Initiative's implementation contractor responsible for managing retailer and manufacturer relationships, reported that TV manufacturers may assign new model numbers based on very small and superficial differences in products. In addition, Energy Solutions staff noted that retailers may add characters to a TV model number to assist in their own record-keeping. As a result, when the TV Initiative launched in 2009, Energy Solutions was able to automatically match a relatively small percentage (27%) of models. As noted above, however, Energy Solutions has worked to understand manufacturers' model numbering conventions in order to distinguish variations in model numbers that signify superficial changes or retailer-added characters from variations that signify product differences with implications for energy use. This understanding has allowed Energy Solutions to increase its match rate to about 75%.

F.2.2. ENERGY STAR Qualified Product Lists

Through the model matching process, Energy Solutions has identified inconsistencies in ENERGY STAR QPLs. In some cases, these inconsistencies included duplicate records, energy consumption values that were outside the reasonable range, and missing data. In other cases, models that had previously been certified would not appear on subsequent QPLs, or a model's energy consumption data, as listed on the QPL, would change, altering the level of incentives that model qualified for from the Initiative. In these instances, Energy Solutions would both work with NEEA and the other program administrators in the BCE Alliance to determine how the Initiative should proceed with incentive payment and tracking, and work with EPA ENERGY STAR staff to identify the source of the problem.

Energy Solutions staff reported seeking to avoid taking on the role of judging which models on the ENERGY STAR QPL truly qualified and which did not. Thus, Energy Solutions would track and authorize incentives for models that dropped off a QPL or changed Initiative incentive levels based on their status on the most recent QPL. If a model that had dropped off the QPL was listed on a subsequent QPL, Energy Solutions would treat it as a newly qualified model and authorize incentives for sales of that model during the time it had been off the QPL. Consistent with its desire to avoid judging the validity of the ENERGY STAR QPL, Energy Solutions worked with EPA and ENERGY STAR certification bodies to identify the source of inconsistencies and seek to resolve them.

F.2.3. Transition to RPP

From the perspective of program administrators like NEEA, Energy Solutions' model matching system functions the similarly under RPP as it did under the TV Initiative, but has been expanded to multiple products. Energy Solutions staff report they have also enhanced their matching structures slightly. Energy Solutions staff noted that the short product cycle for TVs (models are typically on the market for only one year) makes the model matching process more challenging for TVs than for products with longer product cycles.

F.2.4. Assessment of Model Matching Process

The task of matching TV model numbers reported in retailer sales data to ENERGY STAR QPLs is challenging. To effectively match models, one must determine whether slight differences in model numbers signify meaningful differences in product features. Energy Solutions' approach to this task appears logical given the need to prioritize limited Initiative resources. Given the importance of specialized knowledge of manufacturers' model numbering conventions in the model matching process; we are unable to independently verify the accuracy of Energy Solutions' approach.

Energy Solutions' model matching process does not allow them to positively determine that a product is not ENERGY STAR certified. Instead a product may not match an ENERGY STAR list either because it is not certified or because of some inconsistency in the model numbers that Energy Solutions' process fails to resolve. NEEA staff noted that approximately 20% of the models retailers reported selling do not match to an ENERGY STAR list. This is consistent with the market penetration of ENERGY STAR TVs, which was 84% in 2013 (ENERGY STAR 2014e). While Energy Solutions' model matching process likely misses some qualified models, it is unlikely the process greatly misrepresents qualified sales.

Appendix G. Logic Model Review

This memo summarizes Research Into Action's assessment of the Television Initiative logic model for consistency with other sources of program information and the strength of the causal connections in the model. This review is based on a review of program documents and one in-depth interview with NEEA staff. It focuses on the logic model displayed as Figure 4.2.1 in the Initiative's June 30, 2014 Transition Complete Milestone Document (Appendix A).

As described in greater detail below, our interview and document review indicate that some elements of the Initiative logic model do not accurately reflect the TV Initiative's activities under long term monitoring and tracking. In particular, the Initiative is no longer conducting some of the activities included in the logic model.[43] Our suggested revisions remove these activities and their associated outputs and outcomes from the logic model. We also offer some suggestions to revise existing outputs, outcomes, and causal connections to more accurately reflect the TV Initiative in the long term monitoring phase. Appendix B displays the Initiative logic model reflecting our suggested revisions.

The following sections elaborate on the changes we suggest in each section of the logic model and the rationale for each change.

G.1. Detailed Findings and Recommendations

Below we present detailed recommendations to improve the accuracy of the Initiative logic model. The current logic model includes a number of activities that are no longer being conducted in the long term monitoring stage. As described in Table 30, many logic model activities can be deleted.

[43] In some cases these activities are continuing as part of the Retail Products Portfolio Initiative. Nonetheless, the focus of this review is limited to the TV Initiative logic model, and these activities are no longer part of the TV Initiative

Table 30. Logic Model Activities

Existing Activity	Proposed Activity	Reason
"NEEA partners outside of the organization"	**Delete**	No longer conducted
"Collect TV Sales data, industry trends, specifications, and energy use data"	**Revise** to: "Collect TV Sales Data from Retailers as continuing relationships allow and other information from industry sources"	Further specifies where data is coming from
"Establish annual specifications & incentive amounts with utility partners"	**Delete**	No longer conducted
"Timely engage retailers presenting program for adoption"	**Delete**	No longer conducted
None	**Add:** "Track TV technology trends and their implications for energy use."	Tracking trends in TV technology that could suggest a need for further market intervention are an essential program activity but are not currently included in the logic model

Most outputs should be deleted since the activities that result in these outputs are no longer conducted (Table 31).

Table 31. Logic Model Outputs

Existing Output	Proposed Output	Reason
"Agreement to leverage combined regions and incentives for more EE TVs"	**Delete**	Activities that result in these outputs are no longer conducted
"Opportunity report with savings potential, leverage points, and costs"	**Potentially Revise** to: "Up to date knowledge of market progress and effects of technology shifts"	NEEA will continue to track market progress and technology shifts, but NEEA should update this output if it will use a document other than an Opportunity Report to document the findings from its tracking efforts
"Partner aligned Program proposal for Retailers"	**Delete**	Activities that result in these outputs are no longer conducted
"Agreements with retailers"	**Delete**	Activities that result in these outputs are no longer conducted

As described in Table 32, some short-term outcomes should be deleted since the activities that result in these outputs are no longer conducted.

Table 32. Logic Model Short-Term Outcomes

Existing Short-term Outcome	Proposed Short-term Outcome	Reason
"Retailers agree to purchase/sell qualifying models and provide sales/inventory data – Qualifying TVs sold and sales data provided"	**Delete**	Activities that result in these outcomes are no longer conducted
"Increasingly stringent ENERGY STAR specifications published on a consistent basis – ENERGY STAR specifications push market actors to increase efficiency"	**Revise** to: Increasingly stringent ENERGY STAR specifications published on a consistent basis	"ENERGY STAR specifications push market actors to increase efficiency" is captured in med-term outcomes.
None	**Add: "**Ability to determine success of initiative and whether or not new interventions are needed"	This is an important outcome of data collection activities and a key step if further interventions are needed

Some logic model medium-term outcomes should be altered to reflect goals of long term monitoring phase (Table 33).

Table 33. Logic Model Med-Term Outcomes

Existing Med-term Outcomes	Proposed Med-term Outcomes	Reason
"Year-over-year decrease in annual TV UEC of all sizes &price points sold in the Northwest"	**Delete**	This is the ultimate impact of the Initiative rather than a medium-term outcome.
"Manufacturers include Energy Star specifications in designs"	**Revise** to: "Manufacturers increase number of models that meet ENERGY STAR specifications"	Manufacturers are already including ENERGY STAR specifications; the next step is to continue to increase the number of models that are energy efficient.
None	**Add:** "Implement new interventions (if needed)" – as tentative	Part of the purpose of long term monitoring is to determine whether the market as truly been transformed and no longer needs NEEA's interventions. If this is not the case, NEEA may want to consider whether new interventions should be added.

As described in Table 34, long-term outcomes can be combined to add clarity and reduce clutter.

Table 34. Logic Model Long-Term Outcomes

Existing Long-term Outcomes	Proposed Long-term Outcomes	Reason
State Legislatures set higher UEC Standards	**Combine** with: "Federal Agencies Set Higher UEC Standards"	Removes duplicate ideas
Federal Agencies Set Higher UEC Standards	**Combine** with: "State Legislatures set higher UEC Standards"	

Appendix H. Data Collection Instruments

H.1. Retailer Sustainability Staff IDI

H.1.1. Introduction

Thank you for taking the time to speak with me. As I mentioned when we scheduled the interview, NEEA periodically conducts evaluations of their Initiatives to see how they're impacting the market and how they could be more effective. We're working with them to evaluate their Initiative to promote efficient TVs. [If applicable: This is a similar type of study to the one we were working on when we spoke last year].

At the beginning of this year, NEEA shifted from the TV Initiative to its new Retail Products Portfolio Initiative. In this study we're looking back at the TV Initiative to see what lessons NEEA can bring to its work promoting efficient consumer electronics going forward.

H.1.2. Experience with TV Initiative and RPP

Note: This section gathers data on the retailers' opinions of the TV Initiative by asking them to compare it to RPP. Our focus is on the TV Initiative, however, and probes will seek detail on retailers' experience with the TV Initiative. We ask about the TV Initiative in this context because it may be easier for respondents to describe the TV Initiative in comparison to something else than it would be to describe it on its own.

Q1. Are you participating in the Retail Products Portfolio Initiative with NEEA? *[If not, probe on why not and skip to Q4. If respondent doesn't know, ask if they are continuing to receive incentives from NEEA for sales of efficient TVs. If so, probe on changes to the program in 2014. If not, skip to Q4].*

Q2. How is the RPP different from the TV Initiative, in terms of your interaction with Navitas and the utilities?

Q3. How has your merchant teams' reception of the RPP Initiative compared to their reception of the TV Initiative? Why do you think that is?

Q4. Now I'd like to just focus on the TV Initiative that NEEA ran in partnership with other West Coast utilities from 2009 to the end of 2013. I understand that Navitas would contact you with information about the TV Initiative's qualification criteria and incentive levels and you would pass that information on to your merchant teams. Is that correct?

Q5. How, if at all, did your merchant teams' response to the information you gave them about the TV Initiative change over the years that you participated in the Initiative?

H.1.3. Assortment Decision Making

One aspect of the TV Initiative that NEEA is particularly interested in investigating in this evaluation is the influence of the incentive on merchants' assortment decisions. Again, I'd like you to think back to the period from 2009 to 2013, before the transition to RPP.

Q6. First, I'd like to make sure my understanding of the assortment decision process is correct. Am I correct in thinking that merchants work with manufacturers to gather information on the TV models available for the coming year, and that information becomes an input to an algorithm that predicts what an optimal assortment would be?

Q7. Are there situations in which a merchant would use their own judgment to select one TV model over another, rather than relying on the algorithm?

Q8. [*If Q6= Yes*] In what situations would that occur?

Q9. [*If Q6 = Yes] How frequently does that happen?*

Q10. *How do you think the incentives NEEA offered through the TV Initiative impacted your merchants' assortment decisions? Why do you say that?*

Q11. *What specific instances, if any, are you aware of when the availability of incentives for efficient TVs caused your merchant teams to assort a product they might not have otherwise? [If not:] Looking beyond just assortment decisions, can you tell me about any specific instances that demonstrated to you that the merchant teams were considering TV Initiative incentives in their work?*

H.1.4. Attribution

Now I'd like to ask a little bit about the TV Initiative's impact on your sales of qualified products. This is a key issue for efficiency program administrators like NEEA since they need to report the energy savings they've achieved.

Q12. Between January, 2012 and December, 2013, our NEEA TV Initiative tracking records indicate that [**RETAILER NAME**] had sold [**STORE UNIT QUANTITY SALES OF QUALIFIED TVS**] of televisions that qualified for incentives in Oregon, Washington, Idaho, and Montana. [**READ THIS NEXT FOR NON-BEST BUY ONLY**] This translates to [**PERCENTAGE OF TOTAL TV SALES THAT ARE QUALIFIED TVS**] percent of your total TV sales in the Northwest in 2012 and 2013. Does this sound correct?

Q13. TR1b. [READ FOR BEST BUY ONLY] Approximately what percent of total Northwest television sales does this represent for 2012 and 2013?

Q14. Now please think about the NEEA TV Initiative. If this program was not available, do you think your sales of these **QUALIFIED TVS** would have been about the same, lower, or higher?

Q15. **[ASK IF Q13 = Lower or Higher]** Can you please estimate what you believe your store's sales of **PROGRAM QUALIFIED TVS** would have been in absence of the **NEEA TV Initiative**?

[READ: I want to make sure I understand you correctly. You are saying that [Q11 TOTAL QUALIFIED UNITS] of your company's Northwest TV sales were Program Qualified between January 2012 and December 2013 and that without the NEEA program your QUALIFIED TV sales would have been [Q14], or about [Q11 TOTAL QUALIFIED UNITS – Q14)]] less without program support. Is this correct? [IF NOT CLARIFY ANSWERS]

Q16. [ASK IF Q13 = Same OR Higher]Why do you think sales would have been [Q13 SAME/HIGHER] in absence of the NEEA program?

H.1.5. Promotion

Now I'd like to shift away from talking about assortment decisions to talk a little bit about how you decide which TVs to promote.

Q17. I understand that trade promotions play a role in determining what TV models you promote – manufacturers offer special discounts and pay for special displays and ads. Of all the models you promote, roughly what proportion are you promoting because of trade promotions, and what proportion because of your own business objectives?

Q18. Does the proportion vary by the promotional channel (e.g. in-store displays vs. weekly fliers)?

Q19. What about educating sales associates about the features of specific products – to what extent are those efforts led by manufacturers, as opposed to done internally?

Q20. How does a typical marketing partnership with a manufacturer differ (if at all) from the types of marketing partnerships you've had with NEEA?

Q21. Thinking about your marketing partnerships with manufacturers, what, if anything, could NEEA do that they are not currently doing to more effectively promote energy efficient consumer electronics?

H.1.6. Closing

I just have a few more, general, questions about your experience working with the TV Initiative.

Q22. What lessons have you learned from working with NEEA in the TV Initiative that you would like to see them carry forward into future initiatives, like the RPP?

Q23. Is there anything we haven't covered today that you think I should know about your experience working with the TV Initiative and NEEA?

Q24. As I mentioned, in this study, we're particularly interested in learning about how the TV Initiative influenced assortment decisions. We would like to speak with someone from your merchant teams to hear how they used information about the Initiative from their perspective. Is that possible?

H.2. TV Merchants Survey

H.2.1. Introduction

Thank you for taking the time to answer these questions. Your responses will help us determine how much influence energy efficiency programs like NEEA's have had on sales of efficient TVs. This information is extremely important to NEEA and other program administrators who must demonstrate that their use of ratepayer funds is providing measurable, cost-effective energy savings in order to justify continuing their program efforts.

H.2.2. Assortment Decision Making [ASK ALL]

[ASK ALL]

Q1. From the conversations we've had with retailers in the past, we understand that some retailers use mathematical models to predict an optimal product assortment. Do you use this type of algorithm in selecting your TV assortment?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[IF Q1 = 1. YES]

Q2. Once you have the output of the algorithm, are there occasions when you use your own judgment to choose to include one TV model over another in your assortment, or do you buy the models the algorithm has specified?

[SINGLE RESPONSE]

1. Yes – I use my own judgment to select models
2. No – I purchase the models the algorithm specifies
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable
98. Don't know
99. Refused

[IF Q2 = 1. YES]

Q3. Thinking about all the TV models you assort, about what proportion do you typically select using your own judgment, rather than following the algorithm?

[SINGLE RESPONSE]

1. Enter Percent: [OPEN-ENDED RESPONSE]
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[IF Q1 = 1. YES]

Q4. In 2013, did the algorithm you used to select your TV assortment consider whether a TV model qualified for incentives from energy efficiency programs?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[IF Q1 = 2 (NO) OR IF Q1=98, (DON'T KNOW) OR IF Q4 = 2 (NO)]

Q5. Do you consider whether a TV model qualifies for incentives from energy efficiency programs in your assortment decisions?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[IF Q4 = 1. YES]

Q6. In 2013, [Retailer] assorted a monthly average of [number of models] TV models, [Number qualified] of which qualified for incentives from NEEA. How many more TV models that qualified for incentives from NEEA did you include in your assortment in 2013 than you would have included if the incentives had not been available? If possible, please refer to the purchasing algorithm you used to determine your TV assortment in 2013. If you cannot access the purchasing algorithm, please provide your best estimates.[SINGLE RESPONSE]

1. Enter Number: [OPEN-ENDED RESPONSE]
96. OTHER, PLEASE SPECIFY: [OPEN-ENDED RESPONSE]
97. I AM UNABLE TO PROVIDE THAT INFORMATION, BUT SOMEONE ELSE CAN
98. DON'T KNOW
99. REFUSED

[IF Q5 = 1. YES OR Q6 = 98. DON'T KNOW]

Q7. About how many more TV models that qualified for incentives from energy efficiency programs did you include in your assortment in 2013 than you would have included if the incentives had not been available?

[SINGLE RESPONSE]

1. Enter Number: [OPEN-ENDED RESPONSE]
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. I am unable to provide that information, but someone else can
98. Don't know
99. Refused

[IF Q6 OR Q7 = 97. I AM UNABLE TO PROVIDE…]

Q8. The number of qualified models that remain in your assortment in the absence of program incentives is a crucial piece of information for NEEA to understand the effects of their program. What is the best way for us to reach the person who can provide that information?

[SINGLE RESPONSE]

1. I will forward this survey to them.
2. Please send them a link to the survey directly. (please provide name and email)
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK ALL]

Q9. Between January, 2012 and December, 2013, our NEEA TV tracking records indicate that **[Retailer Name]** had sold **[Unit Quantity Sales of Qualified TVs]** of TVs that qualified for incentives in Oregon, Washington, Idaho, and Montana. If the incentives from NEEA and other utilities in the West had not been available, do you think your sales of these qualified TVs would have been about the same, lower, or higher?

[SINGLE RESPONSE]

1. Higher
2. About the same
3. Lower
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK BEST BUY]

Q10. Approximately what proportion of your total Northwest TV sales does the **[Unit Quantity Sales of Qualified TVs] models you sold in 2012 and 2013 that qualified for incentives from NEEA represent?**

1. [OPEN-ENDED RESPONSE]

[ASK IF Q9= 1. HIGHER OR 3. LOWER OR 96. OTHER]

Q11. Please estimate what you believe your sales of program qualified TVs would have been in the absence of incentives from NEEA and other utilities in the West?

1. [OPEN-ENDED RESPONSE]

[ASK IF Q9= 1. HIGHER OR 3 LOWER]

Q12. Why do you think sales would have been **[Q9 response: Higher OR Lower] in the absence of the program?**

1. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know
99. Refused

Thank you very much for your time.

H.3. Implementer Interview Guide

H.3.1. Introduction

Thank you for taking the time to speak with me. As I mentioned in my [phone call/email], we're working with NEEA to understand what the TV Initiative accomplished and what lessons from the TV Initiative NEEA can take into its future efforts. Before we get started, do you have any questions about our work?

H.3.2. Implementer Role

Q1. How, if at all, did your role in delivering the program change in 2012 and 2013, compared to the first few years of the Initiative?

Q2. What changes did you observe in the way retailers engaged with the Initiative in 2012 and 2013?

Q3. What kinds of questions did retailers ask about the Initiative?

Q4. How, if at all, did retailers' questions change over the course of the Initiative?

Q5. Do you think the Initiative included all of the key retailers in the Northwest? [If not:] Which retailers would you have liked to include?

Q6. What direct contact, if any, have you had with the retailers' merchant teams?

Q7. [If they had contact with merchants:] How did the merchants respond to the information you gave them about the program? What kinds of questions did they ask?

Q8. How, if at all, has retailers' engagement with the Initiative and other utility programs changed since the beginning of 2014, when programs began transitioning to RPP?

H.3.3. Initiative Influence

Q9. In this evaluation, NEEA is very interested in understanding the influence the Initiative had on the TV market. Based on your understanding of the market, to what extent do you think the program increased the proportion of qualified TVs in retailers' assortments? [*Probe to get a sense for the magnitude of the impact – did they add one qualified product, or did they double the proportion in their assortment?] Why do you say that?*

Q10. Based on your understanding, did the Initiative influence retailers' assortment on a national level? How did other programs impact these non-program areas?

Q11. [If Q10=Yes:] Did the Initiative's influence on assortment have an equal impact across the country, or did the Initiative influence assortment to a different extent in the Northwest than other places? What about sales of qualified TVs?

Q12. Can you give me examples of any interactions you've had with retailers that show how they are using the information you give them about qualified models?

Q13. And to what extent do you think the program influenced manufacturers to prioritize efficiency in TV design?

Q14. Can you give me examples of any interactions you've had with manufacturers that show how they are using information about the Initiative?

H.3.4. Closing

I just have a few more general questions about the Initiative.

Q15. What were the key differences between the Initiative and other mid-stream TV programs operating around the country?

Q16. What were the greatest strengths of the Initiative? [*Probe for the elements with the greatest impact on sales and the greatest impact on sales*]

Q17. What do you see as the key areas where the Initiative could have improved? [*Probe for any elements that did not influence retailers*]

Q18. To what extent have those opportunities for improvement been incorporated into the design of NEEA's RPP pilot?

Q19. Those are all the questions I have. Is there anything we haven't discussed that you would like to share with NEEA about the TV Initiative?

H.4. ENERGY STAR Representative IDI

Q1. How did NEEA contribute to the most recent spec revision? What value did EPA get from their participation?

Q2. How, if at all, do you think the spec might have been different if NEEA had not participated? Is there anything it would or would not have included?

Q3. Have you noticed a change in the way NEEA has engaged with ENERGY STAR? If so, how have they changed?

Q4. Have you noticed a change in the way other stakeholders (retailers, manufacturers) have engaged with the ENERGY STAR process? If so, how has it changed?

Q5. How do you anticipate TV energy use and energy efficiency will change as UHD comes on the market?

Q6. What about OLED, will that bring about a reduction in energy use? Why or why not?

Q7. Anything else to add?