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Room Air Conditioners: ENERGY STAR Most Efficient Influence Evaluation and Baseline Assumptions Review

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BACKGROUND AND OBJECTIVES

On behalf of the Northwest Energy Efficiency Alliance (NEEA), TRC conducted the *Room Air Conditioners (ACs): ENERGY STAR® Most Efficient (ESME) Development Evaluation and Baseline Assumptions Review*. As part of its work to advance the efficiency of consumer goods, NEEA engages with the U.S. Environmental Protection Agency (EPA) on the development and revision of ENERGY STAR® product specifications. After specification development or revision processes, NEEA conducts third-party evaluations to assess the effectiveness of NEEA and other energy efficiency organizations' efforts to influence the specification and support NEEA's work to incorporate specification revisions into its naturally occurring baseline forecasts, where the baseline refers to the hypothetical market adoption of the product in the absence of the efficiency organizations' involvement.

The objectives of the room AC's evaluation were to:

1. Review NEEA and other organizations' (Pacific Gas and Electric Company [PG&E], Sacramento Municipal Utility District [SMUD], Energy Solutions, and Con Edison; collectively referred to as "efficiency organizations" in this report)[1] contributions to the room ACs' ENERGY STAR Most Efficient (ESME) specification development. Specifically, this review answered the following questions:
    - Did the efficiency organizations influence ENERGY STAR's development of a Most Efficient specification for room ACs through activities including comments to the EPA?
    - If so, in what ways did the efficiency organizations influence the development of the specification?
2. Answer the following questions regarding NEEA's Natural Market Baseline assumptions:
    - Would market adoption of sales meeting the ESME efficiency level continue to be slow/flat without the ESME specification? If not, what would the adoption rate have been?
    - When would that ESME specification have been developed without NEEA and the ENERGY STAR Retail Products Platform (ESRPP) program, particularly through supporting the Emerging Tech Award and work with Midea (a major manufacturer of room AC)?

Based on investigations of the research questions above, TRC provides the following outcomes through this study:

- A qualitative assessment of the efficiency organizations' influence on the U.S. EPA's development of the ESME specification
- Quantitative recommendations for how the specification update is reflected in NEEA's baseline market forecast

METHODOLOGY

This section provides an overview of the data collection activities and analysis methodology for this evaluation.

[1] Some of the organizations we refer to as efficiency organizations are utilities that were promoting energy efficiency for this effort.

Data Collection

To collect data for this evaluation, TRC:

- Reviewed literature, and
- Gathered feedback from stakeholders, primarily through phone interviews.

For the first objective (reviewing the efficiency organizations' influence on the 2020 EMSE specification update), TRC's literature review included:

- Documents from the efficiency organizations.
- Written public comments submitted by the efficiency organizations to EPA in response to the specification drafts.
- Comments from other entities involved in the process, such as manufacturers, to understand how the efficiency organizations fit into the broader specification development process.
- Publicly-available ENERGY STAR slides, notes from public meetings on the specification development, and the final ESME criteria memo, accessible through the ESME 2020 criteria development document repository2.

For the second objective (reviewing NEEA's Natural Market Baseline assumptions), TRC's analysis included reviewing:

- Documents from NEEA.
- 2015 to 2020 market share program data reflective of room AC products meeting ENERGY STAR Version 4 and ESME program efficiency tiers.

TRC conducted phone interviews with staff at various organizations that were active in the ESME specification development process or are manufacturers of room ACs. The primary focus of the interviews was to understand the efficiency organizations' influence on the specification development, but TRC also asked questions to inform its review of NEEA's assumptions for the market baseline.

TRC identified key stakeholders involved in the ESME specification development based on literature review and input from NEEA. Figure 1 below summarizes the interviews completed.

[2] 2020 ESME Criteria Development Document Repository

Figure 1. Number of Completed Interviews by Stakeholder Category

Stakeholder Category	Number of Interviews Completed
NEEA	2[3]
Other efficiency organizations	1
Manufacturers	1
U.S. EPA staff	1
Total	**5**

ESME Specification Influence

Using findings from the literature review and interviews, TRC developed a qualitative assessment of the efficiency organizations' influence on the ESME specification development. The interviews were designed to address gaps remaining after the literature review and confirm the findings of the literature review. TRC noted the efficiency organizations' activities in each step of the specification development process, along with the role of other stakeholders to accurately assess the efficiency organizations' influence. The interviews also requested that stakeholders hypothesize a scenario where the efficiency organizations did not participate in the ESME specification development at all (the counterfactual), as another way of assessing the influence the efficiency organizations had on the ESME Specification.

Market Baseline Review Results

Based on the literature review and stakeholder interviews, TRC developed a projected baseline forecast of estimated market growth for ESME-qualifying room ACs in absence of the ESME program in years 2021 to 2030.

ESME Specification Influence Results

This section summarizes the influence that the efficiency organizations had on the room AC ESME specification development process.

Background

ESME Specification Development Process

According to the EPA website, the EPA publishes ESME criteria each year, which may include new products and updated specifications compared to the previous year. ENERGY STAR also has an Emerging Technology Award (ETA), which the EPA designed to highlight innovative technologies that may not have much market penetration. As product categories with an ETA become more common, these products typically transition to ENERGY STAR specification development. The EPA relies on industry stakeholders, including manufacturers and efficiency

[3] In addition to these stakeholder interviews, TRC had multiple meetings with NEEA to understand NEEA's involvement in the ESME specification revision and to understand their forecasted baseline calculations.

organizations, to help develop and maintain ENERGY STAR specifications. Through its ENERGY STAR program, the EPA hosts a transparent process in which stakeholders participate through written comments, webinars, and continued engagement.[4]

Emerging Technology Award

During 2018 to 2019 the EPA presented LG Electronics with the ENERGY STAR ETA, which recognized room AC products with efficient variable output (EVO) capability as an efficiency technology in the room AC market. This designation resulted from new testing methodologies, developed and refined through collaboration between the EPA, U.S. Department of Energy (DOE), and LG Electronics that were required to accurately characterize variable speed compressor performance and the corresponding efficiency metric, Combined Energy Efficiency Ratio (CEER). The performance criteria that were developed characterized products that outperform the DOE federal minimum CEER. This same criterion was then later utilized in the ESME program for room ACs, after thorough review and stakeholder engagement and feedback.

Overview of Influence

Figure 2 below summarizes the role of the efficiency organizations and their associated outcomes related to technical specification.

Figure 2. Outcome of the Efficiency Organizations' Activities in Technical Specification Development

Area of Efficiency Organizations' Influence	Increase energy savings	Increase ENERGY STAR market penetration
ESME specification development and timing	✓	
Manufacturer participation in ESME		✓

Detailed Findings of Influence

This section describes in detail the influence the efficiency organizations had on the three primary areas of influence shown above in Figure 2.

ESME Specification Development and Timing

During the period that the 2018 to 2019 ETA was awarded, NEEA, along with PG&E, submitted a 2018 comment letter[5] to the EPA advocating for the adoption of EVO room ACs into the ESME program. The EPA incorporated room ACs into the 2020 ESME program year[6]. Since the inclusion of room ACs in the ESME program, NEEA, PG&E, and SMUD have recommended including connected criteria[7] and refrigerant reporting requirements in the room

[4] As described by the U.S EPA, in ENERGY STAR Product Specification Development Process

[5] 2018-2019 Comment letter

[6] 2020 Room AC Memo

[7] Connected criteria refer to network connectivity capabilities that enable products to maximize energy savings opportunities and provide grid benefits. Refer to: ENERGY STAR Connected Criteria Overview

ACs ESME specification through 2020[8] and 2021[9] comment letters. Though the EPA did not include these requirements in the 2020 specification for Room ACs, the EPA did include the following requirements: energy consumption reporting, operational status reporting, remote management, and demand response capabilities. The cooperative effort by the efficiency organizations helped drive the ESME program and namely, the inclusion of room ACs ESME two years after the ETA award.

PG&E and SMUD helped to substantiate the need for a higher efficiency tier ESME program through analyzing customer market share data. Their analysis identified that existing lower-tier efficiency (Version 4) ENERGY STAR room ACs' market share had reached saturation, which indicated a need beyond this efficiency tier to promote higher efficiency room ACs products. The efficiency organizations collaborated with the EPA to review the ESME efficiency requirements, which the EPA set to be the same as the ETA efficiency specifications. The energy efficiency organizations also reviewed and provided comments on the documentation manufacturers would be required to submit to the ESME program operators to get ESME labeling.

In summary, through their written comments and partnerships with various stakeholders, and recognizing that the ETA set the precedent for the ESME, **NEEA and other organizations played a supporting role in influencing the ESME program and specification development.**

Manufacturer Participation in ESME

During stakeholder interviews, the manufacturer of EVO room ACs interviewed noted that the efficiency organizations did not directly influence manufacturers to develop ESME-qualifying products, given that their organization already had EVO room ACs during the ETA program. However, the manufacturer did note that for them, the efficiency organizations are a critical link between the utilities, efficiency program operators, and manufacturers in understanding where the limits to their technology (both lower and upper operational thresholds) should be. The manufacturer views the efficiency organizations as valuable partners that maintain the channels of communication from the industry to utilities and program operators (EPA). They also highlight the efficiency organizations' role in determining how many manufacturers were coming to market with this technology and would be viable candidates to include as partners for ESME. In addition, one stakeholder noted the efficiency organizations as a knowledgeable catalysts for the ESME room AC program's continued evolution and overall "program health". The stakeholder views the efficiency organizations as having a direct influence on ESME program development and operation, based on their ability to keep clear channels of communication between multiple parties and stakeholders, while effectively shepherding the program into the next step of any programmatic process needs. During stakeholder interviews, an early manufacturer of EVO room AC products indicated that their engagement with the efficiency organizations would have been deeper if they had a relationship at the start of their EVO room AC product development efforts.

In summary, **NEEA and other efficiency organizations did not directly influence manufacturers to develop ESME-qualifying products. However, stakeholders see them as having a direct influence on ESME program health and development based on their ability to keep clear channels of communication between multiple parties and stakeholders, while effectively shepherding the program into the next step of any programmatic process needs.**

[8] 2020 Comment Letter

[9] 2021 Comment Letter

MARKET BASELINE REVIEW RESULTS

Market Adoption Without ESME Specification

Overall, TRC estimated that market penetration of ESME-qualified units with capacity greater than 8,000 Btu/hour would continue at its current trajectory—which is low and increasing slowly—in the absence of ESME. While this is difficult to predict, there are several pieces of evidence supporting this baseline, as shown in Figure 3 on the next page. This is primarily based on input from the interviewees, as described below.

When asked how the market share growth would be impacted in the absence of ESME room AC development, the manufacturer speculated that market share for ESME-qualifying products might be about the same as its current trajectory. This speculation was based on their organization and other large manufacturers representing the larger players in the market and already pursuing EVO room ACs before the ETA and ESME programs. [10] They noted that most room AC sales are for the smaller capacity units (5,000 – 6,000 Btu/hour), with sales typically driven by customers selecting the cheapest or most cost-effective product for their needs.[11] This manufacturer did acknowledge that the inclusion of room ACs in the ESME program likely does help educate and incentivize consumers to choose more efficient units. The program then helps drive more EVO room AC sales than simply having a number on an Energy Guide for the non-technical consumers to make a purchase decision.

Another interviewee noted that it was difficult to say what would have happened without ESME, reporting that manufacturers are more likely to maintain the status quo, unless there is a reason to change via some combination of code requirements, approved DOE testing, or programs. The interviewee noted that sales of room ACs spiked this year because of extreme weather conditions and guessed that energy bills were very high this past summer. The interviewee speculated that perhaps the lived experience of hot indoor environments, health concerns, and high utility bills are enough to transform the market. They noted that in the absence of the ESME, it was doubtful that high-efficient units would be adopted nearly as fast.

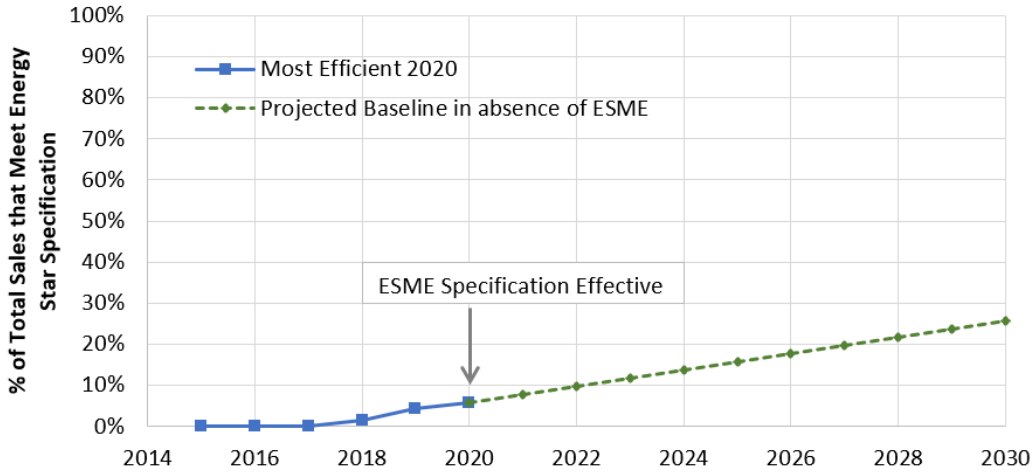
A third interviewee echoed what the second interviewee said regarding manufacturers maintaining the status quo unless there was a reason to change. This interviewee also highlighted that what matters most to customers is the price point.

Based on the responses, TRC developed an approximation of how a slow adoption scenario might look in the absence of the ESME room AC specification development. Figure 3 below reflects this approximation based on a regression applied to ESME-qualifying product market share data of units with capacity greater than 8,000 Btu/hour from 2017 to 2020. Note that market share percentages for ESME qualifying products only existed for 2018 to 2020. We included the ESME-certified sales in 2020 as part of the baseline, because we assume that there would be a one-year lag before the ESME specification starts influencing the market. **TRC estimates that without the ESME program, the percentage of total room AC sales that meet the ESME specification would go from 6 percent to 26 percent from 2020 to 2030. TRC estimates that the market growth in the absence of ESME room AC specification development would be the same with or without the efficiency organizations' influence.**

[10] For market context, there are currently 18 room AC products labeled with ESME from six different manufacturers. The majority of ESME-certified room AC's have cooling capacities less than 14,000 Btu/hour. LG Electronics accounts for all of the currently listed room ACs greater than 14,000 Btu/hour. ESME 2021 Room AC Product List. Accessed December 6, 2021

[11] While the study focuses on medium and large capacity units, the same findings should apply as the smaller capacity units because cost is still number one concern. Interviewees agreed that cost is typically most customers' primary concern.

Figure 3: Historical and Projected market growth in the absence of ESME Room AC Development.



EMSE Specification Inclusion of Room ACs and Timeline

In determining a timeline for which ESME specification would have been developed without NEEA and ESRPP, TRC focused first on the EPA's ETA recognition to LG Electronics for their EVO room ACs. The program runs for no more than two years before the EPA typically transitions a product to the ENERGY STAR or ESME tier. Therefore, with the early work and precedent set by the EVO room ACs ETA process, EPA would likely have included room ACs in the ESME specification within two years of the ETA recognition. In summary, **it is likely that the ESME specification for room ACs would have been effective in 2020 with or without NEEA and ESRPP.**

LIMITATIONS

TRC noted several limitations with this evaluation.

TRC notes that given our small sample sizes, our interview results are anecdotal. For example, TRC spoke with one manufacturer that had engaged with NEEA and is responsible for a large share of EVO room ACs products in the market. However, there are only a few large manufacturers in this space. Also, a few interviewees provided partial responses to a few questions, either because their predecessor was involved (who did not transfer knowledge) or because they had difficulty recalling specific organizational roles, interactions, and timelines from two to three years ago.

Despite these limitations, TRC notes that we were able to develop a good understanding of the efficiency organizations' influence on the ESME specification and baseline assumptions. TRC was able to gather sufficient information to provide an informative evaluation based on stakeholder interviews and their perception of the efficiency organizations' influence on this program. Lastly, from the information gathered in the interviews paired with the literature review, TRC was able to effectively provide quantitative recommendations for how the specification development is reflected in NEEA's baseline market forecast.

CONCLUSIONS

TRC's evaluation indicates that NEEA and other efficiency organizations had a supporting role in the ESME specification development, particularly with regard to the ESME specification development process, timing, and manufacturer participation in ESME. During interviews, stakeholders highlighted the efficiency organizations' joint

comment letter submissions over the last three years as an important influence on the ESME program timing and specification development. In regard to influence on manufacturers, the efficiency organizations did not directly influence manufacturers to develop ESME-qualifying products or the efficiency specification development. However, the efficiency organizations are seen as influencing the health and development of the broader ESME program. This is based on the efficiency organizations' ability to keep clear channels of communication between multiple parties and stakeholders, while effectively shepherding the program into the next step of any programmatic process needs.

TRC's evaluation suggests that in the absence of the ESME program, adoption of higher tier efficiency room ACs would likely follow the same gradual growth for the next ten years as seen in the past two years. Specifically, TRC estimates the percentage of total room AC sales that meet the ESME specification would go from 6% to 26% from 2020 to 2030. TRC estimates that the market growth or room ACs that meet the ESME specification in the absence of ESME room AC specification development would be the same with or without the efficiency organizations' involvement.