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2025 Heat Pump Water Heater Baseline and Key Assumption Review

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Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) engaged Larson Energy Research (LER) to review the 2025 version of its Heat Pump Water Heater Benefit-Cost Model. The review focused on these specific components of the Model:

- Allocation of unit sales within the new construction market
- The use of Retail Product Portfolio (RPP) data in the estimation of retail unit sales
- The counterfactual baseline used to compare realized savings relative to those attributable to federal standards

LER found the choices made in the Model's design and selection of inputs are reasonably supported by the available data. LER recommends maintaining most of the Model in its present form with a few updates. The recommendations are intended to make use of the latest data where available and simplify the model where conclusive data are not available.

Key Findings

New Construction Market

When considering/reviewing new construction homes data in Idaho and Montana, LER has low confidence in the accuracy of the method NEEA is using to estimate the number of HPWHs being installed. However, the data sources needed to produce a more accurate estimate are not available. Further, this particular value has a small effect on the Model as a whole. Idaho and Montana make up a small portion of the four-state electric water heating market, and any new construction units undercounted/overcounted in this estimate are eventually balanced out in the four-state retrofit/existing construction numbers.

LER also found the method used to estimate HPWHs installed in new construction homes in Oregon and Washington significantly undercounts the actual number. The formula currently used in the Model excludes HPWHs in non-code-compliant homes from the new construction totals. Code evaluation studies find a substantial number of HPWHs in non-code-compliant new construction homes. Further, the latest code evaluation study NEEA conducted for Washington shows higher shares of electric water heating, broadly, and HPWH, specifically, in new construction homes than is currently reflected in the Model. LER recommends not using code

compliance factor in the method for estimating HPWHs in new construction homes in Oregon and Washington.

Retail Products Portfolio Data

LER recommends continuing the use of RPP data as the primary source of retail HPWH unit sales for use in the Model. The LER team recognizes that there are likely some retail sales not captured in the RPP data but believe the number is too small to warrant a correction or to have a meaningful effect on the Model overall. Any attempt to adjust the retail unit estimate is likely to require significant effort to produce only a small result, and there would be low confidence that the adjustment improves accuracy.

Counterfactual Baseline

LER also reviewed the original counterfactual baseline that NEEA developed in 2014 (Evergreen Economics, 2014). LER concluded this baseline, constructed from the results of a Delphi panel, grossly overestimated HPWH adoption rate. Indeed, the forecasted baseline has exceeded total actual market sales. LER recommends revising the counterfactual baseline unit sales assumptions or implementing a new baseline derived from national market data.

Introduction

The Northwest Energy Efficiency Alliance (NEEA) periodically engages outside parties to perform independent reviews of aspects of its HPWH (Heat Pump Water Heater) Benefit-Cost Model ("the Model"). Broadly, the Model uses data, assumptions, and estimates from a wide variety of sources to estimate how much energy has been saved within the Northwest Region (Idaho, Montana, Oregon, and Washington) through the adoption of HPWHs. The outputs of the Model are important indicators of the state of the domestic water heating market and NEEA's effect on it. These external reviews help ensure that the Model produces reasonable and useful estimates.

In 2025, NEEA revised its approach in the Model to more appropriately account for savings related to HPWHs in residential new construction by creating new tracking categories to split savings for HPWH sales through the new construction market channel across Idaho, Montana, Oregon and Washington (the "Northwest Region"). The updates were designed to enable NEEA to better categorize HPWH savings that are not already being reported at a state level through residential new construction programs. NEEA engaged Larson Energy Research (LER) to review the 2025 version of its Heat Pump Water Heater Benefit-Cost Model.

The review focused on these specific components of the Model:

- Allocation of unit sales within the new construction market
- The use of data collected through NEEA's Retail Product Portfolio (RPP) program in the estimation of retail unit sales
- The counterfactual baseline used to compare realized savings relative to those attributable to federal standards

Model Review and Recommendations

New Construction (NC) Allocation Methodology

A fundamental function of the Model is to identify how many of the total HPWHs installed in new construction (NC) are installed in each submarket (Oregon, Washington, Idaho/Montana). The Model makes an estimate using two different methods, one used for Idaho/Montana and another used for Oregon and Washington due to the availability of data for these markets. Oregon and Washington estimates are each calculated separately, using data on the number of new homes built and findings about water heating fuel and water heater type from NEEA-conducted code evaluation studies. For Idaho and Montana, an estimate is made for both states combined using utility program data. These three estimates are then divided into products (tanks less than or equal to 55-gal and tanks over 55-gal) and tiers based on key assumptions determined in other areas of the Model. Tiers are representative of efficiency tiers outlined in NEEA's Advanced Water Heating Specification (AWHS) (Northwest Energy Efficiency Alliance, 2025). Each tier level, numbered 1 through 5, is designed to deliver products with increasing energy savings.

The estimate of NC units is also integral to the estimate of retrofit/existing construction units: the latter is the difference between total HPWH unit sales and the sum of NC unit estimates. As a result, any underestimate of NC units increases the estimate of retrofit units.

Oregon and Washington – Code Evaluation Studies

In the Oregon and Washington markets, the Model relies on inputs from code evaluation studies to estimate the number of NC code homes with HPWHs. The Model starts from the number of NC code homes in each state and multiplies it by three different values from the studies:

- Share of code homes with electric water heating
- Share of code homes with electric water heating that have HPWH
- Code Compliance Factor

The most recent code compliance evaluations conducted for Oregon and Washington suggest that the Model significantly underestimates the number of HPWHs in NC (Industrial Economics,

Inc. & Resource Refocus LLC, 2025b and TRC, 2023a). For 2025, an improved estimate would increase the total by 6,646 units (from a current estimate of 15,976), or 41.6%.[1]

Share of Homes with Electric Water Heating

The code evaluation studies found that 50.4% of Oregon homes and 89% of Washington homes have electric water heating. The corresponding value in the Model for Oregon matches (50.4%). For Washington, the Model has a value of 83%. This number matches an older study, Washington Residential Post-Code Market Research (TRC, 2023b).

LER recommends updating the Washington number in the Model to 89%.

Share of Electric Water Heating Homes with HPWH

The Oregon study found that 40.7% of homes have HPWHs. If 50.4% of homes use electric water heating, it follows that 80.8% of homes with electric water heating have HPWHs. The corresponding value in the Model is 80.7%. The difference of 0.1% could be due to rounding and, therefore, LER leaves it to NEEA's discretion to change or not.

The Washington study found that 100% of homes with electric water heating had HPWHs (TRC, 2023a, pp. 3, 32-33, 44-45). The Model has a value of 93%. Like the electric fuel share number, this matches the older study.

LER recommends updating the Washington number in the Model to 100%.

Code Compliance Factor

The Oregon code evaluation study found that 91.4% of homes met code, and this is accurately reflected in the Model. However, the findings related to water heating fuel and water heater type apply to both homes that meet code and those that do not. As defined in the Oregon code evaluation study, the compliance factor (rate) is a measure of the modeled proportion of homes that use as much energy as (or less than) a home that exactly meets code. The report lists reasons for non-compliance including envelope tightness; window, wall, and ceiling U-factor; foundation insulation; and duct location as the largest reasons for a less than 100% compliance rate. None of these building components have anything to do with the number of HPWHs installed in new construction or how the HPWH operates.

[1] The significant digits used throughout the report vary because the authors elected to match the exact values in use in the Model, or in the cited material, to enable future analysts to accurately cross-reference the values

The Washington code evaluation study found 76% of homes met code using a "checklist" approach (that is, homes were only counted as compliant if every element of the home met code). The reasons for non-compliance in Washington were found to be similar to Oregon. As with Oregon, the compliance factor is accurately reflected in the Model, but its use at all does not appear to be appropriate given the water heater fuel and type findings are independent of code compliance.

LER understands that, in the past, information about the presence of HPWHs in non-code compliant NC homes was unavailable. Using the code compliance factor was then an important tool to avoid making assumptions about HPWH installation rates in non-code compliant homes and ensure savings were allocated to the appropriate programs.

In the Model, the number of HPWHs in NC is the sum of HPWHs in "Code Homes" and "Above-Code Homes." There does not appear to be a mechanism to account for HPWHs in non-compliant homes. Any of the total HPWH units not attributed to NC are assumed to be retrofit/existing-construction units. Essentially, using the code compliance factor in the estimation of HPWHs in NC code homes shifts the HPWHs in non-code compliant homes into the estimate of retrofit HPWHs units. Given the data available from the most recent code evaluation studies, allocating HPWHs in non-code compliant NC homes to the retrofit unit count no longer seems appropriate.

LER recommends not using code compliance factor in the method for estimating HPWHs in NC.

Idaho and Montana – Utility Program Data

To estimate the number of HPWHs installed in NC homes in the Idaho/Montana market, the Model assumes the number to be equal to the number of incented HPWHs reported to NEEA by utility partners. For 2024, this approach results in an estimate of two.

Based on the results of the method currently applied to Idaho/Montana, LER is certain it undercounts the number of NC HPWHs. LER is unable to say whether this is because NEEA's reporting partners do not sufficiently cover the market, because partners are not reporting full numbers, due to other factors, or some combination.

Accurately capturing the total number of incented HPWHs, however, might result in an *over*count of NC units, as incentives are available for HPWHs for retrofit installations as well. To be useful, the reported numbers would need to be split between new and existing homes.

LER does not believe the current approach is accurate but is not aware of sources for the data necessary to adopt a more accurate approach. To improve the estimate of NC HPWHs in

Idaho/Montana, LER recommends NEEA collect data on water heater type in a future code evaluation study or from some other source and then adopt the same approach used in Oregon and Washington. Another alternative is described in *Cost Benefit Model Analysis for Heat Pump Water Heaters* (Larson Energy Research, 2023, pp. 6-7).

Until other data are available, continuing to use the current approach is a reasonable option. There would be low confidence that any change is an improvement. LER notes the Idaho/Montana market is a small portion of NEEA's total region. Further, the same savings rates are used for both NC and retrofit HPWHs in these states. Because it would have a fairly small effect on the Model in whole, it may be undesirable to expend effort on changing this aspect of it without greater confidence that it improves accuracy.

Estimation Methodology for Retail Unit Sales

The Model uses data from NEEA's Retail Product Portfolio (RPP) program to estimate the number of HPWHs sold at retail. LER understands these data consist of reported unit sales from the two retailers with the highest volume of HPWH sales in the Northwest Region.

While the RPP data are unlikely to capture all retail sales in the region, LER reasons that other sales make up an insignificant fraction of the market. No other brick-and-mortar retailers in the region are known to stock HPWHs. Any retail sales outside of RPP would be "outlier" transactions rather than a regular line of business, with possibilities such as:

- Out-of-state (online) retailers with direct delivery of HPWHs
- Hardware stores that might special order a HPWH upon request
- Businesses that operate predominantly on wholesale but make occasional retail sales
- Sales made by RPP retail partners not included in numbers reported through programs

The number of HPWHs sold in the first three ways is likely too small for any data on them to be reliably representative of the whole market, or to have a meaningful effect on the Model's outputs.

In the fourth case, NEEA has identified two causes of potential concern. First, one HPWH manufacturer provides data on the number of HPWHs shipped to retail outlets, and those numbers do not align with the RPP data from the retailer known to be that manufacturer's exclusive retail outlet in the Northwest. On its own, this apparent discrepancy does not indicate errors in the data: the difference between units a store receives and the units it sells in a given period (that is, its inventory) can explain significant differences between shipments and sales.

Second, NEEA is aware that one of the retail partners divides their sales of HPWHs into two different sales channels and likely only reports units sold through one of the channels to the RPP program. LER is not aware of any available data source for the other channel or any data that would inform an adjustment of the reported data to reflect the total of the two channels. For the present, LER recommends using the numbers as provided, as there is no support for an adjustment which would confidently be an improvement. LER encourages NEEA to continue to develop relationships with its RPP partners to improve the usefulness of the data collected through the program.

LER is not aware of alternative sources of data on retail HPWH sales that would be applicable to the Model.

LER recommends continuing to use RPP data as the sole source of retail sales data and treating it as the entire retail market. It is both the best and the most reliable data source for retail sales available. It is the most comprehensive data set on retail HPWH sales in the Northwest and therefore the most appropriate one to use in the Model.

Counterfactual Baseline Assumptions

A key assumption to the Model is the baseline unit sales amount. This baseline is defined as the sales that would have happened without NEEA's involvement in the market (a counterfactual baseline). The baseline was originally established in 2014 with a Delphi panel (Evergreen Economics, 2014). The report forecasted baseline unit sales each year from 2009 to 2042. Since the original forecast, NEEA has made two significant adjustments and two adaptations.

Adjustments Assessment

The first baseline adjustment, conducted in 2014, revised downward the forecast for that year because the baseline forecast exceeded the total number of units sold (since, plainly, the forecast was incorrect) (Steinhoff, 2014). The second adjustment, made in 2017, was to remove the increase in HPWH sales that had been predicted to result from the 2015 federal standard on large (>55-gal) tanks. When that standard went into effect, the market provided many "workarounds" to the broad adoption of heat pumps for larger water heaters and little of the expected conversion was realized (Cadmus, 2017a).

Using data from the Model, Figure 1 graphs the original Delphi forecast baseline, the baseline in use in the 2025 version of the Model (this includes the two adjustments), and actual unit sales (through 2024) or projected sales (beyond 2025). Most telling of the original overestimate, the

graph shows the Delphi forecast baseline has always exceeded actual unit sales, often by two or three times. Because the actual unit sales, by definition, include the effects of NEEA's impact on the market, the original forecast, exceeding all sales, cannot be an accurate counterfactual baseline. LER reviewed the Delphi panel project report and found only one of nine panelists forecasted sales below actual sales. Next, in discussions with the NEEA project team, LER learned that experienced NEEA staff were surprised, in 2014, when they learned how large the baseline forecast was (conversation with NEEA program team 8 January 2026). Clearly, the panelists were too optimistic about adoption.

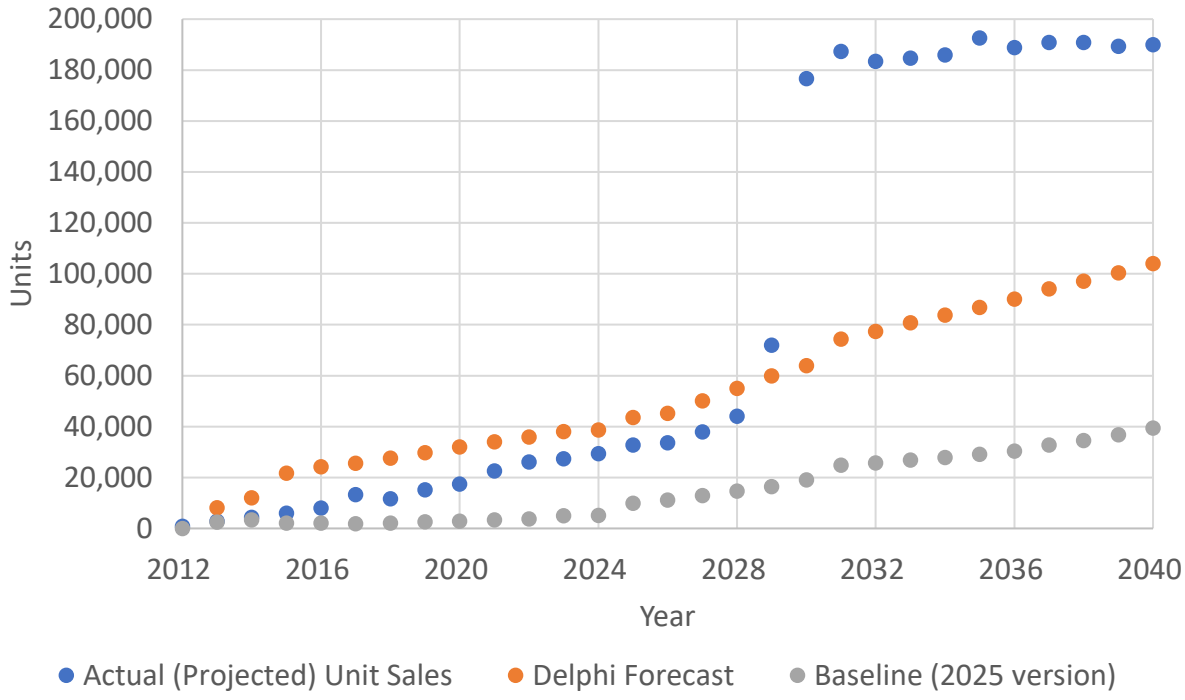

FIGURE 1. UNIT SALES COMPARED

The baseline in use today is still tied to the original Delphi forecast. It has been made plausible in the face of a contradictory reality through significant, but proportional, reductions of that original forecast. Little evidence from the years following the original forecast supports the year-to-year variations in HPWH sales growth it predicted. Given that actual sales have born little resemblance to the original forecast – in either value or proportion – it may be preferable to adopt a new baseline rather than making additional adjustments to the current baseline.

Considering the recurring findings in market progress evaluation reports, including the most recent, of installer reluctance to recommend or install HPWHs, it appears the naturally occurring adoption of HPWHs would be very low absent NEEA and its partners' intervention in the market

(NMR Group 2023 pp 2-4), which have significantly moved the market. Without them it is likely that both past and future sales would be minimal.

LER considered four approaches to establishing a new counterfactual baseline and ultimately recommends using one derived from national HPWH market share.

Recommended New Baseline Approach: National HPWH Market Share

LER suggests examining the national HPWH market share and using a variation of it for NEEA's market. National HPWH data is reported through ENERGY STAR®, and total water heater sales are available through the Air-Conditioning, Heating, and Refrigeration Institute (AHRI). NEEA must adjust the national market sales data, however, because they contain the impacts of incentive programs like those in Maine, California, the Northwest, and others. LER suggests halving the national market share to account for incentive influence. Using the full national market sales saturation is certainly too high due to the aforementioned incentive programs. The recommendation to use one-half is, at best, a simplistic one, but gets closer to a more accurate estimate. In LER's estimation, it is still likely that incentives and code activities account for more than half the national market sales. Therefore, the one-half adjustment value is likely to be conservative, and a one-third or one-fourth adjustment could easily be more accurate. There is simply not data against which to evaluate it, however.

To illustrate this approach, LER created an initial, rough approximation of the result, shown in Figure 2 as "Half National". This is compared to the in-use baseline (2025 version), actual (or projected) unit sales as estimated in the Model, and the original Delphi forecast. Through 2023, the alternative baseline is similar to, though slightly lower than, the current baseline – more so in 2013 and 2014. From 2024-2028 the alternative is forecasted with an exponential fit to the historic data. No forecast is made for 2029 and beyond due to expected changes to the federal standard. The baseline should be evaluated again when the federal standard is in effect.

The distinct advantage of implementing this option is that it is based in factual data as opposed to a forecast, made in the past, about the future. Further, this will simplify the model.

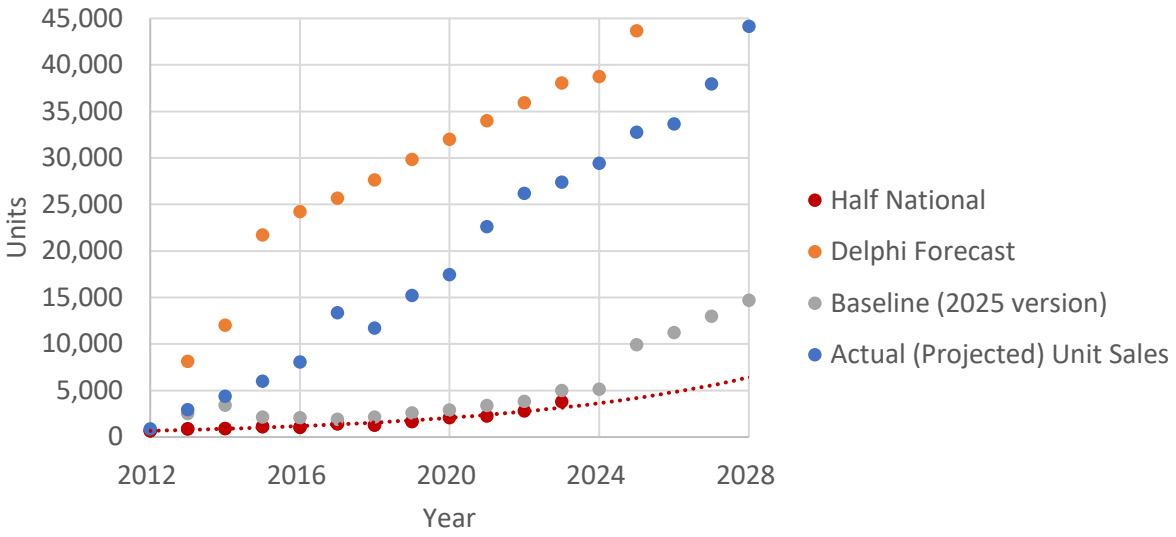

FIGURE 2. ALTERNATIVE COUNTERFACTUAL BASELINE

Rejected New Baseline Approaches

LER considered, and rejected, three other new approaches to setting the baseline. For completeness, they are summarized here.

Comparable Market Comparison

An alternative way to set the baseline would use data from a part of the country with similar electric storage water heater market share but without active programs to promote HPWHs (in other words, it would use a control group). The southeast US could serve as a control; however, it is not feasible to get sales data at the geographical resolution needed.

Panelist C Forecast

A second alternative approach to resetting the baseline is to reference the original Delphi panel report and use “Panelist C’s” forecast. This panelist appears to have guessed the most accurately: Their forecast was the only one that never exceeded the total number of units sold in a given year. LER recommends against this approach, however, because it is an arbitrary selection of one of the many panelists, made possible only in hindsight. The Delphi panel was not set up to be used this way.

Battery Electric Vehicle Market Share

A third option would be to use the market adoption rate of a similar product. Heat pump dryers are a comparable technology and product category (household appliances) to HPWHs but

reached mass-market availability later. Battery electric vehicles became available around the same time as HPWHs, but consumers approach vehicle purchases rather differently than appliances, and cars are subject to very different marketing campaigns and incentive structures. It is unclear how adoption rate data on these products could be adapted into an informative baseline for HPWHs.

Adaptations Assessment

Since the original implementation, NEEA has adapted the baseline forecast to be used in two new areas:

1) Extending the original Delphi forecast to the new construction market. NEEA asserted the baseline market share in new construction would be the same as retrofits.
2) NEEA asserted all energy savings attributable to AWHS Tier 3 and Tier 4 product features were savings above the baseline. Restated, the market would have developed product to the Tier 2 level, but NEEA's efforts pushed them farther. Thus, the incremental savings above Tier 2, for all unit sales, is apportioned to NEEA market transformation activities.

LER agrees with both adaptations. The first, applying the same market share to new construction as retrofit is reasonable, especially given there is no contradictory data. The second, allocating all the incremental savings of Tier 3 and 4 to NEEA activities, is also reasonable given the state of the market. LER directly experienced, in the late 2010s and then in 2020, manufacturers competing with one another to be the first to Tier 3 and then the first to Tier 4. The AWHS framework was moving the market. Further, only AWHS Tier 3 and 4 requirements provide limitations on the use of electric resistance heating in HPWHs. Nothing else in the market, neither the federal standard nor ENERGY STAR, include such limitations (Energy Conservation Program for Consumer Products, 2025; ENERGY STAR Program Requirements for Residential Water Heaters, 2022; CEE, 2025). The AWHS uniquely does so. Consequently, LER finds the second adaption is valid.

Synopsis of Recommendations

1. **Update the new construction HPWH estimation method for Oregon and Washington.**
   - Remove Code Compliance Factor from calculation
   - Increase the Washington share of homes with electric water heating to 89%
   - Increase the Washington share of electric water heating homes with HPWH to 100%

2. **Maintain the current new construction HPWH estimation method for Idaho and Montana until other data is available.**
   The current method is sufficient for the purpose of the Model, but the method used in Oregon and Washington would produce a more accurate result. If studies with water heater type data are made for this market, the other method should be adopted.

3. **Continue to use RPP data as currently implemented in the Model.**
   A more accurate method is not available.

4. **Develop a new the counterfactual baseline.**
   - Create a new, simpler and more data-driven baseline.
   - Use the national market sales for ENERGY STAR water heaters to derive an adoption rate.
   - Apply that new adoption rate to the proportion of electric water heaters in the Northwest Region.
   - Forecast with an exponential fit until the 2029 federal standards change. Revisit further forecasting at that time.

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