Memorandum

April 4, 2019

TO: RBSA Users

FROM: NEEA Market Intelligence Team

CC:

SUBJECT: Residential Building Stock Assessment II Updates

This memo details some issues that were found in the most recent Residential Building Stock Assessment (RBSA II) data, and what is being done to remediate these issues.
NEEA is also taking this opportunity to revise the RBSA II dataset with a new, alternate weighting scheme.

BACKGROUND

In the process of updating its models, staff at Bonneville Power Administration (BPA) noticed some inconsistencies in the RBSA II data. BPA enlisted Cadeo to help them examine the issue more closely. Their work uncovered the following concerns, which have been now been addressed and updated in the reports and database at neea.org/data.

1. *Fixture Flow Rates*

First, there appeared to be some inconsistency in the fixture flow rate measurements as the study results for showerhead flow rates were higher than those recorded in the RBSA I study, raising concerns about market trends and data reliability. Further investigation revealed that Cadmus used two different techniques to measure fixture flow rates for the RBSA II study: a flow bag and a flow microweir, without documenting which method was used at the time of data collection and did not initially calibrate the equipment.

In order to address this issue, NEEA staff asked Cadmus to revisit the flow rates measured during the study. Cadmus subsequently checked with field staff and conducted lab tests to assess the accuracy and frequency of the measurement methods used during RBSA II site visits. Cadmus then developed a calibration factor that could be applied to the RBSA II data to yield results that more accurately reflect average flow rates.

The next step was to test the calibration factor for accuracy. Evergreen Economics, the contractor performing the NEEA Home Energy Metering Study (HEMS) study, visited 15 homes in November and December 2018 that previously participated in the NEEA RBSA II. During the site visits, the Evergreen team measured faucet and shower flow rates using a mass flow calculation—the same methodology Cadmus used to develop flow rate calibration factors for the RBSA II data. While the small sample of homes does not allow us to draw any statistically significant conclusions about the proposed calibration factors, the results show that the calibrated average GPM appears to approximate the average actual flow Evergreen measured in the sample of homes they retested.

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Cadmus has applied the calibration factor to update the full RBSA II database and report, including all tables for bath, kitchen, and showerhead faucets. They have also provided a separate report on this issue and how it was addressed.

2. Home Thermal Performance

A second issue that arose was how UA values (the heat transfer rate) and total heat-loss estimates were calculated. UA values were based on insulation only and did not account for partial insulation, did not consider the crawlspace as a buffer zone, nor calculated basement heat loss using the slab P-value and perimeter (regardless of whether it was conditioned or unconditioned). Additionally, for windows, the u-factor did not factor the presence of storm windows, low-e, or glazing gap.

To address the envelope UA values, Cadmus will update the calculations in the database and tables for consistency with RBSA I and incorporate Regional Technical Forum standard practices, NREL Efficiency Measure Database and Super Good Cents load calculations, including heat loss through building assembly layers and components. The window calculations will not be updated as it was decided early on by the RBSA II working group not to capture the presence of low-e; therefore, these calculations cannot be adjusted.

3. Sample Weighting

Through BPA's review of the RBSA II data, Cadeo observed evidence of an unintentional bias in the RBSA sample not accounted for in the current post-stratification weighting scheme. Sampled sites were concentrated in specific areas within each of the seven large RBSA II sample frames, as opposed to equally dispersed as one would expect based on equal probability sampling. The reason for this is unknown, but the result is that more urban sites were sampled, than equal probability sampling would suggest; the opposite was true for rural sites.

The implication of this finding is that the current RBSA II weights appear to over-represent the characteristics of the heavily-sampled sites (mostly urban sites) and under-represent the less-heavily-sampled sites (generally non-urban sites). This can impact the representativeness of the study results for the region, as any differences in building stock characteristics between the more and less heavily sampled areas would be represented as skewed towards the more heavily sampled populations. For example, for primary HVAC and water heating fuel, the current weights would seem to slightly understate electric, wood, and propane saturations and slightly overstate natural gas.

Cadeo contends that the new weights better tie the sample to the population at a more granular sub-regional level. This adjustment would result in more representative results. In addition, since median values are used for many regional analyses, any slight error in these numbers will have systemic and long-lasting impacts on regional assessments until the next RBSA is conducted.

The current weights could potentially understate the number of electrically-heated households in the region by 30,000 - 45,000 units, which represents approximately 60-65 aMW of load as well as potentially understates electric savings from certain measures in the Power Plan and to a lesser extent the Regional Technical Forum, though it should be noted that these differences are not statistically significant. Finally, while not the primary intent of RBSA II, BPA and others use these average values to compare past and current RBSAs to develop an understanding of trends over time.

Using these new weights could result in less dramatic changes in fuel saturations compared to RBSA I, and will hopefully provide results that are more comparable to future RBSA values. It is important to note that at a regional level this improved weighting scheme does not produce statistically different results than the

original weighting scheme results, which were agreed to by the RBSA working group and alliance stakeholders.

NEEA staff have updated the database with the new weights, in addition to the original weights. There is a new table – Alt_weights – with the site identification and the new alternate weight for each site. The report and tables will not be updated, and as such, will not necessarily match any analysis completed using the new weights. On the RBSA web page - https://neea.org/data/residential-building-stock-assessment - we have included a more detailed, technical memo prepared by Cadeo and provided by BPA, which provides more insight into the process that was followed to develop these new weights.

Implications for Future Stock Assessments

Identifying these issues raises an important point about peer review and continuous improvement with stock assessments. Currently, there is no established protocol for either. This means that when issues such as these arise, there are no established criteria for when to make a change, and no venue in which to discuss and decide on any changes.

The stock assessments figure very prominently in the region. They are a complicated undertaking and are currently updated every five years. This means if an error, or a better methodology, is found, it can be a number of years before any changes can be implemented.

Even with a solid QA/QC process, as people begin using the data from these assessments, potential improvements, or potential errors, will become evident. Peer review and continuous improvement are accepted, and necessary, processes with projects of similar scale and difficulty as the stock assessments. As such, NEEA staff will try to develop the protocols necessary to implement these in future stock assessments.

For the time being, we will take two courses of action. Should errors be identified, we will verify and make changes as we are able as is described for the fixture flow rate and UA values. For potential improvements, such as this enhanced weighting, we will attempt to use our best judgment as to whether it is something that should be looked into in the next version of the stock assessment, or whether it should be brought up to the region in the interim.

If you have any questions or comments, please feel free to contact the NEEA Market Intelligence Team at RBSAinfo@neea.org.