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**MEMORANDUM**

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**TO:** IL TRM TECHNICAL ADVISORY COMMITTEE

**FROM:** CHERYL JENKINS, PROJECT MANAGER; SAM DENT, TECHNICAL LEAD - VEIC

**SUBJECT:** IL TRM VERSION 7.0 NON-CONSENSUS MEMO – SHELL AND HVAC REPLACEMENT INTERACTION

**DATE:** 09/13/2018

**Cc:** CELIA JOHNSON, SAG

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This memo documents positions and comments provided for the following issue for which consensus was not reached during the Version 7.0 update cycle:

Interaction of load reducing measures (e.g., Shell) with HVAC replacement measures

The issue is introduced below, followed by a Comparison Exhibit summarizing the key differences in opinion within the TAC, and finally an Appendix containing key commentary and documentation provided throughout the process.

## Issue Summary

VEIC received an email request (provided in the Appendix) on November 21<sup>st</sup> from Hannah Arnold of Opinion Dynamics asking for VEIC's perspective on the appropriate order of calculating savings for homes that received both shell measures (thereby reducing the heating/cooling load of a home) and early replacement of inefficient heating and/or cooling equipment (that would meet the reduced load of the home with a more efficient unit). VEIC's response was that the order of operation is not important so long as the second measure assumes that the first is installed. If the existing home conditions are used for both measures, the calculation will overclaim the savings; if the new conditions are used for both measures, the calculation will underclaim savings.

VEIC initially circulated a memo (provided in the Appendix) to offer guidance on how to account for this interaction without deviating from the v6 TRM, and also proposed some recommended clarifications to the TRM that may be considered for v7.

When this proposal was reviewed, it led to multiple discussions, with concerns raised that the proposed changes may conflate the problem, particularly because the shell measures were based on site-specific assumptions, while the heating replacement measures were based on default head load assumptions. Ultimately the TAC agreed to change the methodology for calculating heating replacement measures to use 'capacity \* EFLH' to estimate a building's heat load as opposed to using a deemed value. This allowed for the interaction to be treated consistently across the two measures (an example calculation is provided in the Appendix). Using this methodology accounts for the fact that when a new HVAC replacement is downsized following shell improvements to the home (a practice that is routinely performed), this approach will have the effect of including the post condition (reduced load) in the HVAC replacement calculation. Therefore, it was proposed that the shell measure calculation should use the pre-HVAC efficiency in its calculation, such that when the two measures are combined the correct total savings is calculated and it does not underclaim savings by applying post conditions in both measures.

Phil Mosenthal, representing the Office of the Attorney General, raised the issue that, in some income-qualified programs, where the combination of the two measure types are common, while all utilities are paying for and claiming savings for the shell measures, certain utilities do not contribute to the cost of, nor claim savings for, the early replacement of the HVAC equipment through the weatherization program. The concern therefore was that by using the existing efficiency conditions in the algorithm for claiming shell savings, those utilities that did not

contribute to the HVAC replacement are gaining a benefit (increased shell savings) based on assuming equipment that will not exist during the lifetime of the measure and are not accounting for the interaction, since the HVAC replacement measure itself is not included.

Therefore, proposed language was added to the footnotes for the heating and cooling efficiency assumptions within all the load reducing shell measures (Section 5.6 in Volume 3), as follows:

$$\begin{aligned}\eta_{\text{Heat}} &= \text{Efficiency of heating system} \\ &= \text{Equipment efficiency} * \text{distribution efficiency} \\ &= \text{Actual}^1\end{aligned}$$

<sup>1</sup> The program administrators should use the efficiency of the HVAC equipment that would have existed in the home after completion of the project *absent the program administrator's involvement* in the project. If the HVAC system is not replaced, use the existing equipment efficiency. If the program administrator involvement results in HVAC system replacement (as verified by the independent evaluator and consistent with stipulated agreements between utilities, stakeholders, and ICC Staff), then the existing unit efficiency should be used (as the calculation of savings from the HVAC replacement will incorporate the reduced load from the shell measures). If the program administrator is not responsible for the HVAC replacement, then the new system efficiency should be used.

We received an objection from Ameren on the 08/01/18 TAC meeting as documented in the Comparison Exhibit below.

# Comparison Exhibit

## Illinois Statewide TRM Version 7.0: Comparison Exhibit of Non-consensus Technical Items

Item Description	Position Statement		Rationale	Supporting Stakeholders
<p><b>How should the interaction of load reducing and HVAC replacement measures be incorporated?</b></p>	<p>Position One</p>	<p>Within the calculation of savings from load reducing measures, the program administrators should use the efficiency of the HVAC equipment that would have existed in the home after completion of the project <i>absent the program administrator's involvement</i> in the project.</p>	<p><b>VEIC:</b> Attribution is important here because if the PA is responsible for the HVAC replacement, they will be incorporating the interaction between load reducing and HVAC replacement measures within the HVAC replacement algorithm. If the PA is not responsible for or claiming savings for the HVAC replacement, there is no interaction, and they should consider the load reducing measures in the context of the home as it will be for the lifetime of the measures (i.e., use the new efficiency).</p> <p><b>Office of the Attorney General:</b> The Illinois Attorney General's Office supports the compromise position of VEIC on recognition of interactive effects of installation of energy efficiency measures. Failure to recognize the impacts of other installed energy efficiency measures on the calculation of incremental energy savings measures will artificially inflate measures savings. In addition, it is the OAG's understanding that the Illinois Home Weatherization Assistance Program (IHWAP) recognizes the impacts of newly installed measures when accounting for incremental energy savings from other installed measures. Objections that, in effect, artificially inflate the savings generated by individual measures do not further the purposes of Section 8-103B of the Act and put ratepayers at risk for the financing of measures that do not live up to their assumed energy savings value. This is particularly problematic given the new statute's allowance for electric utilities to earn additional profits for achievement of energy savings above the Illinois Commerce Commission-approved annual electric utility savings targets.</p>	<p>VEIC, Office of the Attorney General</p>
	<p>Position Two</p>	<p>The calculation of load reducing measures should not be dependent on the source of funding of the HVAC unit replacement.</p>	<p><b>Ameren:</b> The language being proposed for the TRM around this issue deviates from how whole home retrofit projects are analyzed for savings with respect to other whole home retrofit projects AIC performs, as well as other such projects performed by every other utility in the state. This deviation is based on an improper promotion of a policy by stakeholder(s) that savings calculations should be changed depending on how a program is funded. Moreover, with this issue, the source of funding was imposed due to the litigated positions of other parties, as well as AIC's subsequent attempt to, in good faith, work collaboratively with stakeholder(s) on savings allocation issues that were premised on fairness to stakeholders, including the utilities. Having no valid basis to deviate, Ameren Illinois cannot support the use of the proposed calculation.</p>	<p>Ameren</p>

# APPENDIX

## Attachments for Issue: Interaction of load reducing measures (e.g. Shell) with HVAC replacement measures

### 1.1.1 Initial email from Opinion Dynamics raising the issue:

**From:** Hannah (Arnold) Howard <hhoward@opiniondynamics.com>  
**Sent:** Tuesday, November 21, 2017 1:25 PM  
**To:** Sam Dent <sdent@veic.org>  
**Cc:** Matt Drury <mrdury@opiniondynamics.com>; Mallorie Gattie <mgattie@opiniondynamics.com>  
**Subject:** IL TRM - HVAC and Envelope Measures in Whole Home Programs

Hi Sam,

We wanted to reach out to get your perspective on another TRM application and interpretation issue that has come up as part of the PY9 evaluation of Ameren's Home Efficiency Income Qualified (HEIQ) Program. In this case, the issue is around the calculation of savings from HVAC and envelope measures in whole home programs, and whether the ex ante approach is reasonable. The situation is as follows:

As part of the HEIQ Program, measures are installed by the implementer using a phased approach. The program first implements envelope measures and then HVAC measures. This order has been used over the lifetime of the program so that right-sizing of HVAC equipment can occur, meaning that envelope measures are implemented first so that Manual J calculations (required to right size HVAC equipment) can be performed based on a home that is well-sealed and insulated. From a savings perspective, a well-sealed and insulated home will require a smaller cooling and heating load, thus saving energy by no longer needing to provide as much air to condition the space. The savings calculations are carried out in the same order. Currently, the existing HVAC efficiencies (ultimately representing the larger existing loads prior to air sealing and insulation) are used in the envelope algorithms so that the savings from load reduction by improving the home shell is captured. The calculations for the savings due to the new HVAC equipment are done second (as the equipment is installed after the building shell is improved) so that the loads are more reflective of the home as it exists after an improved shell.

We believe this approach is reasonable given that the TRM does not currently capture new HVAC capacities due to right sizing or reduced loads in the HVAC algorithms for gas furnaces and boilers. If it did, which we would recommend, a better case could be made for using new HVAC efficiencies in the building shell algorithms. Can you let me know if you agree with this approach (at least in the short term before we can submit a TRM update request)?

Thanks,  
Hannah

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**Hannah Arnold Howard**  
*Managing Director*  
Opinion Dynamics

tel 510 444 5050 x 9183  
fax 510 444 5222



## 1.1.2 Initial draft of memo explaining VEIC's original proposal (subsequently replaced):

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### MEMORANDUM

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**TO:** TECHNICAL ADVISORY COMMITTEE

**FROM:** CHERYL JENKINS, PROJECT MANAGER and SAM DENT, TECHNICAL LEAD - VEIC

**SUBJECT:** LOAD REDUCTION AND HVAC REPLACEMENT MEASURE INTERACTION

**DATE:** 12/21/2017

**Cc:** ANNETTE BEITEL, SAG

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This memo describes how to appropriately account for the interaction of measures that reduce heating and/or cooling loads (i.e. air sealing, insulation and duct sealing measures), and heating or cooling system replacements. The TRM Version 6.0 is currently silent on this specific common interactive effect (although the overview section does indicate that such issues should be considered). This interaction should be accounted for and can be without deviating from the current characterizations.

The important issue is that the impact of the first measure(s) (load reducing or HVAC replacement) must be accounted for in the calculation of the second measure. As per the guidance provided previously on interactive effects, ideally the measure with the longest measure life should be calculated first. The load reducing measures generally have a longer measure life so we recommend that these be analyzed first – using the *existing* (not the new) HVAC system specifications in the algorithms.

#### Heating System Replacements:

To calculate savings from a heating replacement, the heat load of the building should represent the *post* shell measure condition. Ideally the reduced heat load would be based on a Manual J or equivalent load calculation (as prescribed in the measure: “Actual if informed by site-specific load calculations, ACCA Manual J or equivalent”). If however the default heat load assumptions provided within the TRM is used, then these defaults should be adjusted to remove the load reducing savings first, (i.e. consistent with a “site-specific load calculations” method). The algorithm for furnace replacement for example should therefore be calculated as follows (red text is added to the existing TRM algorithm):

$$= (\text{Gas\_Furnace\_Heating\_Load} - (\Delta\text{Therms}_{\text{SHELL \& DUCT}} * \eta\text{Heat}(\text{exist}))) * \text{HF} * ((1/(\text{AFUE}(\text{exist})*(1-\text{Derating}(\text{exist})))) - (1/(\text{AFUE}(\text{eff})*(1-\text{Derating}(\text{eff}))))))$$

Note the term  $\Delta\text{Therms}_{\text{SHELL}}$  would include savings from *all* shell measures and could include multiple insulation measures and air sealing.

#### Cooling System Replacements:

Where a cooling system is replaced, the impact of the reduced cooling load from the shell or duct sealing measures should also be incorporated. The implementers should be right-sizing the new AC equipment using a Manual J or equivalent load calculation and the reduced capacity used in the TRM algorithm. Where right-sizing has not occurred, a similar reduction to the cooling load should be implemented as follows:

$$\Delta\text{kWh} = ((\text{FLHcool} * \text{Btu/hr}) - (\Delta\text{kWh}_{\text{cooling}}(\text{SHELL \& DUCT}) * \eta_{\text{Cool}}(\text{exist})) * (1/\text{SEER}_{\text{exist}} - 1/\text{SEER}_{\text{ee}}))/1000$$

VEIC plan to add language to the TRM during the Version 7.0 update cycle to be more explicit about this common interaction (and provide the above algorithms).

### 1.1.3 Updated VEIC memo released on 5/11:

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#### MEMORANDUM

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**TO:** IL-TRM TECHNICAL ADVISORY COMMITTEE

**FROM:** CHERYL JENKINS, PROJECT MANAGER and SAM DENT, TECHNICAL LEAD - VEIC

**SUBJECT:** LOAD REDUCTION AND HVAC REPLACEMENT MEASURE INTERACTION

**DATE:** 05/11/2018 UPDATE TO 12/21/2017 VERSION

**Cc:** ANNETTE BEITEL, SAG

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This memo discusses the interaction of measures that reduce heating and/or cooling loads (i.e. air sealing, insulation and duct sealing measures), and heating or cooling system replacements.

This update to an earlier memo presented 12/21/2017 (provided at the end of this memo) documents an alteration to the position previously presented following two subcommittee calls on 04/12/2018 and 04/26/2018.

Upon review of the first memo, VEIC received a number of comments from stakeholders expressing concern that the proposed adjustment may actually compound rather than improve the estimate of savings resulting from these measures.

The concern stems from the fact that while the shell measure algorithms in the TRM are based on site-specific inputs, the algorithm for the heating system replacements provides a deemed average heat load assumption which is often used to calculate savings in lieu of site specific heat load calculations. The deemed average heat load value is based upon an average of a variety of homes, sizes and conditions<sup>1</sup>. A non-weatherized home that is receiving significant shell improvements is, prior to those improvements, likely to have an existing heat load on the higher side, above the weighted average. Thus reducing the deemed heat load further below the average is likely to draw the calculated savings further from what can be expected to be achieved.

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<sup>1</sup> Based on data from 'Energy Efficiency / Demand Response Nicor Gas Plan Year 1 (6/1/2011-5/31/2012) Research Report: Furnace Metering Study (August 1, 2013)'.

An additional suggestion was made that homes receiving shell measures may on average be larger homes having a greater ability to invest in expensive improvement works, and therefore also, potentially, be on the higher side of an average heat load.

Having discussed these issues, the TAC subcommittee agreed that with the TRM as currently written, when using the deemed heat load estimate, we cannot be sure that accounting for the improved shell savings would bring the deemed heat load for the heating system replacement measure closer to actual. Therefore for PY 2018 it was agreed that the existing conditions should be used as the baseline for all shell measures and for HVAC replacement measures when the deemed heat load estimate is being utilized. Note however, if programs are performing site specific heat load calculations in the evaluation of heating replacement, then it is appropriate to use the post-shell measure condition in that heat load calculation. In this case a site specific calculation is used for both measures and therefore we can be more confident that an adjustment for this interaction in the heat/cool load calculation of the HVAC replacement is bringing that load estimate closer to the actual load of the home.

The committee agreed to consider adjustments to the heating system replacement measures for Version 7.0 to allow for site specific inputs to allow further refinement of the calculation.

#### 1.1.4 Example change to HVAC algorithms (extracted from 5.3.6 Gas High Efficiency Boiler)

V6.0: 
$$\Delta\text{Therms} = \text{Gas\_Boiler\_Load} * \text{HF} * (1/\text{AFUE}(\text{base}) - 1/\text{AFUE}(\text{eff}))$$

V7.0: 
$$\Delta\text{Therms} = (\text{EFLH} * \text{CAPInput} * (\text{AFUE}(\text{eff}) / \text{AFUE}(\text{base}) - 1)) / 100000$$