Report on Tax Credit Software Certification Issues

RESNET Software Calculation Methods Committee
Subcommittee on Tax Credits

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Introduction

Under the auspices of RESNET, a Software Calculation Methods Committee has been established to review the appropriateness of software used for energy ratings. The Software Calculation Methods Committee has established a Subcommittee on Tax Credits comprised of 10 individuals. The Tax Credits Subcommittee has been charged with reviewing the provisions of proposed tax credit legislation to determine if provisions for certification of residential energy analysis tools used for residential energy tax credits present issues of concern to RESNET. This paper presents the preliminary findings of this Tax Credits Subcommittee.

Background

The U.S. Congress has proposed several pieces of legislation that would provide tax credits for efficient homes. During the 107th Congress, RESNET has specifically supported H.R. 778 and S. 207, which are companion bills that provide tax credits for new homes and H.R. 3455 and S. 1709, which are companion bills that provide tax credits for improving existing homes. H.R.778/S.207 specify that qualification for the tax credits shall be based on achieving 30% or 50% efficiency improvements as compared with the "Standard Design" home of Chapter 4 of the 2000 International Energy Efficiency Code (IECC). All of these bills also require the use of "certified" software to determine qualification for these tax credits. Each of the bills requires that the Secretary of the Department of Energy (DOE) "certify" software to be used to determine tax credit qualification based on the California's 2000 Alternative Calculation Method Approval Manual (ACM).

The Subcommittee on Tax Credits has reviewed the legislation, the provisions of Chapter 4, IECC and the California ACM with the goal of identifying the primary issues that may impact RESNET and the Home Energy Rating System (HERS) industry. Each member of the

Subcommittee conducted an independent review of the documents and provided comments on the issues they felt were most important to the Subcommittee Chairman. The Chairman then compiled and organized the resulting issues and submitted the compilation back to the subcommittee for further comment and their "ranking" of the importance of each issue. These comments and "rankings" were then compiled by the Chairman and submitted back to the Subcommittee for review and discussion during a Subcommittee conference call, where the issues and their organization were further refined. This report presents the results of that process.

Findings

It was the general consensus of the Subcommittee that the HERS industry can compete in an environment where software certification is "based on" the California ACM. However, key to this finding is the interpretation of the words "based on." It was also the strong consensus of the Subcommittee that the term "based on" must be understood broadly and that any software certification implementing regulations promulgated by the Secretary of Energy **must:**

- Provide for a range of acceptable simulation results rather than prescribing a single, exact result that must be achieved by all software,
- Incorporate additional software testing considerations like the ability to accurately predict the energy impacts of changes to building components and systems, and
- Be less discriminatory against more simplified methods that can adequately predict the required home energy uses.

On all of the above points, there was strong Subcommittee consensus that the HERS BESTEST procedure provides a more adequate and less burdensome certification process than does the ACM procedures.

The detailed Subcommittee findings that follow are segregated into issues related to the IECC and issues related to the California ACM. This organizational framework is adopted because these two documents serve two separate and distinct purposes:

1. The IECC provides the "rules" by which "reference" home energy uses are established; and
2. The ACM describes procedures by which software may be "tested" to determine its accuracy and reliability.

The issues are further organized and presented in 3 subject areas as follows: Software Testing issues, Modeling Capability issues, and Building Specification issues.

All ten members of the Subcommittee have commented on and ranked the importance of each of the identified issues. Results were compiled in the following manner: The importance rankings were assigned numerical values with 'critical' = 3, 'important' = 2, 'moderate' = 1 and 'unimportant' = 0. Non-votes were considered 'unimportant.' Where members indicated that their ranking fell between two ranks, each of the two ranks was given one-half. The number of votes in each rank was then multiplied by the numerical weight assigned to that rank. All the rank values for the issue were then summed and divided by 10 (there are 10 Subcommittee members, including the Chairman) to arrive at the final weighted average importance values that

are reported here. The following table summarizes the results:

Table A. Summary of Importance Value Results

Importance Value Range	Number of Issues
=> 2.5	1
=> 2.0 < 2.5	6
=> 1.0 < 2.0	6
< 1.0	2

Clearly there is strong Subcommittee consensus on the importance of an issue if it's Importance Value is greater than 2 and 7 of the 15 main issues fall in this group.

The Subcommittee had great concern that burdensome and unnecessary details not overshadow the larger objectives of the certification process. As described by the subcommittee members, a successful certification procedure would be fair and reasonable and be designed to answer relatively simple and straightforward questions, as follows:

- Can the software automatically and accurately generate the proper "reference" home from the data provided by the "proposed" home such that the energy uses of the two homes can be directly compared?
- Are the building parameters established by the "rules" faithfully implemented by the software in a manner that minimizes the opportunity for abuse or fraud by the user. (e.g. Where values are established by "rule", are the users of the software blocked from alteration or manipulation of those values?)
- Can the software accurately estimate the building load and the energy use impacts of changes in the wide variety of principal energy features of homes? In other words, if the insulating value of a building component or the efficiency of a piece of equipment or a system is changed, can the software accurately and faithfully predict the energy use impact of those changes, taken both individually and in combination?
- Are all "official" reports processed and provided in a uniform format that allows for the simple and straightforward administration of the tax credit and the simple and straightforward verification of the software tool?

Results of the Subcommittee review indicate that the Subcommittee felt strongly that certain of the provisions of the ACM software test procedure were either overly burdensome or were designed to accomplished an incorrect objective. Likewise, the Subcommittee identified clear and worrisome issues related to the implementation of the Chapter 4, IECC "rules" within software that can accomplish the above certification objectives.

Table A below lists the 15 primary issues identified by the Subcommittee. The California ACM issues are listed first, followed by the IECC issues. Both groups are listed in descending order of their importance ranking.

Table A. Summary of Results from Issues Importance Ranking

Item Addressed	Importance Ranking
ACM Issues	
ACM approach should be streamlined and simplified	2.80
The ACM tests determine only the qualitative accuracy of software tools.	2.25
Specifying "how" something must be modeled instead of "what" need to be modeled is too limiting.	2.20
ACM methods require hourly modeling. Other methods should be allowed if shown to be sufficiently accurate.	2.10
Basements, crawlspace and slab models as specified by ACM are not adequate.	1.90
ACM detail requires too much time for data collection and input process.	1.70
Reporting standards are too rigid, inflexible and unnecessary except for IRS report.	1.65
Exterior mass walls and solar water heating should be added to minimum modeling capabilities.	1.30
ACM "Effective SEER" = 11 for evaporative cooling systems is too low.	1.00
Should not have to be required to be able to model attic radiant barriers.	0.95
IECC Issues	
IECC specifications are insufficient and/or unclear in some areas	2.30
Baseline defaults not consistent with IECC.	2.25
Compliance by specification vs. compliance by testing & inspection.	2.00
IECC is biased toward cooling loads.	1.45
Standard Design duct leakage default is too high – should be only 10% instead of 20%	0.90

The primary issues contained in Table A above are discussed in detail below where each primary issue is followed by a list of sub-issues or Subcommittee opinions that bear on the primary issue and by a ranking scale that gives the importance ranking of the primary issue. The ranking scale is then followed by a set subcommittee member comments. Primary issues are listed in descending order of their Importance Value within each subject area. At the end of each subject area, a set of general Subcommittee comments is provided.

1. California's 2000 *AB 970: "Low-Rise Residential Alternative Calculation Method Approval Manual* (ACM)" Issues

1.1 Software Testing

1.1.1 ACM approach should be streamlined and simplified.

a Number of ACM test cases is excessive

b Proposed Goal: Fair, reasonable and administratively simple process for certifying energy calculation methods

c Not practical to test for all possible combinations. Evaluation philosophy that defines "big" impacts is needed (i.e. "a difference to be a difference must make a difference")

d Who to implement, administrator and enforce

Importance of this issue: 2.80

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3 2 1 0

Critical ____ Important ____ Moderate ____ Unimportant ____

Member Comments:

- The folks who provide software for the marketplace and review them for acceptability should answer these questions.
- While number of test cases may be excessive. Even an easy to use, and reasonably accurate, tool may require significant time and energy to prepare test cases. However, it is relatively important to confirm that a tool has the capabilities purported before it is used to rate or evaluate a building or compare energy impacts of alternative design ideas.

1.1.2 The ACM tests determine only the qualitative accuracy of software tools. In other words, the only question the ACM answers is whether software outcomes are moving in the correct direction, not whether they are making the correct differences in building load or energy use prediction. Thus, the ACM tests do not determine the quantitative accuracy with which a software tool can predict building loads, energy uses or differences in building loads and energy uses due to changes in building characteristics.

a Recommend using the HERS BESTEST and/or ASHRAE Standard 140 to test both the qualitative and quantitative accuracy of software tools.

b The use of a single "truth" reference (CALRES) as in the ACM is unacceptable. A ***range*** of acceptable building load and energy use predictions is required for both individual test-building conditions and for differences between various test-building conditions.

c Some additional modeling tests may be needed, as follows: attic radiant barrier tests, duct leakage tests, HVAC climate, coil airflow and part load performance tests.

Importance of this issue: 2.25

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3 2 1 0

Critical ____ Important ____ Moderate ____ Unimportant ____

1.1.3 Reporting standards are too rigid, inflexible and unnecessary except for IRS report.

a Reporting requirements should be compared with HERS requirements.

Importance of this issue: 1.65

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3 2 1 0

Critical ____ Important ____ Moderate ____ Unimportant ____

Member Comments:

- Reporting should be easy and understandable.
- Simple % improvement over reference is all that is needed.

Additional Software Testing Issue(s)

Rating Method test should be included

General Software Testing Comments:

- The accuracy of software to predict impact of energy efficiency features on building load is very important. I am not a modeling expert but I do not understand how linking the software to HERS BESTEST will improve the ability of the HERS software to predict building load. CA T-24 software (and for that matter any other state that I know of) has yet to document that the software accurately reflect energy use in buildings.
- Due to variations in Lifestyle and interactive nature of building/energy-use factors, it seems unlikely that a "true" of "precise" quantitative value could ever be agreed on for most – if not all – efficiency measures. I agree that a range, benchmarked against detailed simulation predictions, is probably the best way to evaluate software. My experience is always that accurate energy use projects and comparisons are often somewhat of an art in that the user that understands and has experience with even the crudest software can get very close to actual usage patters in the average situation. Outliers seldom fall close to even the most sophisticated projections.

1.2 Modeling Capabilities

1.2.1 Specifying "how" something must be modeled instead of "what" need to be modeled is too limiting. Examples include:

a Duct leakage is specified as a table of values for distribution efficiency by climate zone and duct location rather than allowing explicit modeling of duct heat transfer and air leakage.

b Ground coupling algorithm, effective soil resistances and effective temperatures are all specified in a manner that requires hourly simulation, ruling out other types of energy models.

Importance of this issue: 2.20

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3	***2***	***1***	***0***
Critical ____	***Important ____***	***Moderate ____***	***Unimportant ____***

Member Comments:

- Title 24 ACM now uses an ASHRAE algorithm for HVAC system loss, not a table of values.
- While acceptable methodologies are often copied and used to model from; requiring ONLY certain models or inputs limits the ability to improve or simplify procedures. Agree that flexibility and options should be up to the developers.

1.2.2 ACM methods require hourly modeling. Other methods should be allowed if shown to be sufficiently accurate. Examples include:

a Ground modeling requires a running average of outdoor air temperatures be used as the ground temperature. Although this may be very accurate, there are questions as to whether this degree of accuracy is necessary.

b Determination of building heating, cooling and ventilation control status requires running average of hourly outdoor air temperatures. There are other algorithms, including monthly algorithms that can be used to determine heating, cooling and ventilation seasons.

Importance of this issue: 2.10

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3 ***2*** ***1*** ***0***

Critical ____ ***Important ____*** ***Moderate ____*** ***Unimportant ____***

Member Comments:

- Agree that other methods could be appropriate because in most cases hourly will be the logical option anyway. However, it is often simpler and accurate enough to simply input an "adjustment" or benchmarking value, especially where precise models do not track with actual observations or extreme weather scenarios.

1.2.3 Basements, crawlspace and slab models as specified by ACM are not adequate.

a Specification of a specific ground model rather than a test for ground modeling accuracy is a questionable practice (see also 1st item under Modeling Capabilities).

Importance of this issue: 1.90

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3 ***2*** ***1*** ***0***

Critical ____ ***Important ____*** ***Moderate ____*** ***Unimportant ____***

Member Comments:

- Thermal dynamics and real-world performance of foundations has always made these models difficult to use. Important rating - -- As stated earlier; a requirement for specific models, rather than directive that certain modeling should be included, is too restrictive.

1.2.4 Exterior mass walls and solar water heating should be added to minimum modeling capabilities.

Importance of this issue: 1.30

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3 ***2*** ***1*** ***0***

Critical ____ ***Important ____*** ***Moderate ____*** ***Unimportant ____***

Member Comments:

- These features can be modeled using Title 24 as defined by the ACM.
- Low volume of applications limit real need in most situations.

1.2.5 Should not have to be required to be able to model attic radiant barriers.

Importance of this issue: 0.95

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3          2          1          0
Critical ____ Important ____ Moderate ____ Unimportant ____
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Member Comments:

- Should be able to model Attic, and other, radiant barriers due to increasing use in possibly inappropriate and non-beneficial applications in some areas and state codes.
- This should be required.

Additional Modeling Capabilities Issue(s)

<u>DHW algorithms should be tested</u>

1.3 Buildings Specification

1.3.1 ACM detail requires too much time for data collection and input process.

a Measuring each surface area in home is unwarranted. *Dissenting opinion: This is simple.*

b Measurement of overhangs and fins is burdensome. *Dissenting opinion: If you don't want to you don't have to.*

c Measurement of interzonal surfaces significant effort for little gain.

d Reporting percent window to floor area ratio difficult to comprehend – should use window to wall area ratio. *Dissenting opinion: Disagree.*

e Thermal mass measurement requirement too onerous. Dissenting opinion: Thermal mass is no longer part of Title 24 standard house design. We don't measure it any more unless someone is building passive solar home (which is rare to nil).

Importance of this issue: 1.70

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3          2          1          0
Critical ____ Important ____ Moderate ____ Unimportant ____
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Member Comments:

- While measuring all details is burdensome, it is necessary IF these features are to be evaluated. If not, it is probably appropriate to ignore some items.
- I disagree with most of these comments, particularly a and d; as for b and e, I thought that these were optional (the only reason to measure fins and overhangs is to take

credit for reduced cooling loads, and thermal mass is to take credit for thermal storage; there's not really any other way to model these if you don't measure those inputs.)

1.3.2 ACM "Effective SEER" = 11 for evaporative cooling systems is too low.

Importance of this issue: 1.00

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3 2 1 0

Critical ____ Important ____ Moderate ____ Unimportant ____

Member Comments:

- Need more input RE: Evap. Cooling efficiency. My observations are that Evap Systems are often over-rated in their estimated efficiency. They use large amounts of energy and perform poorly under many conditions.
- Evap. Cooling should not be modeled with SEER. Use effectiveness & watts/cfm.
- Do we have research on what it "is"?

General ACM Building Specification Comments:

- Building specifications should be set by whatever code becomes the baseline for the tax credits. The current guess would be the 2000 IECC.

2. <u>2000 International Energy Conservation Code (IECC) Issues</u>

2.1 Software Testing

None

2.2 Modeling Capabilities

2.2.1 IECC is biased toward cooling loads.

Importance of this issue: 1.45

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3 2 1 0

Critical ____ Important ____ Moderate ____ Unimportant ____

Member Comments:

- Cooling loads are the concern in CA, especially right now.
- If this is true, I agree; but it's not clear to me at all that it's true.
- How?
- Not sure I agree with comment.

2.3 Building Specification

2.3.1 IECC specifications are insufficient and/or unclear in some areas

a Roof albedo and construction (e.g. cool roofs).
b Wall albedo and construction.
c HVAC sizing and coil airflow.
d Standard Design duct leakage.

Importance of this issue: 2.30

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3                    2                    1                    0
Critical ____        Important ____       Moderate ____        Unimportant ____
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Member Comments:

- IECC insufficiently addresses the items listed. Difficulty in describing, defining and then acquiring field "specs" on site make this a difficult issue in many situations. (ex. what is, and how do I rate, a "cool roof"?

2.3.2 Baseline defaults not consistent with IECC. One assumes that the legislation will be interpreted in a manner that gives priority to IECC, but . . .

Importance of this issue: 2.25

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3                    2                    1                    0
Critical ____        Important ____       Moderate ____        Unimportant ____
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Member Comments:

- I presume the Federal Tax Credits will be based on the IECC, not Title 24 defaults.
- Benchmark against IECC not older versions of code. Most important is to agree on a common reference.
- Code compatibility issues key when setting reference house.

2.3.3 Compliance by specification vs. compliance by testing & inspection.

a Manual D – no inspection required. *Dissenting opinion: Inspection required by Title 24 if you claim credit for Manual D.*
b Duct leakage sampling – HERS Guidelines and IECC require testing. *Dissenting opinion: Sampling working fine. EPA test on sampling supports this technique.*
c House wrap/envelop sealing – HERS Guidelines require testing.

Importance of this issue: 2.00

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3                    2                    1                    0
Critical ____        Important ____       Moderate ____        Unimportant ____
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Member Comments:

- Disagree - In many cases, compliance by specification is acceptable. The issue is in defining what is acceptable and ensuring that the specification is actually followed, rather than simply "checking the box" without a close inspection.
- Testing is key but creates implementation issues and costs

2.3.4 Standard Design duct leakage default is too high – should be only 10% instead of 20%

Importance of this issue: 0.90

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3	***2***	***1***	***0***
Critical ____	***Important ____***	***Moderate ____***	***Unimportant ____***

Member Comments:

- Disagree -- standard duct leakage of 20% is appropriate in many cases -- critical to standardize reference point for comparisons.
- We disagree. Such a low number really warrants testing to verify. We would leave it at 20% based on measure values. See the following paper for real data. Coito, F., Syphers, G., Lekov, A., Richardson, V., 1998. "Are Your Ducts Ali in a Row? Duct Efficiency Testing and Analysis for 150 New Homes in Northern California," The Proceedings of ACEEE Summer Study on Energy Efficiency in Buildings, 1.33-41.
- Where is this in the ACM? I saw the opposite, that it was way too low at 6% of system air flow (page 3-17).
- Should allow variance for different regional building practices, as agreed by Faesy and Andrews at HERS Tech meeting (1/96). (Approved by 15-0 vote)
- Can fix this but 15% might do.

General IECC Building Specification Comments:

- Is there a need to add labeling requirements for building components (i.e. NFRC labels for fenestration components)? This would provide a source of information for critical properties such as U factor, Solar Heat Gain, Visible Light Transmission and Air Leakage. Defaults needed for glazing properties i.e. clear glass, if unknown.