

RESNET[®]
RESIDENTIAL ENERGY SERVICES NETWORK

2019
Conference
New Orleans, LA • Feb 25-27

Enhancing the Consistency of Calculated HERS Index Scores

The RESNET Software Consistency Committee

Neal Kruis, Ph.D.
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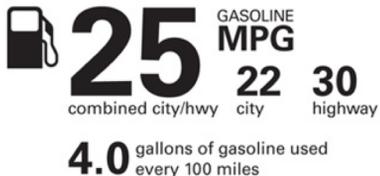
Introduction



Introduction

EPA Fuel Economy and
DOT Environmental Comparisons

 **Dual Fuel Vehicle:**
Gasoline-Ethanol (E85)



Annual Fuel Cost
\$1,680

How This Vehicle Compares

Among all vehicles and within midsize cars



Environment



Your actual mileage and costs will vary with fuel cost, driving conditions, and how you drive and maintain your vehicle. Cost estimates based on 15,000 miles per year at \$2.80 per gallon.

Ratings are based on gasoline and do not reflect performance and ratings using E-85.

See the Fuel Economy Guide for more information.

Visit www.fueleconomy.gov to calculate estimates personalized for your driving, and to download the Fuel Economy Guide (also available at dealers).



Smartphone Interactive

Scan code for more information about this vehicle or to compare it with others.



Introduction



Credit: Argonne National Lab

Introduction

RESNET accredited HERS rating software programs:

- **REM/Rate**TM
- **ekotrope** 
- **EnergyGauge**[®] 
Energy and Economic Analysis Software

Introduction

“Someone with a watch knows what time it is.
Someone with two watches is never sure.”

- Segal’s Law



Introduction

“Someone with three rating software tools is never sure what the HERS index is.”

-Kruis’s Law



Introduction



Setting the Standards for
Home Energy Efficiency

Findings and Recommendations to the RESNET Board of Directors From the RESNET HERS Index Consistency Task Force

October 15, 2013

Background

With the nation's largest production home builders having all of their homes energy rated and marketing the HERS Index Score of these homes, RESNET has a unique opportunity to evaluate the

RESNET staff has received concerns from some of the leading builders about inconsistency to assigning rating scores to homes from the different RESNET Accredited Rating Providers. They found that the same house plan would have a different HERS Index Score from the different providers.

There is a growing number of production and custom relying on the HERS Index Score for marketing

their building energy codes, and MLS listing the scores. With this trend it is vital that RESNET maintain the credibility of HERS by enhancing the consistency in producing HERS Index Scores.

Previous Efforts

2/2014 - Members of RESNET Quality Improvement Committees Appointed

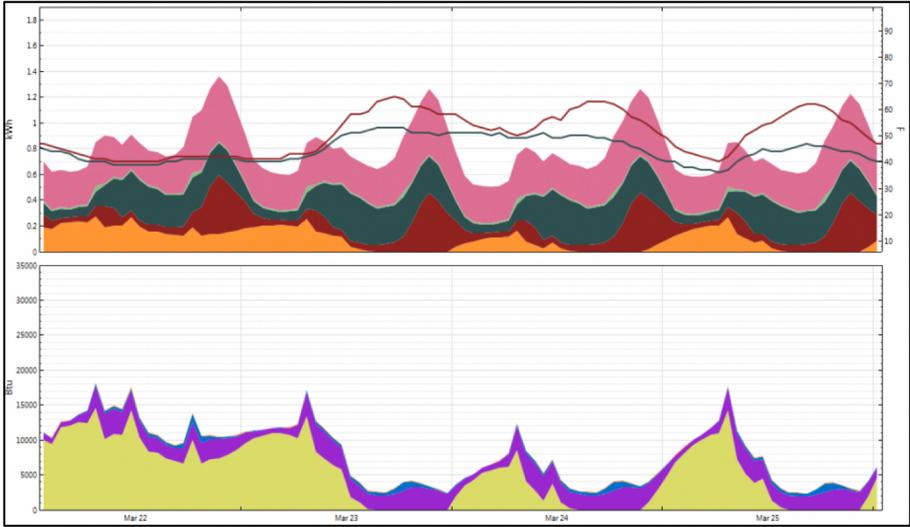
4/2016 – RESNET Embarks on Effort to Enhance Consistency of HERS Software Programs

11/2016 – Report of the HERS Consistency Task Force

11/2017 – Recommendations of RESNET Board Working Group on HERS Index Scores

Outcomes: Hourly Calculation Requirement

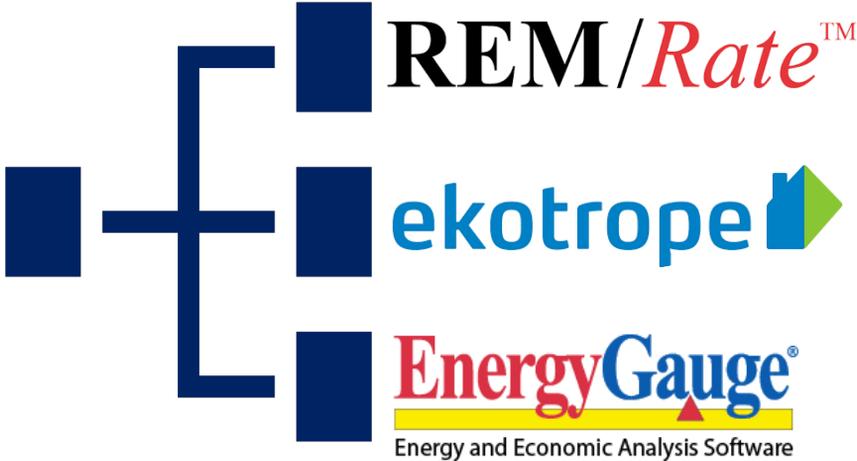
All HERS Index software must be based on hourly simulation by
January 1, 2020



Credit: NREL

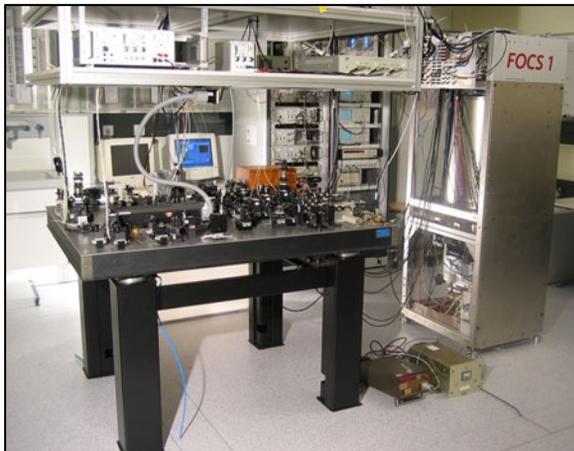
Outcomes: Working Toward a Common Input/Output Schema

Common
Schema



Outcomes: Two Options for Calculation Consistency

1. Common HERS Index Platform



2. Collaborative Modeling



Software Consistency Task Group



Setting the Standard for Quality

Are You A Homeowner?
[VISIT OUR HOMEOWNER SITE](#)

- Home
- Rater/Auditor Information
- Contractor Information
- Builder Information
- Provider Information
- Quality Assurance
- RESNET Standards
- RESNET Conference
- Partners
- Resources
- RESBlog

RESNET FORMS HERS SOFTWARE CONSISTENCY TASK GROUP TO ENHANCE THE CONSISTENCY OF THE CALCULATION OF HERS INDEX SCORES

January 11th, 2018 - Posted by emma@resnet.us under RESNET News



A critical element in ensuring the consistency of HERS Ratings is enhancing the consistency which RESNET accredited HERS Software Programs calculate the HERS Index Score. There are currently situations where a home could have a different HERS Index Score based upon which software program is being used.

At the 2017 Fall RESNET Board of Directors Meeting, the RESNET Board adopted the following actions in terms of enhancing the consistency of how HERS software calculates HERS Index Scores:

RESNET HOT TOPIC

- Conference
- Rater Information
- RESNET News
- Technical
- Training Opportunities
- Upcoming Events

POST AN ENTRY

If you have an event, issue or story that you would like to share with the residential energy efficiency community, please use the link below to submit it to us!

[Post an Entry](#)

Software Consistency Committee



Amber Wood



Philip Fairey



Cy Kilbourn



Scott Horowitz



Martha Brook



Software Consistency Committee: Charter



Setting the Standards for
Home Energy Efficiency

Charter of the RESNET Software Consistency Committee **Adopted by the RESNET Board of Directors on July 12, 2018**

Background of Software Consistency Committee (SCC) – The SCC was formed as part of a mechanism by which RESNET can improve consistency of HERS Index scores and modeled energy consumption (based on the RESNET/ICC ANSI Standard 301) among RESNET accredited HERS Rating Software Tools and enhance accreditation testing parameters. This is intended to be a continuous, ongoing process aimed at improving consistency.

This process will only address HERS ratings moving forward, it will not address ratings that have already been completed. This process is not meant to provide an immediate resolution for a specific rating, but to improve consistency problems over time.

Software Consistency Committee: Charter

- Oversee the continuous improvement in HERS rating consistency over time
- Evaluate and resolve RESNET Member inquiries about general inconsistencies
- Propose changes to enhance publications, tests, and standards to better enforce consistency (collaborative modeling)
- RESNET will hire Energy Modeling Director to chair SCC and act as the technical arbitrator in consistency inquiries

RESNET Energy Modeling Director



Bruce Wilcox, P.E.
(Independent)



Neal Krus




Matt Larson, P.E.


RESNET Energy Modeling Director



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RESNET® SELECTS ENERGY MODELING DIRECTOR: A BIG STEP TO ENHANCE THE CONSISTENCY OF THE CALCULATION OF HERS® INDEX SCORES

October 11th, 2018 - Posted by emma@resnet.us under RESNET News

A key to ensuring the quality of HERS ratings is to enhance the consistency which the various accredited HERS software programs calculate HERS Index scores. Too often in the past, the same home could receive a different score based upon the software program being used.

For the past four years, the RESNET Board has been striving to enhance the consistency of the calculation of HERS Index Scores.

A key element to meet this policy is the establishment of a RESNET Board Software Consistency Committee (SCC) and securing the services of a RESNET Energy Modeling Director.

The RESNET Energy Modeling Director will act as the arbitrator of the SCC, making technical decisions about modeling tests, requirements, and guidelines with the support of other members of the committee. The position will also be the liaison between the SCC and RESNET staff.

» RESNET HOT TOPIC

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- Rater Information
- RESNET News
- Technical
- Training Opportunities
- Upcoming Events

» POST AN ENTRY

If you have an event, issue or story that

RESNET Energy Modeling Director

- Chair the Software Consistency Committee
- Receive and prioritize consistency inquiries
- Propose changes to publications, tests, and/or standards to enhance consistency
- Enhance and expand RESNET test suites to evaluate and enforce consistency
- If needed, assist in the development of a scope of work for a single source engine (common platform).

About Me

About Me: Family



Neal, Cameron, Henry, and Hazel
Lafayette, CO

About Me: Education



B.S. Mechanical Engineering
2007

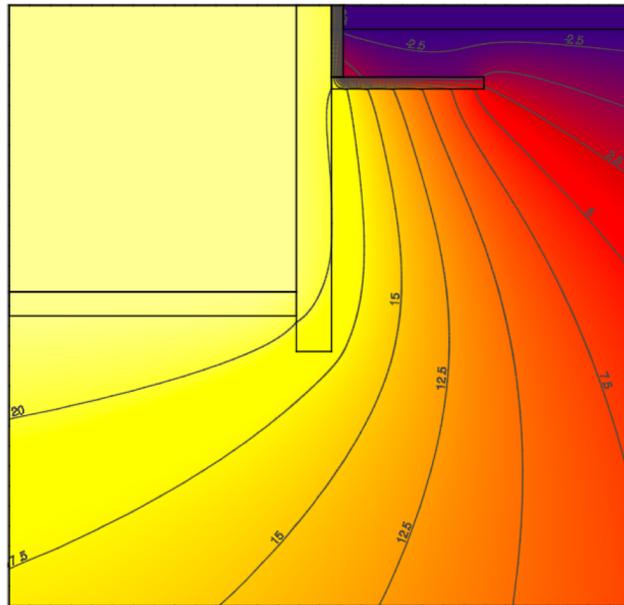


University of Colorado
Boulder

Ph.D. Architectural Engineering
2015

Dissertation:

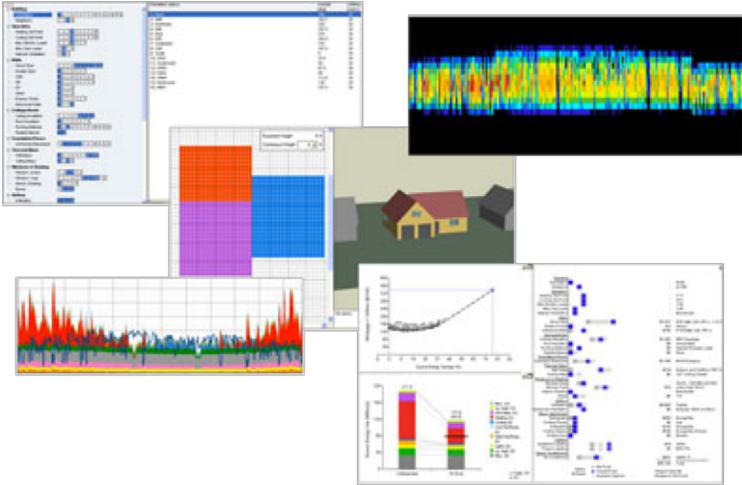
Heat Transfer through Building Foundations



About Me: Work Experience



Residential Research Engineer
2007-2012

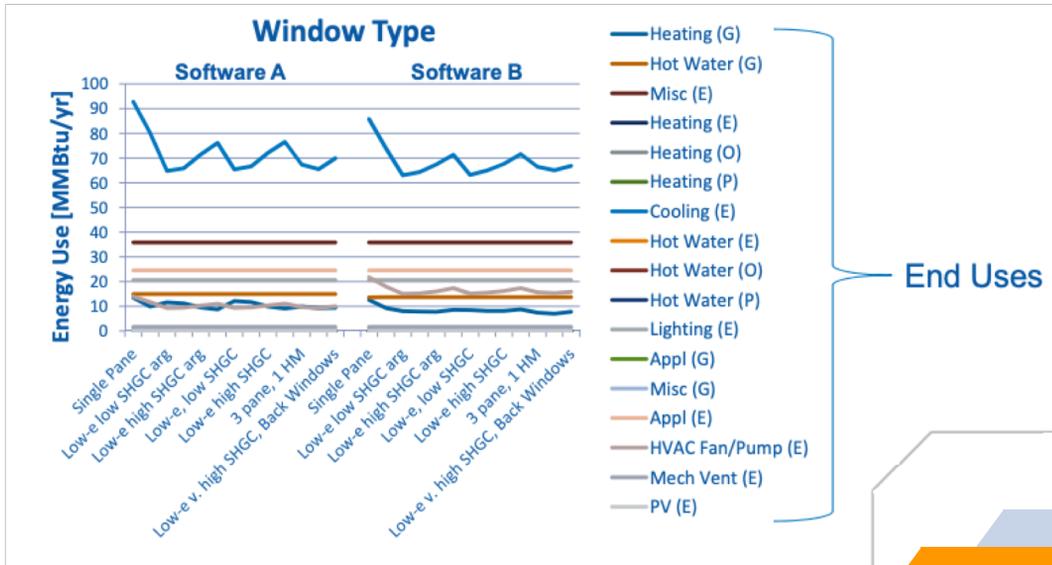


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About Me: Work Experience



Residential Research Engineer
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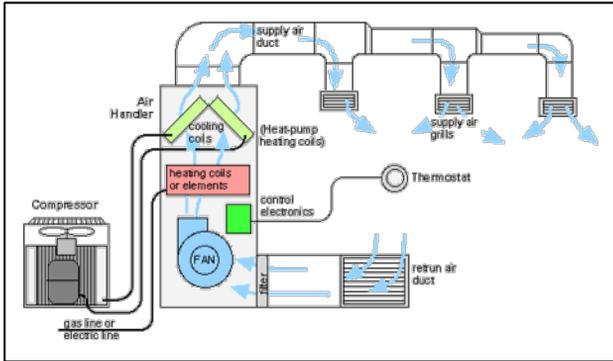


Diagnostic Comparative Tests

About Me: Work Experience



Vice President
2012-Present



Building Science

```
279
280
281 void Cell::ADImath(std::size_t dim, const double Q, const double f, c
      const double (δC)[3][2], double δA, double (δAlt)[
282
283   bVal = Q;
284   double bit{0};
285   for (auto sdim : dims) {
286     if (sdim == dim) {
287       Alt[0] = multiplier * C[sdim][0];
288       Alt[1] = -multiplier * C[sdim][1];
289       A = 1.0 - (Alt[0] + Alt[1]);
290     } else if (sdim < 5) {
291       bit += C[sdim][0] - C[sdim][1];
292       bVal += *(told_ptr + stepsize[sdim]) * f * C[sdim][1] -
293               *(told_ptr - stepsize[sdim]) * f * C[sdim][0];
294     }
295   }
296   bVal += *told_ptr * (1.0 + f * bit);
297
```

Computer Science



About Me: Work Experience



Vice President
2012-Present



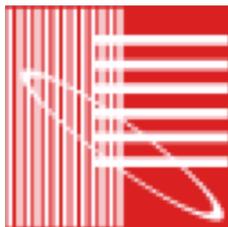
California Simulation Engine

About Me: Professional Engagement



- ASHRAE Standard 205P (Vice Chair): “Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment”
- ASHRAE/ANSI Standard 140 (Voting Member): “Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs”
- Technical Committee 4.7 (Secretary): “Energy Calculations”

About Me: Professional Engagement



IBPSA-USA

- Board of Directors (Treasurer)
- Advocacy Committee (Chair)
- Equalities Committee

About Me: Professional Engagemnet



Software Consistency Committee



Amber Wood



Philip Fairey



Cy Kilbourn



Scott Horowitz



Martha Brook



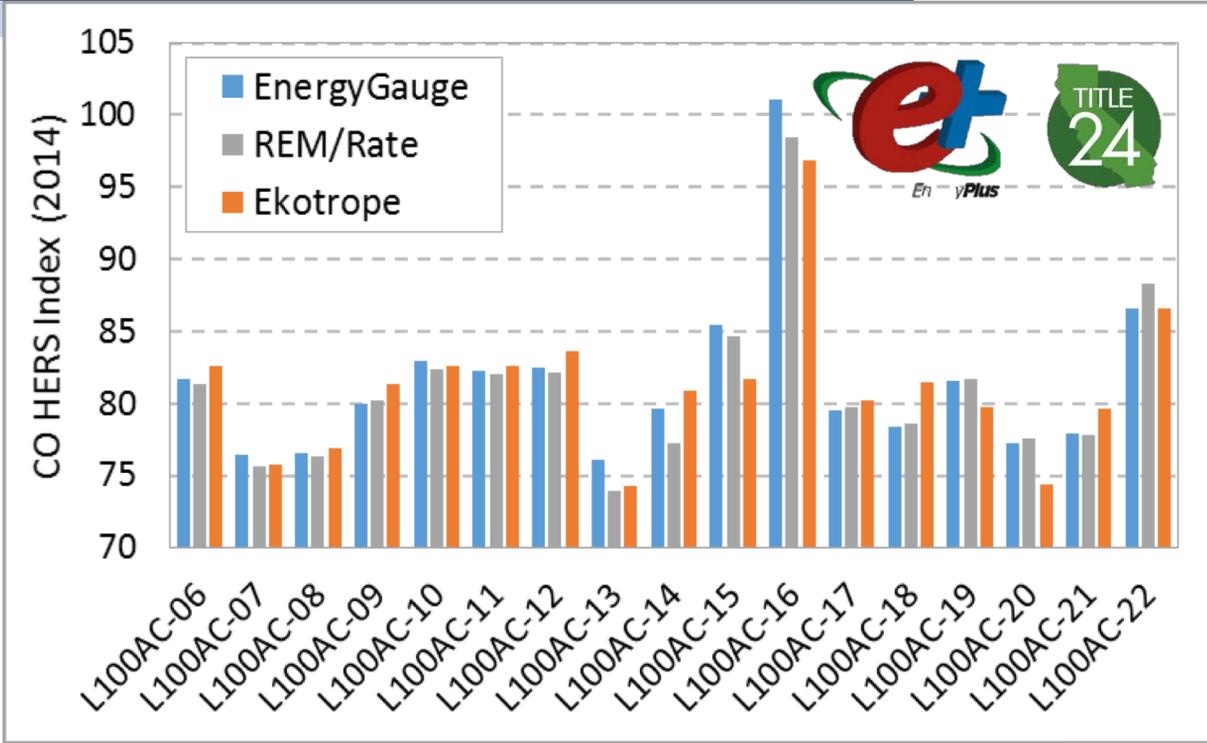
Neal Kruis



Work Plan

- Diagnostic framework
- Consistency inquiry system
- Revise acceptance criteria

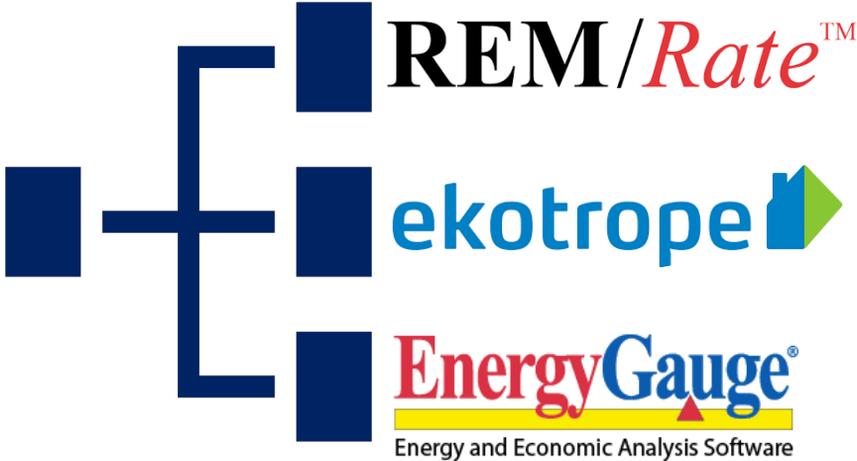
Diagnostic Framework: Test Suite



Credit: Philip Fairey

Diagnostic Framework: Common Schema

Common
Schema



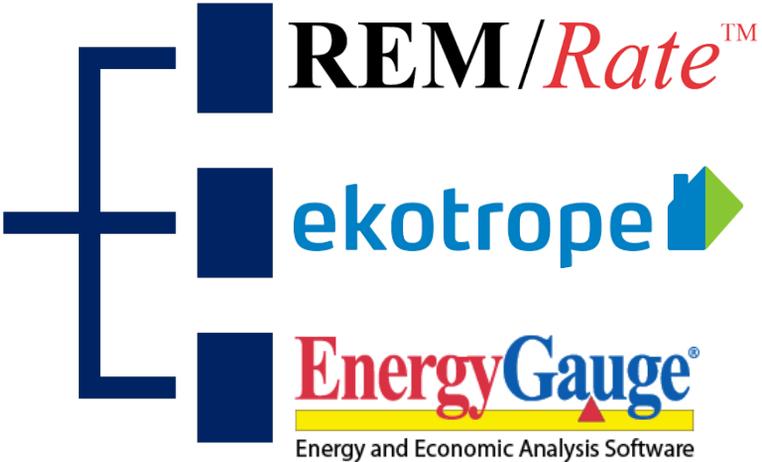
Diagnostic Framework: Common Schema

hpxml?

 gbXML? ■

REMXML?

JSON?



Consistency Inquiry System: Process

1. Inquiry submitted
2. Confirm issue
3. Prioritize
4. Create test case
5. Dig in/determine root cause
6. Consistency resolution

Consistency Inquiry System: Submit

SEARCH | ABOUT US | CONTACT US | PRIVACY POLICY | USER AGREEMENT | LOGIN



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[VISIT OUR HOMEOWNER SITE](#)

Home | Rater/Auditor Information | Contractor Information | Builder Information | Provider Information | Quality Assurance | RESNET Standards | RESNET Conference | Partners | Resources | RESBlog

MODELING CONSISTENCY INQUIRY FORM

Please note that Consistency Inquiries may not be resolved quickly, and are not meant as an immediate remediation to individual consistency issues. The Software Consistency Committee will address inquiries based on the size and nature of the inconsistency, and will use this information to continuously improve consistency across RESNET Accredited software.

All fields below are required for submitting a modeling consistency inquiry to RESNET

Contact Information

Name *

Company *

Join **RESNET** Today

[JOIN NOW](#)

Already a **MEMBER?**

[LOGIN HERE](#)



<https://www1.resnet.us/consistency/>

1. Description of Inconsistent Modeling Results *

A description of inconsistent modeling results between two or more software tools with as equivalent as possible input parameters, including the results from all of the software tools.

You may upload a file above or provide a description below.

AUDITOR/RATER?

Interested in becoming a **Rater/Auditor?**

Find out more

- Certification Requirements
- Business Opportunities

Consistency Inquiry System: Scope

What does the SCC investigate?

- ✗ Specific building products (e.g., brand X is not represented fairly)
- ✗ Ratings of specific homes
- ✗ Non-equivalent inputs
- ✓ General modeling/calculation methods
- ✓ General building components (e.g., windows, air conditioning)

Consistency Inquiry System: Prioritize

[Code](#)
🔔 Issues 656
🔗 Pull requests 32
📁 Projects 2
📖 Wiki
📊 Insights

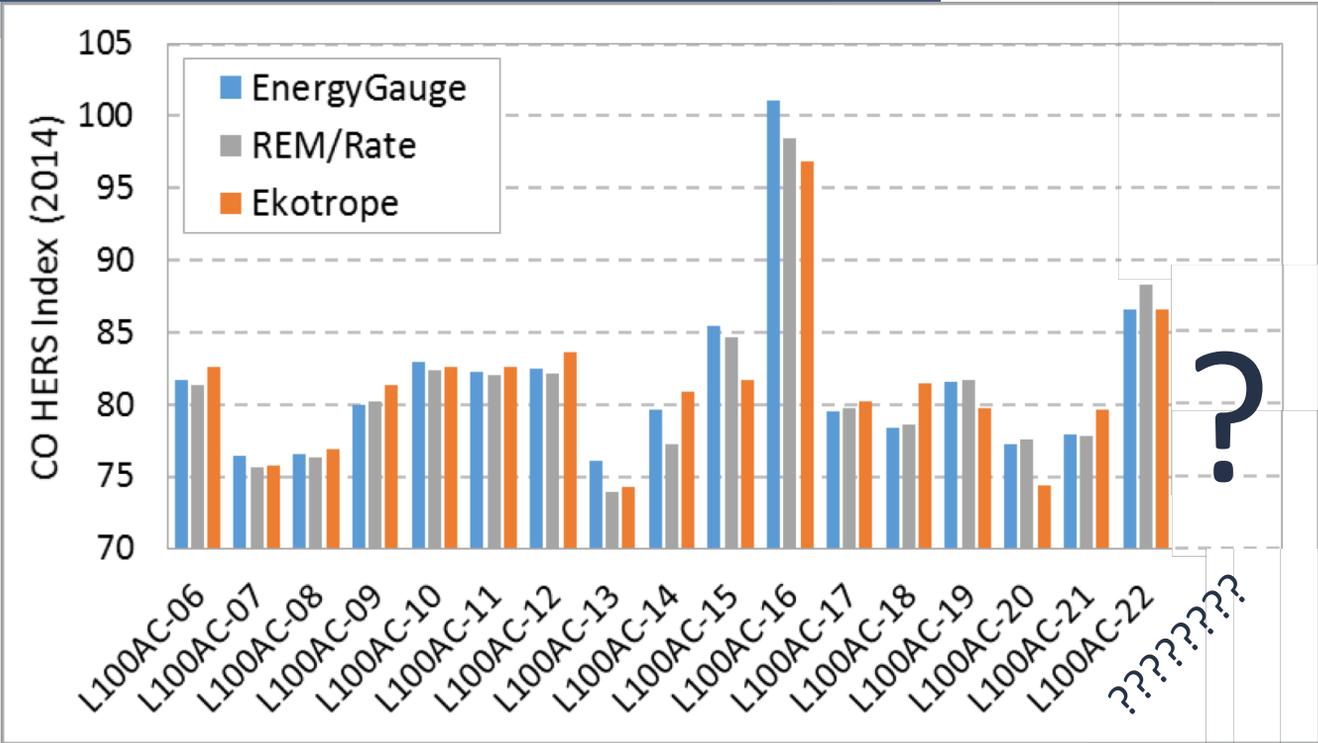
Filters
Labels
Milestones
New issue

🔔 656 Open 5,167 Closed

 Author ▾ Projects ▾ Labels ▾ Milestones ▾ Assignee ▾ Sort ▾

- 🔔 **PsyTwbFnTdbWPb: humidity ratio calculation does not include case for TWetBulb < 0**
#7187 opened 5 hours ago by dmev
- 🔔 **Sequential Loading with Unitary System not working** PriorityHigh
#7186 opened 7 hours ago by mjwitte 🗨️ 0 of 3 🏠 EnergyPlus 9.1.0
- 🔔 **Unexpected EIR values when using single speed air conditioners performance curves** 🗨️ 4
#7185 opened 23 hours ago by dmev
- 🔔 **Feature Request: Modify InternalMass object to reference Zonelist objects**
#7184 opened a day ago by mldichter
- 🔔 **Array bounds error in SizePIU** PriorityHigh 🗨️ 3
#7183 opened a day ago by mjwitte 🗨️ 1 of 3
- 🔔 **Energy Meters report is screwy when simulating with leap days** Defect
#7182 opened a day ago by shorowit 🗨️ 1 of 3

Consistency Inquiry System: Create New Test Case



Credit: Philip Fairey

Consistency Inquiry System: Investigate Differences



**Consistency Inquiry System:
Consistency Resolution**

5 Consistency Resolution Outcomes

Consistency Inquiry System: Consistency Resolution

Interpretation

Cause

Legitimate differences in interpreting publications/standards

Resolution

Propose clarifying language in publications/standards

Consistency Inquiry System: Consistency Resolution

Infraction

Cause

Software is out of compliance with publications/standards

Resolution

Resolved by RESNET Staff (in coordination with software vendor)

Consistency Inquiry System: Consistency Resolution

Prescribed Modeling Methodology

Cause

Different simulation methodology or modeling assumptions

Resolution

Prescribe higher fidelity methodology:

- General fidelity, exact algorithm, exact code

Consistency Inquiry System: Consistency Resolution

Modeling Guideline & Test Criteria Change Cause

Different simulation methodology or modeling assumptions

Resolution

Publish recommended best practice (not required)

Consistency Inquiry System: Consistency Resolution

Dismissal

Cause

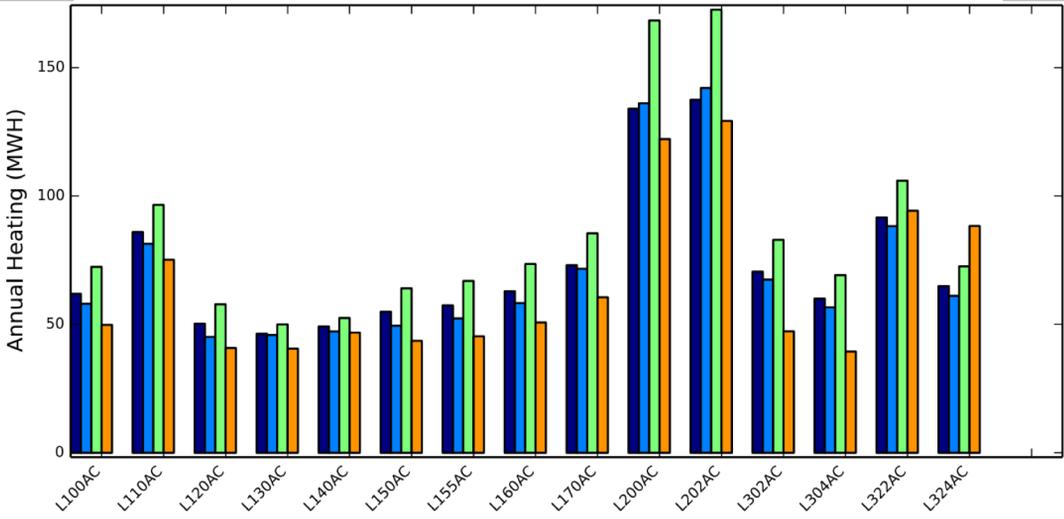
1. Insignificant or acceptable inconsistency.
2. Unsolvable within a reasonable level of effort and resources

Resolution

Dismiss inconsistency. If unsolvable and significant, publish rationale.

Revise Acceptance Criteria

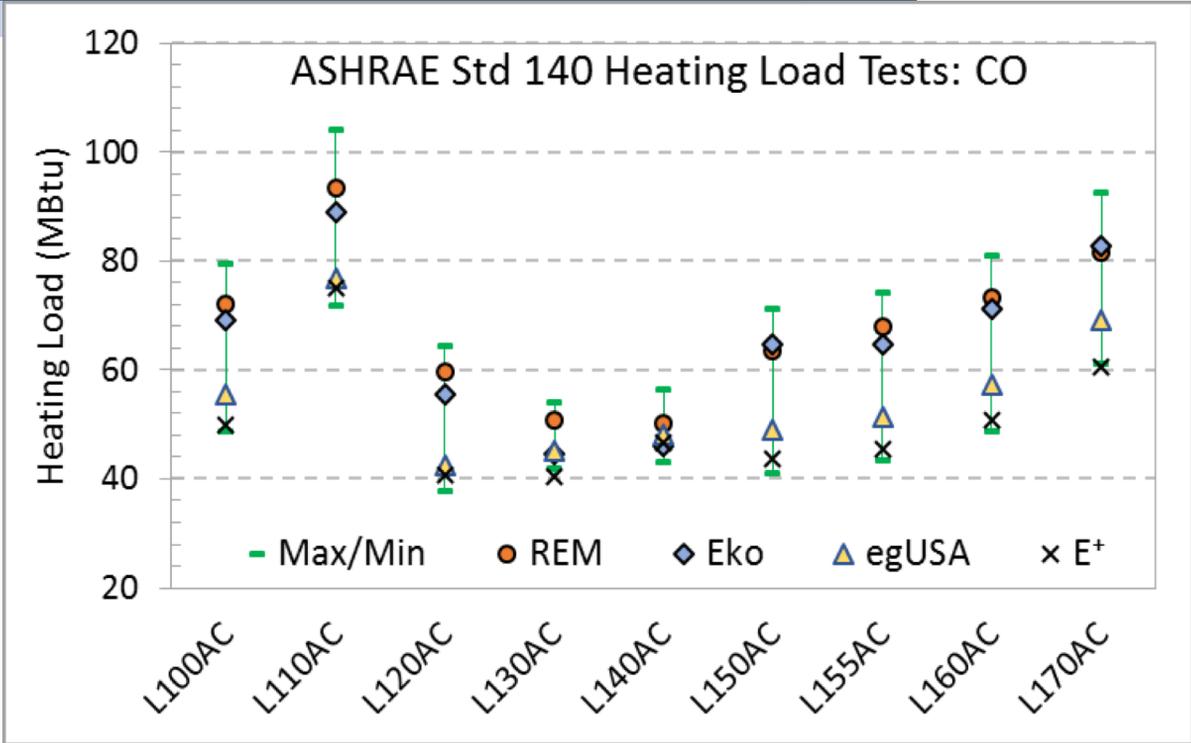
Standard 140-2011 Comparison
Home Energy Rating System (HERS)
Tier-1 Heating Tests - Colorado Springs



Credit: GARD Analytics

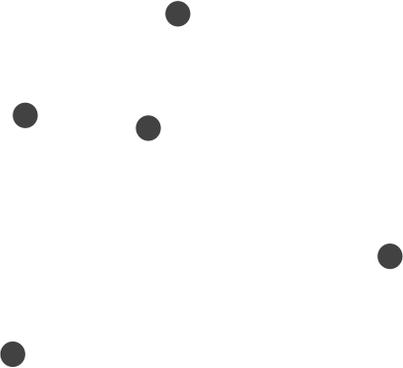


Revise Acceptance Criteria



Consistency vs. Accuracy

Consistency vs. Accuracy



Consistency vs. Accuracy



Conclusion

- RESNET is taking consistency seriously
- Remember to use the online form to submit inquiries

Open Forum Q&A with Software Consistency Committee



<https://www1.resnet.us/consistency/>