Energy Rating Program Evaluation - Appendices

Appendix I.A.

EnergyGauge

1.1 Contacts

Philip Fairey
Energy Gauge Support Office
Florida Solar Energy Center
1679 Clearlake Road,
Cocoa, FL 32922-5703
(321) 638-1492

1.2
1.3 Pricing

Item	Description	Price
ResSim*	Includes detailed DOE 2.1E simulation for design of low-energy buildings and evaluation of hourly peak demand impacts. Includes IECC 1998/2000 code compliance by IECC 1998/2000 code compliance by IECC Chapter 4 whole-building performance method.	$99
ResSim Pro*	Includes all above plus Pollution Analysis, and Tax Credit Qualification Report.	$149
ResRate Pro*	Call 321-638-1492 to order Includes all above plus HERS rating capabilities. Available only to certified Energy Raters.	$149
USA HERS Provider Version	Call 321-638-1492 to order Includes all above plus HERS provider capabilities. Available only to accredited HERS Providers.	$249
Registration (per Rating)	**For ResRate Pro only.** Includes QA, database storage of all registered Ratings, Energy Tax Credit Certification Reports and quarterly Ratings Report to Certified Rater, Accredited Rating Providers acting as software distributor or government funded project manager.	$20

Hardware Requirements

- CPU: Pentium II - 300 MHz (1.5 GHz recommended)
- RAM: 128 MB (512 MB recommended)
- Disk space: the total required hard drive space is 550MB (1 GB recommended), with at least 500 MB (1 GB recommended) on C-drive
- Screen resolution: 800x600 pixels minimum
- Color palette: 24 bit (recommended)
- Other devices: Printer, paper size: "Letter" format (required)
- MS compatible mouse (two button)
- Operating systems: Windows 98 Second Edition / ME / NT4.0 service pack 6 / 2000 / XP

Files

EnergyGauge saves each building information in a database. It can also be saved as a discrete file that can be exported and imported.

Libraries

Editable Libraries

Non-editable Libraries

Custom Features

EnergyGauge USA is a multifunction residential building tool. The standard version, ResSim, includes DOE2.1E simulation for design of low-energy buildings and evaluation of hourly peak demand impacts. It also determines compliance with the International Energy Conservation Code (IECC-1998/IECC-2000, Chapter 4 of the 2003 IECC, and Section 404 of the 2004 IECC and 2006 IECC) and includes a System Sizing feature that calculates whole house heating and cooling loads. The Pro version, ResSim Pro, adds pollution analysis, Improvement Analysis and a Tax Credit Summary Report that provides qualification criteria for Energy Policy Act of 2005 tax credits. The rating version, ResRate Pro, includes all of the above plus HERS rating capabilities. For more information on available EnergyGauge versions refer to the www.energygauge.com web site.

Envelope Leakage and Infiltration Conversions

Used by EnergyGauge® USA v.2.5 Compiled by P. Fairey

There are a large number of descriptors and variables used in the determination and representation of envelope leakage and infiltration in residential buildings. It is possible to convert back and forth between these variables and descriptors. The following discussion provides the necessary conventions for such conversions as they are used in EnergyGauge USA.

General Nomenclature:
ELA = effective leakage area (in^2) [US: ASTM E 779-92] (see Note 1)
CFA = conditioned floor area (in^2)
SLA = specific leakage area (in^2/in^2) = ELA / CFA
C = leakage coefficient (result of least squares regression of test data) (see Note 2)
n = flow exponent (result of least squares regression of test data)
ÄP = pressure differential (Pa)
EqLA = equivalent leakage area (in^2) [Canadian: CAN/SGSB-149.10-M86] (see Note 3)

ach = annual average air change rate (conditioned space volume changes per hour)
ach50 = air changes per hour at 50 Pa pressure differential
cfm50 = airflow through leakage area at 50 Pa pressure differential
cfm25 = airflow through leakage area at 25 Pa pressure differential
CSV = conditioned space volume (ft^3)
W = weather factor (from ASHRAE Standard 136)
NS = number of stories above grade
nL = normalized leakage (from ASHRAE Standard 119)

ASTM Standard E 779-92 Source Equations (SI Units):

Q = C * ÄP^n [equation used to regress test data]
L = C * (ÄPr)^(n-½) * (ñ/2)^½
where:
Q = airflow (m^3/s)
L = leakage area (m^2)

ÄPr = reference pressure differential (Pa) [taken as 4 Pa]
ñ = air density (kg/m^3) [taken as 1.20 kg/m^3]

Conversion Equations (IP units):

nL = 1000 * SLA * NS^0.3 [ASHRAE Standard 119] (1)
SLA = nL / (1000 * NS^0.3) (2)
SLA = ELA / CFA (3)
ELA = CFA * SLA (4)

SLA = ach / (1000 * W * NS^0.3) (5)
ach = SLA * 1000 * W * NS^0.3 (6)
ELA = 0.2835 * C * 4^n ['C' input in IP units] (see Note 4) (7)
EqLA = 0.2939 * C * 10^n ['C' input in IP units] (8)

C = ELA / (0.2835 * 4^n) ['C' returned in IP units] (9)

C = EqLA / (0.2939 * 10^n) ['C' returned in IP units] (10)
cfm50 = C * 50^n ['C' input in IP units] (11)
cfm25 = C * 25^n ['C' input in IP units] (12)
ach50 = (cfm50 * 60) / CSV (13)
cfm50 = CSV * ach50 / 60 (14)

Conditioned Basement Leakage – A Special Case

Some standards require that the basement zone leakage in Reference Homes with conditioned basement be related to the percentage of the conditioned basement exterior gross wall area that is above grade in accordance with the following formula:

SLAbsmt = SLAmain * [(BWAa-g) / (BWAtot)] Eq. 1

Such standards also provide that the overall leakage for homes with conditioned basements be calculated based on the respective conditioned zone areas, as follows:

SLAOA = [(CFAbsmt * SLAbsmt) + (CFAmain * SLAmain)] / [CFAtot] Eq. 2

where:
BWA = gross exterior basement wall area
CFA = conditioned floor area

and where the subscripts represent:
bsmt = basement zone of the home

main = above-grade zone(s) of the home

a-g = above-grade value

tot = total value
OA = overall value including all zones of the home

For HERS Reference Homes with conditioned basements, the 1999 HERS standard specifies that the Reference Home have a normalized leakage (nL) of 0.57. Using conversion equation (2) to convert nL to SLA yields:

SLAOA = nLOA / (1000 * NS^0.3)

For Rated Homes with "proposed" or "tested" leakage, the test protocols require that the measured leakage values represent the entire conditioned space, including the conditioned basement zone. The main zone leakage may be calculated individually by substituting the right hand side of equation 1 into equation 2 to obtain SLAmain, as follows:

SLAmain = [CFAtot* SLAOA] / [CFAbsmt*(BWAa-g / BWAtot) + CFAmain] Eq. 3

SLAbsmt may then be calculated by solving Equation 1 in its original form.

Derivation of the Coefficient Used in Conversion Equation (7)

Beginning with the SI source equations and converting from SI units to IP units:

$Q = C * ÄP^n$ Eq. 4

$L = C * (ÄPr)^(n-½) * (ñ/2)^½$ Eq. 5

To convert from SI units to IP units, both L and C must be converted. The units of L are converted from m^2 to in^2, as follows.

CFL = m^2 * 10.764 ft^2/m^2 * 144 in^2/ft^2 = 1550 in^2 per m^2

From equation 4 the units of C are m^3/s / Pa^n and the Pa^n term cancels in equation 5, leaving the m^3/s term to be converted to ft^3/min (cfm), as follows:

CFC = m^3/s * 35.31ft^3/m^3 * 60 s/min = 2118.6 ft^3/min per m^3/s

To convert L from m^2 to its ELA equivalent (in^2), the right hand side of equation 5 is multiplied by CFL and to convert C from m^3/s to ft^3/min (cfm), the right hand side of equation 5 is divided by CFC, such that the overall units conversion factor is:

CFSI-IP = 1550 / 2118.6 = 0.7316

Applying CFSI-IP to the right hand side of equation 5 yields ELA, as follows:

$ELA = 0.7316*C * (ÄPr)^(n-½) * (ñ/2)^½$ Eq. 6

Simplifying the individual terms of equation 6 yields:

$(ÄPr)^(n-½) = (4^n / 4^½) = 4^n/2$ [standard reference pressure = 4 Pa]

$(ñ/2)^½ = (1.20/2)^½ = 0.7746$ [assumed air density = 1.20 kg/m^3]

And recombining the simplified terms into equation 6 yields:

$ELA = 0.7316 * C * 4^n/2 * 0.7746$
$ELA = 0.2833 * C * 4^n$ Eq. 7

Note that the conversion factor (0.2833) in equation 7 is virtually identical to the conversion factor of 0.2835 given by the referenced Energy Conservancy document (see Note 4).

Notes:
1 The standard reference pressure differential for the calculation of ELA is 4 Pa (U.S. Standard).

2 The units of measured data used in the least squares regression determine the units and value of 'C'. For SI units, 'C' will be derived from airflows measured in m^3/s and for IP units, 'C' will be derived from airflows measured in ft^3/min (cfm). As a result, the value and units of 'C' will differ substantially based on whether the regression is performed using IP units or SI units. The units of pressure in both systems are Pa.

3 The standard reference pressure differential for the calculation of EqLA is 10 Pa (Canadian Standard).

4 Equation as given by: “Minneapolis Blower Door Operations Manual – Model 3”, July 1998, Energy Conservancy, pp. 33 and re-derived herein.

Mechanical Ventilation Calculations

The discussion below shows the EnergyGauge USA calculation procedure for 2006 ratings to meet the interpreted rules of RESNET's method for mechanical ventilation. These changes can be seen by viewing the Infiltration component screen of the 2006 Rated House.

If there is mechanical ventilation:

1. Calculate mincfm based on number of bedrooms and conditioned floor area:
(0.01 * CFArea) + (7.5 * (Bedrooms+ 1)).

2. Calculate amount of expected natural infiltration as

Expected Natural Infiltration = 0.02*CFA.

3. Calculate Excessive(+) or Shortage(-) from Expected
Excessive = Entered Natural Infiltration - Expected Natural Infiltration.

4. Adjust the mechanical mincfm by one half of the excessive natural amount
Mincfm = Mincfm - 0.5*Excessive.

5. Compute entered mechanical cfm for testing:
a. For Fans/ERV with runtime set, the larger of the exhaust or supply entered flow is adjusted by the runtime percent entered
b. For runtime vent with min and max, the entered flow is adjusted by the larger of the min runtime entered or 20%; if max runtime is set lower than 20% it is only adjusted up to the max amount entered

c. For simple runtime vent, no adjustment - the entered ventilation system will be modified (see later step).

6. If the mechanical system flow is less than the mincfm required then the following rules are invoked:
a. For Fans/ERV, use the entered runtime but adjust the flow to cfmmin for the larger of exhaust or supply - note that this means a balanced system will be unbalanced but more energy efficient for supplying a certain volume of air. Thus if a mincfm of 50 is required but the user indicated 60 cfm running just 33% of the time, now there will be a 150 cfm fan running 33% of the time. The power/(exhaust+supply cfm) ratio of the entered system will be applied to the new flow rate to determine the power draw for the ERV.

b. For runtime vent with min and max, if the min or max is less than 20% then set both to 20% and adjust the continuous mincfm to be five times larger (thus for 50 cfm continuous the software will compute 250 cfm). If larger min vent is entered then the flow will be computed on that rate. For example, 33% minvent will yield 150 cfm for this example.
c. For runtime vent (no min or max control), the rated home will be changed to a "runtime vent with min" and minvent and maxvent set to 20% and five times the required continuous flow. In the example, this would result in 250 cfm.

When there is no mechanical ventilation the natural infiltration is adjusted to the higher of the entered value or 0.35 ach for the rated home.

The reference house is modeled with a default natural infiltration all the time. If there is a mechanical ventilation system in the user home then extra fan energy is added to the reference home per RESNET rules.

Appendix I.B.

RemRate

1.4 Developed By

Architectural Energy Corporation
2540 Frontier Avenue, Suite 201
Boulder Colorado 80301

1.5
1.6
1.7
1.8 Contact

Dan Roberts
Phone: (303) 444-4149; Fax: (303) 444-4304
Email: reminfo@archenergy.com http://www.archenergy.com

1.9 Pricing

REM/*Rate*™ is not sold, but rather licensed annually to HERS providers. The license agreement grants providers the use of the **REM/*Rate*™** software, as many copies of the software as the HERS providers needs, free upgrades, and in many cases the right to sublicense to independent, certified HERS raters working within their program. In exchange, the HERS providers pay an annual license fee, and a rating/use fee for each home certified.

At this time licensing of **REM/*Rate*™** is generally restricted to accredited HERS providers.

Annual Software License Fee - $500
Rating/Use Fee - Applies to each home (unique mailing address) receiving an Energy Rating, Energy Star Home Certification or Tax Credit Certification using information generated by the Software.

First 1,000 ratings completed during single contract year	$6 each
Ratings 1,001 through 2,000 in single contract year	$5 each
Ratings 2,001 through 3,000 in single contract year	$4 each
Ratings 3,001 through 4,000 in single contract year	$3 each
All ratings in excess of 4,000 in single contract year	$2 each

Additional Consulting Fees - $100.00/hr. plus reimbursable expenses.

Hardware Requirements
OS: Windows 98, Windows 2000, Windows ME, Windows XP, Windows Vista
CPU: 200 MHz or better
RAM: 64 MB or better
Disk: 20 MB or better free disk space
Other: CD-ROM Drive for software installation
Help: REM help is a compiled HTML file and requires Internet Explorer 4.0 or higher. It can be run as a stand alone program by double-clicking on the file "REM_Help.chm", located in the same directory as the REM executable.

Operating Modes

REM now operates in three different modes: *Trial*, *Provider* and *Rater*. *Trial* is for evaluation and training. Which mode the program runs is determined when the program is registered. *Provider* is designed for use only by accredited HERS Providers. *Rater* mode is for the individual Raters working in the HERS program administered by a Provider. The *Rater* level has the printing capability that the Provider grants it. The operation mode only affects what reports can be printed; all other functions operate in the same manner.

Files

- REMRate projects are created and stored in individual (bdg) data files..
- Files may also be exported to a new or existing database file (MS ACCESS 2000)

Libraries

Building Component Libraries

These libraries contain descriptions of building components which may be common to many buildings. These component library types can be accessed in the Detailed Inputs or Simplified Inputs screens:

Foundation Wall specified by construction type, interior and exterior insulation.
Slab Floor specified by perimeter insulation and under slab insulation.
Frame Floor described by path area and layers or continuous and frame cavity insulation.
Above-Grade Wall described by path area and layers or continuous and frame cavity insulation.
Window/Skylight specified by U-value and Solar heat Gain Coefficients.
Door described by R-value and storm door presence.
Ceiling described by path area and layers or continuous and frame cavity insulation.
Heating Equipment described by type, capacity and efficiency.
Cooling Equipment described by type, capacity and efficiency.
Water Heating Equipment described by type, capacity and efficiency.
Air-Source Heat Pump described by type, capacity and efficiency.
Ground-Source Heat Pump - closed loop systems described by ARI capacity and efficiencies.
Dual Fuel Heat Pumps described by fuel type, heating and cooling capacity, and back-up heating type, and efficiency.
Integrated Space/Water Heating - described by type, capacity and efficiency.

Improvement Analysis Libraries

These libraries are used when performing an energy efficient improvement analysis.
Improvement Measures - This library contains energy efficient improvement measures that are automatically evaluated each time an ***Improvement Analysis*** is requested. Any measures with a preexisting condition found in the building will be evaluated.
Improvement Measures Costs - This library contains measure costs associated with the energy efficient improvement measures of an improvement analysis.

Utility Rates Library

This library contains a description of utility rates. You can create or modify rates based on a set of monthly blocks for different utilities and/or different fuel types.

Library Utilities

Library Set: In previous versions of REM, all libraries were stored in the application folder. Now, libraries can be stored in any number of folders, and REM lets you switch from one folder to another. A folder containing library files is called a *library set.*

Library Transfer lets you transfer library entries to and from transfer files. These files (*.LBT files) may then be copied to a floppy disk, and then onto another machine, where a second copy of REM will be able to load the saved libraries. This allows libraries to be easily shared by different users, and even allows organizations to create and maintain a "master library" that can be easily distributed. The library transfer menu can develop new library transfer menus or create new ones. REM/*Rate* has added two library transfer files, one for **Manual J** components, and one for HVAC equipment.

Code Compliance

REM/*Rate* helps you quickly determine if the building you are analyzing meets the 1992, 1993 or 1995 CABO Model Energy Code (MEC), ASHRAE Standard 90.2 - 1993, or any of the IECC Compliances (1998, 2000, 2001, 2003, 2004, 2006, Energy Conservation Code of New York State, and the Energy Conservation Code of Southern Nevada).

The MEC Uo compliance report compares the overall U-value of the building described in REM/*Rate* to the overall U-value for an identical home insulated to meet the minimum component performance requirements of the MEC. This type of compliance, using an overall U-value, accounts for tradeoffs between different components of the home. The report for MEC Uo compliance lists the U-values for each building component as defined in the MEC for both the code building and the building as designed (R-values are listed for slab floors). In the case where a frame floor is situated over a crawl space or unconditioned basement, the MEC requires either the floor or the foundation walls to be insulated. Of these two areas, REM/*Rate* will use the component most heavily insulated to check MEC compliance.

The ASHRAE Standard 90.2 - 1993 Uo compliance report is slightly different than that for MEC. For each component in the building a *load change* is calculated. The load change is calculated from the difference in U-values for the design building and the standards building, the heating and cooling degree-days for the site, and weighting factors correcting for the relative importance of each component. The sum of the load changes for all components must be positive for the building to comply with the ASHRAE standard.

The ASHRAE and MEC performance compliance reports compare the annual energy use for heating and cooling for the building to the energy use for the same building built to meet the minimum prescriptive code requirements. Some aspects of the building are changed to meet the requirements for performing this type of compliance analysis so the energy values reported may differ from those in other REM/*Rate* reports. What is important is how the energy use compares for the two buildings in this report. If the building in REM/*Rate* uses less energy than the building built to code, the building is in compliance. This type of compliance analysis is well suited for buildings with passive solar features or high efficiency equipment.

User Defined Reference Home

Use this feature to create and customize reference homes. A reference home could describe a local code, or local building practices. Once defined, a **UDRH can be selected** to compare the energy use of any building to that of the reference building.

Custom Features

Batch Mode

This feature allows you to create a list of buildings (batch) to run all at one time. Once the list of buildings has been determined, you can select reports to view, and/or export the buildings. The Batch Mode is also instrumental in comparing energy savings due to energy saving measures. For example, use different types of heating equipment for each home to observe which saves the most energy. Another example might include duplicating a home: Use one as the baseline home to be left unchanged, and the other as the dynamic home. Add an energy saving feature to the dynamic home and note the change. Continue this trend to observe the incremental energy and energy cost savings.

Lights and Appliances

Version 12 of REM requires a **lights and appliances audit**. There are two options to completing this screen, simplified which takes defaults of equipment or detailed which allows you to add equipment information which is taken into account when generating an energy rating.

Orientation – Windows/Wall Input

In REM you find the house orientation in the window screen and exterior walls are assigned to each window, indirectly assigning a wall to an orientation. REM window functionality includes the input of overhangs based upon measurements instead of subjective measurements. REM requires you to input the depth from top of window, and from bottom of window, into the overhang fields.

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Default Values

Default Values inputs allow the user to speed up the data entry for the energy model. The default value applies only to the components that are created after the default is set. For example, changing the default wall constructions will not affect walls

that are already entered in the project, but each new wall created after the default was set would have the new default construction.

Reports

Some reports are available in a two-building format where one building is compared to a reference building and display the differences in energy use and cost. Each of the menu options are discussed below.

Quick Analysis - This subcommand performs an energy calculation based on the selected building file and location, and presents a one-page output of results for a quick overview of energy performance. These results include annual loads for heating, cooling, and water heating, annual consumption and costs for heating, cooling, water heating, lights and appliances, and peak heating and cooling loads for equipment sizing. This is not a printable report.

Action Report - Ranks the building elements with the largest energy consumption on a component basis.

Air Leakage Report - Displays infiltration in all available units (regardless of the user input). Displays duct leakage in all available units if other than the qualitative default is selected. Also displays the building ventilation information and whether or not mechanical ventilation is required. If mechanical ventilation is required, the amount (cfm) and duration (hours per day) are displayed. Ventilation information displayed is based on ASHRAE 62.2 - 2003 requirements.

Building File - Echoes the building inputs. Use for verification or documentation.

Builder Affidavit - Builder affirmation of construction characteristics, coupled with HERS Provider/Rater disclaimer.

Component Loads Summary - Presents the heating and cooling load of the building on a component basis.

Component Consumption Summary - Presents the heating and cooling energy consumption of the building on a component basis.

Component Design Loads Summary - Presents the heating and cooling design load (or sizing load) of the building on a component basis, in kBtuh.

Economic Summary - Shows the simple payback, first year savings, and the present value of savings for one or more design modifications. Use to determine if a specific energy feature, or combinations of multiple energy features are cost effective. Includes entries, such as, interest rate, loan year, and implementation cost.

Emissions Report - Summarizes the absolute values for Carbon Dioxide (CO2), Sulfur Dioxide (SO2), and Nitrous Oxides (NOX) emissions produced by the currently loaded building.

Energy Cost and Feature Report - Summarizes the annual heating, cooling, water heating and lights and appliance costs and the major energy design features of the home.

Equipment Sizing - Provides information about sizing heating and cooling equipment to meet the peak loads and the minimum Sensible Heat Fraction (SHF).

Fuel Summary Report - Summarizes the end-use energy consumption by fuel type.

Lights and Appliances - Summarizes the annual lights and appliance costs of the home.

Performance Summary - Summarizes the annual loads, energy consumption, and energy costs for heating, cooling, water heating, and lights and appliances.

Performance Factors - Shows area normalized and climate normalized consumption..

Source Energy & Emissions Report - Summarizes the Carbon Dioxide (CO2), Sulfur Dioxide (SO2), and Nitrous Oxides (NOX) emissions from the source (power plant) based on the type of fuel used at the home and the location. The emission data for all 50 states were obtained from the American Gas Association.

2005 EPAct Tax Credit - Indicates whether the home qualifies for tax credits under Sec. 1332, Credit for Construction of New Energy Efficient Homes, of the Energy Policy Act of 2205. **The home must be inspected/approved by a certified HERS rater to receive credit.**

Utility Bill Reconciliation - A graphical comparison between the REM output and actual utility bills for the current building.

ASHRAE 90.2 Reports - Compare the Uo or energy performance of the home to the requirements of ASHRAE Standard 90.2-1992.

Energy Star Reports - There are seven different reports related to Energy Star that show whether your building design meets the EPA Energy Star Home requirements, provide a list for inspections, describe code-related characteristics of the building envelope.

IECC Compliance Reports - Compare the Uo or energy performance of the home to the requirements of the International Energy Conservation Code for 1998, 2000, 2001, 2003, 2004, 2006, the ECC of New York, or the ECC of Southern Nevada.

MEC Compliance Reports - Compare the Uo or energy performance of the home to the requirements of the 1992, 1993 or 1995 version of the CABO **Model Energy Code**.

Certificate of Completion - This is a blank standard form developed by Federal National Mortgage Association and Federal Home Loan Mortgage Corporation to be used by HERS (providers) as part of the Energy Mortgage Pilot Program. The form certifies that recommended improvements to the home have been made. (Energy Mortgage Pilot Form 701).

Energy Appraisal Addendum- This is a blank form for attachment to the Uniform Residential Appraisal Report (FHLMC, Form 70; FNMC Form 1004) and submitted in conjunction with the Home Energy Rating Certificate.

Energy Loan Application - This is a blank form for attachment to the Uniform Residential Loan Application (FHLMC, Form 65; FNMC Form 1003).

Home Energy Rating Certificate (HERC) - Provides a **HERS Index** based on the National HERS Standards and annual energy cost in accordance with the National HERS Council. There is also a **logo** selector screen that lets you place bitmaps in the report.

RESNET Standard Disclosure - To be completed for each home that receives a Home Energy Rating. Its purpose is to disclose the Rater's affiliation with the home at the time the final rating is issued.

LEED for Homes Checklist -

Satisfactory Completion Certificate - This is a blank standard form developed by the Federal Home Loan Mortgage Corporation and used by appraisers or inspectors to certify that required repairs and improvements were made to the home. (FHLMC 442 Rev. 6/78).

Summary of Reports Selected - Provides a list and short summary of all other reports selected.

Mailing Label - Fills in the owner's name and address of the current building, on Avery #5164 paper.

This paper has six labels per page, and REM will bring up a dialog allowing you to select where the address will be printed.

Graph - provides the capability to make a quick graphical observation of the heating, cooling, total energy cost, and HERS Index of a building. It also has a feature allowing you to add up to three buildings to perform a comparison. Useful when you have buildings you wish to compare, or when you want to make changes to a building and quickly see the difference.

Error Report - Lists any errors that may exist in a building file.

Improvement Analysis - Begins the process of automatically analyzing multiple energy efficiency improvement measures for the home. A report can be generated that ranks the measures using economic performance. Other reports can also be generated regarding improvements to the building. These include : **IA HERC**, **IA HERC - No Costs, Fannie Mae**, **Energy Efficient Mortgage Worksheet**, **FHA EEM Certificate,** and **Work Order**.

Fannie Mae New Home EEM Report... - Use this report to show the energy savings (for underwriting purposes in accordance with the requirements of the **E**nergy **E**fficient **M**ortgage product) to determine the energy savings related to the property.

User Defined Reference Home -Use this feature to create and customize reference homes. A reference home could describe a local code or local building practices. Once defined, a UDRH can be selected to compare the energy use of any building to that of the reference building.

Rating Use Fee Statement - Send this completed form to AEC when providing information on the number of ratings performed per the terms of your REM/*Rate* licensing agreement.

Print Permissions - This option is available only to the HERS Provider.

Batch - Select a group of buildings, compare output by viewing reports or export.

HOME ENERGY RATING

REM/*Rate* provides a HERS Index and an annual energy cost in accordance with the RESNET HERS Standards. The energy efficiency rating of a house is presented as an Index. The Index is based on a comparison of the annual energy requirements for heating, cooling and hot water in the home being rated (with some standard operating conditions), to the annual energy requirements for the same home reconfigured to RESNET HERS *Reference Home*. The Reference Home is assigned an

Index of 100 points. A Rated Home with the same annual energy requirements as its associated Reference Home would have a HERS Index of 100. Every one percent decrease in the Rated Home's energy requirements from the References Home's energy requirements decreases the Rated Home's Index by one point. Similarly, an increase of one percent in the ratio increases the Rated Home's Index by one point. The RESNET HERS Standards also specifies a star rating.

Weather Data

If the exact location you are interested in is not listed, select a nearby location with similar weather characteristics.

The heating degree-days (***HDD***) and cooling degree-hours (***CDH***) shown on the location selection dialog are used for code compliance purposes only; MEC uses HDD while ASHRAE 90.2 requires both HDD and CDH. Default values are displayed when a weather location is selected. If you need to show compliance for a specific HDD (as is often required by local energy codes), edit the existing value as needed.

Also displayed on the location selection dialog are:
Climate Zone
ASHRAE W Factor
Design Heating Temperature – based on 2005 Handbook of Fundamentals, Design Heating Temperature
Design Cooling Temperature – based on 2005 Handbook of Fundamentals, Design Cooling Temperature

Spreadsheet

REM has a simple spreadsheet in which you can enter numbers, text, and formulas, much like EXCEL. The spreadsheet is visible on the screen at any time. It is part of the building, and is saved and loaded in the building file.

Utility Bills

Use this dialog to enter the actual utility bills for the current building. The data are used in generating the Utility Bill Reconciliation report, which compares the annual billing data to the energy use predicted by REM. The data is associated with the building and saved in the building file.

Manual J

Manual J is a load calculation methodology developed jointly by the Air Conditioning Contractors of America (ACCA) and the Air-Conditioning and Refrigeration Institute (ARI). Manual J provides accurate, practical procedures and data for calculating heat loss and heat gain in residential buildings. This data is taken from the ASHRAE Handbook of Fundamentals. Manual J uses a library of envelope components and assigns each one a Heat Transfer Multiplier (HTM) based on construction, the design temperature difference, and season. REM/*Rate* includes the entire Manual J library as a **Library Transfer File**.

Improvement Measures

REM/*Rate* lets you define improvement measures for a building. Improvement measures are defined by an *Existing* Condition (actual or designed), a *Proposed* Condition, and **Measures Costs**. When an **Improvement Analysis** is performed, improvement measures whose *existing* condition match the current components in the building are evaluated, ranked, and reported in the improvement analysis report.

The following **library-based measures** can be accessed in REM :

Ceiling
Above Grade Wall
Foundation Wall
Frame Floor
Slab Floor
Window
Skylight
Door
Mechanical Equipment - Heating, Cooling, DHW

Library Set

A *library set* is a complete set of REM libraries stored in a folder. During the REM install, a default library set is initially created and saved in the "Libraries" subfolder in the application path. REM can recognize

library files stored anywhere in the file system accessible by your computer. A library set can be locked and password-protected. Individual items in a library can be locked; locked items can't be modified by you unless you enter a password. Or, the entire library set can be locked preventing changes to the set as a whole.

Print Permissions Dialog (Provider Only)

REM/*Rate* gives the Provider a simple, yet flexible way to manage the print permissions for Raters. **The print permissions dialog box is only for use by Providers.** From this dialog, a Provider can view/send permissions to the web site, create permissions to e-mail to a Rater, and set the permission for a building file.

Appendix I.C

TREAT

1.10 Contacts

Weatherization and ESCO's	Caleb Crow (607) 277-6240 x205 ccrow@psdconsulting.com
Raters	Ethan MacCormick (607) 277-6240 x250 emaccormick@psdconsulting.com
Energy Agencies, **Energy Utilities, and** **Home Performance Programs**	Greg Thomas (607) 277-6240 x201 gthomas@psdconsulting.com

1.11
1.12 Pricing

TREAT licenses are available in single or multifamily versions. Multifamily versions are also capable of modeling single family homes and trailers.

Single family version	$495
Multifamily version	$1495
Multifamily version **(non-profit / government discount rate)**	$995

Each license comes with 12 months of technical support and software upgrades. Each license may be installed on two separate computers.

1.13 Renewals

One year of technical support and software upgrades are included with the initial TREAT license purchase. After this period, an annual support and upgrade subscription fee is required for users who wish to continue to receive technical support & upgrades. Current TREAT users will receive a notice approximately 60 days prior to their subscription expiration.

Support & Upgrade Subscription Fees

Single Family Version	$200 annually
Multifamily Version	$400 annually

The TREAT annual support & upgrade subscription allows users to receive one-on-one technical support from Taitem Engineering. These users will continue to receive all software upgrades and enhancements released during that year. Users choosing not to maintain their annual support and upgrade subscription will not receive support and upgrades. Expired subscriptions require users to repurchase the software if they wish to obtain tech support or the latest version of TREAT

1.14 TREAT can be downloaded from the internet for use in demonstration mode. In demonstration mode you will be able to create, calculate, and save TREAT projects and view reports for a period of 30 days from installation. Printing of reports, reports for special programs, multi-family capability, and removal of the 30-

day expiration date are accomplished by registering your version of TREAT. Contact Taitem Engineering by phone or email to receive the registration Password. Copy and paste the Serial Number and Installation Key into an email, and send it to TreatRegister@taitem.com. You will receive a Password that will switch TREAT out of demonstration mode and activate the features that you have purchased. If you wish to register TREAT by phone, fax or mail contact Rob Rosen at Taitem Engineering, 109 South Albany St, Ithaca, NY 14850, phone 607-277-1118 ext 110, fax 607-277-2119.

TREAT & SUNREL Calculations

TREAT employs the SUNREL computer program developed by the National Renewable Energy Lab for load calculations. TREAT supplements SUNREL's load calculations with three types of calculations:

1. Calculations before running SUNREL, such as lights and appliances, the results of which are passed to SUNREL to use for its internal gains.
2. Calculations after running SUNREL, such as equipment energy consumption calculations to meet loads calculated by SUNREL and fuel cost calculations.
3. Calculations which are independent of SUNREL, such as billing calculations.

TREAT also gathers all input from the user, stores the input, and process the output into reports

SUNREL was developed at the National Renewable Energy Laboratory (NREL)by Ron Judkoff, Paul Torcellini, and Mike Deru. SUNREL ™ is a trademark of Midwest Research Institute. NREL is a national laboratory owned by the U.S. Department of Energy and managed by Midwest Research Institute, Battelle Memorial Institute and Bechtel National, Inc.

The SUNREL calculation engine was selected for the following reasons:

- well tested through experimentation, practical use, comparison to other software
- used as benchmark for the International Energy Association testing procedure known as BESTEST.
- hourly model
- uses weather data from TM2 files
- determines loads that HVAC system will encounter (except for mechanical ventilation) due to losses through surfaces/windows, infiltration solar gains, interaction with internal heat gains, etc.).

HVAC calculations

- Additional load due to mechanical ventilation
- appliances, lighting, domestic hot water.
- system efficiency, distribution losses
- calculate annual heating/cooling energy usage
- monthly model, relies on statistical distribution of temperature during each month and monthly outputs of energy calculations.

At this time, TREAT is the sole commercial application of the SUNREL calculation engine.

Energy Model Description (From TREAT 3.0.1.9 User Manual 2005)

- A building is viewed as an aggregation of spaces (rooms). Spaces may be conditioned (heated and/or cooled) or unconditioned. The maximum number of spaces in a building is 100.
- Each space must have at least one surface (wall, ceiling, or floor). Only exterior surfaces and surfaces between heated and unheated spaces may be entered. The total number of surfaces in a project must not exceed 500. Up to 300 of them may be exterior surfaces (including exterior doors). There may be up to 100 unique wall constructions.
- Each space may contain unlimited number of appliances and lighting and a ventilation fan.
- Each exterior surface may contain multiple doors and windows. The total number of window records in the building must not exceed 500. A single window record may be used to describe multiple windows on the same wall by entering window quantity.
- Each wall may have a single overhang, to model shading. The overhang runs the full length of the wall, is located at the top of the wall and is a horizontal surface parallel to the ground.

- The model building must have a heating system that may consist of up to two subsystems: main (primary) and backup (secondary). Each subsystem has its own distribution system. Back up heating is activated when the main heating capacity is exceeded.
- The heating system can be connected to multiple thermostats (the building can have multiple heating zones).
- Each heating/cooling zone may include any number of spaces (rooms).
- The building may have a cooling system. The cooling system may share its distribution with a heating subsystem.
- Heating and cooling systems share thermostats.
- Each conditioned space must belong to one heating/cooling zone (controlled by one thermostat).
- The leakage area of a heated space is distributed among its surfaces in proportion to the surface area.
- If, in addition, the user assigns leakage area to surfaces, then only the remaining (unassigned) leakage is distributed among surfaces in proportion to the surface area.
- Each project may contain a model of a single Base Building and unlimited number of improvement packages for that Base Building.

Hardware Requirements

- CPU: Pentium II - 300 MHz (1.5 GHz recommended)
- RAM: 128 MB (512 MB recommended)
- Disk space: the total required hard drive space is 550MB (1 GB recommended), with at least 500 MB (1 GB recommended) on C-drive
- Screen resolution: 800x600 pixels minimum
- Color palette: 24 bit (recommended)
- Other devices: Printer, paper size: "Letter" format (required)
- MS compatible mouse (two button)
- Operating systems: Windows 98 Second Edition / ME / NT4.0 service pack 6 / 2000 / XP

Files

- TREAT projects are created and stored in Treat Project Group (TPG) data files. Each TPG may contain one or more projects created by the user. Each TPG is stored in a single file with a TPG extension.
- Support for multiple Project Groups: each project group represents a single TREAT database.
- Archiving and data-compression: a TPG file is a compressed TREAT database. It reduces the disk space needed to store the TREAT database by 50% -90%.
- Portability: a single-file appearance facilitates project exchange between TREAT users. The TPG files are small enough to easily email or store on a standard diskette.
- Facilitating library updates: To allow backward compatibility between versions, TREAT may automatically update libraries in databases created with an older version.
- Quick access from the TREAT menu to up to eight most recently used TPG files.
- Links to TREAT website may be used to check for the latest TREAT update patches, library updates and general information on TREAT.
- Limitations:
  - Individual TREAT projects cannot not be moved between project groups (TPG files).
  - Using shortcuts to TPG files instead of the TPG files themselves is not supported and may cause loss of data and errors if used.
  - Opening or saving of TPG files on a network drive or server is not supported and may cause loss of data and errors if used.

Libraries

Editable Libraries

TREAT has the following editable libraries: User, Customer, Contractor, Daily Weather Data and Fuel Rate. They can be accessed from the Main Menu by selecting Library and then the name of the library. There are shortcuts to the libraries from input screens where the library data is used. Any changes to User, Customer, Contractor and Daily Weather Data libraries affect both future and existing projects. Changes made to the Fuel Rate Library affect future projects only.

Non-editable Libraries

TREAT has non-editable libraries including the Fuel Library, Surface Library, Door Library, Glazing Library, Window Frame Library, Lighting Library, Appliance Library, Heating Library, Cooling Library and Domestic Hot Water Library. These libraries can be accessed from the input panel screens only when a corresponding component is being input or edited.

The library entries for Lighting, Appliances, Heating, Cooling, and Domestic Hot Water can be edited for the current project once the entry has been selected and is shown in the input line of the appropriate Building Model screen. The libraries for Windows, Walls and Doors can not be edited for the current building. The databases for these libraries contain additional information beyond the information shown. Energy Star compliance in the libraries reflects the standard requirements in effect as of the version release date.

The depository can store only one copy of each library for future copying to other projects. The Store Editable Libraries option is enabled when a TPG is opened. No changes are made to the libraries in the open project when the Store Editable Libraries option is used. If an editable library, for example Customer Library, is stored then that Customer Library from this TPG will be included in each TPG that is loaded from this point on if user selects to update editable libraries on the window opened from Project Group->Options (see below).

Warning: Use caution when upgrading editable libraries, especially the Contractor, Customer and User libraries, to prevent data loss or inconsistency in project data. For example, you may have a project in ProjectGroup1.tpg that has customer John Smith, who is customer #3 in the Customer library. While working on ProjectGroup2.tpg, you choose to store its Customer library to the internal library depository. In that version of the library, customer #3 is Tom Brown. If you replace the Customer library in ProjectGroup1 with the Customer library from ProjectGroup2
using the TREAT library upgrade feature, then all projects in ProjectGroup1 that referenced John Smith will now have Tom Brown as a customer. Information for John Smith will be lost.

Utility Bill Analysis

TREAT allows calculating average non-HVAC (base) load and heating slope (building heat loss rate) by analyzing utility bills alongside with daily outdoor temperatures during the billing periods. As with any statistical calculations, it is important to have large amount of reliable billing data available in order to get meaningful results. We recommend that you have at least twelve actual utility bills available for each analyzed fuel. If a fuel is used for both base and HVAC load, then the bills must be available for the months without noticeable heating and/or cooling.
You do not have to create a building energy model to run billing analysis.

The Heating Energy Scorecard and the Investment Guidelines for Heating reports show the results of billing analysis performed independently of the model. The Heating Energy Scorecard report demonstrates how your building performs relative to other typical buildings. The Investment Guidelines for Heating report calculates cost effective investment for specified target heating energy consumption and payback. TREAT normalizes billing data based on the calculated heating and cooling degree days per time period. TREAT does not perform regression analysis of the bills. The user has to specify heating and cooling reference temperatures if billing analysis is run independently from the building model. In this case the accuracy of the billing analysis strongly depends on the reliability of the assumptions.

You must have daily weather data available for the building location and the periods covered by the utility bills before billing analysis may be performed. The required data may be downloaded from http://www.engr.udayton.edu/weather/ , a website which contains files of daily weather data for many cities. The files may be imported into TREAT by clicking the *Import* button on the Daily Weather Library screen. Follow the on-screen instructions to complete the import or refer to the Daily Weather Import section of this manual.

Validation of Entries – Model Review

The **Model Inspector** examines the data that has been entered for the base building and improvement packages to catch common data input errors. The verifications are general rules designed to check that the input data has a minimum level of consistency with a logical building model and with TREAT calculation algorithms. Review the warnings on every tab of Model Inspector and modify project inputs as needed.

The **Feedback Panel** shows if the heating, cooling and base load calculated for the model is close to the billing numbers (if billing analysis was performed). Click the True Up Help button for advice on how to reconcile the model and billing outputs.

Review **Design Heating and Cooling Loads Report** to see that the load is distributed between the spaces as you would expect.

Review the **Model Energy Report** to see that the building energy consumption and losses due to the different factors are reasonable.

The **Evaluated Options** section may only be used after the Building Model screens are filled out. Use the screens in this section to evaluate the effect of improvements on annual energy costs. You can run the Model Inspector for every package that you create.

Input Screens

Foundation Depth Below Grade input is available if the foundation type is basement or crawlspace. Enter the average depth of the foundation floor below grade in this field. For example, if the basement foundation depth below grade is set to 4 ft., then each basement wall will be described as two wall sections in the TREAT project. One section will be 4 ft. high and adjacent to ground; the other will be 3 ft. high (basement ceiling height of 7 ft. minus foundation depth of 4 ft.) and adjacent to outdoors. If foundation depth is greater than the default ceiling height for the space, then TREAT will assume that ceiling height of the space is equal to the foundation depth and only the below-grade portion of the wall will be generated. That would correspond to a space that is entirely below grade.

Long Term Weather Site input is essential for both billing and energy model sections. Select the location closest to your building from the list of sites supported by TREAT. Your selection will direct the program to the appropriate TMY2 weather file that contains information on typical climatic conditions for every hour of the year. The file is generated based on hourly meteorological data collected for the 30-year period from 1961-1990. 12 typical months for each station were chosen from statistics determined by using five elements: global horizontal radiation, direct normal radiation, dry bulb temperature, dew point temperature, and wind speed.

Heating Season and ***Cooling Season*** input determines the months during which heating and cooling systems are available. Heating energy usage during the months that are not part of heating season is equal to zero, even if there is non-zero heating load during these months. TREAT assumes that heating starts on the first day of the heating season start month and ends on the last day of the heating season end month. The same rule applies to cooling.

Heating and cooling season input affects both model and billing calculations. Heating and cooling seasons may overlap, for example you may specify heating and cooling season from January to December. Some months may belong to neither heating nor cooling season. Heating season input also affects the way natural ventilation is calculated.

Energy Model Calculation Mode box allows selecting the algorithms used for energy analysis. You may select one of the two available Surface Conductance Algorithms:

- *R-value +heat capacity for heavy walls* algorithm is the optimized version of Layer-by-layer mode used in the versions prior to TREAT 2.5. The algorithm evaluates the material layers in each surface in the project and models each layer either as pure thermal resistance or as thermal mass, depending on layer thickness and material properties. Thermal mass characterizes the ability of material to store significant amounts of thermal energy and delay heat transfer through a building component. This delay leads to several important results, such as lower energy consumption and moving energy demand to off-peak periods. The effect of thermal mass is most noticeable in climates with large daily temperature fluctuations. In heating-dominated climates thermal mass may be used effectively to collect and store solar gains. TREAT Home Energy Rating System Building Energy Simulation Test (HERS BESTEST) testing was performed in this mode.
- *Pure resistances (R-values)* algorithm does not account for the influence of thermal mass. This mode was referred to as "Minimize Calculation Time" mode in the versions prior to TREAT 2.5. The mode is retained in order to support projects that were created with the older versions. It is not recommended for new projects since the R-value + heat capacity for heavy walls algorithm provides more accurate results and comparable calculation speed.

R-value +heat capacity for heavy walls mode is the default mode for all projects created in TREAT 2.5 or later. For all projects created in the prior TREAT versions calculation mode is set to Pure resistance.

Default Values

Default Values inputs allow the user to speed up the data entry for the energy model. The default value applies only to the components that are created after the default is set. For example, changing the default wall constructions will not affect walls that are already entered in the project, but each new wall created after the default was set would have the new default construction.

- *Default Wall Construction* - Wall construction selected on this screen is by default assigned to each new wall that is created on Surfaces/Walls screen. The default value may be edited for each wall on Surfaces/Walls screen.
- *Default Window Frame Type* and *Glazing Type*. - Window frame/glazing that you select on this screen will, by default, be assigned to each new window entered on the Windows screen.
- *Default Door Type* - The door type that you select on this screen will, by default, be assigned to each new door created on the Doors screen.
- *Default Ceiling Height* - The value entered here is used as the default ceiling height of each new space that you create on the Spaces screen.
- *Stories* input is only used for reports. *Number of Dwelling Units* input is used in domestic hot water demand calculations.
- *Total Number of Occupants* is used in domestic hot water demand calculations and for establishing fresh air requirements.
- *Default Building Air Tightness* sets the value of Estimated Seasonal Air Changes per Hour in the Heated Area Infiltration section of the Infiltration screen.
- *Roof Color* and *Wall Color* input is used to set solar absorptivity of exterior surfaces.
- *Total Number of Bedrooms* input is used to calculate domestic hot water load for Home Energy Rating System (HERS).
- *Use window shades in summer* checkbox allows the user to specify seasonal window shading. If the box is checked then the shading factor (or SHGC) of all windows in the building are reduced by 20% compared to the value for an un-shaded window entered on Windows screen for all months that are part of cooling season. Using this option reduces building cooling load
- *Advanced* button - This button allows the user to fine tune the energy model inputs:
- *Shielding Class* strongly affects infiltration calculations if Detailed Infiltration algorithm is used.
- *Entering Cold Water Temperature* is used in domestic hot water calculations for the model.
- *Cooling Latent Load* is used for the load sizing and cooling energy calculations.
- *Common Wall Area* is used in calculation of HERS rating of attached homes.
- *Average Lighting Load Wh/SqFt-Day* is used in Model Inspector to verify accuracy of lighting inputs.
- *Account for climate impact on HSPF and SEER* checkbox adjusts the manufacturer-specified HSPF and SEER to account for site climate. The nameplate HSPF for a heat pump is based on the temperature in Climate Region IV (Pittsburgh, PA) and the minimum Design Heating Requirement (DHR) that is a function of machine heating capacity. This selection limits the contribution of resistance heating because it typically results in relatively high seasonal heating temperature. Site specific HSPF varies significantly with climate.

  All unitary air conditioners are rated using EER, a rating standardized by ARI, which reports steady-state efficiency at 95oF outdoor and 80oF indoor temperature. Smaller air conditioners (i.e., < 65,000 Btu/h) are also rated using SEER, intended to better indicate average seasonal performance. However, for single-speed equipment, SEER is simply estimated as the EER at 82oF outdoor and 80oF indoor temperature condition. SEER rating de-emphasizes high temperature performance.

  The TREAT climate efficiency degradation algorithm accounts for variations of actual equipment efficiency based on its rated efficiency and the climate at the building site. We recommend that this adjustment is used for all TREAT projects

- *Account for Part Load System Efficiency* checkbox adjusts model heating and cooling energy consumption to account for reduced efficiency during part load operation. The algorithm was developed based on information presented in the article "Residential Equipment Part Load Curves for Use in DOE-2" by Henderson, Huang and Parker. Part load ratio for each month was calculated by dividing monthly heating (cooling) load by the energy that the heating (cooling) system could generate at full load conditions during the same time interval. The part load adjustment is calculated for each month depending on equipment type and part load ratio during the month and varies between 0.75 and 1. If part load ratio for boilers is less than 0.1 then monthly usage is adjusted by 0.75+2.5*PartLoadRatio. For forced air heating and cooling systems the monthly usage is adjusted by 0.75+0.25*PartLoadRatio.

- *Default target heating energy usage Btu/SqFt-HDD* - This is a default target value that may be adjusted for each analysis period on the Analysis Periods screen. It is used to calculate the investment potential of the building as indicated on Heating Energy Scorecard and Investment Guidelines for Heating reports. The target is different for different buildings, however the following numbers provide a guideline:
  Best new homes - 2Btu/SqFt-HDD
  Energy Star homes - 5Btu/SqFt-HDD
  Low usage existing homes - 7Btu/SqFt-HDD
  Medium usage existing homes - 11Btu/SqFt-HDD
  High usage existing homes - 15Btu/SqFt-HDD

Spaces

The building can be modeled either as a single space or multiple spaces. The decision as to whether multiple spaces are necessary depends on many factors. If two spaces are operated at different temperatures (have different thermostat set points, overheated or under-heated due to distribution loss, imbalance or internal gains), different heating or cooling schedule, have different mechanical ventilation loads, or one space (perhaps an attic, basement or garage) is unconditioned, then use of multiple spaces may be necessary. If you plan to use TREAT for sizing a heating or cooling system, then each area for which the design load is of interest should be modeled as a separate space. A little experimentation will soon reveal the cases in which a more complex multi-space description is needed. If each room in the building is modeled as a separate space, the input may be very time consuming. In most single-family houses all rooms that belong to one heating/cooling zone and are serviced by one thermostat may be modeled as a single space.

Tips:

1. If an unheated space is vented (for example if this is a vented crawl space) you may choose not to model it as a separate unconditioned space. Instead you may enter the surfaces that are adjacent to this space (floor of the first level) as adjacent to exterior.
2. An un-vented roof cavity that will be filled with insulation may be modeled as unconditioned space.

Walls

- TREAT attaches 0.68' layer of soil to walls that are 1ft high or less. Temperature of surrounding soil is assumed to be equal to the ambient air temperature for the hour.
- TREAT attaches layer of soil equal to WallHeight*0.77 to walls that are between 1 and 3 feet high. Soil temperature is assumed to be equal to the ambient air temperature for the hour.
- Below grade walls that are more than 3 feet high are modeled as two separate walls. First wall is 3' high, has 2.31' layer of soil attached to it, and looses heat to ambient air temperature, Second wall is (WallHeight-3) feet high and has 3' layer of soil attached to it. Temperature of surrounding soil is assumed to be equal to average annual air temperature.

Slab On Grade

Slabs are modeled as two separate surfaces. First surface is 3' wide slab perimeter ring. It has 3' layer of soil attached to it. Temperature of surrounding soil is assumed to be equal to the ambient air temperature. The second surface is of the same area as the remaining section of the slab and has 3' layer of soil attached to it. The temperature of surrounding soil is assumed to be equal to the average annual air temperature.

Slab Below Grade

Losses are calculated from 3' perimeter ring around the slab. 9'layer of soil is attached to the perimeter wring and the temperature of surrounding soil is assumed to be equal to average annual air temperature. Layers of soil are attached to the surface in order to model insulating properties of soil. Thickness of the soil layer is selected to approximate the length of heat flow path through ground. For the typical building configurations the algorithm produces results that are very close to heat loss coefficients specified in ASHRAE Fundamentals.

Windows

The combination of Frame and Glazing allows the user to define a wide range of windows. The NFRC (National Fenestration Rating Counsel) has a standardized testing procedure that is used to create the ratings for U-value and SHGC (Solar Heat Gain Coefficient) that appear on the NFRC label on new windows. The NFRC ratings are for the entire fenestration product (glass and frame combined).

Smaller windows have a greater ratio of frame area to glass area than larger windows, which affects the overall rating of the window. For this reason, the NFRC uses standard sizes, residential size and nonresidential size, to compare different windows regardless of size.

If you have the NFRC ratings for U-Value and SHGC for a particular window, then you may enter these values in the Custom Window Properties dialog. Be aware that the Glazing and Framing type still play a factor in the calculations and must be entered appropriately.

TREAT calculates the U-value and SHCG for the specific sizes of windows in the building model. The SHGC and U-value for a specific window are not the same as the NFRC rated SHGC and U-value unless the window is the same size as the standard "residential" or "non-residential" sizes used to generate the NFRC ratings.

Shading ranges from 0 if there are opaque blinds covering the window to 1 for clear glass with no external or internal shading. By default the shading factor is set to the value that corresponds to the selected glazing with no additional shading. The meaning of the shading factor (SF) is similar to the shading coefficient (SC) found in the ASHRAE Handbook of Fundamentals; however, the numerical values are not the same. The shading coefficient in the ASHRAE Handbook is defined as the ratio of the solar heat gain through a given glazing assembly to that of a reference single-pane, double-strength, clear (DSA) glass. The shading factor used in TREAT is the ratio of the solar heat gain through the given assembly to the solar heat gain through a similar glazing assembly with clear glass of the same thickness. For glazing systems with only clear glass, the shading factor is one. However, for glazing systems with tinted glass or with selective coatings, the shading factor will have a value less than one.

Infiltration

The following *Infiltration Algorithms* are available:
Surface Leakage Proportional to Area (Detailed Infiltration) algorithm converts the input entered on Infiltration screen to the total effective air leakage area (ELA). ELA is allocated to exterior surfaces entered on Walls/Surfaces screen in proportion with the gross surface area. This algorithm accounts for influence of indoor/outdoor temperature difference, elevation of spaces and surfaces and stack effect. The energy calculations may run slower in this mode. The outputs of the algorithm depend strongly on the shape of the building. For example, in a single story building roof/ceiling may have larger surface area than exterior walls. Because of that, most of the effective air leakage area will be allocated to roof/ceiling, which may result in exaggerated stack effect. Users may adjust the default air leakage assumptions by assigning leakage areas between specific spaces and the outdoors. This leakage area allocation algorithm will be enhanced in future versions of TREAT.

Fixed Infiltration Rate algorithm assumes that the infiltration rate is unchanged throughout the year and is equal to the value specified on Infiltration screen. The mode increases calculation speed but does not account for indoor/outdoor temperature difference and stack effect. The accuracy of TREAT calculations in this mode was verified by HERS BESTEST.

Use Surface Leakage Proportional to Area algorithm for high-rise building, where the stack effect plays important role. For low-rise buildings Fixed Infiltration Rate algorithm is recommended.

There are three infiltration screens in the program.

- The *Heated Area Infiltration* screen allows the user to enter combined infiltration of all the heated spaces to exterior and unheated areas. Input may be based on the visual inspection of the building or the blower door test measurements. By default the value is set to Air Changes per Hour based on default building air tightness specified on the Weather/Defaults screen.
- The *Unheated Space Infiltration* screen allows the user to enter infiltration of each unheated space in the project. By default the infiltration is set to 2 ACH for unheated vented spaces and 0.5 ACH to unheated unvented spaces. Modify this value to reflect the actual air leakage. Infiltration input for unheated space is ignored if all the walls in the space are adjacent to "ground".
- The *Holes in the Building* screen allows the user to describe the visible openings in the walls of conditioned spaces. If no input is made on this screen then the value entered on Heated Area Infiltration screen is converted to effective leakage area and allocated to surfaces adjacent to outdoors in proportion with their area. Sealing individual holes can be modeled as an improvement only if the holes are defined on this screen.

Heating/Cooling

TREAT allows specifying main (primary) and back-up (secondary) heating systems. The same thermostat controls both systems. The secondary system is turned on when the primary system capacity is not sufficient to satisfy the building load.

Heat plant output capacity may affect heating consumption of the building due to the following:

1. If there is no secondary heat plant in the project or if there is a secondary heat plant and secondary system control is set to operate the secondary system when primary system capacity is insufficient then model heating consumption displayed on the Feedback Panel and in reports is limited by the capacity of the heating system. In this case if the system output capacity is insufficient to satisfy building heating load, the displayed heating consumption will be lower because on cold days the temperature in the building will be less than the specified thermostat setpoint. Check the load sizing report to make sure that the building heating system is not undersized.
2. Low heat plant capacity leads to longer heat plant run time, which may increase distribution loss and hence overall heating consumption.
3. The current version of TREAT does not model the heat plant stand–by loss. Consequently, oversizing the heating system is not penalized.

Ventilation

The *Ventilation Rate* may be entered as total for the fan or on room-by-room basis. The total ventilation rate is distributed between the rooms that are served by the fan in proportion with the room volume.

The method described in ASHRAE Standard 136 may be used to superimpose exhaust and supply ventilation. Enter the resulting mechanical ventilation rate on the Fans screen.

Water Heater

TREAT uses two efficiency values for water heaters – Recovery Efficiency and either Energy Factor or Stand-by Loss. Efficiency data for variety of water heaters is available in TREAT Water Heater library
Recovery Efficiency – the ratio of energy delivered to the water to the energy content of the fuel consumed by the water heater.
Energy Factor – a measure of water heater overall efficiency determined by comparing the energy supplied in heated water to the total daily energy consumption of the water heater.
Standby loss is the average hourly energy consumption divided by the average hourly heat energy contained in the stored water, expressed as percent per hour.

The following relationships may be used to calculate the Energy Factor using the Energy Guide annual usage estimate:

For gas heaters, Energy Factor = 150 / [Energy Guide Therm/year].
For electric heaters, Energy Factor = 4396 / [Energy Guide kWh/year].

The stand-by loss from combination space and domestic hot water heating systems may differ significantly between heating and non-heating seasons. TREAT allows entering two efficiency values for such systems. TREAT uses the input to calculate the average seasonal efficiency taking into account the heating season months entered on the Weather/Defaults screen. Heating season length is assumed to be 6 months if the heating season entered on the Weather/Defaults screen spans more then half the year.

For tankless water heaters you must use a very small capacity (1 gallon) and an input Btu equal to the input Btu of the boiler. An indirect DHW tank zoned off boiler is modeled as Domestic Hot Water Improvement – Water Heater Replacement. The efficiency of the new system is the boiler efficiency minus losses off pipes and storage tank. A 7% reduction is recommended in Krigger's Residential Energy Book. If the boiler is 93% efficient, then the new DHW systems Recovery Efficiency would be 86 (93-7=86). The input capacity of the DHW is the same as the boiler. In this case the Energy Factor would be .85 (Energy factor must be less than Recovery Efficiency divided by 100*).*

Lighting

According to a pilot study "Incorporating Lighting and Appliance Energy Consumption into the Home Energy Rating Score" prepared by Architectural Energy Corporation, the statistical average connected lighting load in single family houses is 1.25 W/sqft and the lamps are lit on average 2.34 hours/day.

A monitoring project commissioned by the Bonneville Power Administration and Tacoma Public Utilities referenced on LBL website (http://eetd.lbl.gov/btp/papers/38454.pdf, Tribwell and Lerman, 1996) showed similar results, with an average of 2 hours per day operating time and lighting load of 1.47 W/sqft.

When the exact lighting usage in an existing home is not known, the statistical averages presented above should be used to enter the lighting load in TREAT

Lighting load distribution throughout the day may significantly affect heating and especially cooling load.
Compare two cases – in one case a single 60W bulb is lit 24 hours/day; in the other case eight 60W bulbs are lit 3 hours during night/evening time. In both cases the lighting load is 1440Wh/day, but cooling usage on a mild summer day when cooling is needed during the day but not at night may differ significantly. In the first case the lighting increases cooling load; in the second case cooling and lighting do not interact with each other since they do not occur simultaneously.

Load Sizing

Inputs on this screen are used for the Design Heating and Cooling Load report.

Furnace Heating Temperature Drop - design temperature difference between supply and return air temperature. The value is used for duct sizing.

Heat Pump Heating Temperature Drop - design temperature difference between supply and return air temperature used for heat pump distribution system sizing.

Cooling Temperature Drop - design temperature difference between supply and return air temperature used for sizing of cooling ductwork.

Electric Distribution Baseboard Capacity Watt/ft - baseboard capacity per manufactures specifications used to determine the length of baseboard required to meet the space heating load.

Boiler Temperature Drop - design temperature difference between supply and return water. The value is used for pipe sizing.

Hydronic Distribution Baseboard Capacity Btu/hr/ft - baseboard capacity per manufacture specifications used to determine the length of baseboard required to meet the space heating load.

Heating Safety Factor – the value is used to obtain the required heating equipment output capacity as noted on the Design Heating and Cooling Load report.

Cooling Safety Factor – the value is used to obtain the required cooling equipment output capacity as noted on Design Heating and Cooling Load report.

Distribution Safety Factor - specify the safety factor in percent. The value is applied to space distribution CFM/GPM as noted on Design Heating and Cooling Load report.

Note:

TREAT load sizing has been compared to Manual J. Heating and cooling loads calculated by TREAT proved to be slightly more conservative. Please use professional judgment in applying the results to sizing heating and cooling systems.

Other Input Screens

Visual Inspections

This input area includes information gathered from on-site inspections on problems in particular areas or mechanical systems that could affect building energy performance. Additional items include details of the problem observed, recommended actions and repair costs.

Measurements

This screen allows you to document the results of measurements taken in the building that may be important for building energy performance. Locations include: Combustion Appliance Zone, Ductwork, Hotwater heater, Oven, Heating System, Attic, Crawspace, Whole Building. Measurement types include: blower door, CO, CO2, depressurization, duct leakage, flue draft, formaldehyde, temperature. Additional items include details of the recommended actions and repair costs.

Improvement Options

The Evaluated Options section calculates the energy saving benefits of improvements made to the building envelope, HVAC, domestic hot water system, appliances, lighting, etc. Improvements are changes to the Base Building components that are described on the Building Model screens. TREAT allows entering multiple options for improving the same existing component.

If you plan to propose multiple improvements to the homeowner, you may group the improvements in several different packages to fit different budgets or payback periods. Interaction between improvements is accounted for when package savings are calculated.

TREAT calculates the following values for each improvement and package in the project:

- *Cost* of improvement is taken from the user input for this improvement. Cost of a package is equal to the combined cost of all the improvements in the package.
- *Annual Savings MMBtu* is the difference between the energy consumption of the Base Building and the building with the improvement. The energy savings are aggregated for all the fuels used in the building.
- *Annual Savings $* is the difference between the total energy cost of the Base Building and the building with improvements.
- *Payback, Years* is the number of years it will take for the Improvement or Package to pay for itself. It is calculated as a ratio of the improvement cost to the annual dollar savings.
- *SIR* (savings to investment ratio) allows the user to perform a more accurate economic analysis of the improvement feasibility. It compares two alternatives: investing in the improvement versus investing in a bank CD at the specified rate for the term equal to the life of the improvement. The SIR value accounts for inflation. An SIR greater than one indicates that the improvement makes economic sense. SIR is calculated as the ratio of adjusted savings to the investment (cost) of improvement or package. Adjusted improvement savings are calculated using the following formula:
  A- calculated improvement $ savings shown on Improvements screen
  N - improvement life entered on Improvement Wizard screen and shown on Improvements screen
  e - inflation rate entered on Edit Financial Information screen
  i - bank rate entered on Edit Financial Information screen.
  The adjusted package savings are calculated as sum of adjusted improvement savings.
- *Cash flow* is a feature of the Packages screen, not the Improvements screen. Cash flow is useful when the homeowner has to borrow money from the bank to pay for the improvement. Cash flow is calculated as the difference between the annual improvement savings and the loan payments.

The Improvements screen allows the user to create, edit or delete proposed improvements, calculate energy and dollar savings from improvements, and edit financial information. The screen displays the list of improvements created by the user.

Lifestyle Changes

The improvement wizard screens allow entering physical improvements to the building that are usually installed by professionals, such as replacing heating system, installing programmable thermostats, insulating an attic, etc. However, some of the energy savings may be achieved by simple changes in the lifestyle of building occupants. Turning off lights in the room when leaving, reducing shower times, replacing the furnace filter regularly, cleaning refrigerator coils and other similar actions can often produce significant energy savings with minimal or no investment.
TREAT allows estimating energy savings from occupant behavior by associating variety of lifestyle actions with each improvement entered on the Improvement Wizard screen. The inputs are made on the Lifestyle Savings window, which is accessible from the Improvements or Packages screen by clicking the *Lifestyle Savings* button.
The screen is divided in two sections. The upper table is non-editable and shows all improvements in the project or in the selected package, depending on the setting of the filter at the top of the screen. The lower table allows editing inputs.

Reports

Reports may be saved to a file using the Save shortcut on the print preview toolbar. Any TREAT user may open the file with the Open shortcut on the print preview window.

- **The *Fuel Bill Release*** report prints a letter to the utility company requesting that they release the bills for a specified address.
- ***Building Description*** shows all the inputs made on the Building Model screens.
- **The *Design Heating and Cooling Load*** report presents results of the load sizing calculations. TREAT load sizing has been tested in "Minimize Calculation Time" mode and results were compared to Manual J. TREAT heating and cooling loads proved to be slightly more conservative. Please use professional judgment in applying the results to sizing heating and cooling systems.
- ***Model Energy Report*** presents two pie charts for the selected package or the Base Building:

    - .A breakdown of the total energy bill by end use category including heating, cooling, lighting, appliances and hot water.
    - A breakdown of the heating/cooling energy bill by category including infiltration, loss through windows, surfaces and mechanical ventilation.
    - This report is available for any calculated package or the Base Building.
    -
- ***Base Load Report*** provides information on energy consumption by appliances, domestic hot water and lighting in the selected building model. This report is available for models with calculated results. If the model is compared to more than one analysis period, you will be asked to select a single analysis period for inclusion in the report. The *Base Load Report* gives a detailed report on base load energy consumption. The items in this table are sorted by total annual cost of consumed fuel. The top nine energy consumers are shown individually, and the rest of the items are aggregated and presented in a single Other category.
- ***Occupant Lifestyle Savings*** report contains information from Lifestyle Savings screen. This report is made up of two parts – one part summarizes possible savings, the other part shows savings accepted by the home-owner. The main purpose of the report is to educate homeowners about potential of energy conservation behaviors.
- ***Model to Actual Comparison of Base Usage*** table shows the overall non-HVAC energy consumption of each fuel in the selected model and billing analysis period (if any). The percent difference row indicates how well the model base load was calibrated against billing data.
- ***Percentage Improvement*** report compares annual energy savings of the selected packages with the overall energy usage of the Base Building.
- ***Visual Inspection* and *Measurements*** reports display the inputs made on the corresponding screens of Building Inspection section. The *Visual Inspection / Measurements Forms* report prints the requested number of forms for on-site data collection. The forms closely resemble the Visual Inspection and Measurements screens.
- ***Improvement Packages*** report displays the calculation results presented on the Package Wizard screen for the packages selected by the user. The report includes the list of all non-energy benefits of improvements in each package.
- ***Workscopes*** report contains the list of the work scopes for the improvements in the selected package.
- ***Normalized Model to Billing Comparison*** report presents tabulated energy consumption of each fuel for the model and the corresponding billing analysis period. The billing period fuel usage is calculated using the slope and reference temperature from the billing analysis and thirty-year average weather data. The report is available for the analysis periods that are compared to a Base Building or a package.
- ***Investment Guidelines for Heating*** provides an estimate of the cost-effective investment based on the billing analysis slope, reference temperature, cost of heating fuel, target payback and several other criteria. The report is presented for any billing analysis period for which calculations were performed.
- ***Heating Energy Scorecard*** presents a bar chart comparison of the overall annual per square foot energy usage of your building and energy usage of typical new and existing homes.
- ***Normalized Annual Billing Savings Tracking*** report compares the energy usage of the two selected analysis periods. For each period it presents stacked bars for each fuel, providing a breakdown for heating, cooling and base load. Heating and cooling consumption is calculated based on the heating and cooling slope for the period and the thirty-year average weather data.
- ***Actual Billing to Model Comparison*** report displays side by side the average daily fuel usage from each utility bill included in the analysis period and the calculated model usage for the same period. The report is available only for the fuels with the single set of billing data, not for the fuels with multiple individually metered spaces. The actual weather conditions during the billing period and the calculated model slope are used to generate the model usage data.
- ***Customer Information and Mail Merge*** report allows using the customer data entered in TREAT to generate a customer list in the comma-delimited text file format. This file may be used for printing letter headings, mailing labels and for other administrative and marketing activities.
- ***Data Collection Forms*** report prints the forms that should be used for data collection during site visits. The forms very closely resemble the input screens of the Building Model section. Enter the estimated number of spaces in the building, which allows TREAT to evaluate the expected number of walls, windows and lighting in the project and allow enough space on the forms.

Business Reports

TREAT also includes a Business Reports module that generates any number of customized documents that help run a business more efficiently. It merges the project data into a user defined template, producing a customized document ready for inclusion in your package to the customer. The Templates are freely and easily customizable with any editor, such as WordPad, that can process .RTF (Rich Text Format) documents.

Custom Features

Custom Reports are accessible from the main menu. They are available only if a Registration Password that enables them has been entered during the TREAT registration process.

- TREAT offers two customized reports for NY Home Performance program.
- TREAT allows saving information for the selected package to an XML file that may be uploaded to the TREATtracker online database
- Home Energy Rating Report: The report displays the purchased energy broken down by the end use and the rating score. The report may be printed by uploading a TREAT XML data file to accredited HERS providers through an on-line tool such as TREATtracker.
- Weatherization Report: This custom feature allows the user to view or print a report showing the recommended investment for a package that has valid model results.
- Text reports allow users to export fuel usage information for selected package to a text file in comma separated format (.csv). The file may be imported into a spreadsheet program for additional calculations or into word processor for generating custom reports.

TOOLS

- **Combustion Air Calculator** estimates the NFPA 54 fresh air requirement for a space where combustion equipment is located.
- **Utility Bills Import** copies utility bills from a text file into a TREAT project. The Billing Import screen is opened by clicking the Utility Bill Import menu item.
- **The Daily Weather Data Import** utility copies data from a text file into the TREAT Daily Weather Library.
- **The Model Inspector utility** examines the data that has been entered for the base building and each improvement package to catch common data input errors. The verifications are general rules designed to check that the input and output data has a minimum level of consistency with a logical building model and with TREAT calculation algorithms. The tool was developed to catch the typical problems that were encountered by users seeking technical support.

HOME ENERGY RATING

TREAT is not currently one of the RESNET-accredited rating software programs. The rating score is generated by comparing the energy usage of the rated home with the reference home. The **reference home** is a hypothetical home configured in accordance with standard guidelines. It has some similarities with the house being rated, for example it has the same shape and size, same foundation type, same fuel type for heating, cooling and water heating, etc. It also differs from the actual building in many ways. The U-values of all enclosure elements are as set forth in the Model Energy Code; fenestration area is distributed uniformly in each of the four cardinal directions; the efficiency of heating, cooling and DHW equipment conforms to the National Appliance Energy Conservation Act in effect on January 1992; 80% distribution system efficiency; etc. The **rated home** is the specific home being evaluated using actual characteristics of this home modified per operating condition assumptions outlined in the standard. Operating condition assumptions are applied to both rated and reference homes and are aimed at eliminating the bias associated with energy conservation habits of building occupants. The assumptions set such occupant-dependant model parameters as thermostat heating and cooling setpoints; internal heat gains from lighting, people and appliances; hot water consumption; etc.

The reference home has a point score of 80 on a 0 to 100 point scale. Each 5% increase or decrease in the relative energy consumption of the Rated Home in respect to the Reference Home constitute a 1 point increase or decrease in the rated home's score. Any home achieving a rating score of 86 points or greater may be labeled an Energy Star Home. In other words, Energy Star Such houses consume at least 30% less energy than corresponding reference home.

The standard requires that the Home Energy Rating Report contain energy consumption of all non-rated energy consuming devices such as lighting and appliances. Actual efficiency of these devices is not considered and usage estimates are based on the Standard guidelines. Refer to the standard for more details on how the rating is calculated.

The Appliance Survey allows entering quantities and types of appliances in the rated house. The survey is not linked to the inputs made on the Appliances and Lighting screens because of the specifics of HERS requirements. For example, the standard establishes fixed energy usage per appliance which depends on appliance type and may be different from the energy consumption of the appliances found on site. The standard also requires that some appliances (dishwasher, dryer, etc.) are included in the rating even if they are not present in the house but the house has dedicated space/wiring/piping for the appliance. Refer to the Non-rated Energy Consuming Devices section of the standard for more details on how to fill out the appliance survey.

1.15 Frequently Asked Questions (from TREAT website)

1.16 How do I model mechanical ventilation in a multifamily building?

Multifamily buildings often have multiple forms of mechanical ventilation: a common area ventilating fan which includes corridors and stairs, plus individual fans serving the kitchens and bathrooms within each apartment which may be ducted to a single exhaust. The mechanical room will often have a fresh air intake fan.

The corridors should be modeled as a space.

All apartments should be modeled as a space. The basement mechanical room should be modeled as a space.

Assign a mechanical ventilation fan that serves “all apartments” with a ventilation rate equal to the sum of all individual kitchen/bath fans (80 CFM *10 units = 800CFM). Set the operating hours to reflect behavior. Assign a separate fan to specify ventilation for the corridors as fixed CFM or ACH to model corridor ventilation. Follow the same steps for the fresh air makeup fan in the mechanical room. The result is three separate fans serving three separate spaces (common area, apartments, mechanical room).

1.17 How do I model rim joist insulation and air sealing?

To model a rim joist, create a basement with 7’ high walls adjacent to Ground. Then create a 1’ high wall adjacent to Outdoors (TREAT version 2.0 and later include rim joist as a separate surface type). In a simple rectangular structure this creates a basement with 8 walls - 4 adjacent to ground and 4 adjacent to Outdoors. The rim joists have been defined and now can be insulated. Also add an Infiltration Reduction Improvement, because insulating and sealing the rim joists affects infiltration into the basement. Combine the Rim Joist Insulation Improvement and Rim Joist Air Sealing Improvement into a single Package. Otherwise, TREAT will only calculate the change in R-value and savings will be too low.

1.18

1.19 Do I have to enter all the lighting and appliances if I am performing insulation and HVAC improvements? Are there any shortcuts?

Typically lights and appliances give off enough heat to affect the amount of energy used to heat and cool a building, and they must be accounted for in modeling the building.

Lighting Load: According to a pilot study prepared by Architectural Energy Corporation, statistical average connected lighting load in single family houses is 1.25 W/sq ft and the lamps are lit on average 2.34hours/day. You may use this statistic for your input as follows: if space area is 800 sq ft, enter single 1000W fixture that is lit 2.34 hours per day. If the calculated wattage is too high and exceeds TREAT upper limit for this field, you may use count field to specify total wattage. Note that your inputs may differ from average values, for example common area lights in multifamily buildings are usually lit 24 hours a day.
Appliance Load: You may use Appliance Library to enter reasonable appliance load – make sure that all typical appliances are entered and the specified annual usage is realistic.

1.20 **If an existing building does not have air conditioning can it be added as an improvement?**

This can be modeled by putting AC in the base building, but setting the thermostat setpoint very high and the pre-retrofit AC efficiency very high. This will minimize or eliminate existing AC usage. Then create a Cooling System Improvement with AC that you want to install, and an Indoor Temperature Control Improvement with the proper temperature setpoint. Combine both Improvements into a Package. Energy savings will be negative, denoting an increase in kWh use, but it should model this situation well, as a work-around.

Another way to do it is to enter the proposed AC system in the base building with capacity equal to 1Btu/hr, the smallest allowed by TREAT. Enter a heating/cooling thermostat for the base building with realistic cooling setpoints. Existing building cooling usage will be limited by system capacity, so it will be close to 0.

Then create a cooling system improvement and enter the actual AC capacity. This Improvement will model cooling usage, without needing to create a Package.

1.21 **Can I add a new fuel type as an improvement?**

Yes. For example, your building has electric heat and you want to change it to natural gas. To model that you need to enter electricity and natural gas on the Fuels/Rates screen. Then you may create a Heat Plant Improvement and specify natural gas as the new heating fuel.

1.22 **How do I model the reduced infiltration that results from window replacement?**

Create 2 improvements and combine them into a package. Window Replacement Improvement assumes only a change in R-value and solar gain. Infiltration Improvement is

needed if there is also a reduction in infiltration as a result of replacing windows. Combining both in a package will account for the lesser savings from reduced infiltration due to the greater insulation of the building envelope with the new windows. Give the infiltration improvement a cost of $1. SIR of the package will be the SIR of the window replacement project.

1.23 When I create a Surface Improvement that installs wall insulation, why does the Total Improved Area include the area of the windows and doors in that wall?

This is because the Total Improved Area, Sq Ft is used to calculate the total cost of the surface insulation by multiplying by the unit cost. It was felt that any insulation material savings at the window openings would be offset by the increased labor at the window openings. The Total Improved Area, Sq Ft is only used to calculate the total price of the improvement and is not used in energy calculations.

1.24 I modeled an improvement where the cash flow was negative and the payback about 16 or 17 years, but the SIR was greater than 1. How can that be?

SIR compares two options: investing money in the improvement OR keeping money in the bank and earning interest for the life of improvement. SIR depends on improvement cost, energy savings, LIFE OF IMPROVEMENT and DISCOUNT RATE. Discount rate is calculated based on inflation and rate of a competing investment (specified by user). SIR greater than one indicates that you are better off investing in the improvement.

Cash flow evaluates the following scenario: you had to take a loan from bank to finance the improvement. The loan amount is equal to improvement cost. User specifies the loan term and rate. Each year you have to pay the bank a certain amount to pay off the loan. Each year you save money due to reduced energy consumption of your building. The difference between the two is annual cash flow. Cash flow depends on improvement cost, energy savings, LOAN TERM, and LOAN INTEREST RATE. There is no direct connection between SIR and cash flow.

1.25 Why don’t total room loads add up to equipment capacity on the Design Heating and Cooling Loads report?

The equipment capacity is not equal to the sum of the room loads because TREAT calculates the peak simultaneous load on the building, which typically does not coincide with the peak load on each room. The difference between space load and equipment load is covered in notes 3 and 5 of the report.

1.26 **On the Design Heating and Cooling Loads report, how was building load turned into equipment capacity, using the equipment and distribution efficiencies, and the safety factor?**

Required Output Capacity = Building Load * Safety Factor / Distribution Efficiency
This logic is described in Note 5 on the report.

1.27 **When we put in an AFUE figure for efficiency, the Design Heating and Cooling Loads report often displays a line in red text, "HEATING SYSTEM IS UNDERSIZED AND DOES NOT MEET THE REQUIRED HEATING LOAD". Isn't this false, as most of these buildings are in fact overheated?**

There is no contradiction here. On a typical day the building may be overheated due to system imbalance, high distribution losses, inadequate heating control, etc. However, on a few days when outdoor temperature falls to design heating conditions the building may become under-heated.

Also, as part of load sizing, TREAT applies user-specified heating safety factor to required heating input. Default value for the factor is 25%. TREAT reports insufficient heating system capacity if the load is met but not exceeded by the specified safety factor. You may choose to reduce the safety factor to compensate for difference between steady state efficiency and AFUE for load sizing.

1.28 **On the Percentage Improvement Report, it looks like I'm saving more than the building's total usage, how can that be?**

The Percentage column on this report shows the percentage of energy used, not the percentage of energy saved. In this case, "Total Package" has a percentage of 108.5. This means that if "Total Package" is implemented, then the building model will use 8.5% more energy than it would use without the improvements contained in "Total Package". Using more energy is sometimes OK if there is a large reduction in the price of the energy.

For example, converting a building from electric heat to gas heat. Electric heat is 100% efficient, all energy is delivered to the heated space, but the energy is expensive. Gas heat may be 80% efficient due to chimney losses and duct leakage into unconditioned spaces so 120% more energy (fuel) will be required to be put into the system to achieve the same results, but the cost of the energy is 67% less, so it saves a lot of money.

1.29 **Is there a way to export a TREAT report to a word application?**

Only for Users with theCSV Package Export custom feature. This utility allows TREAT users to export fuel usage information for selected package to a text file in comma separated format

(.csv). The file may be imported into a spreadsheet program for additional calculations or into word processor for generating custom reports. The selected package must have calculated results for the entire package and each included improvement.

The generated file will overwrite any existing files with the same name (for the same project and package). However, you may create files for other packages and projects without overwriting information that was previously extracted.

Tip: Double-click the csv file to open it in MSExcel. You may also open the file in Word. To improve the file appearance in Word you may select an individual section of the file (for example, the rows starting with Building Address and ending with Zip) and then select Table->Insert Table to replace commas with table grid.

1.30 **What is the reality check message saying that the reference temperature of 36.83 F is not in the expected interval, when I have not mentioned this value as a reference temperature anywhere?**

The reference temperature is calculated by TREAT based on your model inputs. Reference temperature of 36F means that your building requires heating only when the outdoor temperature falls below 36F. This is unusually low. Typical reasons for such a low value are very high heat gains from lighting, appliances or DHW along with very low infiltration/mechanical ventilation rate and high wall R-values.

Appendix II.A.

RESNET Accredited Rating Providers

Accredited rating providers have the responsibility of ensuring the quality of rating services. Rating providers are accredited by RESNET.

The responsibilities and requirements to be an accredited rating provider are defined in Chapter One of the Mortgage Industry National Home Energy Rating Standards. These responsibilities include:

- Certification of raters
- Selection of accredited rating software programs
- Rating quality assurance
- Marketing of rating services

The following is a listing of home energy rating systems in Alaska that have been accredited through the Mortgage Industry National Home Energy Rating System Accreditation Standard. The systems have been reviewed by either the state energy office or Fannie Mae and Freddie Mac and accredited by the Mortgage Industry Accreditation Review Committee.

Alaska

Conservation Services Group
40 Washington Street
Westborough, MA 01581
Phone: 508-836-9500 Fax: 508-836-3181
Contact: Eric Wilder
Accreditation Identification Number: HERS 2003-017
Date of Expiration: December 31, 2007

Energy Rated Homes of Alaska
P.O. Box 241647
Anchorage, AK 99524
Phone: 907-248-2247 Fax: 907-277-0956
Email: crenfro@alaska.net
Contact: Chuck Renfro
Accreditation Identification Number: HERS 1998-102
Date of Expiration: December 31, 2007

NSpects Ltd.
P.O. Box 221704
Chantilly, VA 20153-1704
Phone: 703-574-4365 Fax: 703-988-0839
Email: lee@NSpects.com
Contact: Lee O'Neil
Accreditation Identification Number: HERS 1998-051
Date of Expiration: Renewal Pending

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1.33 **Appendix II.B.**

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1.35 RESNET Requirements

Accreditation Criteria

A home energy rating system must specifically meet the following minimum standards:

4.A. Minimum Rater Training Standards:
A rating provider shall provide documentation that their raters are trained by a RESNET accredited rater training provider under the criteria contained in Chapter Two of these standards.

4.B. Certification Standards -- Certification and recertification of energy raters shall be through approved training programs, which shall include the following provisions:

1. Initial classroom and/or field training
2. Performance evaluation of ability to perform accurate ratings
3. Continuing Education - 12 hours of approved education and training during the three years of certification.
4. Recertification of raters no less than every three years

4.C. Minimum Standards For Home Energy Rating System's Operation Policies and Procedures must be written and provide for the following:

1. Ratings from plans. If the home energy rating system provides for ratings by from plans, the rating be labeled as from plans. Such ratings may be used to demonstrate energy code compliance or programmatic qualification but must be confirmed through a field inspection upon completion of construction.
2. Field inspection of all homes.
3. Blower Door Test completed on all homes claiming credit for reduced air infiltration.
4. Duct testing completed on all homes claiming credit for reduced air distribution system leakage.
5. When applicable, improvement analysis given to home owner
   a. Recommended improvements with the cost basis supplied for each recommendation by home energy rating system or the rater receiving quotes
   b. Estimated energy and cost savings of improvements based upon assumptions contained in the home energy rating system program
6. Written conflict of interest provisions that prohibits undisclosed conflicts of interest but allows waiver with advanced disclosure. For example, raters could be allowed to install measures recommended by the rating with advance disclosure to the homeowner and the home energy rating system of financial and other interests.
7. Written rater discipline procedures that includes progressive discipline involving Probation - Suspension - Termination
8. Written rater quality control process that contains provision for review of ratings and field evaluation of raters and ratings where problems are identified.

4.D. Required Information To Be Contained In The Home Energy Rating Report

1. Stars (1-5+)
2. Points (1 - 100)
3. Projected Energy Costs
4. Projected Energy Use/Savings
5. Where applicable, energy, economic, and mortgage reports that at a minimum provide the following information:
   a) Indication of the energy mortgage programs for which the property qualifies or may qualify.
   b) Where property improvements are proposed, improvement analysis reports that include, at a minimum, the following information:

1) The basis of comparison from which costs and savings are derived. (i.e. are they projected based on a comparison with the existing home or are they projected from plans of a new home based on a comparison with a recognized, national home energy efficiency standard like the HERS Energy-Efficient Reference home
2) The incremental cost for each proposed improvement.
3) The anticipated lifetime of the proposed improvement measures.
4) The total annual cost savings resulting from all improvements when taken in aggregate as compared with the annual purchased energy costs for the unimproved property.

4.E. Technical Requirements for Home Energy Rating Software Programs

1. A home energy rating provider shall provide documentation that their ratings are produced by a RESNET accredited home energy rating software program that compiles with the national home energy rating technical standards that are contained in Chapter Three of these standards.
2. Documentation that home energy rating software program used by the home energy rating system passed BESTEST developed by the National Renewable Energy Laboratory, "Home Energy Rating System Building Energy Simulation Test (HERS BESTEST)," Vols. 1 & 2 (NREL/TP-472-7332); using the criteria and example acceptability ranges as set forth in Appendix H of the above document.
3. If the rating system provides reports based on economic analysis, the following parameters, as used in the analyses, shall be documented as follows:
   a) All maintenance and any other costs considered by the economic analyses conducted.
   b) The incremental cost for each proposed improvement measures and the cost basis (i.e. rater estimate, written bid, contract, or other specific cost) for each proposed improvement.
   c) All mortgage interest, general inflation, fuel escalation, personal discount and any other periodic rates considered by any economic analysis conducted.
   d) The time period(s) considered by any economic analysis conducted on the improvement measure.
   e) The economic "value types" reported by the economic analysis conducted.

5.0 Accreditation Process

5A. National home energy rating system accreditation will be through the Mortgage Industry Home Energy Rating System Accreditation Committee selected by the Mortgage Industry Steering Committee and recognized by the National Association of State Energy Officials (NASEO).

5.B. Home energy rating systems must meet the accreditation criteria listed above.

5.C. The Residential Energy Services Network (RESNET) will maintain the database of accredited home energy rating systems and will post it on its Internet web site found at http://www.natresnet.org.

5.D. There are two basic paths to home energy rating system accreditation:

5.D.1. State Energy Office Review

a. Where the state energy office does not operate a home energy rating system, a home energy rating system seeking accreditation must file its application with the appropriate state energy office unless it meets the criteria for direct application provided in the following subsection 2. Upon receiving an application, the state may elect to review the application using the accreditation standards set forth herein and forward the application review and its recommendations to the Mortgage Industry Home Energy Rating System Accreditation Committee or it may directly forward the application without recommendation upon determination that the application is complete.

b. If the State Energy Office operates a home energy rating system, it shall file its self-certification statements that its system meets the accreditation set forth herein along with its completed application form to the Mortgage Industry Home Energy Rating System Accreditation Committee.

5.D.2. The following systems may file an application directly with the Mortgage Industry Home Energy Rating System Accreditation Committee.

a. A home energy rating system which desires to operate in a state that operates its own home energy rating system. The Committee shall inform the state(s) in which the operator seeks accreditation and provide an opportunity for the state(s) to provide comments. If the state(s) wishes to submit comments, it shall forward them within 30 days of receiving notice at which

time the Mortgage Industry Home Energy Rating System Accreditation Committee may either approve or deny the application unless state law requires state licensing.

b. A home energy rating system that has obtained certification may seek authority to operate in other states under a reciprocity agreement. The Mortgage Industry Home Energy Rating System Accreditation Committee will maintain a list of reciprocity agreements from states.

c. A home energy rating system that has documented that it has received recognition from Fannie Mae or Freddie Mac through participation in its conventional energy mortgage pilot program.

HOME ENERGY RATING CERTIFICATION

EnergyGauge, REM/Rate, and TREAT are accredited by Residential Energy Services Network (RESNET) to be used for Home Energy Rating System (HERS) ratings. To be accredited, an application must be developed to comply with the "2006 Mortgage Industry National Home Energy Rating System Standards" (Mortgage, 2006) and pass a software verification test suite to verify tool accuracy and comparability. Descriptions of the tests from the verification test suite, taken from "Procedures for Verification of RESNET Accredited HERS Software Tools" (Procedures, 2006), are listed below.

1. **Tier one of the HERS BESTEST** – HERS BESTEST was developed by the National Renewable Energy Laboratory (NREL) for testing the building load prediction accuracy of simulation software. HERS Building Energy Simulation Test (HERS BESTEST) is a procedure for comparing HERS output to the output of "several of the best public-domain, state-of-the-art building energy simulation programs available in the United States" (NREL, 1995). These programs currently are BLAST 3.0 Level 215, DOE2.1E-W54, and SERIRES/SUNCODE 5.7. Very simple houses in two locations (Colorado Springs, CO and Las Vegas, NV) are simulated with these "state-of-the-art" programs using standard HERS assumptions for occupancy and physical properties. The same houses are simulated with the HERS tool being tested. In order to pass the test, the HERS estimate for heating and cooling load (in MBtu/y) must be within a certain percentage of the estimate from the "state-of-the-art" programs for each of these hypothetical houses. (See Section 3.1 of the *Procedure for Verification*.)
2. **HERS Reference Home auto-generation tests** – These tests verify the ability of the software tool to automatically generate the HERS Reference Home. (See Section 3.2 of the *Procedure for Verification*.)
3. **HERS method tests** – These tests verify that software tools can accurately calculate the HERS Index that is used as the numerical indicator of relative performance for a home. (See Section 3.3 of the *Procedure for Verification*.)
4. **HVAC tests** – These tests verify the accuracy and consistency with which software tools predict the performance of HVAC equipment, including furnaces, air conditioners, and air source heat pumps. (See Section 3.4 of the *Procedure for Verification*.)
5. **Duct distribution system efficiency tests** – These tests verify the accuracy with which software tools calculate air distribution system losses. ASHRAE Standard 152 results are used as the basis for the test suite acceptance criteria. (See Section 3.5 of the *Procedure for Verification*.)
6. **Hot water system performance tests** – These tests determines the ability of the software to accurately predict hot water system energy use. (See Section 3.6 of the *Procedure for Verification*.)

RESPONSES FROM CERTIFIED ENERGY RATING PROVIDERS

John Coulter
Advanced Energy
North Carolina
(phone conversation)

Advanced Energy has used REM/RATE for 5-6 years as a provider and rater; have found it very user friendly and the developers are very responsive to their needs

North Carolina has a program called “System Vision” that includes Energy Star rating plus combustion efficiency and ventilation/duct sealing. Advanced Energy guarantees heating and cooling costs for first two years, so they are concerned that the actual costs come close to predicted. They compared Manual J load calcs (using Right-Soft) to REM/RATE and earlier versions of REM/RATE did not come as close to actuals but current version is much better and they are comfortable using it. Advanced Energy did a comparison of Energy Gauge and REM/RATE and found them to be very similar in their output calcs.

REM/RATE is not a load calc program and if that is required you should use a different program, such as Right-Soft or Elite. There is better software for alternative energy analysis. REM/RATE’s internal calcs seem to favor larger homes meeting Energy Star levels better than smaller homes

Summary:

1. Choose a program that provides energy use and another program that provides heating and cooling modeling when those details are needed.

2. Decide how much you really want to be involved in the design of energy use software as opposed to its field applications. Advanced Energy chose to go with REM/RATE even though they could do their own because they want to focus on the field work.

The SystemVision™ Energy Guarantee Program, offered by the North Carolina Housing Finance Agency in partnership with Advanced Energy Corporation, encourages high standards of energy efficiency in the construction of affordable homes.

The Agency will provide a construction subsidy of $4,000 to nonprofits and local governments for each home they develop following SystemVision™ guidelines. The guidelines include specific energy efficiency standards such as smart mechanical ventilation systems that control indoor air quality and humidity levels. Advanced Energy Corporation trains the construction teams in the implementation of these systems.

Under the SystemVision™ Program, Advanced Energy issues a two-year heating and cooling bill guarantee. Typically, this guarantee is that the average heating and cooling costs will be less than $30 per month. If the actual costs are higher, Advanced Energy reimburses the homeowner for the excess. Advanced Energy also issues a comfort guarantee to the homeowner: the center of every room will differ from the thermostat setting by no more than three degrees.

Galo LeBron

Energy Inspectors
California

It would be wiser to adopt a program that has programmers working full time on incorporating new energy products, services, etc., than trying to keep up with it yourself. I don't think you want to be in the energy efficiency software business. It's competitive, and takes a bunch of work.

We use REMRate (Architectural Energy Corporation, talk to Dave Roberts) which is most widely used throughout the USA, and Micropas which is for California, which as you know has the highest residential energy efficiency requirements in the nation. These programs do give you somewhat different results for the same inputs. REMRate does not address California. We use the software for energy star certifications, Title 24 in CA, Federal Tax Credit certifications, and for any other residential energy target any municipality might have anywhere.

How we would change it is a long discussion because we are actually doing in the field the work that software companies are trying to model into their software, and they need constant feedback on different products and techniques, etc., though it difficult to incorporate changes into software readily, so you sometime don't get a real world result from the algorithms used in the software. For example, it has taken years to more correctly model the impact of radiant barrier on a home. There are other products that have no rating because the testing needed for the software has not been done, yet these products do have a favorable impact on the energy efficiency of the home. The software does not know it, nor take it into account.

It is very important to note that experience in using these programs is very critical. The more plans you do, the more you learn about the software and the many things that you can do to make a house energy efficient. Our company has done about 122,000 plans and counting, which may be the most of any provider/rater in the nation, and as such we can use software in ways that would take most a long time to learn.

Brady Peeks
Energy Analyst
Oregon Department of Energy

The State of Oregon and the "lower four" northwest states generally favor program designs that rely upon prescriptive measure implementation. Oregon and Washington have building codes that are prescriptive in nature, and our compliance surveys routinely find much better compliance with code requirements than is found in many other parts of the country, where performance-base approaches (like ratings) are allowed to demonstrate code compliance. Our region's Energy Star Homes program is based upon prescriptive measures that were first modeled on "prototype" homes that are intended to be representative of typical construction in the region. This way, the program's staff have been able to focus upon the materials and technologies we wish to promote into common use without the added cost of running software on each home

under construction. We have found the RESNET-approved software is not sophisticated enough to generate particularly useful energy use, equipment sizing or duct system design information.

For utility-run weatherization programs we have come to much the same conclusion. When one goes into a home, it typically falls into a general class of homes where the measures recommended are the same. We know that certain measures prove to be cost effective time and time again while others tend not to be worthwhile except in certain situations. We have established "deemed" savings for a whole menu of measures based upon studied savings in outfitted homes. Spending time to run modeling software on each home to tell an auditor what she already knows is a worse investment than putting that auditor in the field to work with contractors to ensure the highest quality work possible and help homeowners manage the weatherization process with minimal headache and life disruption.

Our low-income programs are a different story. In that arena they use the software runs to document and justify the funds spent on weatherization and the energy savings being claimed on a house-by-house basis.

In short, unless you rely heavily upon the analysis reports, I suggest you consider keeping whatever software use to the program and measure development realm and focus on putting knowledgeable people in the field to actually work at improving the value of work done in either new construction or weatherization programs. That way you can use more sophisticated analysis on a more limited basis to develop defensible measures without having to police numerous rating runs, each one susceptible to input error or building mis-representation.

Just two cents from "down south." Good luck.
Greg Nahn
Wisconsin Energy Star Homes

Predominately we use Rem Rate to qualify homes in our new construction program (Wisconsin ENERGY STAR Homes) - as a prerequisite before going in the field with the builder. Homes must meet 80 rating index (or lower) based on plans before we proceed with verifying construction details and as built condition. Also, it is used some in the existing homes program where there is customer demand. Last year we did 1500 ratings in new construction and only 200 in existing homes. More assessments are done in existing homes because you don't need a rating to tell you to insulate un/under insulated walls, attics, etc and the rating $ can actually go towards the improvement measure.

WE DO NOT use REM for evaluated or reported program savings

3. How or if you would change it?

I think the software is fine for what we use it for. Most of the changes I would suggest are directed at RESNET in interpreting ventilation run time and default distribution efficiency for duct work located inside conditioned space.

Patrick Haller
Market Manager
Residential New Construction
Efficiency Vermont **phaller@veic.org**

1. *What software program you use?*

Architectual Energy's RemRate, version 12.31

2. *How you use it for your particular programs?*

We use it solely for our Residential New Construction program to:

a. Rating for Estar Performance score (in Climate zone 6, 80 points or less)
b. Verification of EPACT 2005
c. Vermont's Energy Code Compliance. Vermont allows for a rating to be used to show code compliance. Must be 85 points or below.

3. *How or if you would change it?*

a. We would like a more elegant database. The existing "Export Database" is unwieldy. We are happy there is one, and we continue to make progress in learning its usefulness though.

b. We would like for data to be able to be imported directly into the software in order to run a rating. ie, there is field collected data that is common for all houses. RemRate would be very useful if you could import this data directly to the software thus reducing rekeying information.

c. Reports, there are near 100 possible reports. It would be very good if the reporting structure were more dynamic, ie, be able to build your own.

d. Dynamic entry of building component properties. An easy example: Windows come in many combinations of U and SHGC factors. RemRate does not allow you to dynamically enter in the factors. Instead, its a pick list from a clunky library system. Many other building components are like this too.

If I think of more, I'll send them your way.

A huge plus for the software is that the staff at AEC are very responsive and helpful.

Cris Peterson
Energy Rated Homes of Utah
1. *What software program you use*: REM/Rate

2. *How you use it for your particular programs*: Ratings and Energy Star certifications

3. *How or if you would change it?*: all changes and upgrades are handled by software developer- they are very open to suggestions- we have submitted minor changes and suggestions to them as they have been needed.

James Cavallo, Ph.D.
Principal, Kouba-Cavallo Associates, Inc.
6912 Main Street, Suite 126
Downers Grove, IL 60516

We use REM/Rate as our software for Energy Star Homes ratings. It is easy to use and folks in neighboring states also use it - so we can exchange information and learn from one another.

Many of us do not use REM/Rate for other work, such as multifamily audits or weatherization assistances and training.

There are many things that we would like to see change. REM/Rate continues to use heating degree-days rather than a more sophisticated way of representing weather - such as bin data. Also some of us would like to see the Manual J calculations come closer to what other Manual J programs give.

Toby Taylor
HERS Raters of Texas

We currently use REM/Rate software.

Abe Kruger
Project Manager
SOUTHFACE - Responsible Solutions for Environmental Living
241 Pine Street, Atlanta, GA 30308

1. *What software program you use?*
Architectural Energy Corp's REM/Rate

2. *How you use it for your particular programs?*
For all HERS Ratings. Primarily for ENERGY STAR certification purposes, but also to show compliance with the 2005 EPAct Tax Credit. Occasionally we use the ratings for improvement analysis and Energy Improvement Mortgages.

3. *How or if you would change it?*

AEC has amazing customer support I can not say enough about their technical support team. The one thing I would change, however, is how the software models multifamily units and buildings. It seems like that is the one area where some improvement could be achieved.

Terry Smith, Director
Installed
Ohio

1. *What software program you use*: REMrate - TREAT (soon)

2. *How you use it for your particular programs*: Most of our work is for either Energy Star or the 2005 EPACT tax credit. We have a pilot with the Touchstone Energy Cooperatives where they use our services for a bill guarantee program (new construction). These Touchstone Homes get E-Star and Tax Credit as well.

We are also beginning a Home Improvement with Energy Star program in northern Ohio where we will use TREAT software

3. *How or if you would change it?*: The REM software feeds into a tracking and certificate printing tool that we have developed with a consultant. So, as we need changes we have been able to work with Architectural Energy Corp to meet our needs. (I've been using REM for about 10 years now), they have been very good to work with.

Paul Rimelspach
Granville, OH

REM/Rate – I've used REM/Design since 1992 for upgrades, training, ratings, marketing, etc.

I think modeling software should be linked to CAD and/or more directly to HVAC sizing programs – we're all crunching the same numbers in slightly different scenarios – not an efficient use of resources.

I was in Anchorage for my daughter's Midnight Sun marathon a couple of years ago; you have an awesome country up there! Good luck with your search.

Joe Bowling
Energy Wise Solutions, Inc

1- We use REM/RATE from Architectural Engineering

2- We use it for Energy Efficient Mortgages(EEM),

energy improvment audits and Energy Star Audits.

3- We are a fairly new provider, therefore we have not
had much to complain about yet.

Mark Jansen
Energy Efficient Homes Midwest

As an approved RESNET provider, would you be willing to tell us

1. What software program you use REM/Rate
2. How you use it for your particular programs, and Ratings
3. How or if you would change it? NO

Brett Dillon, Vice President
Builders Energy Rater
17325 Bell North Drive Suite1
Schertz, TX 78154

We use REM/Rate for all of our HERS ratings on new and existing homes. I have found it to be the most user friendly program while maintaining the accuracy level needed. We even use the results generated by the software to guarantee energy consumption for heating and cooling for some of our production builder clients.

I am also the VP of IBS Advisors,LLC, and we have recently received RESNET approval as a HERS Training Provider. I have been teaching the HERS courses for the past 3 years as a subcontracted trainer, and all of those clients also used REM/Rate.

The developer of REM/Rate has been particularly helpful when dealing with “bugs” that are inevitable whenever a new version of the software is released and also provides updates whenever the latest regulations are released by RESNET to accommodate compliance.

The one thing that I would change with REM/Rate is the geothermal section. The default values listed are outdated and they need to capture more data on soil conditions, in my opinion. Hope this helps!

For a homebuilder to qualify for the New Energy Efficient Home Credit under IRC Sec. 45L, they must receive a certification that the dwelling unit has met the energy savings requirements of Sec. 45L. An eligible certifier must use an approved Software Program to calculate the dwelling unit's energy consumption for purposes of Sec. 45L. Sec. 45L provides a $2,000 credit for a traditional free-standing home and either a $1,000 or $2,000 credit for a manufactured home depending on the level of energy savings achieved.

Note: These provisions, originally set to expire 12/31/2007, have been extended through 12/31/2008 as set forth in the Tax Relief & Health Care Act of 2006.

IRS Notice 2006-27 (Section 5) and Notice 2006-28 (Section 6) provide for the Service to create and maintain a list of software programs that have been accepted by the Service for use in computing energy consumption for the purpose of certifications under Sec. 45L. An accepted software program will appear on the list below when the software developer submits the following information to both the IRS and RESNET.

1. The name, address, and telephone number of the software developer;
2. The name or other identifier of the program as it will appear on the list;
3. The test results, test runs and the software program with which the test was conducted;
4. A declaration by the developer of the software program, made under penalties of perjury, that the software program has satisfied all tests required to conform to the software accreditation process prescribed in RESNET Publication No. 05-001 (Nov. 17, 2005).

Application	Vendor	Contact	Website
EnergyGauge® USA version 2.5 EnergyGauge® USA version 2.6	Florida Solar Energy Center	Tei Kucharski	EnergyGauge
REM/Rate v.12.2 REM/Rate v.12.3 REM/Rate v.12.4	Architectural Energy Corporation	David Roberts, P.E.	Architectural Energy Corporation
MICROPAS7 v7.1 MICROPAS7 v7.3 MICROPAS7 v7.4	Enercomp, Inc.	Ken Nittler and Robert Scott	MICROPAS
Builder Energy Solutions Calculator	Owens Corning	Dwight Shuler	Owens Corning
EnergyPro v4.4	Energy Soft	Martyn Dodd	Energy Soft

For additional information regarding home certifications and becoming an eligible certifier, refer to RESNET (Residential Energy Services Network).

RESNET

MORTGAGE INDUSTRY NATIONAL
HOME ENERGY RATING PROVIDER ACCREDITATION
APPLICATION

PART ONE: GENERAL APPLICATION

Legal name and full address of home energy rating program. This name and address will appear on the Certificate of Accreditation and the national register of accredited home energy rating providers that is used by the mortgage industry, building code officers, and sponsoring programs such as the Environmental Protection Agency. The annual fee for accreditation as a rating provider is $1,750. There is a non-refundable application fee of $500. If the application for accreditation is approved the $500 application fee will be credited to the accreditation fee. Please include a check in the amount of $500 made out to "RESNET" for your application fee.

State(s) Applied To:

Rating Program's Name:

Organization Name:

Organization Mailing Address:

Program Contact:

Program Contact Title:

Program Contact Telephone #

Program Contact Fax #

Program E-mail Address:

Program Web Site Address:

Program Contact Mailing Address (if different that Organization's)

PART TWO: PROGRAM APPLICATION

I. MINIMUM HOME ENERGY RATER CERTIFICATION PROCEDURES

The national rating standards require that rating providers can only certify raters who have:

- Successfully completed rater training from a RESNET accredited rater training provider,
- Who have passed the National Rater Test administered by RESNET, and
- Successfully completed, at a minimum, an additional three ratings under supervision of the rating provider's quality assurance designee.

The standards also require that by January 1, 2008, all existing raters who have not yet taken the RESNET National Rater Test must take and pass the National Rater Test. (Please attach the section of your policies and procedures that address rater minimum qualifications.)

II. MINIMUM RATER TRAINING STANDARDS

The accreditation standard requires that rating providers use a RESNET accredited rater training provider. The listing of accredited rater training providers and their accreditation identification numbers is posted at www.natresnet.org/accred/training.htm

Name of Rater Training Provider(s) Used to Train Raters

Rater Training Providers' Accreditation Identification Numbers

III. MINIMUM RATER RECERTIFICATION STANDARDS

A. How often are raters recertified (The accreditation criteria require that rater recertification take place at least every three years)?

B. How does your home energy rating program evaluate raters' ability to perform accurate ratings?

C. What are your program's continuing education requirements? (The accreditation criteria require a minimum of 12 hours of the rating system's approved training over the period of three years. Ten of the 12 hours of the continuing education shall be approved by RESNET. RESNET has posted a web page on approved continuing education courses at www.natresnet.org/)

IV. MINIMUM STANDARDS FOR A HOME ENERGY RATING PROVIDER'S OPERATION POLICY AND PROCEDURES

Please address the minimum requirements of the following. (Please attach your home energy rating program's internal policy and procedures documents)

A. Ratings from plans are labeled on the rating certification/report as projected ratings

B. Requirement that data is collected through field inspections of all homes

C. Requirement that blower tests are required on all homes claiming credit for reduced air infiltration

D. Requirement that duct testing be completed on all homes claiming credit for reduced air distribution system leaks

E. Improvement options given to homeowner when applicable

1. Describe how recommended improvement measure costs are developed under your program. (Accreditation Criteria requires that improvement costs are provided by the home energy rating program or provided by rater)

2. Describe how estimated energy savings of improvements are derived. (Accreditation criteria requires that at a minimum they be based upon assumptions contained in the rating software program)

3. Describe how improvements are recommended by your system. (Accreditation criteria requires that at a minimum the improvements are recommended by the rating software program and that this can be customized by the rater)

F. Please document your program's requirement that your rater conflict of interest disclosure. (Accreditation criteria require that raters must complete and give to their clients the RESNET Rater Financial Interest Disclosure Form posted at http://www.natresnet.org/disclosure/ Rating providers must provide to the builder/homeowner the financial disclosure form at their request.)

G. Please attach your rater discipline provisions. (Accreditation criteria requires that this provision at a minimum must involve progressive discipline including probation-suspension-termination)

H. Describe you systems rater quality control process. Accreditation criteria requires that at a minimum the process must include:

- Review by the provider's quality assurance designee (defined below) of a probationary rater's three ratings, during the rater's probationary period.
- Review by the providers quality assurance designee of a minimum of 10% of each rater's building data files
- Field monitoring of a rater's ratings
    - Annually the greater of 1% of the rater's total number of homes or one home

- The quality assurance designee must independently repeat the rating to determine whether it was completed accurately

I. Please name your program's Quality Assurance designee. Accreditation standard requires that the designee's responsibilities include:

- Maintain the provider's quality assurance files
- Review of ratings conducted by rater trainees during their probation period
- Monitoring of ratings by certified raters

Quality Assurance Designees shall at a minimum be either a RESNET certified rater trainer or pass the RESNET Quality Assurance Designee Test (the test will become available by RESNET by March 7, 2005. If your designee changes you must notify RESNET of the new designee within 60 days.

1. Name, phone number, e-mail address, and rater certification number of your Quality Assurance Designee

2. Please attach documentation of either the designee's certification as a rater trainer or passing the RESNET Quality Assurance Designee test

J. Describe your program's rating record keeping provisions. At a minimum these procedures must include:

- The quality assurance record of each home that shall contain at a minimum the electronic copy of the building file (these records shall be maintained by the provider for a minimum of three years)
- A rater registry if all of your certified raters that must be provided to RESNET annually (unless notified RESNET will consider these registries as public information.
- Upon request, must provide to RESNET the total number of projected and confirmed rating for a specified calendar year.

K. Describe you complaint resolution process. Provider shall have process for receiving and responding to consumer complaints. At a minimum this must include:

- Documentation of procedures to respond to and resolve complaints involving the rating services as defined in RESNET's national home energy rating standards and RESNET's Rating Standards of Practice.
- The provider shall require its certified raters to inform their clients of the complaint resolution process
- The provider must maintain the records of complaints received and responses to complaints for a minimum of three years after the date of the complaint.

L. Code of Ethics and Rating Standards of Practice – Document your program's code of ethics and rating standards of practice. The accreditation standards require that the provider must include in their rater agreement a code of ethics and rating standards of practice that at a minimum meets the two standards adopted by RESNET.

M. Please attach a copy of your rating system's report/certificate. (Accreditation criteria the report must contain stars (1-5+); points (1-100); either projected energy costs, use and/or savings)

N. What home energy rating software program does your system use? The accreditation standard requires all rating providers to use RESNET accredited rating software programs. In addition the provider must use the current version of that software that affects the rating score. Accredited software programs and the required version is posted on RESNET's web site at www.natresnet.org/accred/software.htm Please include documentation that you have a users agreement and what version of the rating program software your program is using (you have 60 days upon a release of an updated version of the software program that with changes to the rating score and documented on the RESNET web site to begin using the new version).

PART III: APPLICATION CERTIFICATION AND REPRESENTATION

As an officer of I, the undersigned, do here submit this Application for Accreditation. I certify that the application is complete and accurate.

Name:

Signature:

Title:

Organization:

Date:

RESNET
Residential Energy Services Network
Setting the STANDARD for QUALITY

RESNET Rating Software Tool
Accreditation Application and Instructions

PART ONE: GENERAL APPLICATION

Provide the legal name and full address of the rating software tool developer. This name and address will appear on the Certificate of Software Accreditation and the national registry of accredited home energy rating software tools that will be used by the mortgage industry.

Rating Software Program Name:

Mailing Address:

Program Contact:

Title:

Telephone #

Fax #

E-mail:

Web site address

PART TWO: PROGRAM APPLICATION

1. **Name of and version number of Rating software program**

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2. **Results of HERS BESTEST, Tier 1 Tests**
   For information on the test go to www.resnet.us/programs/software/verification.pdf

   Please use the spreadsheet form named "Bestest_results_form.xls" to record and report your results from these tests. This Excel spreadsheet form may be downloaded from www.resnet.us/hers_software/bestest_results_form.xls.

3. **Results of RESNET HERS Reference Home Rating Software Auto-Generation Test**
   For information on the test go to www.resnet.us/programs/software/verification.pdf

   Please use the spreadsheet form named "auto_results_form.xls" to record and report your results from these tests. This Excel spreadsheet form may be downloaded from www.resnet.us/hers_software/auto_results_form.xls.

4. **Results of HERS Method Test**
   For information on the test go to www.resnet.us/programs/software/verification.pdf

   Please use the spreadsheet form named "method _check-2006_form.xls" to record and report your results from this test. This Excel spreadsheet form may be downloaded from www.resnet.us/hers_software/method_check-2006_form.xls.

5. **Results of HVAC Tests**
   For information on the test go to www.resnet.us/programs/software/verification.pdf

   Please use the spreadsheet form named "HVACresults_form.xls" to record and report your results from this test. This Excel spreadsheet form may be downloaded from www.resnet.us/hers_software/HVACresults_form.xls.

6. **Results of Duct Distribution Efficiency (DSE) Tests**
   For information on the test go to www.resnet.us/programs/software/verification.pdf

   Please use the spreadsheet form named "DSEresults_form.xls" to record and report your results from this test. This Excel spreadsheet form may be downloaded from www.resnet.us/hers_software/DSEresults_form.xls.

7. **Results of Hot Water System Performance Tests**

For information on the test go to www.resnet.us/programs/software/verification.pdf

Please use the spreadsheet named “DHWresults_form.xls” to record and report your results for this test. This Excel spreadsheet form may be downloaded from www.resnet.us/hers_software/DHWresults_form.xls.

Please forward with this application an operating copy of the software program, the test the test runs (input decks) used for each of the software tests, and your results spreadsheets to RESNET along with any explanatory documentation needed to understand and replicate the tests. Please rename the results spreadsheet to replace ‘form’ with a name or acronym that identifies your software.

The above material may be made available by RESNET for review by interested parties.

Any challenge to a software’s accreditation shall be made in writing directly to the RESNET Executive Director. Within 5 working days the RESNET Executive Director shall forward the challenge to the software developer for comment and rebuttal. The challenged software provider must respond to the RESNET Executive Director in writing within 30 days. The RESNET Board of Directors shall review the challenge and response and make a determination within 30 days. If a challenge is made public by the challenger prior to the RESNET Board’s determination, the subject challenge will automatically be determined to be non-substantive.

PART III: APPLICATION CERTIFICATION AND REPRESENTATION

As an officer of I, the undersigned, do hereby submit this Application for RESNET Software Tool Accreditation, I hereby certify that this application is complete and accurate to the best of my knowledge and belief.

Name:

Signature:

Title:

Organization:

Date: