OREGON HOUSING &
COMMUNITY SERVICES
ENERGY SERVICES SECTION

Weatherization Assistance Program

REM/Design™ Technical Policies

Andrea Bell
Director

Michael Figueredo
Weatherization T&TA Coordinator

Oregon Housing and Community Services
North Mall Office Building
725 Summer Street NE, Suite B
Salem, Oregon 97301-1266
Phone: 503. 986.2000 Fax: 503.986.2020 TTY: 503.986.2100
www.ohcs.oregon.gov

EQUAL HOUSING
OPPORTUNITY

Effective July 1st, 2024

REM/Design™ Certification Requirements

REM/Design is the approved computerized audit tool for the Oregon WAP for use in site-built homes, mobile homes, and small (≤ 25 units) individually heated/cooled multifamily buildings. The Oregon WAP requires each local weatherization agency have (1) certified REM/Design™ user. It is recommended that agencies have additional staff certified to ensure continuity in the case of loss of staff. Non-certified REM/Design™ users must have REM/Design™ models reviewed by a certified user before certification is obtained. Both certified and un-certified users must be identified in the "Builder's Name" field on the Property/Builder Information page. When an uncertified user is identified in the "Builder's Name" field, the certified user that has reviewed the REM file must also be identified with a forward slash after the uncertified user's name followed by that individual's name.

REM/Design certification must be obtained within 1 year of promotion/hire date.

OHCS will certify and re-certify individuals in the use of REM/Design™. The agency must request a certification test from OHCS. Upon receipt of the request, OHCS will schedule a time to perform the test. The test is performed via E-mail. The REM/Design™ models will be reviewed for accuracy and compliance to program guidelines. A score of 70% or better is required to pass. Upon successful completion, the user will be issued a REM/Design ™ certificate. Certifications are valid for a period of 5 years.

4 hours of continuing education in the use of REM/Design™ is required annually.

Building Evaluation

Audit Criteria

For heat loss and savings calculations, building components must be measured and area and volume calculations must be accurate. For use in heat loss and savings calculations use the following criteria for building component evaluations:

- Insulation
  - R-values of installed blown-in insulation shall be determined based on an actual measurement of the insulation depth and the R-value per inch for that product. Uneven distribution may be averaged.
  - "Tracks" in existing blown-in insulation may be accounted for by determining the net square footage of the lowered R-value area and modeling it as a separate component of the building.
  - Voids in insulation or ineffective installation of insulation may be accounted for by determining the net square footage of uninsulated/ ineffective area and modeling it as a separate component of the building.
  - Gaps between batt insulation and framing may be accounted for by determining the effective R-value for the insulation using the Effective R-value for Batt Insulation Chart provided below.
- Windows & Doors
  - Windows and doors must be measured and assigned appropriate U-values consistent with the material type and the ratings established by the National Fenestration Rating Council (NFRC). NFRC numbers are stamped on the metal spacer on most double-glazed (or better) units. This number may be looked up in the NFRC guide to determine the precise U-value and Solar Heat Gain Coefficient. On new windows, the U-values and SHGC can be obtained from the NFRC label. If NFRC numbers are not available, see default U-values for windows below.
  - Windows and doors orientation and wall assignment must be modeled accurately.
  - Windows and doors square footage must be entered accurately.
- Ductwork
  - All ductwork must be modeled, improved, and separated by location (e.g. - Mobile home belly or crawlspace) and classification (e.g. - supply or return).
  - Heating duct components (e.g. – supply and return) as well as duct sealing costs may be grouped as an individual measure to determine cost effectiveness.

Default Values for Insulation

When manufacturer's rated R-values for insulation are not available, use the chart below to estimate the R-value per inch for the installed product.

Insulation Type	R-Value Per Inch	Typical Applications
Cellulose Loose Fill	3.7	Ceiling Insulation
Cellulose Dense Pack	3.2	Walls, Enclosed Cavities, Framing Transitions.
Fiberglass Batts	3.0	Floor & Ceiling Insulation, Open Frame Walls.
Fiberglass loose fill	2.8	Attic floors, Existing Wall Insulation.
Fiberglass Dense Pack	4.25	Walls, Enclosed Cavities, Framing Transitions.
Rockwool	3.0	Ceiling, Existing Wall Insulation.
Vermiculite	2.7	Ceiling Insulation.
Poly-isocyanurate, rigid board	7.0	Foundation walls, Attic Accesses, Rim Joists.
Polystyrene, expanded rigid board	4.0	Foundation Walls, Rim Joists
Polystyrene, extruded rigid board	5.0	Foundation Walls, Rim Joists

Effective R Values of Batt Insulation*

Condition:	Good	Fair	Poor
Measured Batt Thickness	Effective Batt R-value R-2.5/inch	Effective Batt R-value R-1.8/inch	Effective Batt R-value R-.7/inch
1"	3	2	1
2"	5	4	1.5
3"	8	5	2
4"	10	7	3
5"	13	9	3.5
6"	15	11	4
7"	18	13	5
8"	20	14	5.5
9"	23	16	6
10"	25	18	7
11"	28	20	8
12"	30	22	8.5

*Derived from ASHRAE document "Heat Transmission Coefficients for   Walls, Roofs, Ceilings, and Floors" 1996

1. Measure the insulation thickness.

2. Determine the condition of the installation using the following criteria:

- Good – No gaps or other Imperfections

- Fair – Gaps over 2.5% of the insulated area. (This equals 3/8 inch space along a 14.5 inch batt.)

- Poor – Gaps over 5% of the insulated area. (This equals ¾ inch space along a 14.5 inch batt.)

3. Look up the effective R-value of the installed insulation using the condition and measured inches.

Effective July 1st, 2024

Default Values for Existing Windows and Glass Doors

Where NFRC numbers are not available, use the following chart to estimate the U-value and Solar Heat Gain Coefficient (SHGC) for existing windows and glazed areas of doors. The values shown below are only estimates. They do not account for all possible window configurations and variations due to airspace thickness, insulated frames, mullions, etc. Since U-values can vary greatly depending on the window type (double-hung, casement, fixed) even within the same manufacturer's model line, it is strongly recommended that NFRC ratings are used whenever the windows are appropriately labeled. It is not allowed to deviate from these default values due to window condition. In the case of poor window condition, when using funds that follow DOE, windows must be replaced following the incidental repair protocol section below.

Default Window Values

Frame Type	Glazing Type	U-Value	SHGC	U-Value w/ low E	SHGC w/ low E
Wood	Single	.90	.65	NA	NA
	Single W/storm	.49	.71	NA	NA
	Double	.49	.58	.39	.45
Vinyl	Double	.46	.57	.36	.45
Metal	Single	1.31	.80	NA	NA
	Double	.87	.73	NA	NA
Metal w/thermal break	Double	.65	.66	.53	.52

Default Values for Existing Doors

As with windows, if actual U/R-Values are not available, use the following table to estimate the R-value of the door. It is not allowed to deviate from these default values due to door condition. In the case of poor door condition, when using funds that follow DOE, doors must be replaced following the incidental repair protocol listed in the report generation section below.

Door	R-Value	U-Value
1-3/4" insulated fiberglass door	5.5	.18
1-3/4" insulated steel door	4.4	.23
2-1/4" solid core wood door	2.8	.36
1-3/4" solid core wood door	2.1	.48
1-3/8" solid core wood door	1.7	.59
1-3/8" hollow core wood door	1.3	.77
1-3/4" wood panel wood door	1.3	.77
1-3/8" wood panel wood door	0.9	1.1
Mobile home outswing door	1.0	1.0

Mechanical Systems Evaluation

Default Values for Mechanical Systems

Whenever possible, actual equipment information indicated on the mechanical equipment are to be input as existing properties, e.g., AFUE, % efficient, for the furnace. Further, a performance adjustment of 100% (functions as new) is used when modeling mechanical equipment for the building. **Reducing the performance adjustment is only allowed when actual energy usage justifies a reduction, <u>and</u> the equipment is in need of repair.** Any time a performance adjustment is used, the equipment must be repaired, and the cost justified, as a performance adjustment improvement, with an SIR of 1.0 or better. When attempting to replace an unsafe or non-working heating/cooling system as an energy conservation measure, enter the system as it was originally designed and installed. This includes the capacity, AFUE, and % of space conditioned. **<u>Default properties are to be used ONLY when values are unavailable from equipment data plates, equipment tags, etc.</u>** Using the REM/Design™ energy audit for change out of mechanical equipment is strictly for efficiency purposes. However, before afaulty or unsafe furnace may be replaced as a health and safety measure, the existing condition to new furnace upgrade must be proven non-cost effective with an SIR of less than 1.0. This is also the case for non-existing furnaces. In REM simply add an improvement by replacing "none" and adding the new equipment. If the SIR is below a 1.0, H&S funds may be utilized to provide safe and adequate heat for the building.

Note: Electric resistance heaters of any type or condition must be considered 100% efficient for modeling purposes.

Replacement Furnaces must include a Manual J heat load calculation to ensure proper sizing based on post-weatherization conditions (SWS 5.0108).

Year of Manufacture		Pre-60	60-69	70-74	75-83	84-87	88-91	92-
Heating Equipment	Units							
Gas Furnace	AFUE	60	60	65	68	68	76	78
Gas Boiler	AFUE	60	60	65	65	70	77	80
Oil Furnace	AFUE	60	65	72	75	80	80	80
Oil Boiler	AFUE	60	65	72	75	80	80	80
Air-Source Heat Pump	HSPF	4.5	4.5	4.7	5.5	6.3	6.8	6.8
Ground-Water Heat Pump	COP	2.7	2.7	2.7	3.0	3.1	3.2	3.5
Ground-Coupled Heat Pump	COP	2.3	2.3	2.3	2.5	2.6	2.7	3.0

Year of Manufacture		Pre-60	60-69	70-74	75-83	84-87	88-91	92-
Cooling Equipment	Units							
Air-Source Heat Pump	SEER	5.0	6.1	6.5	7.4	8.7	9.4	10.0
Ground-Water Heat Pump	EER	10.0	10.0	10.0	13.0	13.0	14.0	16.0
Ground-Coupled Heat Pump	EER	8.0	8.0	8.0	11.0	11.0	12.0	14.0
Central Air Conditioner	SEER	5.0	6.1	6.5	7.4	8.7	9.4	10.0
Room Air Conditioner	EER	5.0	6.1	6.1	6.7	7.7	8.1	8.5

Year of Manufacture		Pre-60	60-69	70-74	75-83	84-87	88-91	92-
Water Heating Equipment	Units							
Gas Storage	EF	0.47	0.47	0.47	0.49	0.55	0.56	0.56
Oil Storage	EF	0.47	0.47	0.47	0.48	0.49	0.54	0.56
Electric Storage	EF	0.79	0.80	0.80	0.81	0.83	0.87	0.88

Effective July 1st, 2024

Wood Heating Equipment

Wood heating equipment is often utilized in homes weatherized by the WAP. It is important to assign the most accurate combustion efficiency possible for the wood heating equipment. The key factor to identifying efficiency of wood heating equipment is EPA certification. This can either be listed on a temporary paper label affixed to the front of the unit (uncommon) or by a metal plate affixed to either the back or the side of the unit.

The following is a brief overview of the different types of wood burning of appliances available and how they should be treated in REM/Design™ modeling.

Open fireplaces: Designed more for show, traditional open masonry fireplaces should not be considered heating devices. Traditional fireplaces draw in as much as 300 cubic feet per minute of heated room air for combustion and then send it straight up the chimney. If a home is encountered where the only source of heat is an open fireplace, the efficiency should be modeled at **30%.** It is not required to model fireplaces in REM/Design if there is an alternative heat source being used.

Fireplace inserts: Fireplace inserts will raise the efficiency of an open fireplace insert considerably as they limit the amount of combustion air utilized and allow for better heat exchange. Non- EPA listed inserts must be modeled at 50% efficiency. Newer EPA listed inserts must be listed at **65%** efficiency unless tested efficiency can be found in the EPA list of certified woodstoves.

Woodstoves: Wood stoves are the most common appliance for burning wood. As with fireplace inserts, combustion efficiency is much higher than open fireplaces. Non – EPA listed woodstoves must be modeled at 50% efficiency. Newer EPA listed woodstoves must be listed at **65%** efficiency unless the tested efficiency can be found in the EPA list of certified woodstoves.

Pellet Stoves: Pellet fuel appliances burn pellets made from compacted sawdust, wood chips, bark, agricultural crop waste, wastepaper, and other organic materials. They are more convenient to operate and have much higher combustion and heating efficiencies than ordinary wood stoves or fireplaces. As a consequence of this, they produce very little air pollution. In fact, pellet stoves are the cleanest of solid fuel-burning residential heating appliances, with combustion efficiencies of 78% to 85%. Pellet stoves must be modeled with a combustion efficiency of **78%** unless tested efficiency can be found in the EPA list of certified woodstoves.

Modeling Requirements

Inputs

Input mode: Detailed inputs are required for all models. Simplified inputs are not allowed.

Property/Builder Information page: Auditors must include their name in the "Builder's name" location in the Builder Information section. If the auditor is not yet Certified in REM, simply enter the auditor's name followed by a forward slash / followed by the REM certified user's name that reviewed the REM per program requirements.

Shell measures: All shell measures may be modeled using "quick fill site built". This includes mobile homes.

Utility Rates

Utility rates used in REM models must be the OHCS five-year averaged EIA rates for these utilities: electric, natural gas, oil and propane or the published actual utility rate, whichever is greater. For EIA rates, the set utility rates must be consistent across all rate tiers and include a monthly service charge if applicable to the client. OHCS will set the rate annually based on a five-year average obtained from the energy information administration. OHCS will release updated rates, every year by October 1st, though a Weatherization Memorandum. If actual published rates are used, there must be documentation of the published rate that coincides with the audit date.

For fuel not covered by the EIA-averaged rates, sources such as wood or pellets, actual rates (supported by documented usage) or local rates at the time of the energy audit must be used.

Utility Usage

In order to calculate the most accurate energy savings, sub grantees are required, when possible, to obtain twelve months prior energy usage of metered energy sources for each dwelling to be weatherized. If 12 months usage is not available, and missing usage can be estimated reasonably, it is allowable to estimate the missing billing periods. Documentation of thought processes to estimate usage must be included in the file. If 12 months usage is not available and the missing data cannot be reasonably estimated, the project must be modeled conservatively.

In the case of multi-family projects, aggregate the usage for all units to provide an average usage for all units.

Cost-Effectiveness Screening Requirements

Actual costs of each prospective energy saving measure shall be screened for cost-effectiveness utilizing the improvement analysis report. Installation of prospective energy saving measures is

allowable when measures are screened as cost-effective in a site-specific energy model. Work will be prioritized and completed in descending order with measures receiving the highest SIR to the lowest SIR.

Furnace replacements must be modeled to determine cost effectiveness and **must** be included and considered with all prospective energy saving measures.

The improvement analysis requires that **all** measures completed during the weatherization process be included in the report.

Improvement Analysis Settings

Improvement Analysis Criteria Screen Definitions & Settings
- **Rank By:** This option specifies which criteria to use when ranking the effect of the improvements being considered. SIR is the required reporting format for the WAP
- **Rank Cutoff Criteria:** The cutoff criteria can be used to limit the number of improvements that will be considered and reported. For example, if a cutoff criterion of 1 is specified and the rank by option is SIR, then only improvements which result in a SIR greater than or equal to 1 will be applied and reported.
- **Economic Factors:** The Calculation Methodology requirement is **Oregon**. This is the same as using the DOE methodology but subtracts the cost of the measure from the calculation and allows for use of PV.

The Discount Rate must be set at **2%.** All other entries will be set to **Default.**

- **Measure Analysis Algorithm:**
  - Consider measure interaction: This box **must** be checked. Measure interaction is required.

- o Show rejected measures on report: This box must be checked. If measures are considered and not completed due to non-cost effectiveness, this checkbox, in conjunction with the rank cutoff criteria setting will allow the measures to be shown on the report as considered.
- **Reports:** Only the IA (improvement analysis) report is required.
- **Report Format:**
  - o The required format is "Existing/Proposed/Measure cost".
  - o Either measure name or measure description is acceptable.
  - o SIR and year savings are required. Simple payback and present value are optional.
- **Additional Output:** The saved improved building file box must be checked. By checking this box, you will be prompted to save the improved building on exit of the IA report. Save the improved building separately from your base building. This will allow you to compare the pre and post building to determine savings in a performance summary report.

Report Generation Requirements

The following Reports must be generated and included in the building file:
- Two Improvement analysis Reports showing:
  - o Measures and SIR's listed individually.
  - o All cost-effective measures, cost effective portion of bought down measures, as well as air infiltration and any incidental repair costs grouped for an overall project-level (or packaged) SIR.
- Fuel summary report
- Performance summary report: A two building report comparing the improved building to the unimproved building.

Truing Requirements

In order to keep projected energy savings as realistic as possible, Truing of REM/Design to actual usage is required to the greatest extent possible for all homes and all fuel types. The procedures for both metered and un-metered fuel types will be addressed.

The following protocol and guidance suggestions assume the building has been properly modeled, all heat sources have been included, and a fuel summary report can be produced without any errors.

Electric Heated Homes:

1. Obtain one year's usage from utility. If one year's usage is not available, refer to the protocol for modeling conservatively listed below. Note: If 12 months usage is not

available, and missing usage can be estimated reasonably, it is allowable to estimate the missing billing periods.

2. Input the year's usage in the utility consumption analysis (UCA) spreadsheet. Note the base load usage total from the spreadsheet.

3. Model the building in REM/Design with the thermostat set point at 65 heating & 80 cooling. Run the fuel summary report (FSR). Compare the base load usage in the FSR annual end use consumption section to the base load calculated in the UCA.

4. Add or subtract from the base load listed in REM on the lights & appliances section to true the base load consumption in REM to the calculated base load amount on the UCA.

5. Re-run the FSR and compare heating usage in the annual end use consumption section of the report.

6. If REM/Design is predicting heating & cooling usage higher than is indicated on the UCA, keep the set point at 65 & 80. Ensure the inputted R-values in the model are accurate, furnace efficiencies are accurate, blower door & duct blaster values are accurate and that all performance adjustments are set at 100%. If all of these settings are correct, note in the file that the REM model has been trued as close as possible. The REM model is complete, and no further action is required.

7. If REM/Design is predicting usage lower than actual, it is allowable to raise the heating set point (or lower the cooling set point if cooling is indicated) until the heating usage matches the heating & cooling usage on the UCA.

Gas Heated Homes:

Obtain one year's usage from both the electric and gas utilities. If one year's usage is not available, refer to the protocol for modeling conservatively listed below. Note: If 12 months usage is not available, and missing usage can be estimated reasonably, it is allowable to estimate the missing billing periods.

1. Input both the year's gas and electric usage in the utility consumption analysis (UCA) spreadsheet. Note the base load usage total from the spreadsheet for both gas and electric if applicable.

2. Model the building in REM/Design with the thermostat set point at 65 heating & 80 cooling. Run the fuel summary report (FSR). Compare the electric and gas (if applicable) base load usage in the FSR annual end use consumption section to the base load calculated in the UCA.

3. Add or subtract from the base load listed in REM on the lights & appliances section to true the base load consumption in REM to the calculated base load amount on the UCA for both gas and electric base load.

4. Re-run the FSR and compare heating usage in the annual end use consumption section of the report.
5. If REM/Design is predicting heating & cooling usage higher than actual. Keep the set point at 65 & 80. Ensure the inputted R-values in the model are accurate, furnace efficiencies are accurate, blower door & duct blaster values are accurate and that all performance adjustments are set at 100%. If all of these settings are correct, note in the file that the REM model has been trued as close as possible. The REM model is complete, and no further action is required.
6. If REM/Design is predicting usage lower than actual, it is allowable to raise the heating set point (or lower the cooling set point if cooling is indicated) until the heating usage matches the heating & cooling usage on the UCA.

Un-metered Fuel Type Homes (Oil, Propane, Wood Pellets etc.)

1. Obtain one year's usage from the electric utility. If one year's electric usage is not available, refer to the protocol for modeling conservatively listed below. Note: If 12 months usage is not available, and missing usage can be estimated reasonably, it is allowable to estimate the missing billing periods.
2. If possible, obtain proof of the previous year's usage of the un-metered fuel type. (Receipts)
3. Input the year's electric usage in the utility consumption analysis (UCA) spreadsheet. Note the base load usage total from the spreadsheet.
4. Model the building in REM/Design with the thermostat set point at 65 heating & 80 cooling. Run the fuel summary report (FSR). Compare the base load usage in the FSR annual end use consumption section to the base load calculated in the UCA.
5. Add or subtract from the base load listed in REM on the lights & appliances section to true the base load consumption in REM to the calculated base load amount on the UCA.
6. If you were unable to acquire usage information for the un-metered fuel, leave the set point at 65 and 80. Ensure the inputted R-values in the model are accurate, furnace efficiencies are accurate, blower door & duct blaster values are accurate and that all performance adjustments are set at 100%. If all of these settings are correct, note in the file that the REM model was trued to base load and the un-metered usage documentation could not be acquired. The REM model is complete, and no further action is required.
7. If you were able to acquire usage for the un-metered fuel type, re-run the FSR and compare heating usage in the annual end use consumption section of the report.
8. If REM/Design is predicting heating & cooling usage higher than actual. Leave the set point at 65 & 80. Ensure the inputted R-values in the model are accurate, furnace efficiencies are accurate, blower door & duct blaster values are accurate and that all

performance adjustments are set at 100%. If all of these settings are correct, note in the file that the REM model was trued as close as possible. The REM model is complete, and no further action is required.

9. If REM/Design is predicting usage lower than actual, it is allowable to raise the heating set point (or lower the cooling set point if cooling is indicated) until the heating usage matches the heating & cooling usage on the UCA.

Homes with a Metered Heat Source and an Additional Un-Metered Heat Source

1. Follow the appropriate protocol listed above depending on the metered fuel source (s). Follow the protocol through step 5.
2. If REM is predicting a higher heating & cooling usage for the metered fuel than the UCA indicates, on the "mechanical equipment properties" screen, un-check the box labeled "Capacity weight % of load served" and **increase** the percentage of use for the metered fuel until it matches the heating load on the UCA.
3. If REM is predicting lower heating & cooling usage for the metered fuel than the UCA indicates, on the "mechanical equipment properties" screen, un-check the box labeled "Capacity weight % of load served" and **decrease** the percentage of use for the metered fuel until it matches the heating load on the UCA.
4. Once the metered fuel source is trued to actual, the balance of heating & cooling usage can be attributed to the additional un-metered fuel source. Unless you have documentation of the additional un-metered fuel source consumption; (receipts) leave the set point at 65 & 80. Ensure the inputted R-values in the model are accurate, furnace efficiencies are accurate, blower door & duct blaster values are accurate and that all performance adjustments are set at 100%. If all of these setting are correct, note in the file that the REM model was trued as close as possible. The REM model is complete, and no further action is required.

Modeling a home conservatively

If usage history cannot be acquired for a home or there is an inadequate history to predict the usage accurately, the home will be modeled conservatively.

1. Model all R-values as you assessed them during your audit.
2. On the general building information screen, under number of bedrooms, input the number of occupants. This will help ensure base load water usage is accurate.
3. Model the set point at 65 heating & 80 cooling.

4. Ensure the inputted R-values in the model are accurate, blower door & duct blaster values are accurate and that all performance adjustments are set at 100%.
5. Model the furnace efficiencies as the furnace was designed. Do **not** reduce the performance adjustment below 100%.
6. Input the actual test results for Duct blaster & blower door tests.
7. Document in the REM notepad that the home was modeled conservatively due to the lack of usage documentation.

Measure Buy-Down

At times, appropriate funding may be used to pay for the non-cost-effective portion of a measure. This is called a "buy down". The following is an acceptable method of determining the cost-effective portion of an individual measure.

Present Value: The amount of the buy down required will be determined by the amount listed under the PV (present value) column.

Component	Life	Cost	Yr. Savings		SIR	PV	SP
Frame Floor 1:	25	2866	134	0.8	-541	21.4	

In the example above, the floor insulation is not cost effective with an SIR of .8. The amount of buy-down required to bring this measure to an SIR of 1.0 is $541. The cost-effective portion equals the total cost minus the present value.

In this case:

Total cost:	$ 2866
Measure buy down:	$ 541
Cost effective portion:	$ 2325

Incidental Repair Protocol

The "Incidental Repair" measure classification helps to determine if prospective projects are beyond the scope of weatherization by providing a cap that establishes maximum allowable DOE investment thresholds for individual dwelling units. When project package SIR's fail to meet or exceed the minimum SIR threshold, with measure-required incidentals included in the energy model, the measure requiring the repair is then determined to be "beyond weatherization" under the scope of the DOE program.

Incidental repairs necessary for the effective performance or preservation of weatherization materials are allowed. When a repair activity is a component of an energy efficiency measure

that is being installed, the installation and materials are part of the efficiency measure and are classified as incidental repair. The cost of incidental repairs must be included in the cost of the package of measures. The entire package of measures installed on a project, including incidental repair costs, must be cost justified with an SIR of 1.0 or better.

All Incidental repairs must be justified in the client file with an explanation for their need and a relationship to a specific energy conservation measure and include photo documentation.

Ancillary items necessary for proper installation of weatherization materials are not considered incidental repairs. These items include small items such as nails/screws, other fasteners, adhesive, sealant, etc. Ancillary items are items required by materials manufacturers; general construction and /or WAP field standards to achieve a finished product in a typical installation where no unusual or extensive repairs are needed. **The costs of ancillary items and installation are to be included in the cost of an individual energy conservation measure (ECM) when calculating the SIR for the individual ECM**.

Examples of ancillary items include:

> a. **Ceilings**: Eave baffles, dams for heat producing fixtures, hatch dams and normal items needed to batt & weather-strip accesses.
> b. **Floors**: Twine/lath, normal items needed to batt & weather-strip interior accesses, Water pipe insulation, ground cover.
> c. **Walls**: Sealing high and low openings in balloon framed homes, removing/replacing siding, Plugging, patching, and priming access holes.

Examples of incidental repairs include:

> a. **Ceilings**: Adding attic vents, screening vents or openings to preserve the insulation, repairing damaged ceiling to allow for insulation to be installed, framing repairs necessary to properly weather strip accesses, minor roof repairs on site-built homes, EPDM roof membrane on mobile homes.
> b. **Floors**: Screening vents and accesses to preserve the insulation, repairing water-damaged flooring to allow for installation of floor insulation, repairing large holes in a mobile home rodent barrier.
> c. **Walls**: Sealing large, unusual openings such as voids between double ceilings or holes in walls.

Following is a brief description of how we are required to handle incidental repairs:

- If the measure needing the repair is cost effective with the cost of the Incidental included, the measure can be completed as usual. The cost is not charged off as an incidental repair as it can be paid for by the energy savings of the measure. This does not apply to windows and doors. (See below)

- If the measure needing repair is cost effective **without** the cost of the incidental repair included, but when the cost of the incidental repair is included, the SIR drops below a 1.0, the repair may be treated as an incidental repair.
- The cost of the incidental repair must then be added to the cost of the measure it is associated with as part of the measure cost within REM.
- All cost-effective efficiency measures must then be grouped together. If the grouped SIR is greater than 1.0, the measure can be completed. If the grouped SIR is less than 1.0 the measure cannot be completed with DOE funds.
  Note: If non-cost-effective measures are completed using an appropriate funding source, they should not be included in the grouped measures.
- There must be two REM/Design improvement analyses in the file. One showing all measures individually and one showing all cost-effective measures as well as air infiltration and any incidental repair costs grouped for an overall SIR.

Replacing Windows and Doors as Incidental Repairs

WINDOW AND DOOR REPAIRS: Window and door repairs are allowable as IRMs to preserve the integrity of the associated ECM(s), when they meet the definitions and requirements of IRMs listed above. Additional window and door repair details are as follows:

1. Window or door repairs are allowable as a H&S measure, if:

   a. It resolves a bulk water intrusion issue that is the cause of visible biological growth, and;

   b. The H&S Window or Door repair is well documented with written explanation and photos of the biological growth in the client file.

2. Window or door repairs are only allowable as an ancillary cost to an ECM that would typically require such a repair as a part of the ECM installation.

WINDOW AND DOOR REPLACEMENTS: Window and door replacement(s) must first be modeled and treated as ECM(s) if cost justified. Window and door replacements shall **not** be included in the air sealing ECM. Window and door replacements are allowable as IRMs to preserve the integrity of the associated ECM(s), when they meet the definitions and requirements of IRMs listed above.

Effective Useful Life

All measures considered in the REM/Design software must be assigned the appropriate effective useful life from the chart below.

Effective Useful Lives			
	US DOE/BPA	**ECHO/LIHEAP Stick Built**	**ECHO/LIHEAP Mobile Home**
Measure	*Life (yrs)*	*Life (yrs)*	*Life (yrs)*
Ceiling Insulation: loosefill and batt	30	45	25
Ceiling Insulation: all other types	20	45	25
Floor Insulation: loosefill and batt in enclosed cavity	30	45	25
Floor Insulation: all other types (loosefill and batt NOT in enclosed cavity)	20	45	25
Wall/Kneewall Insulation: densepack, batt type in enclosed cavity, rigid foamboard	30	45	25
Wall/Kneewall Insulation: all other types (loosefill and batt NOT in enclosed cavity)	20	45	25
Rim/Band Joist Insulation	20	45	25
Slab/Foundation Wall Insulation	20	45	25
Replacement Doors	20	20	20
Windows	20	25	25
Low-E Storm Windows	15	20	20
Water Heater Replacement	13	15	15
Duct Sealing	10	20	20
Duct Insulation	20	20	20
Refrigerators	15	15	15
Infiltration	10	15	15
Heating Systems: Fuel-Fired Furnace/Boiler	20	20	20
Heating Systems: all other types, except Heat Pumps	18	20	20
Central Heat Pump/Air Conditioning System	15	15	15
Ductless Heat Pump	15	15	15
Smart/Programmable Thermostat	15	15	15
Heating/Cooling System Tune-up	3	3	3

Appendix A: Modeling Electric Resistance Heat

Electric forced air furnace
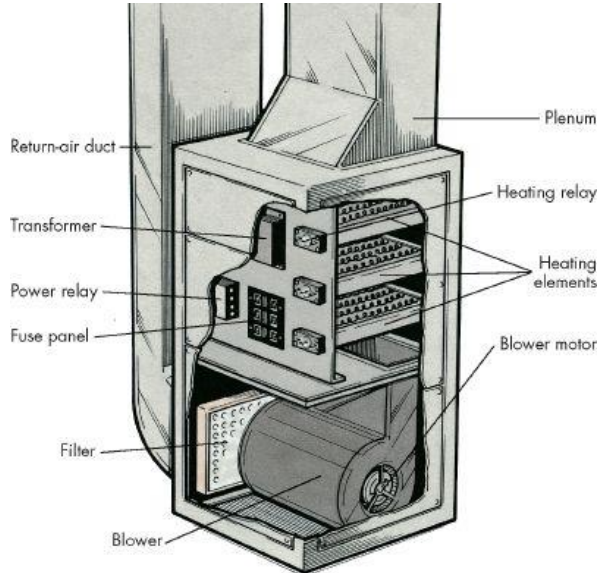
In each electric furnace there are coils of elements. Think of these as the same strip heat you see in a toaster. You can count each coil by counting the number of relays by removing the service cover. See the diagram for reference. Each element represents 5kW. Most commonly, we see three elements, which would represent a 15kW unit. You convert kW to BTUs/hr by using the conversion factor.

1kW = 3412.142 BTU/hr.

So, if you have a 5kW element, the formula would look like this:

5kW = 3412.142*5 = 17,060.71 BTU/hr. This would be the output capacity for each heating element.

It is recommended for auditors to make three library entries: a 2-element (10kW), a 3-element (15kW), and a 4-element (20kW) electric furnace. Name each library entry according to the kW. So, a two-element unit would be named "10kW Electric Furnace" and so on.

K Series
Baseboard Heater
Replacement Parts
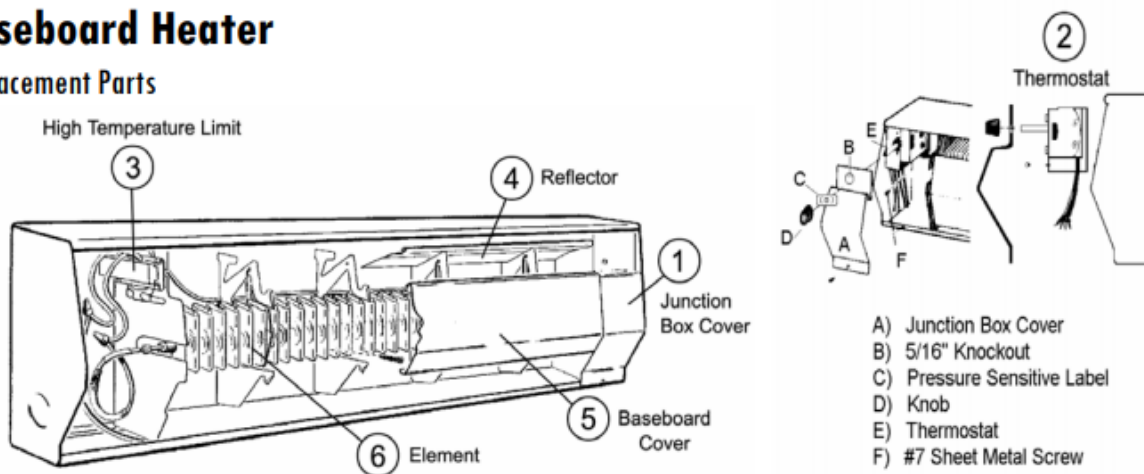
When wired for 240vac operation, a baseboard heater puts out 250 watts per lineal foot. When converted to BTUs (250 x 3.412), it's equal to 853BTU/ft. If you model that in REM, the entry for 6ft of electric baseboard would have a Rated Output Capacity (kBTU) of 5.118.

It is recommended to create a library entry for a 1ft or 2ft electric baseboard heater and then adjust the # of units to reflect the total lineal feet of baseboards based on the audit and what you may want to replace with heat pump technology.

*NOTE: If you model 1ft or 2ft sections of baseboard and adjust the number of units to reflect the total lineal feet in REM and then replace those with a heat pump, REM will model the same number of units as the same number of heat pumps in the improved building. Be sure to account for this in the improved building before reporting total mmBTU savings.