EA-Quip Model Tuning

As referenced in the Multifamily Procedures Guide, EA-QUIP energy audits will be "trued-up" to the heating utility bills using the EA-QUIP "Building Modelling Report," according to the following goals: Baseload: within < 10%; Peak Heating Months: within < 10%; Shoulder Months (early Fall and late Spring): within < 25%; Overall Energy Consumption: within < 10%.

Step #1 - True up the baseload

Since baseload affects building energy use for every month of the year, it is the first priority for truing up.

1. The main driver for baseload is domestic hot water (DHW) consumption, which is located in the "Appliance" component.
2. Ensure that you have the correct input capacity of your DHW system, in MBtu/hr. (1,000 btu/hr.).
3. Ensure that your "uninsulated DHW pipes" length and average diameter is accurate. Uninsulated DHW pipes are those which are losing their heat to unconditioned spaces (outdoors, unheated basements, boiler rooms, etc.).
4. Estimate the total amount of DHW used in the building. A good starting point is 20 gal of DHW/building occupant/day. Elderly occupants may use less (15 gal/person/day), and large families with in-unit laundry may use more (25 gal/person/day). Adjust within this range (15-25 gal/person/day) as necessary, ensuring that you have accurate total occupant numbers and accurate demographic information.
5. Estimate the DHW heater efficiency, which should range from 80% for a new, sealed combustion appliance, to 70-75% for atmospheric DHW heaters and tankless coils (your summertime tankless coil efficiency is generally 5-10% less than your wintertime boiler efficiency).
6. The DHW temperature should be the water temperature at the tap closest to the boiler room.
7. An acceptable model is +/- 10% difference between the modeled consumption and actual fuel bills. After the baseload is tuned, address the heating load of the building.

Step #2 - True up the heating load

The key for truing up the heating load is to enter the information you know to be a fact first, and then focus on any estimated data. The data which, once entered, should not change (unless more definitive measurements and information is available after the initial inputs), includes the surface area, wall types, roof type and insulation, number and size of windows, number of doors, basement type and area, and the heated square footage per floor. Lighting and refrigerator information should also rarely change once entered. However, 3 inputs which are typically known to a lesser degree of accuracy are: Heating system combustion efficiency, heating day and night thermostat settings, and infiltration (typically in air changes per hour).

1. Heating System: The combustion efficiency of the heating system should be measured as part of the audit and should be the maximum efficiency entered in the heating system screen. However, keep in mind that an SSE test is a snapshot of the condition at that particular time. When at the site, ask the building operator whether any conditions have changed (and which way – for better or worse) from the time of the billing period used in the analysis to the present day. Also, other conditions witnessed in the boiler room might be reason for a further reduction of the entered combustion efficiency to reflect the system's true operational efficiency. This can include, but is not limited to:
    - Substantial boiler leaks/regular refilling with city water
    - Near boiler piping leaks
    - Regular boiler short cycling
    - Severe rusting and/or no boiler insulation
    - Improper controls set-up

- Based on those additional conditions, it might be necessary to deduct 1-7% from the measured combustion efficiency to help the model better true up with the actual fuel bills.

2. Control and Distribution: Heating day and night thermostat settings are what temperature the building is heated to during the day and night. Enter the average target temperature for the building for both day and night. A number of factors could cause that average temperature to change slightly from what you initially entered, including:
   - You can usually only get to a sample of apartments, and this data can be within +/- 2°F of the overall average in-unit temperature.
   - You are not usually there at night, so this would need to be estimated based on interviews and any other data in you can collect.
   - If the audit is conducted during a non-heating season, it is very difficult to estimate temperatures, and can be done through interviews with tenants.
   - If they have existing thermostatic controls (TRVs, wall thermostats, or building management systems), record and enter those settings.
   - The most accurate method would be to distribute data-loggers and collect the data but may prove time-consuming.
   - Also ensure that uninsulated heating pipes are accurate (length and average diameter) and are only for pipes in unconditioned spaces.
3. Infiltration: Since it is difficult to conduct a blower-door in a multifamily building, estimated Air Changes per Hour (ACH) is typically used. During the building visit, inspect the general conditions of windows, doors, A/C sleeves, walls, basement, and roof. Based on that inspection, enter an ACH which falls within these ranges. Adjust as necessary to better true-up the model, but never go beyond a range that you feel accurately describes the building.
   - TIGHT: 0.25 - 0.4
   - MODERATE: 0.4-0.6
   - LEAKY: 0.6-0.75
   - VERY LEAKY: 0.75-0.95

Step #3 - Modeling Goals

We typically try to model within these ranges. For each instance, it is better to have modeled energy consumption slightly less than the actual building's energy consumption according to fuel bills (which will ensure a level of conservatism). If the modeled energy consumption is greater than the actual consumption according to fuel bills, the savings may be overstated.

- Baseload: within < 10%
- Peak Heating Months: within < 10%
- Shoulder Months (early Fall and late Spring): within < 25%
- Overall Energy Consumption: within < 10%