

# **Refrigeration Energy Consumption**

## Background

Commercial refrigeration equipment covered by this Tech Topic include the following types, which must be rated by AHRI:

- 1. Walk-in refrigerators
- 2. Walk-in freezers
- 3. Refrigerated casework and/or display cases

As per the *Refrigeration Modeling Method* section of the ANSI/ASHRAE/IEC Standard 90.1-2016 Performance Rating Method Reference Manual (2016 PRM RM<sup>1</sup>), two aspects of performance must be accounted for:

- 1. Electricity consumption of the refrigeration equipment
- 2. Internal heat gain/removal into the thermal zone for the purposes of HVAC interactivity

Both aspects shall be explicitly captured in the model and the use of any refrigeration specific calculation engine is not required. The refrigeration system electricity consumption and the HVAC system interactivity can be modeled as two separate values as described and calculated in the supporting Excel Refrigeration Energy Calculator.

## Process

## Step 1 – Certificates and Spreadsheet

Gather AHRI 1200 certificates from manufacturer for each refrigeration unit. Each certificate should mimic the format shown in the AHRI 1200 Data Format tab of the Refrigeration Energy Calculator.

Using the Refrigeration Energy Calculator and the AHRI 1200 certificates, report each refrigeration unit type as separate columns in the *Ref Data Entry* tab.

To determine the applicable equipment class geometry (e.g HZO, SVO, etc) use diagrams of Appendix D of AHRI 1200 for reference. See example excerpt in the figure below

<sup>&</sup>lt;sup>1</sup> <u>https://www.pnnl.gov/main/publications/external/technical\_reports/PNNL-26917.pdf</u>



ANSI/AHRI STANDARD 1200 (I-P)-2013



Figure 1: AHRI 1200 - Appendix D

The Refrigeration Energy Calculator will automatically calculate the baseline (existing conditions for retrofit and Appendix G for new construction) kWh/day allowances of each eligible commercial refrigeration unit.

### Step 2 – Electricity Modeling Input

Electricity consumption of refrigeration units should be modeled as W or W/SF inputs with a 8760 fractional schedule based on the kWh/day allowances calculated, the rated CDEC values of the proposed units based on standard AHRI 1200, and the allowances of unregulated walk ins.

The electricity consumption should be modeled as a direct load on the electric meter or assigned to a thermal zone but with the zero sensible and latent heat gains to the space. (Modeling internal gains from refrigeration equipment is described in the following steps.)

### Step 3 – HVAC Interactivity Modeling Input

The Refrigeration Energy Calculator will auto calculate Q per thermal zone on the *Model Inputs* tab for the purposes of modeling internal heat gain or removal for each thermal zone to capture HVAC system interactivity. Q is the rate of heat removal from the space due to the continuous operation of the refrigeration system (kBtu/h). Q can be positive or negative depending on condenser location.



# Example Screen Shots - DOE2/eQUEST

### Electricity Modeling Input

Enter the total kW from the *Model Inputs* tab of the Refrigeration Energy Calculator.

| Totals                   |      |
|--------------------------|------|
| Proposed Regulated, kW   | 17.9 |
| Proposed Unregulated, kW | 2.8  |
| Baseline Regulated, kW   | 27.0 |
| Baseline Unregulated, kW | 2.8  |

| Electric M | leter | Properties        |                         |        |              |      |               |
|------------|-------|-------------------|-------------------------|--------|--------------|------|---------------|
| Curren     | tly / | Active Electric M | eter: EM1               |        |              | •    | Type: Utility |
| Basic      | Spe   | cifications Bu    | ilding and/or Submeters | Direct | Loads        |      |               |
|            |       |                   |                         |        |              |      |               |
| Inte       | rior  | Direct Loads —    |                         |        |              |      |               |
|            |       | Load (kW)         | Schedule                |        | End          | luse | <b>_</b>      |
|            | 1     | 27.00             | 24/7 SCH                | -      | Refrig. Disp | lays | <b>•</b>      |



### HVAC Interactivity Modeling Input

Enter the total Q for the applicable zone determined from the *Model Inputs* tab of the Refrigeration Energy Calculator.

| M  | Modeling Inputs (Pr = Proposed Design, BL = Baseline Design) |              |              |  |  |  |  |  |  |  |  |  |
|----|--------------------------------------------------------------|--------------|--------------|--|--|--|--|--|--|--|--|--|
|    | Thermal Zener                                                | EL1 Core Spc | EL1 Core Spc |  |  |  |  |  |  |  |  |  |
|    | inermai zone:                                                | (G.C5)       | (G.C6)       |  |  |  |  |  |  |  |  |  |
| Pr | Rate of heat removal, Q, kBtu/hr                             | 21.40        | -7.22        |  |  |  |  |  |  |  |  |  |
| BL | Rate of heat removal, Q, kBtu/hr                             | 30.17        | -6.27        |  |  |  |  |  |  |  |  |  |

#### Space Properties

|         | Curr | rently Active Space: EL1 Core Spc (G. | C5)                            | ▼ Zo                | ne Type: Cond          | ditioned             |   |
|---------|------|---------------------------------------|--------------------------------|---------------------|------------------------|----------------------|---|
| Basic S | pecs | Equipment Infiltration Daylightin     | ng Contents                    | Lighting            |                        |                      |   |
| Equi    | pmer | nt                                    |                                |                     |                        |                      |   |
|         |      | Equipment Schedule                    | Input Power<br>Density (W/ft2) | Input Power<br>(kW) | Sensible HG<br>(ratio) | Latent HG<br>(ratio) | - |
|         | 1    | EL1 Bldg Misc Sch 👻                   | 0.422                          |                     | 1.00                   | 0.00                 | - |
|         | 2    | EL1 Bldg OffEq Sch 👻                  | 0.000                          | n/a                 | 1.00                   | 0.00                 | - |
|         | 3    | EL1 Bldg OffEq Sch 👻                  | 0.000                          | n/a                 | 1.00                   | 0.00                 | — |
|         | 4    | EL1 Bldg OffEq Sch 👻                  | 0.000                          | n/a                 | 1.00                   | 0.00                 | - |
|         | •    |                                       |                                |                     |                        | l F                  |   |
|         |      |                                       |                                |                     |                        |                      |   |

Internal Energy Sources

|   | Source Schedule | Source Type | Input Power<br>(Btu/h) | Sensible HG<br>(ratio) | Latent HG<br>(ratio) |
|---|-----------------|-------------|------------------------|------------------------|----------------------|
| 1 | 24/7 SCH 🗸      | Process -   | 30,170.0               | 1.00                   | 0.00                 |
|   |                 |             |                        |                        |                      |



# DOE2/eQUEST Productivity Tip

This tip is for the purposes of simplifying the formal reporting of regulated and unregulated refrigeration energy in the ERP.

In the Electric Meter input as shown in Step 1, assign the unregulated refrigeration energy to an available end use category that is not being used in the project. For example, if the models do not use the Task Lighting end use consumption category, it can used for the purposes of isolating unregulated refrigeration energy for use of the Parms.csv file and pasting results into the ERP.

If all end uses are used in the simulation, then manual adjustment of the results will be required when using the pasting features associated with the *Results from eQUEST* tab.

| Totals                   |      |
|--------------------------|------|
| Proposed Regulated, kW   | 17.9 |
| Proposed Unregulated, kW | 2.8  |
| Baseline Regulated, kW   | 27.0 |
| Baseline Unregulated, kW | 2.8  |

### Unregulated Electricity Modeling Input

| Electric N | /leter | Properties        |              |             |        |                  |      |           |
|------------|--------|-------------------|--------------|-------------|--------|------------------|------|-----------|
| Curre      | ntly / | Active Electric M | leter: EM1   |             |        | •                | Туре | : Utility |
| Basic      | Spe    | cifications Bu    | ilding and/o | r Submeters | Direct | Loads            |      |           |
| Int        | erior  | Direct Loads —    |              |             |        |                  |      |           |
|            |        | Load (kW)         |              | Schedule    |        | Enduse           |      | <u> </u>  |
|            | 1      | 27.00             | 24/7 SCH     |             | -      | Refrig. Displays | -    |           |
|            | 2      | 2.80              | 24/7 SCH     |             | -      | Task Lighting    | •    |           |



## Adjustments to the ERP

| M11            | * 1 × × A                                                                         | -AVERAGE       | (M7:M1    | 0)            |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|----------------|-----------------------------------------------------------------------------------|----------------|-----------|---------------|-------------|-------------------|-----------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------------|---------------------------|-----------------|--------------|----------------|---------------|-----------------------|--------------|-----------------|---------------------|
| al             | A                                                                                 | в              | c         | D             | E           | F                 | G               | н                     | 1 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                           | j.               | K                         | t               | M            | N              | 0             | P                     | Q            | 8               | s                   |
| 1 Re           | sults from eQUEST Parms.c                                                         | sv File(s)     | )         |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 | -            |                |               |                       |              |                 |                     |
| 2 Ins          | tructions                                                                         |                |           |               | otels and   | all D'Me for thi  | a project       |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           | 15              |              |                |               |                       |              |                 |                     |
| 21 6           | or Appendix & projects, copy baseline ru                                          | ins from the a | pproprie  | ate Parms.c   | sy file and | i paste values li | nto rows 7-10 b | iow. For ASHRAE 6     | (Q projects, paste the                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | proposed design in row    | 7 and leave row  | ws 8-10 blenk.            |                 |              |                |               |                       |              |                 |                     |
| 3) F<br>185    | or Appendix & projects, copy proposed ru<br>parametric run modelect (For ASHBAF ) | on from the a  | pprorpri  | ate Parms.c   | sy file and | I paste values i  | nto row 12 belo | w. For ASHRAE BEQ     | projects, paste the ba                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | aseline run into row 12 b | elow. For both   | paths, this will be the   |                 |              |                |               |                       |              |                 |                     |
| -4) 0          | opy runs that correspond to each ECM fi                                           | rom the appro  | opriate P | Parms.csv fil | e(s), inclu | iding final run f | rom Step 3, and | paste into rows 13    | 35 (leave un needed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | rows blank). Do not inc   | lude the baselin | ne runs.                  |                 |              |                |               |                       |              |                 |                     |
| 3 517          | or unregulated lighting systems, specif                                           | ic those load  | is in the | "Task Light   | ing" input  | section under 5   | ipace Propertie | s of the internal Los | ids tab.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |                  |                           | 1               |              |                |               |                       |              |                 |                     |
| 5              |                                                                                   |                | _         |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           | -               | THE R.       |                |               |                       | 1000         | 1               | lectric Usage:      |
|                |                                                                                   | Internal       | Case      | Short         | Carry       | Incremental       | Incremental     | Date & Time of        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  | 55-D<br>Peak Cooling Coll | PS-E<br>Ambient | PS-t<br>Task | PS-E           | PS-E<br>Space | PS-t<br>Space         | PS-E<br>Heat | P3-E<br>Pumps & | PS-E<br>Ventilation |
|                | warm rythe                                                                        | Loads          | PS .      | Name          | Fwd         | First Cost (5)    | (5)             | Run                   | File meme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Case of                   | escription       | Lood                      | Lights          | Lights       | kWh            | Heating       | Cooling               | Reject       | Aux             | Fans                |
| 7              |                                                                                   |                | -         |               | -           |                   | -               |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  | KUO4                      | RWIN            |              |                | 6.VVII        | ayen                  | KWIN         | KWID            | KWS                 |
| 8              |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  | 3                         |                 |              |                |               |                       |              |                 |                     |
| 9              |                                                                                   | -              | -         | -             |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  | 1                         | -               | -            | -              | -             |                       | _            |                 |                     |
| 10<br>11 Are   | rate Baseline                                                                     |                | -         | -             |             |                   |                 | -                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  | #DIV/01                   | #DIV/01         | #D1V/01      | #Drv/01        | #DIV/01       | #DIV/DI               | #DIV/01      | #DIV/01         | #D(V/0)             |
| and the second |                                                                                   |                | -         |               |             |                   | -               |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
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| F26            | * E × √                                                                           | fx ='R         | esults    | from eQ       | uest'!N     | 111*0.00341       | 3               |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
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| 1              |                                                                                   | c              |           | _             | r           |                   | 0               | 1                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|                |                                                                                   |                |           |               |             |                   | Property        |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|                | End Use                                                                           |                |           | Bas           | eline Ele   | etricity 1        | Froposea        |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|                |                                                                                   |                |           |               | (MMBt       | u) (u             | (MMBtu)         |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 10             |                                                                                   |                |           |               |             |                   | ()              |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 11             | Energy Cost S/MMBtu                                                               |                |           | s             |             | - S               |                 | -                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 12             | Space Heating (Regulated)                                                         |                |           |               |             | 1.0               |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 13             | Cooling (Regulated)                                                               |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 14             | Ventilation (Regulated)                                                           |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 15             | Water Heating (Regulated)                                                         |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 16             | Lighting (Regulated)                                                              |                |           |               |             |                   |                 | -                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 1/             | Lighting (Unregulated)                                                            |                |           |               |             | •                 |                 | -                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 10             | Pumps (Regulated)                                                                 |                |           |               |             | -                 |                 | -                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 20             | Supplemental Heat Pump (Res                                                       | mlated)        |           |               |             |                   |                 | -                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 21             | Exterior Usage (Regulated)                                                        | unitedy        |           |               |             |                   |                 | 1                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 22             | Plug and Process Load (Unreg                                                      | (ulated)       |           |               |             |                   |                 | 1                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 23             | Elevator/ Mise. Energy (Regul                                                     | ated)          |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 24             | Misc. Energy (Unregulated)                                                        |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 25             | Refrigeration (Regulated)                                                         |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 26             | Refrigeration (Unregulated)                                                       |                |           |               | #DIV/0      | 01                |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|                |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|                |                                                                                   | 1              |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| M12            | * E X V                                                                           | fx             |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| ан<br>1940 -   |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| af.            | A                                                                                 |                |           | В             | C           | D                 | E               | F                     | G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | н                         |                  | 1                         |                 | J            |                |               | К                     |              | L               | M                   |
| 1 F            | Results from eQUEST                                                               | Parms          | .csv      | File(s)       | 1           |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 2 1            | nstructions                                                                       |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 1              | Open Parms.csv file(s) that in                                                    | nclude res     | ults fo   | r baselir     | ne and p    | proposed m        | odels and a     | II ECMs for this      | project.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 2              | For Appendix G projects, copy                                                     | baseline       | runs fr   | om the a      | ppropri     | ate Parms.c       | sv file and p   | aste values in        | to rows 7-10 belo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ow. For ASHRAE bE         | Q projects, p    | aste the propose          | ed design       | in row 7     | and leave      | rows 8-10     | blank.                |              |                 |                     |
| 3              | For Appendix G projects, copy                                                     | proposed       | run fro   | om the a      | pprorpri    | iate Parms.c      | sv file and     | baste values in       | to row 12 below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | For ASHRAE bEQ p          | rojects, pas     | te the baseline r         | un into ro      | w 12 belo    | w. For be      | oth paths,    | this will be          | the          |                 |                     |
| 14             | ast parametric run modeled (F                                                     | or ASHRAE      | bEQ p     | projects, 1   | the 'Med    | sure Simulat      | ion' tab acc    | ounts for energ       | y consumption i                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ncreasing in each :       | subsequent       | parametric run).          |                 |              | a share been a |               |                       |              |                 |                     |
| 3 5            | For unregulated lighting syst                                                     | ems sner       | ific the  | ose load      | s in the    | "Task Lighti      | ing" input s    | ection under Sr       | pace Properties of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | of the internal load      | is tab           | -needed rows bia          | ink). Do r      | lot includ   | e the bas      | enne runs     | R.                    |              |                 |                     |
| 4              |                                                                                   | and a part     |           |               | - an effe   | . asn eighti      |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Logital and Logital       |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 5              |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
|                |                                                                                   |                |           |               |             |                   |                 |                       | Records of the local sectors o |                           |                  |                           |                 |              |                |               | SS-D                  |              | PS-E            | PS-E                |
|                | Run Turra                                                                         |                | 1         | nternal       | Case        | Short             | Carry           | Incremental           | Annual Maint                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Date & Time of            | (et              | le Name                   |                 | Case Dece    | intion         | Pei           | ak Cooling Co         | bil          | Ambient         | Task                |
|                | Nun Type                                                                          |                |           | Loads         | #s          | Name              | Fwd             | First Cost (\$)       | (S)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Run                       | FI               | ie ivanie                 | 1               | case Desc    | ipaon          |               | Load                  |              | Lights          | Lights              |
| 6              |                                                                                   |                |           |               |             |                   |                 |                       | (0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                           |                  |                           |                 |              |                |               | kBtu                  |              | kWh             | kWh                 |
| 7              |                                                                                   | _              |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              | _              |               |                       |              |                 |                     |
| 8              |                                                                                   |                | 1         |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 9              |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 10             |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               |                       |              |                 |                     |
| 11 A           | verage Baseline                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               | #DIV/0!               |              | #DIV/0!         | #DIV/01             |
| 12             |                                                                                   |                |           |               |             |                   |                 |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                  |                           |                 |              |                |               | and the second second |              |                 |                     |



| G26 | 5   | Ŧ           | : ×         | $\sim$   | $f_X$   | ='Results from | n eQuest'!N          | v12*0.0          | 03413              |                           |
|-----|-----|-------------|-------------|----------|---------|----------------|----------------------|------------------|--------------------|---------------------------|
| 1   |     |             |             |          |         |                |                      |                  |                    |                           |
|     | Α   | D           |             |          | Е       |                | F                    |                  |                    | G                         |
| 10  |     |             |             | End Us   | e       |                | Baseline Ele<br>(MMB | ectricity<br>tu) | Pro<br>Elec<br>(MN | posed<br>tricity<br>ABtu) |
| 11  |     | Energy Cos  | t \$/MMBt   | u        |         |                | \$                   | -                | S                  | -                         |
| 12  |     | Space Heati | ing (Regu   | lated)   |         |                |                      | -                |                    | -                         |
| 13  |     | Cooling (Re | egulated)   |          |         |                |                      | -                |                    | -                         |
| 14  |     | Ventilation | (Regulate   | ed)      |         |                |                      | -                |                    | -                         |
| 15  |     | Water Heat  | ting (Regu  | lated)   |         |                |                      |                  |                    | -                         |
| 16  |     | Lighting (R | legulated)  |          |         |                |                      | -                |                    | -                         |
| 17  |     | Lighting (U | nregulate   | d)       |         |                |                      | -                |                    | -                         |
| 18  |     | Pumps (Reg  | gulated)    |          |         |                |                      | -                |                    | -                         |
| 19  |     | Heat Reject | tion (Regu  | lated)   |         |                |                      | -                |                    | -                         |
| 20  |     | Supplement  | tal Heat Pi | ımp (Re  | gulate  | d)             |                      | -                |                    | -                         |
| 21  |     | Exterior Us | age (Regu   | lated)   |         |                |                      | -                |                    | -                         |
| 22  |     | Plug and Pr | rocess Loa  | ıd (Unre | gulate  | d)             |                      | -                |                    | -                         |
| 23  |     | Elevator/ M | isc. Energ  | y (Regu  | ulated) |                | -                    |                  | -                  |                           |
| 24  |     | Misc. Energ | gy (Unreg   | ulated)  |         |                |                      | -                |                    | -                         |
| 25  |     | Refrigerati | on (Regul   | ated)    |         |                |                      | -                |                    | -                         |
| 26  | - [ | Refrigerati | on (Unreg   | ulated)  |         |                | #DIV/                | 0!               |                    | -                         |

### Complete Results from eQUEST tab in the ERP

#### Results from eQUEST Parms.csv File(s)

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| Run Type         | loternal<br>Loads | Case<br>Ps | Short<br>Name                                                                                                   | Carry<br>Field | Incremental<br>First Cost (5) | Incremental<br>Annual Maint.<br>(5) | Date & Time of<br>Run | File Name                | Case Description | SS-D<br>Peak Cooling Coll<br>Load<br>KBtu | PS-E<br>Ambient<br>Lights<br>KWh | PS-E<br>Task<br>Lights<br>KWb | PS-E<br>Misc Equip<br>KWh | PS-E<br>Space<br>Heating<br>KWh | PS-E<br>Space<br>Cooling<br>KWh | PS-E<br>Heat<br>Reject<br>KWh | PS-E<br>Pumps &<br>Aux<br>KWh | PS-E<br>Ventilation<br>Fans<br>KWh | PS-E<br>Refrig<br>Display<br>KWb |
|------------------|-------------------|------------|-----------------------------------------------------------------------------------------------------------------|----------------|-------------------------------|-------------------------------------|-----------------------|--------------------------|------------------|-------------------------------------------|----------------------------------|-------------------------------|---------------------------|---------------------------------|---------------------------------|-------------------------------|-------------------------------|------------------------------------|----------------------------------|
| n/a              | n/a               | 0          |                                                                                                                 | 1              | \$0                           | \$0                                 | 07-20-20@11:50        | Project 19 - Baseline De | si Base Design   | 590.083                                   | 90465                            | 6047                          | 46271                     | 0                               | 26656                           | 0                             | 494                           | 20820                              | 58309                            |
| n/a              | n/a               | 0          |                                                                                                                 | 1 1            | 50                            | 50                                  | 07-20-20@11:50        | Project 19 - Baseline De | si Base Design   | 590.083                                   | 90465                            | 6047                          | 46271                     | 0                               | 26656                           | 0                             | 494                           | 20820                              | 58309                            |
| n/a              | n/a               | 0          |                                                                                                                 | 1 1            | \$0                           | \$0                                 | 07-20-20@11:50        | Project 19 - Baseline De | si Base Design   | 590.083                                   | 90465                            | 6047                          | 46271                     | 0                               | 26656                           | 0                             | 494                           | 20820                              | 58309                            |
| n/a              | n/a               | 0          |                                                                                                                 | 1 1            | \$0                           | \$0                                 | 07-20-20@11:50        | Project 19 - Baseline De | si Base Design   | 590.083                                   | 90465                            | 6047                          | 46271                     | 0                               | 26656                           | 0                             | 494                           | 20820                              | 58309                            |
| Average Baseline |                   |            | 1. The second |                |                               |                                     |                       |                          |                  | 590.083                                   | 90465                            | 6047                          | 46271                     | 0                               | 26656                           | 0                             | 494                           | 20820                              | 58301                            |

### Measure Simulation Tab

Baseline regulated and unregulated energy have been assigned appropriately.

| F2( | 5 | -             | $\times \checkmark f_x$ | ='Results from                  | n eQuest'!M11*0.0                  | 03413 |  |
|-----|---|---------------|-------------------------|---------------------------------|------------------------------------|-------|--|
| 1   |   |               |                         |                                 |                                    |       |  |
|     | Α | D             | E                       |                                 | F                                  | G     |  |
| 10  |   |               | End Use                 | Baseline Electricity<br>(MMBtu) | Proposed<br>Electricity<br>(MMBtu) |       |  |
| 11  |   | Energy Cost   | \$/MMBtu                |                                 | s -                                | s -   |  |
| 12  |   | Space Heatin  | ng (Regulated)          |                                 | -                                  | -     |  |
| 13  |   | Cooling (Reg  | gulated)                |                                 | 91                                 | -     |  |
| 14  |   | Ventilation ( | (Regulated)             |                                 | 71                                 | -     |  |
| 15  |   | Water Heati   | ng (Regulated)          |                                 | -                                  | -     |  |
| 16  |   | Lighting (Re  | egulated)               |                                 | 329                                | -     |  |
| 17  |   | Lighting (Un  | regulated)              |                                 |                                    | -     |  |
| 18  |   | Pumps (Reg    | ulated)                 |                                 | 2                                  | -     |  |
| 19  |   | Heat Rejecti  | on (Regulated)          |                                 | -                                  | -     |  |
| 20  |   | Supplementa   | al Heat Pump (Regulate  | d)                              | -                                  | -     |  |
| 21  |   | Exterior Usa  | ge (Regulated)          |                                 | -                                  | -     |  |
| 22  |   | Plug and Pro  | ocess Load (Unregulate  | d)                              | 158                                | -     |  |
| 23  |   | Elevator/ Mi  | sc. Energy (Regulated)  |                                 |                                    | -     |  |
| 24  |   | Misc. Energ   | y (Unregulated)         |                                 |                                    | -     |  |
| 25  |   | Refrigeratio  | on (Regulated)          |                                 | 199                                | -     |  |
| 26  |   | Refrigeratio  | on (Unregulated)        |                                 | 21                                 | -     |  |