

# OREGON DEPARTMENT OF ENERGY

## SOLAR INCOME CALCULATION INSTRUCTIONS

### OPTION 2: SOLAR GRAPH SHADING

#### GENERAL INFORMATION

These instructions are to be used only in conjunction with the Business Energy Tax Credit Form (BETC). Follow appropriate instructions and print out completed form and attach to Application for Preliminary Certification.

This form and calculation are property of the State of Oregon and shall only be used in conjunction with application of the Business Energy Tax Credit.

#### REQUIRED INPUTS

##### **STEP 4: Input Building Shading Percentage:**

Option 2:

- a. Input the building shading percentage by using a solar graph.
- b. Draw a site plan of the building showing surrounding solar obstructions. Scale site plan appropriately. Building floor plans and walls should be modeled at 45 and 90-degree angles. For example, a circular building would be modeled with eight sides each equal. Treat unique buildings as a rectangle. (Appendix 1, Figure 1A)

The Ecotrust Building in Portland, OR was used for an example. Refer to Appendix 1 for examples to each instruction listed below.

- c. Select ground level reference points for the building.
  - Reference points will be taken at ground level at each building corner and at ground level in the center for each wall longer than 75'. Walls longer than 300' shall have equal spaced points no greater than 150' apart. Walls 30' or shorter can be modeled using only one ground level point in the center of the wall. (Appendix 1, Figure 1)
- d. Select roof reference points for the building.
  - Roof reference points will be taken in the middle of the north and south walls of the roof and in the center for roofs longer in the north/south direction than 75'. For roofs wider than 300' (east/west) equally space points no greater than 150' apart. (Appendix 1, Figure 1)

- e. Select vertical reference points for the building.
  - Buildings taller than 30' must have vertical reference points. Each point will be taken 30' above each ground level point. (Appendix 1, Figure 2)

For example, the proposed example building is a 75' tall building and has walls of 100' on the north and south and 200' on the east and west. Ground level reference points would include one at each building corner and one at the center of the east, south and west walls. The building would have two vertical reference points above each ground level reference point (30' and 60'). The roof would have three points (south, center and north) giving the building a total of 24 points.

- f. Using the Sun Chart for Photovoltaics, (found at [www.energy.state.or.us/res/tax/3174sunc.pdf](http://www.energy.state.or.us/res/tax/3174sunc.pdf) ) draw the view from the building looking directly south at each reference point. Draw exactly what you see when you look directly south at each reference point. It is recommended that a plan view and elevations be drawn to determine the correct angles with respect to the each reference point. Example: South Wall (Appendix 1, Figures 3-16)
- g. For east walls shade out the west side of the chart, for west walls shade out the east side of the sun chart. Double the percentages of the sun chart on the east side if the wall is an east wall, or on the west side if it is a west wall. Example: East Wall (Appendix 1, Figures 17-21)
- h. For each point, add the percentage amount listed in the boxes that are covered by objects in the suns path. From our example we will list each shading percentage for each reference point for the south wall below. The total shading percentage is the average of the nine points. Input this number into the spreadsheet for that particular wall or façade.

<u>South Wall Points</u>	<u>% Shaded</u>
3A	24
3B	16
3C	9
4A	48
4B	39
4C	25
5A	66
5B	51
5C	36

Total Average = 35%

- i. Input the shading percentage for each wall and facade into the wall's corresponding Shading Percentage Cell.

The screenshot shows a Microsoft Excel spreadsheet titled "Solar and Water Budget Spreadsheet". The spreadsheet is divided into two main sections: "Building Solar Energy Budget Inputs" and "Building Energy Use Inputs".

**Building Solar Energy Budget Inputs:**

- Proposed Building: Ecotrust
- City (Select most applicable): Portland
- Weather Data Used (Selected From Chart Above): Portland
- Roof Area: 21,280 sq ft, Glazing Area: 0 sq ft, Shading Percentage: 4.8%
- N Wall Area: 6,270 sq ft, Shading Percentage: 0.0%
- NW Wall Area: 6,270 sq ft, Shading Percentage: 0.0%
- W Wall Area: 11,260 sq ft, Shading Percentage: 6.0%
- SW Wall Area: 6,270 sq ft, Shading Percentage: 35.0%
- S Wall Area: 11,260 sq ft, Shading Percentage: 1.0%
- SE Wall Area: 11,260 sq ft, Shading Percentage: 1.0%
- E Wall Area: 11,260 sq ft, Shading Percentage: 1.0%
- NE Wall Area: 11,260 sq ft, Shading Percentage: 1.0%
- Overall Shading Percentage: 1.0%

**Annual Solar Budget (MWh):**

January	136.2
February	188.5
March	318.3
April	418.7
May	529.5
June	575.2
July	636.3
August	552.5
September	420.8
October	280.2
November	153.2
December	116.5
<b>Total</b>	<b>4325.0</b>

**Building Energy Use Inputs:**

- Electricity Annual Usage: 0 kWh
- Natural Gas Energy Usage: 0 therms
- #2 Fuel Oil Energy Usage: 0 gallons
- Other Energy Source: 0 kBtu
- Total Building Floor Area: 0 sq ft
- Building Energy Use Index (EUI): #DIV/0! kBtu/Sq Ft./year
- Building Energy Use: #DIV/0! kWh, #DIV/0! therms, #DIV/0! kBtu/year
- Total annual incoming solar as a % of building energy usage: #DIV/0!
- Converted solar energy as a % of building energy usage: #DIV/0!
- Converted solar energy as a % of building electricity usage: #DIV/0!
- Converted roof solar energy as a % of building energy usage: #DIV/0!
- Converted roof solar energy as a % of building electricity usage: #DIV/0!

**Annual Incoming Solar Energy:**

- 4,325,000 kWh
- 147,569 therms
- 14,756,901 kBtu

**PV System Efficiency:**

- Annual Converted Energy by PV System: 0 kWh
- Annual Converted Energy by PV covered Roof: 0 kWh

**Water:**

- Annual amount of Water that falls on the roof: 542,829 gallons

**Notes:**

- Provide percentage of blockage of surrounding obstructions calculated on the sun chart.
- Provide Attached Solar Percentage Calculation Sheet

**Footnotes:**

- When the percentage of converted solar exceeds a hundred percent, the building is a net producer of energy and may be able to sell back excess energy.
- Building Energy Use is total building energy use converted to three forms of common energy units.

- j. Move to Step 5.