Photovoltaic System Design

Designing a system that is right for you and your home requires careful consideration of many factors including budget, energy usage, insolation, product availability and space requirements. The following worksheets are for you to use as a guide. Bring the applicable completed worksheets to your consultation with us.

Grid-Tied System Design

1. Find your monthly average electricity usage from your electrical bill______________________

   This will be in kilowatt-hours (kwh). Because of air conditioning, heating and other seasonal usage, it is a good idea to look at several bills. You can add the typical summer, fall, winter and spring bills and divide by four to find the average monthly usage.

2. Find your daily average electricity use____

   Divide the monthly average number of kwh use by 30 (days).

3. Find your locations average peak sun hours per day____

   We use 3 hours as an average for New England's year round average.

4. Calculate the system size (AC watts) to provide 100% of your electricity_________________________

   Divide your daily average electricity use by the average sun hours per day. For example, if the daily average electricity use is 30 kwh, and the site is in New Hampshire, then the system size would be: 30 kwh/ 3h= 10 kw AC

5. Calculate the number of PV modules required for this system____________________________________

   Divide the system AC watts in step 4 by the CEC watt rating of the modules to be used, then divide by the inverter efficiency, usually 0.94 and you get the total number of modules required. (Round this number up)

Off-Grid Loads Worksheet

Calculate your AC loads

1. List all AC loads, wattage and hours of use per week on a separate sheet. Multiply watts by hours/week to get watt-hours per week (WH/Wk). Add up all the watt hours per week to determine AC watt-hours per week. The wattage of appliances can usually be determined from tags on the back of the appliance or from the owner's manual. If an appliance is rated in amps, multiply amps by operating voltage (120 or 240) to find watts.

Description of AC loads run by inverter	Watts	x	Hours/Week	=	Watt Hours/Week

2. Convert to DC watt-hours per week. Multiply the total watt hours/week from step 1 by 1.15 to correct for inverter loss.____________________

3. Inverter DC input voltage; usually 12, 24 or 48 volts. This is DC system voltage.____________________

4. Divide line 2 by line 3. This is total DC amp-hours per week used by AC loads.____________________

Calculate your DC loads

5. List all DC loads on a separate sheet in the same way as the AC loads. If you have no DC loads, enter "0" in line 7 and proceed to line 8.

Description of DC loads	Watts	x	Hours/Week	=	Watt Hours/Week

6. DC system voltage. Usually 12, 24 or 48 volts.____________________

7. Find total amp-hours per week used by DC loads. Divide line 5 by line 6.____________________

8. Total amp-hours per week used by AC loads from line 4.____________________

9. Add lines 7 and 8. This is total amp-hours per week used by all loads.____________________

10. Divide line 9 by 7 days. This is total average amp-hours per day that needs to be supplied by the battery. Enter this number on line 1 on the PV Design Worksheet and on line 1 of the Battery Sizing Worksheet on page 97.____________________

Off-Grid PV Array Design Worksheet

1. Total average amp-hours per day neede from the System Loads Worksheet, line 10____________________

2. Multiply line 1 by 1.2 to compensate for loss from battery charge/ discharge____________________

3. Average sun-hours per day (in New Hampshire we use 3 for a year round average)____________________

4. Divide line 2 by line 3. This is the total solar array amps required____________________

5. Optimum or peak amps of solar module used. See module specifications____________________

6. Total number of solar modules in parallel required. Divide line 4 by line 5____________________

7. Round off to the next highest whole number____________________

8. Find the number of modules in each series string to provide DC battery voltage by using the chart below____

volts	12 volt module	24 volt module
12	1	N/A
24	2	1
48	4	2

9. Total number of solar modules required. Multiply line 7 by line 8______________________________

Battery Sizing Worksheet

1. Total average amp-hours per day required from the Systems Load Worksheet, line 9_______________

2. Maximum number of continuous cloudy days expected in your area______________________________
(In New Hampshire we use ? Days as a figure)

3. Multiply line 1 by line 2____

4. Divide line 3 by 0.8 to maintain a 20% reserve after deep discharge period. (Dividing line 3 by a more conservative 0.5 will maintain a 50% reserve and increase battery life and is recommended.)____________

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Special Conditions (if no special conditions exist skip to step 9)

Special Condition #1: Heavy Electrical Load

5. Maximum amperage that will be drawn by the loads for 10 minutes or more______________________

6. Multiply line 5 by 5.0____

Special Condition #2: High Charge Current

7. Maximum output amperage of PV array or other battery charger________________________________

8. Multiply line 7 by 10.0 hours____

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9. Amp hours from line 4, 6 or 8, whichever is largest____

10. If you are using lead acid batteries, select the multiplier form the battery temperature chart below which corresponds to the battery's wintertime average ambient temperature _________________________

Battery Temp	Multiplier
80oF	1
70oF	1.04
60oF	1.11
50oF	1.19
40oF	1.3
30oF	1.4
20oF	1.59

11. Multiply line 9 by line 10. This is your optimum battery size in amp-hours_______________________

12. Amp-hours of battery chosen____

13. Divide line 11 by line 12. This is the total number of batteries in parallel required_________________

14. Round off to the next highest whole number. This is the number of parallel strings required_________

15. To determine the number of batteries required in series, divide the system voltage (12, 24 or 48) by the voltage of the chosen battery (2v, 6v or 12v)____

16. Multiply line 14 by line 15. This is the total number of the chosen battery needed for the system_____