



3 (from previous page )	Total DC watt-hours/day	
4	Total corrected DC watt-hours/day from line 2 +	
5	Total household DC watt-hours/day =	
6	System nominal voltage (usually 12 or 24) ÷	
7	Total DC amp-hours/day =	
8	Battery losses, wiring losses, safety factor × 1.2	
9	Total daily amp-hour requirement =	
10	Estimated design insolation (hours per day of sun, see map on p. 582) ÷	
11	Total PV array current in amps =	
12	Select a photovoltaic module for your system	
13	Module rated power amps ÷	
14	Number of modules required in parallel =	
15	System nominal voltage (from line 6 above)	
16	Module nominal voltage (usually 12) ÷	
17	Number of modules required in series =	
18	Number of modules required in parallel (from line 14 above) ×	
19	Total modules required =	
<b>BATTERY SIZING</b>		
20	Total daily amp-hour requirement (from line 9)	
21	Reserve time in days ×	
22	Percent of useable battery capacity ÷	
23	Minimum battery capacity in amp-hours =	
24	Select a battery for your system, enter amp-hour capacity ÷	
25	Number of batteries in parallel =	
26	System nominal voltage (from line 6)	
27	Voltage of your chosen battery (usually 6 or 12) ÷	
28	Number of batteries in series =	
29	Number of batteries in parallel (from line 25 above) ×	
30	Total number of batteries required	

**LINE-BY-LINE INSTRUCTIONS**

**Line 1** Total all average watt-hours/day in the column above.

**Line 2** For AC appliances, multiply the watt-hours total by 1.1 to account for inverter inefficiency (typical by 90%). This gives the ac-

tual DC watt-hours that will be drawn from the battery.

**Line 3** DC appliances are totaled directly, no correction necessary.

**Line 4** Insert the total from line 2 above.

**Line 5** Add the AC and DC watt-hour totals

to get the total DC watt-hours/day. At this point, you can fax or mail the design forms to us, and after a phone consultation we'll put a system together for you. If you prefer total self-reliance, forge on.

**Line 6** Insert the voltage of the battery system; 12-volt and 24-volt are the most common. Talk it over with one of our tech staff before deciding on a higher voltage, as control and monitoring equipment is sometimes hard to find.

**Line 7** Divide the total on line 5 by the voltage on line 6.

**Line 8** This is our fudge factor that accounts for losses in wiring and batteries, and allows a small safety margin. Multiply line 7 by 1.2.

**Line 9** This is the total amount of energy that needs to be supplied to the battery every day on average.

**Line 10** This is where guesswork rears its ugly head. How many hours of Sun per day will you see? Our Solar Insolation Maps in the Appendix (page 582) give the average daily Sun hours for the worst month of the year. You probably don't want to design your system for worst possible conditions. Energy conservation during stormy weather, or a back-up power source, can allow use of a higher hours-per-day figure on this line and reduce the initial system cost.

**Line 11** Divide line 9 by line 10; this gives the total PV current needed.

**Line 12** Decide what PV module you want to use for your system. You may want to try the calculations with several different modules. It all depends on whether you need to round up or down to meet your needs.

**Line 13** Insert the amps of output at rated power for your chosen module.

**Line 14** Divide line 11 by line 13 to get the number of modules required in parallel. You will almost certainly get a fraction left over. Since we don't sell fractional PV modules, you'll need to round up or down to a whole number. We conservatively recommend that any fraction from 0.3 and up be rounded upward.

If yours is a 12-volt nominal system, you can stop here and transfer your line 14 answer to line 19. If your nominal system voltage is something higher than 12 volts, then forge on.

**Line 15** Enter the system battery voltage. Usually this will be either 12 or 24.

**Line 16** Enter the module nominal voltage. This will be 12 except for unusual special-order modules.

**Line 17** Divide line 15 by line 16. This will be how many modules you must wire in series to charge your batteries.

**Line 18** Insert the figure from line 14 and multiply by line 17.

**Line 19** This is the total number of PV modules needed to satisfy your electrical needs. Too high? Reduce your electrical consumption, or add a secondary charging source such as wind or hydro if possible, or a stinking, noisy, troublesome, fossil fuel-gobbling generator.

## BATTERY SIZING WORKSHEET

**Line 20** Enter your total daily amp-hours from line 9.

**Line 21** Reserve battery capacity in days. We usually recommend about three to seven days of back-up capacity. Less reserve will have you cycling the battery excessively on a daily basis, which results in lower life expectancy. More than seven days' capacity starts getting so expensive that a back-up power source should be considered.

**Line 22** You can't use 100% of the battery capacity (unless you like buying new batteries). The maximum is 80%, and we usually recommend to size at 50% or 60%. This makes your batteries last longer and leaves a little emergency reserve. Enter a figure from 0.5 to 0.8 on this line.

**Line 23** Multiply line 20 by line 21, and divide by line 22. This is the minimum battery capacity you need.

**Line 24** Select a battery type. The most common for household systems are golf carts at 220 amp-hours, or L-16s at 350 amp-hours. See the Battery section for more details. Enter the amp-hour capacity of your chosen battery on this line.

**Line 25** Divide line 23 by line 24; this is how many batteries you need in parallel.

**Line 26** Enter your system nominal voltage from line 6.

**Line 27** Enter the voltage of your chosen battery type.

**Line 28** Divide line 26 by line 27; this gives you how many batteries you must wire in series for the desired system voltage.

**Line 29** Enter the number of batteries in parallel from line 25.

**Line 30** Multiply line 28 by line 29. This is the total number of batteries required for your system.



# Power Consumption Table

Appliance	Watts	Appliance	Watts	Appliance	Watts
Coffeepot	200	Electric blanket	2,000	Compact fluorescent	
Coffee maker	800	Blow dryer	1,000-1,500	Incandescent equivalents	
Toaster	800-1,500	Shaver	15	40 watt equiv.	11
Popcorn popper	250	WaterPik	100	60 watt equiv.	16
Blender	300	Computer		75 watt equiv.	20
Microwave	600-1,700	Laptop	50-75	100 watt equiv.	30
Waffle iron	1,200	PC	200-600	Ceiling fan	10-50
Hot plate	1,200	Printer	100-500	Table fan	10-25
Frying pan	1,200	System (CPU, monitor, laser printer)	up to 1,500	Electric mower	1,500
Dishwasher	1,200-1,500	Fax	35	Hedge trimmer	450
Sink disposal	450	Typewriter	80-200	Weed eater	450
Washing machine		DVD Player	25	¼" drill	250
Automatic	500	TV 25" color	150+	½" drill	750
Manual	300	19" color	70	1" drill	1,000
Vacuum cleaner		12" b&w	20	9" disc sander	1,200
Upright	200-700	VCR	40-100	3" belt sander	1,000
Hand	100	CD player	35-100	12" chain saw	1,100
Sewing machine	100	Stereo	10-100	14" band saw	1,100
Iron	1,000	Clock radio	1	7¼" circular saw	900
Clothes dryer		AM/FM car tape	8	8¼" circular saw	1,400
Electric NA	4,000	Satellite dish/Internet	30-65	Refrigerator/freezer—	
Gas heated	300-400	CB radio	5	Conventional Energy Star	
Heater		Electric clock	3	23 cu. ft. 540 kWh/yr.	
Engine block NA	150-1,000	Radiotelephone		20 cu. ft. 390 kWh/yr.	
Portable NA	1,500	Receive	5	16 cu. ft. 370 kWh/yr.	
Waterbed NA	400	Transmit	40-150	Sun Frost	
Stock tank NA	100	Lights		16 cu. ft. DC (7) 112	
Furnace blower	300-1,000	100W incandescent	100	12 cu. ft. DC (7) 70	
Air conditioner NA		25W compact fluorescent	28	Freezer—Conventional	
Room	1,500	50W DC incandescent	50	14 cu. ft. (15) 440	
Central	2,000-5,000	40W DC halogen	40	14 cu. ft. (14) 350	
Garage door opener	350	20W DC compact fluorescent	22	Sun Frost freezer	
				19 cu. ft. (10) 112	