SYSTEM SIZING WORKSHEET

AC device	Device watts	×	Hours of daily use	×	Days of use per week	÷	7	=	Average watt-hours per day
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	

1 Total AC watt-hours/day ______

2 × 1.1 = Total corrected DC watt-hours/day ______

DC device	Device watts	×	Hours of daily use	×	Days of use per week	÷	7	=	Average watt-hours per day
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	
		×		×		÷	7	=	

3 Total DC watt-hours/day ______

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 page 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 =	
BATTERY SIZING		
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 1.05 to account for inverter inefficiency (typical by 95%). This gives the actual 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 send 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, 24-volt, or 48-volt.

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 424) 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 backup power source, can allow use of a higher hours-per-day figure on this line and reduce the initial system cost. The National Renewable Energy Laboratories (NREL) provides peak sun hour date for each state; visit pvwatts.nrel.gov for peak sun hour info and more.

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, or at least pick a wattage if you can't settle on a manufacturer just yet. 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. Consider your method of mounting the panels and who will be doing the work. If you're designing a system you'll be installing on your own, make it easy on yourself and install a larger quantity of smaller, and easier to work with, modules.

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; 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 generally be 12 for lower-wattage modules or 24 for larger ones.

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 many modules for you? 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 (no bias of course).

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 five days of backup capacity. Less reserve will mean that the battery cycles excessively on a daily basis, which results in lower life expectancy. More than five days' capacity starts getting so expensive that a backup 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% to be safe. 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. See the Battery section of our website for amp-hour capacity and more details (realgoods.com/catalog search/result/?cat=0&q=batteries). 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	4,000	Satellite dish/Internet	30–65	Refrigerator/freezer—Conventional ENERGY STAR	
Gas heated	300–400	CB radio	5	23 cu. ft.	540 kWh/yr.
Heater		Electric clock	3	20 cu. ft.	390 kWh/yr.
Engine block	150–1,000	Radiotelephone		16 cu. ft.	370 kWh/yr.
Portable	1,500	Receive	5	Sun Frost	
Waterbed	400	Transmit	40–150	16 cu. ft. DC	112
Stock tank	100	Lights		12 cu. ft. DC	70
Furnace blower	300–1,000	100 W incandescent	100	Freezer—Conventional	
Air conditioner		25 W compact fluorescent	28	14 cu. ft.	440
Room	1,500	50 W DC incandescent	50	14 cu. ft.	350
Central	2,000–5,000	40 W DC halogen	40	Sun Frost freezer	
Garage door opener	350	20 W DC compact fluorescent	22	19 cu. ft.	112