Worksheet for Designing a Solar System Based on Power Consumption

Input fields in Grey

Daily Power Consumption Analysis

Appliance DC	Amps	Hours At Anchor	Hours On Passage	Daily AH *1* At Anchor	Daily AH On Passage
Refrigeration	5	10	10	50	50
Radar	4		4	0	16
Computer - Laptop	4	1	10	4	40
Autopilot	4		10	0	40
Cabin Lights (LED)	1	4		4	0
Nav/Anchor Lights	0.2	10	10	2	2
Stereo	1	3	3	3	3
VHF Radio	0.5	10	10	5	5
Instruments	1		8	0	8
Pressure Water	6	0.25	0.1	1.5	0.6
Phone Charger	1	2	2	2	2
Other				0	0
Other				0	0
Total Amp Hours				**71.5**	**166.6**
AC - Equipment powred by an Inverter (Watts)					
Microwave (Watts)	1100	0.1	0.1	10.2	10.2
Other				0.0	0.0
Other				0.0	0.0
Windlass *2*				0.0	0.0
Total Amp Hours				**10.2**	**10.2**
Total Amp Hours Consumed per Day				**81.7**	**176.8**
Battery Charging Voltage			13		
Total Watt Hours Consumed per Day				**1,061.5**	**2,297.8**

1 AH - Amp Hours - Amps of current consumed in one hour

2 Windlass is often not considered because the engine alternator is running when used

3 5 hours avg. is a good estimate for horizontal panels, 7 for panels with tilt & rotate
See http://www.bigfrogmountain.com/SunHoursPerDay.html for hours in your area.

4 Charge efficiency factor - Lead Acid ≈ 1.2, AGM ≈ 1.1 , LiFePO4 ≈ 1.04

5 Solar efficiency - Partly cloudy ≈ 70%, Mostly cloudy ≈ 50%, Very cloudy ≈ 30%

6 Useable battery capacity - Lead Acid ≈ 50%, AGM ≈ 60%, LiFePO4 ≈ 95%

Solar Power Requirement Analysis (Full Sun)

			At Anchor	On Passage
Average Hours of Sun per Day	5	*3*		
Battery Charge Inefficiency Factor	1.2	*4*		
Watts of Solar to Replenish Battery Bank Daily			**254.8**	**551.5**

Solar System Design Analysis (MPPT Controller)

Capacity of Each Solar Panel (Watts)	130			
Number of Solar Panels Required			**2.2**	**4.7**
Number of Solar Panels Installed	3			
Minimum Capacity of Solar Controller (Amps)	**30.0**			
Daily Useable Solar Power in Full Sun (Watt Hrs)	1,755.0			
Daily Power Drawn from Battery Bank (Watt Hrs)			1,061.5	2,297.8
Excess or (Deficit) of Power (Watt Hrs)			693.5	(542.8)
Factor for Cloudy Days				
Solar Efficiency on Cloudy Days (percentage)	30%	*5*		
Solar Power Generated on a Cloudy Day	526.5			
Power Drawn from Batteries on a Cloudy Day (Wh)			535.0	1,771.3
Number of Continuous Cloudy Days	2			
Sunny Days to Make Up Battery Draw Down			**1.5**	**-**

Battery Capacity Analysis

			Amp Hrs at Anchor	Amp Hrs on Passage
Scenario 1 - Based on Cloudy Days - with Solar				
Ah Drawn from Batteries on Cloudy Days			82.3	272.5
% of Battery Capacity Useable	50%	*6*		
Rated Battery Capacity Required (AH)			**164.6**	**545.0**
Rated Battery Capacity (Ah)	120			
Number of Batteries Required (in parallel)			**1.4**	**4.5**
Scenario 2 - Based on Days of Reserve Capacity (no solar)				
Number of Days of Reserve Battery Capacity	2			
% of Battery Capacity Useable	50%	*6*		
Rated Battery Capacity Required (AH)			**326.6**	**707.0**
Rated Battery Capacity (Ah)	120			
Number of Batteries Required (in parallel)			**2.7**	**5.9**

Steps to use this worksheet
1. Determine the average daily power consumption both at anchor and on passage.
2. Configure the solar system (battery and solar panel inefficiencies are considered).
3. Modify the solar system configuration to accommodate anticipated cloudy days.
4. Analyze the capacity of the battery bank.

Note: This methodology does not take into consideration power generation from other sources such as engine alternator, generator, wind generator, fuel cell or shore power.

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