Our group has conducted a power consumption analysis for our system to predict how long the battery used by our solar module is going to last.

1) Basic understanding: Our power system consists of three main components which are a solar panel, a sealed lead acid battery, and a solar charge module. The solar panel inputs voltage/current to the solar charge module, and the solar charge module then outputs a fixed voltage/current to the battery to charge it. This fixed voltage/current can be adjusted with a potentiometer attached to the solar charge module. We then connected the solar charge module output and the system in parallel with the battery.

2) Details: The voltage from the solar panel will have to be adjusted by the potentiometer due to the change in sunlight throughout the day. The amount of sunlight will determine whether the solar panel or battery will power the load. If the solar panel produces a amount of power significantly higher than what the system needs then the solar panel will both charge the battery and power the system. If the solar panel is producing less power than what the load requires, then the battery will be powering the system. The potentiometer acts as a voltage divider, and we will aim to adjust it so that the solar charge module produces 13.5V-13.8V output since this is the recommended charging voltage of our battery.

3) Components:
i) 12V 7AH Sealed Lead Acid Battery
ii) 12V 10W Solar Panel
iii) 12V Solar charge module with an adjustable potentiometer and maximum 1A charging current

4) Total Power needed to power our system:
a) Voltage: 5-20V.
b) Current: We measured current to be 50-100mA, but we went with 100mA just to be safe.
c) Power: We use the power formula to find the total power our system consumes. P = V X I = 12V X 100mA = 1.2W.

5) Power produced by our power system: Calculations are based on ideal sunny conditions.
a) Voltage: 12V
b) Current: 100mA
c) Power: V x I = 12V x 100mA = 1.2W

Power generated by solar panel: The power generated by the solar panel varies due to the amount of sunlight. The solar panel we are using produces 10W and 12V in ideal sunny conditions. This results in a current output of 0.83A for the solar panel. Weather conditions are not typically ideal, so we will rely on the solar charge module to adjust the voltage/current.

Power generated by solar charge module: The solar charge module has a maximum charging current of 1A. This means that even if its output current exceeds 1A, the solar charge module will only allow 1A output. We can adjust the potentiometer at a resistance that will give us the exact current and voltage that the solar panel produces. If the solar panel is producing more than 12V (More than what is ideal) then we can adjust the potentiometer's resistance to get a lower voltage to meet our requirements.

Expected battery life (without solar panel): 7AH / (100mA x 0.95) = 73.7 hours

Battery charging time (time needed to charge dead battery): 7AH / 730mA = 9.59 hours.

Battery charging speed: Assuming ideal sunny conditions, our battery will be receiving more charge than it is producing to the load. The battery will receive 830mA, but the load will receive 100mA at the same time. This means realistically our battery is being charged at 730mA. If we assume that we have 5 hours of ideal sunlight, then we will have 19 hours where the battery is not being charged. This means that after those 19 hours our battery will be at 5.1AH, 7AH - (100mA x 19H) = 5.1AH. Then if we assume 5 hours of ideal sunny conditions, the battery will be fully charged, 5.1AH + (730mA x 5H) = 8.75AH = 7AH. Anything that is 7AH or over is fully charged.

Nonideal conditions: If there is less sunlight than the ideal, the system will be powered by the battery. If there is more sunlight than ideal, the potentiometer should be adjusted so that the output voltage of the solar charge module is what we want it to be. All calculations made are based on ideal weather conditions, but since weather isn't always the same then this means parameters are always changing thus the current that our system receives is changing as well.

Special Cases: The 12V 7AH sealed lead acid battery that we are using has a recommended charging voltage of 13.5V-13.8V. This means that if we have weather conditions that exceed ideal weather conditions for the solar panel, we can adjust the voltage on the solar charge module to produce an output of 13.5V-13.8V. Our system is recommended to take in between 7-12V but it can handle 5-20V. Since the amount of sunlight determines whether the solar panel or battery powers our system, we do not have to worry about our system possibly overheating when receiving 13.5V-13.8V as we charge the battery with this voltage. This means we can use a 13.5V-13.8V output from the solar charge module instead of 12V.