# Power Requirements

The requirements imposed on the power subsystem stem from the primary requirement RCL-MOP2, which defines the minimum mission success lifetime as six months of operations. To support this requirement RCL-MOP2-PWR1 requires the construction of a detailed power budget that incorporates the power consumption and power generation of the spacecraft to ensure a positive net power margin per orbit.

RCL-MOP2-PWR1-A requires an energy storage device to serve as the spacecraft’s primary power source and power storage to support a positive net power margin.

RCL-MOP2-PWR1-B requires an Electrical Power System to serve as the interface between the battery and spacecraft bus, incorporating the necessary redundancies and failsafes to safeguard the power source from short circuits, current overdraws, and adverse environmental conditions. The Electrical Power System will also manage the power distribution across the spacecraft bus through the use of regulated power lines.

RCL-MOP2-PWR1-C requires that the spacecraft generate a sufficient amount of power to compensate for the spacecraft’s energy consumption to support a positive net power margin.

# Power Subsystem

The power subsystem is responsible for generating, storing, managing, and distributing the energy required to conduct the mission. The subsystem consists of batteries, solar arrays, and any circuitry necessary to operate the subsystem.

The spacecraft’s batteries serve as the primary power source. Historically, CubeSats have used lithium-polymer batteries over more traditional nickel-cadmium batteries for energy storage because of the relative light weight and small volume combined with their high energy density of lithium-polymer. CubeSat architecture lithium-polymer batteries are available from commercial vendors at various capacities, with a standard 1U battery holding a 10 watt-hour charge. Many commercially available CubeSat batteries come integrated with an Electrical Power System board.

The Electrical Power System (EPS) serves to manage the power flowing to and from the batteries, connecting to both the spacecraft bus and the solar arrays. The EPS must provide over-current against a short circuit and under-voltage protection to prevent a complete discharge of the batteries. The EPS should also include a number of Battery Charge Regulators (BCRs) that regulate the incoming voltage and current from the solar arrays to the batteries, maximizing the efficiency of the battery charging cycle. The EPS must also be able to relay battery and solar array health data to the Command and Data Handling subsystem.

The spacecraft must be able to generate power to recharge the batteries. While there are several methods of doing this, the most practical is to mount a system of solar arrays to the spacecraft’s exterior. Commercial CubeSat solar arrays can come in a variety of sizes, configurations, and generation capacities. The simplest of the 3U CubeSat-scaled arrays are static panels, though deployable arrays are also available. Though deployable arrays generate significantly more power, it comes at the cost of increased mass and complexity. A preliminary power generation budget based on the Spectrolab Improved Triple Junction (ITJ) solar cells showing three different array configurations can be found in Table X.