Step 1: Determine the different stages of flight
Step 2. Determine the power required for each stage of the flight
The following method for sizing a battery builds up the energy required for each stage of flight.

$$Energy = Power * Time$$

$$E_{flgiht} = \sum P_{flight\ phase} * T_{flight\ phase}$$

The power required for each flight phase can be gathered from the initial sizing and performance requirements.

*Note: The power for each flight phase should be the **electrical power required**, not the mechanical power. In other words, this includes the inefficiencies in the propulsion system.*

$$P_{electrical} = \frac{P_{mechanical}}{\eta_{propeller} * \eta_{motor} * \eta_{ESC}}$$

Step 3. Determine the time in each stage of the flight. This can be estimated based on cruise speed, flight path, and general historical data. Typical stages of flight include: Warm-up, takeoff, climb, cruise, turning flight, descent, landing, and power down.

Step 4. Determine the battery energy from the flight energy. Once the total energy required for the flight is known, add in inefficiencies and surplus.

- The battery is not perfectly efficient, so assume an inefficiency factor (probably around 90+%)
- The battery should not be discharged below 80% ever. Assume this extra 20% to be "fuel in the lines" that cannot be removed.
- Always include a safety factor. It is very rare that the pilot will be right on the dot with throttle and therefore the actual power being used will vary. **Assume that the pilot uses too much power**.

$$E_{actual} = \frac{E_{flight}}{0.80 * \eta_{battery}} * Safety\ Factor$$

A note on LiPo battery energy: The size of a LiPo battery is usually given in the number of cells (s) and the capacity (in mAh). mAh is a measure of how many milli-amps the battery can give continuously for 1 hour. It is not energy. To convert to energy use the following formula:

$$E\ [in\ joules] = (number\ of\ cells) * 3.7v * (number\ of\ mAh) * 3.6\ [A/(s * mAh)]$$