Powering Electric Flight

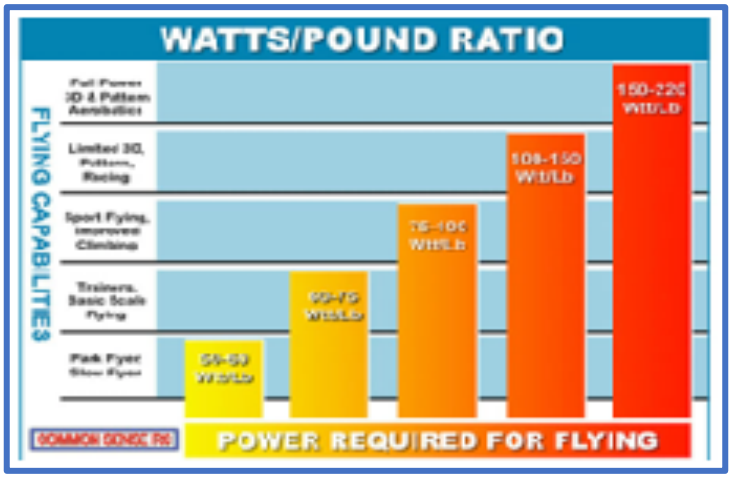
An under-powered model is a disaster waiting to happen.
A good model is one that is balanced in terms of power and flying weight (All Up Weight or AUW).

Step 1: Estimate the Power Needed by Type of Plane

Here are estimates of power by type of plane:

Vintage types, park flyer, slow flyer	**50w~60w per 1lb**
Trainers, gliders and high wing scale	**60w~75w per 1lb**
Sport flyer with general aerobatic performance	**75-100w per 1lb**
EDF Jets and limited 3D	**100w~150w per 1lb**
3D, F3A and high performance Models	**150w~200w per 1lb**

Summary:



Step 2: Choose a Battery: Capacity & Voltage

"C" is the discharge capacity rating of a battery
"S" is the number of cells in the battery
3.7 volts is the nominal voltage per cell
4.2 volts is fully charged for a cell

The maximum amps should be about 50~60% of the capacity (C) rating of the battery. For example, if you purchase a 2200mAh 20c pack, then it is rated for 44A constant discharge, so keep the max amps at around 20% more than continuous amps.
Generally, for low powered models, choose 20c packs, for general flying choose 20c~25c packs, for high performance models 30c + packs.
So, for the power determined in Step 1, select the battery size using the calculations above and this table of watts to number of cells:

Up to 50w	**1s~2s**
Up to 100w	**2s~3s**
100w Up to 500w	**3s (This is the practical upper limit for 3s Lipo's, so basically, models of 5lb)**
500w up to 800w	**4s (This is favored by many club flyers)**
800w up to 1000w	**5s**
900w up to 1500w	**6s**
8s~10s packs are for very large and generally specialized models.	

A warning on batteries:
Cycle life is reduced by discharging at full C rate to 3v.
End of life is best measured by Internal Resistance (IR). IR is another article.

Example 1	Trainer/Sport Model, 1lb AUW, Typical would be a 100w motor (3s 20c battery), mid KV for general flying, (probably around 1200kv~1400kv), so about a 8"prop would be good to test on the watt meter.
Example 2	3D/F3A Model: 1lb AUW, Typical would be a 150w motor (3s 20c~30c battery), low KV, (1000kv or under). With a 10~11" prop, it should be highly efficient at low throttle openings, giving lots of prop wash over control surfaces at all times, high thrust for low RPM, and low amps draw at higher throttle openings.
Example 3	High Speed Delta type model: 1lb AUW, 200w motor (3s 25c~30c battery) 2200kv~3200kv motor. Try a 5"~6" prop giving high speed/low torque, low thrust at low throttle, high speed from high RPM at full throttle.

Step 3: Choose a trial motor (thousand RPM Per volt (KV) and a trial propeller (length and pitch)

Use the total flying weight (AUW) and aircraft type as your starting point.

Ultimately you need adequate power (thrust, as measured by watts) to fly your aircraft.

Using the examples with table above, choose a motor and prop size.

STEP 4: Choose an ESC (Electronic Speed Control)

1. Look at the maximum amps given by the motor manufacturer and generally add 25%.
Example: If a motor is rated to 15A, then choose at least an 18A ESC, or a 20A.
Next make sure that the ESC voltage is compatible with the battery.

2. Functionality: For example, if you are flying a glider, you will want a brake facility so that the prop stops when soaring without power, allowing the prop to fold by not windmilling.
Newer ESCs may not need programming; older ones may require getting a programming tool.
Some ESCs have telemetry capability embedded to hand-shake to the receiver.

3. Look at BEC rating. The BEC (Battery Elimination Circuit) supplies radio receiver and servo's power. It prioritizes servo control over motor power under low voltage.
Consider the number of servo's needing power. If the servo count is over 4, as it is on many models these days, then consider purchasing an ESC with a high AMP rated SBEC (switching BEC) OPTO type ESC's (they have no BEC, keeping the ESC separate from RX supply) are recommended for large models.

STEP 5: Test the power train on the aircraft.

1. Get a Wattmeter.

2. Plug it in between the LiPo battery and the ESC.

3. With the propeller installed, run up the motor. Read the total watts generated.

4. Weigh the airplane

5. Divide the total watts by the weight of the plane and compare the reading to the chart above for the type of aircraft.

6. Change prop size and prop pitch as needed to achieve the power your plane needs. Test with different sizes and pitches.

7. If you can't get adequate power with prop changes, try a different motor.

STEP 6: Go Fly.