and Aerobatic Category Airplanes, the regulation under which most general-aviation light single-engine aircraft are constructed, the following requirements exist:

> 23.1351 General
>
> (a) Electrical system capacity. Each electrical system must be adequate for the intended use. In addition—
>
> (1) Electric power sources, their transmission cables, and their associated control and protective devices, must be able to furnish the required power at the proper voltage to each load circuit essential for safe operation; and
>
> (2) Compliance with (a)(1) of this section must be shown as follows—
>
> (i) For normal, utility, and acrobatic category airplanes, by an electrical load analysis or by electrical measurements that account for the electrical loads applied to the electrical system in probable combinations and for probable durations...

The electrical system has to be capable of handling anticipated electrical requirements plus be able to keep the battery in a state of constant charge. Another advantage of the AC alternator was its 3-phase characteristic permitting electric motors to shed precious pounds without losing power. Finally, the alternator requires less maintenance costs and downtime.

High on the list of reasons for reduced maintenance is the fundamental design difference between alternators and generators. A generator has brushes and commutators that channel the high-current flow out of the rotating armature. This leads to electrical arcing, commutator-bar burning, and rapid brush wear, all of which lead to high maintenance costs. Also, the rotating part of the generator is heavy, which leads to greater wear on the bearings.

The alternator does not have these problems because it is connected to the external circuit by slip rings instead of a commutator, and the armature (stator) is a stationary member. The electromagnetic field (EMF) becomes the rotating member (rotor) and turns within the stator. In an alternator, the high current of the stator can go through a set of fixed leads rather than through brushes and a rotating commutator, as it does in a generator.

In all fairness, the alternator has some problems, too. Alternating current (AC), because of its expanding and collapsing nature, causes "noise" in avionics. The solid-state alternator is, in general, more prone to electrical damage than the generator, which has mechanical relays. Improper polarity can literally destroy an alternator. And an otherwise healthy regulator can burn out as a result of an unrelated alternator problem.

From an operational standpoint, there is one significant drawback to the alternator: it requires approximately 2 amps of electricity provided by the battery for it to work. Once the alternator begins to produce current, it becomes self-exciting and will continue to run, despite the condition of the battery. But if the battery is dead before engine start, you're in trouble.

Hand-propping the aircraft, or using a GPU, may start the engine, but the alternator will never produce current without at least 2 amps from the battery, and you can't recharge the battery if the alternator isn't working. It is the classic Catch 22. Of course, the engine will continue to run because the ignition system is powered by the independent magneto system, but there will be no other electrical power in the aircraft.