# A Jet-Powered Glider?

How Glowfly does hybrid for the Jet Age

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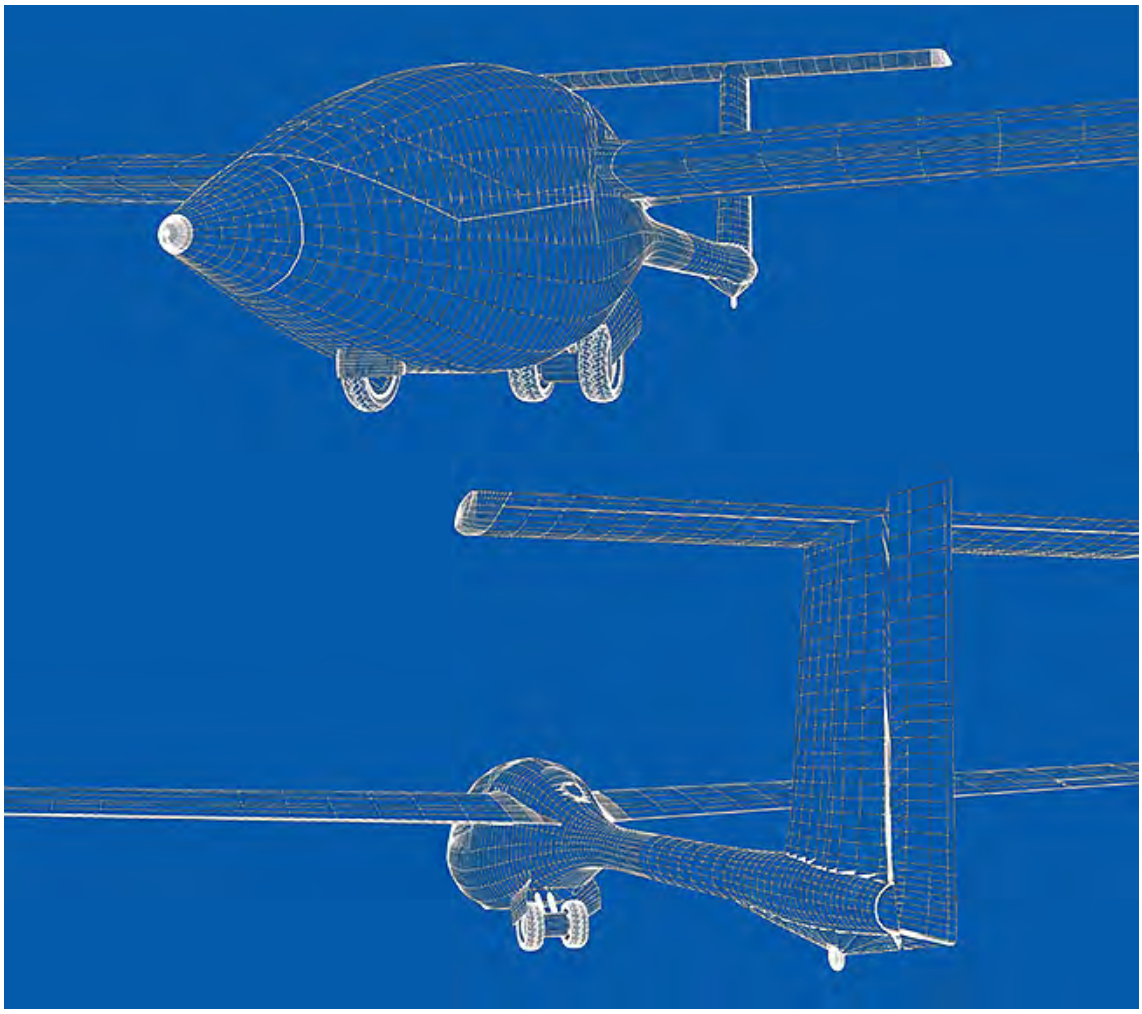
*Dan Johnson*



**T**he term “hybrid” gets used a lot these days, even when it doesn’t really fit. Of course, most people hear the term and think of a car with a combination drive system: an electric motor assisted by a small gasoline engine to take up the slack and charge the batteries if need be. In aviation, there aren’t any production “hybrids” yet, but we’re close, and leading the way is one design that pushes the envelope both in terms of technology and believability. Okay, this might be April, but this design is no joke.

The airplane I’m talking about is called “Glowfly,” and it’s still in development but looks promising. The name, as you might have noticed, hints for us to just “go fly.” It can also refer to the glow needed to ignite a turbine engine. Take that as a clue of one of the hybrid aspects. Glowfly is indeed a jet-powered sailplane that uses electric-powered main wheel propulsion to assist the taxi and takeoff roll. As I see it, this takes the term “hybrid” into new territory.

Glowfly has indeed glowed, but it has yet to fly, at least as of this writing. Still, the blending of technologies behind it is so novel [well, see the sidebar] that we needed to take a closer look.

***Glowfly uses an ingenious strategy, an electric motor to run the main wheel for taxi and to help the jet engine get the glider up to speed for self-launched takeoffs. Crazy? Nope. Even the airlines are exploring the idea, at least for taxi operations.***

Now it seems to me that gliders are a great place to launch new propulsion schemes. After all, gliders, which are supposed to be non-powered aircraft that if they climb at all climb on nature's power, have been using motor-assist for takeoff and climb just about forever.

There was a need, to get launched without having to rely on a towplane or a winch, so hybrid technology serves a really useful purpose in gliders. Power up, launch, then stow the motor and hit the thermals. Glowfly does the same thing, just in a very different way.


## GETTING ALOFT

As a longtime hang glider pilot and sometimes sailplane pilot, I love the idea of soaring without needing any gasoline or electricity. Mother Nature delivers powerful lift on many days to those who know how to find it. However, first you have to get some altitude. Lifting conditions commonly start at 1500 to 3000 feet. Somehow you have to get to that point before using thermals or ridge lift to climb "baby's ladder."

You can launch from a mountain, usually on a fairly steep incline—it is not as hazardous as most imagine it to be. You can be tow launched from a ground vehicle: car, truck winch, even a modified motorbike scooter engine. You can be towed aloft by another aircraft modified for the task. Or, if you are particularly lucky, you can have a self-launching aircraft. That's what Glowfly is, except how it does so turns conventional self-launching gliders on their head.

***Glowfly makes use of an electric motor to drive the main mono gear, actually a two-wheel bogey. The pilot can use the electric motor for taxi operations and then for takeoff, getting the craft up to speed to the point that the tiny turbine can do its thing and get the Glowfly up to flying speed. We expect to see this technology get wide acceptance in GA and commercial flying in the years to come.***

Glowfly (just like “Concorde,” nobody says “the” Glowfly) is the brainchild of ProAirsport, established just a couple of years ago, with the goal of creating a light aircraft that combined a compact turbine and wheel-driving electric assist. The driving goals were to enable simplicity of operation, self-sufficiency, and lower cost.

## JET POWER TO CLIMB

How does it all work? Let’s take a look.

First, let’s consider the flight engine. We’ll come back to the electric assist.

ProAirsport selected a turbine engine called Titan from AMT in Holland. A mature unit used in drones or UAVs, Titan is actually a tiny engine that uses a single radial compressor and an axial flow turbine stage to produce 88 pounds of thrust. *Of related interest, AMT is the company that provided the powerplants for David Mayman to fly a jetpack around the Statue of Liberty on November 3, 2015.*

Eighty-eight pounds of thrust doesn't sound like much and indeed it can't launch the Glowfly sailplane airframe on its own.

Using a turbine engine on a sailplanes is not entirely new, but these engines have not been employed for self-*launching*. Instead, jet engines are used on sailplanes as sustainer engines that extend from the*fuselage*. Such installations need mechanical systems to deploy them, which adds weight and complexity. This kind of stowable technology is also employed on many motor glider designs.

On Glowfly, the engine is integrated into the fuselage. Burying the jet engine makes it quieter and safer, argues the developers; safety containment measures can be designed into the fuselage itself. An air intake scoop is all that moves, opening and closing as required. The exhaust tailpipe remains exposed but is smoothly faired in a low-pressure zone. An embedded engine, compared to those that must be raised out of the fuselage on a system of supports and cables, contributes little drag penalty.

Titan is a full FADEC engine, completely automated for the start and stop sequences. From cold, the system auto-starts and in less than 25 seconds is ready for full thrust. Following startup, spool up takes only four seconds.

Stop is similarly automated with four seconds to spool down followed by a period of cooling.

Therefore, the pilot needs only a master switch with three positions: Start, auto-stop, and stop. Normally, the pilot will use only the first two positions, unless stop is required urgently. Other engine controls include a throttle that is essentially a rotary potentiometer arranged as a thrust lever.

At full throttle, AMT's Titan burns fuel at 20 gph. As on most aircraft, full throttle is used for launch and initial climb. A five-minute climb at a forecast rate of 400-500 fpm will burn about a gallon and a half of jet fuel contained in a single fuselage tank holding about eight gallons. Once aloft, a soaring pilot uses convective lift to rise higher so they can shut down the Titan jet.

Potent as the little jet is, however, it can't get Glowfly aloft on its own, so ProAirSport CEO Roger Hurley came up with a better idea, giving birth to his form of "hybrid."

***Unlike other gliders with jet engines, Glowfly's turbine is permanently housed in the fuselage, eliminating complex, heavy and potentially troublesome retraction mechanisms.***

## ELECTRIC TO ACCELERATE

By itself, the little AMT turbine would result in a ridiculously long takeoff run and it would burn too much fuel for too little action.

Enter an electric motor to drive dual main gear wheels. The side-by-side wheels allow wings-level taxiing. That's good for getting to the end of the runway for launch. Then the magic really happens.

ProAirsport's "e-drive" helps Glowfly accelerate during the initial takeoff roll. Electric motors deliver high torque, which gets Glowfly moving fast enough for the tiny Titan turbine to take over thrust. Think of e-drive as a modest form of aircraft carrier catapult.

The e-drive setup uses a brushless DC motor from Revolt in Israel, a rather fantastic bit of engineering weighing only 6.6 pounds and measuring just 4.3 by 3.9 inches. It develops 9.4 horsepower through a belt drive using 2:1 reduction.

That horsepower is used only for taxiing and a short takeoff run of less than 30 seconds. Brief use of high energy to accelerate to turbine speed is easier on batteries than electric power used to power a propeller throughout takeoff and climb. Therefore, Hurley can use a much smaller and lighter weight battery pack, which in turn, saves money.

The battery is a 72-volt lithium iron phosphate pack, weighing just over 15 pounds, a figure that includes a built-in battery management system. The British company believes three or

four takeoffs will be possible, depending on taxi length and overall battery health. A charger juices the battery pack to full in less than an hour.

Similar to the Titan engine, all the pilot sees is a master switch and a rotary potentiometer "throttle."

Early tests show e-drive can accelerate to 45 mph with no jet contribution. Also, e-drive will help the pilot taxi back after landing without using the turbine engine. You can even park carefully as Glowfly's nose-wheel is steerable and a reverse function in the e-drive controller allows three-point turns.

***Diminutive and of very niche interest, Glowfly might seem like an unlikely technology test bed. But the technology actually makes sense, as the small turbine that functions independent of any retraction mechanism and the electric drive wheel mechanism combine to provide a cost-effective supplemental power solution for the craft. At the same time, the hybrid drive technology is likely to migrate to larger aircraft, including large commercial jets.***

## PUTTING IT ALL TOGETHER

A typical takeoff will look like this: Drive to the holding point using the electric motor only. At the hold point, start the turbine and let it run up to "ready" (less than 30 seconds).

Line up with the e-drive, select full thrust from the turbine, apply full e-drive acceleration—both systems in the hybrid work in concert—and fly Glowfly to takeoff.

For the first part of the takeoff roll, e-drive does most of the work. As airspeed increases, the jet will increasingly contribute power until Glowfly achieves rotation and climb speed. Once aloft, you turn e-drive off, retract the gear, and climb to soaring altitude.

Glowfly's flight control systems are glider traditional: pushrods for elevator, ailerons and airbrakes, cables for the rudder. Rudder pedals and seat back adjust for body size and leg length. The canopy has a single hinge at the front, tipping forward assisted by gas springs. The

main undercarriage is manually retractable with a gas spring. The nosewheel is tiller steerable and does not retract.

***Glowfly represents a remarkable marriage of dissimilar technologies, but it promises to do it in an elegant way. When, after all, was the last time you heard of a jet designed to dead stick it back in every time out?***

Any interested pilot will ask when ProAirport expects to test Glowfly. Hurley's team reports finishing the flight control installations and are refining the ergonomics of the dual motor control systems. First flight may occur by spring of 2016.

Current pricing is given as $66,000 (converted from £43,950). Compared to any other self-launching motorglider I have examined, this is an excellent value, especially for a self-launching sailplane that can be flown—at least in England—with little regulatory hassle.

Glowfly represents a remarkable marriage of dissimilar technologies, but it promises to do it in an elegant way. When, after all, was the last time you heard of a jet designed to dead stick it back in every time out?

We'll keep you apprised on Glowfly's progress.

## First-Ever Jet-Powered Glider?

Well, not really, but it's a small crowd

*Robert Goyer*

Glowfly is a cool project to be sure, and its combination of an electric-motor-driven dual-wheel monogear—yes, many sailplanes have a monogear—and a jet engine for the remainder of the takeoff and climb is the only one we've ever heard of to entertain such an arrangement. But it will not be the first jet-powered glider; they've been around for awhile in very limited numbers. For a number of reasons, there probably won't be a groundswell of them either. After all, the whole idea of a glider or sailplane is to not have an engine. It's true that motor gliders are somewhat popular because they free the pilot of the need for launch assistance, and jet engines are an intriguing solution because they're small, light, low in vibration and powerful for their weight and they eliminate a few big problems associated with other propulsion systems. There's no prop or the vibration associated with one or, more importantly, the need to stow a prop. But jet engines are relatively expensive, they run white hot, burn through fuel in a hurry and require special care and handling, even more than piston aviation engines, which are no picnic themselves.

While there are no full production jet-powered gliders, there are a few companies selling jet-assist or jet-sustaining designs. The Bonus Jet is a Czech-designed and -produced motor glider, designated the TST-1 and nicknamed "Bonus." The addition of a small retractable turbine engine, the PBS TJ-100, also a product of the Czech Republic, turns the Bonus into the Bonus Jet. A company in New Mexico, Desert Aerospace LLC, designed the retract mechanism and did the conversion. The Bonus Jet glider can take off under jet power and can climb at an impressive 1,000 fpm, allowing it to climb into conditions of good lift before the pilot shuts off the turbine and goes soaring in earnest. The company, run by airshow star Bob Carlton, who does a tremendous show in a Bonus Jet, conducts training in the aircraft, which requires a type rating, for which Desert Aerospace offers training to pilots with a Private certificate or higher and a glider rating. At around $2,000 including the flying, it's the cheapest type rating a pilot will ever get.

A South Africa sailplane manufacturer, Jonker Sailplanes, offers a jet-assist version of its stunningly beautiful high-performance JS-1 model. The engine is a German-built EASA-certificated M&D model that puts out minimal thrust, like the one on Glowfly. It's not enough for takeoff under jet power, but it can be used to sustain flight when the lift is hard to find.