ELECTRIC DREAMS

The OpenPPG project is leading the way in developing the next generation of electric-powered paramotors – using ideas and innovation from the world of consumer drones. Jeff Goin gets to play

Battery-powered paramotors are not new, and neither is the dream that drives their development. The thought of flying a paramotor that is as easy to operate as a hair-drier appeals to many pilots, including non-powered paraglider and hang glider pilots who would otherwise turn their noses up at their powered cousins.

But so far the dream has remained elusive. A decade ago Chinese company Yuneec showed off their prototypes at the Coupe Icare, but nothing commercial came of it. Instead, after various forays into electric-aviation and an investment round that included $60m from Intel in 2015, they headed off to make drones.

With a couple of exceptions then (eg Exomo), the e-powered paramotor market has remained fairly quiet. The problem is always the battery: why pay thousands of dollars/pounds/euros for something that runs out of power after 15 minutes? Add more batteries and you simply add a lot more weight: you'll never get off the ground.

However, these ideas never go away, and the latest approach to e-power is the innovative OpenPPG project. This open-source electric paramotor project is dedicated to developing an ePPG via community-driven design – and uses readily-available consumer electronics parts to do it. Pilots who want to can buy a build-your-own kit and find support and innovation in the OpenPPG forum; or they can pay more and buy a fully-built unit.

The project is certainly innovative: the machine folds up and will fit in the back seat of your car. And then there are the propellers. There are four of them and they look like drone props. They *are* drone props!

At the start of this year our resident paramotor expert Jeff Goin got his hands on one of OpenPPG's latest models and took it for a test fly. Is it the first step towards a genuine mass market e-powered paramotor revolution? Or is it once again a false dawn? Here's what Jeff found out.
Ed Ewing

▲ON/OFF
Jeff Goin flies the community-driven, open-source electric paramotor from OpenPPG. Note the four propellers instead of the more typical one
Photo: Jeff Goin

◄◄GREEN DREAM
Flying a traditional two-stroke paramotor above wind turbines in Spain. Electric paramotoring offers the potential to be powered by eco-power – batteries topped up by renewable energy
Photo: Karen Skinner

First, let me thank Florida's Rob Catto for letting me try out his new OpenPPG four-prop electric paramotor. It's the brainchild of brothers Paul and Zach Whitehead who have a background in building high-end racing drones. Paul drove the project and Zach handles its programming. Together they have built both a machine and an ecosystem around their clever creation.

This was my first electric flight since trying Yuneec's prototype almost 10 years ago – a machine that wasn't quite ready for prime time. I am aware that other, more traditional electrics are out there – with more coming – and I look forward to trying those when the opportunity arises.

The basics

I did several flights using two different battery packs. First on a 1kWh version, then on a stock 2kWh set which had been fully charged the night before.

Rob uses the small set primarily for letting people feel the thrust. They also get the vibration, sound, and feel for what it's like on the ground. These smaller batteries only provide 10 minutes of flight time though, so one test I did was to see how it performed when the meter got down to 0% at cruise power. Would there be enough for a go-around? Read on.

The unit weighs 10kg without batteries. Batteries are 10kg for 20 minutes or 20kg for 40 minutes. My flights were on a 16m² Niviuk Dobermann in 20°C sea level conditions (Florida in January). I got 22 minutes out of the stock batteries even on that small wing so the published endurance seems conservative. The time included probably three landings where I brought the wing down and took off again.

Flying impressions

There is no downside when flying, at least while full power is available. The throttle may be too sensitive during launch, but it's awesome in flight. Conditions turned thermic and bumpy by the time I had finished, which gave me plenty of time to figure out how to finesse thrust. Plus I did some foot-dragging, climbs and turns – real-world flying.

It's comfortable and has good weightshift. Throttle response is linear and far quicker than anything I've flown to date. Because of its four-prop arrangement, there is no torque – not even that momentary bit from spin-up, so it turns equally well in either direction.

The harness would be good for soaring which is a perfect mission for this machine if you don't mind the extra drag and have no other way to launch. It will likely tolerate five minutes of full power climb, averaging 140 pounds of thrust.

Launching

The OpenPPG comes with a thumb-throttle that requires an adjustment to how you hold the risers during forward launches. I put the centre-A between my index and middle finger, which worked well during several test inflations and runs. Other than that there is no difference from any other paramotor – except for a complete lack of torque.

The throttle takes very little force – too little in fact – to activate. On launch it bumped the thrust up and down with each footfall. Owner Rob said he was going to add a spring to it to create a bit more tension.

I tried the throttle in my left and right hand and found it surprisingly natural. When the wind picked up, reverse launching was just as simple as any other machine.

Landing

Unlike a traditional two-stroke there is no engine to idle – throttling-off produces silence since the props stop and there's no idling engine. That's so cool.

Instant power means that it's extremely easy to power-up into a foot-drag or power-on landing.

I was told that when the throttle display shows 0% at cruise power it's recommended to land. While flying the small battery set I wanted to know if there was enough left for a go-around and quick return to the landing site – in case, for example, you wanted to abort a landing at the last moment.

There wasn't. I climbed about 40 feet (12m), started to turn, and the power began to fade. So I just landed straight ahead instead of risking a downwind landing. I did the same test on its big

▲CLOCKWISE FROM TOP LEFT
The unit folds away, propellers and all. Because there is no oil or petrol it's also straightforward to pack into your car

The OpenPPG logo

Owner Rob Catto mounting the batteries

The throttle, with digital display telling you how much battery you have left

Photos: Jeff Goin

▲THE SOUND OF SILENCE
Unlike a two-stroke, when you release power on an electric paramotor there is no noise. Throttling-off produces silence since the props stop and there is no engine on idle
Photo: OpenPPG.com

battery pack and was able to get back around into the wind.

That suggests it would be wise to plan your flights with at least a five-minute reserve, or spend the last few minutes above your LZ.

Powerplant

Batteries power four brushless DC motors through individual speed controllers according to throttle position. Voltage and remaining power shows on the throttle as a percentage ("%") but it's not terribly accurate. At full power it read 0% after only a few minutes of flight, even though I flew for another 10 minutes.

Full power is reported to be about 80 amps at 50 volts, which is 40kW (50hp). That would likely drain the stock batteries (4 Bonka 488 watt-hr 22v packs) in around six minutes.

This is an open source project so even the code to see how it works is online. I've done coding, ironically enough for Rob Catto, this motor's owner, who built a virtual reality paramotor simulator. One question I had was how the OpenPPG handled a pressed-throttle situation, where the pilot didn't realise full power was being commanded and tried to arm it. That would cause sudden and unexpected full thrust upon arming it. Thankfully, the throttle must be idle before the code will allow arming. (Search 'Github OpenPPG' to go deeper into that.)

Maximum power will degrade during the flight but I couldn't tell until the very end; an advantage of being relatively lightweight.

Prepping and starting

All the batteries are charged at once in about three hours from a standard wall charger. 'Starting' is brilliant. Turn the master on. It chirps periodically to let you know it's on but not armed. Once you're ready to launch, press 'Arm'. The beeping stops and power is at the tip of your thumb. It's weird (but cool) that there's no sound whatsoever until throttle up. No idling, nothing.

A master switch puts power to the whole unit by rotating a two-position knob. One click right for on and one click left for off. Rotary motion resists accidental activation or deactivation. It can be reached while in the motor but that takes practice and dexterity. It would be nice if it were more accessible.

Harness and ergonomics

It uses a split-leg Apco harness with lightweight buckles (used on other harnesses, too) that require two hands to operate. Plan on using your hook knife if submersion becomes likely since they're harder to get out of in an emergency.

The harness is quite comfortable, even on the ground since the weight is so close to your back. On a gas machine, this harnesse's lack of padding would transfer vibration, but here it's not a problem.

It was easy to run with and easy to get seated without having to reach down, although I did so to get seated quicker. It allows great weightshift through well implemented gooseneck bars. Like many machines, I had to hike it up a bit to keep the bottom from hitting my calves.

The throttle is just a bit too short. I would occasionally feel a tug and could imagine pulling out the wires which makes it shut off.

Electric versus gas (petrol)

I love my petrol paramotor. It allows frequent or long flights and refuelling takes just a few minutes. But I dislike all that it requires to be happy, and how many fragile bits must keep working. It is a shame that endurance is what's traded away for the benefits of electric propulsion.

Batteries are, of course, the big issue. Judging from quadcopter (drone) forums, with good care you can reasonably expect to get 300 cycles out of your $900 pack.

I did a spreadsheet for operating cost on the tested machine and they turn out to be remarkably close to gas: around $6.50 per hour. That accounts for energy cost, battery replacement, and piston engine overhaul.

While the energy is dirt cheap relative to gas, especially considering the expensive two-stroke oil, battery replacement is also expensive. I tried to use numbers that reflected reality but there are a lot of variables and a bit of luck. Some pilots do all the right things with their two-stroke motors and still end up with cracking, quitting lemons. Others have motors that never seem to die in spite of their best efforts. And it crosses all brands.

One thought is that electric performs better at higher altitude since it doesn't depend on air for power. Thrust may drop for other reasons but it won't be due to lower oxygen content.

Four props versus a single prop

Having four points of thrust allows some cool possibilities for vanquishing unwanted motion. Imagine turbulence trying to twist you left. Thrust could be decreased on the right two motors and increased on the left two motors in a way to stop the twist. That hasn't been implemented yet but, judging from what drones can do, it's within reach.

Having tiny props spinning at high RPM makes it sound a bit like it's screaming even at cruising speed. They're not actually loud as measured by a decibel meter, they just sound like it. You'll still appreciate ear protection.

Rotational inertia is the resistance to twisting, or tendency to keep twisting once started. Picture this: you're holding the centre of a two-metre bar with 10kg balls at each end. That's a lot harder to get spinning than if those balls were only 20cm apart. This design has its motors out away from the centre of rotation but they're pretty lightweight so the effect is still minimal.

Buying

For about $5,000 US you can buy a complete unit ready to fly. They take orders in batches. When enough orders come in (about 10) they order all the parts that aren't in stock and put machines together.

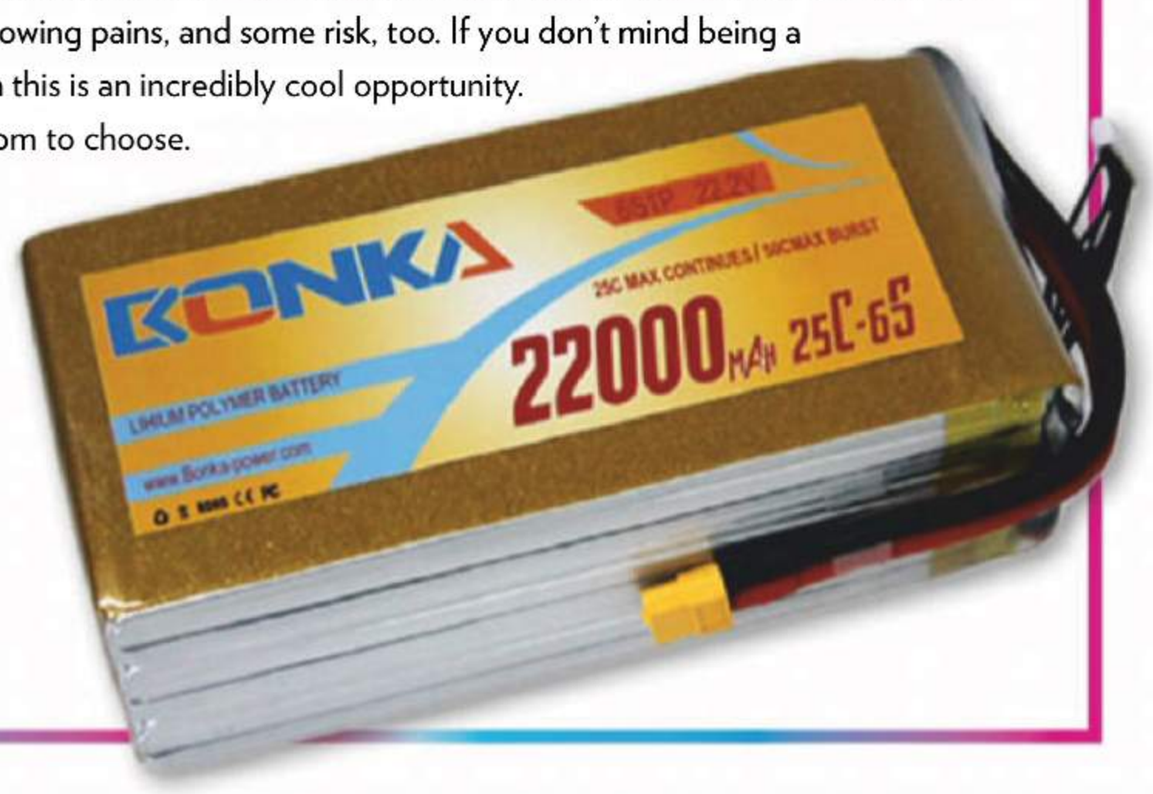
Yes, there is some trust required but that's no different than ordering paramotors anywhere else, and they have a good track record. You can save

TAKING CARE OF BATTERIES

If batteries get hot they swell up (get 'puffed' out) and are at greater risk of catching fire. Puffed batteries must be disposed of, which at $900 a set is expensive. Here are some tips to taking good care of them:

- Don't ever let them get too hot. Overcharging is sin number one, but using an approved charger generally prevents that
- Don't fly an already hot battery. Let them cool after charging
- If your mission allows, only charge to 90%
- If you won't be flying for a while, only charge them halfway before storing. Then fully charge the night before flying but with enough time to cool off before flying
- Avoid physical damage and definitely don't fly with a damaged battery
- Consider charging and storing them in a fireproof container. YouTube "Lipo fire" for encouragement. They are rare but it has happened, especially with the hobby batteries common on these and electric-start gas/petrol motors.

We're all beta testers with paramotors but even more so with an open source project like this. There will be some growing pains, and some risk, too. If you don't mind being a bit of a test pilot, than this is an incredibly cool opportunity. And I relish the freedom to choose.



▲ELECTRIC FUTURE
The OpenPPG project is crowdsourcing the development of electric paramotors and building a fan base of believers. Rob Catto is an early adopter and supplied the machine Jeff demoed. Another electric dream, a Tesla, sits in the background
Photo: Jeff Goin

about $400 by getting a kit with all the parts and putting it together yourself.

Another cool element of this is that you can download all the details, 3D pieces, even the control software, and build your own. That's impressive given how clever this thing is, although it's a bridge too far for most of us.

The four wood quadcopter props can be bought from hobby sources, or the OpenPPG.com website for under $30 each. Yes, there's only one zero after the 3.

Storing and travelling

I watched the owner Rob remove the net and fold everything up in well under five minutes. What's left easily fits in a car seat.

Each arm has a clever locking mechanism that releases the arm to fold in for storage. Even if the locking mechanism is released, as long as the motor is under power it would keep pushing. However, it did feel like the release could easily be done accidentally and there was little or no physical detent (catch).

Travelling with batteries on airliners is a problem since rules limit batteries to 160 watt-hour (wHr) – way less than a single standard Bonka battery pack (488 wHr). Shipping by air is possible but batteries will be treated (rightfully) as dangerous goods.

Safety

Prop safety is improved dramatically but fire risk is less known. Gas machines, in spite of having litres of fuel near a hot engine, don't catch fire very often at all. Pilots of this machine are using hobby batteries which aren't built for human flight, so there is likely some added risk.

The machine does, however, mitigate that risk somewhat with a good firewall that has two parallel plates. It would benefit from a battery temperature warning that vibrates the throttle handle to allow precious time to make a safe landing before a fire gets going. That's not yet implemented but could be.

Final thoughts

I'm excited by the prospects of this machine – in fact by all electric paramotors. For some pilots who are willing to express their pioneer spirit, this is a perfect fit. The machine's polished look belies its home-grown origins.

By using mass-market drone parts they have brought prices down at some trade for refined, industrial-grade safety. It's a trade we've been making since choosing to fly and I'm thankful for the choice.

Here's hoping the brothers Whitehead and community keep it going. XC