# GUEST COMMENT

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Speed, silence, range, and payload. These are critical requirements of high-performance drones for fertilizer dosing and application.

Drones, also known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASs), are increasingly being used in agriculture. In addition to liquid fertilizer application, they are deployed to spray pesticides and herbicides.

Manned light aircraft and helicopters have performed these activities in the past, but with the shortage of skilled pilots and the high risk and cost of manned aviation, the attractive economics and safety profile of UAVs are winning the day.

Battery operated drones lack the power and range to displace light aircraft in many agricultural applications. Due to the heavy battery, there is little power left to lift the liquid fertilizer cargo. So, alternative fuels and powertrains with superior performance are essential.

The combination of kerosene and an internal combustion engine, as used in light aircraft, can be extended to drones, but there is a superior alternative.

When maximising the profitability of UAV fleet ownership and operation is the priority, liquid hydrogen stands head and shoulders above other fuels. When combined with a PEM or high-temperature PEM (HTPEM) fuel cell, it aligns perfectly with modern agricultural use cases.

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### Liquid hydrogen: creating value for farmers through performance

In aviation the challenge is to conquer gravity, and this battle is most acute when considering vertical take-off and landing (VTOL) hover drones which are at the frontline of modern fertilizer dosing and application. In this respect, hydrogen is the stand-out choice. No other fuel touches it: the gravimetric energy density of hydrogen is almost three times that of kerosene.

A hydrogen-fed drone powertrain using an HTPEM fuel cell offers a power-to-weight ratio up to 1.2 kW/kg, competing with an internal combustion engine. So, when combining the fuel and the powertrain, the hydrogen system is well placed. The third element in the power train system is the hydrogen storage tank.

Aluminium alloys combine strength and light weight with a reasonable cost and high availability. This has led them to be the default choice for aircraft bodies and wing structures. Due to their strength-to-weight ratio and resistance to hydrogen embrittlement, aluminium alloys are also ideal for building cryogenically insulated liquid hydrogen fuel tanks for drones.

Putting together the HTPEM fuel cell, liquid hydrogen fuel and aluminium storage means the drone will have outstanding mission capabilities, combining higher speed, increased maximum take-off weight (MTOW) and extended range.

As food security and affordability come further into the spotlight, and international competition is fierce, modern farming will need to turn to high productivity tools like UAVs and UASs to compete.