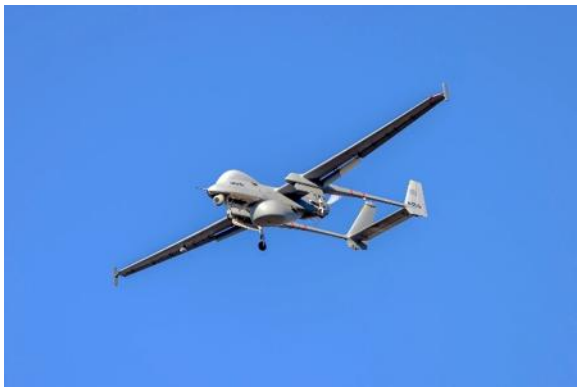
Why long-range drones still need combustion engines

The limitations of battery-powered UAVs in terms of range and flight time

Electric drones have made tremendous progress in recent years. Electric engines offer numerous advantages, particularly in smaller UAVs used for surveying, inspection, film production, or short-term reconnaissance missions, such as low maintenance requirements, quiet operation, high dynamic performance, and a relatively simple system architecture.

But when it comes to range, flight duration, and payload, battery-powered designs continue to face physical limitations. This is precisely why internal combustion engines still play a central role in long-range drones, particularly in professional and security-related military applications.



Picture 1: Military reconnaissance drone powered by an internal combustion engine

The most important factor is energy density. Compared to today's lithium batteries, liquid fuels such as gasoline can store a significantly higher amount of energy per kilogram. While batteries quickly become a significant weight factor on longer missions, a UAV with an internal combustion engine can carry enough energy to operate for many hours with comparatively little additional weight.

This is particularly relevant for:

- ISR missions (Intelligence, Surveillance, Reconnaissance)
- border surveillance
- maritime reconnaissance
- BVLOS operations (Beyond Visual Line of Sight)
- transport and logistics drones
- long-range military operations
- critical infrastructure monitoring

In these applications in particular, it is not just the flight time that matters, but also the ability to provide a stable power supply to sensors, communication systems, or additional payloads over long periods of time.

Range and endurance as strategic factors

Many modern long-range UAVs must be capable of operating autonomously for several hours or even days. This results in requirements that are currently hardly feasible, either economically or technically, with solely battery-powered systems.

An internal combustion engine, such as the one from Sky Power, enables

- significantly longer flight times
- greater range
- stable power output over long mission profiles
- rapid refueling instead of long charging times

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- higher payload capacities
- better performance at low temperatures

Military and security-related applications, in particular, require systems that can operate independently of charging infrastructure. In remote regions or tactical deployment scenarios, securing a supply of electrical charging power is often significantly more difficult than transporting or supplying fuel.

In addition, operational times with internal combustion engines can be scaled relatively easily. More fuel usually equals more range. With battery-electric systems, however, the total weight increases disproportionately, which negatively impacts efficiency and flight performance.

Thermal management and continuous power

Another key factor is sustained performance under real-world operating conditions. Long-range drones often operate in changing weather conditions, at high altitudes, or under conditions that demand sustained high performance.

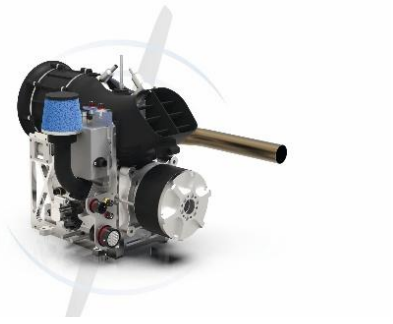
Internal combustion engines offer several advantages in this regard:
- consistent power output over long periods
- less range loss in cold conditions
- high energy availability even under continuous load
- robust performance under varying environmental conditions

Battery systems, on the other hand, are more sensitive to temperature, state of charge, and aging. Especially in cold environments, the actual usable capacity often drops significantly.

Hybrid concepts as a bridging technology

It is interesting to note that the market is not moving exclusively toward "all-electric" or "internal combustion" solutions. Instead, hybrid UAV propulsion systems are becoming increasingly important.

In this context, the internal combustion engine often serves as a generator or range extender, while electrical systems are responsible for:
- precise flight control
- load peaks
- VTOL phases
- redundant power supply



Picture 2: SP-55 FI TS Generator Application from Sky Power

Larger UAV platforms in particular now combine the best of both worlds:
- high energy efficiency
- long range
- electrical stability
- lower fuel consumption
- flexible mission profiles

As a result, the internal combustion engine remains a central component of modern UAV architectures, even in increasingly electrified platforms.

The reason why the internal combustion engine is undergoing further technological development in the UAV sector

The role of the internal combustion engine is also changing significantly. Modern UAV engines have little in common with traditional small engines. Today, the focus is primarily on the following aspects:

- weight optimization
- low vibration
- low fuel consumption
- high reliability
- digital engine control systems
- reduced signatures
- long maintenance intervals
- high power density

Two-stroke boxer engines, in particular, as well as modern Wankel and hybrid designs, are being specifically developed for UAV applications. The goal is to achieve maximum range and efficiency while minimizing system weight.

This results in specialized propulsion solutions for:

- NATO Class 1 UAVs
- tactical reconnaissance drones
- maritime platforms
- heavy-lift drones
- autonomous supply systems

The debate over electric mobility has thus not spared the UAV industry. Nevertheless, the physical constraints clearly indicate that long-range drones will continue to rely on internal combustion engines for the foreseeable future, especially where:

- long range
- long operating times
- heavy payloads
- rapid operational readiness
- and maximum operational independence

Especially where long ranges are critical, internal combustion engines currently offer significant advantages over purely battery-electric solutions.
The future probably does not lie in an either/or choice, but rather in intelligent hybrid and high-performance concepts in which modern UAV internal combustion engines continue to play a key role.

About Sky Power
Sky Power International is a leading manufacturer of 2-stroke combustion- and Wankel engines for UAS (Unmanned Aerial Systems) and hybrid applications. Besides in-house development and manufacturing, Sky Power International produces all engines in Germany. Custom adaptations, new developments and continuous performance improvements of the combustion engines are ongoing company objectives.
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