Are drones the energy sector's golden ticket?

Coupled with advances in autonomy and AI, Uncrewed Aircraft Systems (UAS) like drones are rapidly permeating all aspects of modern life. As the regulatory landscape for their use opens up and compliance protocols mature in the user market, there's almost unlimited potential to augment if not replace many conventional modes of energy surveillance, transport, and beyond line-of-sight (BVLOS) operations. But crucially, while drones have the power to revolutionise the energy industry, they are highly dependent on persistent and reliable connectivity, so we need to ensure we have built-in resilience that stands the test of time.

Here, Tristan Wood, CEO and Founder of the world's leading experts in hybrid network technologies, Livewire Digital, explores the potential of drones for the energy sector, and asks, are they the golden ticket we've been waiting for?

Some forecasts predict the drone economy exceeding $90 billion globally by the end of the decade, as numerous industries realise the potential to transform their operations, from enterprise and logistics to first responders and defence.

The market materialised in the late noughties, originally out of a military requirement but was quickly adopted in civilian life, initially for aerial photography and video. News, media, and broadcasters followed quickly.

In the ensuing two decades, the commercial and civil market of UAVs has experienced exponential growth, attaining a worldwide value of $2.9 billion by 2018, more than doubling in size since then. According to Statista, excluding defence, its market value is forecast to reach $4.7 billion by 2028, with nearly one million drones expected to be in operation, in the UK alone, by 2030 (PwC, 2022).

Today, UAVs are making themselves indispensable in a myriad of other sectors, from disaster recovery, search and rescue, weather tracking, geotechnical mapping, and precision crop monitoring, to law enforcement and border control. As increasing investment pours into this still nascent industry annually, the development of hundreds more applications are underway, including those more left of field, such as patient drug delivery both in rural and city environments bypassing natural and man-made obstructions on the ground.

Drones in the energy sector

One of the most immediate ways drones are making a difference is through remote inspections. Historically, energy companies have relied on helicopters, ground crews, or costly shutdowns to inspect critical infrastructure. For example, if a technician must access infrastructure from the air, it can be a risky and time consuming task. Today, a drone can complete the same job in a fraction of the time, delivering high-resolution images and thermal data with pinpoint accuracy, all while keeping workers safely on the ground.

In offshore environments, drones have become particularly valuable. Wind farms out at sea pose logistical challenges that make regular inspections difficult and costly.

Drones, however, can be dispatched in adverse weather, fly to difficult to reach areas, and return real-time data for analysis, ensuring maintenance is only performed when necessary and with far less disruption to energy production, and risk to human life.

The data advantage

While drones are excellent for gathering visual data, the real value comes from what we do with that data. Drones equipped with advanced sensors, such as lidar for mapping or thermal cameras for detecting heat anomalies, can provide insights that go far beyond what the human eye can see. This is particularly useful for predictive maintenance, a concept that is becoming increasingly important as the industry focuses on reducing downtime and improving operational efficiency.

The data collected by drones can be processed using artificial intelligence (AI) and machine learning algorithms to detect patterns, predict equipment failures, and recommend preventive maintenance. Rather than sending a team to inspect a pipeline every few months, drones can continually monitor key parameters and alert engineers only when intervention is required. This approach not only reduces costs but can also prevent catastrophic failures that could result in environmental damage or energy supply disruptions.

At Livewire Digital, we've been working on solutions to ensure that drones stay connected and operational even in the most remote environments. Whether flying BVLOS or transmitting data in real-time from remote offshore platforms, ensuring continuous, reliable connectivity is critical. Drones are only as good as their ability to remain connected to their control systems and data processing centres, and this is where hybrid networks are proving to be a game-changer.

What's the problem?

As the market develops, so the world around it needs to adapt quickly, with more energy infrastructure required to maintain safe operations in the face of growing volumes of energy plants, and with that, complexity and risk.

As governments and regulators work to enable the widespread use of UAS, a key focus is on aircraft visibility and identification, with robust communication and safety, especially for BVLOS operations, remaining essential. Policymakers are balancing privacy, security, and environmental concerns with the benefits UAS offer. A decade ago, the FAA began offering exemptions for drone use in sectors like insurance and agriculture. Today, countries like China, India, and the UK are developing regulatory frameworks essential for managing this growing but potentially high-risk industry.

Two main safety concerns persist: aerial collisions and loss of control. Collisions can occur if drones can't avoid crewed aircraft, especially under 500 feet, where incidents are rising globally. Loss of control can result from system failures, signal loss, or interference. While technologies like Return to Home (RTH) and Detect and Avoid (DAA) mitigate risks, reliable connectivity remains critical. However, with only 20% of the globe covered by terrestrial networks, satellite connectivity, including LEO services, may be necessary.

What connectivity?

Commercial drones typically use 2.4 GHz or 5.8 GHz RF data links within the unlicensed ISM spectrum, which are reliable for short-range operations but inadequate for BVLOS and vulnerable to hijacking and jamming. UAVs using licensed cellular networks, such as LTE/4G, below 6 GHz, or faster 5G, are better suited for demanding tasks like streaming real-time HD video in autonomous missions. These systems, including multi-sim and e-sim options, rely on existing infrastructure, limiting their use in remote areas, which cover about 80% of the globe.

For example, Nokia and Swisscom recently launched a nationwide drones-as-a-service (DaaS) network in Switzerland, enabling public safety agencies to request drone flights for real-time data collection, utilities and infrastructure inspection as well as perimeter protection. While such solutions work well where cellular infrastructure exists, much of the world remains without such networks.

This is a clear example where satellite technology, with high uptime and reliability, can offer global always-on communication and control, even in highly networked countries.

Historically, satellite technology has been expensive to integrate and generally been deployed on large, high endurance, and military UAVs flying over large distances and at high altitude. Until quite recently, few commercial deployments have not been able to justify the capital, & operational costs, power budget, and equipment weight associated with satellite connectivity, especially when they may be operating at low elevations where the line of sight to the satellite may be compromised.

Despite recent advances in telecommunications technology, from 5G and disruptive low-cost LEO satellite services, no single network service can address the exponential demand for seamless connectivity on the move. Nor is there any provider that can offer a single comprehensive solution that can address coverage, bandwidth, reliability, and most importantly cost.

Welcome to a heterogeneously connected world

As we have seen, all network technologies have their advantages, so what if one could blend all of these together, with none of their downsides? The answer is a true hybrid, or more accurately, a heterogeneous connection to provide the most resilient solution to always-on, ubiquitous connectivity well beyond the horizon, independent of the coverage of terrestrial infrastructure and not solely reliant on satellite.

Designed to meet the challenges presented by speed and mobility as an asset moves through different areas of network coverage, smart networking enables a dynamic connection to various operators using a range of underlying communication technologies such as 3G, 4G, 5G, Wi-Fi, and satellite.

True hybrid is not a failover, or a redundancy technology, neither being the same thing anyway as both these technologies serve different purposes. At their core, true hybrid networks become 'heterogenous', turning a single connection, fixed line, cellular, satellite, point-to-point radio, whatever the underlay or infrastructure, into one bonded seamless connection. The benefits of which, for the user, are off the grid.

A heterogeneous connection also enables intelligent management of physical, virtual, and financial resources to suit an almost limitless range of conditions.

Central to hybrid is SD-WAN, a technology that uses software-defined networking concepts to distribute network traffic across a Wide Area Network (WAN). This architecture creates a virtual overlay that bonds underlying private or public WAN connections, such as Wi-Fi, 3G, 4G/LTE, 5G, LEO, GEO & MEO satellites. As a result, hybrid SD-WAN networking can agnostically combine and transition between these networks.

In this way, multiple network technologies can work seamlessly together, actively sharing the load and resources, by combining, and binding together a potentially unlimited variety of bearers into a single 'pipe'.

Delivering a faster and, crucially, more reliable service, a hybrid platform adapts to a range of variables associated with each bearer's performance and other environmental conditions affecting it, to optimise performance and manage costs. Being able to integrate existing with future connectivity services is also a powerful proposition enabled by the inherent agnostic characteristics of software-defined network technology.

Always connected UAVs

The concept of a UAV, fitted for example with a world-first solution like RazorLink, which Inmarsat has embedded within its newly launched maritime-focused NexusWave, agnostically making use of any carrier network, based on location, cost, or quality of service, has too long been a guarded secret. But it shouldn't be. In UAS and many other sectors, the market opportunities are seemingly unlimited for the adoption of true hybrid.

Many other industries spanning defence, space exploration, connected and autonomous vehicles, emergency services, telehealth, cloud-based HPC, as well as AI and machine learning, require more than just connectivity; they demand an 'intelligent connection'.

The golden ticket for the energy sector?

There are plenty of use cases where drones will play a crucial role in the future, including swarms of drones or other distributed systems. However, their capabilities will only be fully realised with the robust connectivity that true hybrid alone can guarantee. So, are drones the golden ticket the energy sector needs? They can be cheaper, safer, and faster, so I would argue they are, but crucially, only when we fully embrace 'heterogeneous' connectivity.

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