Skyports Offshore Renewable Deliveries Commercial Viability Report

Contents

Acronyms

Tag	Description
ATPL(H)	Airline Transport Pilot License for Helicopters
BEIS	Business, Energy, and Industrial Strategy
BVLOS	Beyond Visual Line of Sight
CAA	Civil Aviation Authority (UK)
CAGR	Compound Annual Growth Rate
COTS	Commercial Off the Shelf
CTV	Crew Transfer Vessels
DFT	Department for Transport
EASA	European Union Aviation Safety Agency
EC	Electronic Conspicuity
FAA	Federal Aviation Administration (USA)
GCS	Ground Control Station
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
LTO	Landing Take-off Cycle
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OLTER	Offshore Low Touch Energy Robotics and Autonomous Systems workstream
OPEX	Operating Expenditure
OSC	Operating Safety Case
RP	Remote Pilot
RPAS	Remotely Piloted Air System
SORD	Skyports Offshore Renewable Deliveries
UA	Un-Crewed Aircraft
UAS	Unmanned Aerial System
UTM	Uncrewed Traffic Management
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VMC	Visual Meteorological Conditions
VTOL	Vertical Take Off & Landing

Introduction

The use of Uncrewed Aircraft Systems (UAS), or drones, has become increasingly prevalent in numerous major industries, including the offshore energy space. This report seeks to provide an in-depth analysis of the commercial viability and business case for operating highly automated remotely piloted aircraft systems in the offshore energy space.

The SORD Project

This report was written during the Skyports Offshore Renewables Delivery (SORD) project, a 6-month program which was part of the Net Zero Technology Centre's (NZTC) Offshore Low Touch Energy Robotics and Autonomous Systems (OLTER) workstream. The project was designed to demonstrate how state-of-the-art Beyond-Visual-Line-Of-Sight (BVLOS) uncrewed aircraft can operate effectively in real-world offshore environments to address a number of highly relevant, industry-developed, use cases.

This project culminated in an offshore test campaign in early February 2023. These flight trials included flagship technology demonstrations operating over a one-week period, under a range of conditions and environments demonstrating how offshore use cases could be realised with the new technologies Skyports Drone Services and its partners have developed.

This report aims to explain the commercial viability of a complete offshore logistical solution similar to that demonstrated during the SORD project. A technology report has been written for the SORD project and will also be made available to industry through the Net Zero Technology Centre (NZTC).

The Market for Drones

There is collective agreement across industry and within the analyst community that drone technology has great potential to re-imagine everyday operations and deliver transformative change to a wide range of industry sectors, benefitting the wider economy, delivering differentiated services, and creating high-skill, high-tech jobs for the future. In July 2022, PwC[1], in conjunction with the Department for Business, Energy and Industrial Strategy (BEIS) and the Department for Transport (DfT), published an update to its 'Skies without limits' report, making an up-to-date assessment of the opportunities afforded by drone technologies and projecting the wider economic and other benefits that will be realised as adoption rates increase. The report reaffirmed the commercial opportunities afforded by drone technologies, with key conclusions summarised in the diagram below, which shows projected impacts by 2030.

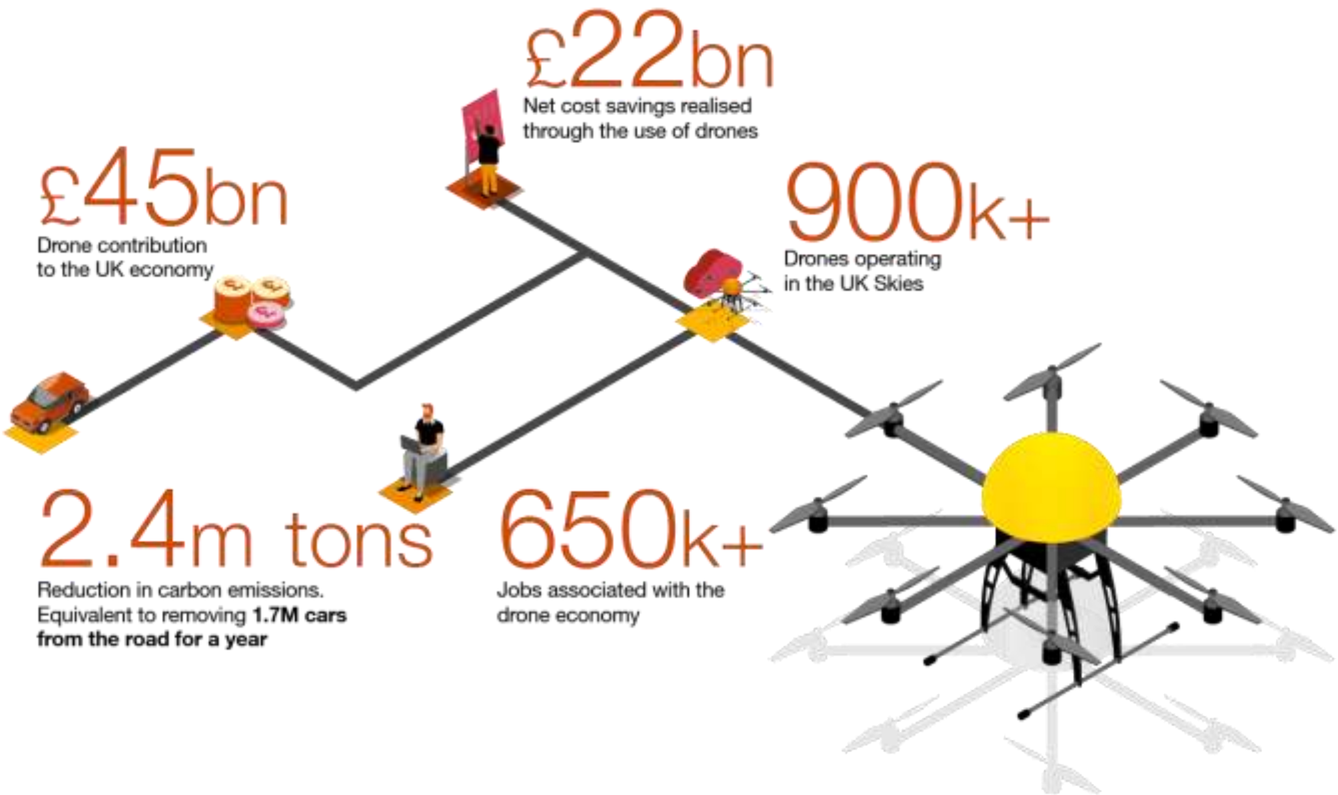

Figure 1: The projected economic impacts of drone technology by 2030.

In general, PwC predicted even better outcomes than had been suggested in earlier versions of the report, reflecting the increased traction in terms of drone deployment, and concluded that *'drones offer public and private organisations an opportunity to carry out tasks faster, safer, cheaper and with less impact on the environment than traditional methods.'* PwC continue to believe commercial UAS operations will centre around low ground and air risk use-cases for initial commercial exploitation.

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[1] *PwC Skies Without Limits v2.0, July 2022*

The Offshore Market

While the figures in the section above clearly show the large potential for the drone services market as a whole, the offshore market for drone services is not insignificant, in fact, many reports suggest the offshore market is already an early adopter of drones. The Single European Sky ATM Research (SESAR) Offshore Drones Outlook Study[2] forecasted that 10,000 drones will be operational in the EU by 2035, of which 15% would be used in offshore facilities. To further back up this study, Fact.MR produced the Offshore Drone Inspection Market[3] report which anticipated the global offshore drone market to be worth $422M (£337M) by the end of 2023 with the EU compromising about 15.6% of that value. By 2033, this market is expected to grow to nearly $1.5 billion.

Further recognising the development of drones in the offshore market, the PwC report noted above considered the impact of drone services on a sector-by-sector basis. The report recognised that large companies operating offshore assets, such as Equinor, SSE, Orsted and others, have already been creating proof-of-concept operations for drone technologies. As part of their report, PwC predicted that productivity gains in the order of £2 billion will be realised in the gas and electricity sector, with this productivity improvement to deliver a GDP contribution of around £1Bn. In the following sections, we explore how both offshore renewables assets, as well as oil and gas assets, could each benefit from drone services.

Offshore Renewables

The financial benefits noted above by implementing a comprehensive offshore drone services market have the potential to be greater in the offshore renewables space given the projected growth of the industry in the UK and EU. Research by the Offshore Renewable Energy Catapult[4] shows between 2000-2021 the offshore wind industry grew in the UK at a Compound Annual Growth Rate (CAGR) of 27%. This is expected to continue, with the UK working on a pipeline of over 60GW across the next decade, as shown in below in Figure 2.

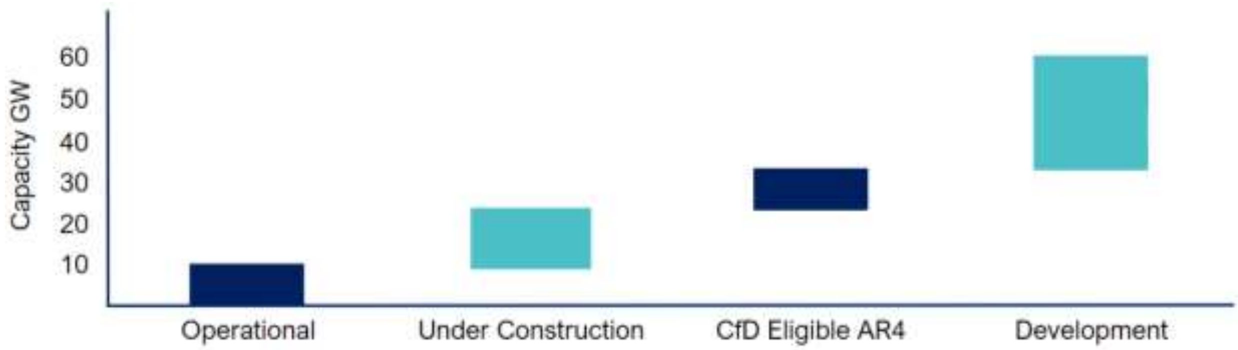

Figure 2: Growth projects for the Offshore wind industry

[2] *SESAR, European Drones Outlook Study, November 2016*
[3] *Fact.MR, Offshore Drone Inspection Market, December 2022*
[4] *Catapult Offshore Renewable Energy, Offshore Wind Market and Cost Reduction Update, April 2022*

In the near term the global offshore market value is expected to double from 2020 to 2030 due to the need to meet 2030 renewable targets, as shown in Figure 3[4]. This spike in projected growth creates areas of opportunity to reduce operational expenditure by deploying offshore drone services.

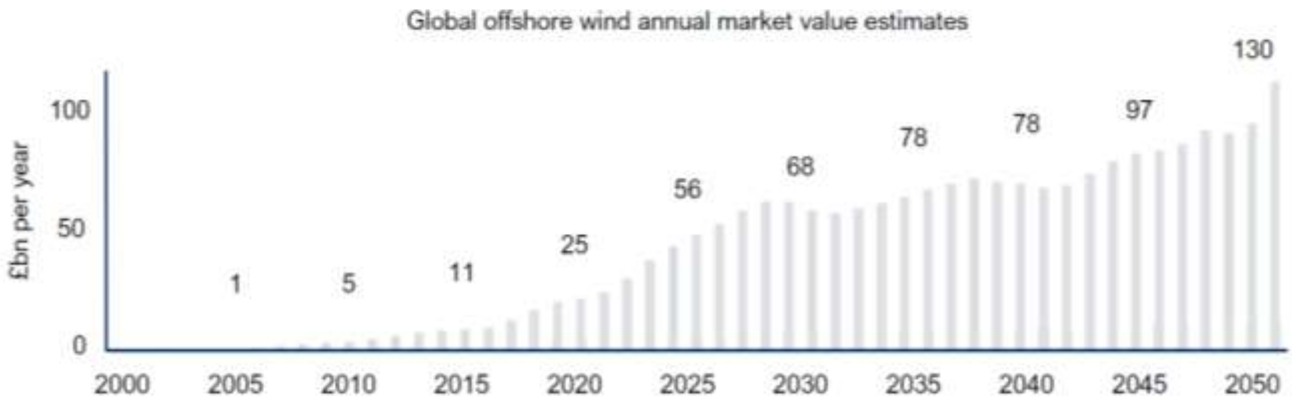

Figure 3: The global offshore wind annual market estimates

Renewables Operations and Maintenance

As part of the ORE Catapult analysis, the typical cost breakdown of offshore renewable assets was analysed which revealed Asset Operations and Maintenance (Asset O&M) contributes significantly to the annual expenditure costs as seen in Figure 4[4]. As new assets are built further offshore O&M can be enabled by autonomous UAS technologies working in conjunction with helicopters.

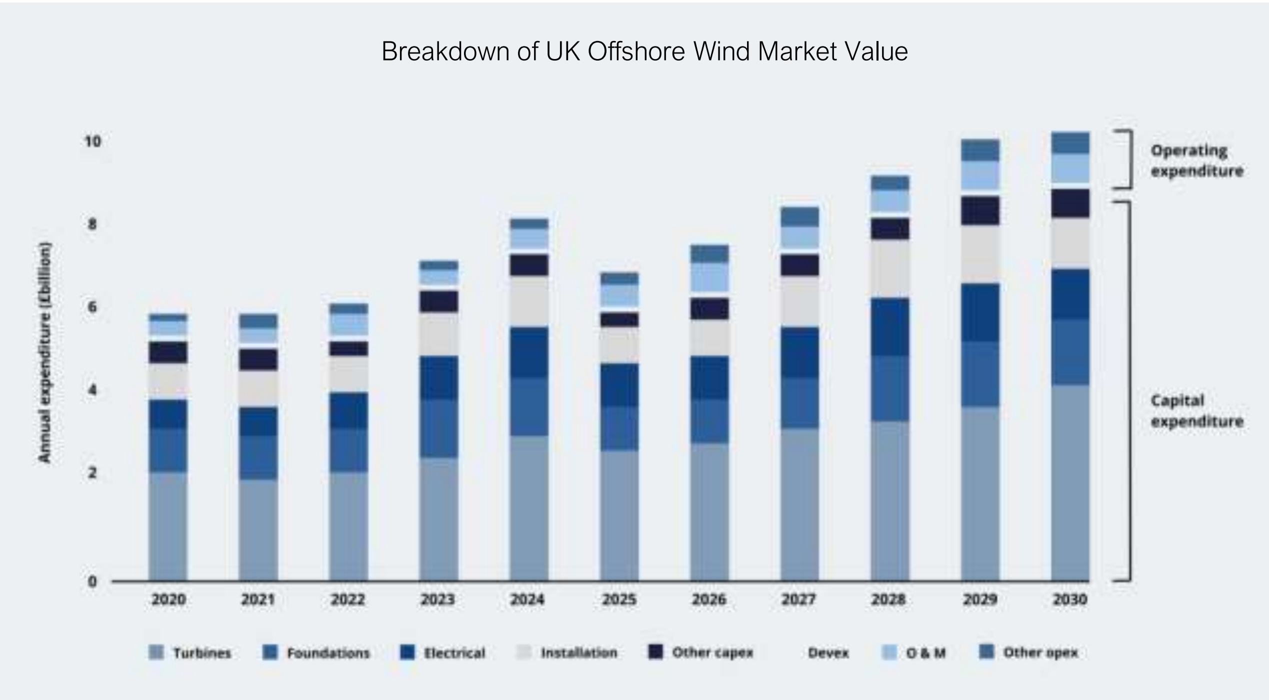

Figure 4: The breakdown of offshore operating and capital costs [4]

Across the O&M value chain new technologies are constantly being developed which could improve the commercial position and balance of expenditure. In 2019, Wood Mackenzie[5] assessed maturity of the different aspects of Asset O&M in the renewable offshore space and concluded the most mature value chain is Asset Management & Remote Support with the least mature being Supply Chain & Marine Coordination, as depicted in Figure 5. Through the SORD project, Skyports have been able to demonstrate that drone technologies have matured to the extent that further work should be undertaken to accelerate commercial deployment of every day offshore drone delivery services by addressing the key technological, regulatory, and operational barriers that remain. The SORD work further underscored the fact that real benefits to offshore industries could be achieved through deployment and adoption of everyday drone delivery services. Drone services can deliver enhanced supply chain management, for a range of use cases that include optimised delivery of parts, enhanced inventory management, automated logistics management and emergency medical equipment response.

O&M value chain	Asset management & remote support		Supply chain and marine coordination		Turbine maintenance & repair		BoP maintenance & repair	
New technologies	• Big data and AI • CMS and remote component monitoring • Digital twin		• Remote vessels • Supply chain management		• Drone inspection • Robot blade crawlers • Self-hoist cranes		• Drone inspection • Submersible ROVs	
Usage	• Turbine failure prediction • AI based plant management • Increased production/revenues		• Optimised spare parts inventory levels • Automated logistics management		• Minor blade repairs • Blade and tower visual inspections • Capital component repairs		• Cable and foundation visual inspections	
Total yearly market potential (2019e)	€125M		€500M		Inspections: €25M Minor repairs: €76M		Cable inspections: €5M Foundation inspections: €37M	
Technological and commercial readiness	Technological ◕	Commercial ●	Technological ◔	Commercial ○	Technological ◕	Commercial ◕	Technological ◑	Commercial ◑

◔ Less ready ● More ready

Figure 5: Asset operations and maintenance value chain maturity [5]

[5] *Wood Mackenzie Power & Renewables, Offshore Wind Operations and Maintenance Trends, May 2019*

Oil and Gas

In terms of UK offshore oil and gas, it is projected that existing, and newly developed oil and gas fields will continue to operate into the 2050's, with 10's of billions of barrels of recoverable oil and gas reserves believed to remain. In the near term, UK oil and gas production is expected to increase, in part to address the rising costs of imported energy, but also to strengthen the UK's resilience in the face of other geo-political shocks. UK waters hold significant reserves and analysts anticipate the North Sea region will become a hotspot for new drilling operations and for future development of new oil and gas fields, with new fields recently approved for use by the UK Government, who also supported the fast-tracking of the necessary licenses. The UK Government has also expressed its desire for operators to maximise the potential economic value of remaining oil and gas reserves, therefore, the UK market remains highly competitive when compared to other regions which have mostly been consolidating their markets. As a result, Mordor Intelligence[6] projected a CAGR of 7.5% for the period 2023-2028 for the UK oil and gas industry, as summarised in Figure 6.

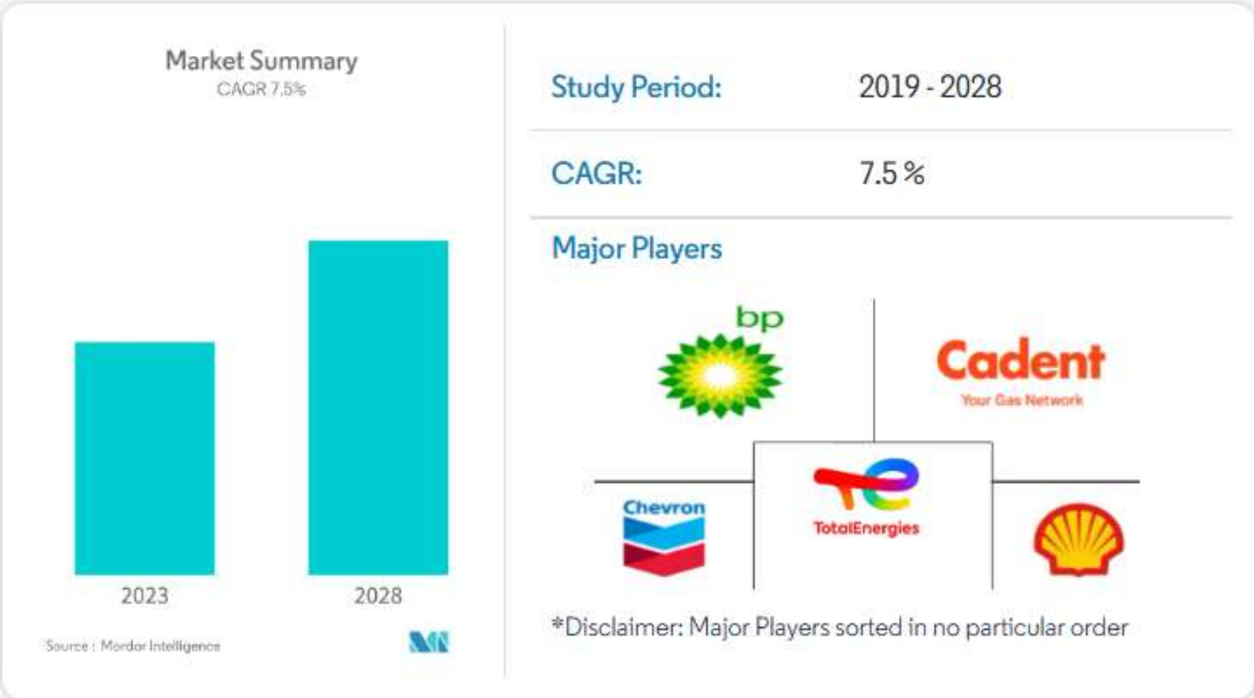

Figure 6: UK oil & gas industry overview [6]

[6] *Mordor Intelligence, United Kingdom Oil and Gas Market - Growth, Trends, Covid-19 Impact, And Forecasts (2023 - 2028), 2022*

Carbon Reduction

In addition to the focus on cost reduction, the UK Government and offshore industries are committed to delivering significant carbon reductions. In March 2021, the UK Government and the UK offshore oil and gas industry agreed a first-of-its-kind deal – the North Sea Transition Deal[7] – to accelerate the green energy transition and create a new generation of green jobs in communities across the country. As part of the deal, there was a commitment to deliver 15 million tonnes of carbon reductions from industry production by 2030 – the equivalent of annual emissions from 90% of the UK's homes.

To support this goal, organisations such as the Net Zero Technology Centre are working collaboratively with a number of global partners to transform the sector, undertaking technology screening, field trials and commercialisation activities, acting as an accelerator for start-up businesses to enable the industry to meet its decarbonisation goals.

[7] *North Sea Transition Authority, The North Sea Transition Deal, March 2021*

Unit economics

Drones are a game-changer for offshore industries as they can operate in extremely poor weather conditions, outside of Visual Meteorological Conditions (VMC) and in dangerous or high-sea sea states. They are able to fly when helicopters cannot, reducing the need for standby rescue crews, and eliminating risks to human life. Unlike traditional delivery methods, such as crewed helicopters, drones can operate at a much lower cost, showing as much as a ten-fold reduction in operation and commissioning costs. Drones also offer much greater agility and flexibility in performing tasks, further reducing operational expenditure.

Moreover, the use RPAS reduces the carbon footprint of offshore operations since the majority of RPAS are 100% electric. The reduction in the need for helicopters and other fuel-powered machinery further contributes to environmental sustainability, making drones a smart investment for offshore industries.

This chapter will explore in-depth, the unit economics of using drones in offshore industries, highlighting their advantages as well as their areas of improvement. We will also discuss the emissions savings, logistical service response times and how drones can provide use cases that were previously unfeasible.

Cost

Offshore drone services can create significant cost savings when compared to conventional transport and logistical methods widely used in today's offshore market. Through high-level analysis comparing offshore Helicopters and Crew Transfer Vessels (CTVs), today's generation of drone delivery services are 90% cheaper per hour than helicopters and more than 50% cheaper than CTV's. The main contributors to this difference are the labour costs behind CTV and helicopter pilots, coupled with the fuel costs associated with operating these vehicles.

A common offshore transport helicopter operating offshore is the medium lift twin-engine Sikorsky S-92. The S-92 requires two trained pilots who have an Airline Transport Pilot (ATPL(H)) licence which costs upwards of £100,000 and a minimum of 1500 Pilot in Command (PiC) hours.

These qualifications and experience requirements are high because, unlike drone operations, people are physically onboard the aircraft during operation. The level of training to reflect that level of risk is substantially more costly and complex than that of a drone pilot. A drone pilot qualified to operate a system like that shown in the image above requires 4 weeks of dedicated training and costs less than £10,000.

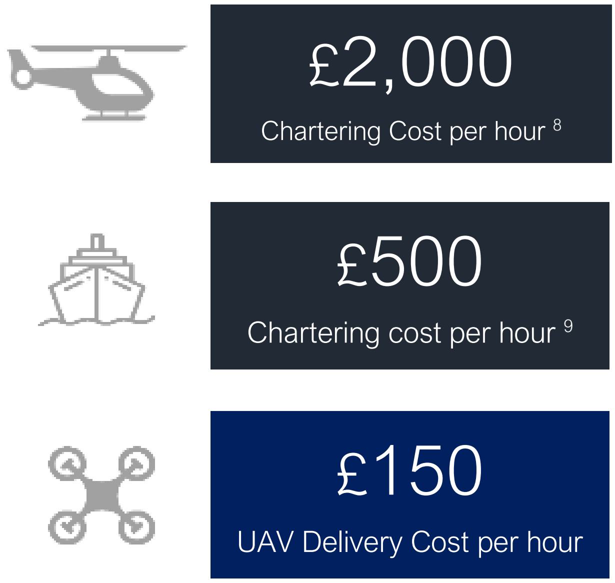

Figure 7: Average cost for operations by offshore vehicle type

[8] *Aircraft Cost Calculator, S-76 Chartering Cost Per Hour*

[9] *Reuters Event, Offshore wind operators, Cutting Vessel Trips, March 2019*

Similarly, the strict standard of maintenance required, coupled with the high fuel burn of helicopters lead to a much greater operational expense that is difficult to reduce even with advanced improvements in the engineering and manufacturing of helicopters. The smallest and most affordable offshore helicopter used in the North Sea is the Airbus AS350B2 which represents 20% of the offshore UK fleet. Even with only 1 engine, as opposed to the twin engine S-92, it costs an average of £1000 per hour of operation [10].

Through widespread adoption of drone services in the offshore logistics industry the costs of drone operations will further decrease as the economies of scale are introduced and the technological readiness level of manufacturers increases too. Skyports Drone Services has already realised these economic benefits through technological advances with its hybrid electric VTOL fleet as shown in Figure 8. In just two years Skyports has doubled its payload from its first-generation to second-generation aircraft while maintaining very similar operating costs per hour and pilot training requirements. At the time of writing, Skyports are onboarding a heavy payload aircraft, the Pyka Pelican Cargo, which has a payload capacity of 200kg. Through the potential markets and growth discussed in previous sections, the progress of technological advancements will bring even more cost-benefits over conventional commercial transport.

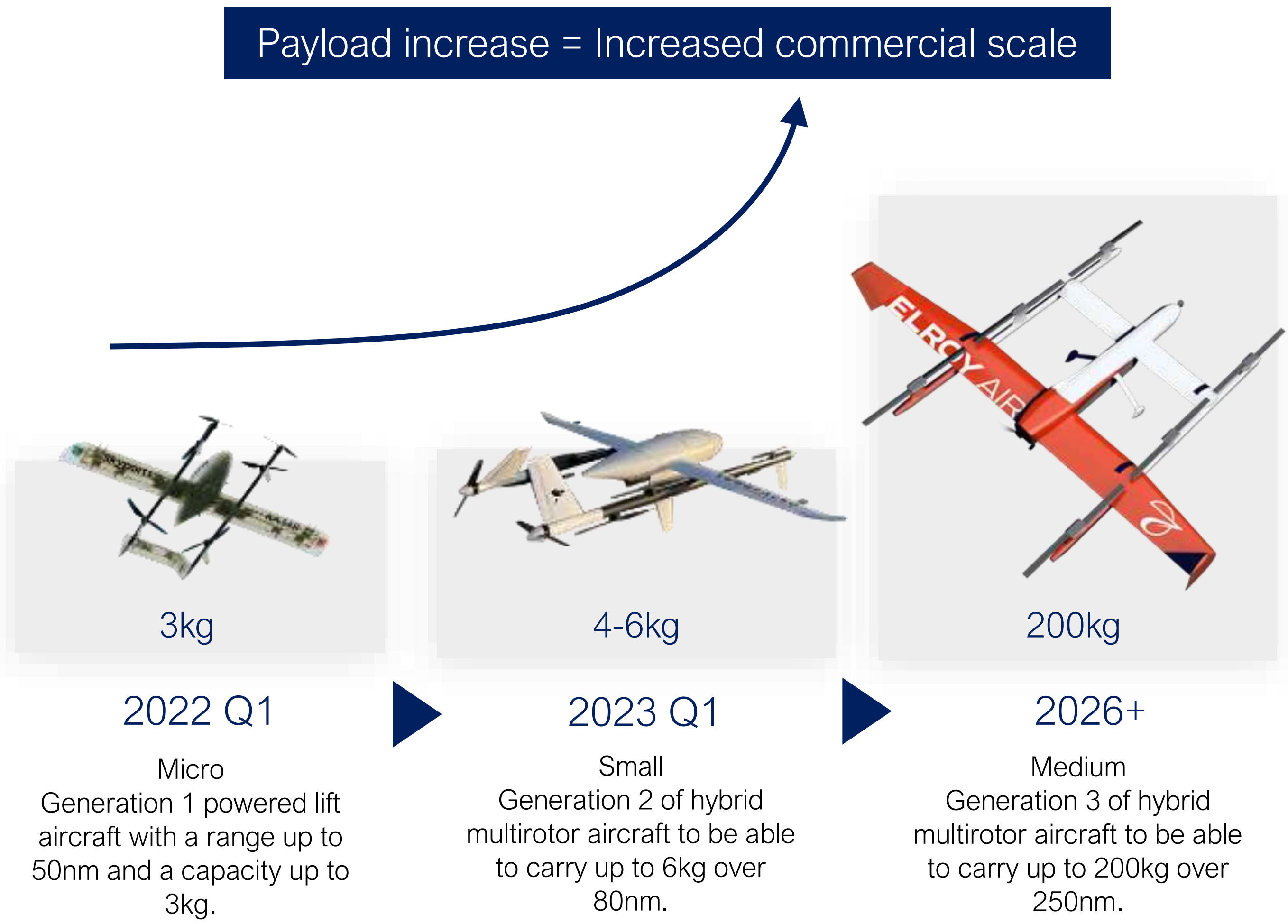

Figure 8: Skyports Drone Services hybrid electric VTOL fleet

[10] *Aircraft Cost Calculator, AS350B2 Price and Operating Costs*

Advances in multi-drone to single pilot operations compound this growth even further with the hourly cost reducing as fewer humans are involved with the operation. As detect and avoid and Uncrewed Traffic Management (UTM) systems improve, the level of autonomy that can be achieved in uncrewed aircraft will accelerate. This will allow the pilot to move away from acting in the loop, to on the loop, and eventually into a symbiotic process involving a machine and human.

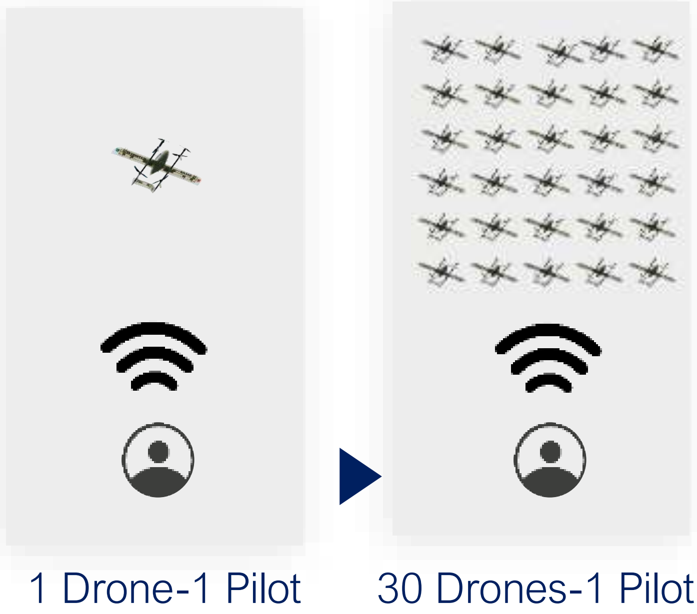

Figure 9: Advances in one-to-many drone operations

Emissions

Approximately 230 helicopters are employed for offshore operations across 11 European countries[11], with the majority of these used for platforms in the North Sea. The UK and Norway possess 70% of the European offshore helicopter fleet and 95% of the regions S-92s, EC225s and AS332s. There are 228 helideck-fitted platforms and up to 100 mobile helidecks located in UK coastal waters, as per a 2013 report by UK Oil & Gas trade association. To support these assets, there were 141,000 helicopter trips made in just one year[12].

A model created by the Federal Office of Civil Aviation, Switzerland[13] aimed to fill significant gaps of knowledge concerning the determination of helicopter emissions and to further improve the quality of their inventory. This model was based on engine measurements as well as confidential engine manufacturing data to produce a confident estimate of the Landing Take-Off Cycle (LTO) and one-hour emissions for individual helicopter types.

The results that are pertinent to this report are the S-92, EC225 and AS332 emissions as they dominate the European Offshore fleet. The models' emissions are shown in Figure 10.

Helicopter Type	LTO CO_2 per Hour	Cruise CO_2 per Hour
AS332	87 kg	478 kg
EC225	242 kg	1546 kg
S-92	310 kg	2315 kg

Figure 10: Emissions by helicopter type

[11] Helicopter Investor, Market Analysis: UK Offshore Helicopter Fleet, March 2023

[12] UK Oil and Gas Economic Report March 2013

[13] Federal Office of Civil Aviation Switzerland, Guidance on the Determination of Helicopter Emissions, December 2015.

With these emission estimates considered, and by averaging the utilisation of each helicopter type, in Europe alone the offshore helicopter industry contributes to 1.5 million metric tonnes of CO_2 each year. The uncrewed aircraft that could be used for a significant share of these operations are electrically powered therefore producing little to no CO_2 or any other emissions while in use. As a rough estimate, it can be assumed that a current generation sub 25 kg UAS produces about 0.2 kg of CO2 per flight hour (kWh) based on the aircraft being fully powered by fossil fuel generated electricity. These emissions are removed entirely when the aircraft is powered by fully renewable means. With renewable energy set to continue to grow continuously as the UK, and other countries, progress towards net-zero, offshore drones can provide enormous emission benefits to contribute to a greener operation.

Speed of Operations

At the time of writing helicopters still hold the advantage over Commercial off the Shelf (COTS) drones that are ready to be deployed offshore when investigating cruise speed and time to complete a longer distance mission. However, most offshore helicopter operations fall into the sub-1.5-hour mission duration category since a significant amount of time is spent in the LTO and approach phases of flight. In this mission category, drones match or exceed conventional helicopter delivery times with modern hybrid VTOLS cruising around 101 knots. The absolute quickest response time that is expected in the offshore sector comes from Search and Rescue (SAR) operations. Here aircraft are expected to respond to emergency situations within 15 minutes of receiving a distress call with their helicopters and crew on standby. While a drone is likely to be airborne quickly, it is likely they would respond in 30 minutes or more.

During the SORD flight trials, one trial objective was to demonstrate and collect data on the response time of the team and aircraft of an offshore drone delivery request to a location offshore. These tests were completed with the crew in a standby configuration, and it was found that the aircraft was in the air within an average of 6 minutes after receiving the request. Combined with the fact that the standby crew only consists of a single trained payload operator there is a strong case for offshore drones when considering response time.

Other Use Cases

Throughout the last section the use case that has been discussed has just been offshore deliveries – a shore to rig operation transporting parts and other critical items. There is an abundance of other use cases where offshore drones have a strong economic case behind. An example of this is Methane monitoring. A company called FlyLogix has flown BVLOS drones to monitor methane emissions from offshore platforms. During their BVLOS operations in the Irish sea, the onshore pilot was over 30 miles from the offshore asset they were monitoring. Given the ease and commercial nature of these operations, more drone operators are conducting routine BVLOS methane detection and facility monitoring flights over many North Sea oil platforms.

In a scenario such as this, uncrewed aviation has the potential to radically change the standard practises and procedures. Since BVLOS drone operations are more financial viable than helicopter operations, they can enable new ways of working that were previously not economically viable.

Eventually the Oil and Gas industry will see increased integration between drones and infrastructure. We expect to see that in time offshore assets will be designed partly around the use of uncrewed systems, where “drone in a box” solutions fly autonomously and are triggered by sensors on the asset and managed by Artificial Intelligence.

Industry Feedback

Industry Stakeholders

As part of the SORD project, the Net Zero Technology Centre, in collaboration with Skyports Drone Services, gathered data from various energy companies and organisations. The aim of this survey was to collect feedback from key potential and current stakeholders on what they believe the minimum viable products would be for an offshore logistical drone service, as well as what use cases they have for drone deliveries today and in the future. The companies surveyed are displayed.

equinor

TotalEnergies

bp

Chevron

sse

Civil Aviation Authority

CATAPULT Offshore Renewable Energy

Ørsted

The results from the survey found that the logistical service that required the highest frequency of deliveries per day was transporting 6 kg offshore multiple times a day. With today's generation of offshore drones such as the VTOL platform that Skyports operate, it is possible to service this requirement with a high level of uptime. With all but a few offshore assets within the 150 nautical mile range of the Skyports aircraft, this operational requirement required by offshore stakeholders can be performed by current technology.

The results also highlighted that regular, urgent and lightweight deliveries are in high demand, with medium payload deliveries not utilised regularly. This implies one of two things may occur with critical low payload requests. Either, there are helicopters being loaded with a very minimal load factor, or, critical items are delayed until enough load is required to justify the cost of sending a helicopter offshore. Both scenarios would cost offshore operations unnecessary money where a continual, highly automated drone logistical service could step in.

Today's current regulatory and technological environment in the uncrewed aircraft space severely limits the heavier payload logistical service. As the smaller and medium payload services are more widely adopted, the framework to approve and regulate larger scale operations will become more and more robust. Along with this, the reliability and assurance standards of the technology will similarly progress, coming from increased experience and flight hours. Drone manufacturers are aware of this and are staging their development of heavier high-autonomy vehicles as the environment becomes more mature. In the near term the offshore helicopter service will only be augmented by the drone service and not completely replaced. This will diminish the need for frequent helicopter trips, resulting in a daily heavy payload service.

Payload	Frequency	Response Time
150 kg	Daily	30 minutes
25 kg	Twice Daily	30 minutes
20 kg	As needed	Half Day
10 kg	Daily	Half Day
6 kg	Multiple Per Day	45 minutes

Table 1: Feedback from Offshore Survey

The second question directed at the stakeholders of this survey was what use cases they had for offshore drones today. The most frequent results are shown alongside this text. Many of these items can be carried easily within the volumetric limitations of today's UAVs.

A popular suggested use case was operations during low visibility and similarly when there is a high sea state. This is where offshore drones can provide a service that is unrivalled with current drone technologies. When visibility is too low, in fog or low-level cloud, helicopters cannot reach the rig even if they are flying Instrument Flight Rules (IFR) within Instrument Meteorological Conditions (IMC). To land at an offshore asset, the approach requires a minimum visual range to allow the aircraft to land under Visual Flight Rules (VFR) as complex automated landing systems still are not present on offshore assets. If conditions do not permit a descent into VFR to allow an approach, the helicopter cannot reach the rig, therefore restricting any deliveries to the asset via the air. UAS currently have the ability to land in minimum visibility conditions and so can continue offshore deliveries through harsh weather. The economic impact of this is huge, as when offshore assets aren't operational due to part delivery delays, a company is billed by the minute. In the case of Skyports' operations it takes 6 minutes to get airborne, even in IMC conditions.

During high sea states, a gap in the current service offering is also highlighted. If the sea is too rough, limitations in the ditching or landing at sea performance of the helicopter and life rafts onboard start to take effect. Sea state 6 is recognised as seas with waves of 4-6 meters and CAP 1145 (CAA publication reviewing offshore transport helicopter operations) limits all offshore helicopter operations (unless for rescue) to sea state 6.

- Low Visibility Operations
- Urgent Small parts
- Non ATEX rated Items
- Food and Supplies
- Cash
- Fast Samples
- Tool Deliveries
- Emissions Monitoring
- Intra Field Deliveries
- Temporary Sensor Deployment

The EASA Airworthiness Directives' proposed limitations based on factory emergency flotation systems, advises that the EC225, AS332 and S-92 are certified to sea state 6. Despite this, CAP1145 goes on to explain that there is a considerably higher risk attempting to land in sea state levels beyond 4, as life rafts become increasingly harder to deploy. Additionally, advisory material (FAA AC 29-2C) in the certification requirements notes, that for a safe landing at sea, "ditching" in a sea state of 4 must be assumed - further reinforcing the fact that ditching in states greater than 4 cannot guarantee a safe landing. In parts of the North Sea, sea state 4 is annually exceeded 34% of the time, and in winter 65% of the time (CAP1145)[14]. During these periods of operation, a safe landing may not be possible and therefore for winter operations in large areas of the North Sea safe landings are not possible for a significant amount of time. Therefore, an offshore drone service not only saves cost, but minimises helicopter exposure to challenging sea states.

Table 2 summarises the impact of restricting operations to certificated helicopter ditching performance found in CAP1145.

Operating Area	Helicopter Ditching Performance (Sea State)			
	3	4	5	6
	% Operations Lost			
Average all areas	61.8	27.7	8.55	1.4
Northern North Sea / West of Shetlands (avg. routes A & B*)	66.4	33.8	12.2	2.4
Mid North Sea (avg. routes C & D*)	55.0	19.8	4.3	0.4
Southern North Sea (avg. routes E & F*)	64.0	29.7	9.2	1.4

Table 2: % Operations that would be lost by restricting flights to certain Sea States, from CAP1145

[14] *Civil Aviation Authority – Safety review of offshore public transport helicopter operations in support of the exploitation of Oil and Gas*

Future Improvements to Services

While it is clear that there is a promising business case surrounding offshore logistics, there are of course challenges and improvements in the pipeline to overcome to ensure all of the benefits outlined in the sections above are fully realised in the coming years. The main features are as follows:

- Regulatory environment
- Increased autonomy
- Aircraft capabilities in challenging weather conditions

Regulatory Environment

The current regulatory environment for drone operations in the UK currently makes drone operations a slow process, with limitations on operating times and the length of time drone operations can be carried out, with permissions only lasting 3 months in a “Temporary Danger Area” (TDA). Similar rules to this TDA structure are in place across countries in the EU.

Skyports, as well as other partners across the U.K. and Europe, are working on implementing Transponder Mandatory Zones (TMZ). By implementing these, drones can be integrated into airspace with other aircraft communities, including helicopter operators or other general aviation airspace users as they will be conspicuous and more easily identified. TMZs will enable improved “detect and avoid” capabilities and also move towards having UTM systems provide traffic services to drone operators. This in turn enables safer drone operations in unsegregated airspace, outside of the TDAs within which drone operations currently take place. The timeline for TMZ implementation is for testing to happen within 2024, commercial operations in low-risk airspace 2025 onwards, with higher traffic operations being enabled as the framework to assess this type of airspace improves.

Increased Autonomy

As outlined in the Technical Report for the SORD project, increased levels of autonomy in the drone industry will bring benefits to the commercial viability of the solution offered by Skyports. Currently, the CAA quantifies the level autonomy of a system summarised in Table 3.

UAS Automation Levels in Flight Operations							
Level	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Components of Trusted autonomy
Functions	No automation	Assisted Automation	Partial Automation	Supervised Automation	High Automation	Full Automation	
Human – Machine Teaming	Human Led	Human-In-the-loop	Human in-the loop	Human-In/On-the-loop	Human-On-the-loop	Human-off the loop	Human – Machine Symbiosis
Sustained Manoeuvre Control	Human	Human and Machine	Machine (Managed by Human)	Machine (Supervised by Human)	Machine	Machine	Machine
Object and Event Detection and Response (OEDR)	Human	Human	Machine (Managed by Human)	Machine (Supervised by Human)	Machine	Machine	Machine
Fallback (Integrity threshold exceeded)	Human	Human	Human	Human	Fall back ready Human	Machine (limited or Segregated Operations)	Optimised Human AND/OR Machine
Communication with External Systems (Ground and Airspace systems)	Human	Human	Human OR machine (Managed by Human)	Machine (Supervised but Human)	Machine	Machine	Machine

Table 3: Automation levels in flight operations

The system utilised by Skyports during this project is at Level 3, with the pilot only acting to control the aircraft in emergency or safety critical moments. Else the aircraft performs the flight as per conditions set out in the flight plan, uploaded and simulated prior to take-off. This means the pilot in command is on-the-loop, rather than in-the-loop, as the pilot only monitors the aircraft.

To improve the commercial viability of the service provided by Skyports, increased autonomy to Level 4, would allow for the cost of drone delivery to fall. This is because it would reduce the need for human to be involved in the end-to-end process – for example, operations for one pilot to many drones could be implemented, or the need for a hub operator at a take-off / landing locations could be removed.

Aircraft capabilities in challenging weather conditions

Given the location of offshore assets, they are inherently challenging conditions to operate aircraft in. Therefore, the drones operated in these areas should be designed to withstand high wind speeds, and in a wide range of temperatures, specifically in icing conditions. While the Swoop Kookaburra used on this project is able to handle up to 30 knots of wind, as well as light rain, offshore winds often exceed this value. Therefore, as time progresses, newer more resilient aircraft should be brought onboard to meet the needs of offshore clients. Skyports has commenced this task and is currently onboarding the next generation aircraft from Swoop, the Kite. Table 4 compares the capabilities of these aircraft.

Item	Kookaburra	Kite
Aircraft Category	Medium Range Medium payload powered lift	Long Range, Medium Payload EVTOL
Powertrain	4x Electric Lift Motors 2x Electric Forward Motors	8x Electric Lift Motors 2x Electric Forward Motors
MTOW	17kg	24.9kg
Cruise Speed	55kts / 105kmh	66kts / 122kmh
Max speed	68kts /126kmh	107kts / 200kmh
Operating Temperatures	0°C to 45°C	-5°C to 50°C
Altitude Limit	5,500Ft Density Altitude	10,000ft density altitude
Max Payload	3Kg	4kg
Max Range	100km	225km
Operating Conditions	Non-icing, Heavy Rain	Icing conditions, heavy rain
Max Wind Limitation	27Kts	35kts
Availability	Available Immediately	Available Q3 2023

Table 4: A comparison between the Kookaburra and the Kite

It is clear from these specifications that the increased payload, range and wind speed tolerance of the Swoop Kite is a significant improvement and would allow this new aircraft to provide a reliable drone delivery service to offshore customers in the UK. This service reliability will only improve as technology advances and brings forward improved aircraft types.