SAILDRONE

CARBON IMPACT REPORT 2022

EXECUTIVE SUMMARY

In 2022, Saildrone avoided 99.9% of comparable ocean data collection emissions and 143% of its own total Scope 1 – 3 carbon emissions

Oceans cover 72% of the planet's surface and play an important role in regulating climate, sustaining life, and fostering interconnected ecosystems—yet we know more about the topography of Mars than we do about Earth's oceans. Saildrone uncrewed surface vehicles (USVs) provide innovative autonomous ability to gather the large volumes of ocean data needed to address a daunting array of challenges, from seafloor mapping and maritime security to storm intensification, carbon cycling, and sustainable fisheries management.

Saildrone technology supports the company's vision of "a healthy ocean and a safe, sustainable planet." Powered almost entirely by renewable wind and solar energy, Saildrone USVs deliver critical data from the most remote corners of the ocean. Our solutions are a force multiplier, enabling crewed vessels—the traditional source of maritime data collection—to prioritize other missions, while helping to preserve the ecological integrity of our planet.

This report serves as Saildrone's inaugural Carbon Impact Report, a vital step in our commitment to environmental stewardship. Saildrone's approach to assessing our carbon impact required two separate initiatives: first, we analyzed the emissions resulting from our business activities; and second, we analyzed the emissions avoided through the use of our zero- and low-carbon solutions as compared to traditional alternatives.

This report will help us focus our efforts on both "doing less harm" by mitigating our operational emissions and on "doing more good" by expanding technology adoption to avoid emissions generated by ocean data collection.

Two striking results emerged from our evaluation.

First, Saildrone USVs produced only 10 metric tonnes of carbon dioxide equivalent (tCO_2e) while collecting data during missions in 2022—compared to 8,299 tCO_2e that would have been produced by traditional vessels to complete the same missions. That means that Saildrone's fleet, which in 2022 consisted almost wholly of zero-carbon Explorer class USVs, avoided 99.9% of operational emissions for maritime data gathering (Figure 1).

Second, when comparing the 8,299 tCO_2e that were avoided by using Saildrone USVs to the total emissions of Saildrone's operations in 2022 (5,806 tCO_2e across Scopes 1, 2, and 3), we found that we avoided 143% of the total emissions we produced. In other words, even after accounting for all of the emissions resulting from our business and value chain activities, we avoided over 1.4 tCO_2e for every 1 tCO_2e our operations produced (Figure 2).

FIGURE 1

COMPARISON OF OCEAN DATA COLLECTION EMISSIONS BETWEEN SAILDRONE USVS AND TRADITIONAL VESSELS

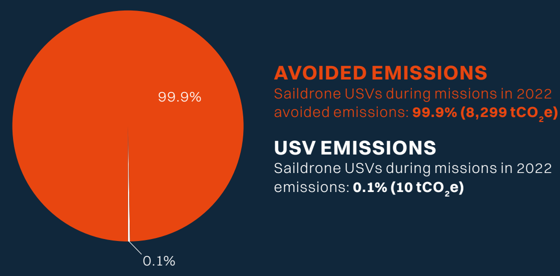
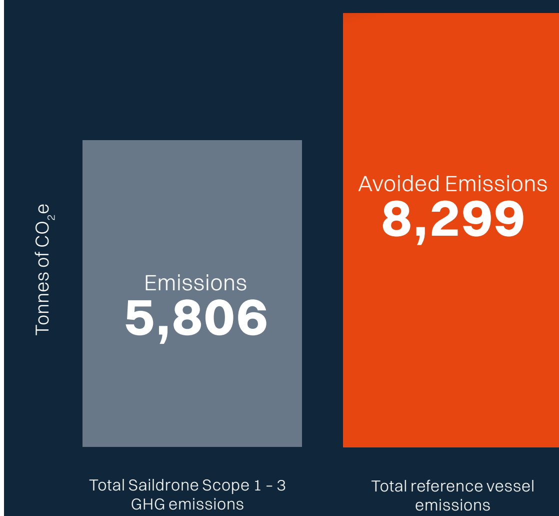


FIGURE 2

COMPARISON OF SAILDRONE TOTAL SCOPE 1 – 3 EMISSIONS AND REFERENCE VESSEL EMISSIONS



"Reducing the carbon footprint of maritime data collection has been part of our core mission from the beginning.

As we grow our fleet in support of our science, commercial, and defense customers, so too do **we grow the amount of carbon we offset.**
It is an honor to be a part of the long-term carbon solution."

RICHARD JENKINS
SAILDRONE FOUNDER & CEO

CARBON ACCOUNTING CONTEXT

Saildrone is committed to addressing the effects of a changing climate by measuring, monitoring, and managing its carbon impact. Employing a dual approach, Saildrone measures its carbon impact by accounting for both the emissions generated by its business and the emissions that are avoided through the use of its innovative zero- and low-carbon solutions. The quantification of emissions across both measurements is expressed in terms of CO_2e, the universal unit of measure for translating the varying global warming potentials (GWP) of different greenhouse gases (GHGs) into the GWP of carbon dioxide.

In measuring the emissions generated by its business, Saildrone has followed the Greenhouse Gas Protocol[1], a corporate accounting and reporting standard widely considered to be the best practice in such quantification efforts. This framework separates a company's emissions into three areas:

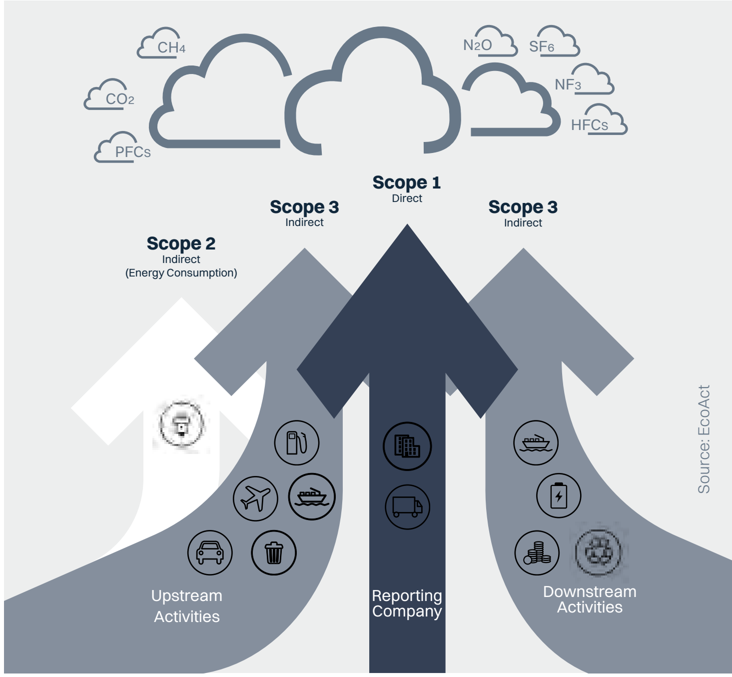
1) Scope 1: Direct Operational Emissions
Direct emissions from owned or operated assets

2) Scope 2: Indirect Operational Emissions
Indirect emissions from the generation of purchased electricity, steam, heat, or cooling

3) Scope 3: Indirect Value Chain Emissions
Indirect emissions emitted by other entities (upstream and downstream) as a result of the company's activities.

Within the GHG Protocol framework, Scope 1 and 2 emissions reflect a company's operational emissions within its direct control—for example, the electricity consumed in Saildrone buildings and the limited diesel usage of its larger USVs. In contrast, Scope 3 emissions are typically outside a company's direct control, accounting for the emissions of a company's entire value chain. This includes upstream sources of emissions, such as the emissions from producing materials purchased by Saildrone to manufacture its USVs [2].

In measuring the emissions that its solutions avoid, Saildrone has used the guidance established in 2023 by the World Business Council on Sustainable Development (WBCSD) for quantifying avoided emissions[3]. Although Saildrone USVs were designed to operate in conjunction with customers' crewed vessels and augment (rather than replace) customers' existing fleets, the WBCSD's framework in this case requires calculating avoided emissions as if the USVs were replacing traditional alternative technology. This entails comparing the GHG impact of Saildrone USVs during customer missions to the GHG impact of the most likely alternative technology that would have been used had Saildrone's solutions not been available. Given the versatile applications of Saildrone USVs, multiple use cases were developed to define the most likely alternative scenarios for the various customer missions completed in 2022.



1 https://ghgprotocol.org/

2 Downstream sources of emissions, such as use phase emissions or end-of-life treatment of sold products, are not applicable to Saildrone, as it does not sell its USVs.

3 Saildrone recognizes the importance of the WBCSD guidance and acknowledges that its current avoided emissions calculations are not fully aligned with this framework. For example, the WBCSD's guidance requires the full lifecycle emissions of a solution to be evaluated. However, Saildrone's current avoided emissions calculations only consider the operational emissions resulting from specific missions—as it would be impractical to calculate the lifecycle emissions of its solutions vs. those of existing alternative solutions (e.g., emissions associated with manufacturing USVs vs. manufacturing of every type of reference vessel).

SAILDRONE'S GHG EMISSIONS

Saildrone partnered with **EcoAct**, an international sustainability consultancy and project developer with nearly 20 years of experience in corporate GHG accounting and comprehensive decarbonization strategies, to calculate its Scope 1 – 3 GHG inventory for calendar year 2022. Our inventory followed the operational control approach within the Greenhouse Gas Protocol, resulting in a total Scope 1 – 3 footprint of 5,806 tCO_2e. As Figure 3 shows, Scope 3 emissions account for over 90% of total emissions for the year.

Saildrone designs, manufacturers, and assembles many USV components at its Alameda, CA headquarters.

Scope 1 and 2 emissions for 2022 totaled 392 tCO_2e, including the operation of real estate assets (310 tCO_2e) and supporting vehicles, such as forklifts, telehandlers, support boats, and medium- and large-class USVs (82 tCO_2e). The primary source of Scope 1 and 2 emissions is facility electricity consumption, representing 5% of total Scope 1 – 3 emissions. The minor amount of emissions resulting from USV-related diesel consumption is explained by the fact that only one Surveyor-class USV was operational in 2022; with the exception of this vehicle's missions, Saildrone's remaining 2022 customer missions were completed with Explorer-class USVs, which are entirely renewably powered and thus produce zero emissions when operating. Further details on our Scope 1 and 2 emissions can be found in Table 2 in the appendix.

Scope 3 emissions for 2022 totaled 5,414 tCO_2e, more than 10x Saildrone's combined Scope 1 and 2 emissions. These emissions were generated by the operations of non-Saildrone entities, such as the suppliers who manufacture the materials used to build Saildrone USVs and the third-party logistics providers who transport Saildrone vehicles to and from deployment and recovery sites. Saildrone offers its USVs to customers using a "mission-as-a-service" model rather than selling the vehicles to customers. As a result, only upstream Scope 3 categories (specifically, the first 7 categories in Table 3 in the appendix) are relevant to the analysis—since the emissions from

FIGURE 3

SAILDRONE'S TOTAL GHG EMISSIONS BY SCOPE (TONNES OF CO2E, IN 2022)

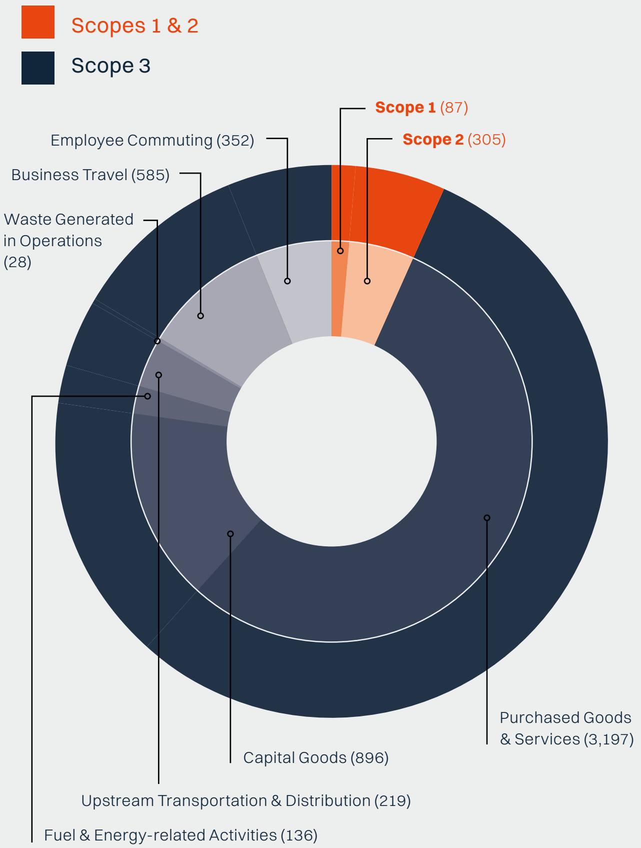
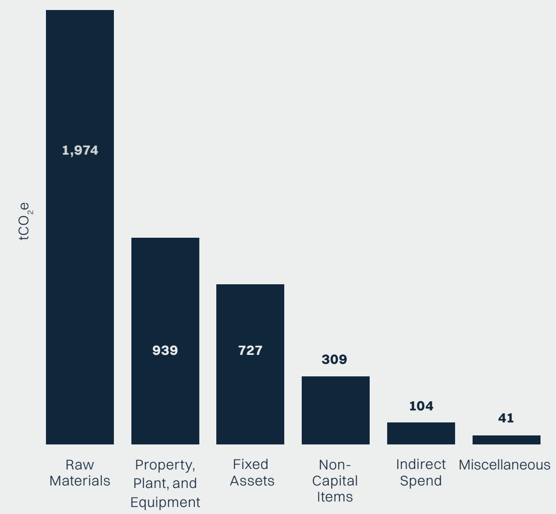


FIGURE 4

SAILDRONE SCOPE 3 CATEGORIES 1 & 2 EMISSIONS BREAKDOWN BY SPEND CATEGORY



SAILDRONE SCOPE 3 CATEGORIES 1 & 2 EMISSIONS BREAKDOWN BY MATERIAL TYPE

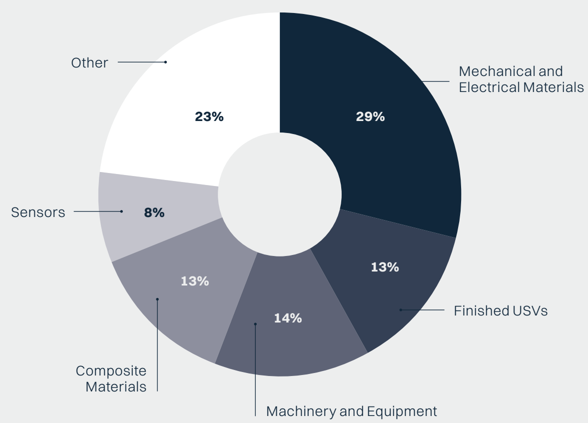
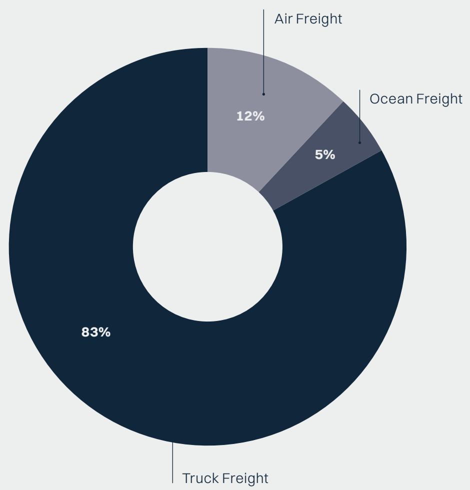


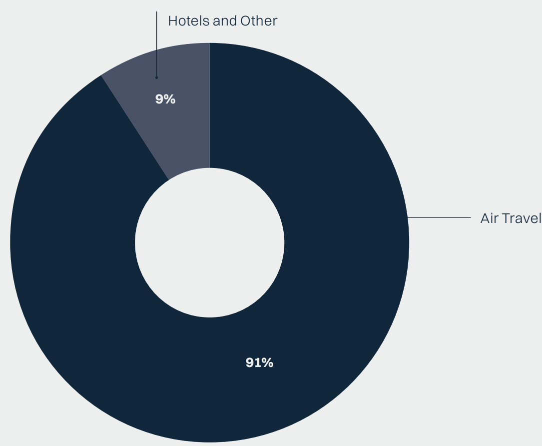
FIGURE 5

SAILDRONE SCOPE 3 CATEGORIES 4 (LEFT) & 6 (RIGHT) EMISSIONS BROKEN DOWN BY EMISSIONS SOURCE

UPSTREAM TRANSPORTATION & DISTRIBUTION EMISSIONS



BUSINESS TRAVEL EMISSIONS



deploying, operating, and servicing Saildrone vehicles are captured in these categories. Please refer to Table 3 for further details on the results of Saildrone's screening to determine the relevancy of each Scope 3 emissions category, the calculation methodology and emission factor sources used for each category, and the resulting 2022 emissions.

Saildrone's Scope 3 emissions are primarily concentrated in two areas of the business: how the company *manufactures* its USVs and how the company *moves* and *deploys* them after they enter Saildrone's active fleet. Scope 3 emissions related to USV manufacturing fall under Category 1 (Purchased Goods and Services) and Category 2 (Capital Goods). These two categories collectively account for 70% of total Scope 1 – 3 emissions. Figure 4 shows the breakdown of these emissions by spending category (left) and material type (right). Since Saildrone is a fast-growing company and made a large investment in expanding the fleet in 2022, it is no surprise that raw materials and fixed assets used to manufacture the vehicles emerge as the dominant sources of emissions. This includes key elements such as mechanical and electrical materials, large USV components such as hulls, machinery and equipment, composite materials, and sensors.

Scope 3 emissions associated with the transportation and deployment of Saildrone USVs fall under Category 4 (Upstream Transportation and Logistics) and Category 6 (Business Travel). Category 4 captures emissions linked to transporting Saildrone USVs and other equipment to and from mission deployment and recovery sites, while Category 6 encompasses emissions tied to the movement of Saildrone employees to and from these same deployment and recovery sites. Combined, these categories constitute 14% of total Scope 1 – 3 emissions. Figure 5 shows the breakdown of the emissions sources for Category 4 (left) and Category 6 (right).

SAILDRONE'S AVOIDED EMISSIONS

Saildrone partnered with **Rightship**, the world's leading Environmental, Social, and Governance (ESG)-focused digital maritime platform, to calculate its avoided emissions. The first step in this process was to separate our various customer missions into similar "use cases" against which we could make comparisons. For each use case, the WBCSD guidance requires us to define the most likely alternative technology scenario that would have occurred in the absence of Saildrone's USV solutions (referred to as a "reference scenario" in the WBCSD guidance). Reference scenarios can sometimes be straight-forward (e.g., an ocean mapping USV being compared to a traditional ocean mapping vessel), but sometimes they require more analysis—especially when Saildrone USVs are not operating in place of a traditional vessel. For instance, when a Saildrone USV is used in place of a data collection buoy, it avoids emissions associated with the fossil fuel consumption from vessels otherwise required to service the buoy. Another example is when a Saildrone USV performs a mission that traditional vessels could not undertake due to considerations of crew safety (e.g., studying storm intensification by sailing into hurricanes).

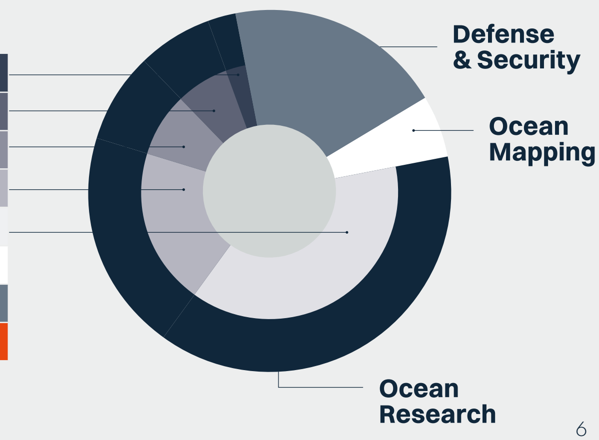
As these examples illustrate, the diversity and novelty of Saildrone's solutions make it difficult, if not impossible, to consider like-to-like comparisons and take a full lifecycle view in quantifying the avoided emissions. Therefore, this report compares Saildrone USV solutions to their respective reference scenarios beginning with transit from the start and end points of the mission, including all mission activity in-between, but excludes a comparison of emissions activities outside of mission-related activities, such as manufacturing and transporting the USVs or alternative existing technology solution to and from mission start and end points. Through this approach, we are able to calculate the difference in reference vessel emissions and Saildrone USV emissions for each mission and quantify the aggregate net avoided emissions.

While each reference case is, by definition, different from other use cases, certain core parameters are consistent across all reference case calculations. In all cases, Saildrone adhered to the European Standard Methodology for Calculation and Declaration of Energy Consumption and GHG Emissions of Transport Services (EN 16258:2012) and calculated the avoided emissions on a well-to-prop basis for all reference cases. This accounting methodology captures the full life cycle emissions of fuel consumption, including upstream fuel extraction, refinement, transportation, and, ultimately, the final combustion of the fuel.

Reference use case methodologies are grouped into Saildrone's three solution areas: Ocean Research, Ocean Mapping, and Defense & Security. Table 1 below presents the total avoided emissions for each solution area and use case, resulting in a grand total of 8,289 tCO_2e avoided emissions for 2022. For additional information on the methodologies, use cases, and individual missions, refer to Tables 4 and 5 in the Appendix.

TABLE 1: SUMMARY OF SAILDRONE 2022 AVOIDED EMISSIONS BY SOLUTION AREA AND USE CASE

Solution Area	Use Case	Net Avoided Emissions (tCO_2e)
Ocean Research (Ocean Research Subtotal: 6,193)	Fisheries	222
	Storm Mitigation	535
	Buoy Mitigation	664
	Scientific Observations	1,646
	Float Deployment	3,126
Ocean Mapping	Multibeam Bathymetry	460
Defense & Security	Maritime Domain Awareness	1,636
	Total	8,289



OCEAN RESEARCH

Saildrone 2022 customer missions for Ocean Research resulted in an avoided emissions total of

6,193 tCO_2e

Saildrone collects real-time in situ meteorological and oceanographic data at, above, and below the sea surface. Ocean Research missions are typically performed with Saildrone Explorer USVs, powered entirely by renewable wind and solar energy, which allows them to remain deployed at sea continuously for up to a year. Saildrone USVs are not designed as a replacement for traditional data collection vessels but rather are intended to augment existing research assets by providing data on a broad temporal and spatial scale without impacting the environment they are monitoring. Collecting a similar set of metocean data to that of weather buoys, robotic floats, or research vessels, Saildrone USVs transit autonomously to and from the area of operation and do not require a mooring to remain stationed in one location.

Saildrone's 2022 customer missions for Ocean Research resulted in an avoided emissions total of 6,193 tCO_2e. In line with the WBCSD guidance, each customer mission was classified under a specific use case to accurately reflect the mission activities and calculate the resulting emissions that the traditional alternative solution would have generated had Saildrone USVs not been utilized. Ocean Research use cases are defined below.

FISHERIES

This reference case is used to calculate avoided emissions for missions that collect measurements for fisheries management, quota setting, and research. Fisheries missions require both a trawling component as well as acoustic measurements. The trawling component, by its nature, will always require a crewed vessel that would allow for physical specimen observation, classification, and measurement. Saildrone USVs would not impact this portion of fisheries surveys, and thus, the trawling component is not considered in this reference case. For Saildrone's carbon avoidance analysis, this reference case only considers emissions that would be avoided by using Saildrone USVs in place of traditional crewed vessels for the acoustic component of the fisheries mission. This research data is traditionally collected by a fossil-fuel-powered research vessel. We calculate avoided emissions assuming the reference vessel travels the same distance as Saildrone USVs.

Saildrone Explorer SD 1020, equipped with a special wing for the Southern Ocean, completes the first uncrewed circumnavigation of Antarctica to collect critical data about air-sea carbon exchange.

STORM MITIGATION

This reference case is used to calculate avoided emissions for missions that collect data during storm events, such as hurricanes. Traditional crewed vessels could not collect in situ data during these storm events due to safety considerations; therefore, this research data would typically be collected through a buoy observation array that requires regular servicing. For purposes of this calculation, Saildrone conservatively assumes that such a buoy network would already be in existence and therefore does not account for avoiding any of the emissions associated with the initial setup of the hypothetical buoy network. Instead, we only calculate the emissions that would be avoided by the annual servicing required for such buoy networks, which would be accomplished by a fossil-fuel-powered vessel. Considering buoy observation radius and Saildrone USV coverage distances, we estimate that each Saildrone USVs can cover the same area as three buoys. We calculate avoided emissions by combining the distance traveled to and from mission points, an assumed fixed distance traveled to service buoys during the mission, and additional time spent idling during repairs for such annual service trips.

BUOY MITIGATION

This reference case is used to calculate avoided emissions for missions that repeatedly collect ocean measurements in a specific maritime area over several years. Such research data is traditionally collected through the creation of a buoy observation array that requires regular servicing. For purposes of carbon avoidance calculation, Saildrone assumes that the buoy network is already in existence and does not account for avoiding the emissions associated with the initial setup of the buoy network. Instead, we only calculate the emissions avoided by the annual servicing required for such buoy networks, which would be accomplished by a fossil-fuel-powered vessel. We calculate avoided emissions by combining the reference vessel's distance traveled to and from the buoys and time spent idling during repairs for such annual service trips.

SCIENTIFIC OBSERVATIONS

This reference case is used to calculate avoided emissions for missions that collect scientific data for a specified period of time in areas of the ocean where a buoy network would not be likely to be created (i.e., in areas where repeated missions do not occur on a year-by-year basis). Such research data would traditionally be collected by a fossil-fuel-powered research vessel that would need to travel to the mission location and spend a fixed period of time collecting the data. We calculate avoided emissions assuming the reference vessel travels the same distance to and from the mission site as Saildrone USVs, then idle in a fixed position for the duration of the mission.

FLOAT DEPLOYMENT

This reference case is used to calculate avoided emissions for missions that collect scientific data over an extended distance in areas of the ocean where a buoy network would not be likely to be created (i.e., in areas where repeated missions do not occur on a year-by-year basis). Such research data would traditionally be collected by robotic floats deployed by a fossil-fuel-powered vessel that would need to travel to the mission start location and then travel along the mission route. We calculate avoided emissions assuming the reference vessel travels the same distance covered by Saildrone USVs.

CASE STUDY
ECMWF ATLANTIC GULF STREAM 2021-2022

Funded by a generous grant from the Google Foundation, Saildrone deployed a group of Explorer-class USVs into the Gulf Stream in order to improve long-range weather forecasting and global carbon models, in partnership with the European Centre for Medium-Range Weather Forecasts (ECMWF) and the University of Rhode Island (URI).

Deployed from Newport, RI, the Saildrone Explorers spent over 570 days on mission in a notoriously rough ocean region that is difficult and dangerous for in situ data collection—specially in winter when frigid, violent storms barrel across the North Atlantic. The mission delivered a data set on a spatial and temporal scale not previously possible with traditional crewed vessels.

The Float Deployment use case was used to calculate the carbon avoided by using Saildrone USVs in place of a traditional crewed research vessel. The first step was to compile a set of reference vessels that could have been used in place of Saildrone USVs, assuming risks to the vessel and crew were ignored. This set of five vessels comprised a wide range of sizes (370 – 1,597 metric tonnes deadweight), service speeds (10.5 – 15 knots), and engine powers (932 – 6,645 kW). These specifications were used to calculate the range of fuel consumption rates (7.8 – 41.1 kg/nm), yielding an average burn rate of 21.3 kg/nm for the reference vessels.

The distance traveled by Saildrone USVs was broken down into mission distance and transit distance. Since scientific measurements for this mission began immediately after deployment of the USVs, the mission distance was measured as the distance sailed from the deployment point to end point of data collection, totaling 26,285 nautical miles (nm). The transit distance sailed from the end point of data collection back to the recovery site was calculated at 591 nm (calculated as the average of the transit distance of the five USVs deployed).

Combining this information with the average fuel consumption rate of the reference vessels, the average reference vessel would have traveled a total distance of 26,876 nm, burning 571 tonnes of fuel and generating 1,947 tCO_2e. Since the Saildrone USVs used in this mission were Explorers with zero carbon emissions during operation, Saildrone's emissions to perform the mission were 0 tCO_2e, resulting in net avoided emissions of 1,947 tCO_2e.

A Saildrone Explorer is deployed from Newport, RI, in December 2021, bound for the Gulf Stream.

OCEAN MAPPING

Saildrone 2022 customer missions for Ocean Mapping resulted in an avoided emissions total of

460 tCO_2e

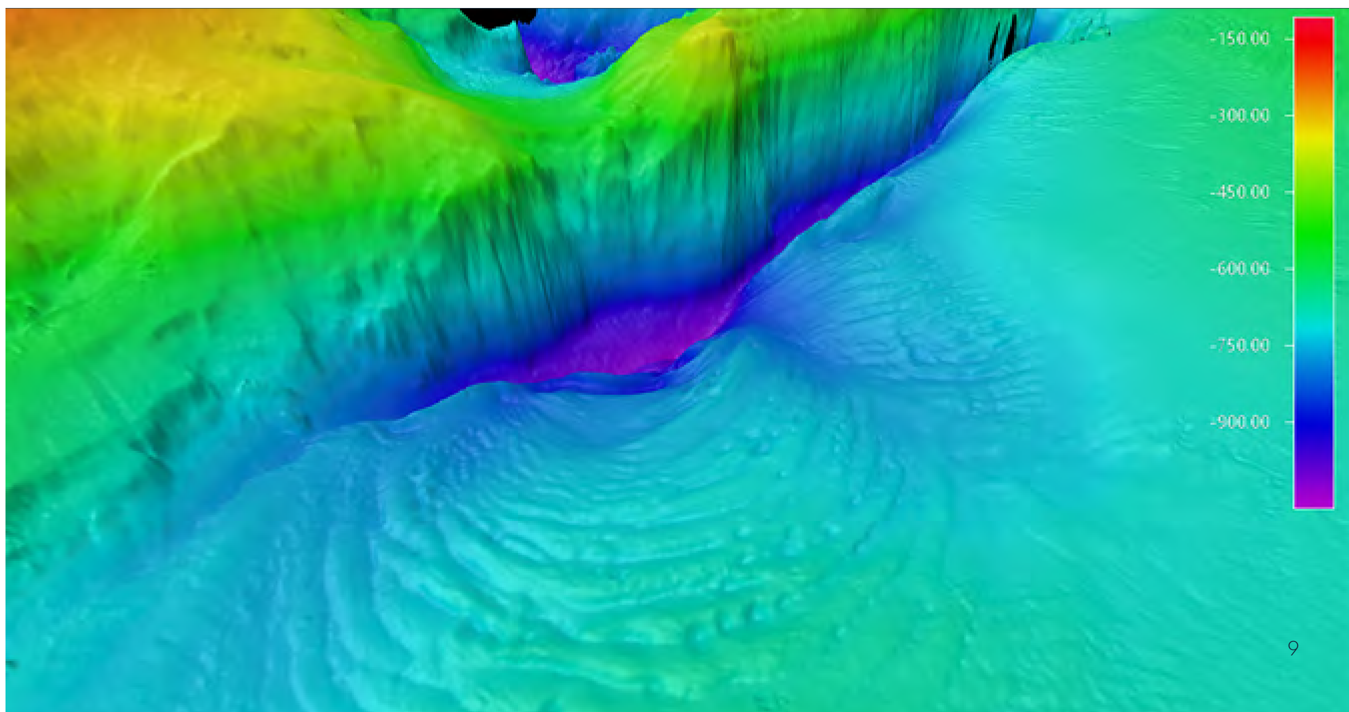
To date, only about 25% of the ocean has been mapped using modern technology. This lack of exploration is largely due to the high cost of access, which has traditionally been undertaken by large survey ships that are expensive to build and operate as well as limited in number. Saildrone USVs are equipped with industry-leading sonars for near-shore and open-ocean bathymetry, delivering high-quality data sets that meet the most stringent industry standards. Saildrone USVs provide an economical, low-carbon solution to rapidly increase global knowledge of the seafloor, and allow traditional vessels can focus on areas that require crewed exploration.

Saildrone's 2022 customer missions for Ocean Mapping resulted in an avoided emissions total of 460 tCO_2e. In line with the WBCSD guidance, each customer mission is classified under a specific use case to accurately reflect mission activities and calculate the resulting emissions that would have been generated by the traditional alternative solution had Saildrone USVs not been utilized. The Ocean Mapping use case is defined below.

DEEPWATER MULTIBEAM BATHYMETRY

This reference case is used to calculate avoided emissions for missions that focus on mapping the seafloor with a multibeam sonar array, in depths greater than 300 meters. This research data would traditionally be collected by a fossil-fuel-powered survey vessel that would need to travel to the mission location and map the same survey area that the Saildrone USV mapped over the course of the mission. While the area surveyed is assumed to be identical for Saildrone USVs and the traditional vessel, we calculate avoided emissions by taking into account that Saildrone USVs conduct surveys primarily under wind-powered propulsion, which requires tacking, whereas traditional survey vessels are motor-powered and can survey each transect in a straight line. Therefore, avoided emissions were calculated assuming the reference vessel conducts the survey using a more structured survey plan as compared with that used by Saildrone USVs.

Unprocessed raw multibeam data collected by Saildrone around Alaska's Aleutian Islands.



CASE STUDY
ALEUTIANS UNCREWED OCEAN EXPLORATION

This months-long survey was a multi-agency public-private partnership funded by the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM) to address ocean exploration gaps in remote areas using uncrewed surface vehicles (USVs). Utilizing its first Surveyor-class USV, Saildrone surveyed more than 4,500 square nautical miles of previously unknown ocean floor around Alaska's Aleutian Islands.

The Aleutian chain, by far the least explored region of the US Exclusive Economic Zone (EEZ), has been identified as one of the highest-priority survey areas because it holds potential opportunities for conservation, climate science, and the Blue Economy.

The Surveyor mapped 4,740 square nautical miles of seafloor around the Aleutian Islands in 52 days, collecting high-quality data despite, at times, 35-knot winds and wave swells over 5 meters—conditions that would have proven too dangerous for most crewed survey vessels. Preliminary data revealed unprecedented detail of the Aleutian arc seafloor, including previously unknown structures, some indicating potential hydrothermal vents. Discoveries like this improve our understanding of the physical processes of the ocean and help scientists identify unique habitats that need further exploration.

The Deepwater Multibeam Bathymetry use case was used to calculate the carbon avoided by using a Saildrone Surveyor USV for this mission in place of a traditional crewed research vessel. The first step was to compile a set of reference vessels that could have been used in place of the Saildrone Surveyor to collect this data and average them together to create the hypothetical survey vessel. This set of four vessels comprised a wide range of sizes (104 – 731 metric tonnes deadweight) and main engine powers (1,176 – 2,056 kW), though all had the same mission speed of 7.5 knots. These specifications were used to calculate the range of fuel consumption rates (10.9 – 26.9 kg/nm), yielding an average burn rate of 21.7 kg/nm for the reference vessels.

The distance traveled by the Surveyor was broken down into mission distance and transit distance. Mission distance was measured as the distance sailed by the Surveyor from the starting point of data collection to the end of the survey route, totaling 3,151 nm. Transit distance was measured as the distance sailed from the Surveyor's deployment location to mission start, and from the end of data collection back to the USV recovery site, totaling 4,815 nm. Given that the reference vessel travels under motor and can map entire transects in a straight line while the Surveyor may tack in order to optimize the prevailing wind conditions, the reference vessel's straight-line transit distance was calculated at 2,045 nm and its survey route was calculated to be 4,598 nm.

Combining this information with the average fuel consumption rate of the reference vessels, the average reference vessel would have traveled a total distance of 6,643 nm, burning 179 tonnes of fuel and generating 470 tCO_2e. While the Saildrone Surveyor is not fully renewably powered, it relies much less on fossil fuels, and in this mission yielded a transit fuel consumption rate of 0.35 kg/nm and a mission fuel consumption rate of 0.57 kg/nm. Taking into account the transit and mission distances traveled, the Surveyor burnt a total of 3.12 tonnes of fuel, generating 10 tCO_2e.

By using the Saildrone solution, the net avoided emissions for this mission amounted to 460 tCO_2e—or about 98% of the emissions that would have been produced by the reference vessel to collect comparable data.

Saildrone Surveyor departs Dutch Harbor for the Aleutians Uncrewed Ocean Exploration expedition.

DEFENSE & SECURITY

Saildrone 2022 Defense & Security customer missions resulted in total avoided emissions of

1,636 tCO_2e

Saildrone is revolutionizing how navies and law enforcement agencies (LEA) monitor and protect our oceans, enabling accurate, dynamic, and confident decision-making and response for the full spectrum of maritime threats and challenges. Saildrone USVs are not designed to be replacements for traditional vessels, but rather monitoring and alerting platforms that enable navies and LEAs to more efficiently use low-density/high-demand crewed assets and prioritize resources.

Saildrone's 2022 Defense & Security customer missions resulted in total avoided emissions of 1,636 tCO_2e. In line with the WBCSD guidance, each customer mission was classified under a specific use case to accurately reflect mission activities and calculate the resulting emissions that would have been generated by the traditional alternative solution had Saildrone USVs not been utilized. The Defense & Security use case for 2022 is defined below.

NEAR-SHORE MDA PATROL

This reference use case is used to calculate avoided emissions for missions that focus on conducting surveillance over a large coastal area. This surveillance would traditionally be conducted by a crewed, fossil-fuel-powered patrol vessel. Patrol vessels not only perform reconnaissance work but also intervene as needed if any contacts of interest are detected during patrols. The intervention component, by nature, requires a crewed vessel for physical response. Saildrone does not perform this critical portion of patrol ships and, therefore, operates as part of an integrated fleet of manned and unmanned vehicles. Based on realistic mission conditions, our methodology assumes a certain percentage of detections and interventions by a crewed patrol vessel. We calculate avoided emissions for the patrol work by using a coverage area comparison, assuming the reference vessels patrol the same total area patrolled using Saildrone's detection capabilities, then we deduct the crewed-vessel intervention emissions from the total emissions avoided by using our USVs for the surveillance and detection portion of the patrol function.

A Saildrone Explorer operates with fast response cutter USCGC *Robert Goldman* in the Arabian Gulf during a bilateral exercise between the United States and United Kingdom. US Navy photo by Chief Mass Communication Specialist Roland Franklin). The appearance of US Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

CASE STUDY
TASK FORCE 59

The US Naval Forces Central Command (NAVCENT) established Task Force 59 to test unmanned systems and artificial intelligence and understand how these new technologies could be rapidly integrated with maritime operations in the US Navy 5th Fleet area of operations, which encompasses nearly 2 million square nautical miles of water area and includes the Arabian Gulf, Gulf of Aqaba, Gulf of Oman, Red Sea, and parts of the Indian Ocean.

Saildrone was selected as one of several unmanned systems to be used by Task Force 59. A group of Saildrone Explorer USVs equipped with 360° cameras, combined with AIS and proprietary machine learning models, demonstrated Saildrone's ability to offer enhanced visual detection at sea. Saildrone USVs serve as a force multiplier, enabling rapid and effective response from high-value manned assets. Throughout 2022, Saildrone sailed more than 46,000 nm and logged some 28,000 operational hours patrolling the US Central Command (CENTCOM) area of operations, returning over 10,170 unique contacts and operating up to 220 consecutive days without refueling or maintenance.

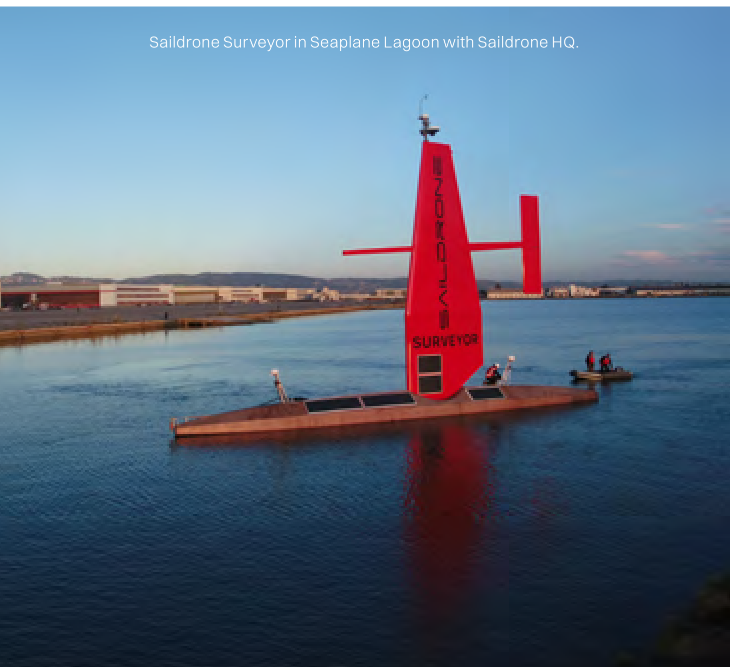
The Near-shore MDA Patrol use case was used to calculate the carbon avoided by using Saildrone Explorer USVs for the detection portion of this mission in place of traditional manned patrol vessels. The first step was to compile a set of reference patrol vessels that could have been used in place of the Explorers to conduct this surveillance and average them together to create a hypothetical patrol vessel. This set of three reference vessels comprised a wide range of sizes (359 – 4,600 metric tonnes deadweight), speeds, and engine fuel burn rates.

The avoided emissions for this reference case were calculated using an integrated approach that accounted for the detection range of the cameras installed on the Explorer USVs and the distance traveled during the patrol period to calculate the coverage area for the area patrolled by the USVs. This coverage area was then used to calculate the amount of time that would have been required for a crewed patrol vessel to patrol the same area. Combining this with the average fuel consumption rate of the reference patrol vessels yielded an emissions total of 1,676 tCO_2e. Since certain USV detections required crewed-vessel interventions, the emissions required for those interventions (calculated at 40 tCO_2e) were deducted from the total reference patrol avoided emissions to yield net reference avoided emissions of 1,636 tCO_2e. Since this mission used Explorer USVs, which are entirely renewably powered and thus generate zero emissions when operated, no USV emissions were deducted, resulting in net avoided emissions of 1,636 tCO_2e.

A Saildrone Explorer operating in the Arabian Gulf.
US Navy photo by Mass Communication Specialist 2nd Class Jeremy R. Boan. The appearance of US Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

SAILDRONE'S OVERALL CARBON IMPACT

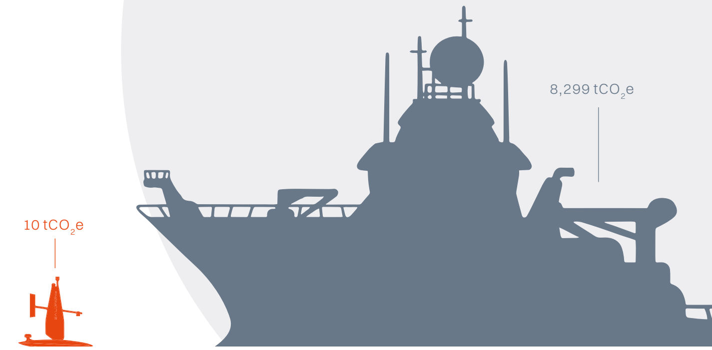
As shown in Table 5 of the Appendix, our USV fleet generated only 10 tCO_2e in conducting its missions in 2022, while the total emissions that would have been generated by the reference vessels amounted to 8,299 tCO_2e. Operationally, this means that Saildrone produced only 0.1% of the emissions that would have been produced by existing vessels—and that we therefore avoided 99.9% of the carbon that would have been produced by traditional maritime solutions to perform the same missions.



Saildrone Surveyor in Seaplane Lagoon with Saildrone HQ.

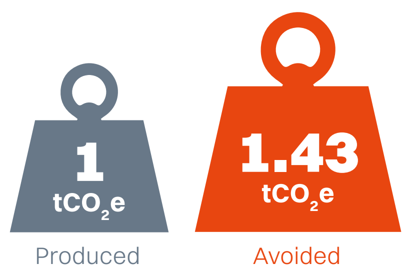
In expanding the analysis to compare our total Scope 1 – 3 emissions footprint vs. the total avoided emissions, we noted an overlap in these calculations, as the emissions related to USV fuel burn during missions are captured both in Saildrone's Scope 1 emissions and in its avoided emissions. Specifically, we include 10 tCO_2e as part of our Scope 1 "Mobile Diesel – Surveyor" emissions in Table 2 in the appendix; meanwhile we deduct this same 10 tCO_2e from our reference vessel emissions in Table 5 of the Appendix to calculate our net avoided emissions. Although this overlap in USV emissions has a very small impact on our 2022 results, we expect USV-generated emissions to grow in 2023 and beyond as our Voyager- and Surveyor-class fleet sizes increase.

To account for this overlap in emissions, Saildrone's overall carbon impact is calculated as the ratio between Saildrone's Scope 1 – 3 emissions (5,806 tCO_2e) and the gross reference vessel emissions (8,299 tCO_2e), yielding a 143% "emissions avoidance" ratio. In other words, for every tonne of CO_2e produced in our 2022 operations, we avoided 1.43 tonnes of CO_2e that would have been produced had Saildrone USVs not been utilized. We are proud of this 143% emissions avoidance ratio, as it demonstrates the role Saildrone's solutions play in progressing to a low carbon maritime future.



SAILDRONE'S FLEET, WHICH IN 2022 CONSISTED ALMOST WHOLLY OF OUR ZERO-CARBON EXPLORER CLASS USVs, **AVOIDED 99.9% OF OPERATIONAL EMISSIONS** FOR MARITIME DATA GATHERING.

FOR EVERY TONNE OF CO_2e PRODUCED IN OUR 2022 OPERATIONS, **WE AVOIDED 1.43 TONNES OF CO_2e** THAT WOULD HAVE BEEN PRODUCED HAD SAILDRONE USVS NOT BEEN UTILIZED.



THE ROAD AHEAD

As we look ahead, it is important to recognize the impact Saildrone's rapid growth trajectory will have on its carbon footprint. Our 2022 emissions reflect a fleet composition that consisted almost entirely of our Explorer-class USVs, which produce zero emissions when operating. For 2023, we expect our fleet composition to shift towards a greater mix of our Voyager-class USVs. As a result, it is expected that Saildrone's Scope 1 emissions from mobile combustion will increase as operations expand using these larger USV classes that burn small amounts of diesel fuel. Simultaneously, Scope 3 emissions are expected to increase as our USV fleet operations are scaled up and transportation operations increase to accommodate a greater number of missions using larger and heavier USV drones.

In parallel, Saildrone's avoided emissions are expected to grow as well—and given our 2022 carbon avoidance results, we believe the carbon avoided metric will grow at a faster rate than our carbon emissions. For 2023, we expect mission composition to shift towards a greater mix of Defense & Security operations. As our analysis shows, Defense & Security missions result in one of the largest avoided emissions totals. This sizable impact is logical, given that the reference vessels used by navies and LEAs to complete these missions in the absence of Saildrone USVs are larger and have a much greater fuel consumption rate than the reference research and survey vessels. Defense & Security missions also typically last longer and are more persistent in nature compared to Ocean Mapping and Ocean Research missions. As Saildrone continues to partner with navies and LEAs, we expect significant increases in avoided emissions in 2023 and beyond.

Saildrone is excited to release this inaugural Carbon Impact Report, and we are committed to continuing this journey by measuring and reporting annual impact metrics. While future year calculations will involve the development of additional reference cases and comparisons with our Voyager and Surveyor USV classes, the underlying nature of the work will remain the same: measure the emissions created by our business and the emissions avoided by using our fleet of USVs. We are proud to have avoided almost 100% of the emissions that would have been produced by reference vessels while conducting 2022 missions, and we aim to continue avoiding >95% of carbon emissions resulting from missions in future years. Equally as important, we recognize the significance of avoiding 143% of our total emissions footprint in 2022 and remain committed to actively managing our carbon impact so that we continue avoiding greater than 100% of our total Scope 1 – 3 footprint. By meeting both targets, we will continue to further our mission to sustainably explore, map, and monitor our oceans.

A fleet of Saildrone Explorer USVs sail off the coast of Honolulu.

GLOSSARY

Avoided Emissions: Avoided emissions are defined as the positive impact on society when comparing the GHG impact of a solution to an alternative reference scenario where a solution would not be used.

CO_2 equivalent (CO_2e): The universal unit of measurement to indicate the global warming potential (GWP) of each of the greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis.

Emission Factor: A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g., gallons of fuel consumed, amount spent on raw materials).

Explorer-class USV: Saildrone's 7 m (23 ft) USV. Powered exclusively by renewable wind and solar energy, the Saildrone Explorer offers a long-term solution for meteorological and oceanographic research with a zero operational carbon footprint. The Explorer carries a payload of sensors for metocean data collection, carbon monitoring, fisheries surveys, single-beam mapping, and more.

Global Warming Potential (GWP): A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of given GHG relative to one unit of CO_2.

Greenhouse Gases (GHG): GHGs are the seven gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF_6).

Greenhouse Gas Protocol (GHGP): The comprehensive global standard to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains, and mitigation actions.

Reference Vessel: Alternative traditional vessels that could have been used in place of Saildrone USVs to conduct its missions.

Reference Vessel Emissions: The emissions that would have been produced had Saildrone's missions been conducted with reference vessels instead of Saildrone's USVs.

Scope 1: The category of greenhouse gas emissions resulting from all owned or operated assets.

Scope 2: The category of greenhouse gas emissions resulting from the generation of electricity, heating/cooling, or steam purchased for consumption.

Scope 3: The category of greenhouse gas emissions derived from all activities within an entity's value chain not captured by Scope 1 and 2. This is split into a further 15 subcategories representing different sources of emissions within an entity's value chain.

Surveyor-class USV: Saildrone's 20 m (65 ft) USV. Powered by a combination of renewable wind, solar energy, and a high-efficiency diesel engine, the Saildrone Surveyor is equipped with industry-leading sonars for near-shore and open-ocean bathymetry, and produces data sets that conform to the most stringent industry standards. For MDA/ISR applications, the Saildrone Surveyor fuses radar, cameras, and advanced machine learning for IUU fishing, counter smuggling, and SOLAS mission applications. The Surveyor detects vessels near shore and in deep ocean, even those not transmitting their position, and can carry passive acoustic sensors to further discriminate threat contacts.

Uncrewed/Unmanned Surface Vehicle (USV): A vehicle that is capable of operating on water surfaces without a crew on board.

Voyager-class USV: Saildrone's 10 m (33 ft) USV. Powered by a combination of renewable wind, solar energy, and a small auxiliary motor, the Saildrone Voyager uses radar, cameras, and advanced machine learning to deliver comprehensive situational awareness remotely for MDA and ISR customers from anywhere in the world. For bathymetry applications, the Saildrone Voyager carries an impressive payload for near-shore and lakebed survey operations, including high-resolution MBES and Innomar SBP systems. The Voyager is the only survey USV that can deliver long-duration multibeam mapping surveys and ocean data collection at depths to 300 m.

Well to Tank (WTT): Boundary of fuel-based emissions accounting that only includes the upstream extraction, production, and transportation of fuels consumed.

Tank to Prop (TPP): Boundary of fuel-based emissions accounting that only includes the downstream combustion of fuels consumed.

Well to Prop (WTP): The full life cycle emissions of fuel consumption, including both the Well to Tank (WTT) and Tank to Prop (TPP) components.

APPENDIX

Table 2 presents detailed data inputs and results from Saildrone's Scope 1 and 2 emissions inventory. Facility emissions were calculated using direct electricity and diesel consumption measurements, except for two locations where this data was unavailable. For one of these locations, electricity consumption was estimated using a square footage allocation of the entire building's consumption, while the other location provided total utility spend, which was converted to electricity consumption using the average local electricity price. Mobile combustion emissions were calculated using direct diesel consumption for Saildrone's USVs. For the vehicles operated by Saildrone, fuel consumption was estimated using the average annual fuel prices from the US Energy Information Administration. All emissions were calculated using emission factors from US EPA's emission factor databases.

Table 3 presents detailed calculation methodologies and results from Saildrone's Scope 3 emissions inventory. Saildrone determined that Categories 1 – 7 were the only relevant sources of Scope 3 emissions due to the nature of Saildrone's business. Emissions were calculated using various sources of data such as spend, fuel and electricity consumption, and logistics activity data. Spend-based calculations used emission factors from the VitalMetrics CEDA 6.0 database. Activity-based calculations used emission factors from the US EPA's 2022 database and the Department for Environment, Food, and Rural Affairs (DEFRA) 2022 database.

Table 4 presents definitions and assumptions used to design the avoided emissions use cases. For each use case, Saildrone defined a calculation methodology based on the most likely scenario that would have occurred without its technology. This also necessitated defining the most likely vessels that would have completed the missions in lieu of Saildrone USVs. Saildrone evaluated a wide range of alternative vessels to ensure a robust approach to the avoided emissions calculations. With these unique vessel specifications, including deadweight and engine power, each reference vessel was simulated according to the use case parameters to calculate the fuel consumption rates. This process allowed a representative "average" reference vessel to be created. However, it is worth noting that these vessels could travel at different speeds due to circumstances such as weather and wind patterns, and thus, this simulation methodology and resulting fuel consumption rates remain a point of uncertainty.

Table 5 presents the detailed avoided emissions results for each mission completed in 2022, which are calculated by taking the average of the vehicle fuel consumption rates for the set of reference vessels defined for each use case in Table 4. The inclusion of missions completed in 2022 is an important distinction. This 2022 Carbon Impact Report includes missions initiated in 2021 and concluded in 2022 but excludes missions that began in 2022 and were still ongoing in 2023. Since Saildrone is a rapidly growing company whose number of missions has been increasing year-over-year, we believe this methodology design will likely result in a more conservative estimation of avoided emissions. As Saildrone's business grows and incorporates more programmatic work, rather than shorter missions with defined end points, there may be a need to cut off avoided emissions calculations on a calendar year basis in certain cases.

TABLE 2: SAILDRONE'S SCOPE 1 AND 2 EMISSIONS

Scope	Emissions Source	Activity Data	Activity Data Unit	Emissions (tCO_2e)
Scope 1	Stationary Diesel	1,526	liters	4
	Mobile Diesel – Surveyor	6,541	liters	18
	Mobile Diesel – Support Vehicles	3,138	liters	8
	Mobile Propane – Support Vehicles	14,139	liters	21
	Mobile Gasoline – Support Vehicles	15,365	liters	36
Scope 2	Electricity	1,222	MWh	305
			Total Scope 1 & 2 Emissions	**392**

TABLE 3: SAILDRONE'S SCOPE 3 EMISSIONS

Scope 3 Category	Relevance	Calculation Methodology	Emission Factor Source	Emissions (tCO_2e)
Purchased Goods & Services	Relevant, emissions calculated	Spend-based	CEDA	3,197
Capital Goods	Relevant, emissions calculated	Spend-based	CEDA	896
Fuel- and Energy-Related Activities	Relevant, emissions calculated	Activity-based	DEFRA	136
Upstream Transportation & Distribution	Relevant, emissions calculated	Hybrid Spend- and Activity-based	CEDA and DEFRA	219
Waste Generated in Operations	Relevant, emissions calculated	Activity-based	US EPA	28
Business Travel	Relevant, emissions calculated	Hybrid Spend- and Activity-based	CEDA and DEFRA	585
Employee Commuting	Relevant, emissions calculated	Activity-based	DEFRA	353
Upstream leased assets	Not relevant, Saildrone does not lease upstream assets	N/A	N/A	N/A
Downstream Transportation & Distribution	Not relevant, Saildrone does not sell any products	N/A	N/A	N/A
Processing of Sold Products	Not relevant, Saildrone does not sell any products	N/A	N/A	N/A
Use of Sold Products	Not relevant, Saildrone does not sell any products	N/A	N/A	N/A
End-of-Life Treatment of Sold Products	Not relevant, Saildrone does not sell any products	N/A	N/A	N/A
Downstream Leased Assets	Not relevant, Saildrone does not lease any assets to other parties	N/A	N/A	N/A
Franchises	Not relevant, Saildrone does not have any franchises	N/A	N/A	N/A
Investments	Not relevant, Saildrone does not have any investments	N/A	N/A	N/A
			Total	**5,414**

TABLE 4: SUMMARY OF USE CASE METHODOLOGIES AND ASSUMPTIONS

Saildrone Solution Area	Avoided Emissions Use Case	Avoided Emissions Calculation Methodology	Reference Vessels	Deadweight (metric tonnes)	Main Engine Power (kW)	Moving Fuel Consumption Rate (kg diesel / nm)
Ocean Research	Float Deployment	Miles-to-miles comparison, assuming the reference vessels travel the same total distance as Saildrone USVs.	Atlantis	1,332	4,413	21.9
			Nancy Foster	370	932	15.0
			Go America	864	1,250	7.8
			Ronald H. Brown	1,332	6,645	41.1
			Knorr	1,597	2,908	20.6
			Average	**1,099**	**2,908**	**21.3**
	Storm Mitigation	Combined methodology using miles-to-miles comparison for average transit distance to and from the mission points, and a hypothetical distance traveled (50 nm) and time spent idling (48 hours) during the mission to setup or service buoys. Saildrone USVs are assumed to service the same area as three buoys.	Bluefin	1,080	1,324	11.9
			Ka'imimoana (Ocean Titan)	742	2,400	16.1
			Oak	350	4,530	22.4
			Maple	350	4,530	22.4
			Average	**630**	**3,196**	**18.1**
	Buoy Mitigation	Combined methodology using miles-to-miles comparison for average transit distance to and from the mission points, and a hypothetical distance traveled (50 nm) and time spent idling (48 hours) during the mission to setup or service buoys.	Bluefin	1,080	1,324	11.9
			Ka'imimoana (Ocean Titan)	742	2,400	16.1
			Oak	350	4,530	22.4
			Maple	350	4,530	22.4
			Average	**630**	**3,196**	**18.1**

	Scientific Observations	Combined methodology using miles-to-miles comparison for transit distance to and from mission points, and time-based comparison for mission duration.	Atlantis	1,332	4,413	21.9
			Nancy Foster	370	932	15.0
			Go America	864	1,250	7.8
			Ronald H. Brown	1,332	6,645	41.1
			Knorr	1,597	2,908	20.6
			Average	**1,099**	**3,230**	**21.3**
	Fisheries – Great Lakes	Miles-to-miles comparison, assuming the reference vessels travel the same total distance as Saildrone's USVs.	Sturgeon	180	1,104	10.2
			Kiyi	132	954	8.9
			Muskie	67	719	4.4
			Stanford H. Smith	28	372	1.7
			Average	**102**	**787**	**6.3**
	Fisheries – Marine Coastal	Miles-to-miles comparison, assuming the reference vessels travel the same total distance as Saildrone's USVs.	Reuben Lasker	718	2,220	16.1
			Lisa Marie	135	1,119	8.3
			Oscar Dyson	796	2,300	14.4
			Average	**550**	**1,880**	**13.0**
Ocean Mapping	Deepwater Multibeam Bathymetry	Miles-to-miles comparison, assuming the reference vessels travel the same total distance as Saildrone's USVs.	Fairweather	695	1,810	24.4
			Rainier	528	1,810	24.4
			Okeanos Explorer	731	1,176	10.9
			Ferdinand R. Hassler	104	2,056	26.9
			Average	**515**	**1,713**	**21.7**
Defense & Security	Near-Shore MDA Patrol	Coverage area comparison, assuming reference vessels cover the same total area that was captured in the cameras on Saildrone's USVs.	National Security Cutter (WMSL)	4,600	Confidential	Confidential
			Medium Endurance Cutter (WMEC)	1,800	Confidential	Confidential
			Fast Response Cutter (WPC-154)	359	Confidential	Confidential
			Average	**2,253**	**Confidential**	**Confidential**

TABLE 5: SUMMARY OF SAILDRONE'S 2022 MISSIONS AND AVOIDED EMISSIONS CALCULATIONS

Saildrone Solution Area	Avoided Emissions Use Case	Mission Name	USV Class Employed	Average Reference Vessel Emissions (tCO_2e)	Saildrone Emissions (tCO_2e)	Net Avoided Emissions (tCO_2e)
Ocean Research	Float Deployment	Arctic MISST 2022	Explorers	472	0	472
		ECMWF Atlantic Gulf Stream 2021-2022	Explorers	1,947	0	1,947
		SO-CHIC 2022	Explorers	280	0	280
		USF 2022	Explorers	427	0	427
		TPOS 2022	Explorers	547	0	547
	Storm Mitigation	Atlantic Hurricane Mission 2022	Explorers	535	0	535
	Buoy Mitigation	NOAA NDBC Buoy Mitigation 2022	Explorers	117	0	117
	Scientific Observations	SMODE 2022	Explorers	1,646	0	1,646
	Fisheries – Marine Coastal	NOAA SWFSC 2022	Explorers	178	0	178
	Fisheries – Great Lakes	USGS Great Lakes 2022	Explorers	44	0	44
			Subtotal	**6,193**	**0**	**6,193**
Ocean Mapping	Deepwater Multibeam Bathymetry	Aleutians Uncrewed Ocean Exploration	Surveyor	470	10	460
			Subtotal	**470**	**10**	**460**
Defense & Security	Near-Shore MDA Patrol	Task Force 59	Explorers	1,636	0	1,636
			Subtotal	**1,636**	**0**	**1,636**
All			**Grand Total**	**8,299**	**10**	**8,289**

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