ASV unmanned marine systems

C-Enduro

AUTONOMOUS SURFACE VEHICLE

"ASV's mission is to be the leading supplier of unmanned marine systems to save lives, save money, save time and gather data about the environment we live in".

ASV design and build unmanned marine systems for both military and commercial applications. Based in the UK, ASV has supplied over 50 different Unmanned Surface Vehicles (USV's) to international security and defence, oil and gas and environmental industries.

Products include long endurance survey catamarans, station keeping buoys, oil and gas services vehicles, marine target drones and mine countermeasure vehicles.

C-Enduro

Data collection over large areas for long periods

C-Enduro is a long endurance autonomous surface vehicle used to safely and cost effectively collect data at sea.

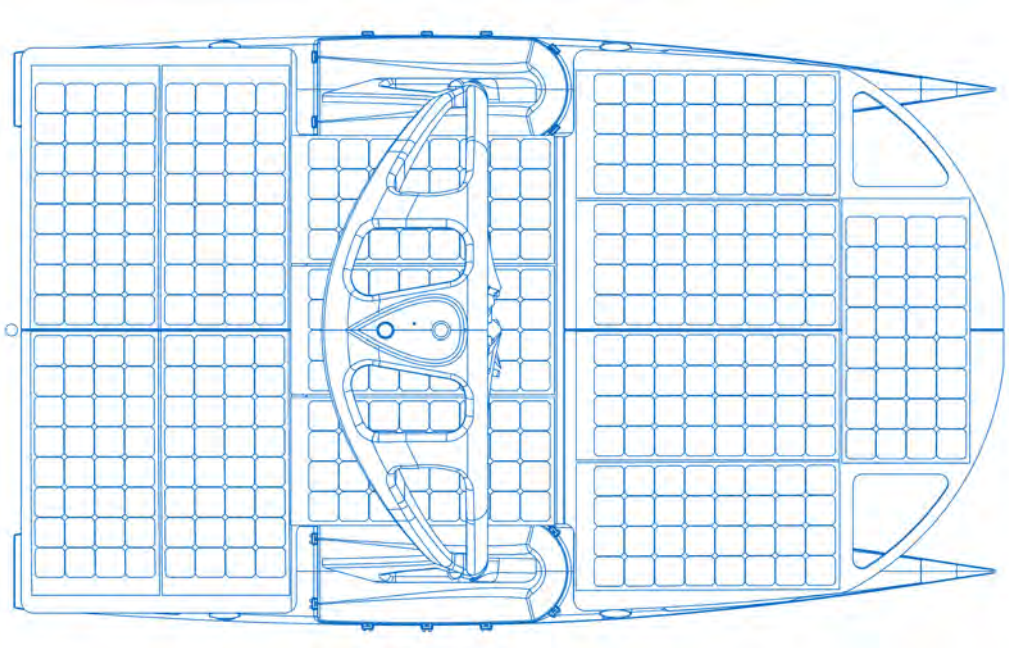
Built to operate in all marine environments, C-Enduro uses energy harvesting technology combined with an efficient self righting hull to deliver unprecedented payload capacity and power. It was developed by a passionate team of naval architects, oceanographers, scientists and roboticists.

The C-Enduro offshore monitoring system is the result of an intensive research and development programme part funded by the UK government through the Technology Strategy Board (TSB), National Environmental Research Council (NERC), National Oceanography Centre (NOC) and Defence Science Technology Laboratory (DSTL).

Technology Strategy Board Driving Innovation
NERC SCIENCE OF THE ENVIRONMENT
National Oceanography Centre NATURAL ENVIRONMENT RESEARCH COUNCIL
dstl

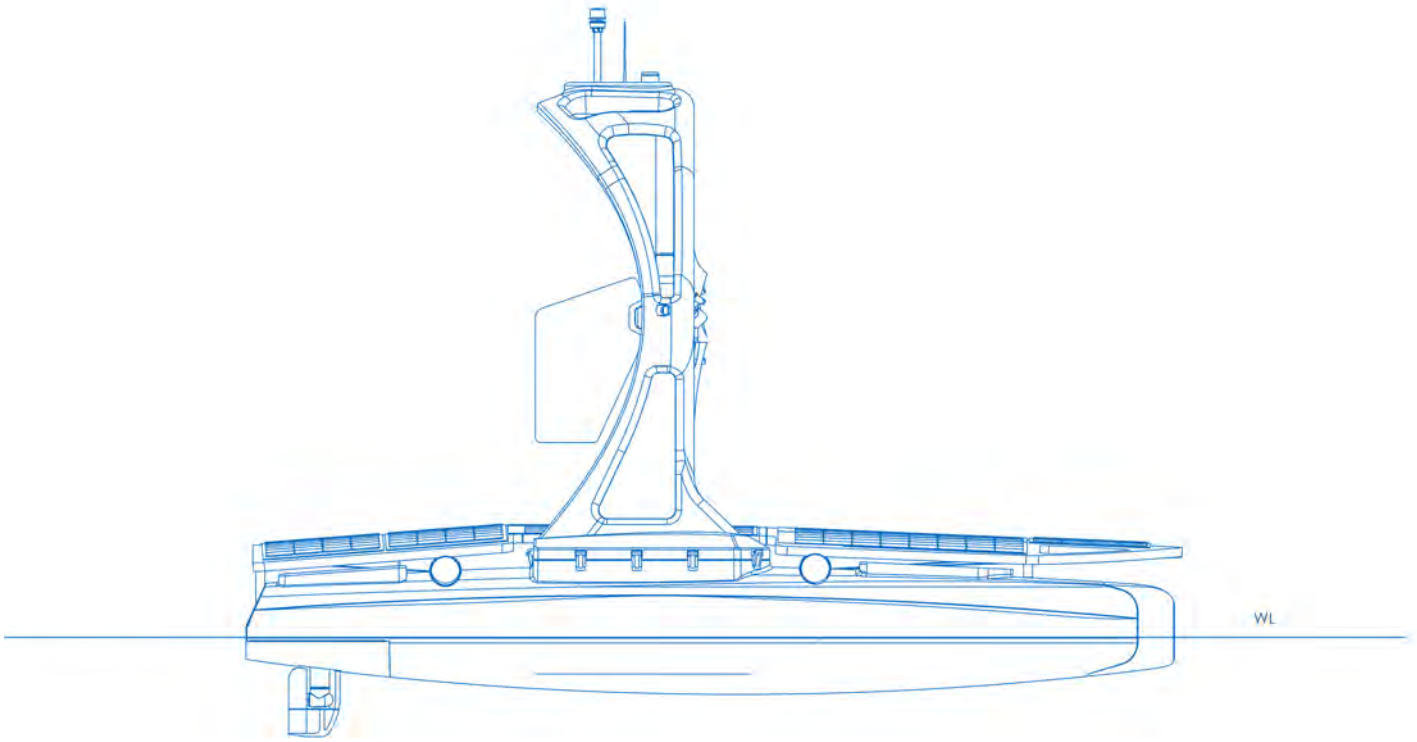
C-Enduro capability and performance

High payload capacity	**0-100kg**
Payload electrical power	**500W peak (24 V DC) with an average of 100W during mission**
Cruise speed	**3.5 knots**
Sprint speed	**7 knots**
Endurance	**60 to 90 days** **Mission planning tool allows the user to assess operating requirements and profile**
Range	**5000 to 7500 Nm at cruise speed (3.5 knots)**
Control system	**Advanced mission planning and monitoring software with sat-comm or radio connections**



C-Enduro specification

Length	**4.2m**
Beam	**2.4m (road transportable)**
Height	**2.8m (including antennae), 1.5m (for transportation)**
Draft	**0.4m**
Weight	**350kg (lightship), ~500kg (fully loaded)**
Primary propulsion	**2 X DC brushless motors driving protected fixed pitch propellers**
Solar panel system	**12 high efficiency panels generating a peak electrical power of 1200W**
Diesel generator system	**Diesel generator providing a peak charging power of 2.5kW**
Wind turbine system	**720W peak**
Battery	**4.4kWh of Lithium-ion battery (upgrade option to 8.8kWh)**
Control	**Mission planning tool, ASView+ control system. Iridium short burst data modem (SBD) or line of sight IP Radio**
Support equipment	**Road trailer, beach launch trolley, spares kit and base control station**



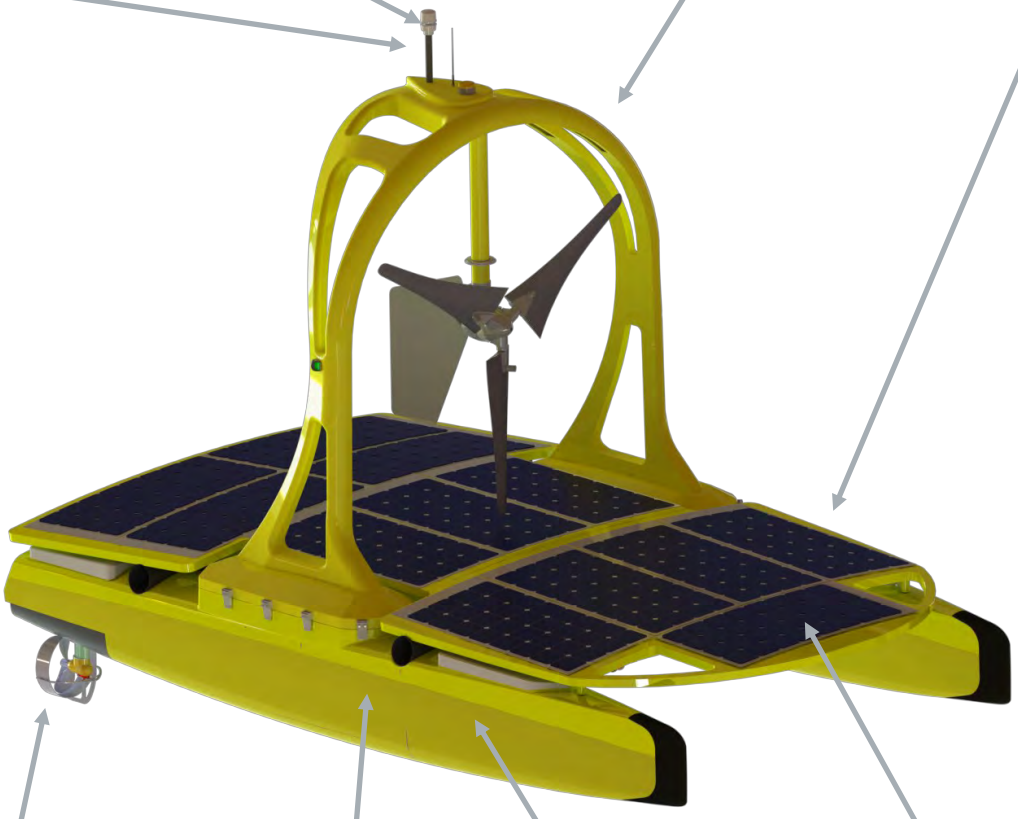
C-Enduro technology


Command and control

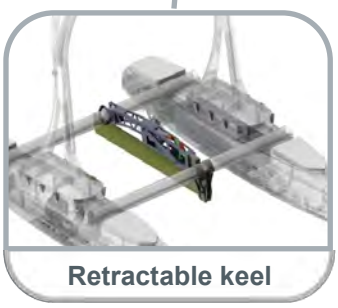

AIS collision avoidance

Carbon fibre structure


Lightweight generator



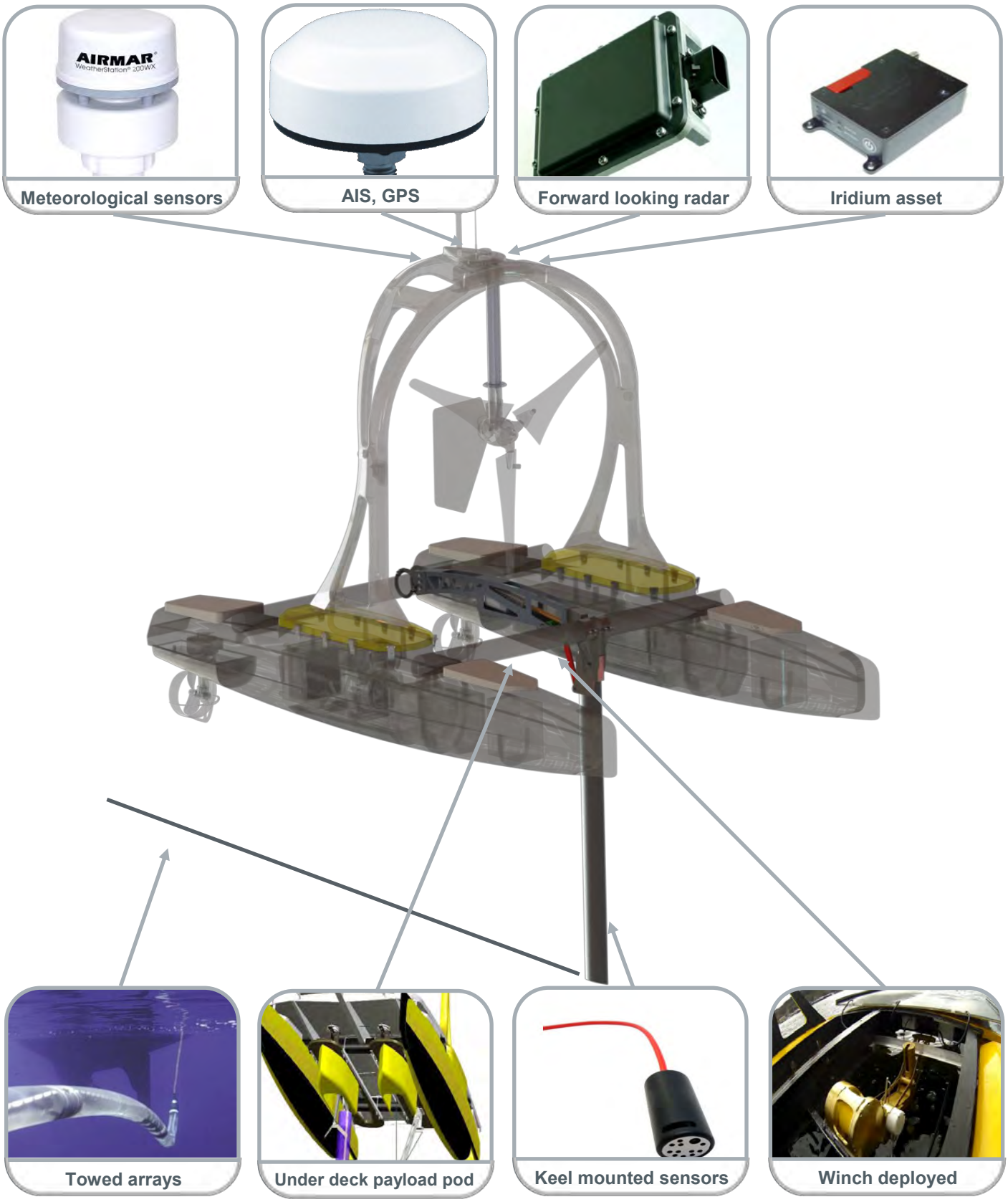

Propulsion pod


Retractable keel


Lithium-ion batteries

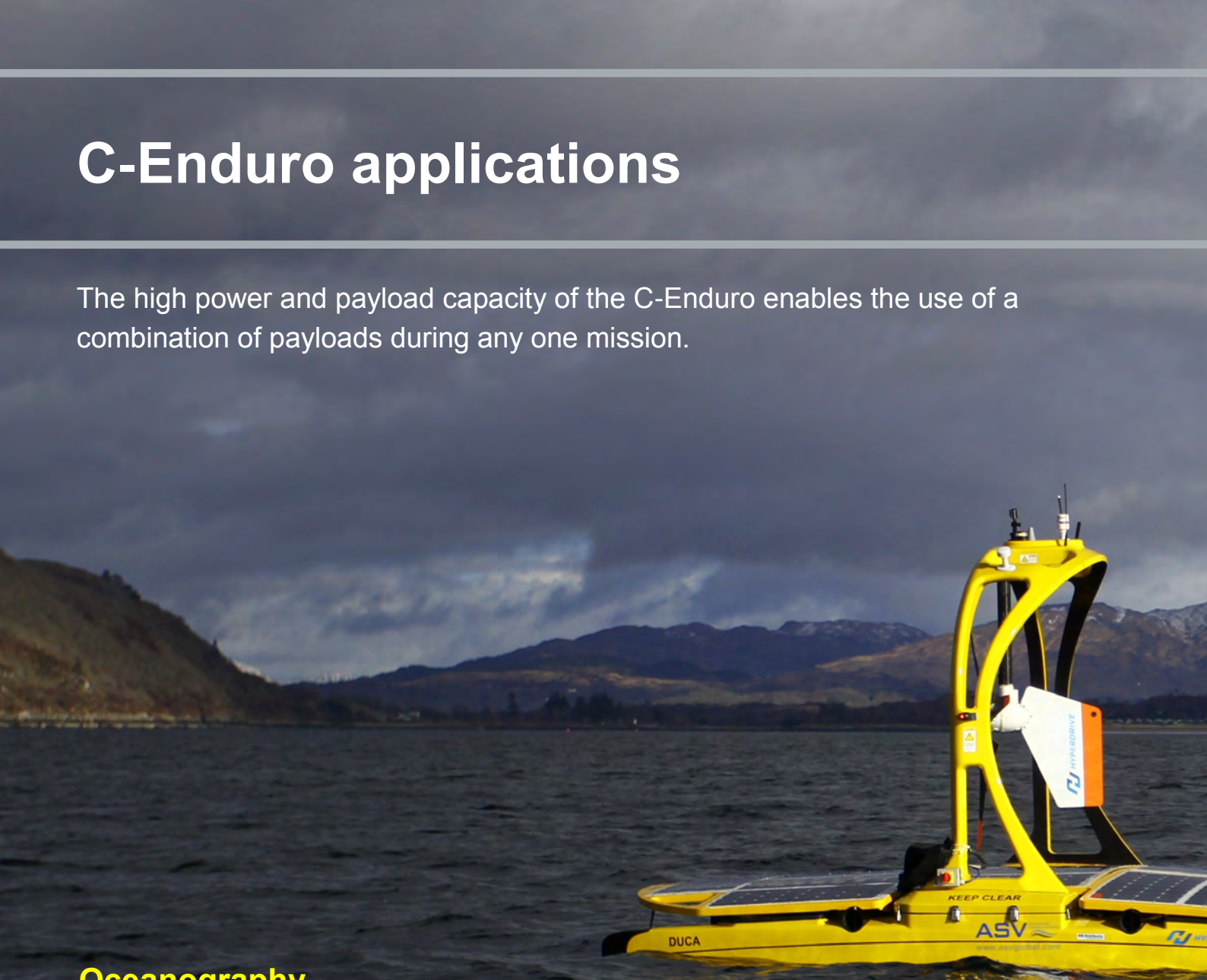

Solar and wind power

C-Enduro payloads



C-Enduro applications

The high power and payload capacity of the C-Enduro enables the use of a combination of payloads during any one mission.



Oceanography

- Temperature monitoring salinity profiling (CTD)
- Ocean current monitoring (ADCP)
- Environmental noise (PAM)
- Bird/species monitoring
- Chemical/biological parameters
- Fish stock assessments
- Hydrocarbon monitoring
- Subsea communications, communicating with seabed equipment and other unmanned systems
- Guest sensors can be used alongside a combination of any of the above

Security and Defence

- Security and situational awareness
- Chemical detection
- Anti submarine warfare (ASW)
- Rapid environmental assessment
- Noise ranging and acoustic modelling
- AIS extension
- Electronic warfare (EW)

C-Enduro operations

1. Mission planning

Each C-Enduro is supplied with a secure web based mission planning tool. This graphical interface allows the user to plan a mission taking into account the prevailing environmental conditions.

Mission co-ordinates can then be transferred to ASView+, ASV's own command and control software. This interface allows for payload control, mid mission updates and monitoring of feedback parameters.

ASV mission planner

2. Regulations and permissions

ASV has significant experience of operating ASV craft all over the world. We offer standard operating safety guidelines and support with regulatory compliance.

3. System configuration

ASV provides a payload integration service where our engineers/scientists will work with your team to ensure the payload is installed correctly, data storage and transmission interfaces are setup and the equipment calibrated before launch.

Customers preferring to develop their own payloads are provided with an ICD with details of mechanical, electrical and software connections.

4. Launch

The lightweight C-Enduro is transportable on a standard road trailer which allows for simple slipway or beach launching and recovery. The C-Enduro can also be lifted by a dockside or ship crane. The ASV training course provided with each vessel provides both classroom and practical instruction of launch and recovery procedures.

Slipway launch

5. Initiate mission

Before beginning any mission there are a set of standard system checks to be completed. Then, once the mission has been loaded to the vessel via ASView+, it is ready for initiation.

C-Enduro can be started in manual control mode before proceeding to operate autonomously.

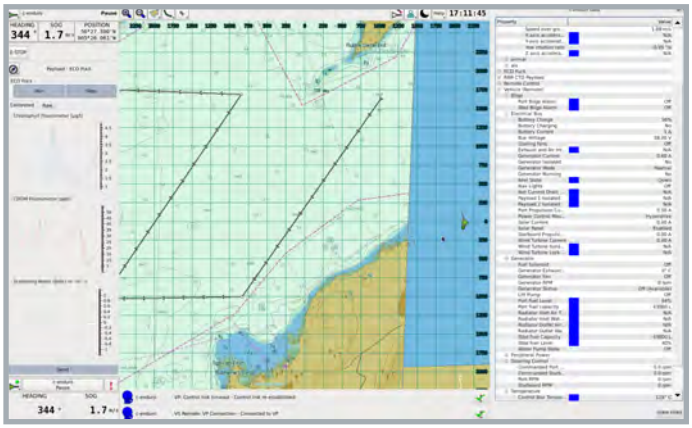
ASView+ control console, software and belly pack.

6. Monitor

ASV can provide a vehicle control and monitoring service from its HQ in Hampshire, UK or through one of its regional centres in Houston, Lafayette, Rio, Cape Town, Aberdeen, Mexico and Singapore.

The customer can also provide complete control and monitoring themselves via the ASView+ system provided with each C-Enduro. ASV provide a list of suggested core skills and run a training course for new operators.

The C-Enduro is monitored via satellite comms (iridium BGAN/Im) when operating over the horizon or on L-Band/UHF radio communication if within a 20 mile radius of an antenna/ground control station.



ASView+ control software

7. Collect data

The pre-configured payloads can both log data on-board the C-Enduro and transmit data back to an operator station. The on-board winch can be set to automatically profile over a range of 0-300m depth. The mast provides an ideal location for air quality and MET sensors to be located whilst the keel and hull provide capacity for in-water sensors, transducers or a towed array connection.

C-Enduro on a mission

8. End mission

Once the planned route or station keeping mission has been completed, the C-Enduro can be met by a small coastal vessel or pilot and escorted back to shore for recovery. The vessel can be lifted out of the water by a dockside crane. Once ashore, all data can be downloaded from the on-board computer and planned maintenance and cleaning should be completed before redeployment.

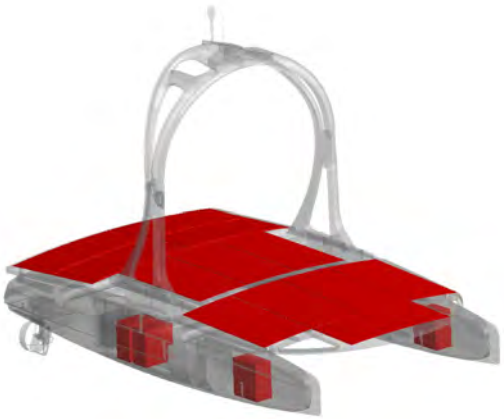
C-Enduro on the trailer ready for transport

C-Enduro configurations

C-Enduro's three pillar energy system gives the flexibility to tailor the power options to meet performance requirements and operational environments. ASV will work with the customer in configuring the energy system to deliver the best possible solution. Some examples are shown below but there are additional configurations and options including methanol fuel cells.

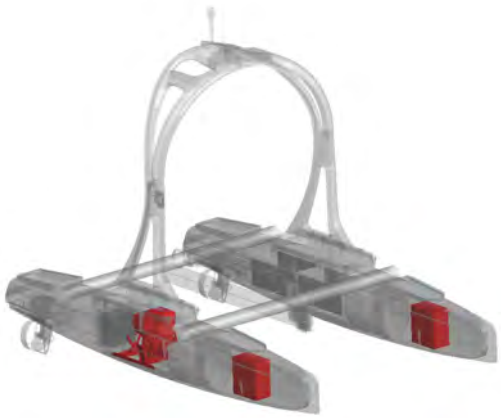
Three pillar solution:

A power management system combines a solar array, wind turbine and compact diesel generator with the Lithium-ion battery bank. This system provides a reliable energy supply in all environmental conditions.



Battery and solar:

When operating in areas with high solar energy the C-Enduro can be configured to run solely on solar panels charging an extended battery bank.



Battery and generator:

The lightweight diesel generator can be coupled with the battery bank to run the C-Enduro in full diesel-electric mode.

C-Enduro training and support

ASV offers a comprehensive training programme for both operators and maintenance engineers of the C-Enduro. Each course is 5 days long and can be held at ASV's facility or at a user specified location. The course is run by knowledgeable and experienced ASV instructors and the course materials are of high quality and available in most languages.

An outline of the course is provided below:

	Operators	Maintenance Engineers
Day 1	Classroom based overview of C-Enduro and control station and an introduction to the ASView+ remote control software.	Classroom based overview of C-Enduro and control station, and review of maintenance plans and associated documentation.
Day 2	Workshop and shore side operations including remote connection to C-Enduro and start up checks/tests.	Practical walkthrough of the vessel systems and demonstrations of preventative and routine maintenance.
Day 3	Launch and recovery practical and on water start up/shut down tests/checks.	Launch and recovery practical and on water start up/shut down tests/checks.
Day 4	Remote control operations of C-Enduro at sea.	Troubleshooting
Day 5	Remote control operations of C-Enduro at sea.	Troubleshooting

ASV offers ongoing customer support after completion of the training programme:

- Telephone
- Remote dial in
- Web/email
- Spares
- Support team


DUCA


KEEP CLEAR
ASV

ASV has built over 50 unmanned marine systems for international science and survey, oil and gas and military and security industries.

Marine Targets

Military and Security

Oil and Gas

Science and Survey

ASV Ltd

Unit 6a Trafalgar Wharf, Hamilton Road

Portchester, Hampshire UK PO6 4PX

+44(0)23 9238 2573

sales@asvglobal.com

ASV US

10615 Shadow Wood Drive, #100

Houston, TX 77043, USA

+1 713 468 1536

sales@asvglobal.com