



Situational Awareness at Sea:

# A Security Concept for Offshore Wind and Critical Infrastructure

Executive summary of the OX2 Security Concept, January 2025



# Energy Security

The world is facing a defining moment in the energy transition. The urgent need to combat climate change demands a swift transition to greener energy sources. At the same time the geopolitical landscape underscores the necessity of energy independence. Europe stands at a crossroad where achieving sustainability and security is essential to secure a stable future.

To reduce the reliance on fossil fuels, wind and solar power will play a vital part of an independent energy system. However, this must go hand in hand with robust measures to safeguard the infrastructure. The energy transition relies on assets that many times are located in remote or offshore locations and are vulnerable in a world of hybrid threats.

The recent security climate has shown that energy independence is also about ensuring resilience against hostile activities. From cyber attacks to physical sabotage, critical infrastructure faces risks that could disrupt societies and economies if left unaddressed.

By prioritizing innovation in green energy and investing in state-of-the-art security systems, Europe can fortify its energy sovereignty and reach its climate goals. The path forward lies in collaboration between industries, governments and communities to create a sustainable, secure and resilient energy future.

# Protection of energy infrastructure

An offshore wind farm is critical infrastructure. Everything from households to industries and food systems rely on its electricity production. In a complex security environment it will therefore also face hybrid threats. Managing such facilities comes with a responsibility to also focus on situational awareness to effectively counter threats and secure a resilient energy system.

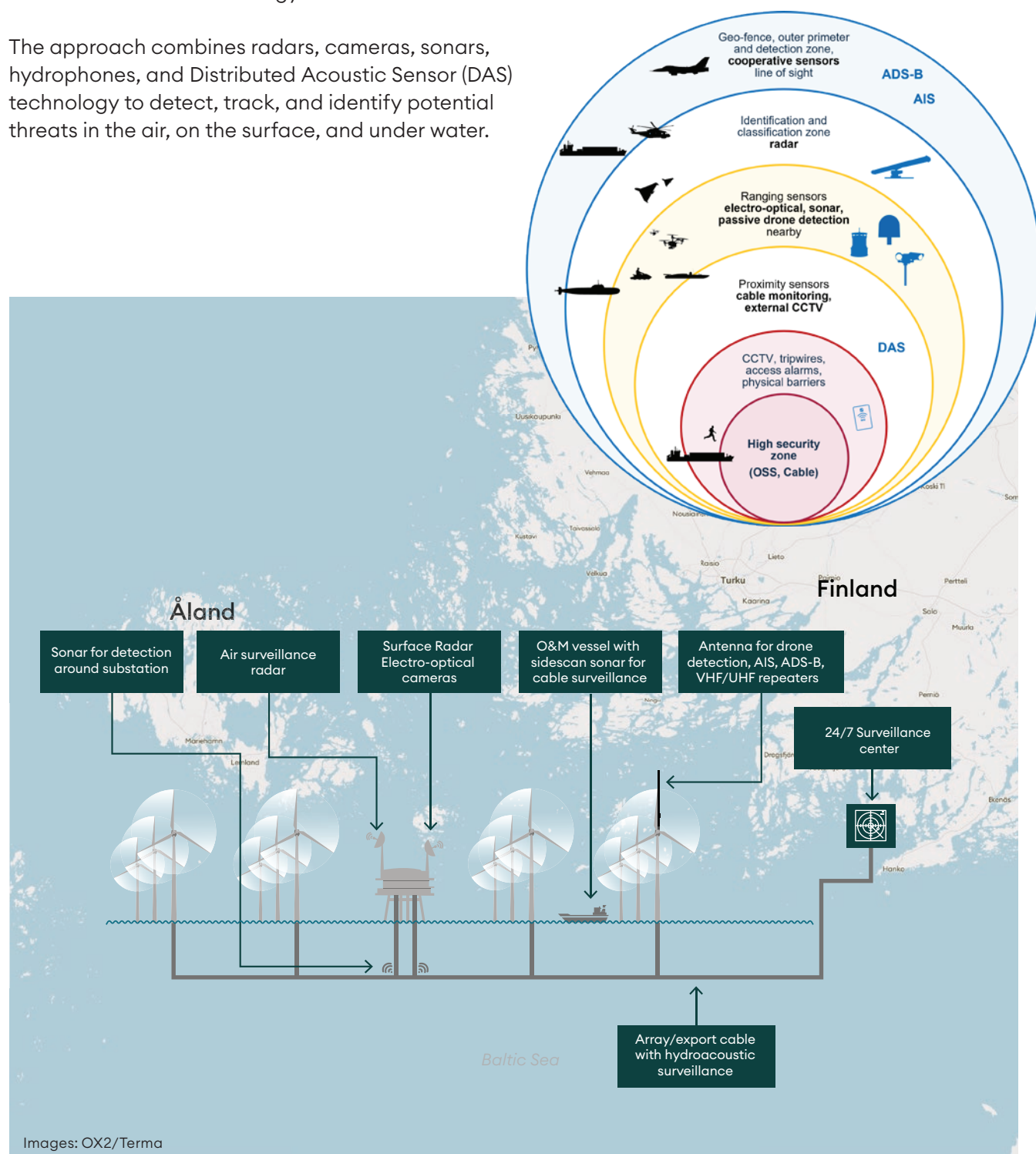
Safeguarding large offshore infrastructure involves the capability to detect, track and identify hostile activities in the air, on the surface and under water. This should deter hybrid threats and deny adversaries the advantage of plausible deniability. This shall strengthen the civil society's resilience and not interfere or disturb other core security activities.



# The Concept

The OX2 Security Concept is designed to create situational and security awareness around offshore critical infrastructure like offshore wind farms and export cables by combining the latest commercial technology into a virtual fence.

The approach combines radars, cameras, sonars, hydrophones, and Distributed Acoustic Sensor (DAS) technology to detect, track, and identify potential threats in the air, on the surface, and under water.



Images: OX2/Terma

# Real-life test of the Concept

In September 2024, OX2, together with technology partners, conducted live demonstrations and tests of the Security Concept on the Åland Islands. The tests took place during three weeks on the island Lilla Båtskär south of the Åland Islands in the existing offshore wind farm Båtskären.

More than 200 different threat scenarios were applied, involving aircraft, drones, high-speed boats, jet skis, Remotely Operated Vehicles (ROVs), divers (scuba and rebreathers), anchor drops and dragging as well as activities at landfall and around the onshore substation.

The hybrid and realistic threat simulations were observed through monitoring and surveillance from a control room located 25 km away via a dedicated fiber set-up. All data was recorded, processed and shown on the screens in real-time for the operators and specialists.



## Findings

The demonstration and tests showed that offshore wind farms can create and enhance situational awareness in all domains – air, surface and under water. Not least on the seabed in remote areas where no such sensors exist today (+ 30 km from coastline) benefiting the Asset Owner with indicators and warnings if someone is tampering with the subsea cables.

Real-time detection significantly reduces the ability of adversaries to claim plausible deniability. Threats include, but are not limited to, drone activity, subsea anchors, Autonomous Underwater Vehicles (AUVs), ROVs, rebreather divers, speed boats, surveillance vessels, and aircrafts.

The results underline the potential for future collaboration with armed forces and authorities, while also proving the commercial viability of this security concept in protecting offshore energy infrastructure. This initiative strengthens the broader resilience and security of our societies.

The demonstration in Åland also showcased that the necessary technologies are already developed and commercially available to achieve these objectives.

## Main hypothesis which were demonstrated through the test:

ID	Challenge	Findings with the OX2 Security Concept in place	Challenge Mitigated?
1	Turbines cause radar shadows and blank spots for surveillance	Correct, however the assessment from the demonstration is that the shadow effect is very limited thus detection of (even small) drones is possible.	Yes
2	Underwater threats cannot be detected due to noise in the water induced from the wind turbines.	The underwater surveillance and monitoring technologies used in the test showed outstanding resilience to ambient noise making detection of underwater threats possible. Modern sensors can filter out ambient background noise.	Yes
3	Cables hard to monitor and protect in remote areas (+40 KM offshore)	The DAS technology showed remarkable detection ability and enables very precise monitoring of activity on and around the cable. Albeit not showcased in the test, DAS reaches in excess of 200 km from measurement point.	Yes
4	Rebreather divers hard to detect	The test showed that detection is possible despite the target's very low noise profile.	Yes
5	Data collected is hard to handle securely	Dedicated fiberoptics will support secure data exchange along with regular cybersecurity requirements for energy asset owners. In the test the technology providers were responsible for their own data exchange using the OX2 dedicated FO optics cable.	Yes
6	Data cannot be exchanged between private entities and public authorities	This is already done by government agencies today incl. real time filtering mechanisms to distinguish between authorities' own sensors and other external sensors.	Partly, no signals were shared
7	Commercial of the shelf (COTS) equipment enable the creation of situational awareness	Yes, COTS provides several options for creating credible surveillance and security systems. The showcased technology comprised of only COTS and no ITAR (Military grade) regulated technology was used.	Yes
8	Can offshore wind act as an additional support for SAR operations?	Yes, especially radars and cameras in the offshore areas combined with regular service & maintenance vessels at site will make a difference.	Yes, a specific SAR scenario was executed with local SAR boat and team

# More information

The OX2 Security Concept real-life test generated a vast dataset of nearly 50 terabytes. This extensive dataset is readily available to key authorities upon request to address specific inquiries, provide detailed explanations, or clarify potential areas of interest.

With the test results and a continued open dialogue, we aim to foster a clear understanding of how the concept can be tailored to meet diverse security needs in challenging environments, while at the same time ensuring our business investments are safe and secure.

## Contact persons:

**Anders Wiklund**

+358 457 57 59 211

[anders.wiklund@OX2.com](mailto:anders.wiklund@OX2.com)

**Camilla Fredman Svensson**

+46 76 134 89 17

[camilla.fredman.svensson@OX2.com](mailto:camilla.fredman.svensson@OX2.com)



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**OX2 AB**  
Lilla Nygatan 1  
Box 2299  
103 17 Stockholm

+46 8 559 310 00  
info@OX2.com

OX2.com