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From saving the oceans.
To safeguarding the planet.

ARMADA TECHNOLOGIES

Passive Air Lubrication System (PALS)

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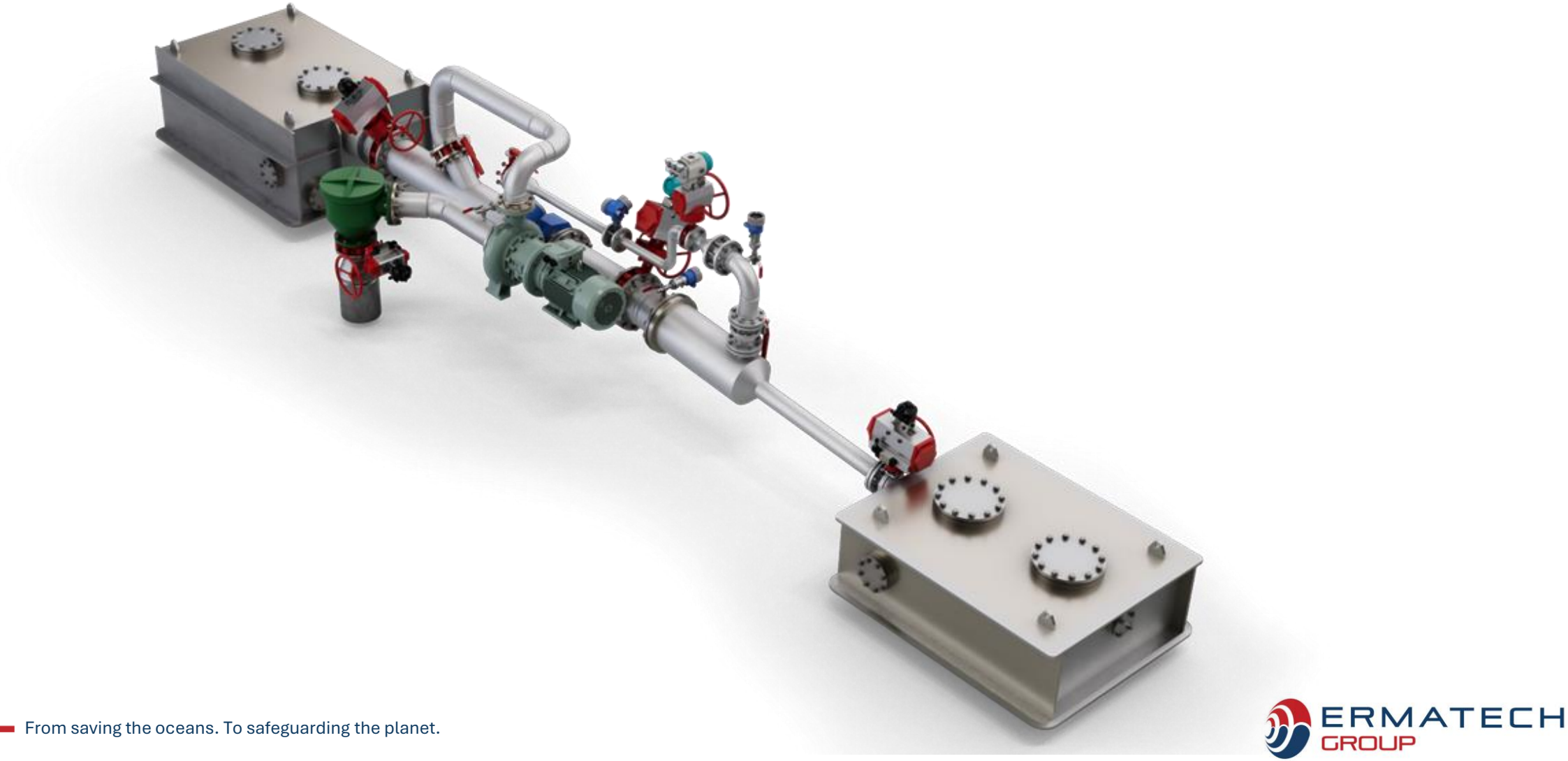
ARMADA PALS-
PASSIVE AIR LUBRICATION SYSTEM



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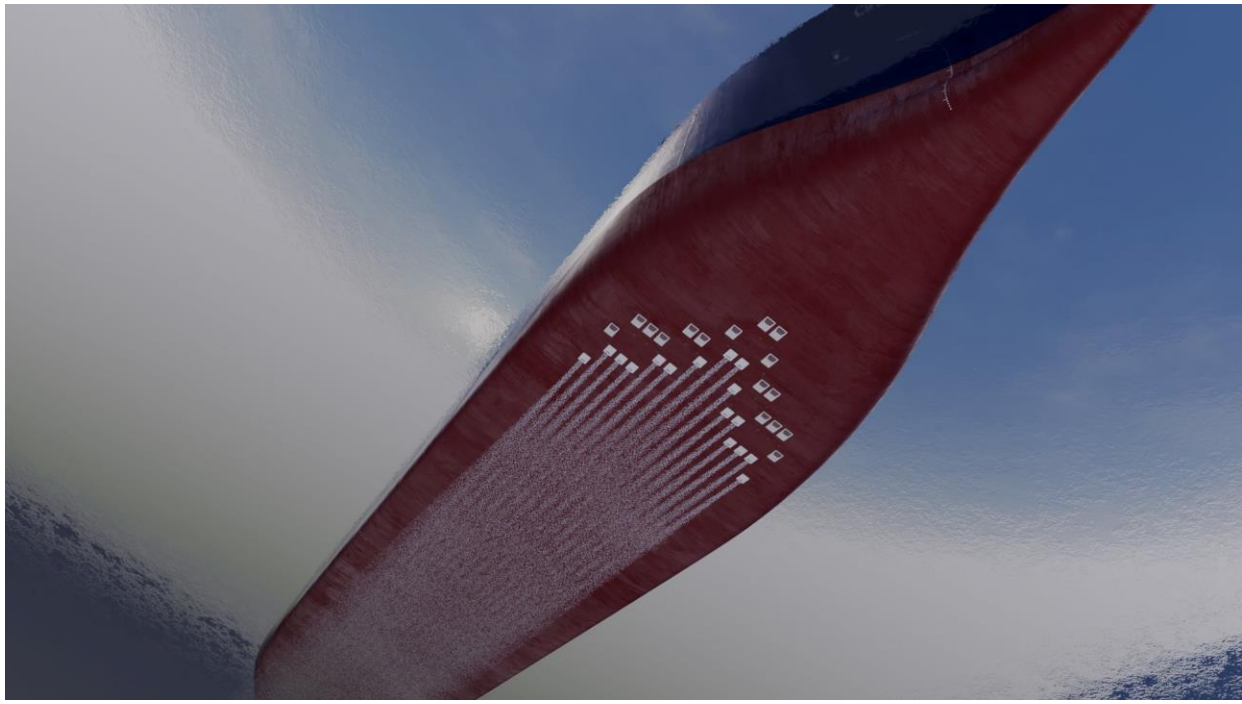
Passive Air Lubrication System (PALS)

DECARBONISATION

The worlds first **compressor-free**, passive air lubrication system (PALS) offers the vessel owner genuine fuel savings.

Armada Technologies' Passive Air Lubrication System (PALS) uses the forward motion of the ship to draw air from the deck and to create a precise air-water mixture for lubrication.

- No compressors
- Significantly less power
- Different operating modes based on vessel's speed and sailing weather conditions



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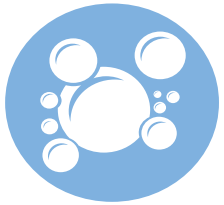
RETROFIT-TECH:
AIR LUBRICATION SYSTEMS (ALS)

How do hull air lubrication systems work?



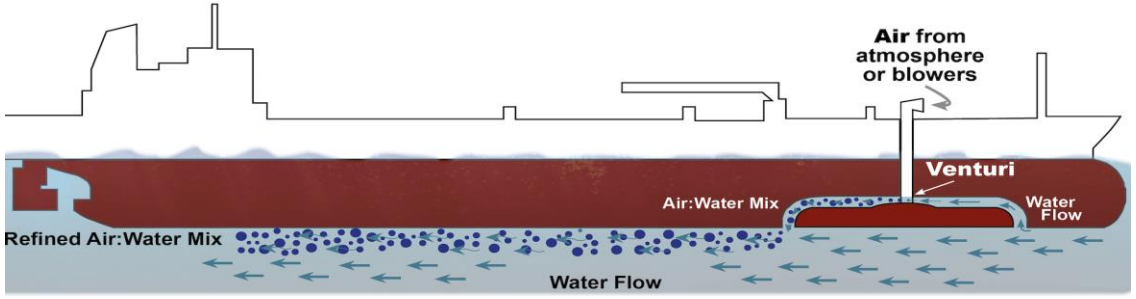
- **Well recognized:** Release of (micro) bubbles within ship boundary layer to dilute seawater and reduce overall frictional resistance.
- **Emerging experience:** Modifies boundary layer turbulence delivering additional favorable viscous drag reduction properties

Why is reducing drag important?

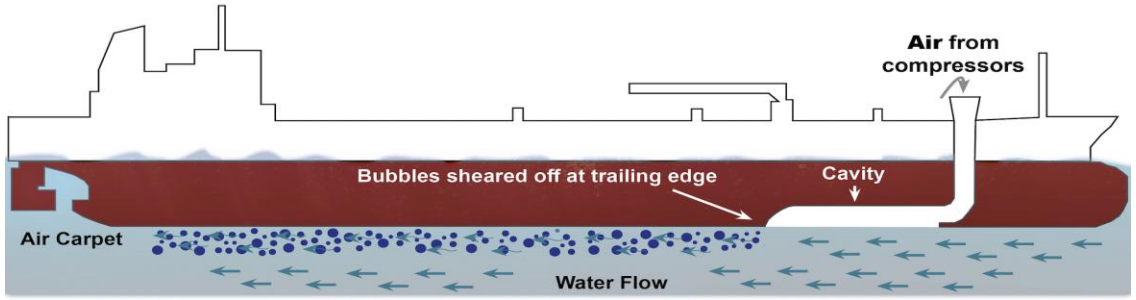
- Reducing drag is crucial because it decreases the power needed to propel the vessel, ultimately leading to lower fuel consumption, higher vessel profit margins and a cleaner environment

DIFFERENT TYPES OF HULL AIR LUBRICATION SYSTEMS

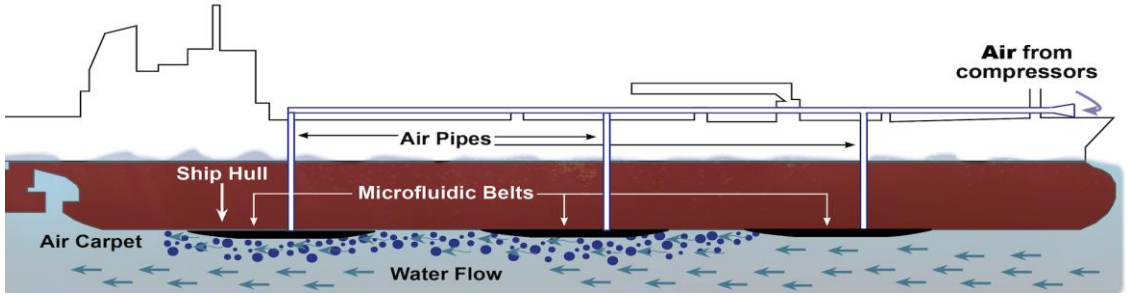
Comparison of Hull Air Lubrication System Technologies



Armada Technologies Passive Air Lubrication System



Cavity-based Air Lubrication Systems



Fluidic Air Lubrications Systems

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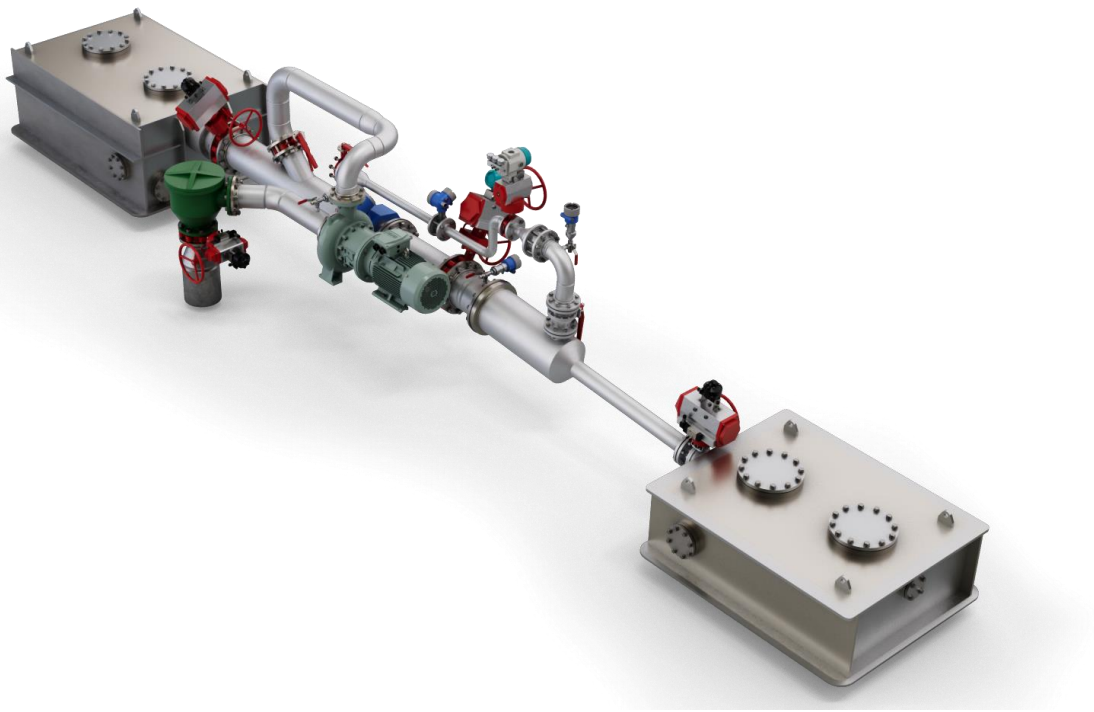
TECHNOLOGY OVERVIEW: PALS MODULAR POD DESIGN



PALS constitutes an optimal number and configuration of Pod units.

Structurally, the Pods consist of:

1. An inlet transition piece
2. An outlet transition piece
3. A venturi ejector + diffuser
4. An active water intake

Electro-mechanically, each Pod consists of:

1. A small centrifugal pump
2. Hull isolation valves
3. Non return valves
4. Pressure Transmitters (air & water)
5. Flow Transmitters (air & water)
6. Flow control valves (air & water)

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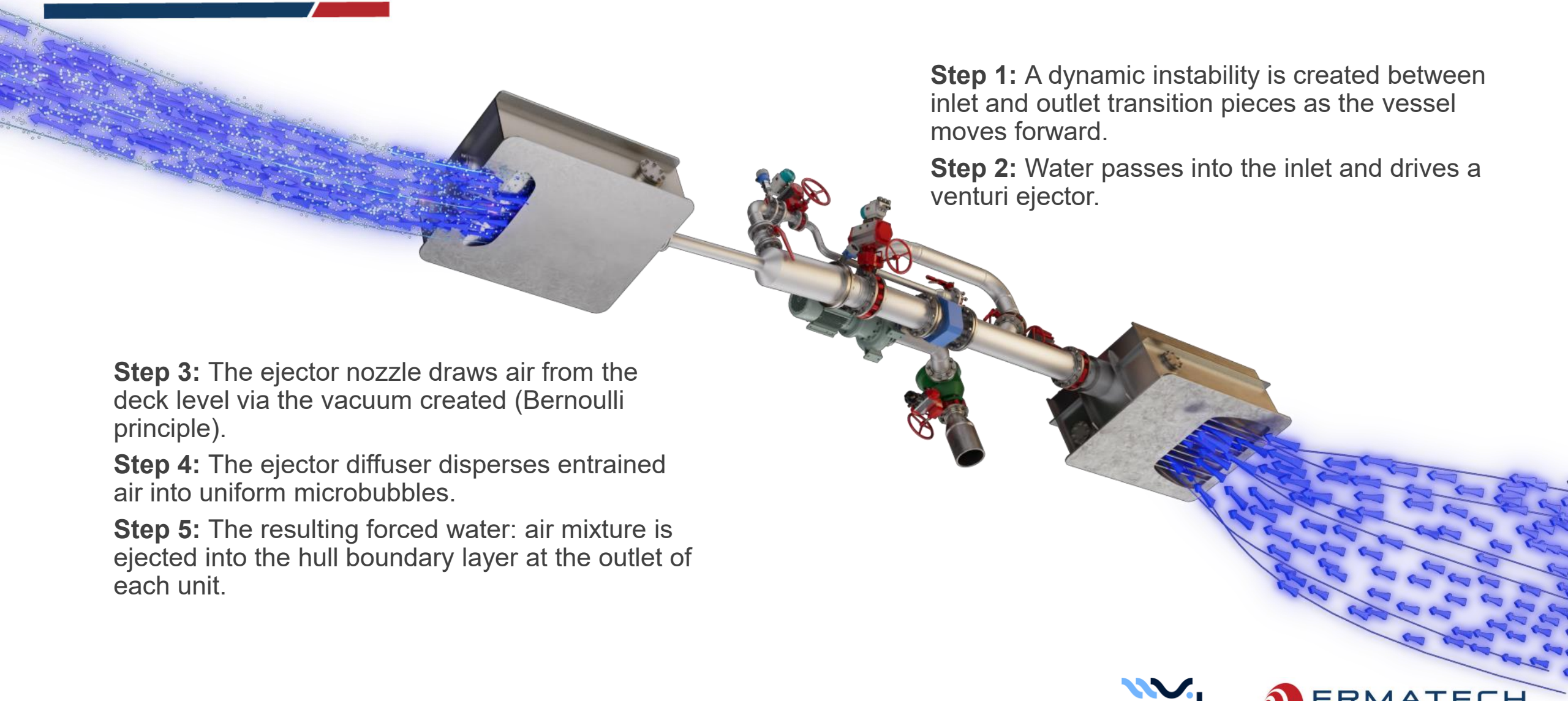
TECHNOLOGY OVERVIEW: PROCESS FLOW



Step 1: A dynamic instability is created between inlet and outlet transition pieces as the vessel moves forward.

Step 2: Water passes into the inlet and drives a venturi ejector.

Step 3: The ejector nozzle draws air from the deck level via the vacuum created (Bernoulli principle).

Step 4: The ejector diffuser disperses entrained air into uniform microbubbles.

Step 5: The resulting forced water: air mixture is ejected into the hull boundary layer at the outlet of each unit.

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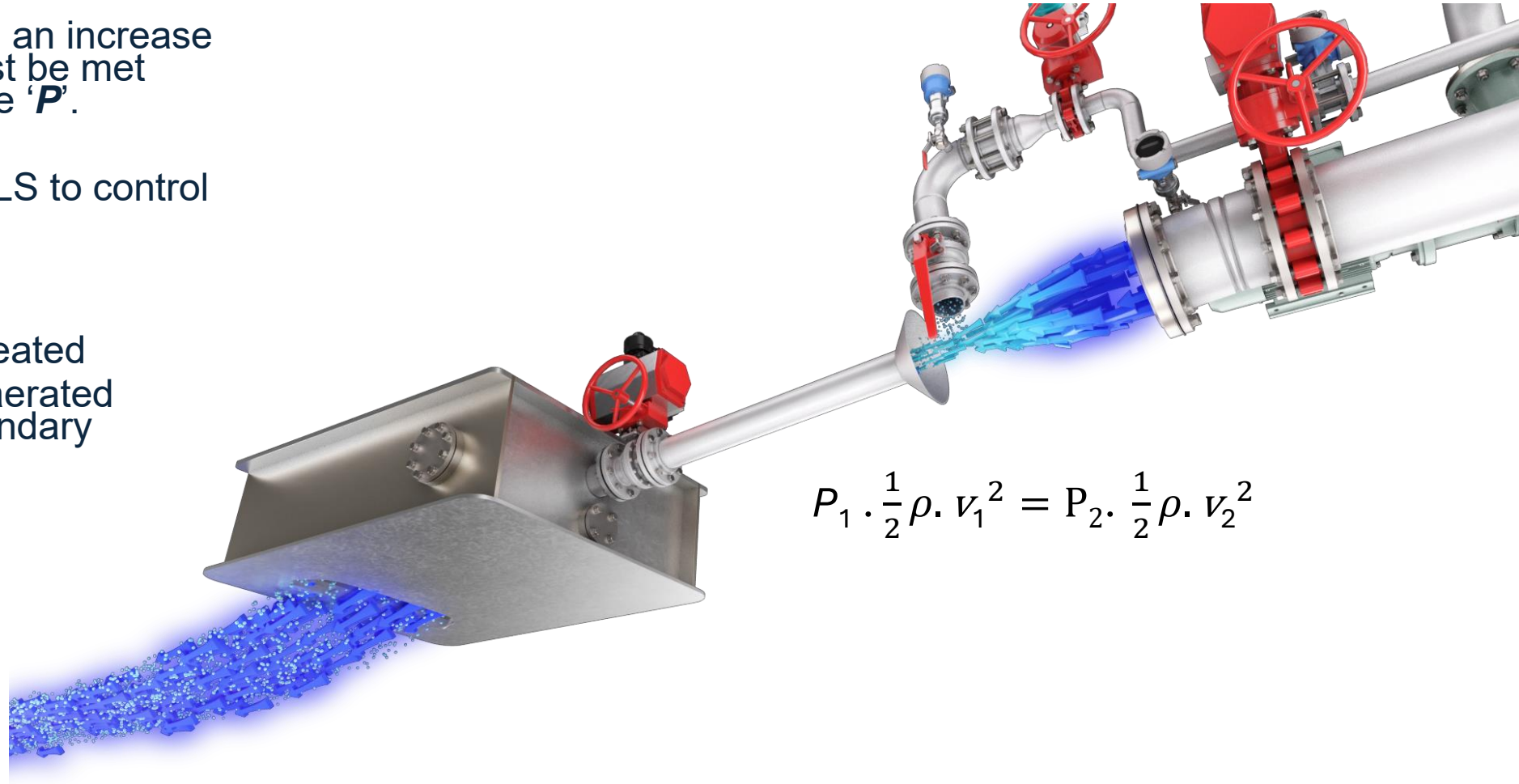
TECHNOLOGY OVERVIEW: FUNDAMENTAL WORKING PRINCIPLE

Under Bernoulli's principle, an increase in water flow speed '***v***' must be met with a decrease in pressure '***P***'.

A control of '***v***' enabled PALS to control '***P***' and therefore refine:

1. Volumetric air delivery
2. Air: water ratio
3. Diameter of bubbles created
4. Controlled injection of aerated mixture into vessel boundary layer

Each Pod works independently!



$$P_1 \cdot \frac{1}{2}\rho . v_1^2 = \mathrm{P}_2 . \frac{1}{2}\rho . v_2^2$$

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KEY TECHNOLOGY DIFFERENTIATORS

	armada TECHNOLOGIES	1st Generation Technologies
Less GhG Emissions & Fuel Use	☑	☑
No Compressors / Low Maintenance	☑	
Small Footprint	☑	
No Dependence on Sea State	☑	
Reduces Underwater Radiated Noise	☑	☑
Easy to Operate / No Extra Crew	☑	
Retrofit & Newbuild Installation	☑	☑
Easy, Low-Cost Installation	☑	

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PALS Installation Configuration

Kool Husky

LNG Carrier

KOOL HUSKY INSTALLATION

The first-ever installation of PALS was successfully completed in October 2024 on the CoolCo LNG carrier, ***Kool Husky***.

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KOOL HUSKY: *INSTALLATION WITHIN 7-DAYS

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INSIGHTS GAINED DURING KOOL HUSKY INSTALLATION

The insights gained during the initial *Kool Husky* installation will provide guidance for refining and improving future installations and performance.

We are committed to continuously enhancing PALS with the goal of achieving even quicker installation times, greater reliability, and optimized efficiency.

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Why ARMADA PALS

DECARBONISATION

Reduced GhG emissions - Higher fuel efficiency - Lower power consumption

➢ No Compressors

- ✓ 30% increased efficiency in developing the air lubrication effect*
- ✓ Reduced underwater radiated noise signature
- ✓ Lower maintenance and less workload on crew to manage the system
- ✓ Theoretically no ‘off’ condition that would otherwise induce drag

➢ Quicker Installation

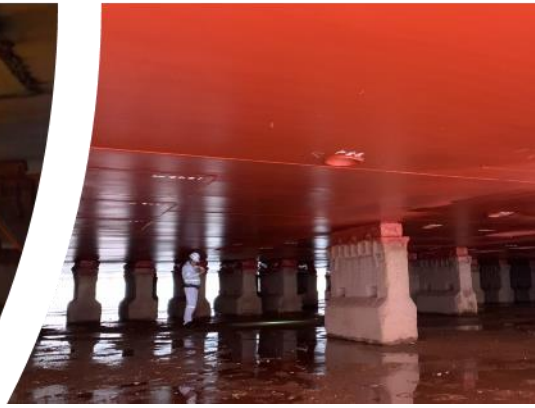
- ✓ Installation within 7-days (hull integrity scope)
- ✓ Modular design means PALS fabrication can be decoupled from project timeline
- ✓ No need to match ALS install with sub-cooler or other large retrofit project dry-docking
- ✓ Small Footprint

➢ System Controllability

- ✓ Controllable system output for refined environmental tuning - each pod is a separate operating unit
- ✓ Increased effectiveness of air lubrication over the vessel’s entire operating profile
- ✓ Potential for long distance course-keeping to reduce rudder angle deflection

➢ Significantly Reduced Dependence on Sea State

- ✓ PALS has a much wider operating window compared to first generation Air Lubrication technologies



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THINK DECARBONISATION …

THINK ENVIRONMENTAL PROTECTION …

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