

MARITIME



SOLUTIONS

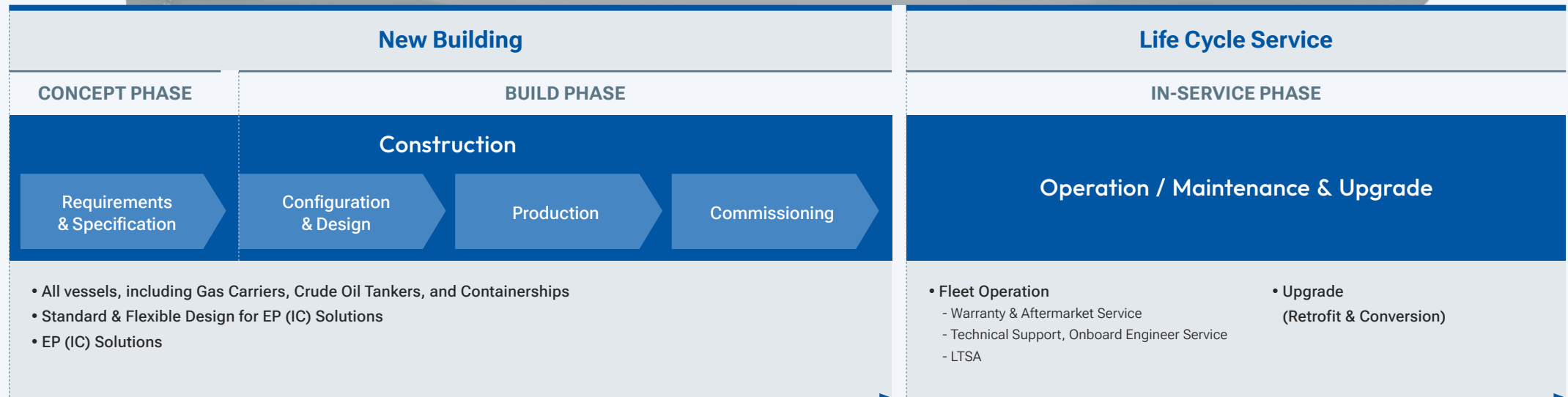
CONTENTS

Hanwha,
**YOUR TRUSTED PARTNER
FOR SMARTER, LONGER-LASTING SHIPS**



Vessels, from Cradle to Grave

Your partner for the full lifecycle of your vessels



Customized Total Care

Vessels

Leap from shipbuilder to global ocean solution provider

Pioneering cutting-edge technology, Hanwha empowers the safe and efficient transportation of advanced fuels, such as LNG, ammonia, and LPG—maximizing cargo capacity while minimizing fuel consumption.

LNG Carrier / LNG-FSRU



Ammonia / LPG Carrier



Containership



Tanker



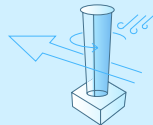
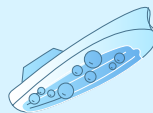
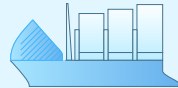
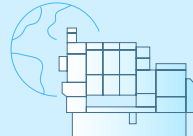
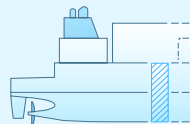
Green Ship



Energy Technologies

Revolutions in fuel conversion and efficiency

Hanwha is developing technologies to improve ship efficiency, low-carbon and carbon-free propulsion systems such as Dual Fuel engines, NH₃ GT, and ESS, and is working on developing technologies for decarbonization. These technologies can be applied to both new and retrofit ships.

Energy-Saving	BOG Re-liquefaction 	WAPS-Rotor Sail 	ALS (Air Lubrication System) 	WSC (Wind Saver Cap) 	Bulbous Bow / Propeller Optimization 
Marine Propulsion	Engine (Diesel & Dual Fuel) 	LNG Dual Fuel Retrofit 	Ammonia Gas Turbine 	ESS & Fuel Cell 	
General Retrofit	Cargo Capacity 	EPLO (Engine Part Load Optimization) 			
Low-Emission	OCCS (Onboard Carbon Capture and Storage) 	DeNOx® SCR (NOx Reduction System) 	GCU (Gas Combustion Unit) 		

Smartship Solutions

We aim to enhance the safety and efficiency of ship operations by leveraging ICT. We integrate the ship's operation and equipment management systems to collect and analyze key equipment data on board in real-time, providing optimal operational services. Hanwha's smartship solution increases ship stability, reduces maintenance costs, and further serves as the basis for the development of unmanned autonomous navigation technology.

IAS

(Integrated Automation System)



Cyber Security



Remote Engine Monitoring Solution & CEMS



Services

Hanwha provides proactive warranty services with cutting-edge expertise and accumulated data-driven insights. We are dedicated to ensuring safe and economical vessel operations by providing unwavering support and exceptional service anytime, anywhere, throughout the vessel's entire lifecycle.

Technical Support

Maximizing customer value and profitability

Seamlessly integrating your technical requirements with the latest insights through collaboration.

Life Cycle Care Service

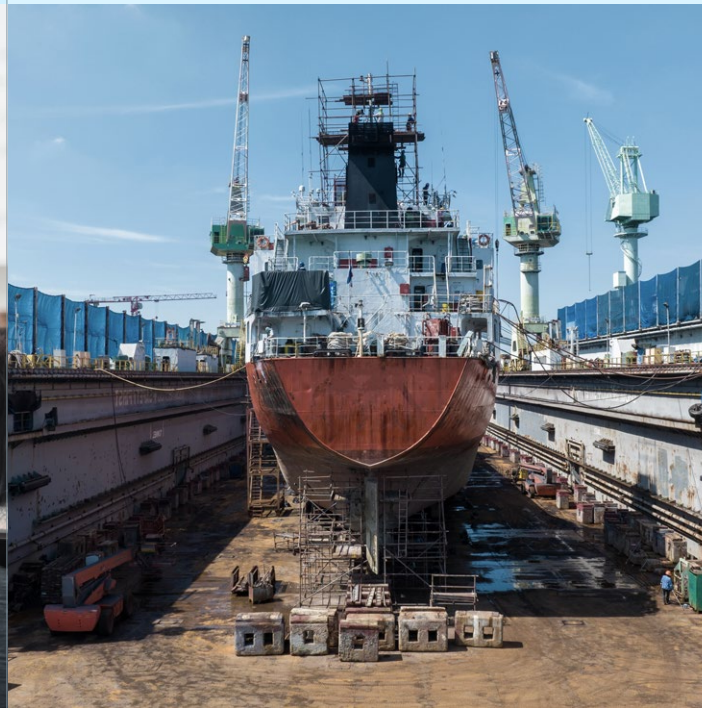
24/7 Service

One-stop service, close to where you are.

LTSA (Long Term Service Agreement)

Sharing The Responsibility with The Dedicated Experts

LTSA with a reliable partner allows customers to keep the vessels in safe and stable condition. Hanwha contributes to creating greater value for customers.



Why Hanwha? Here's the Edge.

Cut Costs. Maximize Efficiency. Extend the Life of Your Fleet.
Hanwha, Your Trusted Partner for Smarter, Longer-Lasting Ships.

4 Key Benefits by Hanwha



1

Total Marine Solution

From Design to Delivery,
Newbuild, Retrofit, and Engineering,
All in one



2

Technology Driven

Value-driven, Powered by
Hanwha's Trusted Expertise
Across Energy and Technology



3

Cost-Effective Operations

Optimize Both CAPEX and
OPEX with Smart,
Long-term Solutions



4

Global Capability

Worldwide Support,
Local Execution Backed
by Hanwha's Global Network

Global Network



About Hanwha

Hanwha Today

Hanwha is South Korea’s seventh-largest business group with a diverse portfolio that includes innovative businesses in the areas of energy, ocean, aerospace, finance, and retail & services. As a multinational company ranked in the Fortune Global 500, we boast a robust network of domestic and global affiliates, which allows us to leverage synergy to deliver future-ready solutions and impactful innovations that sustainably power industries and communities.

With strong fundamentals in core industries, Hanwha enhances lives through our technologies, products, and services. Our relentless commitment to sustainability drives our bold innovation, allowing us to create transformative solutions for individuals, society, and the planet.

Business Enterprise
Ranking in
South Korea



TOP 7

Years since Founding



72

Global Networks



821

Total Sales



64.1B USD

Ranking on
Fortune Global 500



372

One of the TIME 100
Most Influential Companies

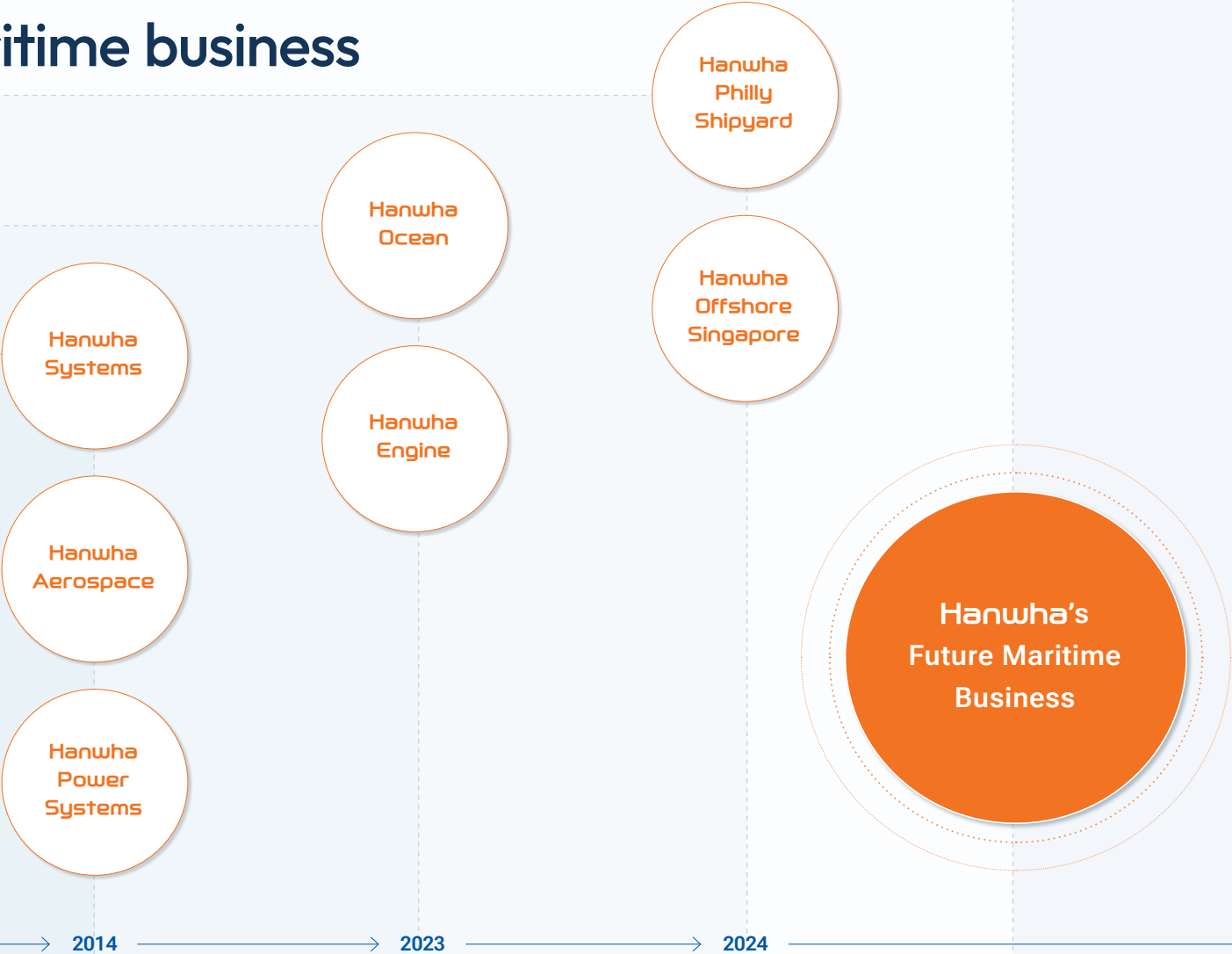
TIME 100

About Hanwha

Hanwha Group's Bold expansion in the maritime business

Hanwha's Marine Business Expansion

Hanwha is widely recognized for its precision and high-end technologies, especially in the defense industry. However, it has recently expanded its maritime business through the acquisitions of Hanwha Ocean and Hanwha Engine. The recent acquisitions of Hanwha Philly Shipyard and Hanwha Offshore Singapore, a singaporean manufacturer of floating marine equipment, further strengthened its presence in the maritime business. Thus, Hanwha now covers all areas, including land, air, ocean, and even space.



We navigate boldly toward limitless oceans

Hanwha Ocean

Business Area

Commercial

- LNG Carrier / LNG-FSRU
- Ammonia / LPG / Ethane Carrier
- Tanker
- Containership
- LCO₂ Carrier / LH₂ Carrier
- Future Green Ship



Offshore

- Production Facilities
 - LNG-FPSO, FPSO, Fixed Platform, FPU
- Drilling Facilities
 - Drillship, SEMI-RIG



Naval

- Destroyers
- Frigates
- Submarines



Wind Power & Plants

- Onshore & Offshore Wind Power
- Petrochemical Plants, Power Plants, Industrial/Environmental Plants



Remarkable Records

Every step we take shapes tomorrow and defines the course of history

- First yard to deliver 200 LNG carriers
- First Korean company to enter the U.S. shipbuilding market
 - First in Korea to perform MRO services for U.S. Navy vessels
 - Acquisition of Philly Shipyard
- Delivered the world's first Arctic LNG icebreaking carrier
- Successfully conducted the world's first STS (Ship to Ship) LNG Loading at a quay
- Delivered the world's largest containership
- Delivered the world's first LNG-FPSO

Founded in 1973

52 years

Total Sales

USD 7.3B

* Based on the 2024 year-end business report; exchange rate as of Dec 31, 2024 (KRW 1,470/USD) applied.

Surface Area of Shipyard

4.9M_m²

Total Assets

USD 12.1B

* Based on the 2024 year-end business report; exchange rate as of Dec 31, 2024 (KRW 1,470/USD) applied.

Global Networks

16

Employees

30,000+

* Based on the 2024 year-end business report (including subcontractors).

Your optimized lifecycle partner for energy equipment and solutions

Hanwha Power Systems

Hanwha Power Systems is now your trusted global partner, delivering services and solutions throughout the entire lifecycle of your vessels. Our mission is to evolve into a comprehensive provider, taking full responsibility for ships from launch to retirement.

Business Area

Marine Solutions

- Warranty Service
- Propulsion System (Ammonia Gas Turbine)
- Retrofit / Conversion

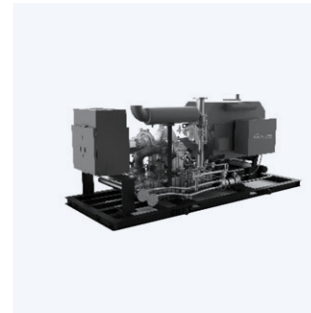
Engineering & Procurement (New Building)

- New Building Engineering
- Procurement Service
- Shipyard Supervision



Compressor Business

- Instrument Air, BOG
- Fuel Gas Booster
- Process Air/Gas
- LD Compressor



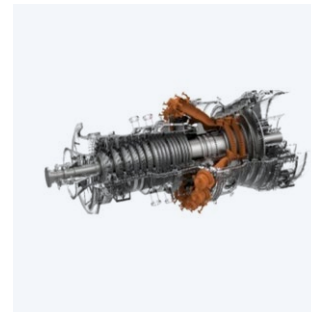
LTA Business (Long Term Agreement)

- Compressor Services
- Gas Turbine Services
- Marine Solution Services



G/T Service Business

- H₂ G/T Retrofit Solution
- Power Plant based on G/T Retrofit Tech



Power Gen. Business

- Waste Heat Recovery
- Concentrated Solar Power
- Small Module Reactor



Powering the future of maritime

Hanwha Engine

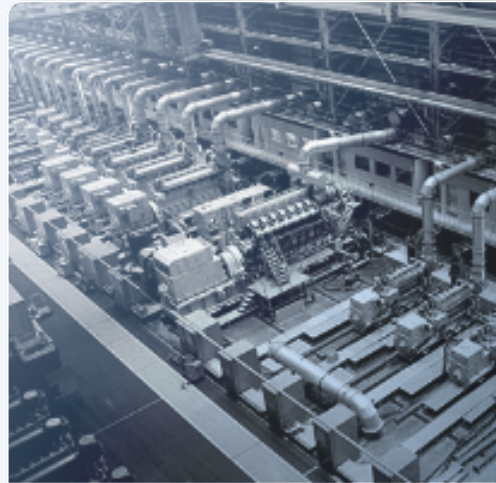
Business Area



Main Engine

Deliver Eco-friendly Engines with a legacy of Low speed expertise, proven technical credibility, and innovative global impact.

- 2 Stroke Engines
 - Licensed by Everllence and WinGD
 - Specialized in Dual Fuel Engines (LNG, Methanol, Ammonia DF) with EGR, iCER solutions



Generator / Propulsion Engine

Supply high-efficiency 4 stroke engines for electricity generation and mechanical/ electrical propulsion in various maritime vessels.

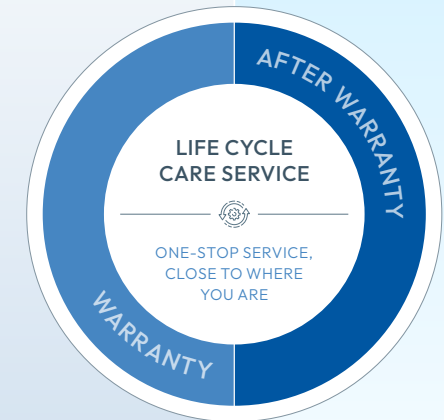
- 4 Stroke Engines
 - Licenced by Everllence
 - Specialized in Dual Fuel Engines (LNG DF)



DeiNOx® System

Offer marine DeiNOx® System with proprietary technology, outstanding emission reduction, and regulatory compliance.

- DeiNOx® System
 - LP SCR
 - HP SCR



After Market

Provide One-Stop Service with timely supply of Parts, high-quality technical service, customized service.

- Life Cycle Care Service
- Spare Parts Supply
- Technical Service
- DT Solutions
- Solutions for Environmental Regulation

The innovating pioneer for a sustainable tomorrow

Hanwha Aerospace

With sustainable technologies and continuous efforts,
Hanwha Aerospace is keep moving forward to protect the planet and create new values.

TOTAL SOLUTIONS

A global total solution provider
from aerospace to defense

LAND

No.1 defense company on the
global stage with second-to-none
competitiveness in product quality
and next-generation technologies

Firepower·maneuvering·air defense·MUM-T
Guided missiles·ammunition·laser·navigation

SEA

No.1 global innovator of pioneering
new maritime energy ecosystems
in a sustainable way based on
advanced eco-ESS technology

Lithium-ion battery systems for submarines
and ships (ESS), naval vessel engines,
gas turbine generators

AIR

Expanding the value chain from
components to systems with
independent source technologies,
and reinforcing the reputation
in the global aviation industry

Gas turbine engines and components for
aircraft, and indigenous engines developed for
missiles and unmanned aerial vehicles (UAVs)

SPACE

A total solution provider
in the space domain with
innovative and cutting-edge
technologies

Space transportation
Satellite (communication, observation)

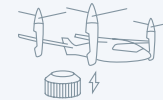
SYNERGY

Hanwha Aerospace will
expand business and create
synergy in coordination with its
affiliates—Hanwha Systems,
Hanwha Ocean and Satrec
Initiative.



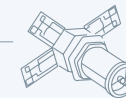
 Hanwha Ocean

A maritime and shipbuilding
expert offering tailored
and exclusive solutions



 Hanwha Systems

A system expert offering tailored and
exclusive smart technologies which are combined
with cutting-edge defense electronics
and future ICT innovation



 SI

Korea's sole exporter of
satellite systems with
verified capabilities in satellite
systems development

VESSELS



LNG CARRIER / LNG-FSRU

Most technologically advanced gas carrier in the world



- **Unrivaled LNG Expertise**
Over 200 LNG carriers delivered, including the world’s first FSRU—solidifying our leadership in the global LNG market.
- **Optimized Propulsion & Integrated Systems**
ME-GI and X-DF dual-fuel engines paired with proprietary FGSS and GMS technologies minimize boil-off gas, reduce methane slip, and ensure full compliance with IMO and EU regulations.
- **Future-Fuel Ready**
Flexible designs support bio-LNG, e-LNG, and ammonia fuel pathways—future-proofing fleet investments for the energy transition.

Product Line-up		Main Options	
LNG Carrier	174,000 CBM	Energy Efficiency & Decarbonization	Air Lubrication System
	180,000 CBM		Shaft Generator
	200,000 CBM		Rotor Sail
	270,000 CBM		OCCS
LNG-FSRU	174,000 CBM	Cold Environment Operation	HS4 ¹⁾
	200,000 CBM		ICE/Winterization
	263,000 CBM		Arctic Design

1) Smart Ship Solution & Service

AMMONIA / LPG CARRIER

Future-proofed carrier for ammonia and LPG -Safely delivering tomorrow's fuel



- **Pioneering Large-Scale Ammonia & LPG Transport**
150K VLAC design tailored to meet growing and diverse ammonia and LPG cargo demands.
- **Fuel & Engine Flexibility**
Equipped with Everllence B&W ME-LGIP engines, convertible to ammonia-fueled engine — empowering operators to stay ahead of zero-carbon targets.
- **Advanced Ammonia Safety Systems**
Enhanced ship design includes toxic-zone segregation, optimized ventilation, and integrated ammonia leak detection for maximum crew safety.

Product Line-up

Ammonia / LPG Carrier	45,000 CBM
	88,000 CBM
	93,000 CBM
	150,000 CBM
Ethane Carrier	98,000 CBM
	100,000 CBM

Main Options

Energy Efficiency & Decarbonization	Air Lubrication System
	Shaft Generator
	NH ₃ Fuel Ready
	HS4®

CONTAINERSHIP

A front runner of lower emission containerships



- **Proven ULCS Leadership**
Delivered industry-leading Ultra Large Container Ships (ULCS), including Maersk’s Triple-E class—now advancing to next-generation LNG dual-fuel vessels.
- **MCTIB® LNG Fuel Tank Technology**
Proprietary high-manganese steel Type-B LNG fuel tanks (MCTIB®) offer superior cargo efficiency, operational flexibility, and optional ammonia compatibility.
- **Built-in Energy Saving Devices (ESDs)**
Integrated shaft generators, air lubrication systems, and wind saver cap delivers significant fuel and emissions savings.

Product Line-up		Main Options	
Containership	3,700 TEU	Energy Efficiency & Decarbonization	Air Lubrication System
	5,500 TEU		Shaft Generator
	9,000 TEU		Wind Saver Cap
	13,000 TEU		LNG/NH ₃ as Fuel
	15,000 TEU		HS4®
	16,000 TEU		
	24,000 TEU		

TANKER

No.1 market position with unrivaled shipbuilding technologies

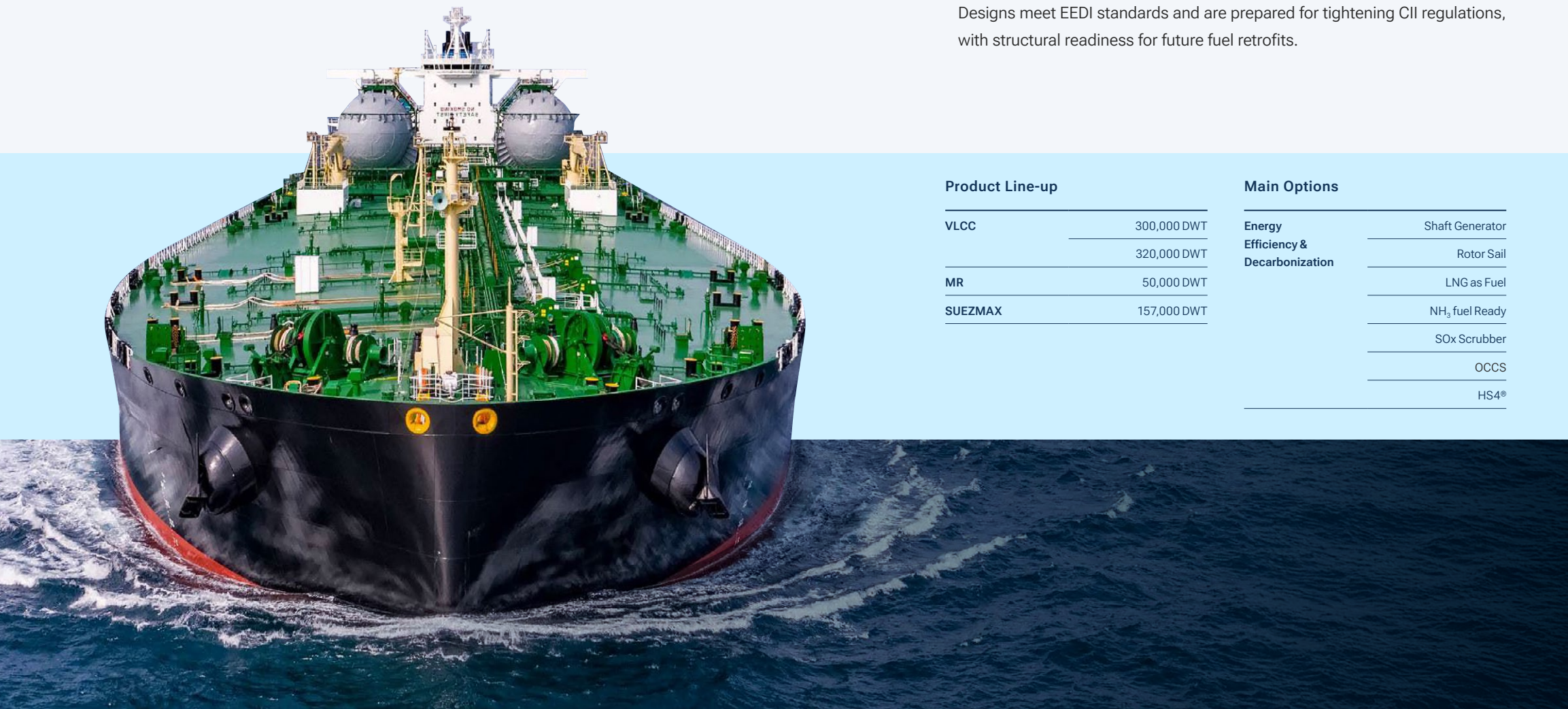
- **Leading VLCC Market Presence**
Hanwha-built VLCCs represent ~20% of the global active fleet—trusted by major energy companies, charterers, and shipowners worldwide.
- **ME-GI Dual-Fuel Propulsion Excellence**
Proven ME-GI dual-fuel two-stroke engines deliver optimal fuel efficiency, ultra-low methane slip, and LNG fuel flexibility.
- **Regulatory Compliance & Retrofit Readiness**
Designs meet EEDI standards and are prepared for tightening CII regulations, with structural readiness for future fuel retrofits.

Product Line-up

VLCC	300,000 DWT
	320,000 DWT
MR	50,000 DWT
SUEZMAX	157,000 DWT

Main Options

Energy Efficiency & Decarbonization	Shaft Generator
	Rotor Sail
	LNG as Fuel
	NH ₃ fuel Ready
	SOx Scrubber
	OCCS
	HS4®



GREEN SHIP

Enhances customer value through technology innovation



- **Driving the Future of Green Shipping**
Actively developing liquefied CO₂ (LCO₂) and large-scale liquid hydrogen (LH₂) carriers to support emerging decarbonization markets.
- **Integrated Group Green Technology**
Leveraging Hanwha Group’s renewable energy expertise to embed advanced green technologies into ship design.
- **Digital Compliance Assurance**
HS4® digital twin platform integrates real-time MRV and lifecycle GHG emissions management—ensuring regulatory compliance and operational transparency.

Product Line-up		Main Options	
LCO ₂ Carrier	20,000 CBM	Energy	HS4®
	40,000 CBM	Efficiency &	NH ₃ /H ₂ as fuel
	70,000 CBM	Decarbonization	Energy Saving Devices
LH ₂ Carrier	24,000 CBM		OCCS
	80,000 CBM		Gas Turbine
			ESS, Fuel Cells

Retrofit & Engine solutions

ENERGY TECHNOLOGIES

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Energy Technologies

1

We continue to drive innovation by advancing the use of alternative fuels such as LNG and ammonia.

MARINE PROPULSION TECHNOLOGY

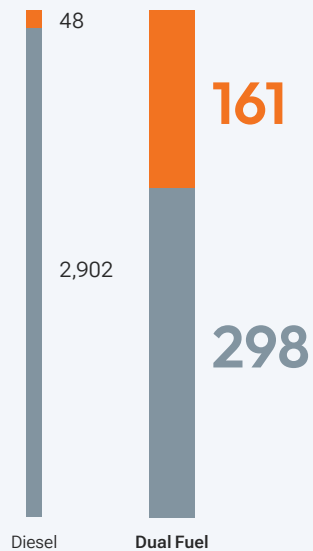
Global Top Tier Marine Engine Maker, Specialized in Dual Fuel Engines

Specialized in Dual Fuel Engines

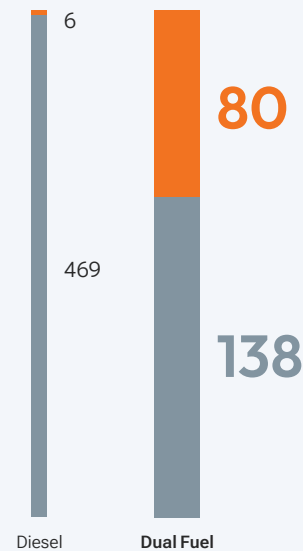
(Unit: Q'ty)

● Delivered
● Backlog

Everlence



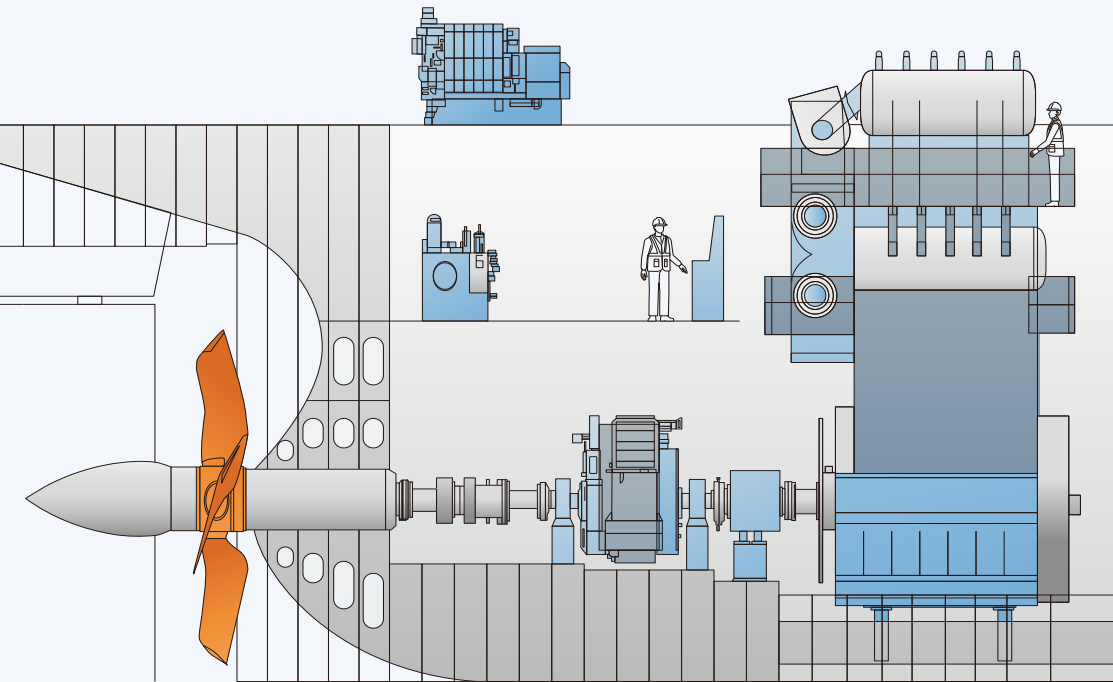
WinGD



(As of July 2025)



We are a global top-tier marine engine maker, leading the future of low-carbon shipping with our expertise in dual-fuel (DF) engines. Through continuous innovation, we deliver high-efficiency, low-emission engine solutions trusted by shipbuilders worldwide.



Main Engine

(As of July 2025)

Product Line-up		Specialized in Dual Fuel Engines (Unit: Q'ty)			
		Licensior	Fuel	Delivered	Backlog
Diesel Engine	All Size of Everllence, WinGD Type	Everllence	Diesel	2,902	48
LNG Dual Fuel Engine			Dual Fuel	298	161
			Sub-total	3,200	209
Methanol Dual Fuel Engine		WinGD	Diesel	469	6
			Dual Fuel	138	80
Ammonia Dual Fuel Engine			Sub-total	607	86
Total				3,807	295

Generator / Propulsion Engine

— Diesel — Dual Fuel

Everllence Product Line-up									
Type	Engine Type	Power [MW]						Speed [rpm]	
		2	4	6	8	10	12	14	
Generator	21/31	—							900 ~ 1,000
	21/31DF-M	—							900 ~ 1,000
	23/30	—							720 ~ 900
	23/30DF	—							720 ~ 900
	28/32DF	—							720 ~ 750
	27/38	—							720 ~ 900
	L32/40		—						720 ~ 750
	V32/40			—					720 ~ 750
	L35/44DF CD		—						720~750
	L35/44CD			—					720~750
Propulsion	21/31	—							1,000
	27/38		—						750 ~ 900
	175D			—					1,800 ~ 2,000
	28/33D STC				—				1,000
	L32/40			—					720 ~ 750
	V32/40				—				720 ~ 750
	L32/44CR				—				720 ~ 750
	V32/44CR					—			720 ~ 750

LNG Dual Fuel Retrofit

DF conversion on vessels involves retrofitting the ship's propulsion system, including main engines and fuel systems, to enable it to use an alternative fuel, aiming to improve fuel flexibility, reduce emissions, and lower OPEX, ensuring compliance with regulations. Converting to Dual Fuel is the most efficient and reliable solution for addressing both the demand from charterers for lower emission transportation and decarbonization legislation at the IMO and regional levels.

Retrofit Concept
(Scope of Work)

1

Main Engine
Retrofit

2

Fuel Gas Supply System
with Bunker Station

3

Alternative Fuel
(LNG, Methanol, Ammonia) Tank

***Technical Benefit :** Compliance GHG regulation,
Fuel Flexibility

CAPEX for LNG

About

25-55
Mil. USD

CAPEX for MeOH

About

28-45
Mil. USD

Cost Benefit

* For VLCC LNG DF Conversion
* Estimation in Fuel Price, EU ETS and Operating Profile
* Plus 4 – 5 Mil. USD per year considering Fuel
EU Maritime

2-3
Mil. USD per year

Project Schedule

* incl. work in repair yard

Total

22-24
months

NH₃ GT

(Ammonia Gas Turbine)

Leveraging Hanwha Group's proven strengths in sustainable solutions and broadening our scope, we are fully committed to developing next-generation ammonia gas turbines in partnership with energy technology leader Baker Hughes. These turbines are designed for use on 174K LNG carriers as well as container ships of various sizes. They are capable of running on 100% ammonia—with zero pilot oil—enabling truly carbon-free operations.

In addition, they offer outstanding fuel flexibility, operating on 100% ammonia, 100% natural gas (NG), or any ammonia-NG blend. This versatility ensures cost-effective performance in line with future fuel prices and emissions regulations. Emissions are kept to an absolute minimum, with negligible methane slip, ammonia slip, and N₂O emissions, while still meeting Tier III NO_x standards for large low-speed engines—without the need for after-treatment systems.

Their compact design allows for ammonia fuel storage without compromising cargo capacity, and they include dedicated safety enclosures to address the unique handling requirements of ammonia fuel.

1

Applicable
to All
Commercial
Vessels

2

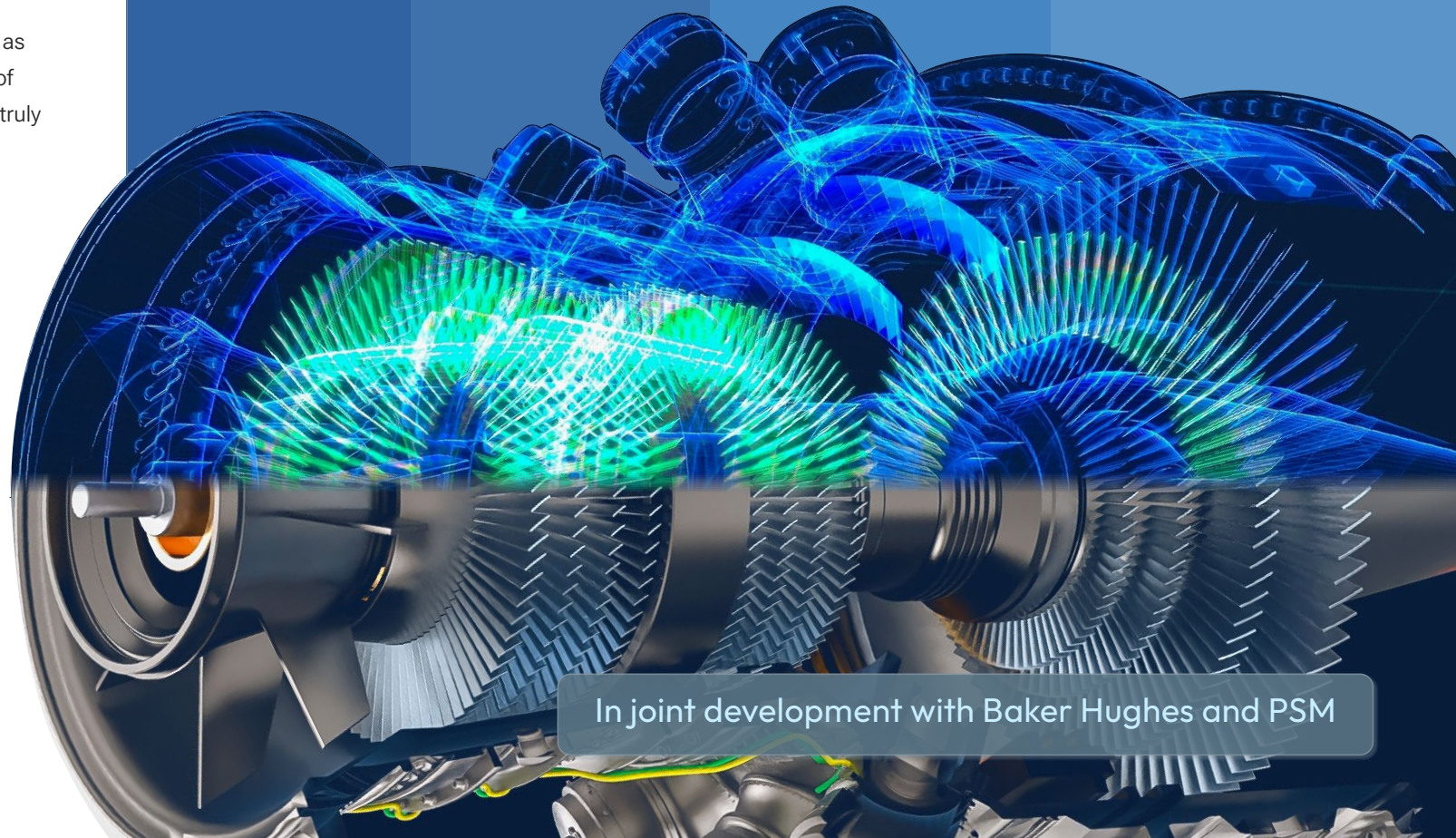
Full
Carbon-Free
Operation

3

Negligible CH₄,
NH₃ slip and
N₂O emissions

4

Increased Fuel
Flexibility and
Affordable Costs



In joint development with Baker Hughes and PSM

ESS & Fuel Cell Based Electric Propulsion

ESS (Energy Storage System)

Flexible application depending on vessel type, based on various chemistry

World-class safety design :

From the unit cell to the lithium battery system, multiple safety measures have been integrated such as status detection at each stage and establishment of countermeasures in case of failure, to ensure unparalleled safety in extreme marine environments.

1 Seal Energy

NCM (Nickel-Cobalt-Manganese) Battery with Non-Hazardous Insulating Liquid Immersion Solution

Seal energy provide ZERO risk propagation by maximizing cooling efficiency and innovative fire safety & heat rejection.

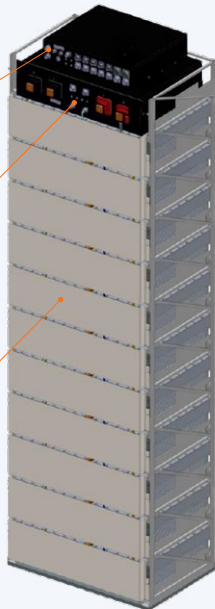
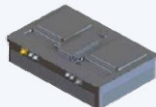
SPU (System Protection Unit)



BPU (Battery Protection Unit)



Battery Module



2 Coral Life

LTO (Lithium-Titanium-Oxide) Battery Solution:
For the Best Power, Safety, and Life Time

CORAL-LIFE is a Long-Life and High-Safety Battery Solution with High C-rate Support. It uses LTO batteries with the lithium-Titanate anode material. It is designed with a rack-less structure, allowing battery packs to be stacked in a plug-and-play manner. Therefore, there is no need for external busbar connection or communication cabling.



3 Coral Eco

LFP (Lithium-Iron-Phosphate) Battery Solution:
For better safe and economical Solution

CORAL-ECO is a lithium-ion battery system for use in applications such as battery-powered and hybrid vessel and etc. It adopts Lithium Iron Phosphate battery, which has the competitive edges in life-cycle, fire safety, and cost-efficiency.

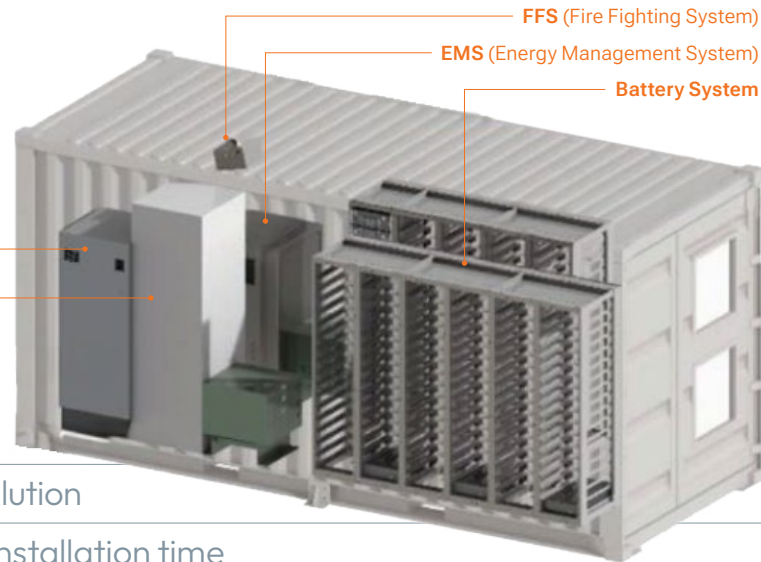


Container Solution

Swappable operation reduces charging time and increases operational efficiency, thereby minimizing operational downtime and addressing the challenge of a lack of on-shore charging infrastructure.

DC/AC Switchboard

FFP (Fire Fighting Panel)



Hanwha provides

Plug-and-Play battery room solution

that can significantly lower its installation time

and provide easy maintenance and efficient space.

Onshore Charging Station

Hanwha provides Reliable and Sustainable "Total package solution" to cover both Marine and On-shore charging ESS application. Regardless of various project requirements, Hanwha is capable of supplying "package solution" to meet the requirement.

- NCM and LFP solution is available
- "Indoor" and "Outdoor Enclosure Type" are available depends on different installation environment
- Upon Customer's request, Hanwha is also flexible of scope of work including "AC equipment" and installation at site

Shore to ship



Floating type



Container type



Renewable linked



AC: High Voltage (Cruise, Container) / DC: Low Voltage (Ferry, Harbor craft)

FC MARINE 200

The Future of Marine Fuel Cell Power

The Future of Marine Fuel Cell Power

A next generation fuel cell system engineered specifically for maritime applications. Combining cost effective design with marine-specialized features, it delivers efficient performance without compromising reliability. Designed for front accessible maintenance, the system ensures minimal downtime and simplified servicing.



Applications

- Ferries / Cruise
- Car carrier
- Hydrogen carrier
- Ammonia/LPG carrier
- Inland/river cruise vessels
- Onshore electric charger

Features

- Exceptional efficiency and uncompromising life time with in-house marine-specialized fuel cell stack
- Self-contained dual redundant cell voltage monitoring system
- Dedicated extendable controller for seamless control of multi modules
- Comprehensive safety architecture for maximum protection
- Zonel NE compliance with minimal vent flow via unique airflow design

Energy Technologies

2

Renovate ships to operate more efficiently and reliably.

Retrofitted ships increase the shipowners' satisfaction with efficient operation.

GENERAL RETROFIT TECHNOLOGY

Cargo Capacity Improvement Retrofit

The cargo capacity can be maximized by increasing the stack weight and tier of the containership through the additional tier of the lashing bridge or Mickey mouse for the vessel.

Retrofit Concept (Scope of Work)

1

Accommodation (Deck house)
Elevation

2

Higher Lashing
(Additional Tier)

3

Added Mickey
Mouse

4

Lashing Concept
Change

Effect

It maximises the financial return on slots and reduces the carbon intensity of each box carried

Accommodation (Deck House) Elevation



Higher Lashing (Additional Tier) with Mickey Mouse



EPLO

(Engine Part Load Optimization)



- Höegh Autoliners secures fuel savings and long-term CII compliance
- with Accelleron and Hanwha Engine part-load optimization

Increase the value of vessel,
Comply with upcoming regulation,
Reduce cost

Saving fuel oil
consumption



EU ETS
cost saving



CII
improvement



2-stroke engines with Accelleron Turbocharger

- MC/ME Series
- RTA/RT-Flex Series

- The main engine is derated and tuned for part load operation
- The turbocharger(s) are rematched to the new rating to optimize engine performance



Energy Technologies

3

These lower emission technologies enhance
by structurally retrofitting existing ships and maximizing fuel reutilization.

ENERGY-SAVING TECHNOLOGY

BOG Re-liquefaction

Hanwha develops existing own NRS®(Nitrogen Refrigerant System) for targeting LNGC. BOG is re-liquefied by using cooling duty produced by compressing and expanding the N₂ refrigerant through N₂ Reverse Brayton Cycle.

Retrofit Concept (Scope of Work)

1

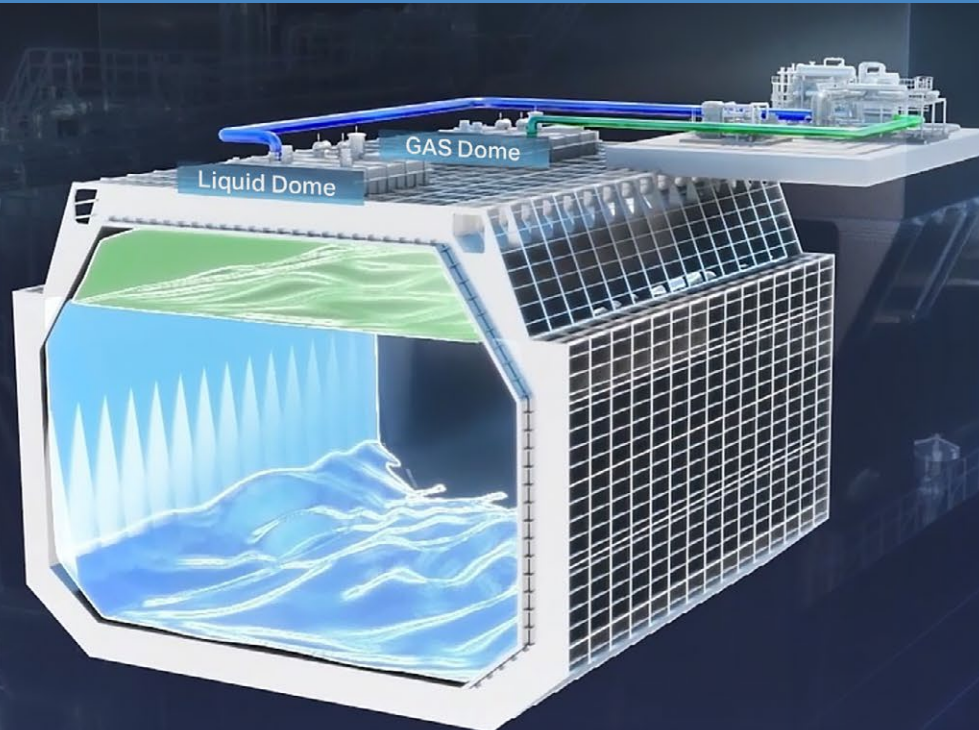
Re-liquefaction System
(Hanwha NRS / Sub-cooler)

2

Cooling Sea/Fresh Water Pump/
Cooler in Engine Room

3

Electrical
Modification



Major Modification Work Scope

- BOG/Condensate Pipeline for Re-liquefaction System (Supply/Return)
- Cryogenic Valve / Filter Train / Insulation

Re-liq. Capacity

Hanwha NRS (for Retrofit Vessels)

2.1/2.8 TPH

Sub-cooler

1.5/2.1 TPH

WAPS- Rotor Sail



Rotor sails are a flagship energy-saving solution that harness wind power – a clean and renewable resource. Hanwha delivers rotor sails to the market that meet top-tier performance and efficiency standards.

- High-quality design by engineers with long experience in ship design
- High operational stability through collaboration with the world's first land test center
- Operational convenience through optimal arrangement on a vessel through collaboration from the early stage of ship design and various options for safety, maintenance

Power & Fuel saving and EEDI

LNGC

25M (L) x 5M (D)

Number of Rotor Sail

1



2



Power saving
@ 17.0 knots

2.7%¹⁾ ~ 11.2%²⁾

5.1%¹⁾ ~ 22.4%²⁾

VLCC

35M (L) x 5M (D)

Number of Rotor Sail

1



2



3



Power saving
@ 12.0 knots

3.7%¹⁾ ~ 13.4%²⁾

7.4%¹⁾ ~ 26.8%²⁾

10.8%¹⁾ ~ 39.1%²⁾

- 2021 guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI and EEXI is adopted (MEPC 76)
- Based on global wind data on the main global shipping routes
- Interaction effect between rotors or the rotor and superstructures were considered

¹⁾ Calculation according to MEPC 76 guidance based on global wind probability ²⁾ Calculation under the most favorable wind condition

- Optimal arrangement of Rotor Sail through CFD Analysis considering international regulations
- Reliable performance prediction with CFD, Wind tunnel test & Prototype Test

ALS

(Air Lubrication System)

Hanwha developed ALS (Air Lubrication System).

With the Air Lubrication System control and monitoring system, you can expect a technical effect of about 5% to 9% of net power saving.

Retrofit Concept

(Scope of Work)

1

One(1) Air Compressor
(Turbo Type, less OPEX than Screw Type)

2

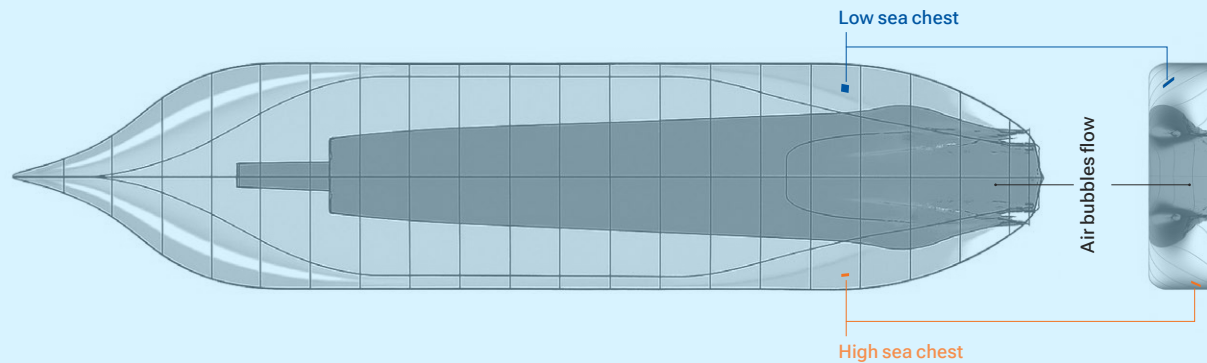
Air Injection units with including
pipelines, flow control valves

3

FW, LO Coolers for
air and compressor

4

Control &
monitoring system

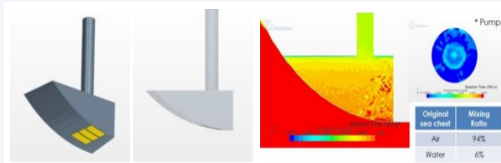


Model and Performance based on CFD Analysis

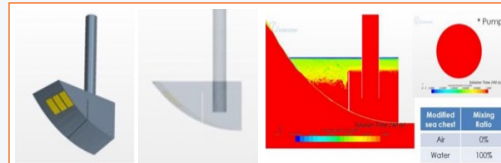
- Air Flow and Sea Chest Modification

- Prevent air inflow to the seawater pump suction
 - 1) The inlet position and internal structure of the sea chest to be modified
 - 2) Air vent pipe to be installed and seawater pipelines to be modified
- Based on full-scale CFD simulation results, the air bubbles are not drawn into the sea chest
- Considering actual sea conditions, sea chest modification is recommended to ensure no risk of airflow into the seawater system

Original sea chest



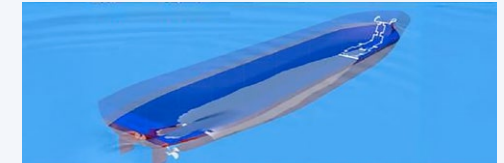
Air outlet hole Modified sea chest



Air outlet hole



Air layer on bottom



WSC

(Wind Saver Cap)

WSC is a structure that reduces air resistance on a containership, improves fuel efficiency, and protects cargo by dispersing airflow at the front and sides of the ship.



Expected Efficiency

1.5-2 %

Project Schedule

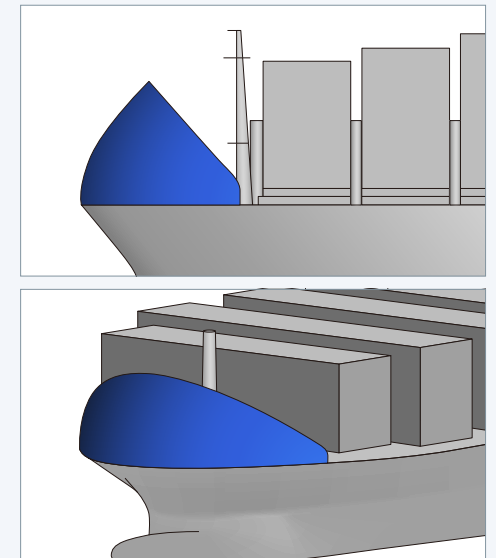
Total **4.5** months Dry-dock **18** days

Reference (order book) : Total 6 vessels

- Hapag-Lloyd, 23K TEU CNTR x 2
- HMM, 23.7K TEU CNTR x 4

- Numerical wind tunnel is employed to evaluate wind cover design
- Effectively reducing the wind resistance on a container stack
- Estimation of wind cover was carried out considering various wind speeds and wind directions at full loading conditions

2 Types



Bulbous Bow / Propeller Optimization

By retrofitting the bow to align with the vessel's operating profile, Hanwha delivers significant efficiencies.

1

Hull resistance reduction

2

Propulsion efficiency increases

3

Reduction of carbon emissions & fuel consumption

Expected Efficiency

3-5 %

Project Schedule

Total

1 Week

Reference

- **WALLENIUS 8,000 Units PCTC : (3) Engineering : Bulbous Bow Only**
- **WALLENIUS 6,700 Units PCTC : (2) Engineering : Bulbous Bow Only**
- **Sonangol 160K LNGC : Feasibility Study : Bulbous Bow & Propeller Optimization**



Energy Technologies

4

We realize a Sustainable Voyage by developing differentiated
Low-emission propulsion technologies and next-generation energy carriers.

LOW-EMISSION TECHNOLOGY

OCCS

(Onboard Carbon Capture & Storage)

OCCS is a technology that captures carbon dioxide generated during ship operation and stores it onboard the ship or transports it to land for storage. This is one of the key technologies that contributes to achieving the shipping industry's carbon neutrality goal by reducing carbon emissions from ships.

R&D Plan

Pilot-scale Test Plan (2025~2026)

- Lab. Test
- Manufacture and install skid on vessels (Pilot-scale)
- For 300K VLCC, CO₂ Capture Capacity : 36 TPD (24 TPD except for CO₂ that is additionally generated by OCCS operation)
- Utility consumption (under improvement)
- Steam for regeneration : about 2 ton/h, Electric power for aux. system and liquefaction : about 370 kW

Actual-scale Detail Design (2026~2027)

- For Commercial Vessels: LNGC, VLCC, Container, VLGC, LCO₂C
CO₂ Capture Capacity : about 150 TPD or more
- For Offshore Plant: FPSO, Drill ship
CO₂ Capture Capacity : about 1,400 TPD or more

Testing Onboard during Sea Trial (Aug. 2022) [174Kcbm LNG Carrier]

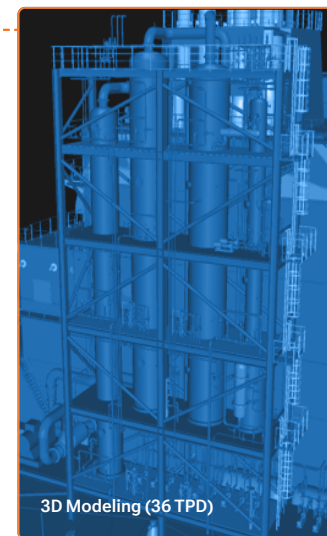
Test Skid

Capacity

50kg/h
of CO₂ Capture

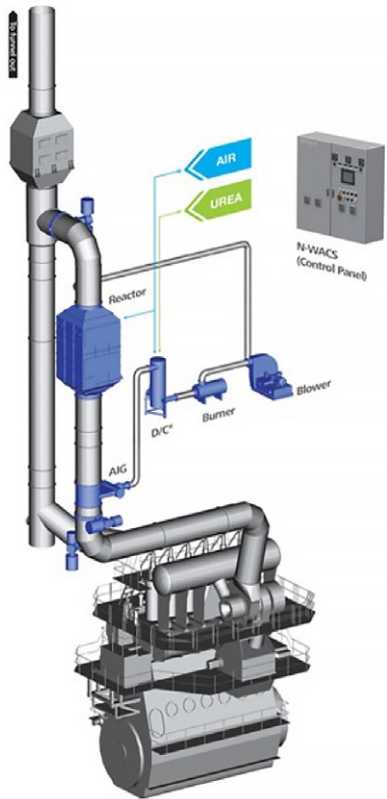
Test Scope

CO₂
Capturing Onboard

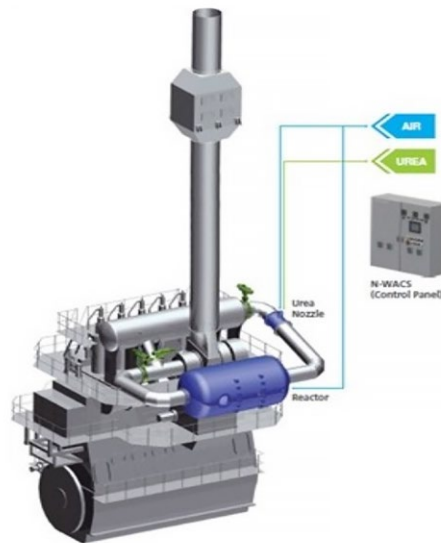


DeINOX[®] SCR (NO_x Reduction System)

LP-SCR at downstream of T/C

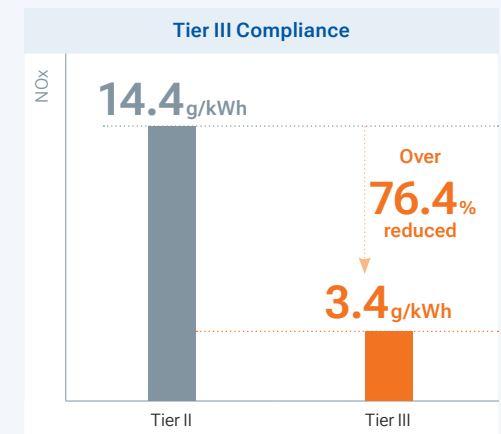


HP-SCR at upstream of T/C



Hanwha manufactures NO_x reduction system (DeINOX[®]) for ships and land based industries such as diesel power plant, and responds to customer needs through providing installation, maintenance & repair services and various technical supports.

DeINOX[®] has the LP (Low Pressure)-SCR system at downstream of turbocharger (T/C) and HP (High Pressure)-SCR system at upstream of T/C. LP-SCR is the world's first SCR system installed at the downstream of T/C and applied low temperature catalyst as a new concept. Based on excellent performance and technology, it is being produced in earnest from 2016 when IMO Tier III regulation came into effect.

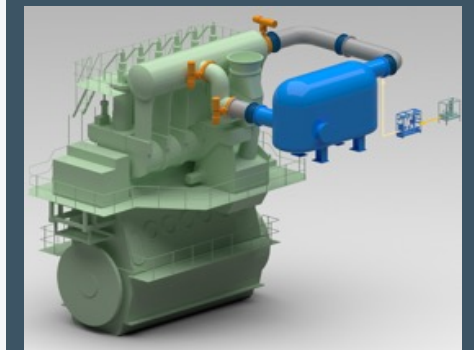


Product Line-up

Type	Power Range	
Low Pressure SCR (0.1% S)	3~82 MW	Vertical Reactor
		Horizontal Reactor
High Pressure SCR (0.1% S, 3.5% S)	6~64 MW	Conventional HP SCR
		Compact U-SCR

Development of compact type U-SCR

- Reduce the footprint
- Remove the installation restrictions
- Flexible and easy installation



GCU (Gas Combustion Unit)

On LNG carriers, GCU burns excess boil-off gas for safety reasons.

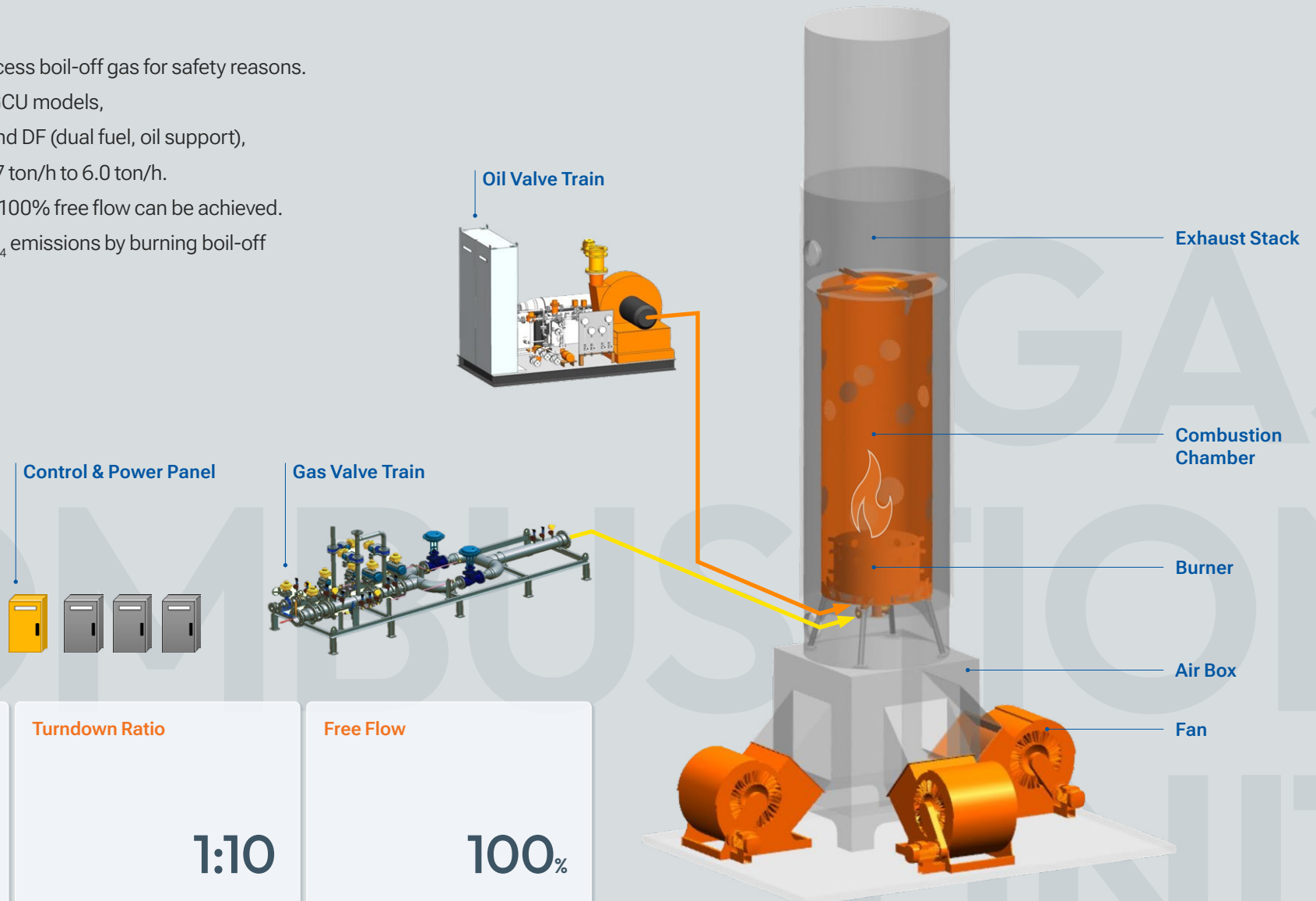
Hanwha offers two types of GCU models,

SF (single fuel, spark ignition) and DF (dual fuel, oil support),

with capacities ranging from 1.7 ton/h to 6.0 ton/h.

The turndown ratio is 1:10, and 100% free flow can be achieved.

The DF model can minimize CH_4 emissions by burning boil-off gas under N_2 rich conditions.



Capacities Ranging

1.7-6.0 ton/h

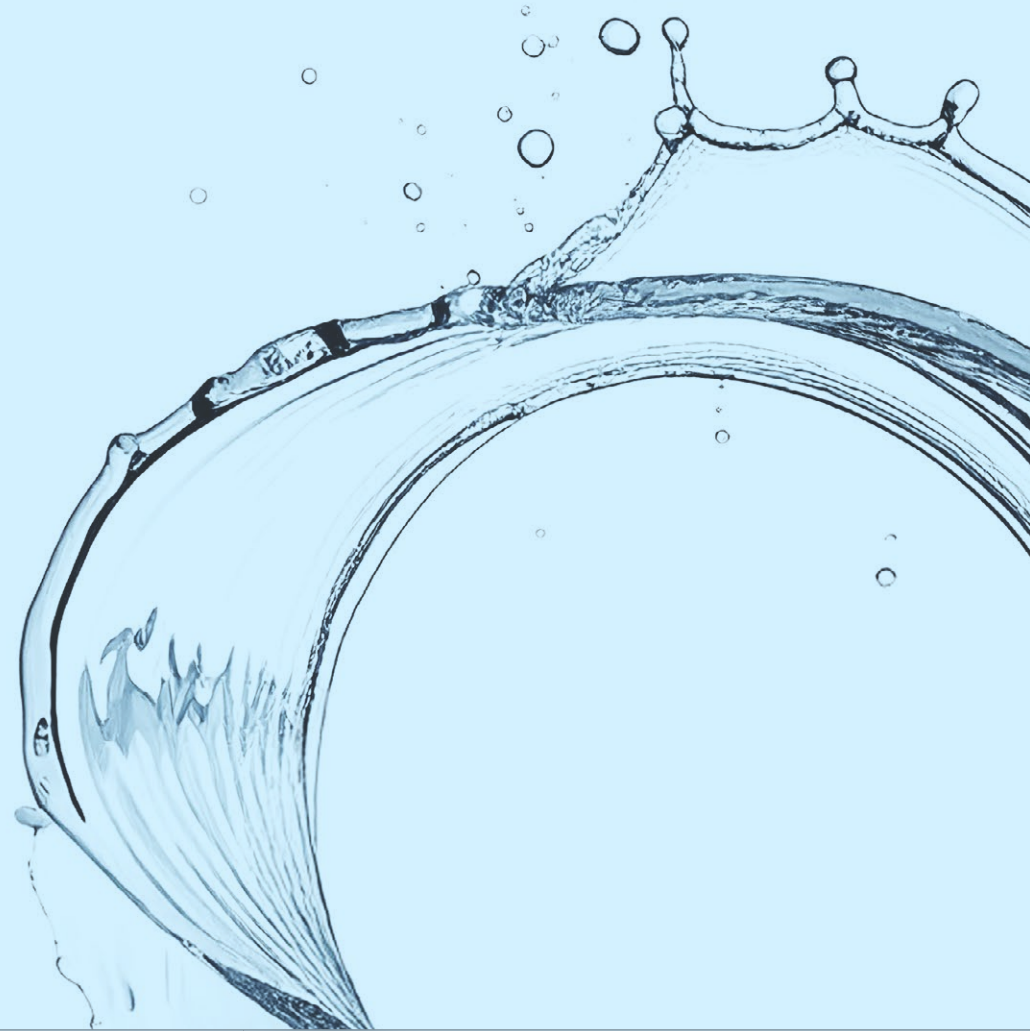
Turndown Ratio

1:10

Free Flow

100%

SMARTSHIP SOLUTIONS



46

49

50

Smartship Solutions

Since 2018, Hanwha has been pioneering digital-based smartship solutions with its HS4® platform. In 2023, Hanwha expanded its innovation by developing the Data Platform tailored for small and mid-sized vessels and the Integrated Automation System (IAS). Hanwha is committed to delivering a total data-driven smartship solution that ensures comprehensive monitoring and control of vessel conditions - both onboard and onshore.

Onshore

MRO

Maintenance, Repair, and Operations

- Ensure reliable system performance through repair
- streamlines spare part management for prompt maintenance

CBM

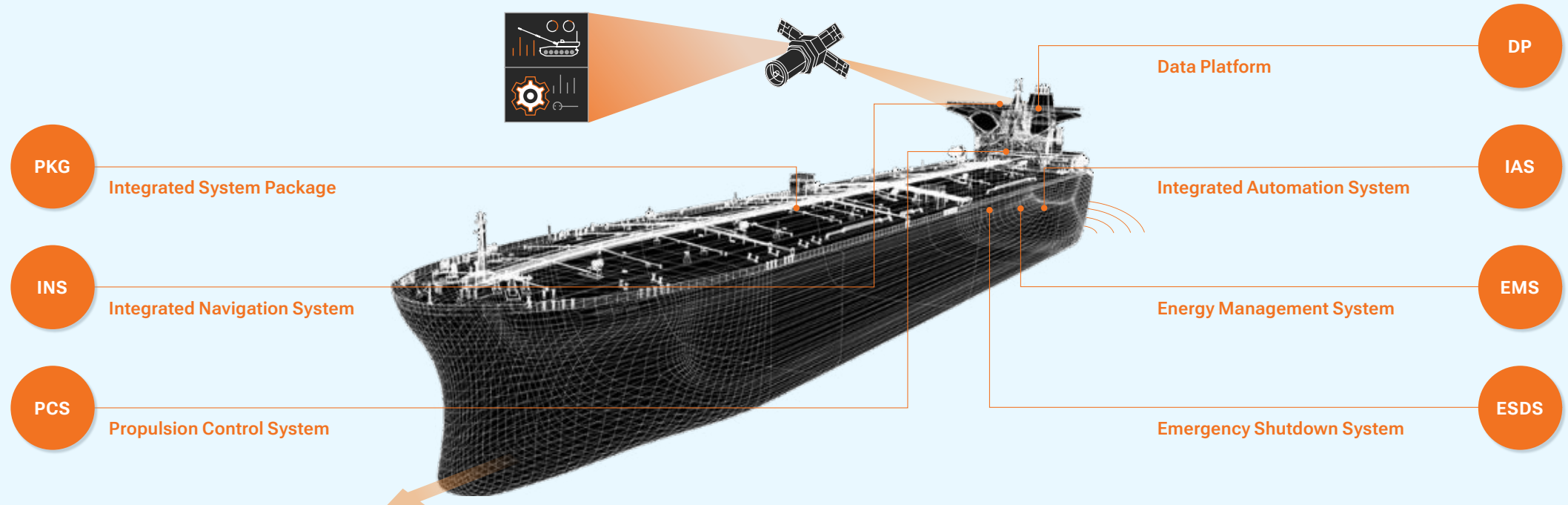
Condition-Based Maintenance

- Predictive failures with real-time equipment monitoring
- Optimizes maintenance schedules based on data

RMS

Remote Monitoring System

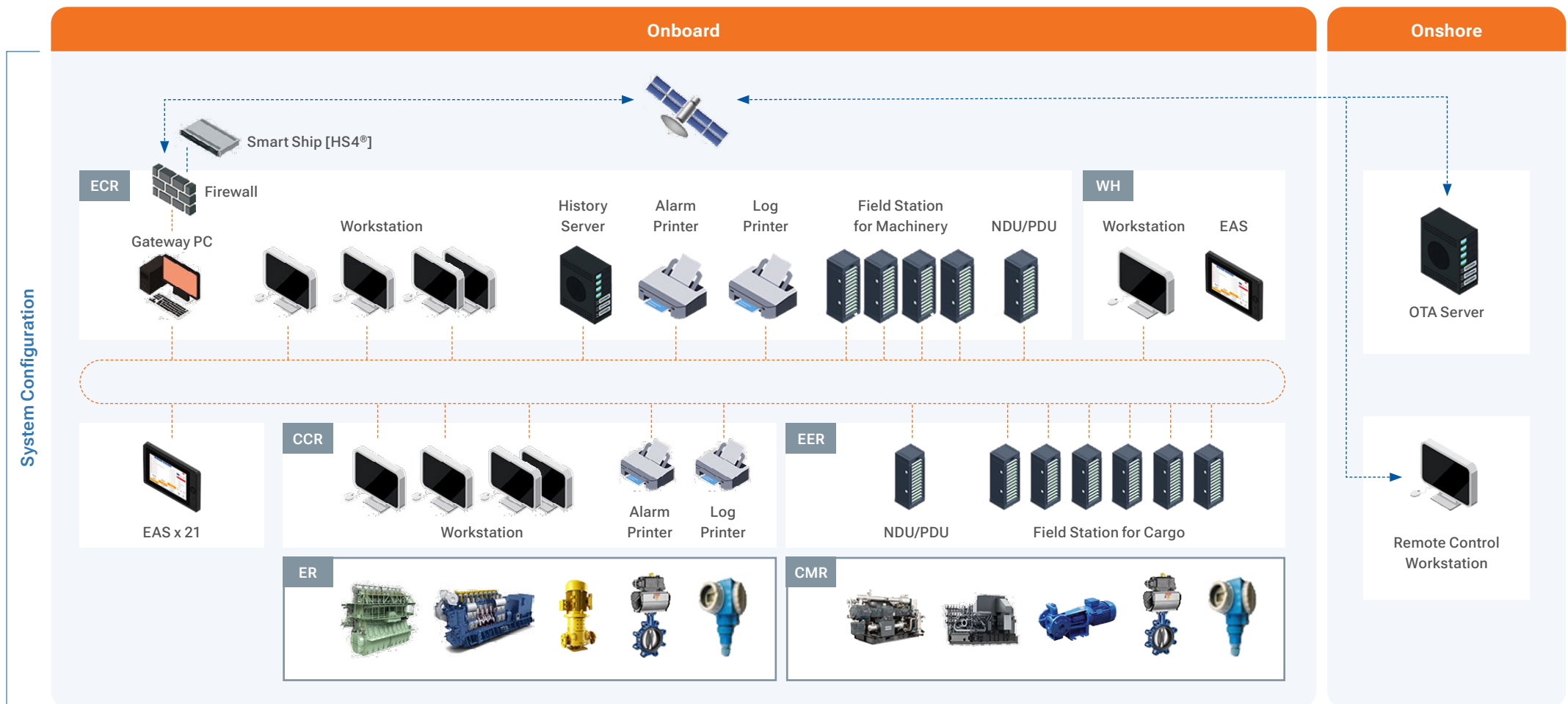
- Enables shore-based access to onboard data
- Enhances operational efficiency with remote support



IAS (Integrated Automation System)

HICS (Hanwha Intelligent Control System)

Hanwha's Integrated Automation System (IAS) delivers reliable, high-performance control and Monitoring for modern marine operations. With a focus on system stability, HICS offers intuitive operation and simplified maintenance. Its compact and robust architecture ensures smooth integration with various shipboard system, supporting efficient and safe vessel management.



HS4® (Hanwha Smart Ship Solution & Service)

The Hanwha Smart Ship Solution & Service (HS4®) is a comprehensive solution designed to enhance the management and operation of your ships, making them more efficient, safe, convenient, and transparent. By providing real-time operational data on critical equipment and systems, HS4® supports informed decision-making and ensures seamless control both onboard and ashore. This enables up-to-date and comprehensive fleet management at a higher level, giving you the tools you need to optimize performance and safety.

Efficient

Safe

Convenient

Transparent

Smart Maintenance

- Condition Monitoring
- Alarm Monitoring
- Smart BOG

Smart Ops for Crew

- Data Viewer & Report
- Network Monitoring
- HS4® System Management

Smart Navigation

- Voyage Monitoring & Planning
- Performance Monitoring
- Emission & CII Monitoring



Onshore Service

- Fleet Management
- Remote Monitoring
- Data Sharing with API

Data Platform & Framework

- Open, Flexible and Robust
- Secure Network Inside and Outside of Ship
- Connectivity with Various Protocols



Data Platform

The Smart Foundation for Vessel Information Systems

Data Platform is a versatile solution designed to collect, distribute, and analyze data and events from third-party systems. Supporting up to 10,000 tag points, it securely stores data alongside alarms and events in high-performance databases for optimized operations. This solution operates independently of the HS4® full-service platform and is engineered for compatibility across various vessel types. Its flexible architecture includes compact, lightweight devices for seamless integration on board. Connected shoreside services offer cloud-based data management and advanced analytics for alarms and events — providing valuable insights to enhance vessel operations and performance.

Cloud-based real-time data collection solution to acquire maritime and ship data customized for **A variety of sized vessels**
Focused on decarbonization and compatibility

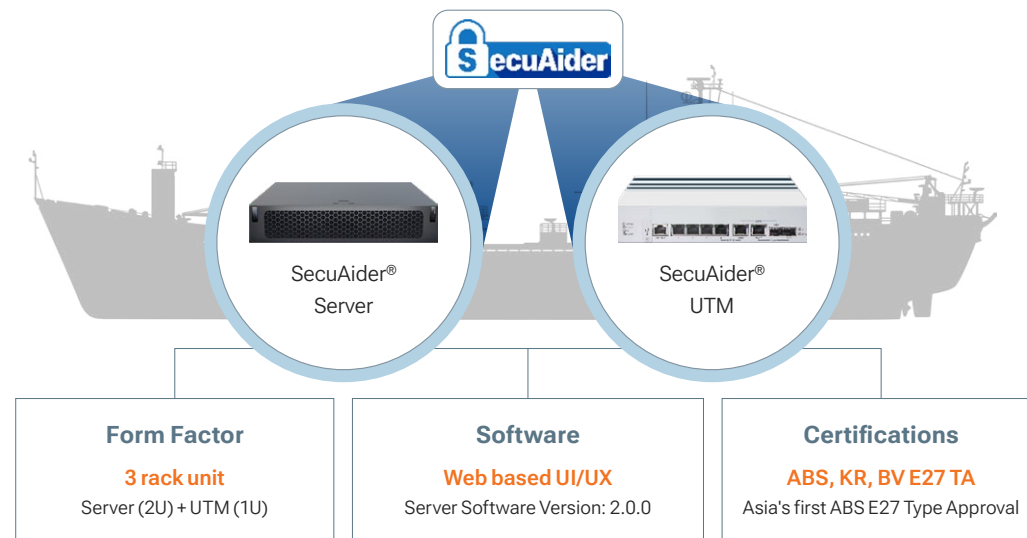
Key Benefits

- Global remote service support
- Localized, single-source repository
- Remote data analysis with automation
- Enhanced security
- Compact and cost-effective
- Customizable AMS, PCS, ESS, EMS data and Compatible with our smart ship services

Cyber Security

SecuAider®

Hanwha proposes SecuAider® as a strategic solution to support E26 compliance, enhance cyber resilience, and reduce OPEX for maritime industry - Shipowners, Builders, Class Societies and Suppliers.



Cyber Risk Management for Cyber Resilience of Ships

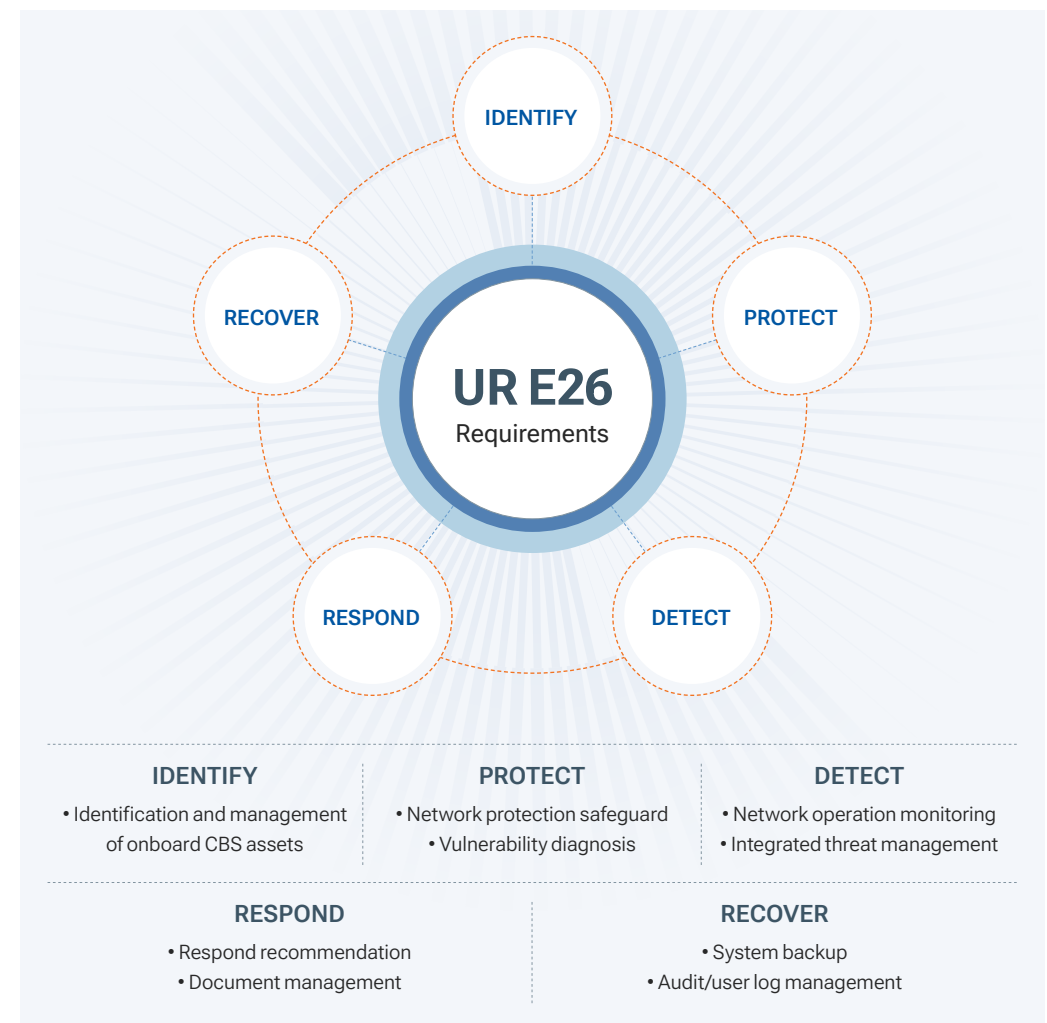
Proven in Defense

SecuAider®-Naval solution is operating in naval combat ships of ROK Navy

Proven in Maritime

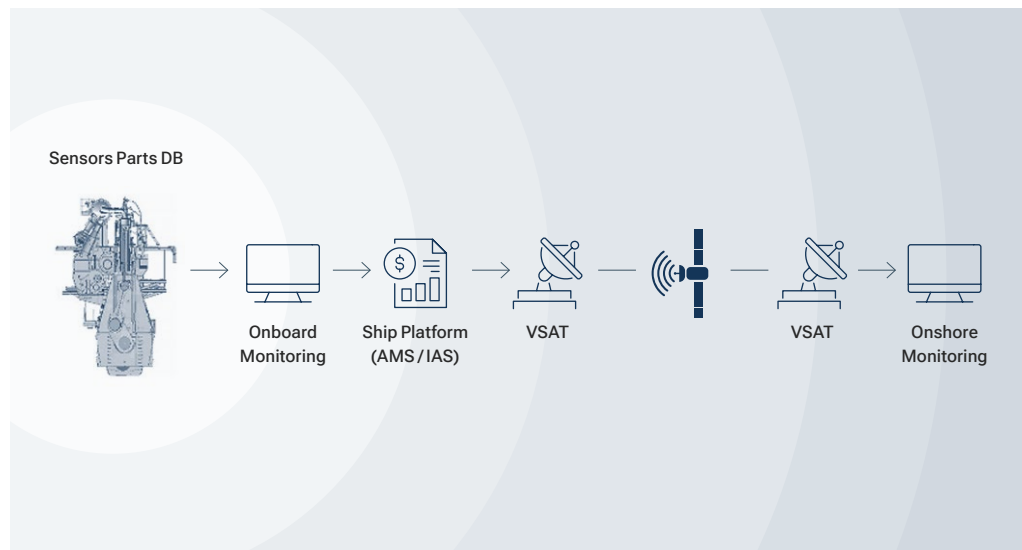
SecuAider® is being deployed across diverse vessels, including VLCCs, LNG carriers, Containerships, FPSOs, and icebreaking research vessel

SecuAider®'s Primary Functions for UR E26 Compliance



Remote Engine Monitoring Solutions & Hanwha Engine CEMS

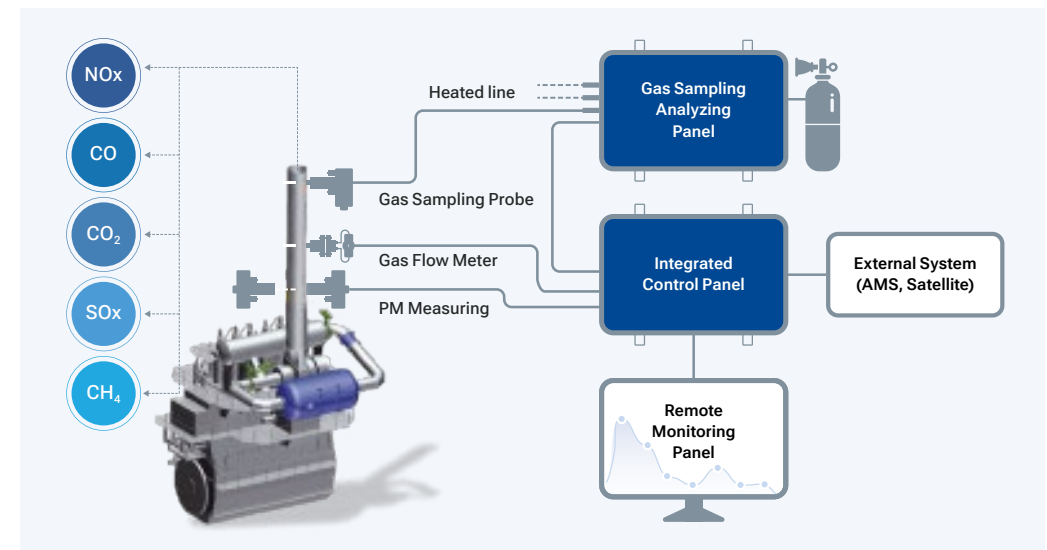
Hanwha Remote Engine Monitoring Solution



Web-Based Remote Engine & SCR Monitoring Solution

Our web-based monitoring solution enables continuous observation of both main and auxiliary engines, as well as the Selective Catalytic Reduction (SCR) system, from onshore locations. By continuously collecting and analyzing engine and emission system data, the solution allows for early detection of anomalies, root cause identification, and prompt development of effective countermeasures. As part of the smartship solution, SCR operations are monitored via the cloud, with SCR experts analyzing operational data in real time to help customers resolve alarms quickly and accurately. Accessible from anywhere with an internet connection, the platform offers global visibility into engine performance and emission control conditions—greatly enhancing vessel reliability and maintenance efficiency.

Hanwha Engine CEMS



Hanwha Engine CEMS – Optimized for IMO & EU Emission Regulations

Developed with Hanwha Engine's proprietary technology, the Continuous Emission Monitoring System (CEMS) is a high-precision solution designed to fully comply with IMO MARPOL as well as the latest EU environmental regulations, including EU ETS, MRV, and DCS. Hanwha Engine is the only supplier capable of independently developing and manufacturing the Main & Aux engine, SCR system, and CEMS, providing a fully integrated solution. By connecting the entire process—from measurement and monitoring to reporting—into one system, we deliver unmatched operational efficiency for both shipowners and operators.

SERVICES



Technical Support

Your Trusted Partner

Driving Customer Value.
Powering Profitability.

Through open exchange of ideas
and the latest insights,
we deliver solutions that
drive performance and innovation.



Design
Forum

Technical
Seminars

Bespoke
Presentations

Co-creation

Update
Bulletins

Pilot
Programmes

Concept, Design, Delivery

Operation

Contract



Design



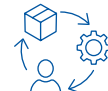
Manufacturing



Life Cycle



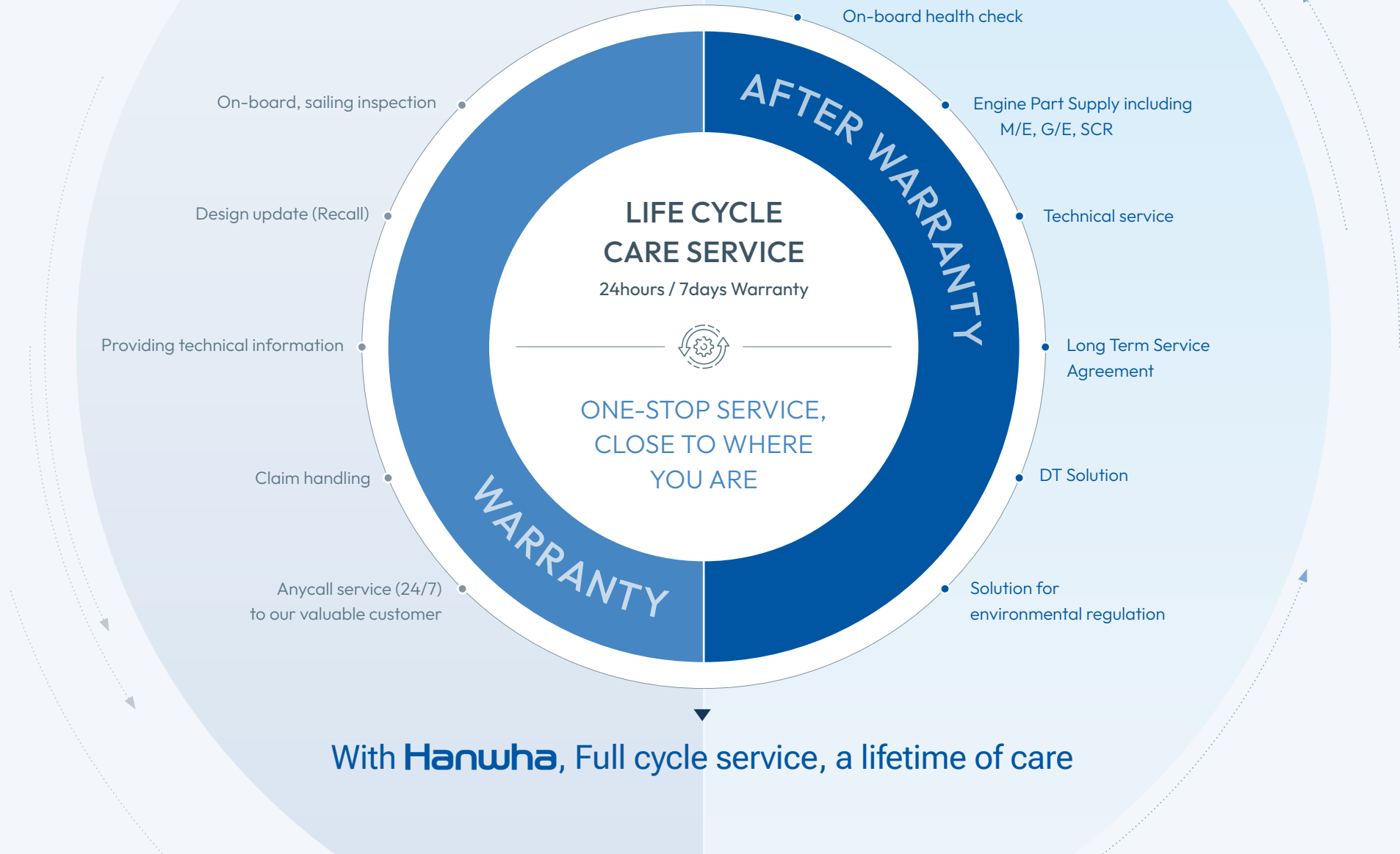
Life Extension



Whatever the challenge, Hanwha delivers solutions

Customer Satisfaction

Life Cycle Care Service



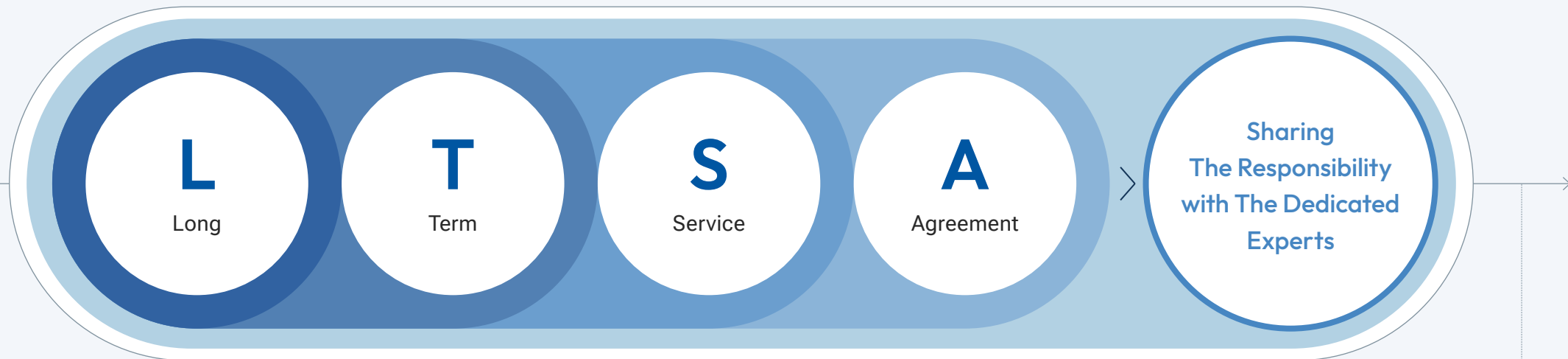
With **Hanwha**, Full cycle service, a lifetime of care

Customer Satisfaction

LTSA (Long Term Service Agreement)

LTSA with a reliable partner allows customers to keep the vessels in safe and stable condition.

Hanwha contributes to creating greater value for customers.



Saving Cost

- Prevent unexpected price increment



Saving Manpower

- No need for daily purchase activity



On Time Delivery

- All the spare parts will be delivered on time



Strategy & Planning

- Budget management
- Process set-up



Asset Management

- Operating cost
- Risk management
- Maintenance history

A large, stylized graphic of a water splash or wave, rendered in a light blue color, centered on the page. It features several concentric, overlapping loops and droplets, creating a sense of motion and fluidity.

Hanwha,
Your trusted maritime partner

