

# Accelerating decarbonization via hull efficiency improvement

Scaling up the adoption of advanced hull coatings

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**ROYAL DANISH  
EMBASSY**  
Manila



# Marine Biofouling: Fouled Underwater Hull



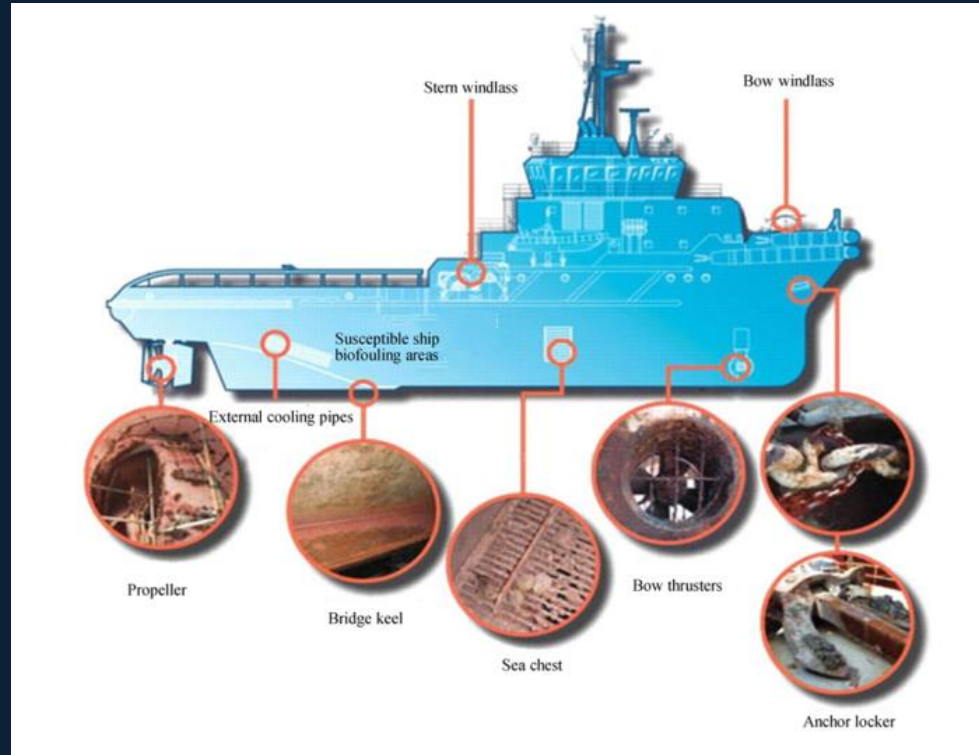




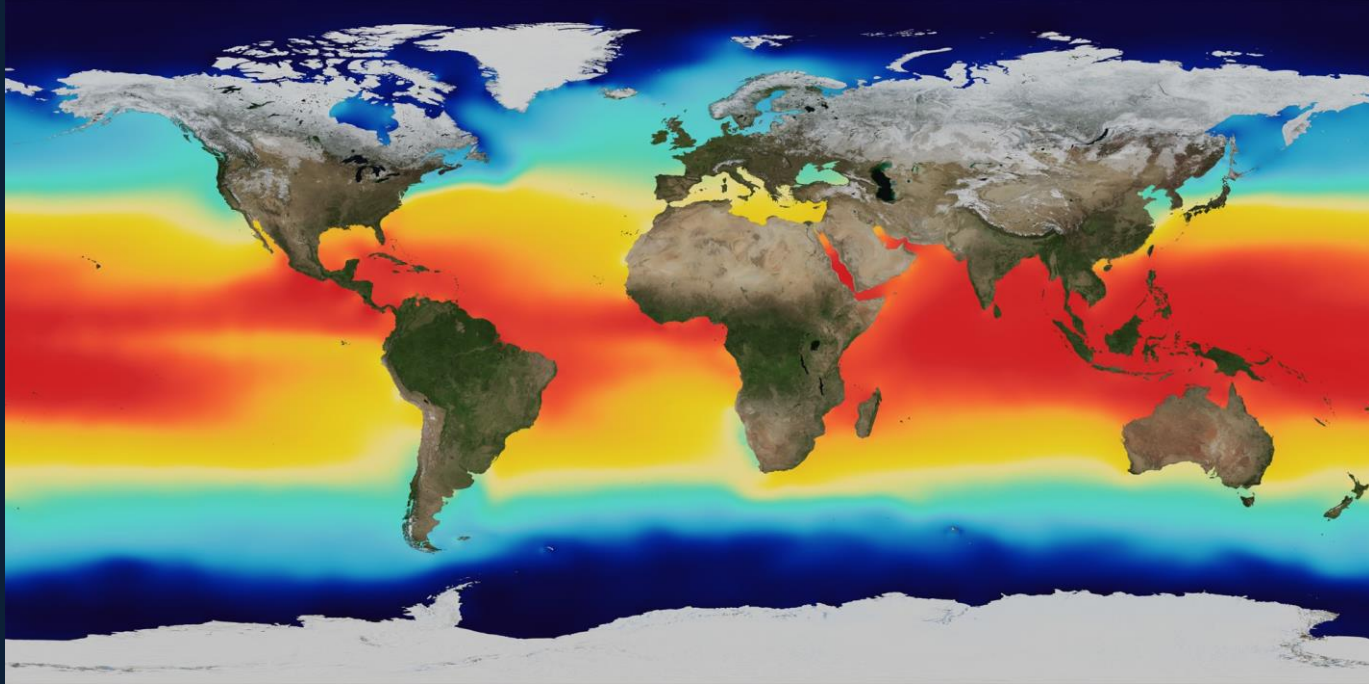
## Invasive Species: [Black-striped Mussel](#)

- High-risk threat to Northern Territory waters.
- Invaded Darwin Harbour marinas in 1999 but was successfully eradicated.
- Spreads on hulls and internal seawater plumbing of commercial & recreational vessels.
- Multiplies rapidly and forms dense groups that can substantially reduce local biodiversity.
- Can cause massive fouling on wharves, marinas & seawater systems, and can damage marine farms.

# Vessel biofouling as a vector for invasive species



# Water temperature and fouling pressure



# The effect of fouling: Fuel Penalty



Slime fouling  
~1-5% fuel penalty

Increase in fouling



Weed fouling  
~10-15% fuel penalty

Increase in frictional  
resistance



Animal fouling  
~40% fuel penalty

Increase in fuel  
consumption

# Combating the fouling challenge: **Hull Coating Solutions**

**AF  
(SPC)**

## **Conventional Antifouling coatings**

Work by delivering biocides from a polymer system that deters the settlement of fouling organisms

**FR**

## **Fouling Release coatings**

Work through physical means involving modifying the surfaces of the coatings making it difficult for fouling organisms to remain attached.




**FD**

## **Fouling Defence coatings**

Utilises both methods as mentioned above.

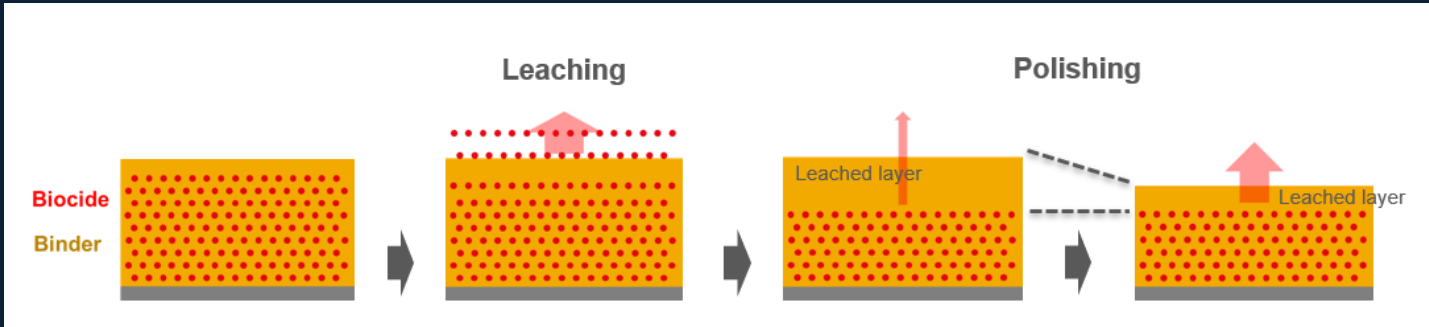
# Biocide types & combinations: Designed for maximum antifouling performance

- Not all the biocides have the same effectiveness against the organisms.
- A smart biocide combination lowers the minimum concentration required at the surface to keep it clean.

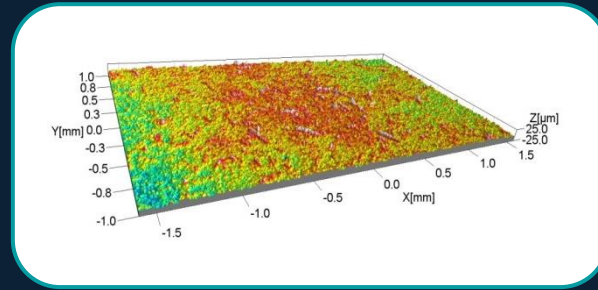
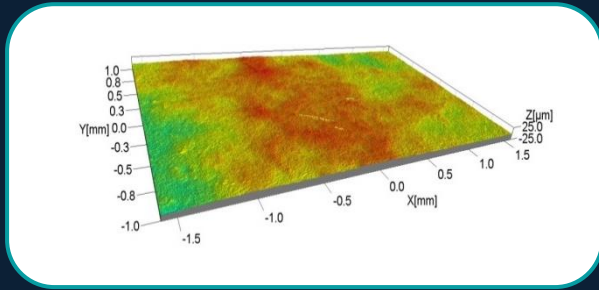
Type		High effect	Medium effect
Hard Fouling		<b>Cuprous oxide</b> Selektope Econea	<b>Copper Pyrithione</b> Sea Nine
Algae		<b>Copper Pyrithione</b> Sea Nine Zineb	<b>Cuprous oxide</b>
Slime		Surface characteristics: Antiadherent (FR) Polishing (AF)	All biocides ( <b>Copper Pyrithione</b> ) Concentrated amount



# Conventional Antifouling: Working mechanism

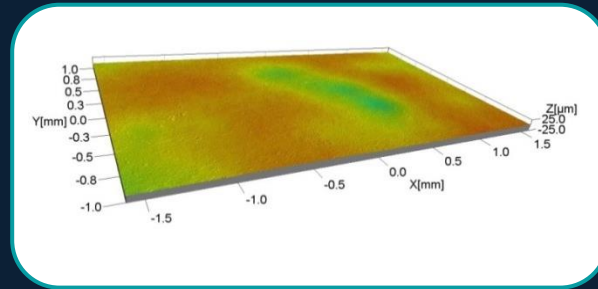
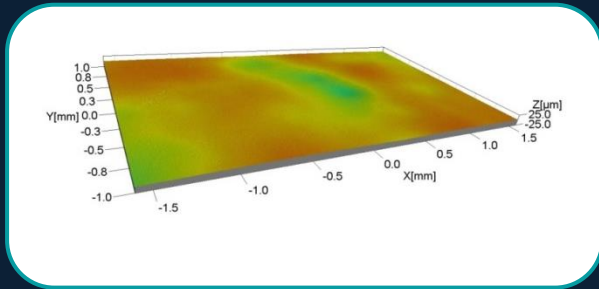


# Silicone has higher smoothness



Leached (empty)  
layer formation

Silyl acrylate before (left) and after 7 weeks of immersion in 30°C artificial seawater at 20 knots (right). The microroughness increases clearly.




NO Leach layer formation

Hempaguard X7 before (left) and after 7 weeks of immersion in 30°C artificial seawater at 20 knots (right). Virtually no effect of immersion on the microroughness.

# Hempel's journey in silicone solutions: Fouling Release and Fouling Defense



# Silicone coatings is being verified as one of the best investments




Applying Hempaguard is one way for ship owners to improve the Ship CII

**20%**

CII Improvement vs. average coating solutions

**6%**

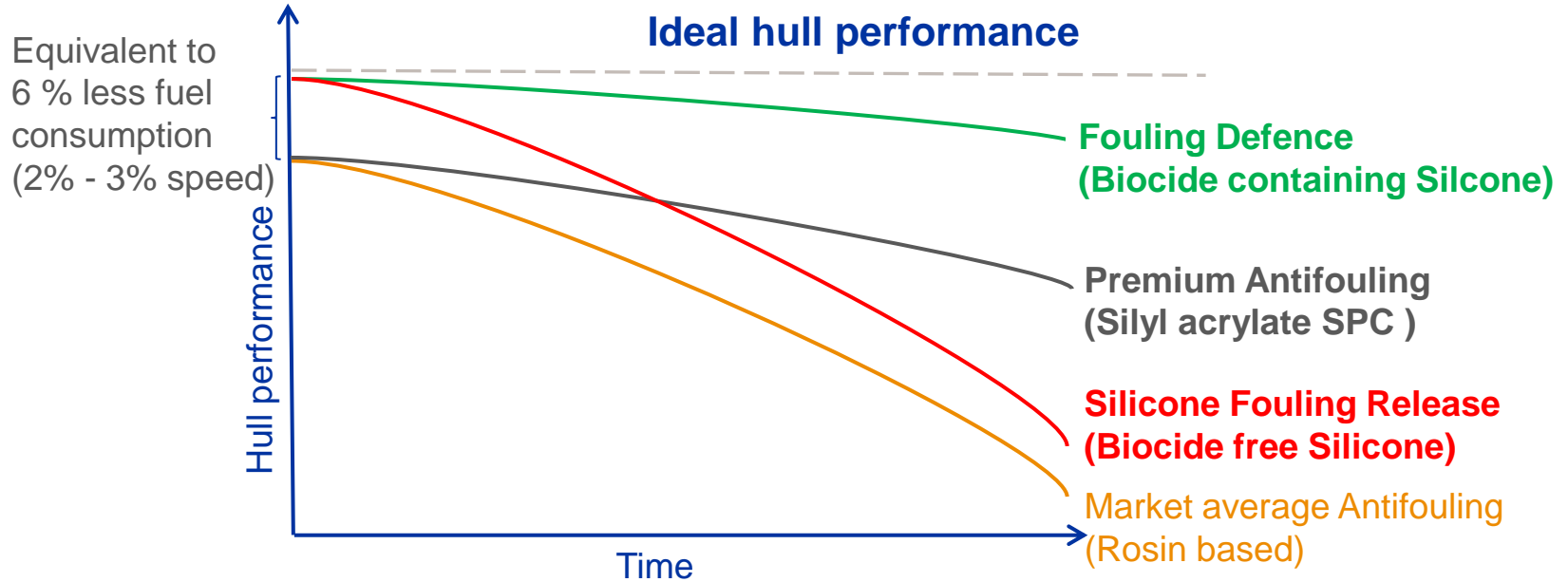
CII Improvement vs. top tier coating solutions



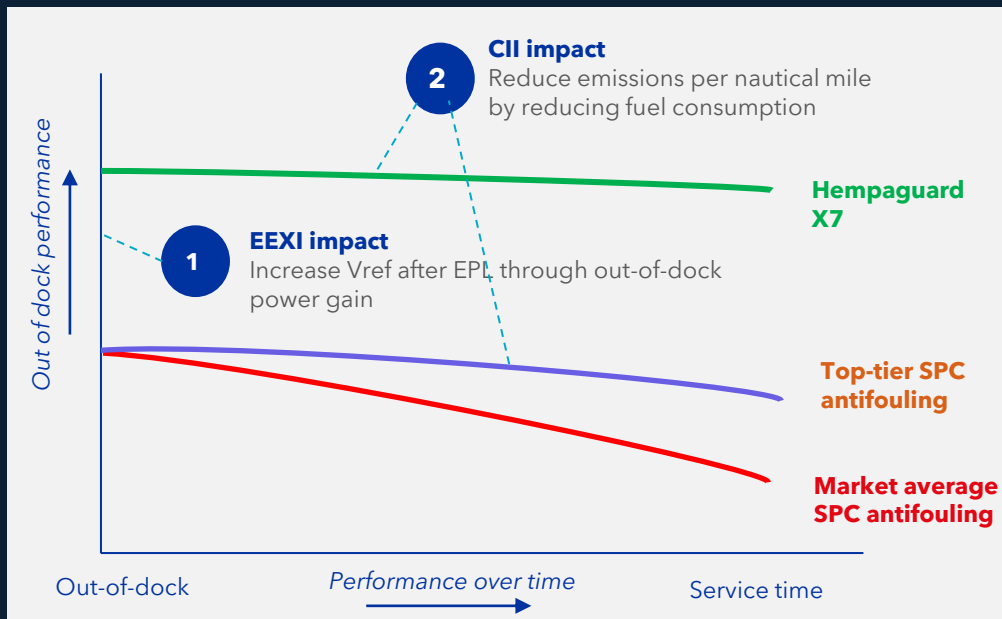
	Claimed Savings	Cost – Estimated CAPEX	ROI
Rudder Surf Bulb	5%	Moderate	< 36 month
Rudder Surf Fins	1%	Moderate	< 132 month
PBCF	1%	Moderate	< 14 month
Contra Rotating Propeller (CRP)	3%	Moderate	< 132 month
Mewis Duct	3-7%	Moderate	< 14 month
Propeller Duct	3%	Moderate	< 24 month
Wake Equalizing Ducts	2%	Moderate	< 18 month
Pres-Swirl Fins	2%	Moderate	< 30 month
<b>Silicon Anti-fouling Paints</b>	<b>6%</b>	<b>High</b>	<b>&lt; 9 month</b>
Air Lubrication	4%	High	< 60 month
De-rated ME	< 6%	Low	< 60 month
Part Load Optimization	3%	Moderate	N/A
Turbocharger Cut-Out	3%	No	N/A



# Comparing commercially available technologies: Antifouling / Fouling Release / Fouling Defense



# Impact of hull coating upgrade on CII & EEXI



Quantifiable on project basis

Out-of-dock power gain	Speed loss over time	EEXI improvement <i>one-time</i>	CII improvement <i>5-yr avg</i>
6%*	1.4%**	2% speed increase Vs any NB antifouling	20% Vs mrk avg 7-10% Vs top tier
0%	1.5-2.5%	No impact	10-13% Vs mrk avg
0%	5.9%	No impact	-

\* Proved based on frictional studies, towing tank tests and model large scale tests run by independent partners. Confirmed by actual data from ships in service using performance monitoring equipment.

\*\* Full hull application.

1% speed loss requires 3% power increase to maintain speed

# HEMPAGUARD X7 & X8 Silicone Fouling Defence



**2-3%**  
Out of dock  
speed  
increase

**Up to  
20%**  
Total fuel  
savings in **5**  
years

**1.2% -  
1.4%**  
guaranteed  
speed loss  
over 5  
years

**120 days**  
Idle  
guarantee

Full  
operational  
flexibility

**3,000+**  
vessels  
applied



# Thank you!

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