Underwater Radiated Noise (URN) Workshop

IMO – 18-19 September 2023

Direct Application of Wind Power

Wind Energy

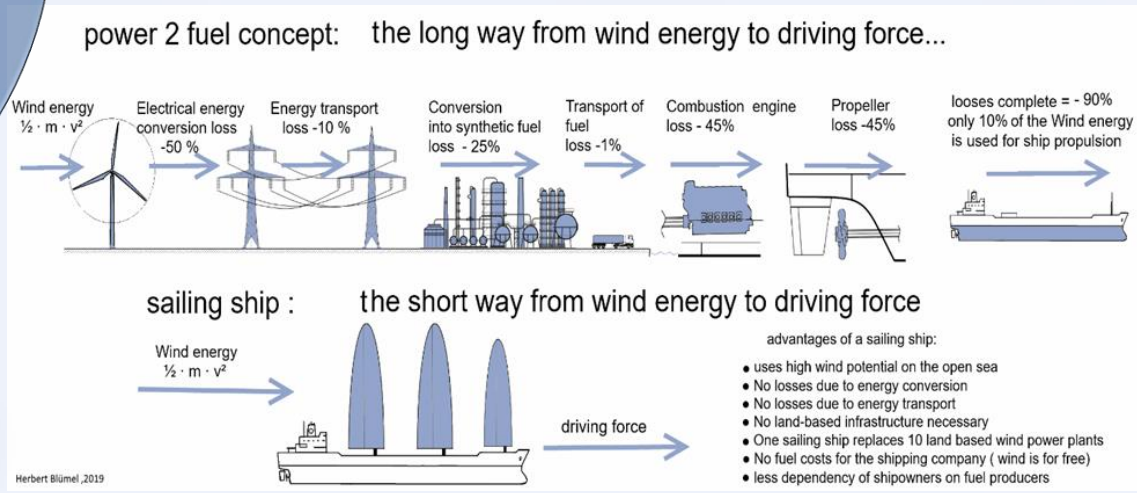
Zero - **Emissions**
Zero - **Cost**
Zero - **Volatility**
Zero - **Infrastructure**
Zero - **Storage**

Wind Propulsion Technology

Zero - **Development Time**
Zero - **Compatibility Issues**
Zero - **Additional Crew**
Zero - **CAPEX?**

RETROFIT
5-20% propulsive energy
& optimised up to 30%

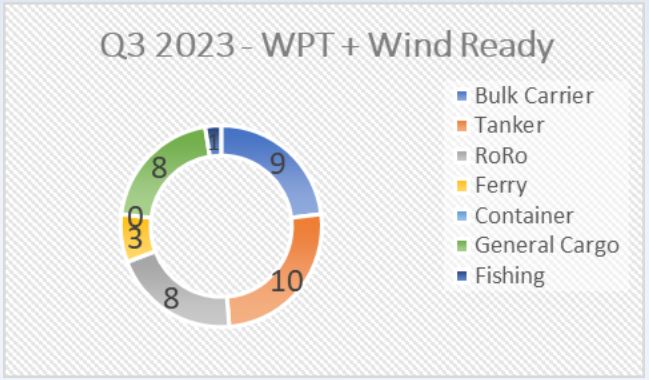
OPTIMISED NEWBUILD
50-80%+ possible with
operational changes



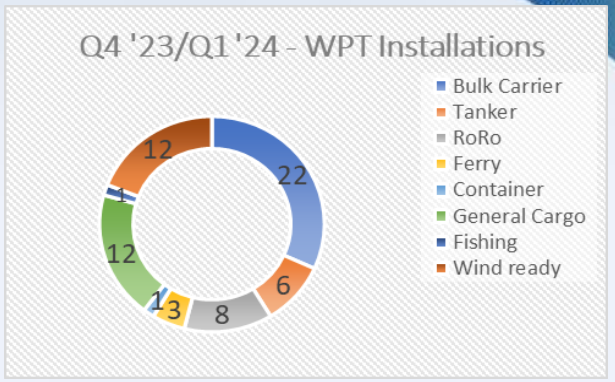
Win-Win-Wind Situation

IWSA International Windship Association

Market Development – 2023+



31 (39) Installations



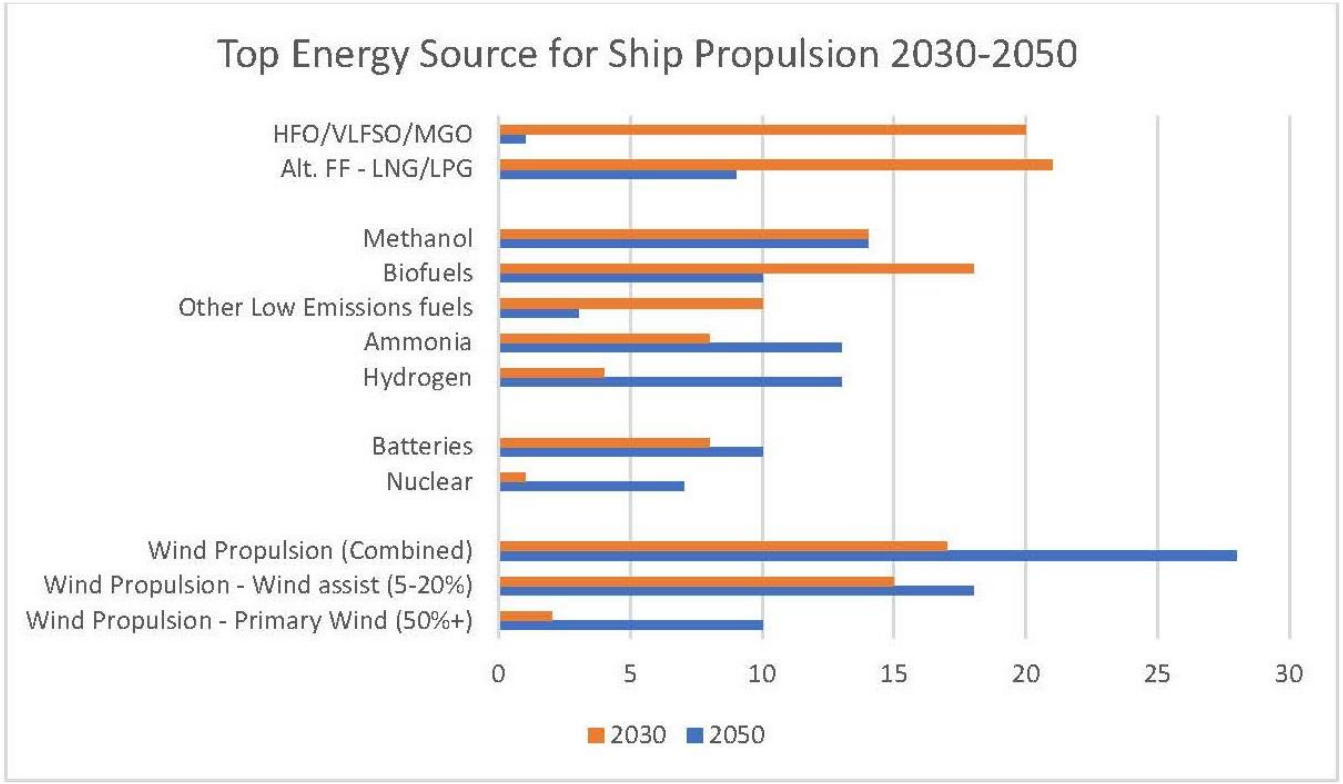
49-53 (65) Installations

2030 - <u>EU Report 2016</u> *'…market potential for bulk carriers, tankers & container vessels =* ***up to 10,700 installed systems*** *(varied by fuel price, speed, discount rate)*

2050 - UK Government <u>Clean Maritime Plan</u> (July 2019), research: **37,000 – 40,000 vessels** with wind propulsion systems installed or roughly **40-45% of the global fleet.**

Wind Propulsion & Energy Mix 2030 & 2050

What are the top five energy source you believe ships will use for propulsion in 2030 and 2050?



Source: IWSA Industry & Policy Makers Survey: June 2023

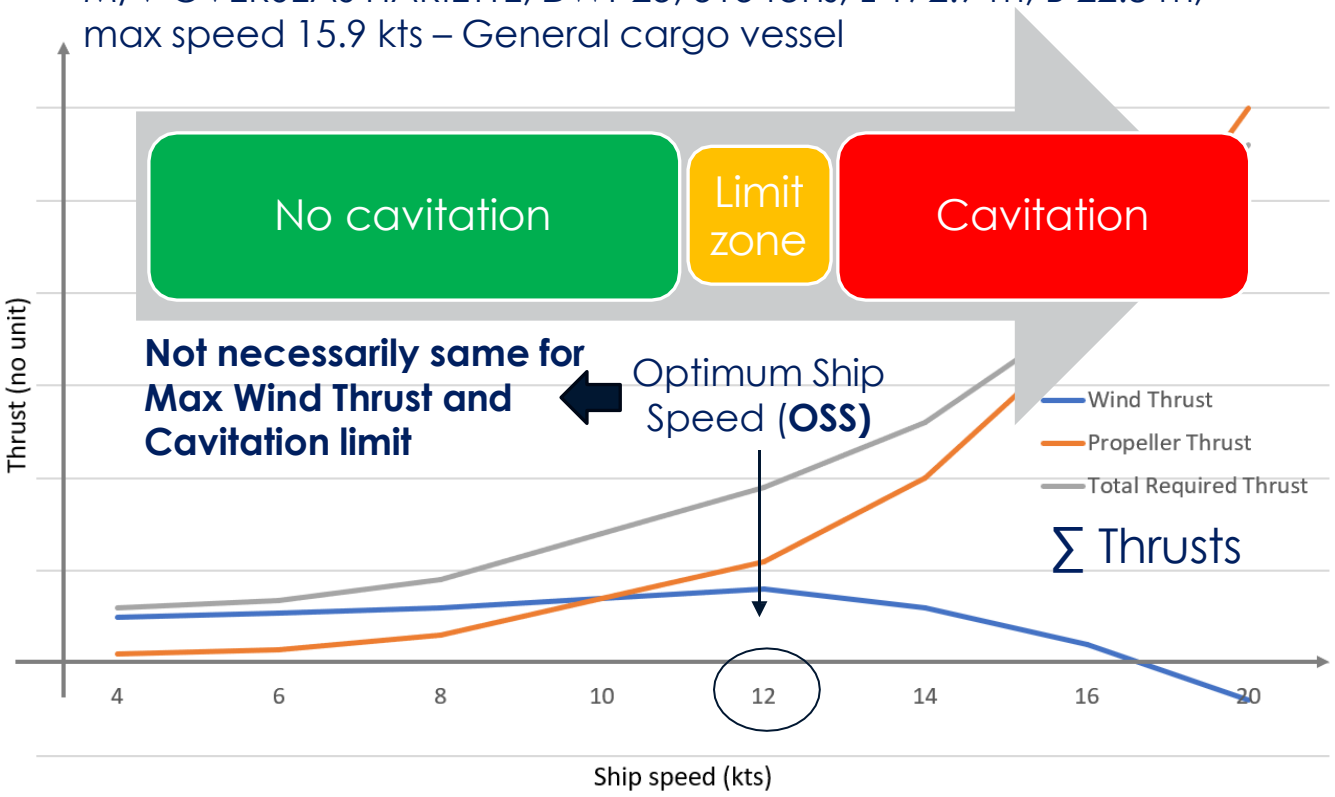
Benefit of wind propulsion contribution
Example of a conventionally propelled vessel fitted with WASP (not defined)

Wind data:
- TWS = 15 kts
- TWA = 60 deg

Wind contribution increases up to the OSS (12 kts):
- AWS = 23 kts
- AWA = 35 deg

Above the OSS :
- Wind thrust ↘
- Propeller rpm ↗
- URN ↗

M/V OVERSEAS HARIETTE, DWT 25, 515 tons, L 172.9 m, B 22.8 m, max speed 15.9 kts – General cargo vessel



From XP Sea 2023

Comparison between 2 cases at the same speed of 12 kts (OSS):

- Case A : **100%** conventional propeller propulsion (no WASP)
- Case B : **60%** conventional / **40%** wind propulsion (WASP)

Parameter	CASE A 100% Conventional Propulsion	CASE B 60% Conventional 40% Wind	Difference
Ship speed (knots)	12.0	12.0	
Thrust form conventional propulsion	100%	60%	
Thrust form wind propulsion	0%	40%	
Propeller rotational speed (rpm)	105	68	-37
URN maximum levels	Values in dB from Figure 5 except (*)		(dB)
10 – 31.6 Hz	178	165 (*)	-13
31.6 Hz – 100 Hz	179	165 (*)	-14
100 Hz – 316 Hz	170	161	-9
316 Hz – 1000 Hz	164	161	-3
> 1000 Hz	159	156	-3

XP Sea analysis of Arveson Vendittis 1999 data

(*) Noise levels from machinery equipment which are usually isolated, URN therefore capped to 165 dB

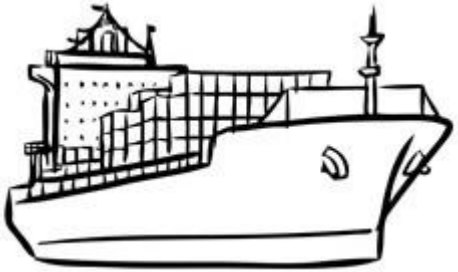
URN source

- Case A = Blade Cavitation
- Case B = Diesel Generator (no cavitation)

Selected frequency of 100 Hz (max URN)

- Case A = 169 dB
- Case B = 155 dB => **-14 dB**

Equivalence in terms of URN generation in the same area for -14 dB offset at 100 Hz



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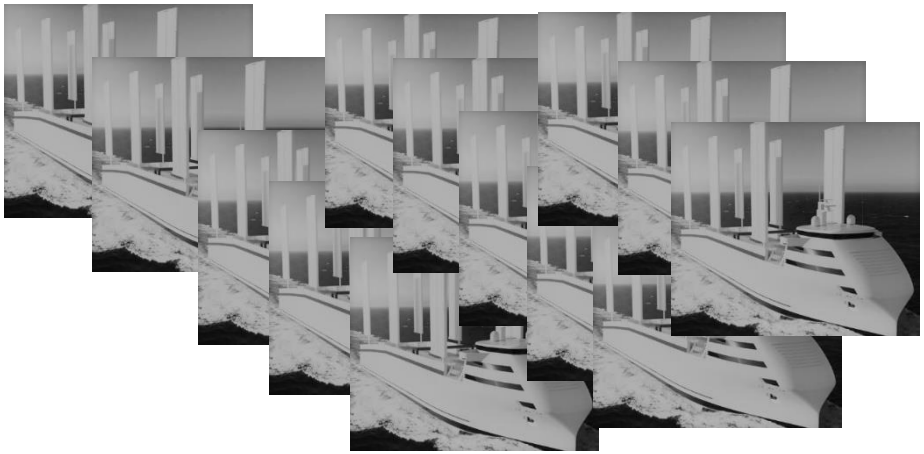


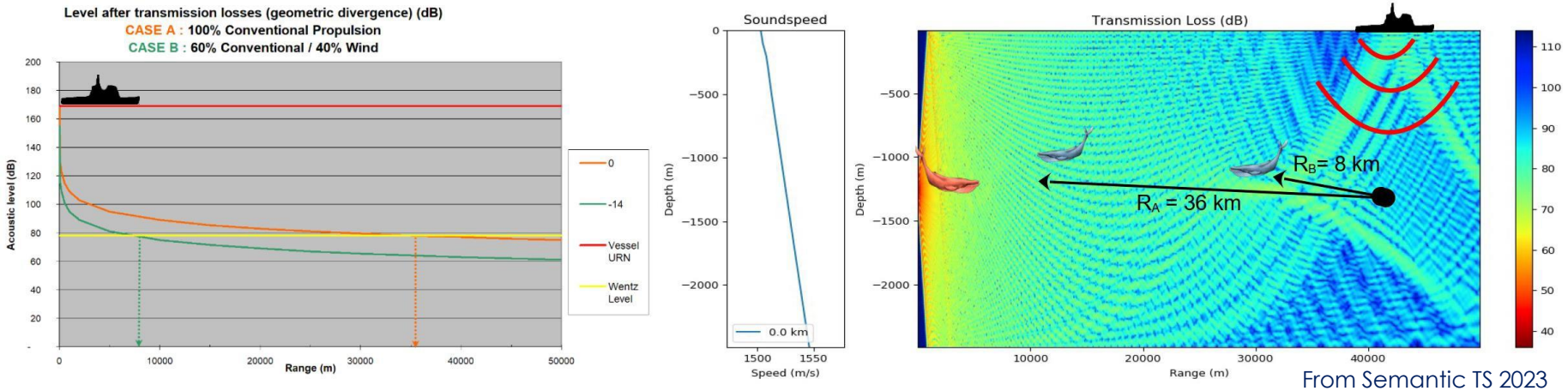
1 CASE A Vessel 100% conventional propulsion

25 CASE B Vessels 40% Wind Propulsion

$$10^{\frac{14}{10}} = 25$$

Communication range reduction / Gathering distance increase

- Reference maximal communication distance is R= 40 km in our example
- When a vessel comes close to one of two individuals (or groups)
  - The communication distance is then reduced by R_n
  - They need to gather by a range R_n to communicate



From Semantic TS 2023

Minimum required gathering distances

- Case A : R_A = 36 km
- Case B : R_B = 8 km

Wind Propulsion reduces the disturbance distance by 28 km

Macro estimating the impact of wind propulsion benefits based on a reference low Ambient Noise Level (ANL)

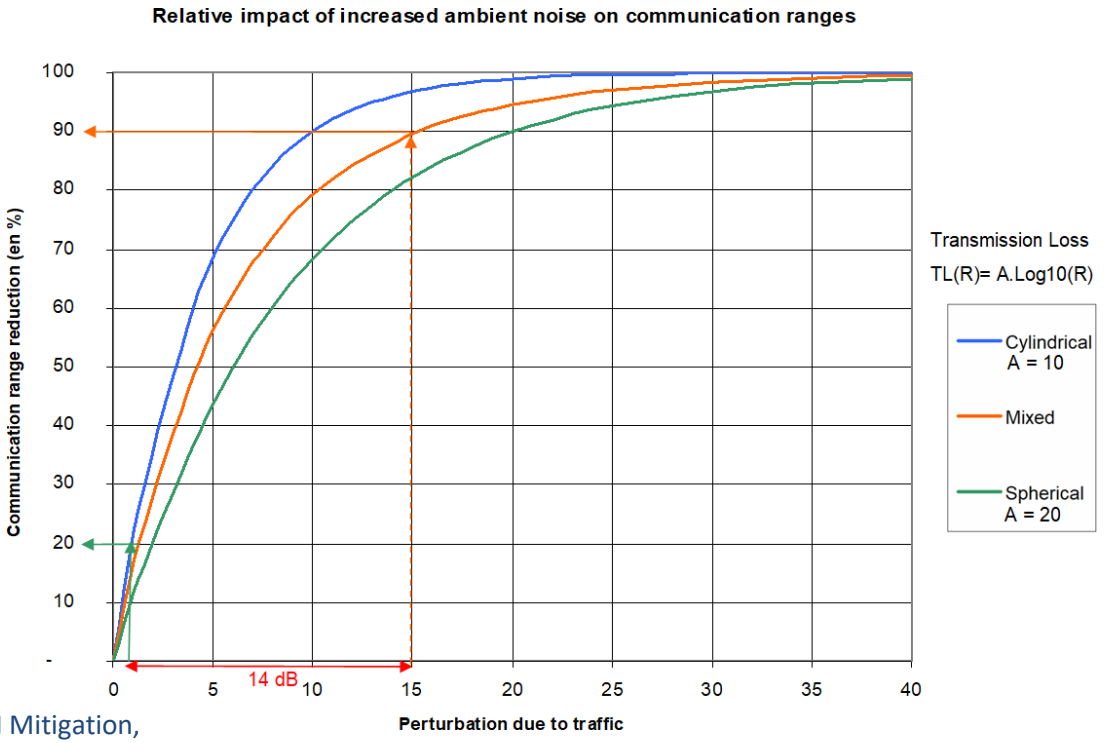
ANL increase

- Case A : by **15.3 dB**
- Case B : by **1.3 dB**

Communication distance decrease

- Case A : by **90%**
- Case B : by **20%**

Wind Propulsion has the potential to drastically reduce URN and disturbance of marine life for only 40% of wind contribution



Source: MEPC80/INF.33 – Paper: Wind Propulsion & URN Mitigation, Cordier & Noël: RINA/IWSA Conference, Feb 2023

Key Points in the Analysis of Wind

- In-Market: reduce 50% costs by 2026
- Weather routing/predictability/satellite
- Multiple installations – sizes, position, type

- ROI – only energy source (stable price)
- Level playing field: TCO, 20-yr GWP, LCA
- Leasing/Pay-as-you-use/Service

Potential | Financial

Risk | Trends

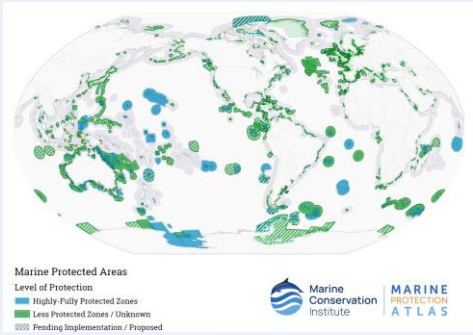
- Spills, leakage, safety
- Global availability/access
- No shifting of emissions

- Primary wind
- Modular/containerised
- Integration – tech & ops

Additional Considerations

Wind as Main Propulsor

- Primary Wind - 50%-80%+ - even more significant reductions.
- Wind-assist – during certain weather conditions – 100% wind power.
- Heavy weather – lessens propellor load substantially during these heavy load periods.



MPA's & Sensitive Areas

- Option: fully wind or maintain speeds at substantially reduced rpm
- Range extension enables diversions without additional fuel
- Research/monitoring on primary wind vessels

Operations

- Range extension/Free Energy = reduce bottlenecks, adopt new or underused ''uneconomical' routes.
- Wind Routing, Voyage Optimisation, LiDAR etc. integration – planning routes for wind
- Payback/ROI – net gain from tech – Just/Equitable Transition

Further Action Required

- ✓ **Update Analysis of Wind:** most reports/analysis are using outdated or inaccurate assessment and financial data.
- ✓ **Level Playing Field**: Include all specific wind related operational parameters, LCA and other TCO considerations.
- ✓ **URN Simulations**: More refined and wide spectrum analysis on various types/sizes of vessel and operational profiles.
- ✓ **Funding Research Project**: For field analysis of primary wind and wind-assist URN mitigation performance.