



Weather Routing for Wind Propulsion Vessels

Key Ingredient for Decarbonization

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Agenda

- NAPA introduction
- Weather Routing - a must for Wind propulsion ships
- Sumitomo-Norsepower-NAPA study
- Solutions to Challenges of Veer
- Solutions to Challenges of Wah Kwong
- Conclusion



NAPA – for efficient and safe ship designs and operations



**World-leading
Software, Services and
Data Analysis for
Ship Design and
Operation**



95% of newbuilds yearly
built by NAPA customers



12 000 active users for
NAPA applications



200 employees



Over 30 years of
experience



- Optimal
- As sailed



Weather Routing - a must for Wind propulsion ships

VOYAGE SIMULATION INPUTS:

- Ship's performance model (Digital Twin)
- Operational conditions
- Voyage plan
- Wind-propulsion device characteristics

FLEXIBLE SCHEDULE

ETA (UTC)	DURATION	AVG. SPEED (kn)	AVG. RPM	AVG. LOAD (%)	CII	FUEL CONS.	TOTAL COST	PROFIT
2022-11-20 10:56 +00:00	18 d 22 h	13.7	74	53.6	B 2.1			
2022-11-20 03:11 +00:00	18 d 14 h	13.9	75.4	56.6	B 2.2			
2022-11-19 18:12 +00:00	18 d 5 h	14.2	76.7	59.6	B 2.3			
2022-11-19 10:10 +00:00	17 d 21 h	14.5	78	62.6	C 2.3			
2022-11-19 04:31 +00:00	17 d 15 h	14.6	79.2	65.6	C 2.4			
2022-11-19 00:14 +00:00	17 d 11 h	14.8	80.3	68.6	C 2.5			
2022-11-18 18:58 +00:00	17 d 6 h	15	81.5	71.6	C 2.5			

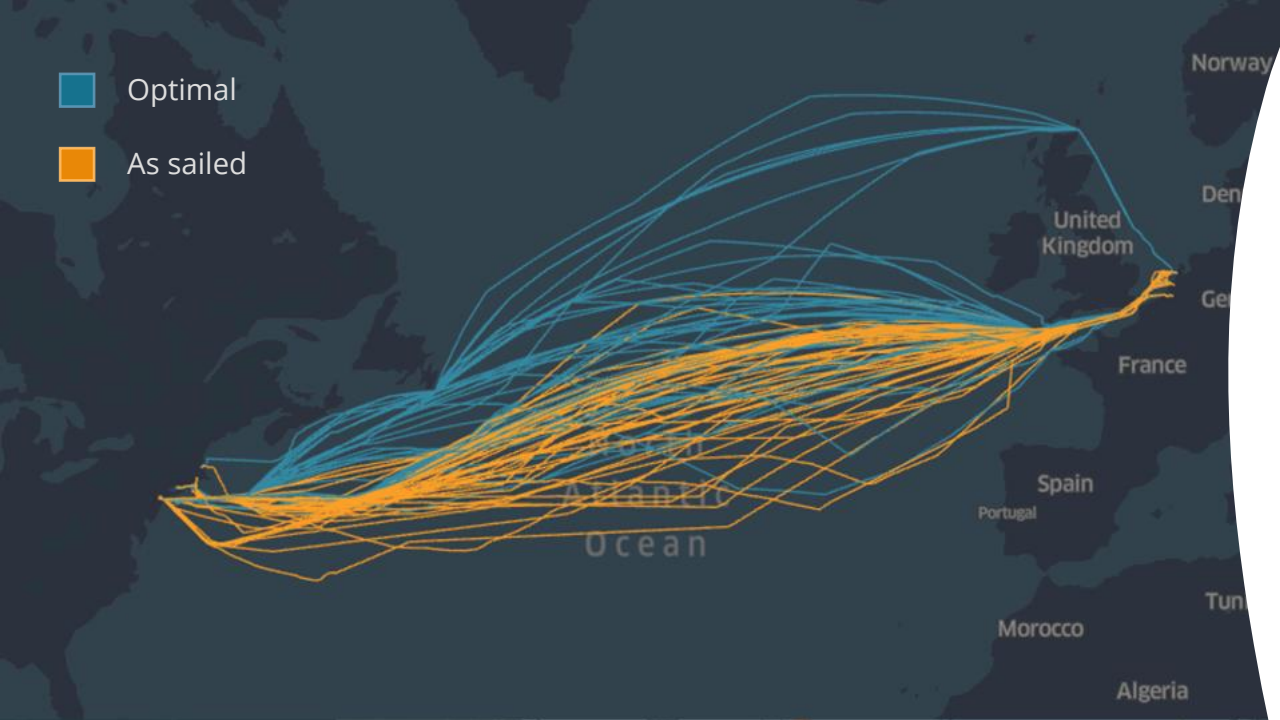
SELECT **CANCEL**

Optimizing for **profit, CII score or fuel consumption** might yield very different results

Understanding the sensitivity of the outcome to the different decisions is crucial



■ Optimal
■ As sailed



Weather Routing - a must for Wind propulsion ships

CONCEPT / DESIGN PHASE:

Support for commercial and technical decision making

VESSEL IN OPERATION:

Verifying performance and further Improvement by Voyage Optimization software

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Background – Norsepower / Sumitomo / NAPA study

Simulation method – NAPA Fleet Intelligence

- Optimized voyages to have minimum fuel cost by using NAPA Voyage Optimization technology
- Weather data: Nowcast in 2022
- Fixed ETA/ETD

Ship model – Tanker

- Ship specific configuration was provided by Sumitomo

Wind assisted device

- Norsepower rotor sails
- 30 m (H) * 5 m (D) * 4 pcs

6 Routes



4 Cases

SHIP: Conventional or wind assisted ship

X

ROUTE: Base or optimal route

Results – Norsepower / Sumitomo / NAPA study

Route : Amsterdam ⇔ New York (Total 48 voyages in 2022)

Case	CO2 emission
1 CONVENTIONAL Base	
2 Optimal	
3 WIND ASSISTED Base	
4 Optimal	

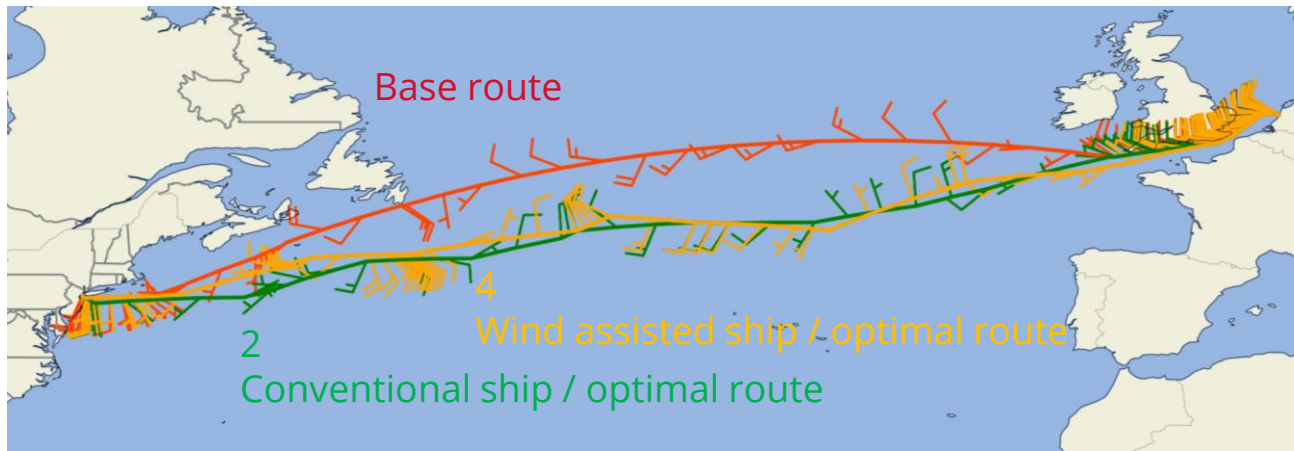
Average CO2 saving

Wind assisted + optimal route

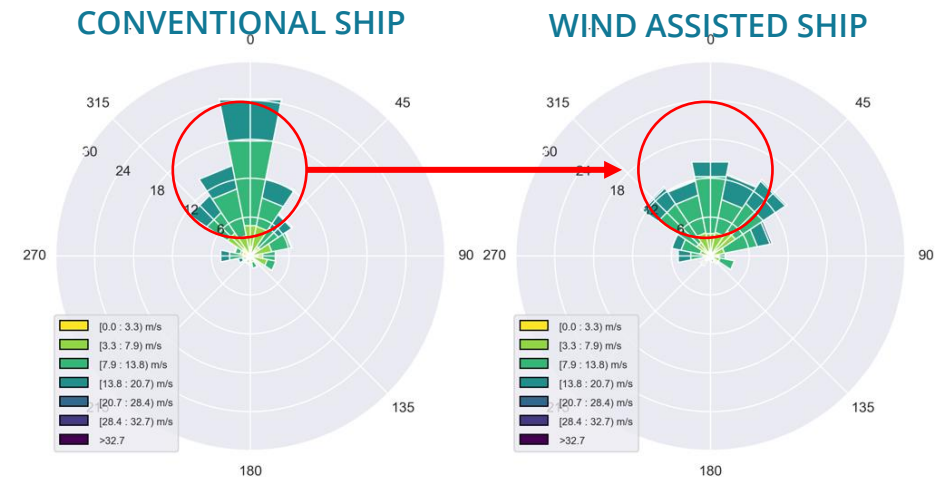
28 %

Optimal route contribution

12 %



Amsterdam to New York route



Apparent wind comparison (2 ⇔ 4)



Solutions to Challenges of Veer

1

CHALLENGE: Stakeholder confidence – Long-term contracts

Collaborative studies with key stakeholders using e.g. voyage simulation technology brings critical insight to inform commercial and operational decisions at the design stage.

2

CHALLENGE: Business model

Although the vessel is primarily wind powered there is times when wind is mild and hydrogen will be used as auxiliary power. Then impact of Operational optimization through Weather routing is even bigger due to Green hydrogen being premium priced compared to traditional fuels.

3

CHALLENGE: Crew training

The complexity of optimal weather routing for wind propulsion ships is beyond human capabilities, thus it's of very essence that the weather routing software is easy to use and requires no lengthy training courses for crew.

Solutions to Challenges of Wah Kwong



RECOMMENDED SOLUTION IS COMBINATION OF

- Low/Zero Carbon fuels
- Carbon Capture Systems (CCS)
- Wind propulsion devices
- Weather routing software



Conclusion

Optimal weather routing

A must for Wind propulsion ships

Data driven ship design

Crucial step for Business model and technical verification

Understanding the vessel's technical and naval architectural aspects

Key to Operational Optimization and Competitiveness of your fleet

MAKE SURE YOU HAVE THE BEST WEATHER ON YOUR ROUTE FOR DECARBONIZATION!



GLOBAL WEATHER DATA



CHART DATA



ALGORITHMS & VESSEL MODEL



OPERATIONAL DATA



AIS DATA

