

A large blue and white cargo ship, the MV Ankie, is shown sailing on a dark, choppy sea. The ship has a long, flat deck and a white superstructure. Two tall, grey, cylindrical wind assist units are mounted on the deck, each with the word 'ECONOWIND' written vertically on its side. The ship's name 'ANKIE' is visible on the side of the hull. The overall scene is dimly lit, suggesting dusk or dawn.

**SOME INSIGHTS IN OPERATION OF
WIND ASSIST UNITS ON MV ANKIE**

The Econowind logo consists of two horizontal bars, one red and one blue, stacked vertically.

ECONOWIND



WHAT IF.....





WE GO SAILING...



2011 - 2015

Wind propulsion studied

COLLABORATION:



Studied designs / systems



SKYSAILS

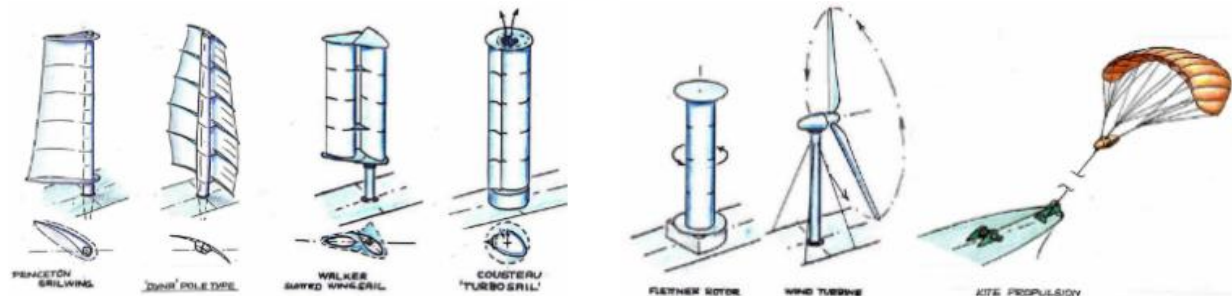


FLETTNER ROTORS



TURBO-SAIL

	eConowind VentiFoil	Magnus Rotor	WingSails	Sails	Kites
Price Per Green KW	++ Medium Capex	- High Capex	+	+ Low Capex	+ Medium Capex
Ease of installation	++++	-	+	-	++
Folding	+++	+/-	+/-	- RISK Safety	- RISK Safety
Rental concept / leasing	+++	Integratie	?	+	+
Overall	+++	++	++	...	?



Most promising:

Jacques Cousteau

TurboSail ~1985



www.bluegreenpictures.com



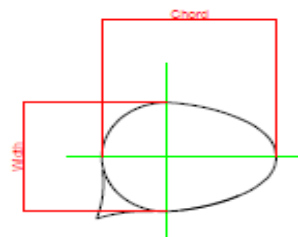
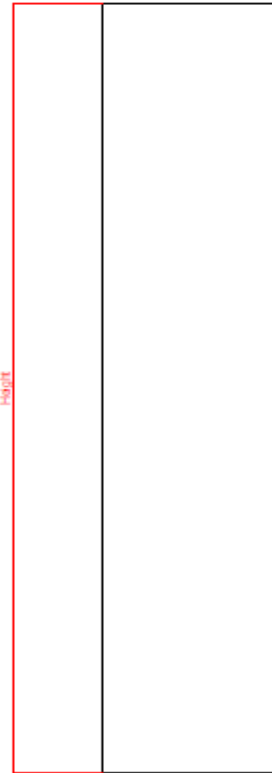


VERSIONS AVAILABLE INCLUDING
SEA MARGIN



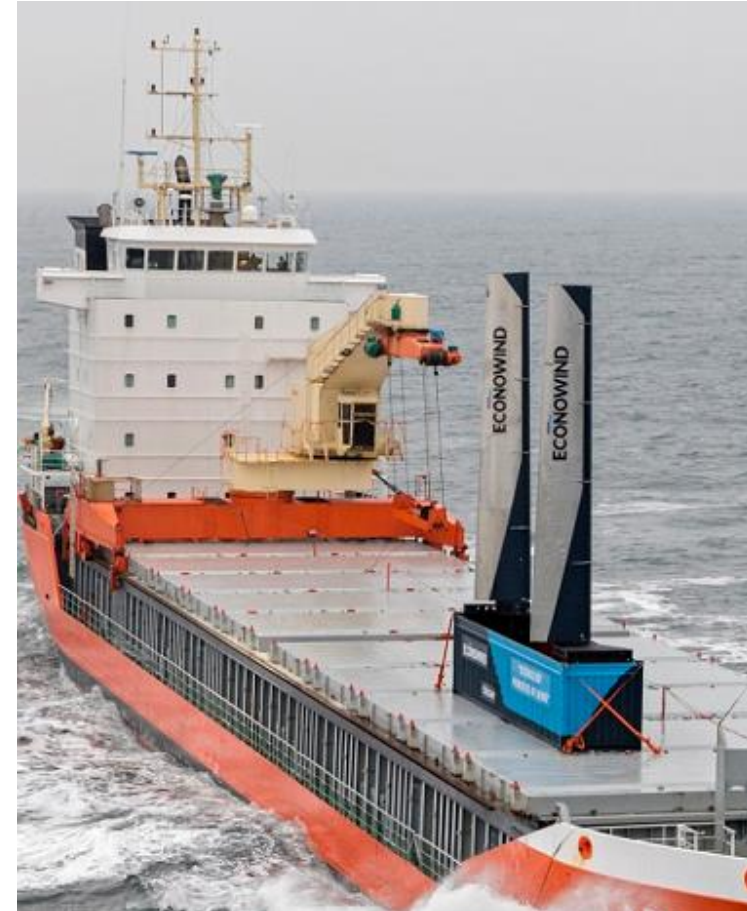
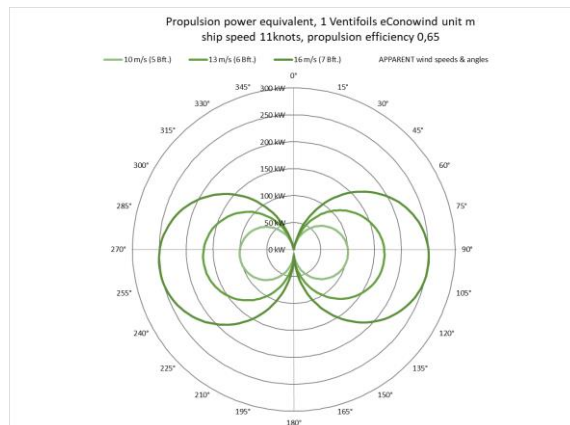
ECONOWIND

ECONOWIND VERSIONS



Type	Output (KW) at 11 Knots	Height (m)	Chord (m)
Flatrack 250	250	10	3
Flatrack 480	480	20	3
Retrofit 160	160	10	2
Retrofit 270	270	16	2
Container 250	250	2 ventifoils 40 ft container	

***Containerized
Up to 250 KW/ unit***

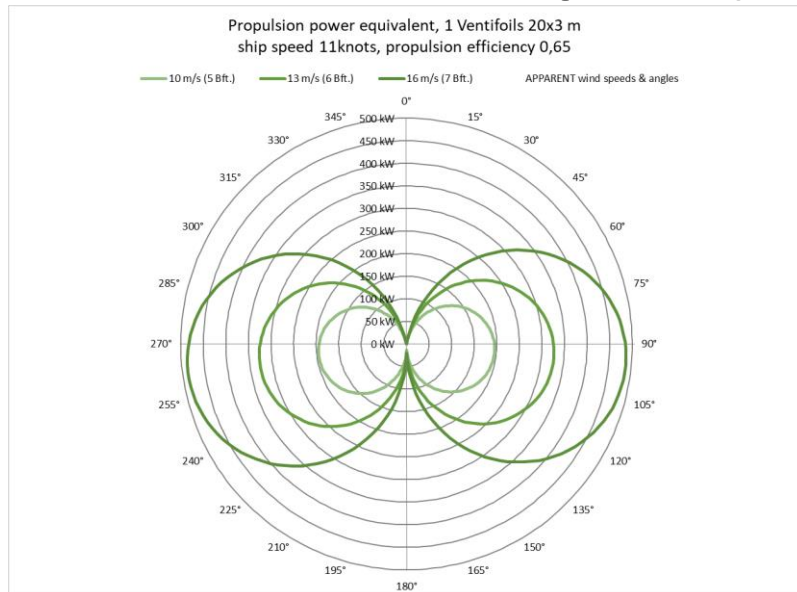


Flatrack

Movable by hatchcrane

Ventifoil 250 KW / unit, 10*3

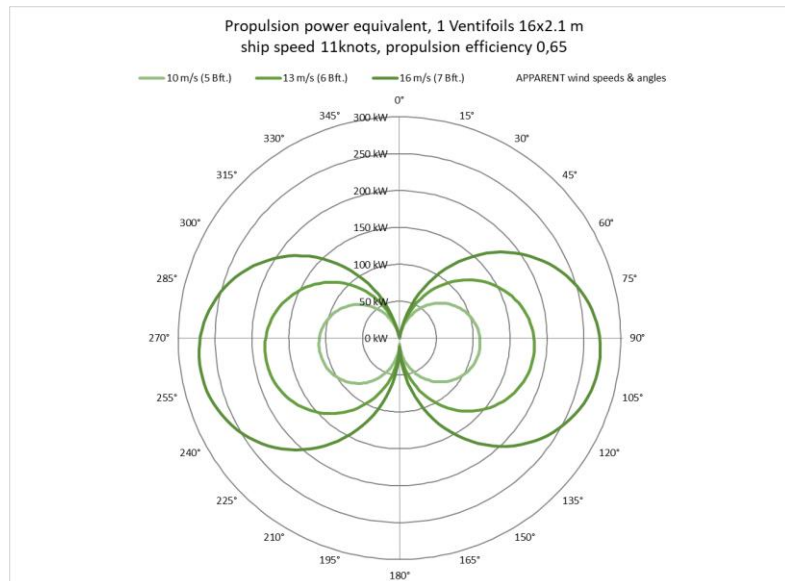
Ventifoil 480 KW / unit, 20*3



Retrofit:

Ventifoil 160 KW / unit, 10*2,1

Ventifoil 270 KW / unit, 16*2,1





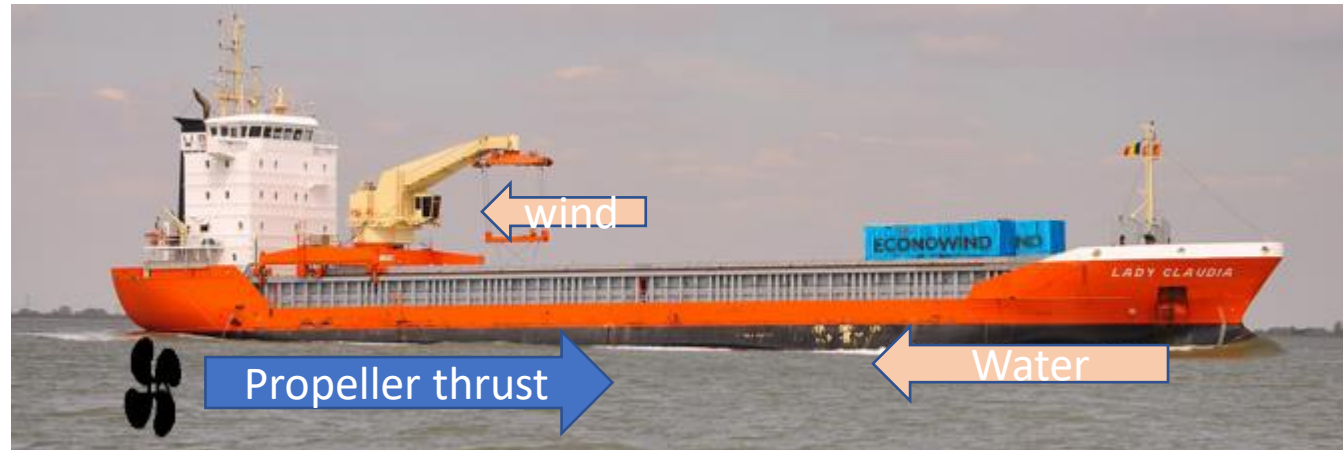
THEORY OF WIND ASSIST



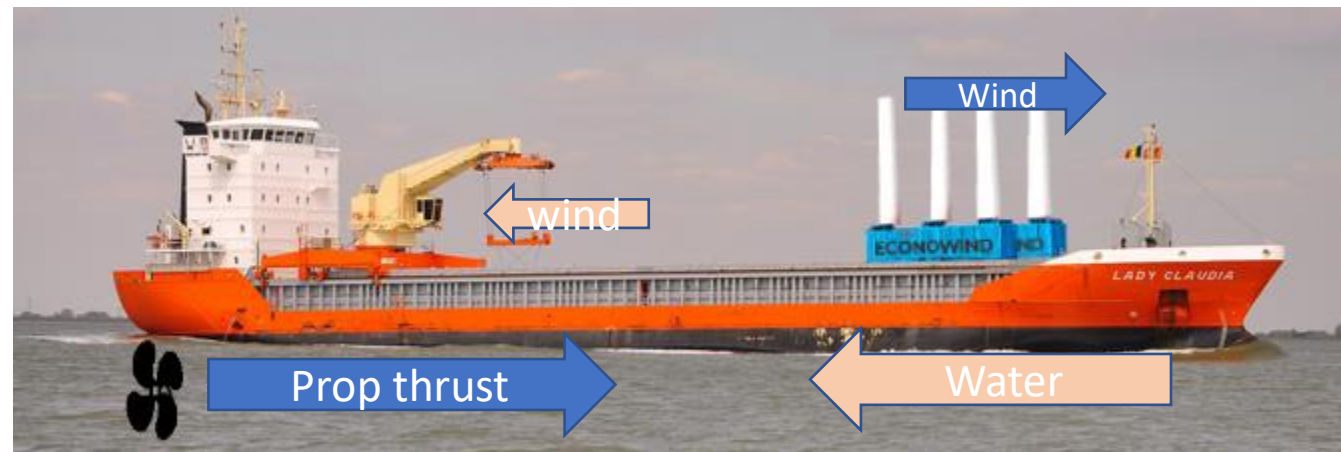
ECONOWIND

ECONOWIND THEORY

$$\text{Thrust} = \text{resistance}$$

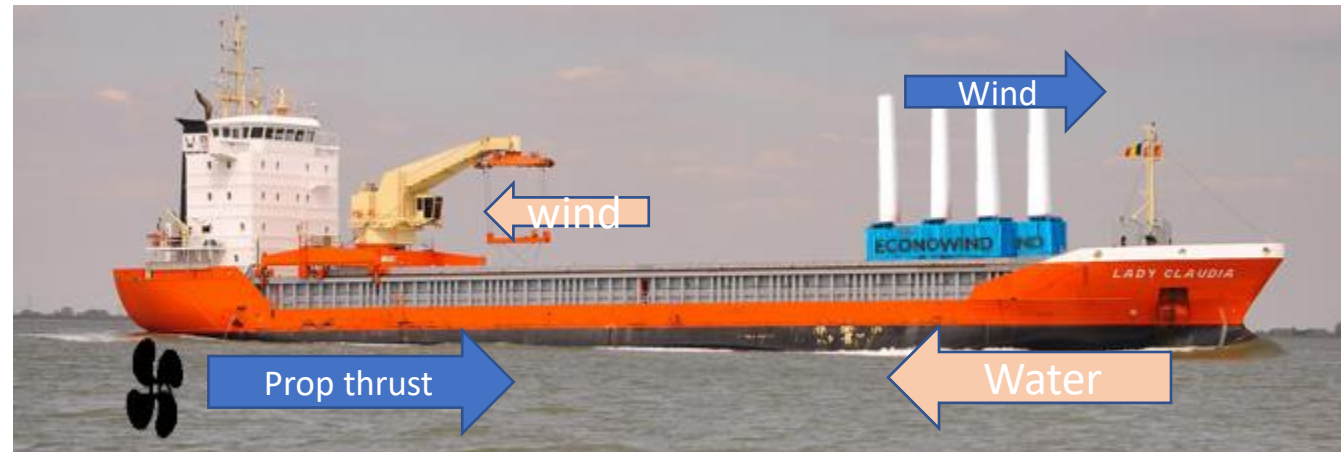


Thrust = resistance



Speed increases

Thrust = resistance



Maximal saving at original speed

Conclusion:

**We need to evaluate extra speed
and fuel consumption**

An aerial photograph of the ship Lady Christina, a large cargo vessel with a red hull and white superstructure, sailing on a grey, choppy sea. The ship is equipped with two large, grey, rectangular sails mounted on tall poles. The sails have the word 'ECONOWIND' printed vertically on them. A blue banner on the side of the ship reads 'ECONOWIND' and 'TECHNOLOGY POWERED BY WIND'. The ship's name 'LADY CHRISTINA' is visible on the bow. In the foreground, the text 'ECONOWIND' is written in large, bold, black letters, with a small red and blue horizontal bar above the 'O'. Below it, the text 'EEXI with econowind' is written in a smaller, dark blue font.

ECONOWIND

EEXI with econowind



MV Ankie: 10 x 2,3m

Prediction

9 knots, 10 m/sec: 20 – 25%

	0				0		15						
	ship speed		Distance time		True wind speed	wind to heading	Apperent wind speed	Angle to heading	Cx Thrust coef	Thrust Force	Total Resistance ship	Motor force	Force reduction %
	knots	m/s	miles	hours	m/s	degrees	m/s	degree		Fwd kN	kN	kN	
stretch 1	9	4,63	1000	111	10	0	14,6	0,0	-1,3	0,0	50	50	0,0%
stretch 2	9	4,63	1000	111	10	15	14,5	10,3	-0,3	0,0	50	50	0,0%
stretch 3	9	4,63	1000	111	10	30	14,2	20,6	0,6	3,1	50	47	6,2%
stretch 4	9	4,63	1000	111	10	45	13,7	31,1	1,6	7,1	50	43	14,2%
stretch 5	9	4,63	1000	111	10	60	13,0	42,0	2,5	10,2	50	40	20,1%
stretch 6	9	4,63	1000	111	10	75	12,1	53,2	3,4	12,0	50	39	23,7%
stretch 7	9	4,63	1000	111	10	90	11,0	65,2	4,2	12,5	50	38	24,8%
stretch 8	9	4,63	1000	111	10	105	9,9	78,1	5,0	12,0	50	39	23,7%
stretch 9	9	4,63	1000	111	10	120	8,7	92,4	5,7	10,6	50	40	20,9%
stretch 10	9	4,63	1000	111	10	135	7,5	109,0	6,3	8,7	50	42	17,1%
stretch 11	9	4,63	1000	111	10	150	6,4	128,9	6,6	6,6	50	44	13,1%
stretch 12	9	4,63	1000	111	10	165	5,7	152,8	6,1	4,8	50	46	9,5%
stretch 13	9	4,63	1000	111	10	180	5,4	180,0	4,4	3,1	50	47	6,1%

1444

Sailing:

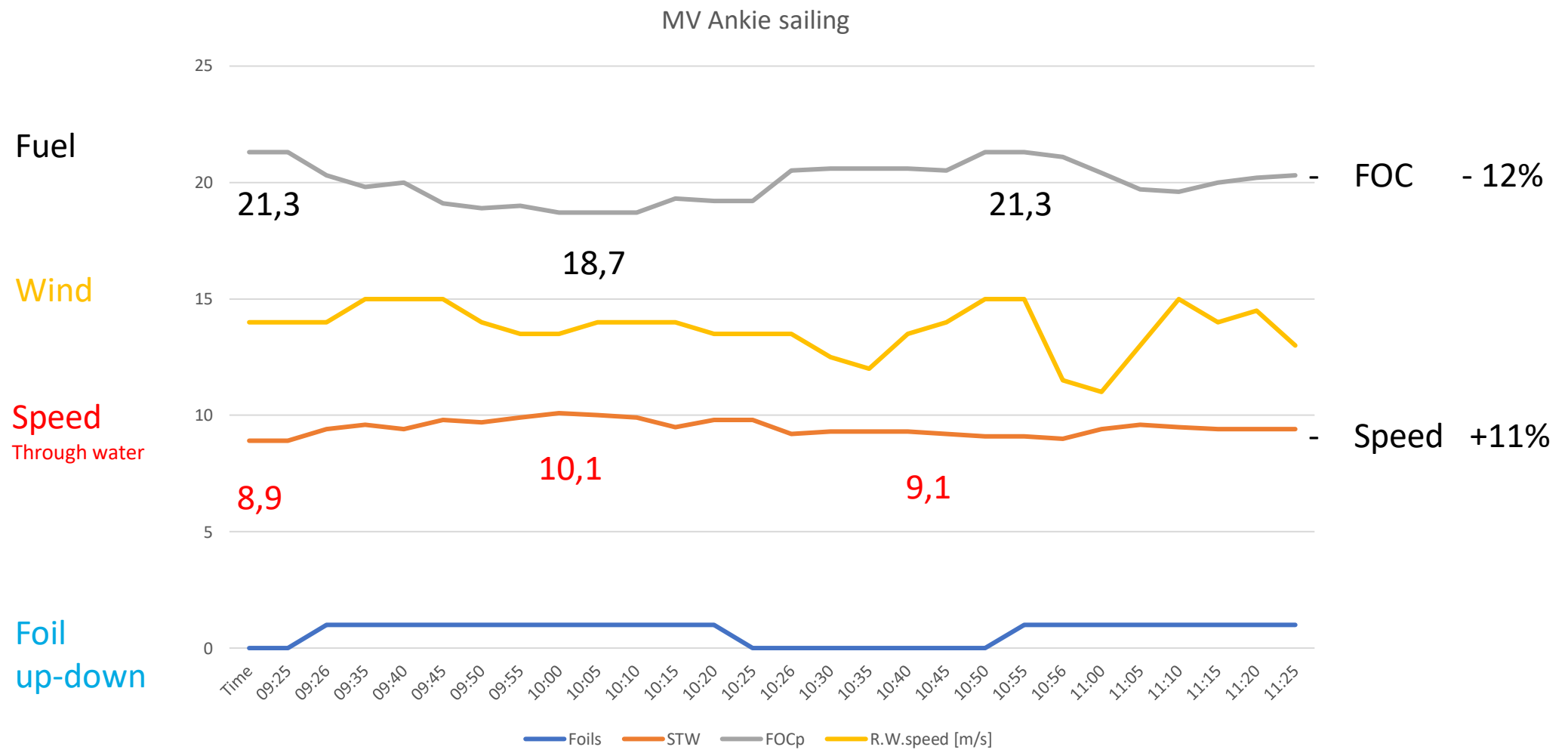


ECONOWIND

MV ANKIE







Energy Efficiency Design Index for existing ships (EEXI).

- Enter into force in 2023.
- EEXI will be applicable for all vessels above 400 GT

Source (MEPC 75 in November 2020)

$$EEXI = \frac{FOC * EF}{DWT} = \left[\frac{kg CO2}{ton * NM} \right]$$

- FOC = fuel oil consumption based on stw = $[kg fuel/NM]$
- EF = emission factor = $3.17 \left[\frac{kg CO2}{kg fuel} \right]$
- DWT =
Deadweight (carrying capacity of the ship) =
3638 [ton]
 $CO2_{saving} = 3.17 * Fuel_{saving}$

Logged by third independent party

Example route:



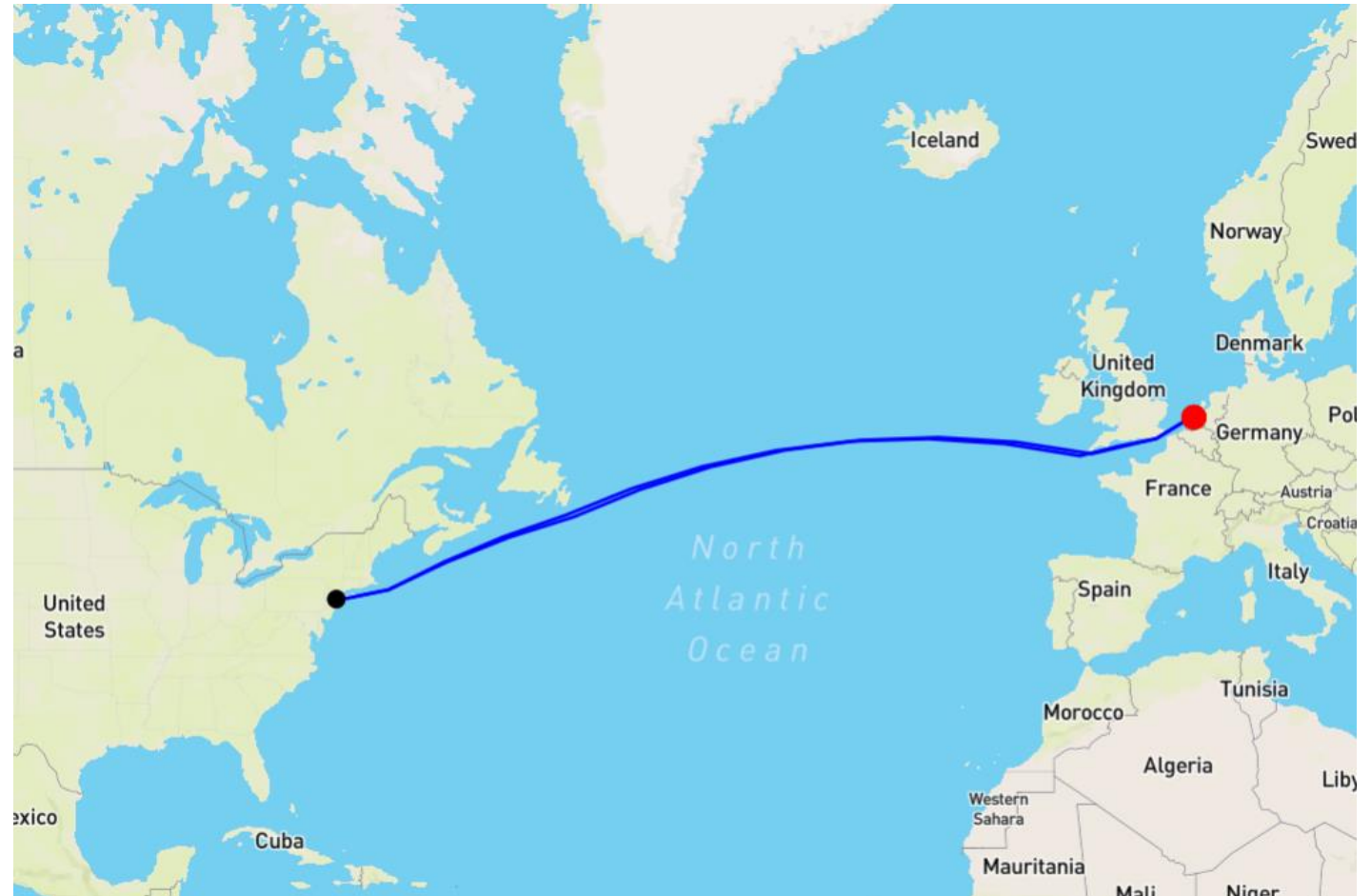
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MV ANKIE



Route

- Rotterdam
- New York
- Rotterdam



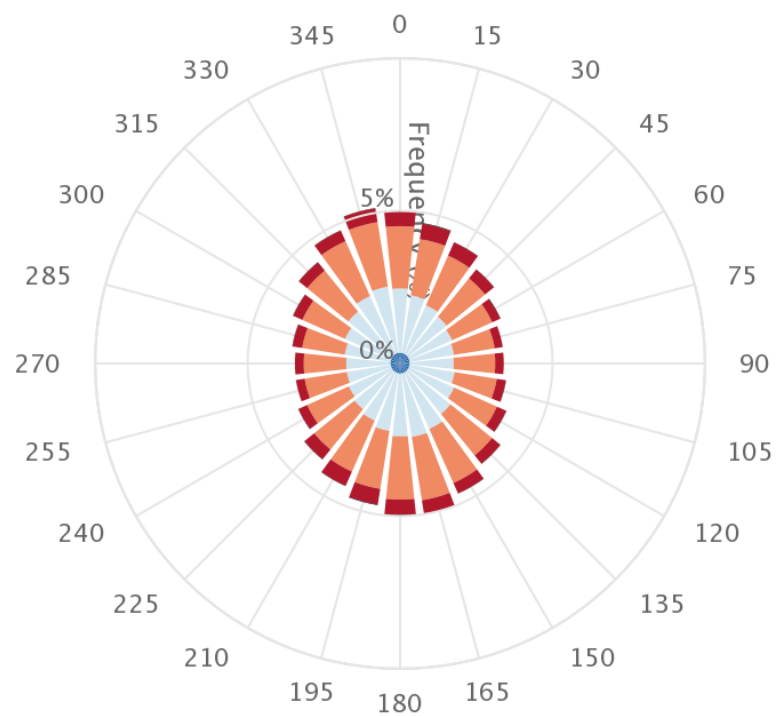
Influence of shipspeed



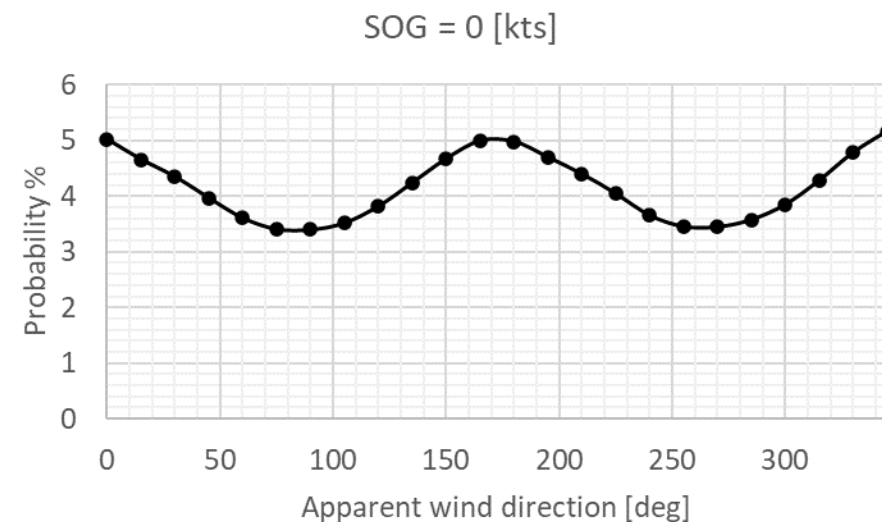
SOG = 0 [kts]

Apparent Wind @ 0 kts ship speed

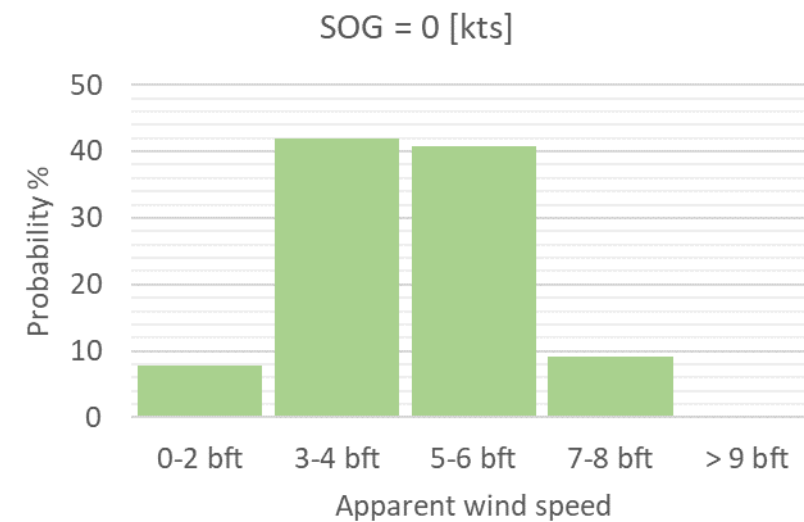
Source: ERA-5 (1989–2019)



Variation due to
tradewinds



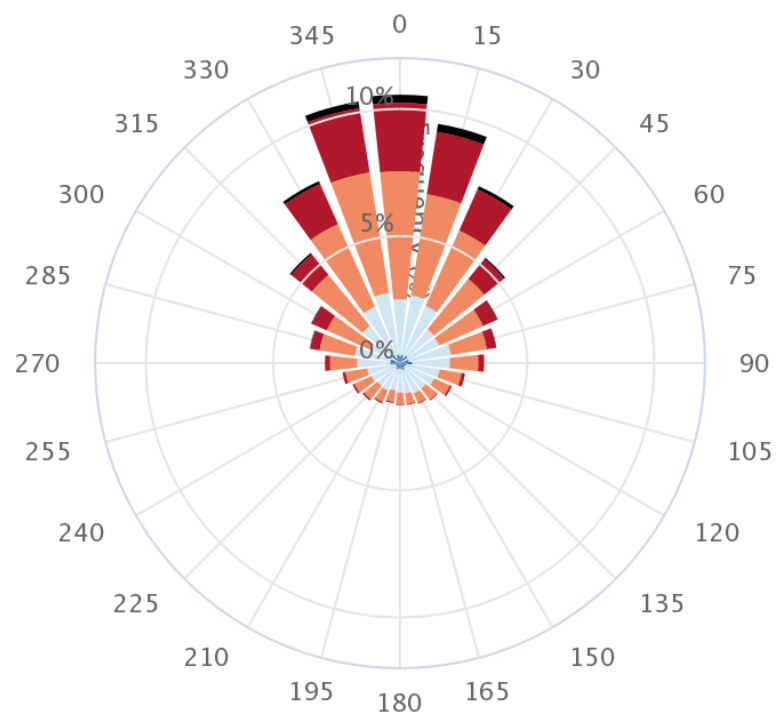
- 0-2 bft
- 3-4 bft
- 5-6 bft
- 7-8 bft
- > 9 bft



SOG = 10 [kts]

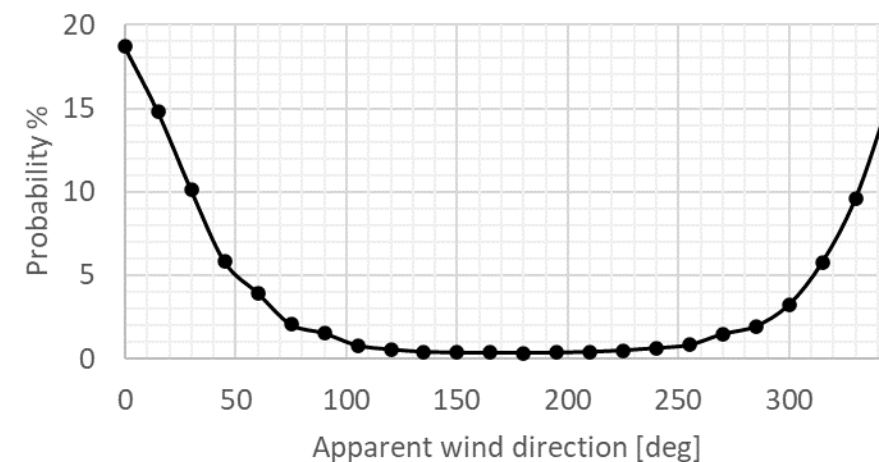
Apparent Wind @ 10 kts ship speed

Source: ERA-5 (1989–2019)

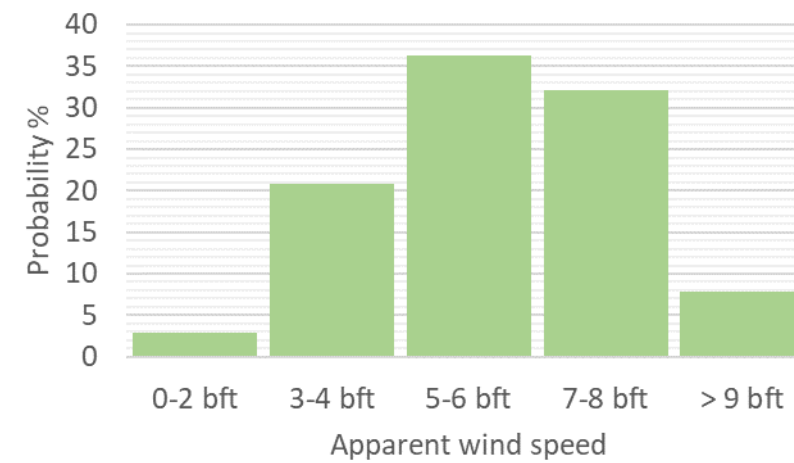


- 0-2 bft
- 3-4 bft
- 5-6 bft
- 7-8 bft
- > 9 bft

SOG = 10 [kts]



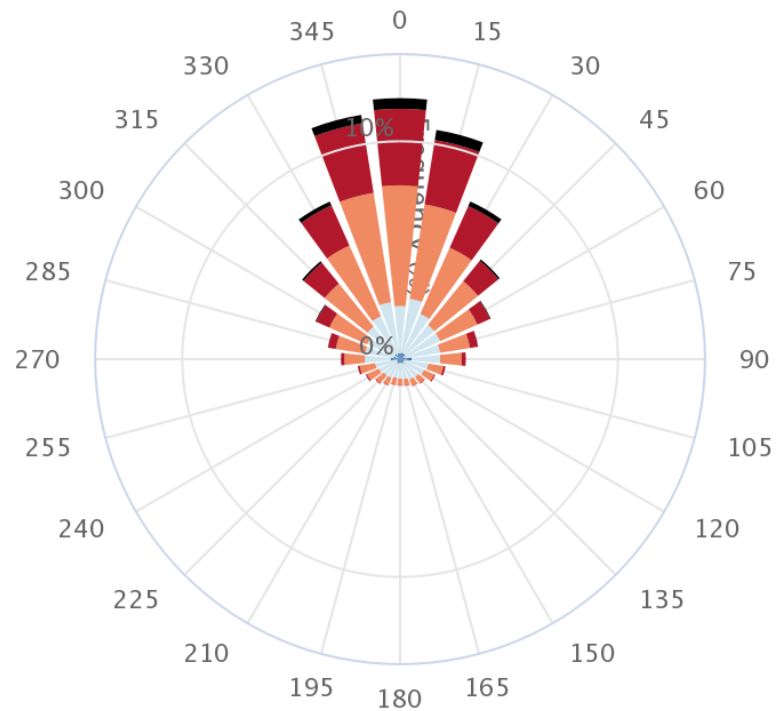
SOG = 10 [kts]



SOG = 12 [kts]

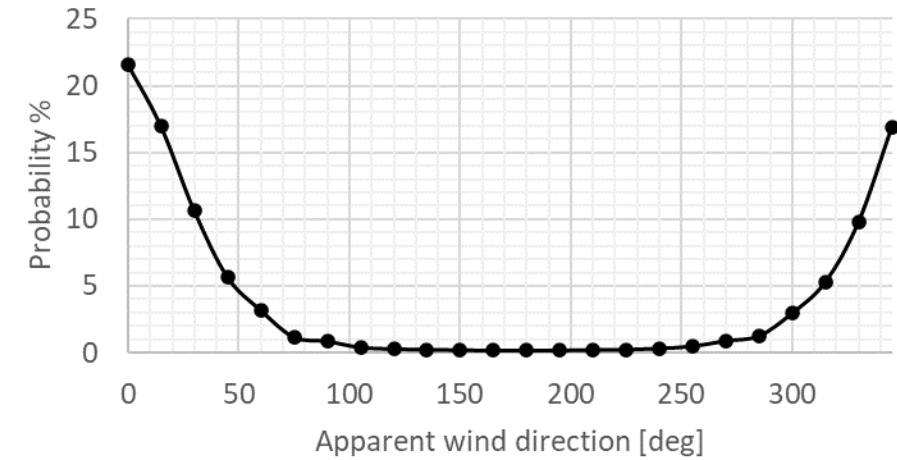
Apparent Wind @ 12 kts ship speed

Source: ERA-5 (1989–2019)

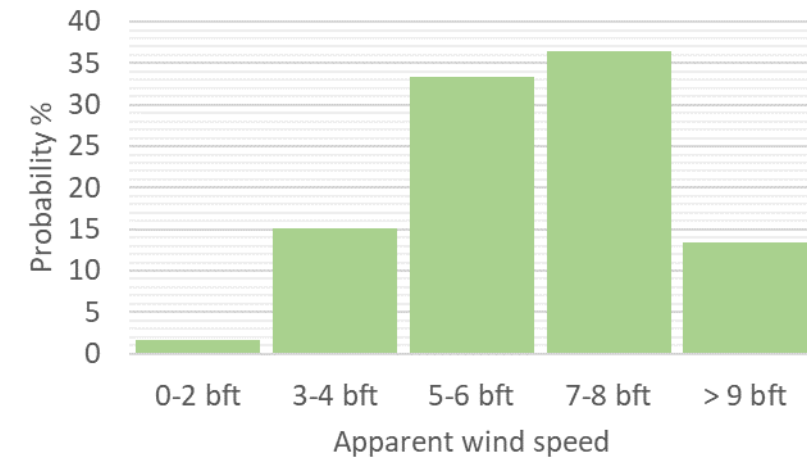


- 0-2 bft
- 3-4 bft
- 5-6 bft
- 7-8 bft
- > 9 bft

SOG = 12 [kts]



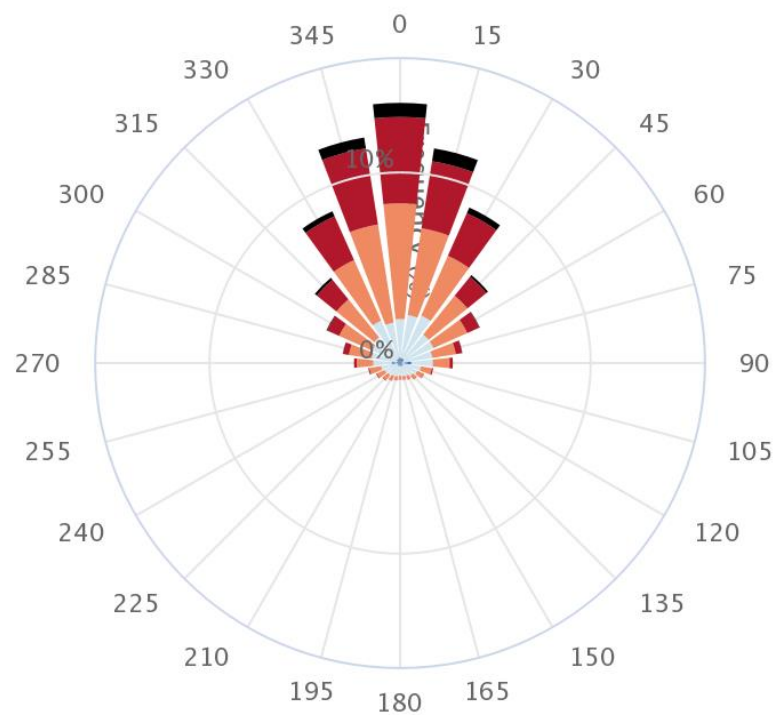
SOG = 12 [kts]



SOG = 14 [kts]

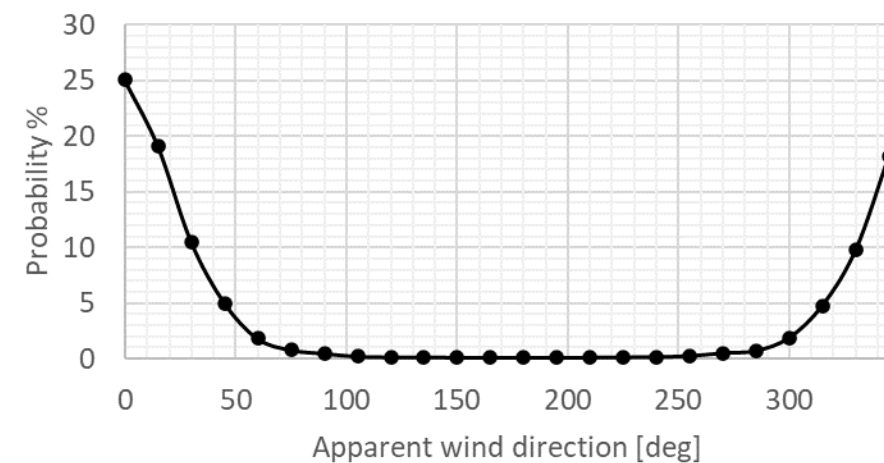
Apparent Wind @ 14 kts ship speed

Source: ERA-5 (1989–2019)

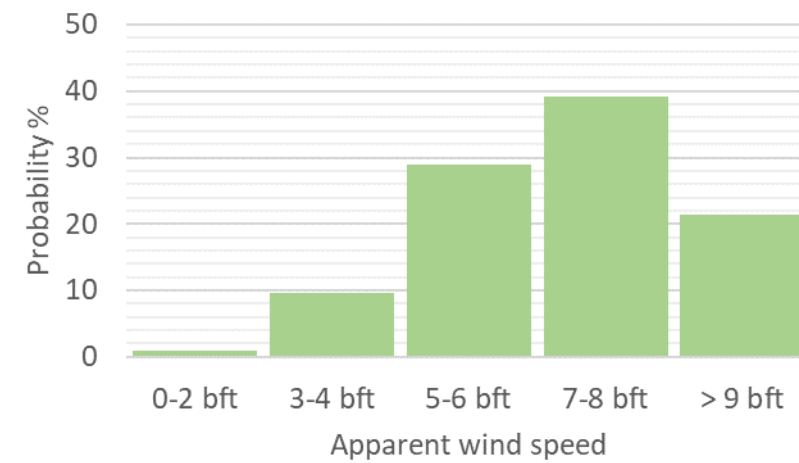


- 0-2 bft
- 3-4 bft
- 5-6 bft
- 7-8 bft
- > 9 bft

SOG = 14 [kts]



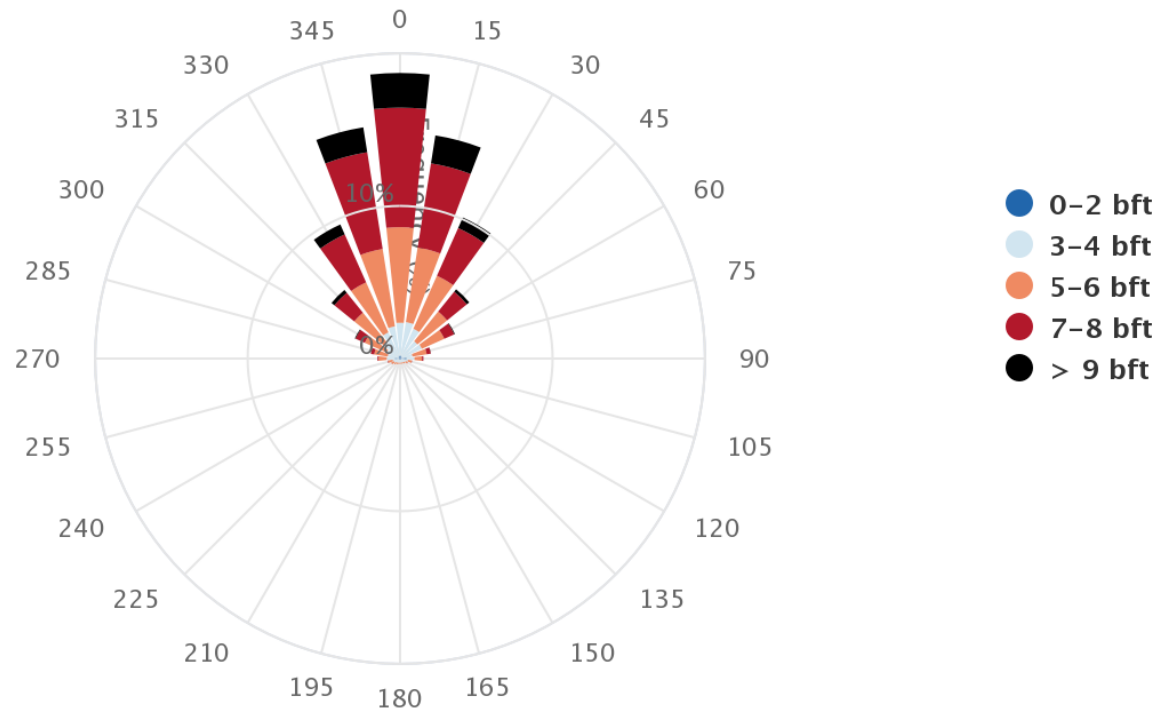
SOG = 14 [kts]



SOG = 20 [kts]

Apparent Wind @ 20 kts ship speed

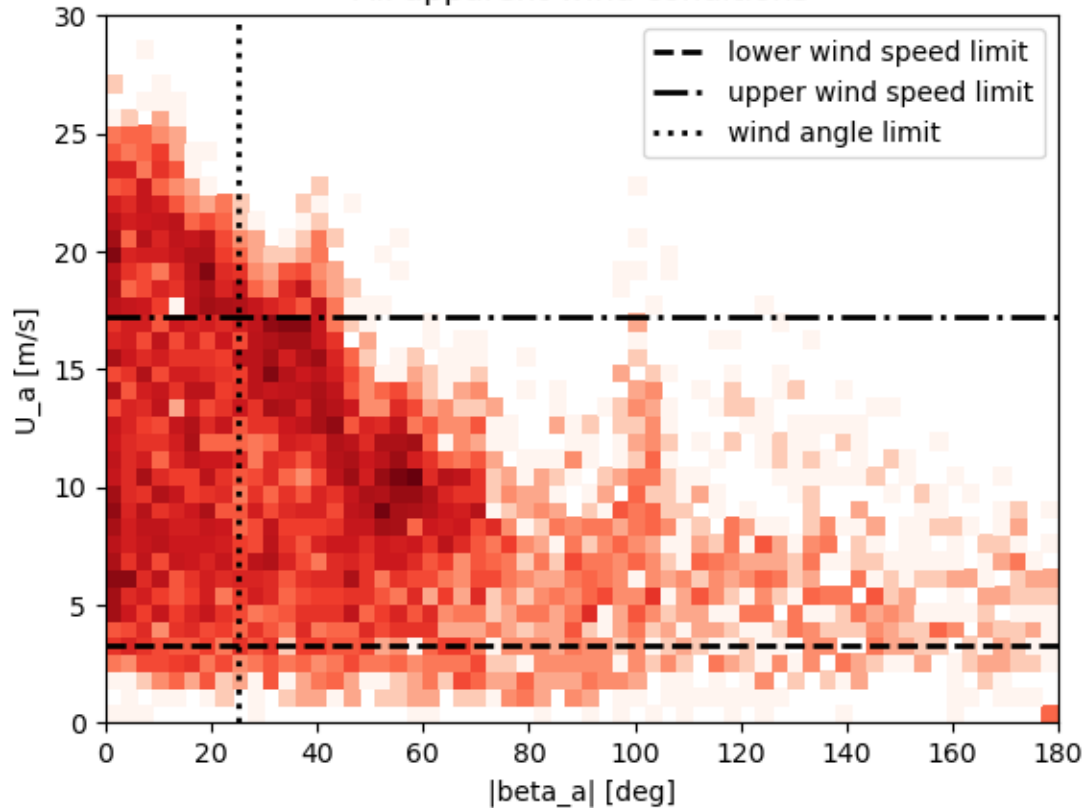
Source: ERA-5 (1989–2019)



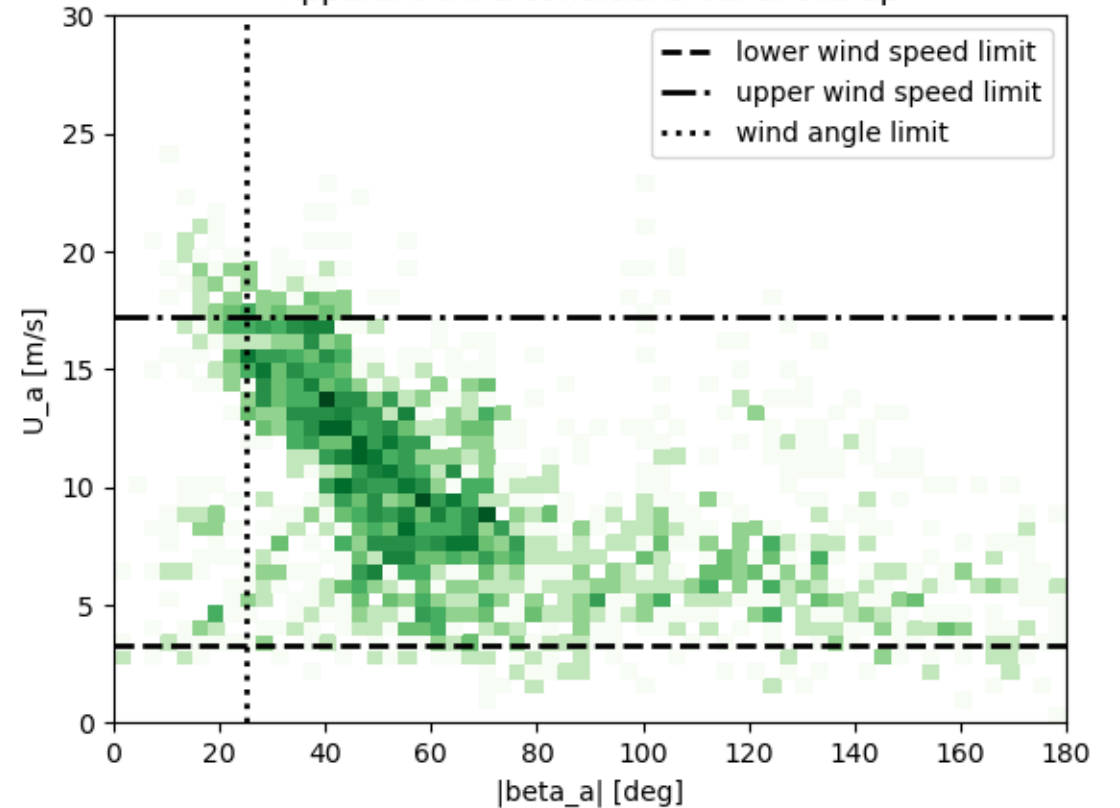
Wind conditions

- Data after 1-11-2020
- VentiFoil used when usable = 42%

All apparent wind conditions



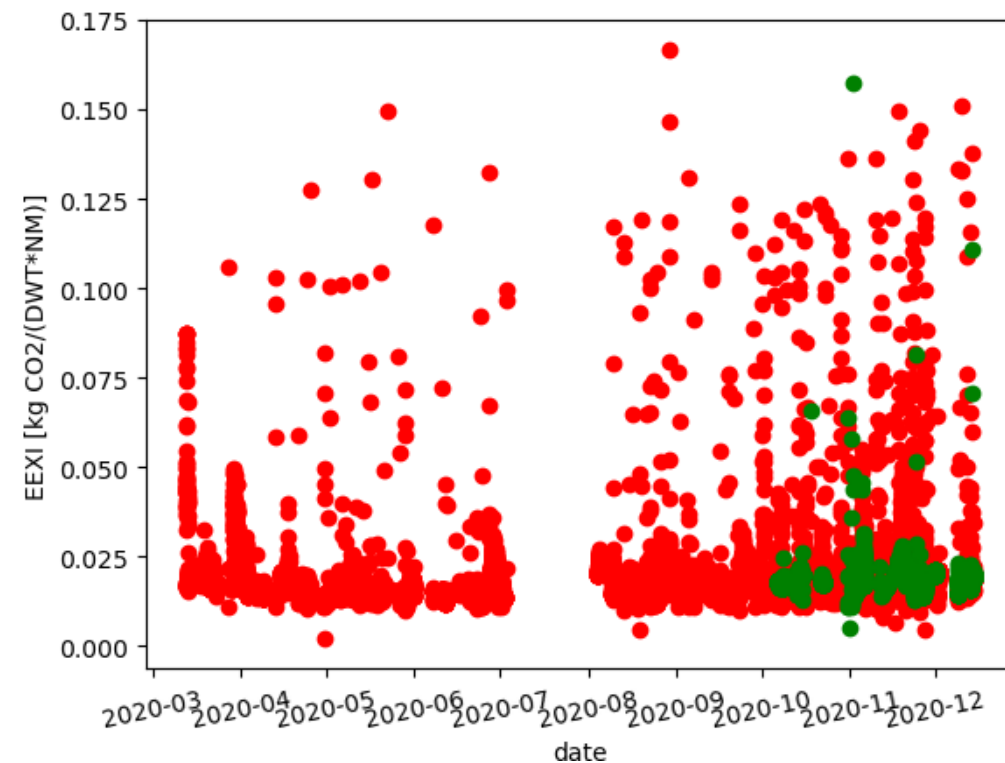
Apparent wind conditions VentiFoil up



FOC logged by second party
reviewer every 5 minutes

Red datapoints → VentiFoils
down

Green datapoints → VentiFoils
up

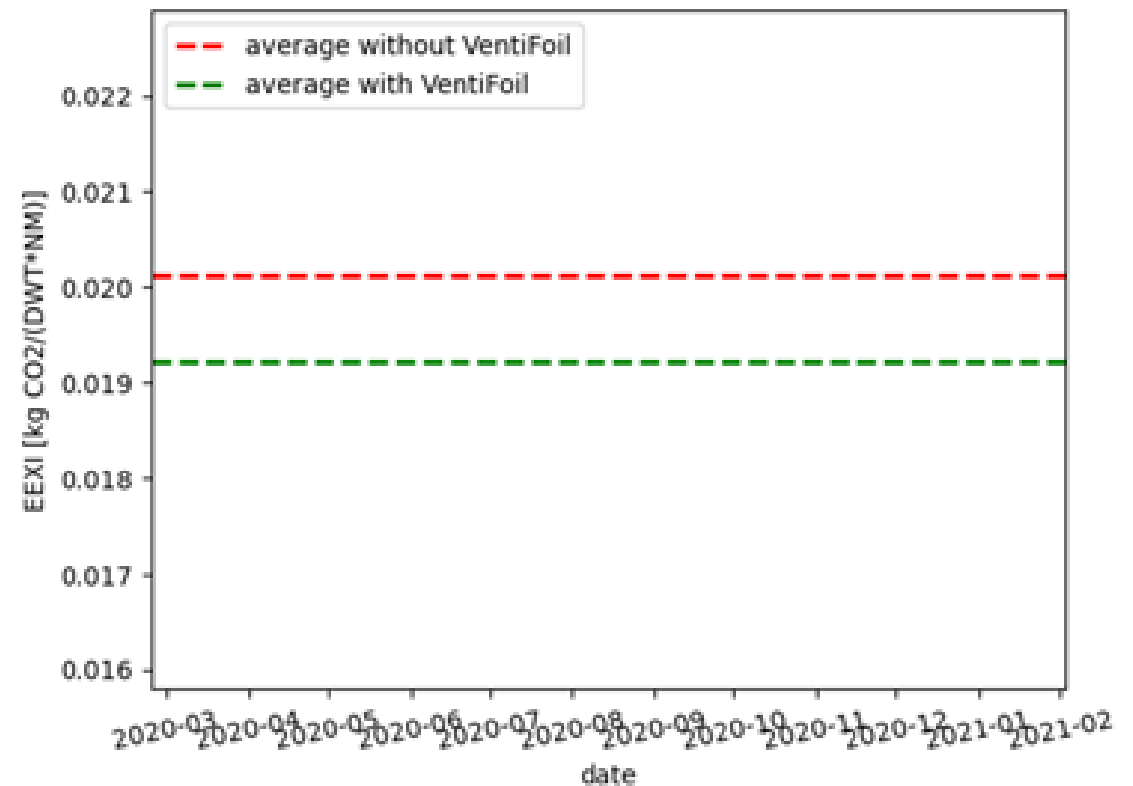


EEXI is lowered by 5%

When accounted for power input of Ventifoil this is 4,5% reduction

Fuel and Emission savings!

Overlong run 8% is expected



2021:

Extension from 10 to 13 meter

Overlong run 10% is expected



eConowind units offers scalable way to achieve emissions reduction in shipping, saving money in the long run: Econology.

VentiFoil

- ✓ Available today
- ✓ Foldable solution
- ✓ Reduction of EEXI (CO2 Emission / Nm)
- ✓ Realistic savings up to 20%
- ✓ No significant modifications necessary
- ✓ Automatic Steering
- ✓ Pay as you Sail

CUSTOMERS VALUE



ECONOWIND