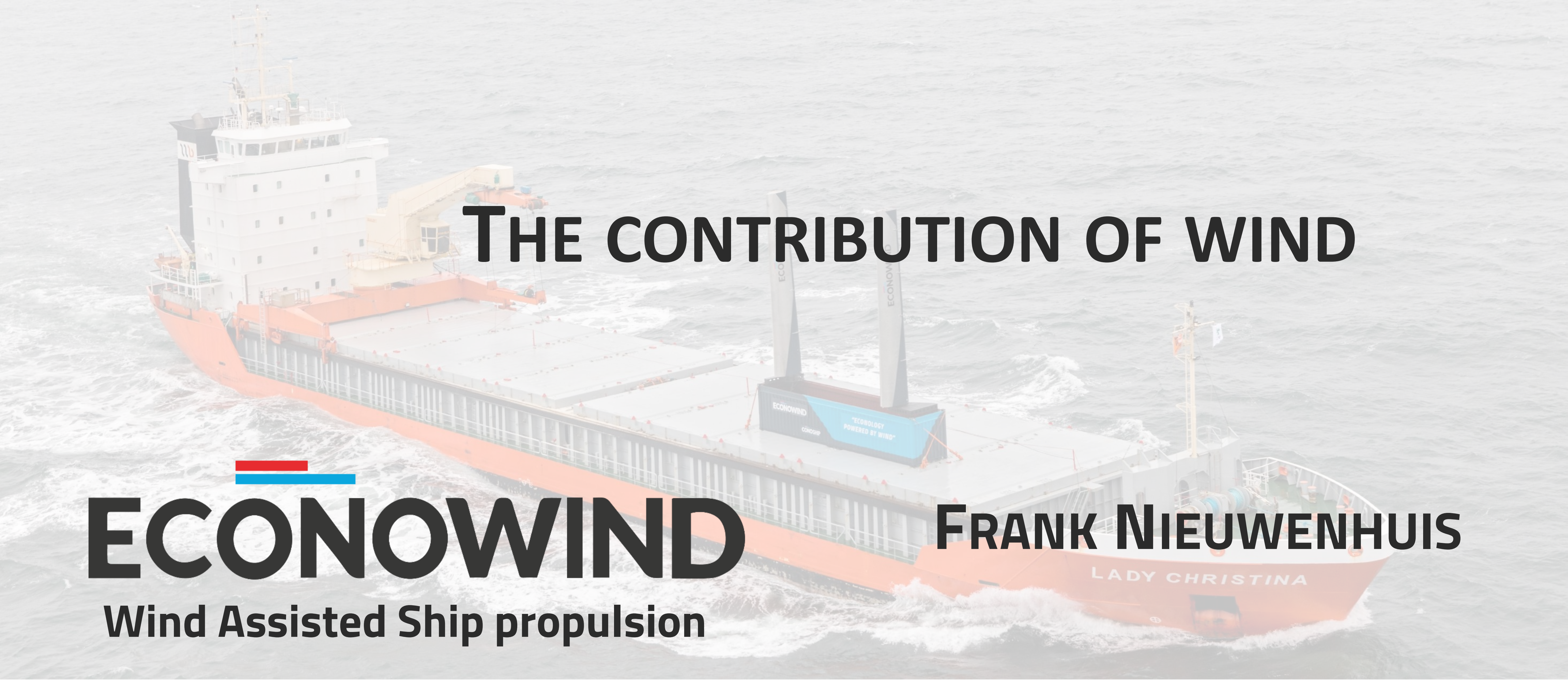
Natural propulsion in ship design

ECONOWIND
Wind Assisted Ship propulsion

Frank Nieuwenhuis



The contribution of wind

ECONOWIND

Wind Assisted Ship propulsion

Frank Nieuwenhuis

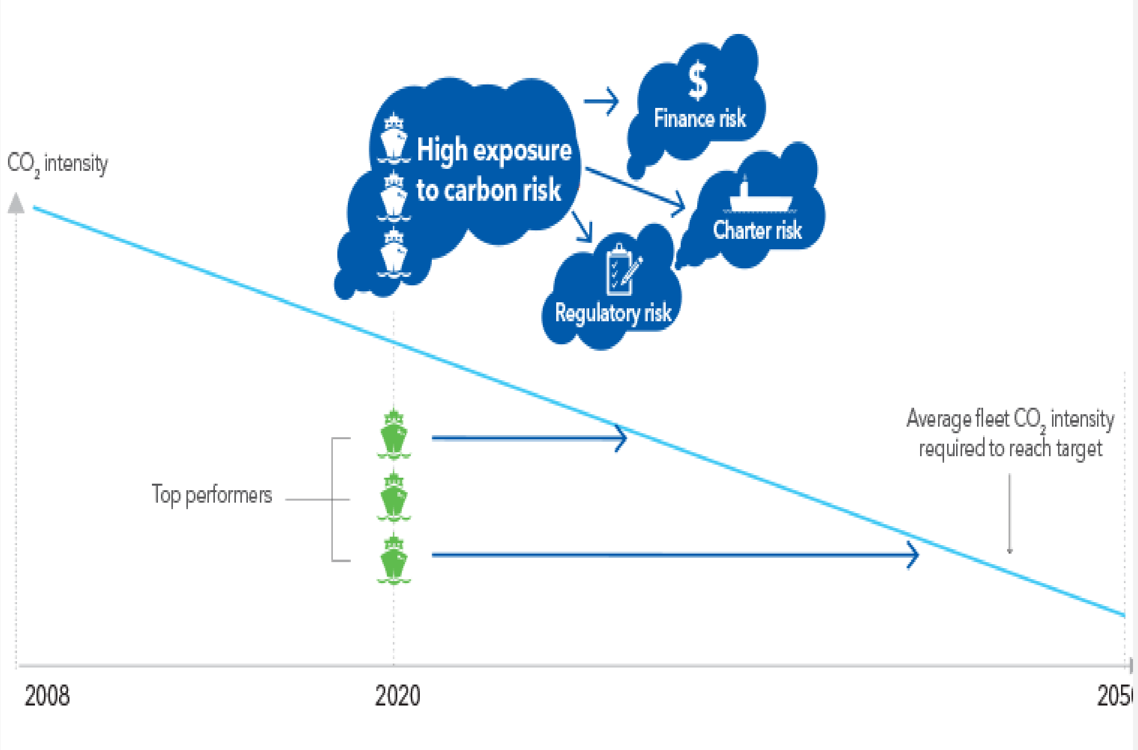
SHIPPING OWNER PAINS

Shipowner's challenge:

- IMO: from 2023 ships must reduce carbon intensity by 2% annually
- 2023: EU ETS will add costs per ton CO2 to shipping
- IMO: by 2050 target to lower emission intensity by 70%

It is an ongoing proces…..

….. starting today



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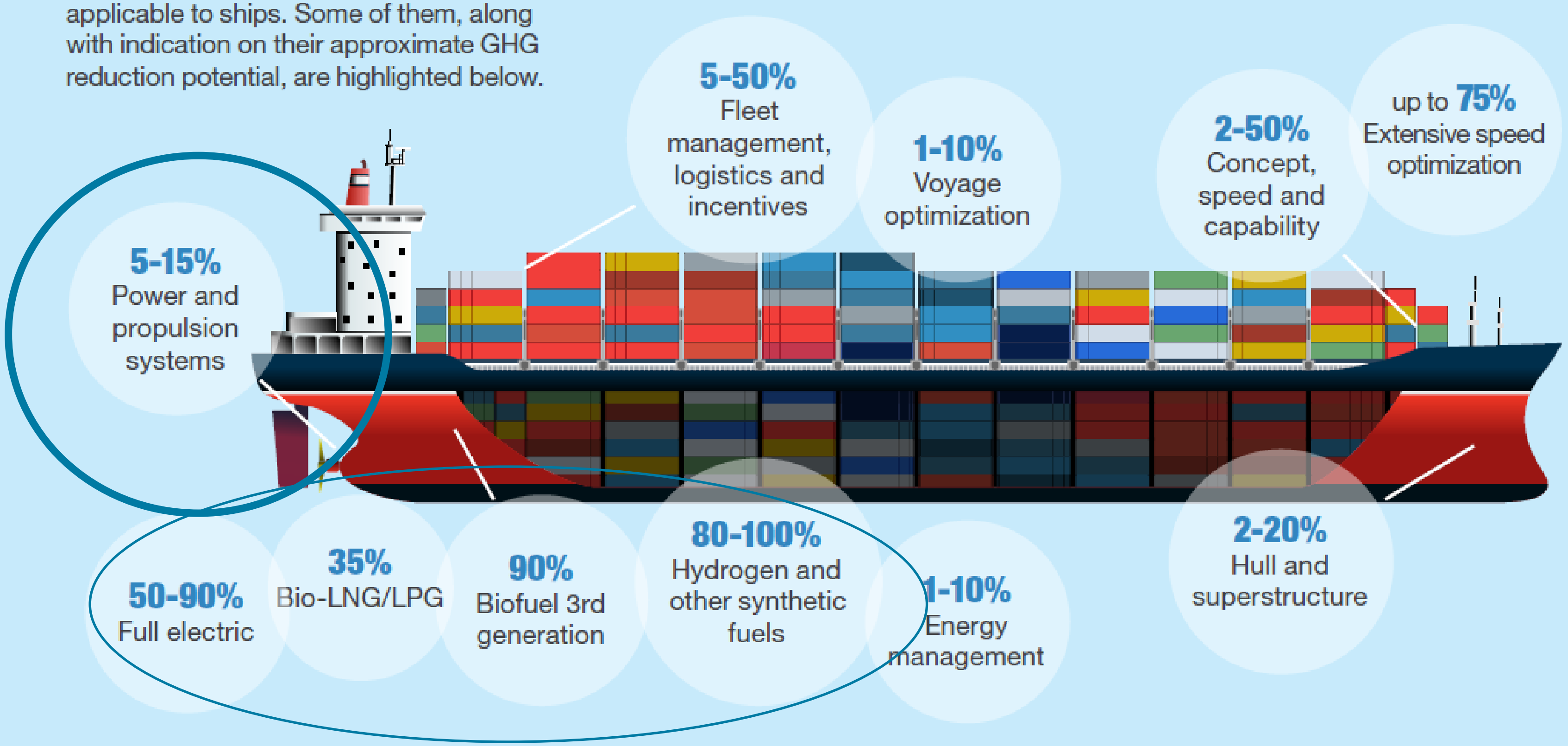
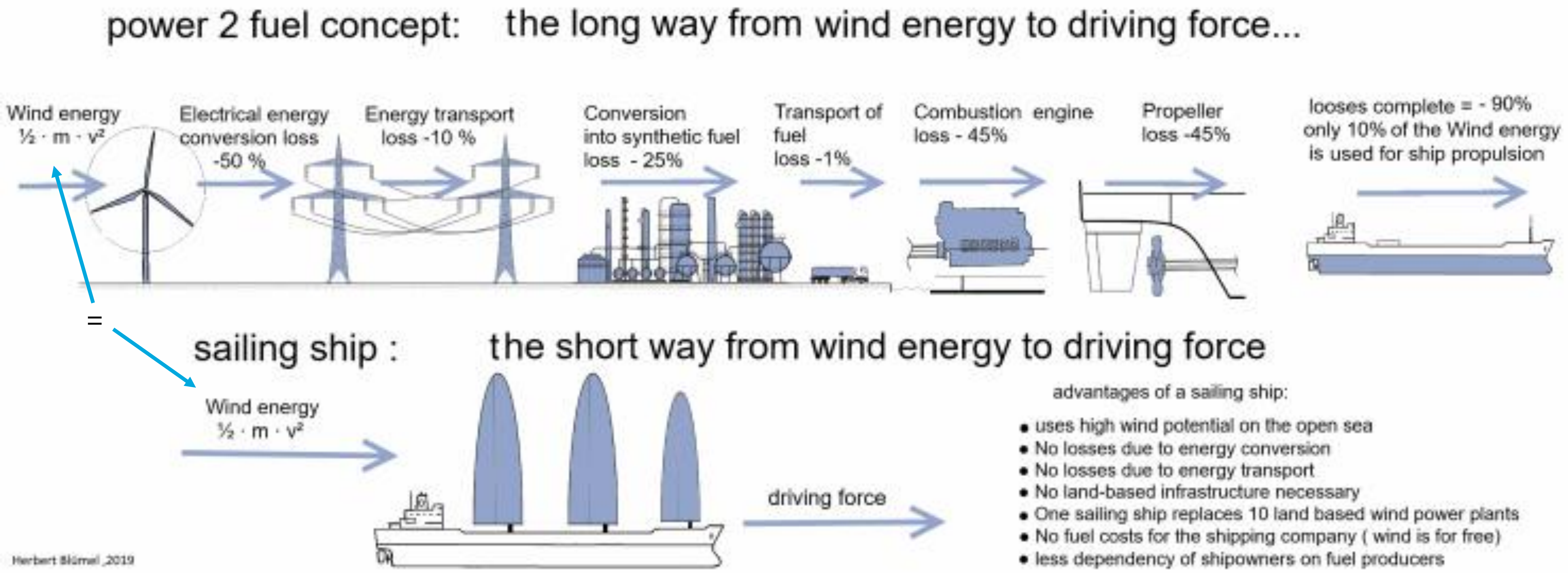
IMO EXPECTATIONS

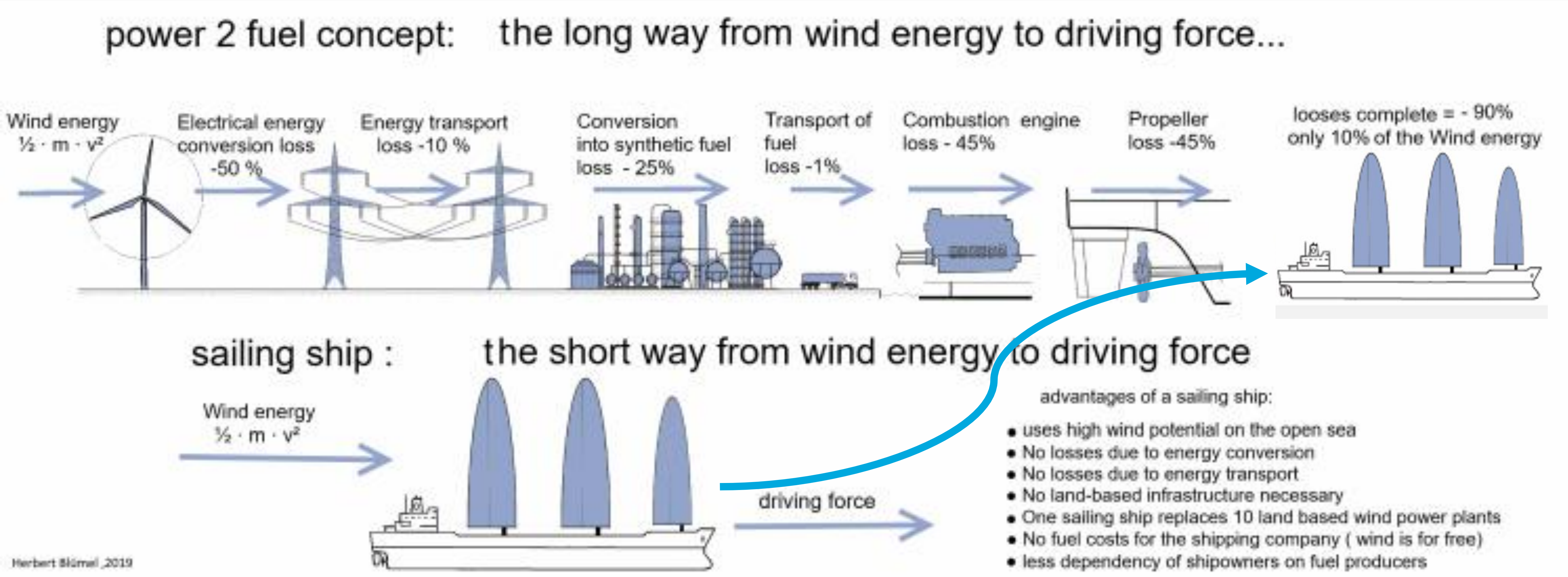
A wide variety of design, operational and economic solutions

Achieving the goals of the Initial IMO GHG Strategy will require a mix of technical, operational and innovative solutions applicable to ships. Some of them, along with indication on their approximate GHG reduction potential, are highlighted below.



WIND?


power 2 fuel concept: the long way from wind energy to driving force...
Wind energy
½ · m · v²
Electrical energy
conversion loss
-50 %
Energy transport
loss -10 %
Conversion
into synthetic fuel
loss - 25%
Transport of
fuel
loss -1%
Combustion engine
loss - 45%
Propeller
loss -45%
looses complete = - 90%
only 10% of the Wind energy
is used for ship propulsion
=
sailing ship : the short way from wind energy to driving force
Wind energy
½ · m · v²
driving force
advantages of a sailing ship:
• uses high wind potential on the open sea
• No losses due to energy conversion
• No losses due to energy transport
• No land-based infrastructure necessary
• One sailing ship replaces 10 land based wind power plants
• No fuel costs for the shipping company (wind is for free)
• less dependency of shipowners on fuel producers
Herbert Blümel 2019



Not always good winds: Hybrid systems

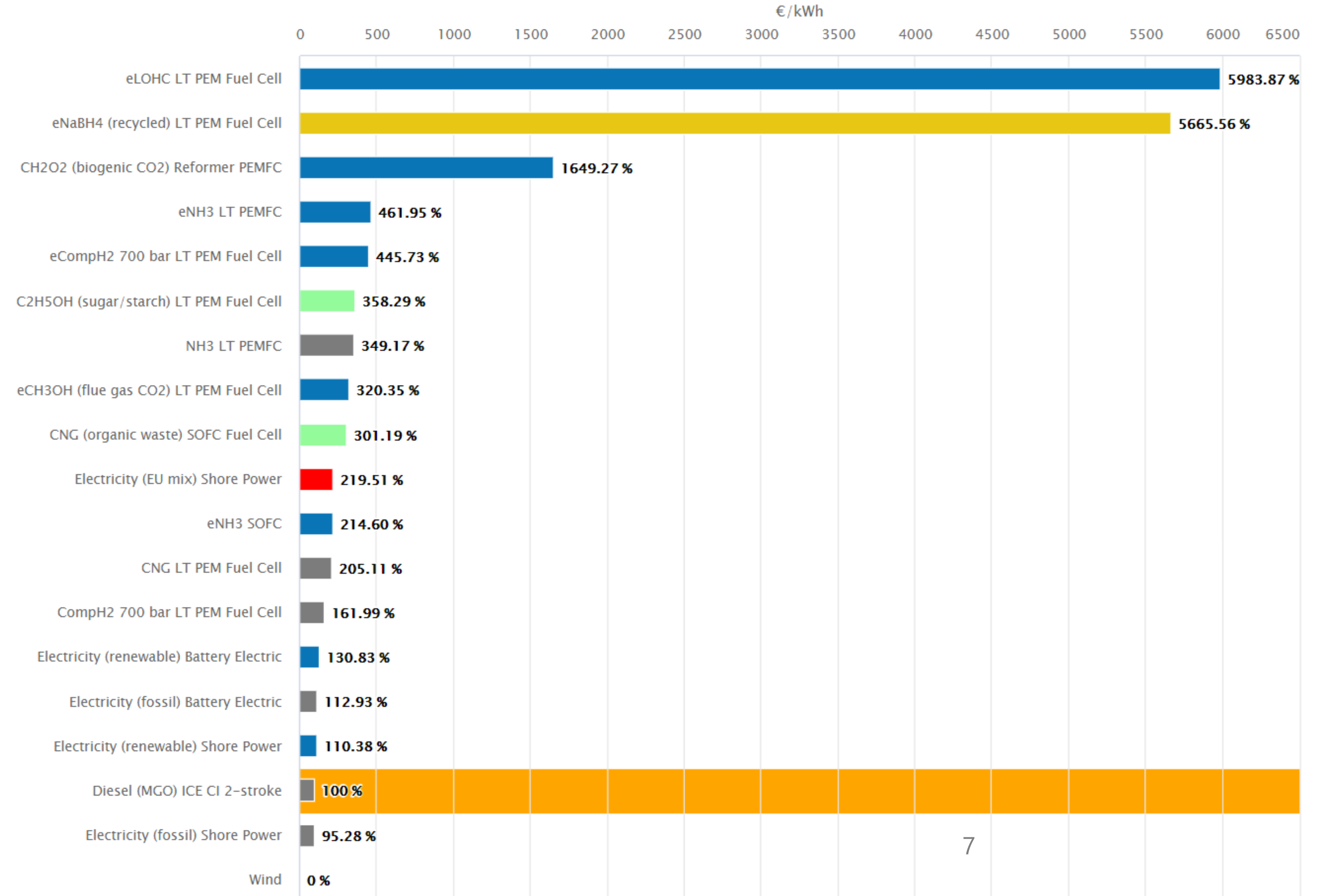
On RENEWABLE ENERGY

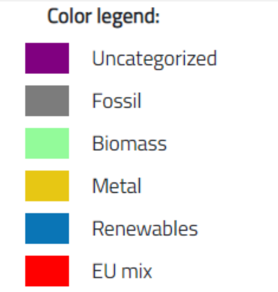
Wind lowest € / kWh

Wind does not need infrastuctre

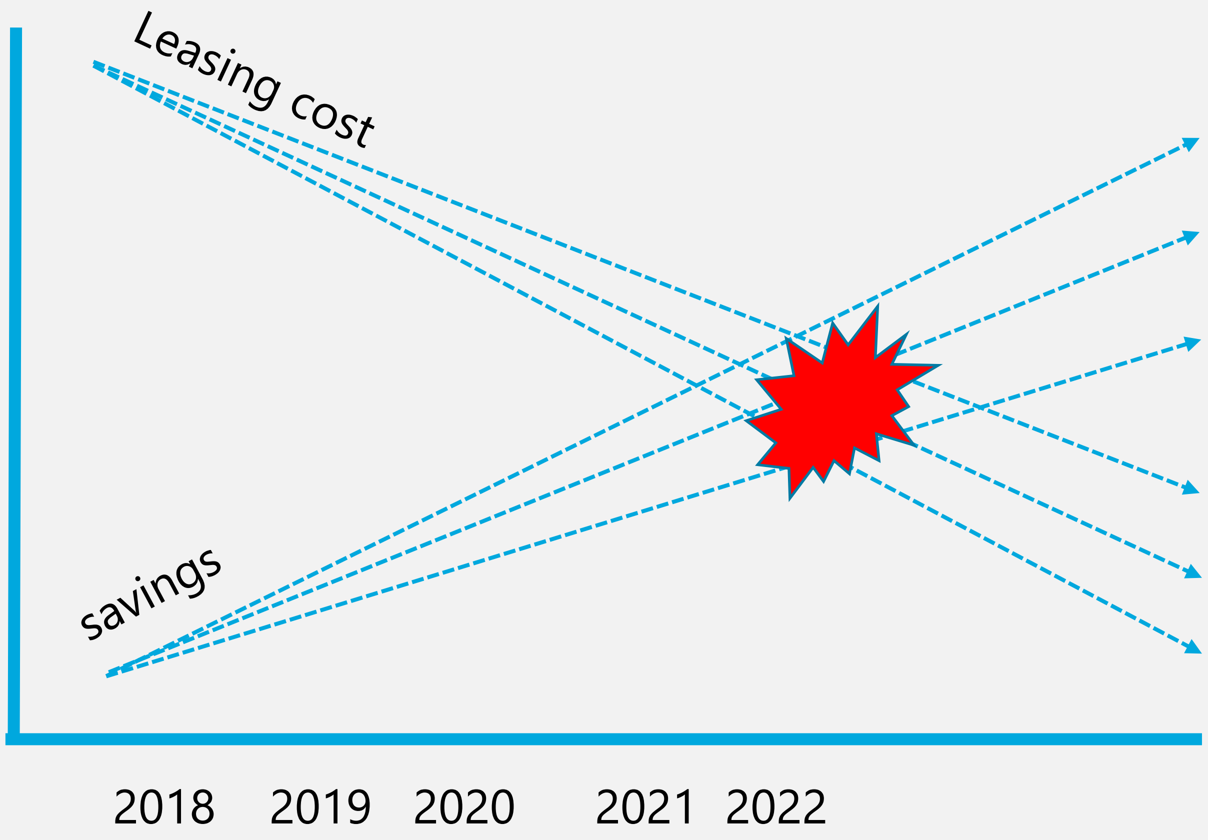
Wind is readily available now

……… Wind varies ……..





THE SINGULARITY POINT IS HERE!



Routing

and

Systems

2 APPROACHES TO 0-EMMISION

Start 0 emission and scale-up

Start at current ships and increase savings

2 APPROACHES TO 0-EMMISION

Start 0 emission

Scale up

Multiply by 20.000

2 APPROACHES TO 0-EMMISION

Start at current ships

Add Wind Assisted propulsion

Scale up

Multiply by 20.000

ECONOWIND

IWSA International Windship Association

: Many wind assisted systems available

STUDY

2011 - 2015

Wind propulsion studied

COLLABORATION:

Conclusion :

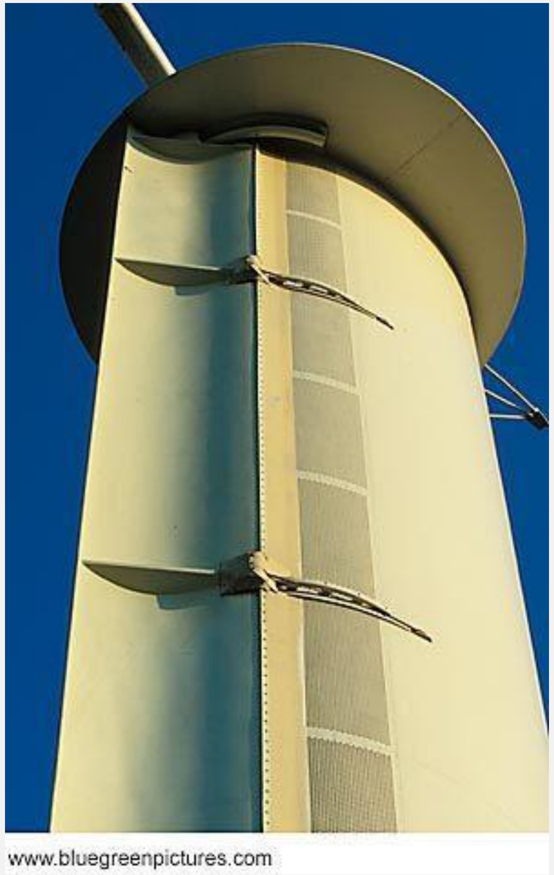
- Wind assisted propulsion is feasable.
- Start with systems up to 25% fuel reduction.

WIND PROPULSION STUDIED

Most promising:

Suction Sail

Jacques Cousteau ~1985



Concept:

- Suction Sail
- Foldable
- Fixed, flatrack or Containerized

Containerized:

ECONOWIND

MAYDEN VOYAGE ON MV LADY CHRISTINA

SNN
SAMENWERKINGSVERBAND NOORD-NEDERLAND
• Stimuleert • Faciliteert • Verbindt

Flatrack

Movable by hatchcrane

STEPS TOWARDS 2050

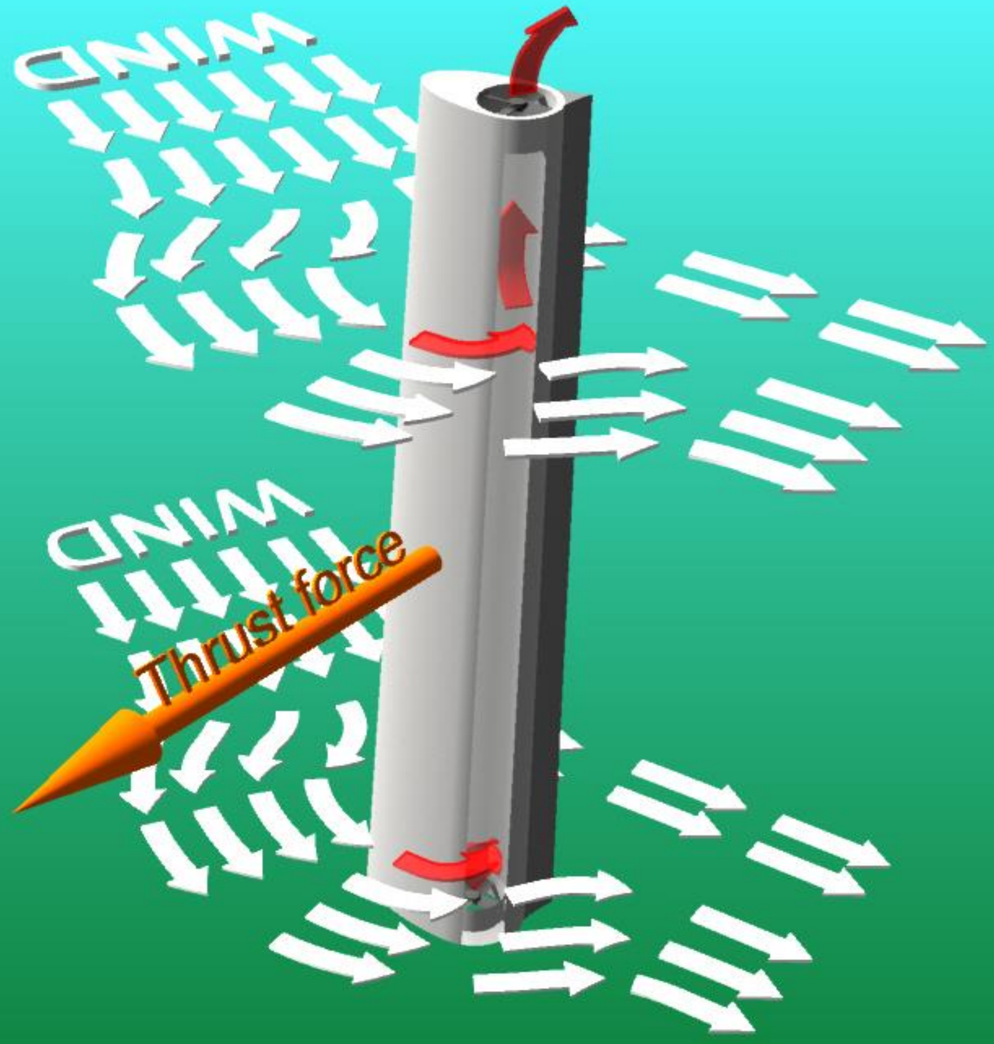
Retrofit:

Why “Suction Sail” ?

Wing with Suction:

Triple force

By optimal aerodynamics

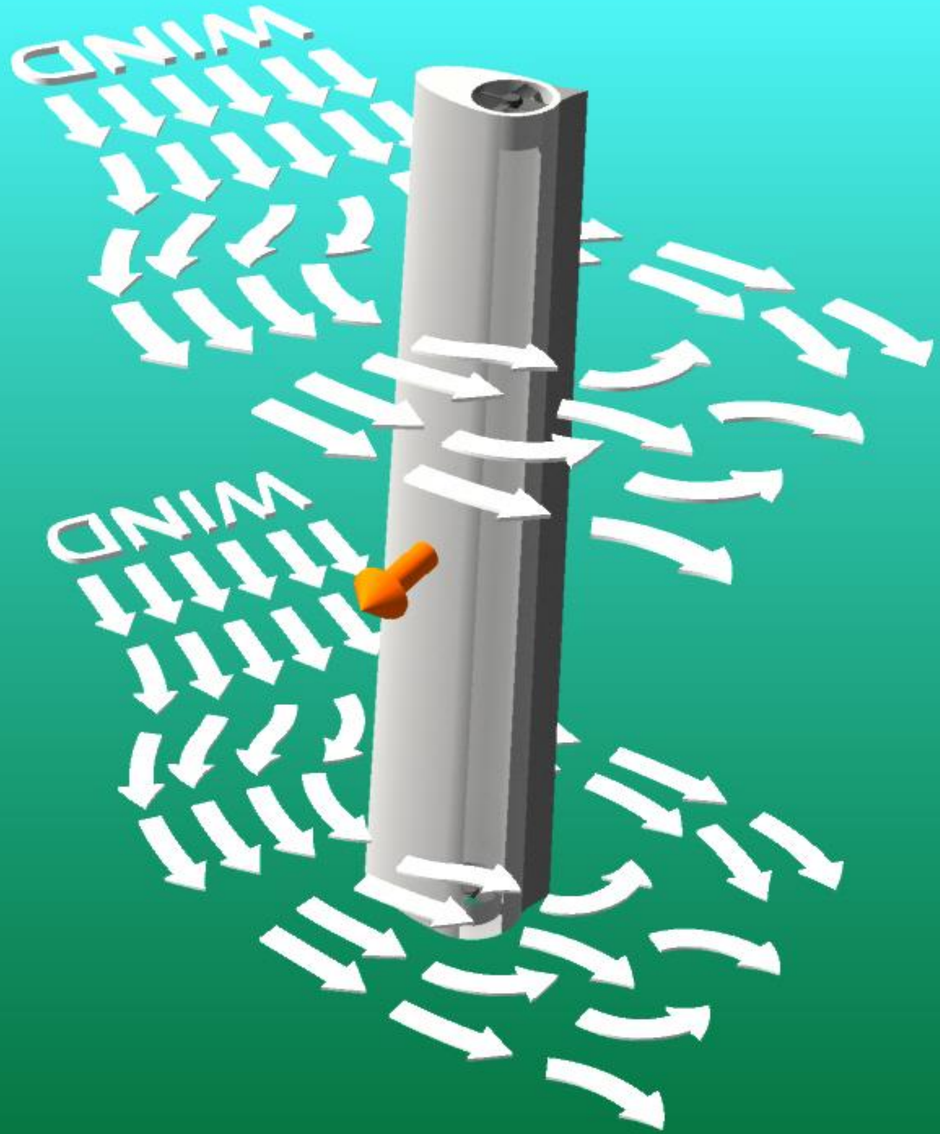


Aero dynamics

Wing without Suction:

Limited force

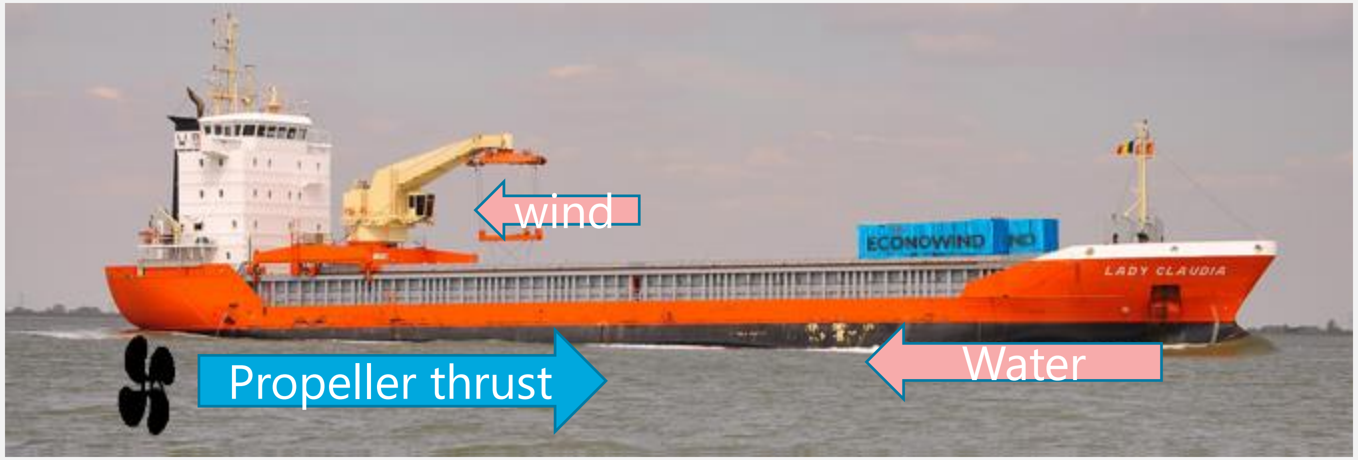
By stalling wing



AERO DYNAMICS

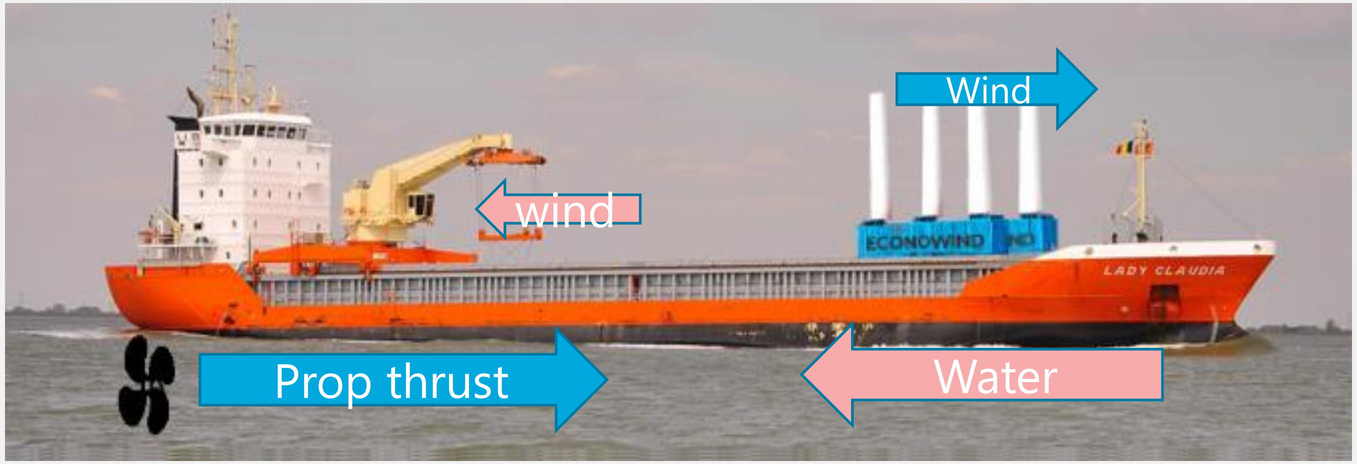
THEORY

Thrust = resistance



REALITY

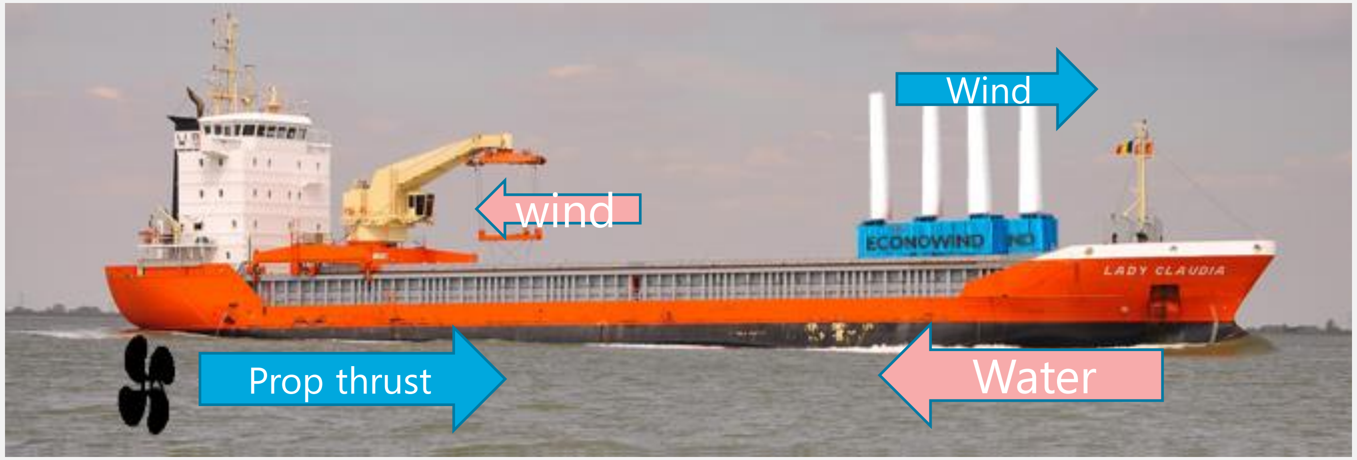
Thrust = resistance



Speed increases

REALITY

Thrust = resistance



Maximal saving at original speed

Conclusion:

We need to evaluate extra speed and fuel consumption

Interreg North Sea Region WASP

European Regional Development Fund

EUROPEAN UNION

Testing for Real:

MV Ankie: 10 x 2,1m

MV Ankie: 10 x 2,3m

ECONOWIND

MV Ankie

Interreg
North Sea Region
WASP
European Regional Development Fund

EUROPEAN UNION

Prediction

	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									

Prediction

9 knots, 10 m/sec: 20 – 25%

	0				0	15							
	ship speed knots	m/s	Distance miles	time hours	True wind speed m/s	wind to heading degrees	Apperent wind speed m/s	Angle to heading degree	Cx Thrust coef	Thrust Force Fwd kN	Total Resistance ship kN	Motor force kN	Force reduction %
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									

ECONOWIND

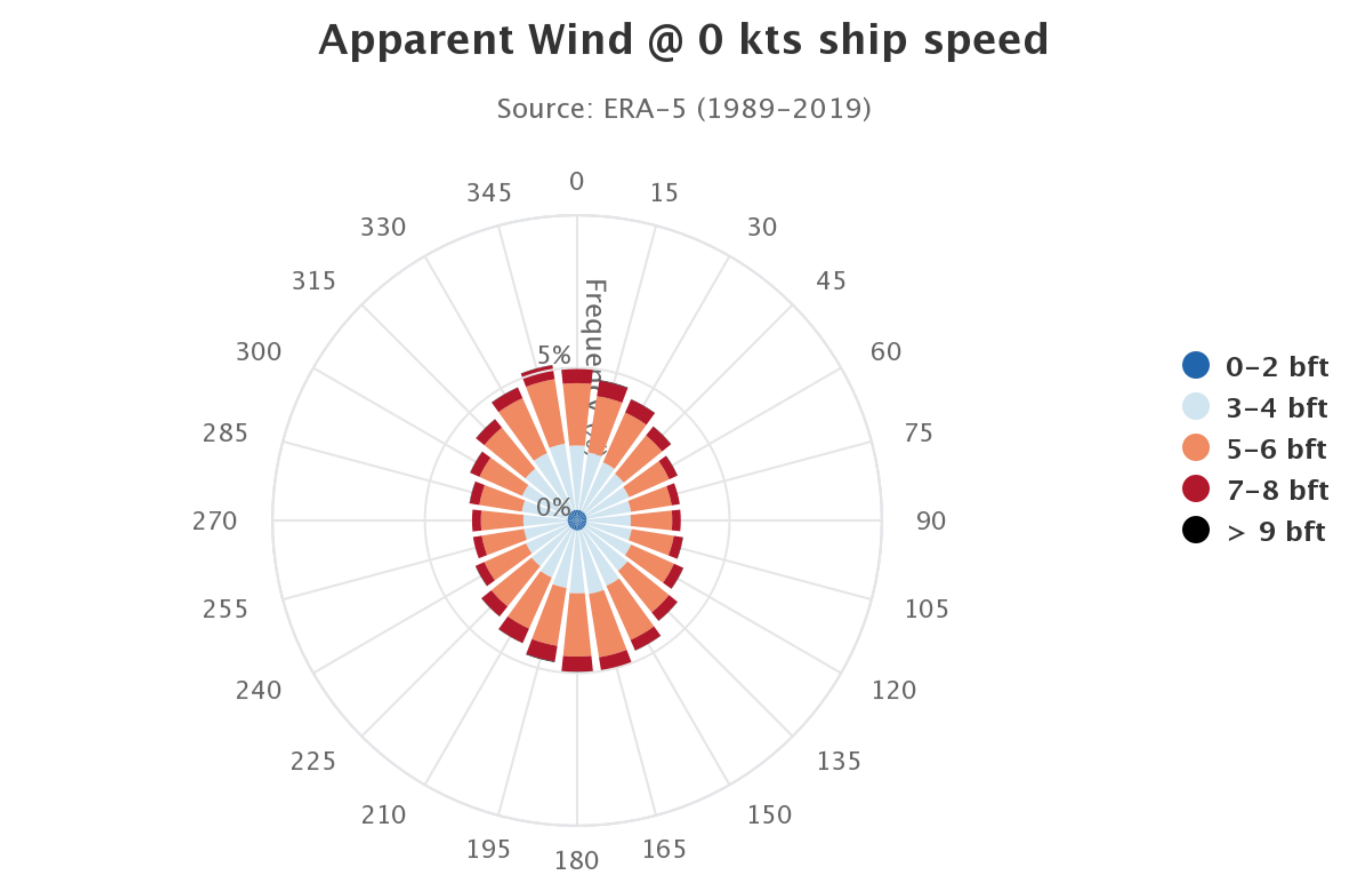
MV ANKIE

Sailing:

MV Ankie

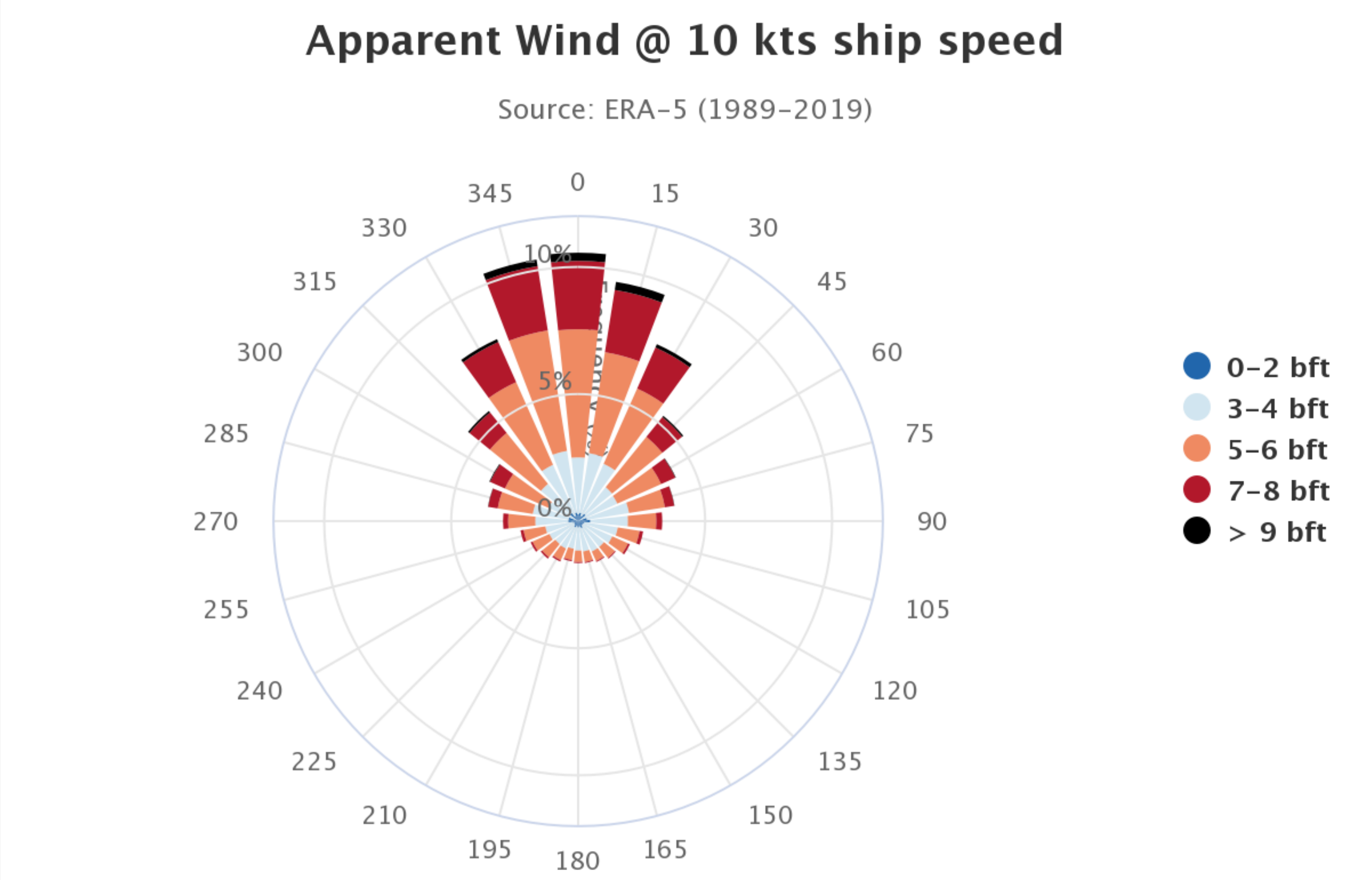
Influence of shipspeed

SOG = 0 [kts]



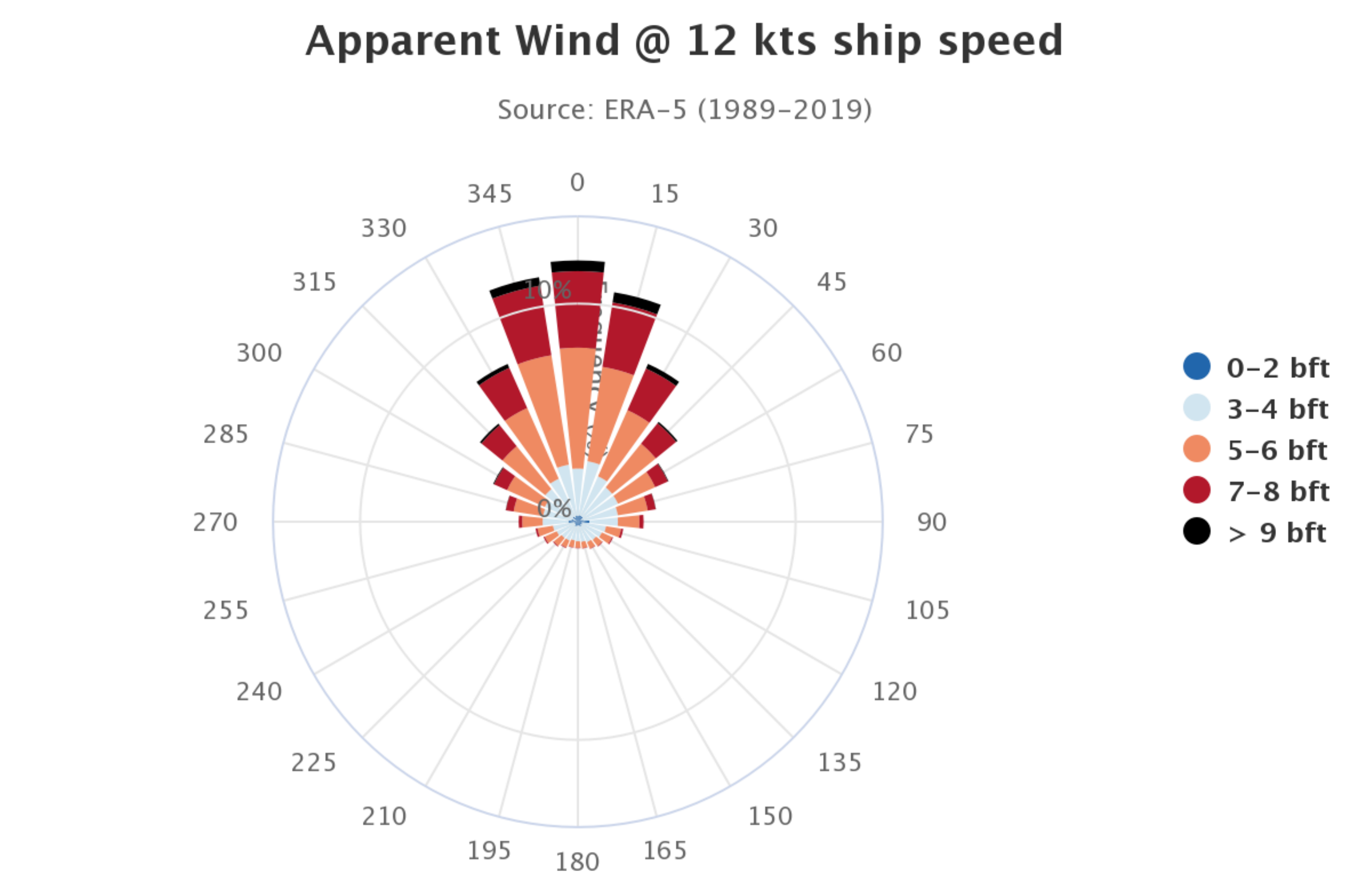
ECONOWIND

SOG = 10 [kts]



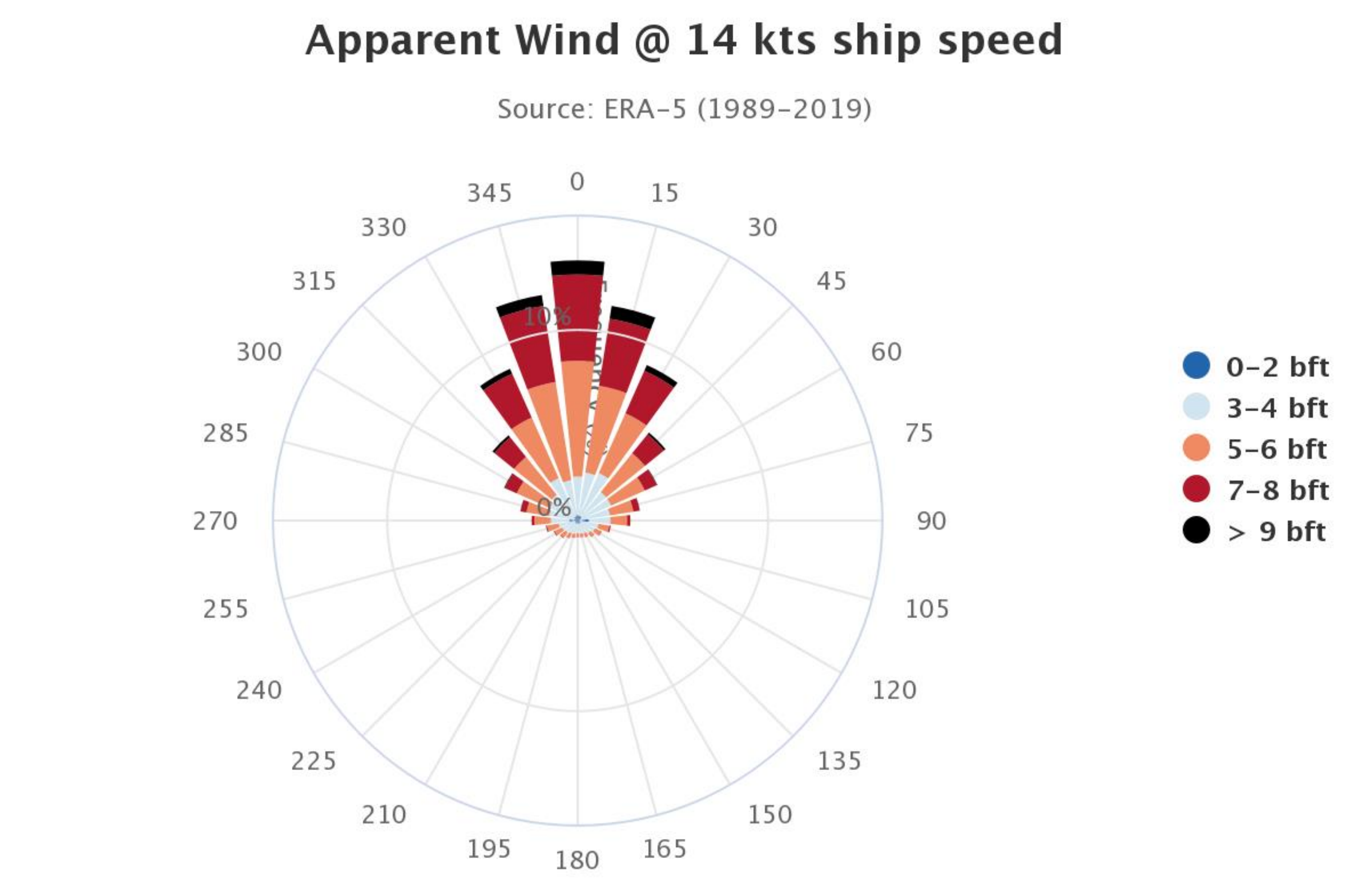
ECONOWIND

SOG = 12 [kts]



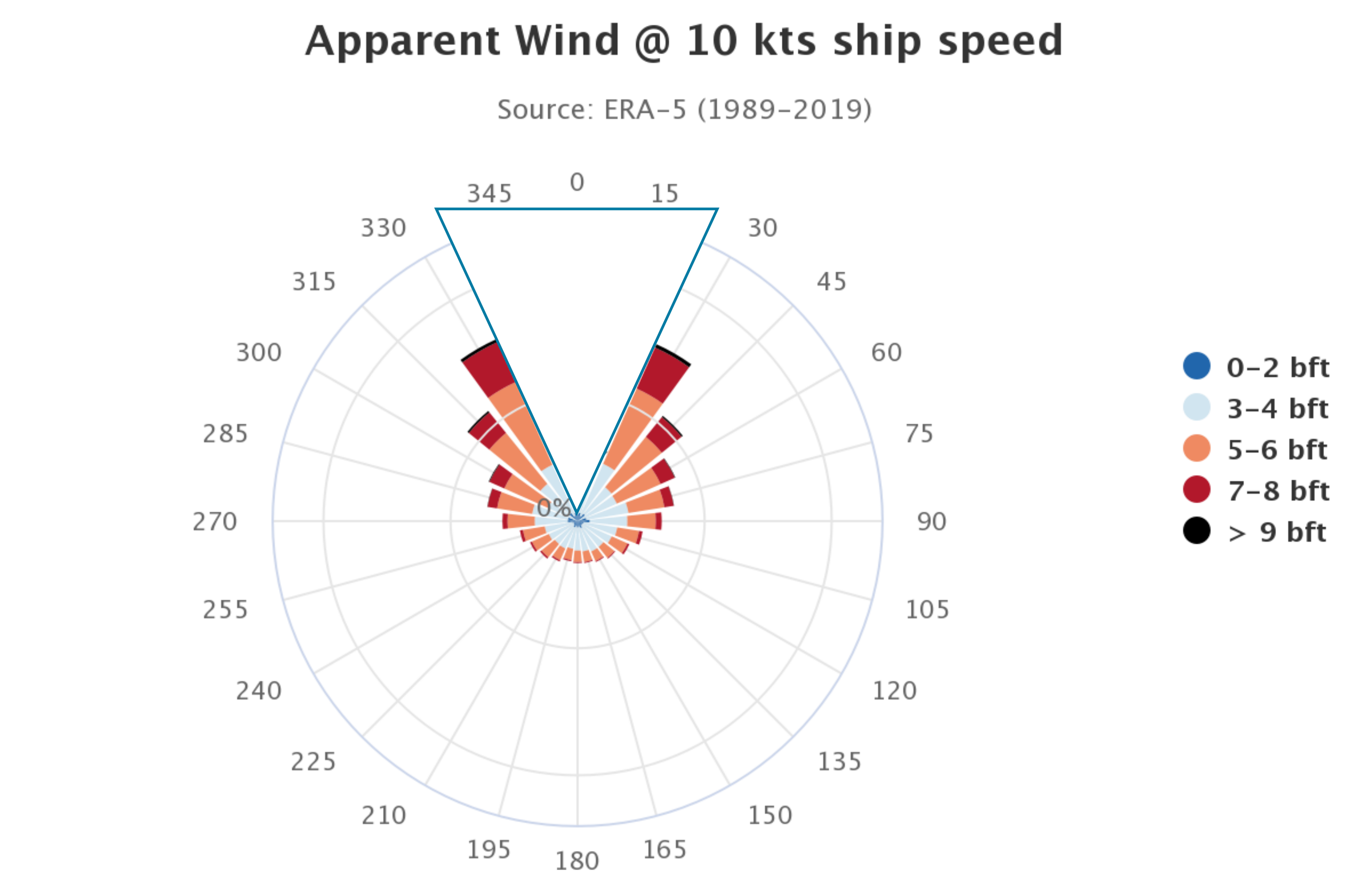
ECONOWIND

SOG = 14 [kts]



ECONOWIND

SOG = 10 [kts]



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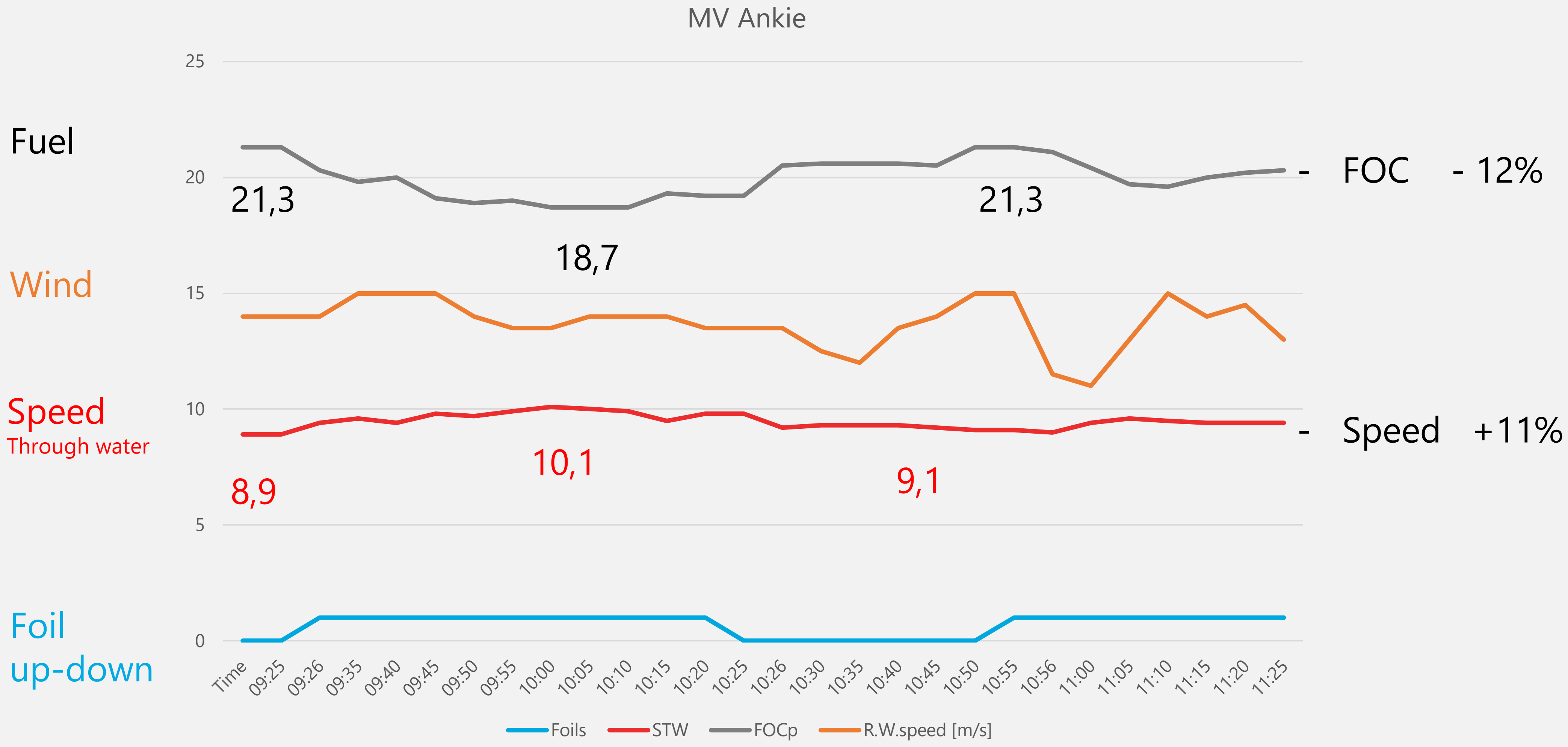
SWL 300 KG

Results:



ECONOWIND

MV Ankie

Results:

In reality over whole year / all routes?

MEASURING IN ACTION

Measurements over 2 years period

Interreg
North Sea Region
WASP
European Regional Development Fund

EUROPEAN UNION

STEPS TOWARDS 2050

TAKE AWAY MESSAGE:

- Wind assist is available TODAY
- Savings can equal leasing costs
- Changing to new fuels is easier with WASP

Thank you for watching

Questions?

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