"CASH IS THE SHADOW OF CARGO FLOW"

KOMARINE 2024

INTERNATIONAL REGULATIONS ON GREEN HOUSE GAS EMISSION AND EXAMPLES TO SOLVE CHALLENGES BY BIG DATA ANALYTICS

2024

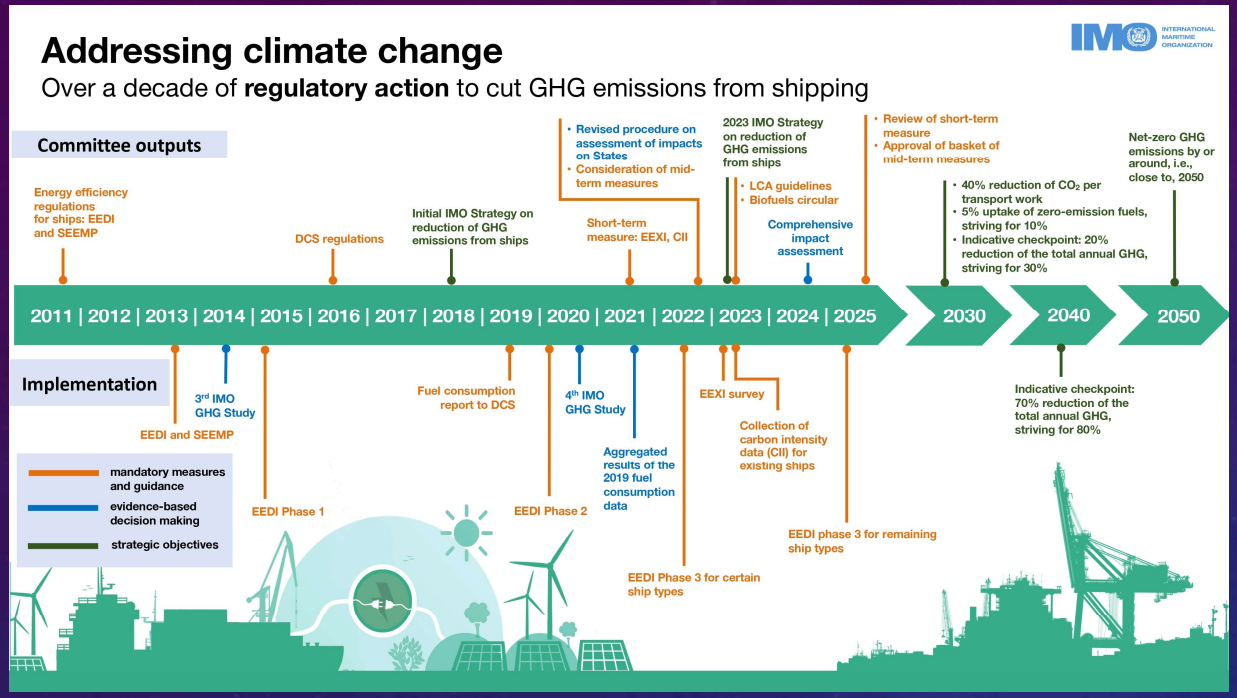
HUNTER S. URM, CEO

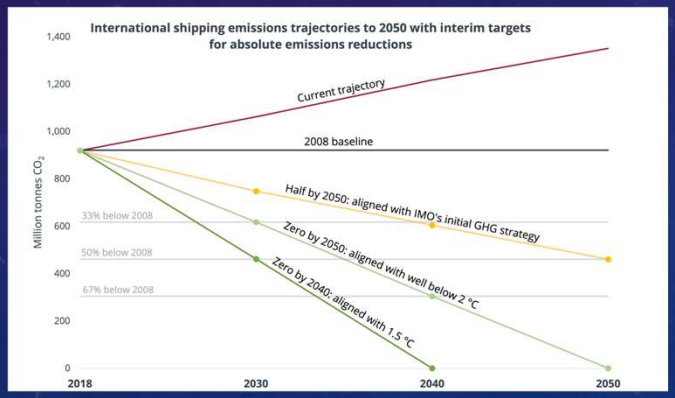
ALL SEA DATA INC.

Note: All slides hereinafter are based on our current best knowledge subject to change without prior notice.

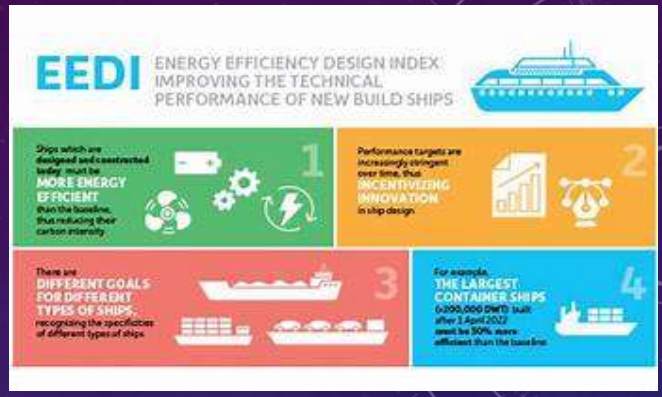
INTERNATIONAL REGULATIONS ON GHG

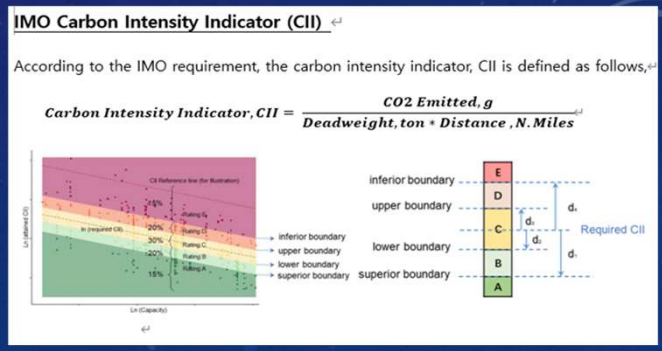
IMO REGULATIONS





Source: ICCT





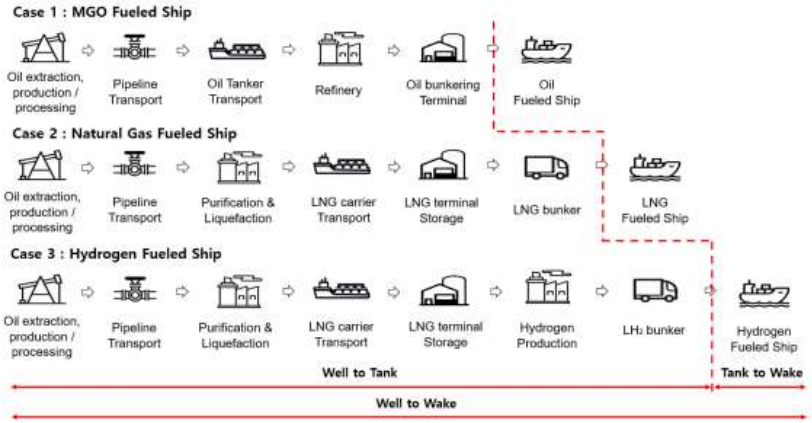
Source: IMO

IMO LCA - WELL TO WAKE

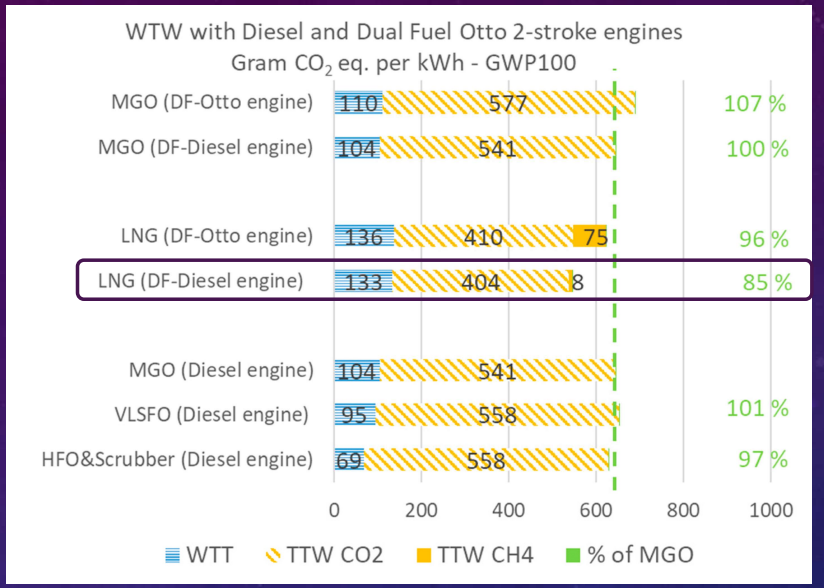
Global warming potential over a 100-year time-horizon (GWP100)

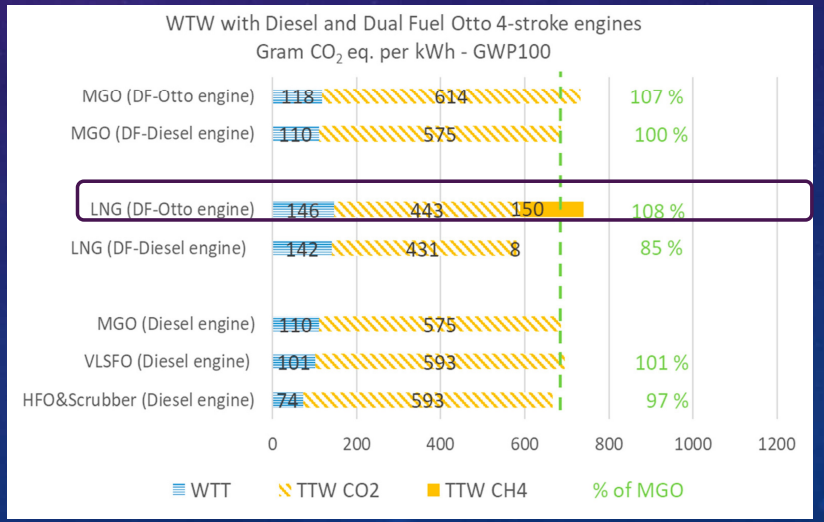
$$g_{CO_{2eq}(100y)} = 1 \times gCO_2 + 28 \times gCH_4 + 265 \times gN_2O)$$

- Well-to-Wake: From a fuel production to fuel consumption to operate ship.
- Well-to-Tank: From a fuel production to a fuel tank of ship.
- Tank-to-Wake: From a fuel tank of ship to fuel consumption to operate ship.



Source: Sang Soo Hwang, *et. al.*, 2020

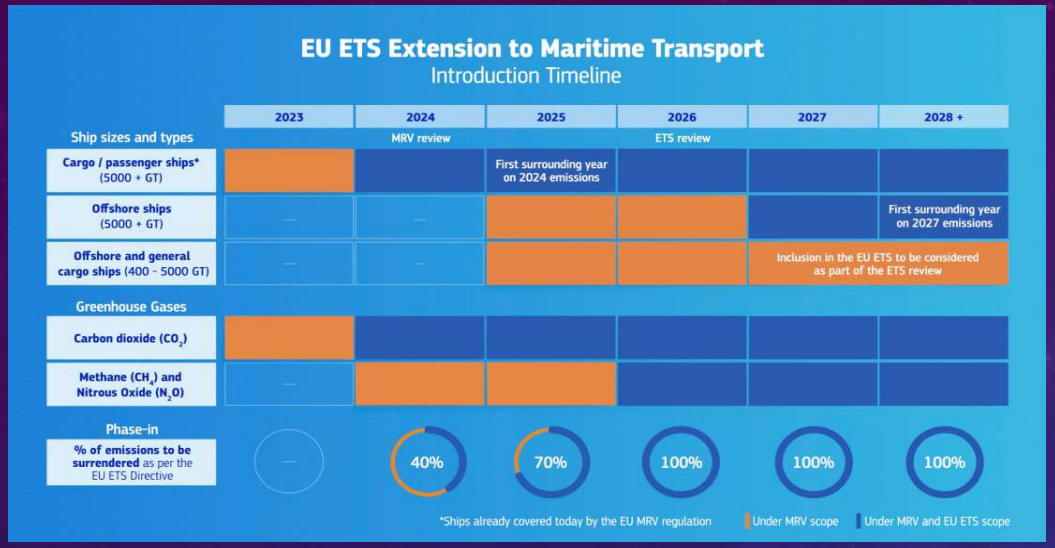




- How to measure "Well to Wake"?
- Difficult to track source of fuels

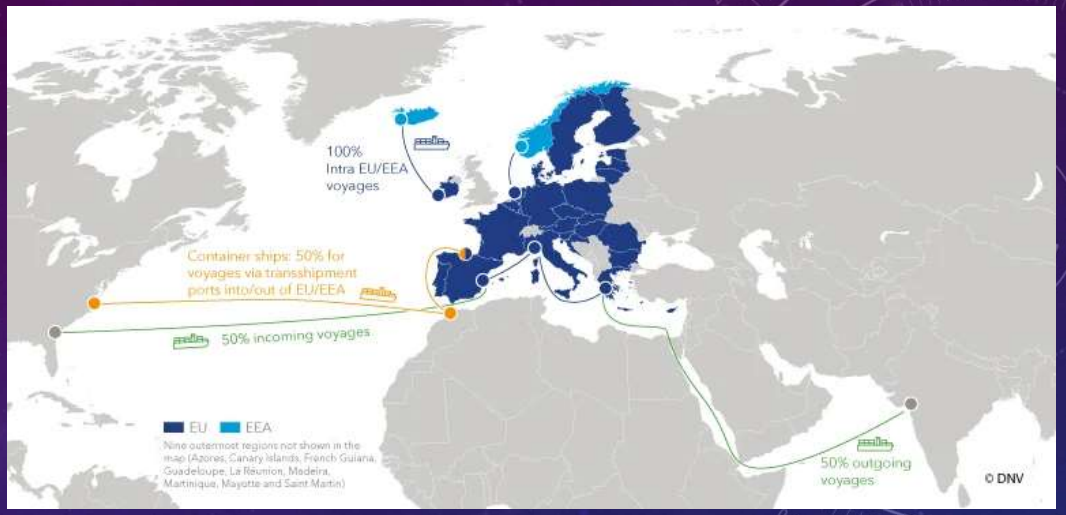
Source: Elizabeth Lindstad et. al,, Decarbonizing Maritime Transport: The Importance of Engine Technology and Regulations for LNG to Serve as a Transition Fuel, 2020

EU MRV & ETS

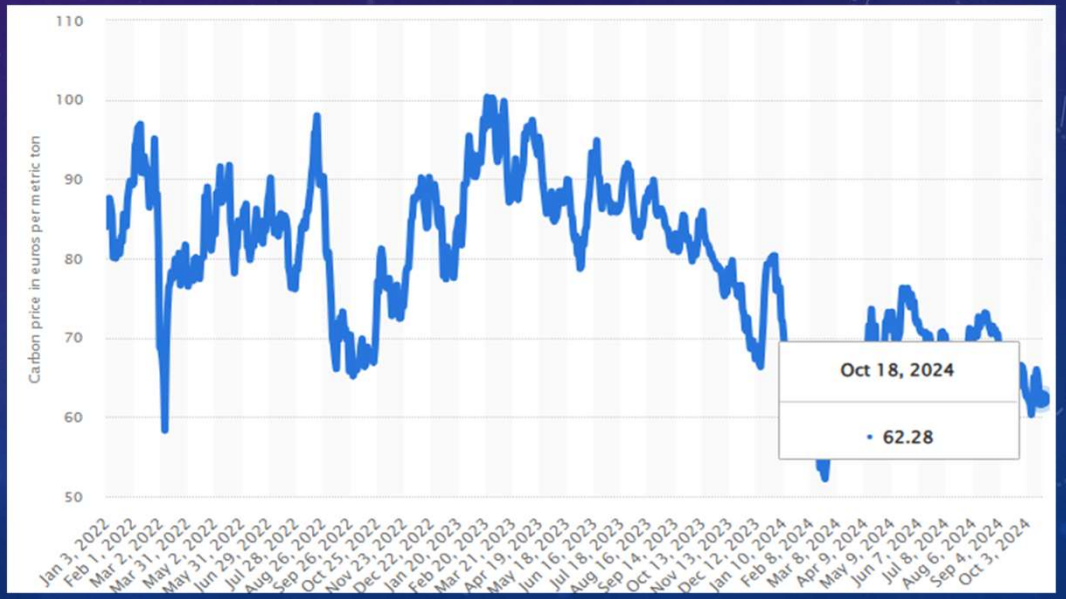


Trade	DRY	REEFER
	Surcharge per TEU in EUR	Surcharge per TEU in EUR
Central America/West Coast South America to Europe North/South, North Africa, East Med	€ 43	€ 61
Central America/West Coast South America/East Coast South America to Mayotte	€ 70	€ 88
Central America/West Coast South America/East Coast South America to Reunion	€ 119	€ 137
East Coast South America to Europe North/South, North Africa, East Med	€ 29	€ 43

Source: https://www.cma-cgm.com/local/brazil/news/543/customer-advisory-ets-surcharge

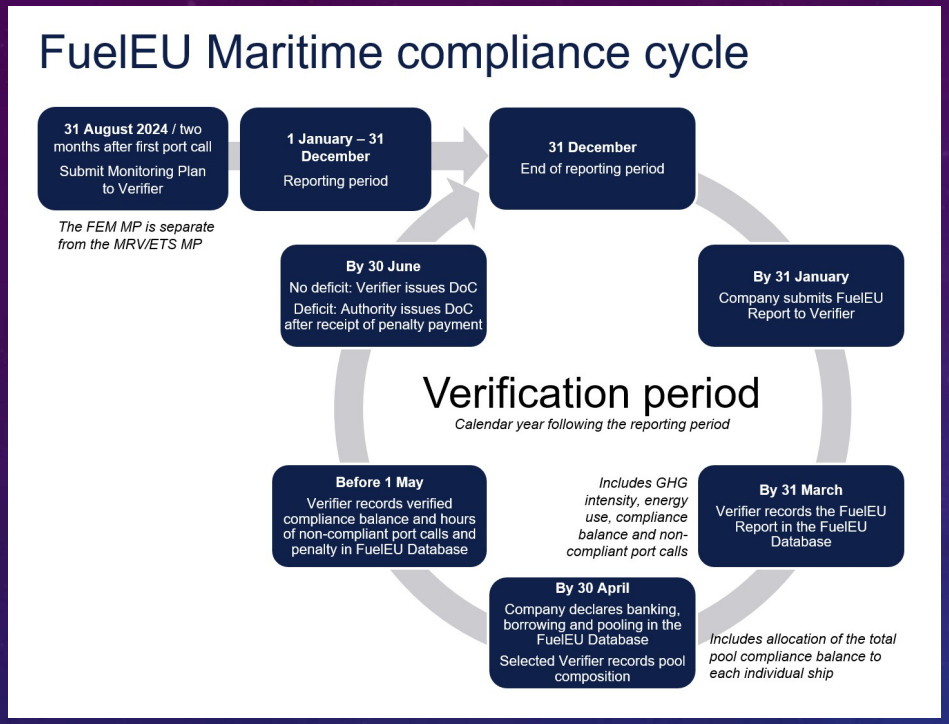


Source: DNV



Source: STATISTA

FuelEU REGULATIONS



The penalty:
EUR 2,400 per ton of VLSFO-equivalent.

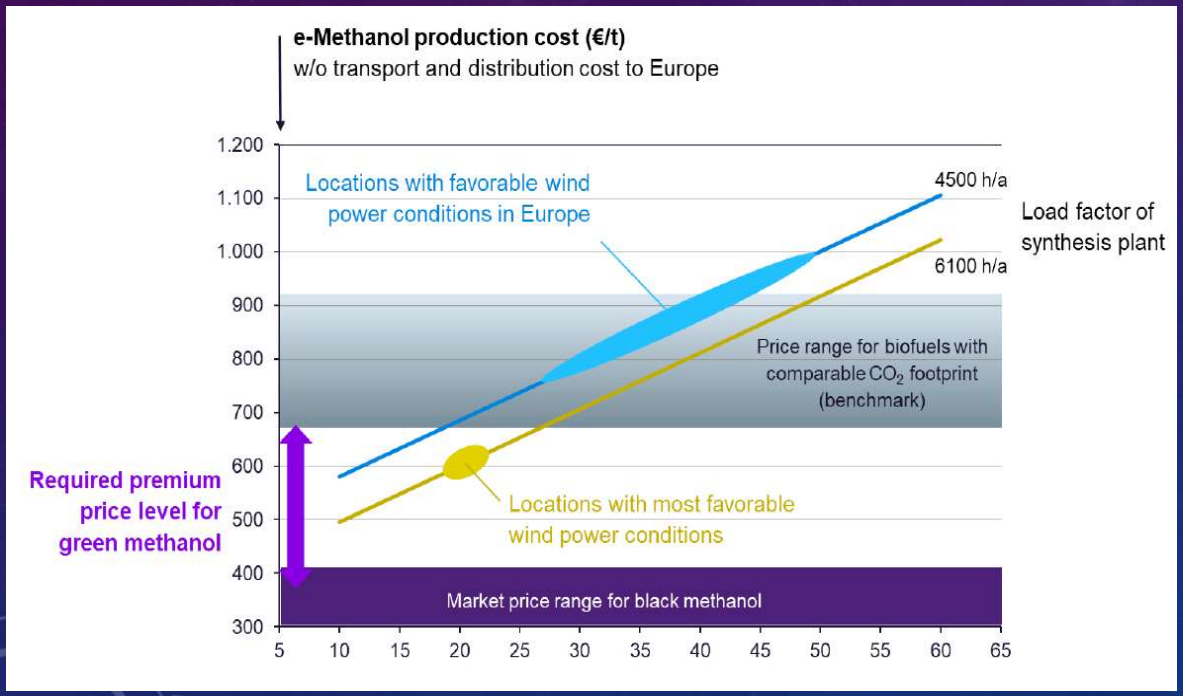
Fuel	Pros	Cons
Methanol	● Less initial investment ● Room temperature	● Less economical
LNG	● Very low SOX emission ● Low fuel cost ● Boil off rate <0.15%	● Economical ● High initial investment cost ● High LNG storage tank price. ● LNG bunkering infrastructure is need. ● Applicable to large vessels
LPG	● Less investment than LNG. ● Extensive experience	● High fuel price ● LPG infrastructure is necessary
Ammonia	● No CO_2 emission	● High fuel cost ● Separate Low temperature tank ● Toxic material
Liquid hydrogen	● Cleaner ● No CO_2 emission ● High energy density ● High boil off rate (>1.0%/day)	● Not economical so far ● High investment ● Extreme low temperature and dangers (cracks, explosion) ● Special material for material and welding. ● High cost for infrastructure. ● Low volumetric efficiency ● Marine engine is under development

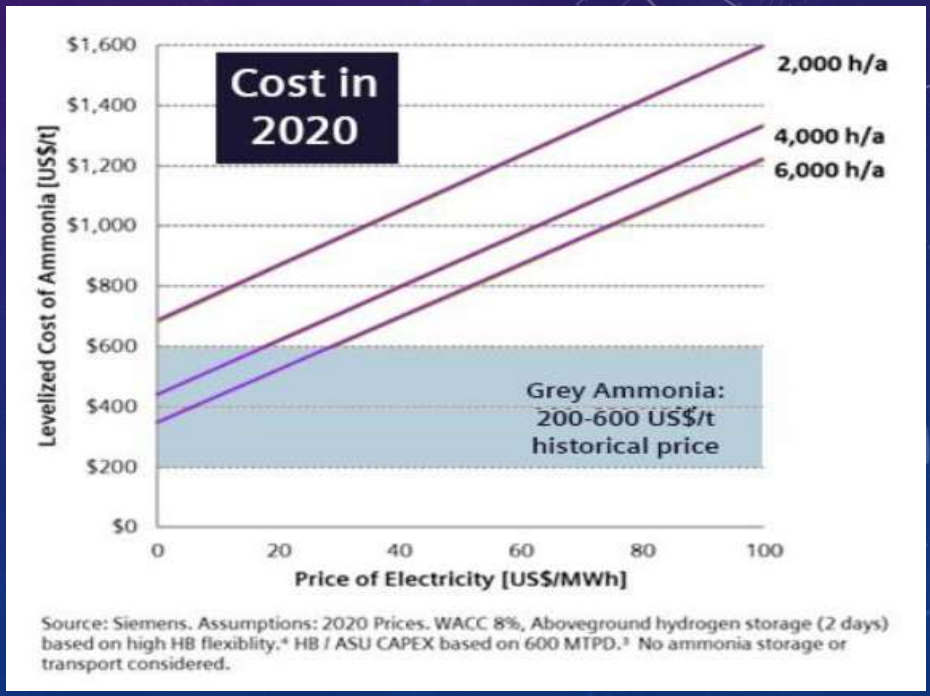
E-METHANOL OR E-AMMONIA?

- Price of e-Methanol or e-Ammonia by renewable energy is still high
- It will take some time to be a reasonable price level, as electricity price is more than USD100/MWh for OECD countries.

Electricity price, USD/MWh

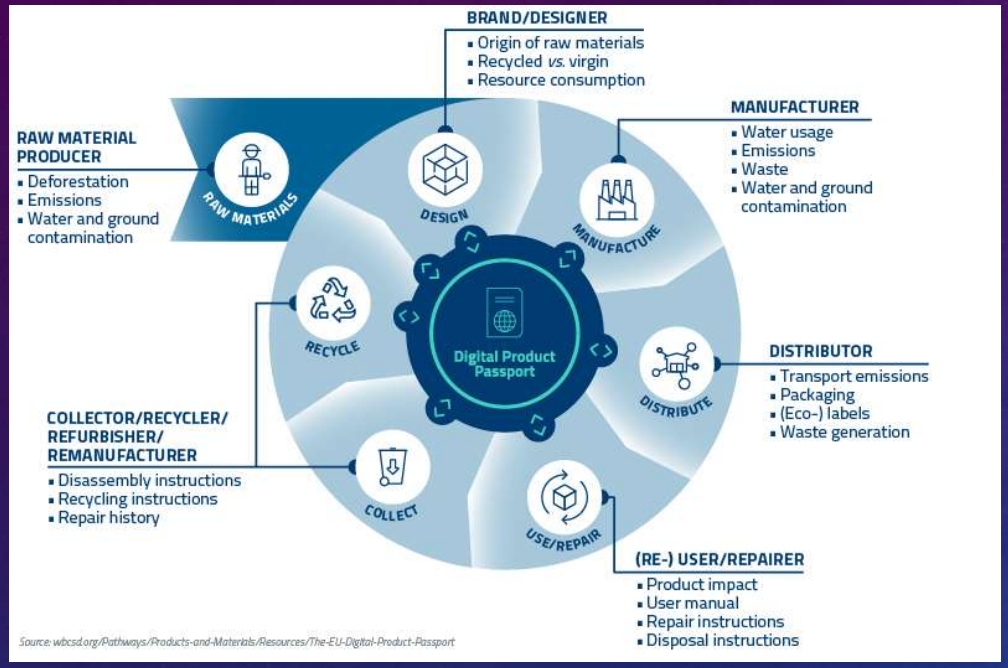
- Korea: 108
- China: 86
- USA: 150
- Saudi Arabia: 48
- Japan: 245





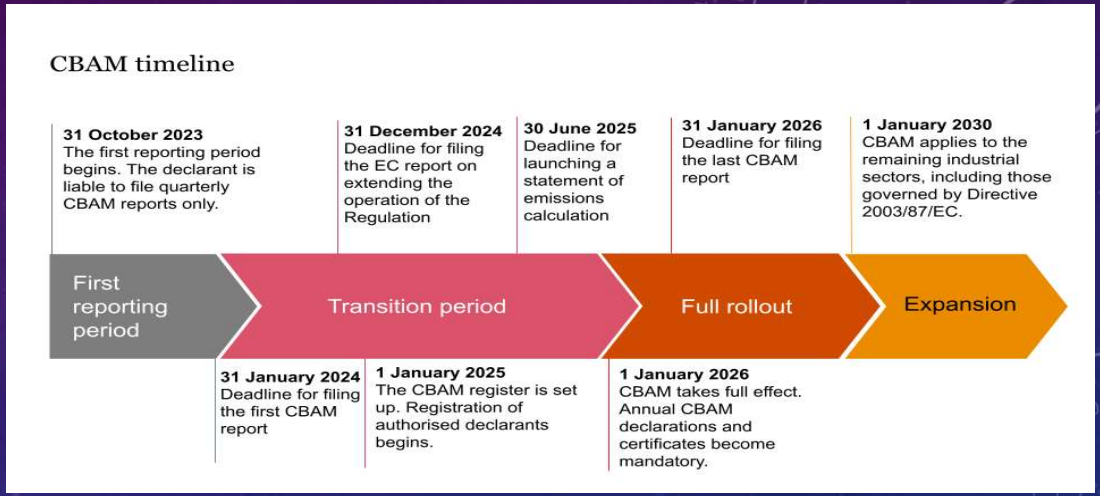
Source: Siemens-energy.com, e-Methanol, e-Ammonia, 2021

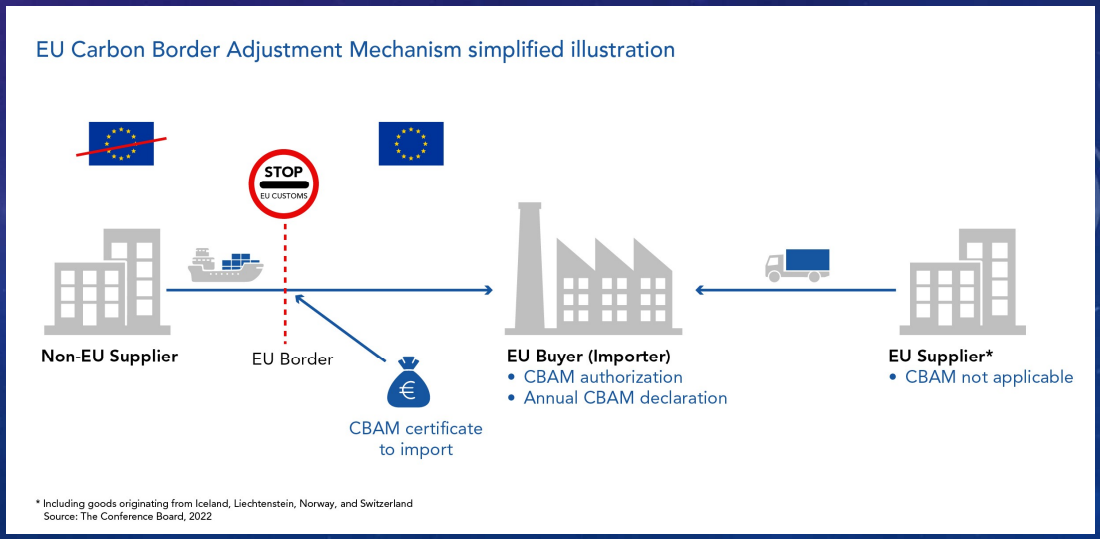
EU DIGITAL PRODUCT PASSPORT (DPP)



EU CBAM

https://mindlink.lv





USA CBAM

- Global Arrangement on Sustainable Steel and Aluminum (GASSA)
- MARKET CHOICE Act
- Energy Innovation and Carbon Dividend Act
- PROVE IT Act

CLEAN COMPETITION ACT (CCA), DECEMBER 2023

- Covered Products: Fossil fuels, refined petroleum products, petrochemicals, fertilizer, hydrogen, adipic acid, cement, iron and steel, aluminum, glass, pulp and paper, and ethanol, CO2, CH4, N2O, HFCs, PFCs, SF6
- Impose a price of ***$55 per ton of extra carbon dioxide*** in both imported and domestic covered products, above the average amount of carbon it takes to make that product in America.
- Use the carbon fee revenue to help reduce carbon pollution further.

Fair, Affordable, Innovative, and Resilient Transition and Competition Act (FAIR Act)

- Estimating the costs for American companies to meet the regulations that reduce their carbon pollution and applying that cost to foreign competitors to balance the playing field.
- Use the carbon fee revenue to help reduce carbon pollution further. The Foreign Pollution Fee Act does not specify how to use the revenue

FOREIGN POLLUTION FEE ACT

- Covered Products: Aluminum, biofuels, cement, crude oil, glass, hydrogen, methanol, ammonia, iron, steel, lithium-ion batteries, critical minerals, natural gas, plastics, petrochemicals, pulp and paper, refined petroleum products, solar cells and panels, wind turbines, CO2, CH4, N2O, HFCs, PFCs, SF6
- Scientists with performing economic modeling

EU VS. US CBAM

구분	미국	EU
적용 품목	• 에너지 집약 산업 (정유, 석유화학, 철강, 유리, 제지 등) 12개 품목 HS Code 6자리 기준 -'27년~'28년: 500파운드(약 225Kg) 제품으로 확대 -'29년~'30년: 100파운드(약 45Kg) 제품으로 확대	• '23년 10월~'25년 12월 시범기간, '26년 1월 시행 -철강, 전력, 비료, 알루미늄, 시멘트, 수소 6개 -추가: 철광석 등 원료제품 및 스크류, 볼트 등 -제외: 유기화학품, 플라스틱, 암모니아 (26년 도입 예상)
과세표준	• 제품별 탄소배출량 • 원산지국 산업/제품 탄소배출 집약도 고려	• 제품별 탄소배출량 (EU 무상할당비율 고려) • 수출국 탄소세 차감
탄소가격	• 톤당 55 USD	• 매주 탄소배출거래제(EU-ETS) 가격 연동
도입시기	• '25년 1월1일, '26년 6월 30일 신고 • Annualreport, 납부 9월 30일	• '23년 10월, 본격 시행 '26년 1월 • 분기별 신고, 연 1회 추가 납부/환급 (5월 31일까지)
고려사항	• 제품별 탄소측정, 생산지/생산공정 정보 제공 • HS Code 분류 • IRA, 전략물자, 생산지(원산지국 집약도) 전략	• 제품별 탄소측정, 생산지/생산공정 정보 제공 • ETS 가격 변동 추이

< 상위 10대 對美 수출 품목 >

(단위: 억 달러, 전년비 %)

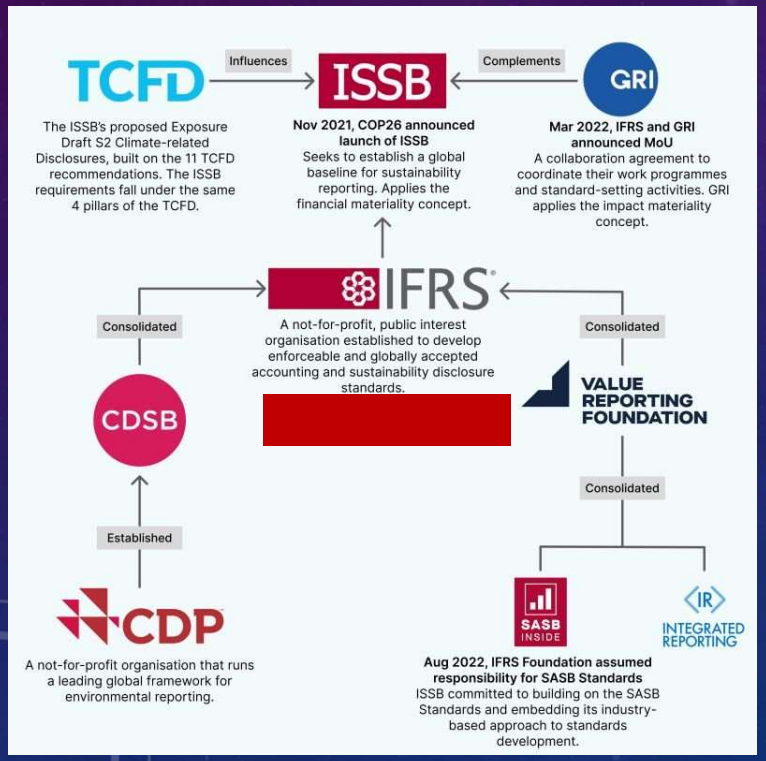
순위	HS 4단위	품목명	2019		2020		2021		2022		2023	
			수출액	증감률	수출액	증감률	수출액	증감률	수출액	증감률	수출액	증감률
1	8703	자동차	157	15.5	157	0.1	171	8.9	222	29.7	322	44.6
2	8708	차량용 부분품·부속품	53	5.4	47	-11.3	59	25.0	70	17.8	70	0.0
3	2710	석유제품	43	20.8	23	-46.4	47	104.1	62	30.3	57	-8.4
4	8507	배터리	9	-19.0	12	30.4	27	123.9	41	50.0	48	16.8
5	8473	컴퓨터 부분품·부속품	42	-10.3	57	37.7	72	24.8	65	-8.7	38	-41.9
6	8418	냉장고	13	22.6	17	29.0	25	50.4	20	-19.6	22	6.7
7	8479	각종 기계류	5	-16.3	6	20.5	5	-4.9	9	72.2	19	100.2
8	2841	산화금속산염 과산화금속산염	0	82.8	0	210.5	2	453.0	13	658.8	18	35.5
9	8523	비휘발성 기억장치	16	226.9	41	156.1	51	25.1	58	12.8	16	-71.9
10	8517	휴대폰 및 부품	38	-30.1	27	-29.0	27	-0.7	12	-55.1	16	30.4
전품목			733	0.9	741	1.1	959	29.4	1,098	14.5	1,157	5.4

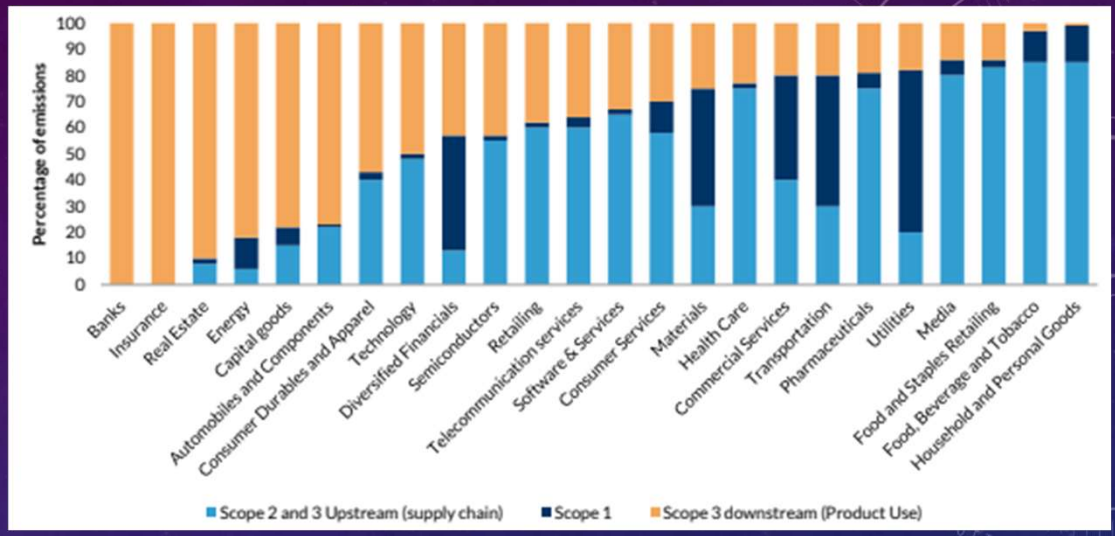
주 : HS 4단위 기준
자료 : 한국무역협회 Kstat

Source: 삼일PwC (2024)

ESG SCOPE 3

- 데이터 수집의 어려움과 한계
- 배출량 산출 등에 대한 규제 정립의 불분명성
- 이해관계자의 소극적 태도
- 2025년: 거래소 상장사 적용
- 2027년: 법정공시로 전환





TCFD(2021. 10), “Guidance on Metrics, Targets, and Transition Plans”

BIG DATA ANALYTICS

AllSeaData

- 1977 – 1981 Seoul National Univ., BSc.
- 1982 – 1984 Seoul National Univ., MSc.
- 1988 – 1991 Newcastle Univ., Ph.D.
- 1981 – 2019 Head of Central R&D Institute, DSME
- 1998 – 2012 VP. Of DNV
- 2020 – present Founder & CEO of All Sea Data Inc.

A MARINE BIG DATA COMPANY

200+
Combined Man-Years of Domain Experience

3.0+
Billion Data Points for GHG Emissions Assessment

2.6+
Million Real Routes of Ships Positions and Environmental Loads

3
Korean National Awards in 2021 and 2022

5
Patents on Maritime Big Data Analytics

SUPPLY CHAIN BIG DATA BY ALL SEA DATA

3.0+ bil. Data	2.6+ mil. Route Data	5 Big Data Patents	3 National Awards

Supply Chain	No.
주요 물자 DB	5,700+
전세계 광산 및 관련기업 DB	40,000+
희귀/분쟁 광물 DB	50+
원자재 수출입 기업 DB	100,000+
원자재 가공 기업	600+
원자재 이동 현황, 선박	65,000+
전세계 주요공항	45,000+
전세계 항공기 소유현황	422,000+
HS기준 세관통관 가격 DB	500,000+?
거래상대방 배경 조사 DB	770만+
수출입 도시, 국가 DB	200,000+
Oil & gas, 재생에너지 플랜트	24,000+

Item	No.
선박	860,000+척
조선소	4,000+개
해상항로	100+만개
해상환경	2TB/년
엔진 정보	4,000+개
선가 및 폐선가	20,000+개
항구:	12,000+개
해상플랫폼	8,000+
선주사	290,000+
해운관련사	240,000+
선박운항회사	1,800+
기자재 업체	60,000+
선박컨설턴트	1,290+
조선해운기관	680+
해운운임관련사	300+
조선소	4,100+
선주보험사	43
초대형 금융사	77

CO2 ASSESSMENT

- CII Improvement
- Ship Performance score
- Ship Operation Efficiency score

Ship Particulars

imo	type	category	dwt	teu	lbp	breadth	depth	draught	v_design_knots
Hidden	Oil Tanker	Small	11548	0	132.80	21.24	10.72	7.31	14.00

builder	Builder Country	owner	built
Hidden			

Weather Condtions Encountered

Hwave_avg	Hwave_max	Vavg	Vmax	Vwind_avg	Distance, mile
0.66	3.09	2.31	12.81	5.57	20,100.80

Estimated Time Analysis

operation_hour	anchor_hour	ballast_hour	berth_hour	loaded_hour	sea_hour
8708	5279	6892	643	1816	2786

Estimated FOC, ton

FOC_calm_water	FOC_wave	FOC_wind	FOC_aux	FOC_boiler	FOC_me	FOC_total
504.27	126.76	23.91	807.41	562.37	654.94	2,024.73

Estimated CII Value and Its Components

CII estimated	CII est/req	CII grade	CII calm water	CII wave	CII wind	CII auxiliary engine	CII boiler	CII_main engine
26.47	1.60	E	6.02	1.51	0.29	10.99	7.66	7.82

Estimated CII Values of Ship in Operation

CII_anchor	CII_berth	CII_sea
12.25	3.02	11.20

Estimated Score of Ship Performance (1 - 5)

Peer group	Score CII	Score ship	Score calm water	Score wave
1846	1	1	1	1

Estimated Score of Ship Opreration Efficiency (1 - 5)

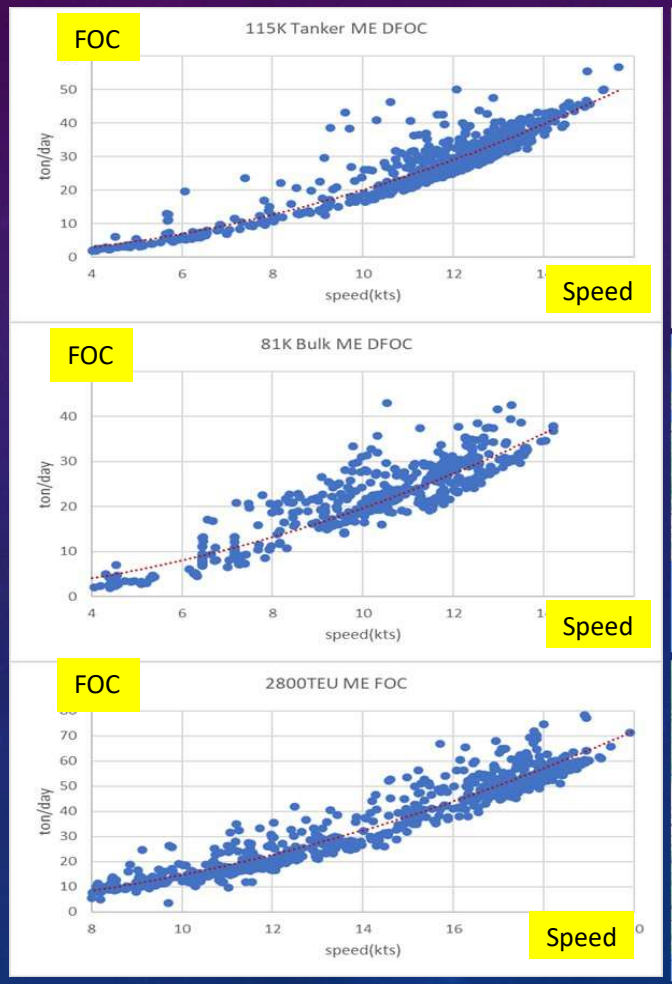
Peer group	Score Operation	Score EEOI	Score anchor	Score loaded	Score route
1846	1	1	1	2	2

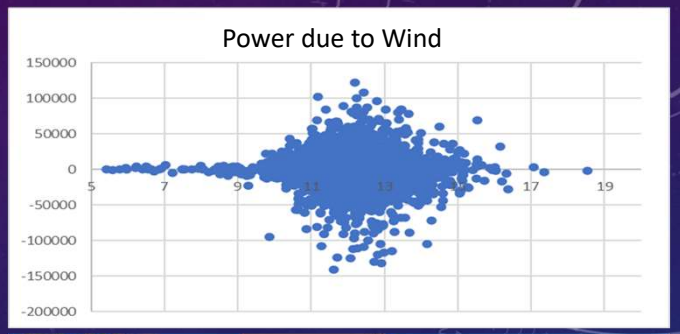
Estimated CO2, ton

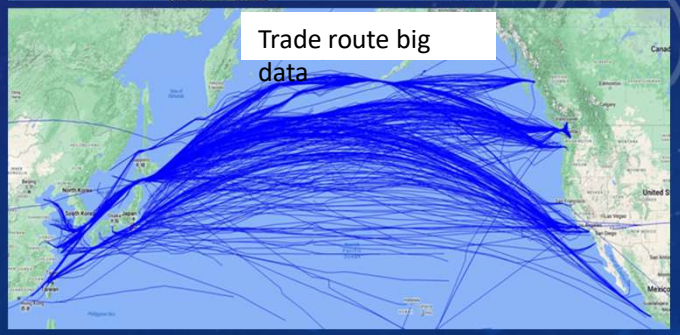
CO2_calm_water	CO2_wind	CO2_wave	CO2_auxiliary engine	CO2_boiler	CO2_main engine	CO2_total
1,588.96	75.35	399.41	2,544.14	1,772.04	2,063.72	6,379.91

BIG DATA ANALYTICS FOR ACCURATE CO2 EMISSION ESTIMATION

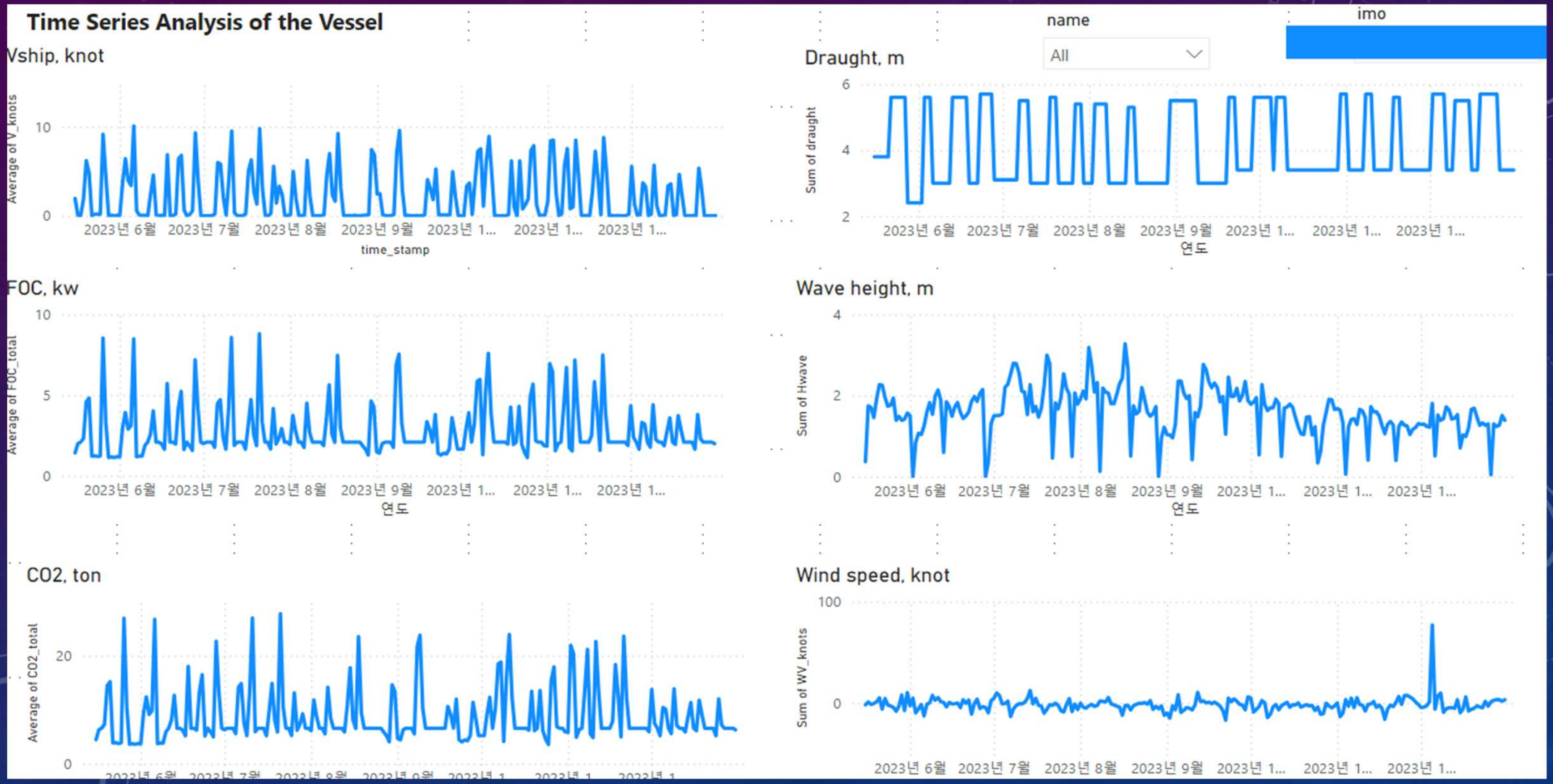
- CO2 emission assessment for the global fleet analytics.
- Precise calculations of CO2 emissions using big data from over 3 billion data points of actual ship routes.
- In-depth analysis of CO2 emission components considering ship performance in both calm and rough sea conditions.
- Assessment of ship operational performance including optimal routing, port operations, and fleet management.







DATA ANALYSIS: A MR TANKER CASE



Wave Energy

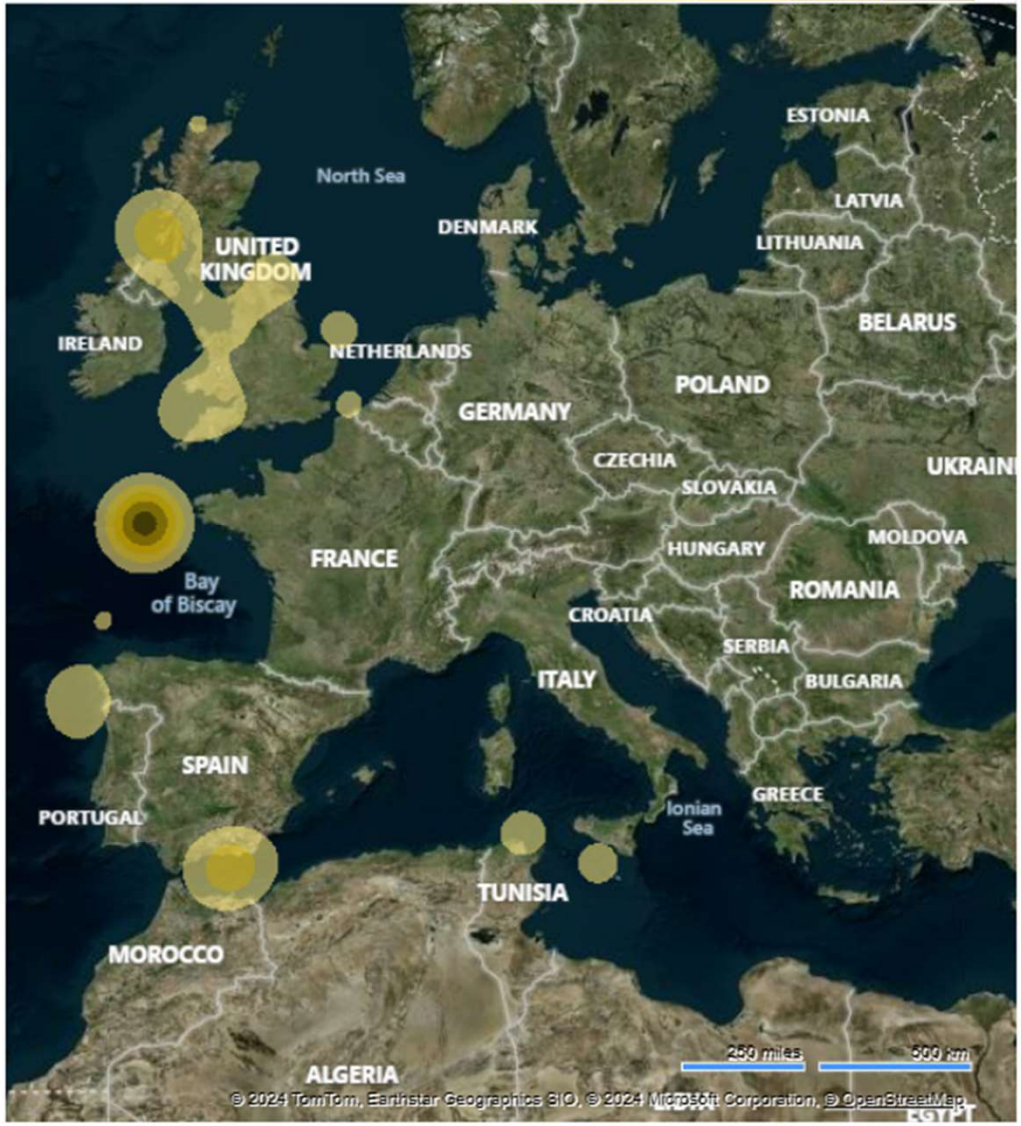
291/291 displayed

10.8 32.3 53.9 75.4 97.0 108

Wind Energy

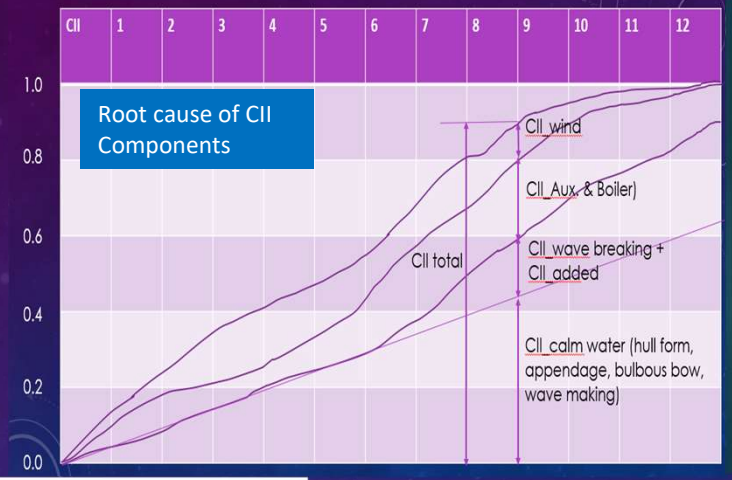
291/291 displayed

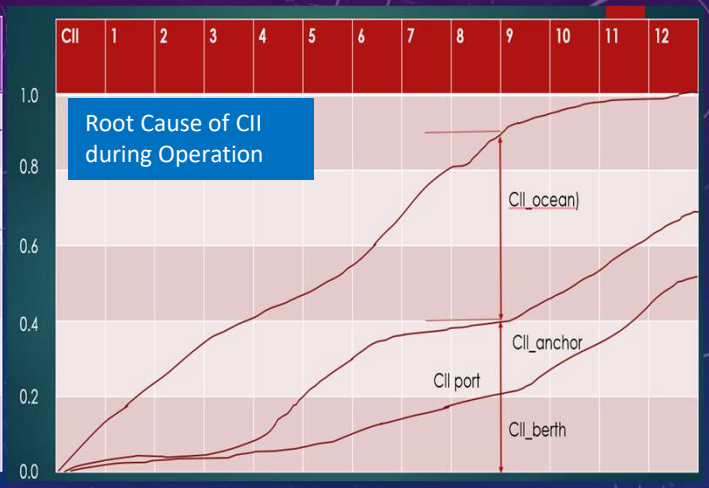
580 1.74k 2.90k 4.06k 5.22k 5.80k

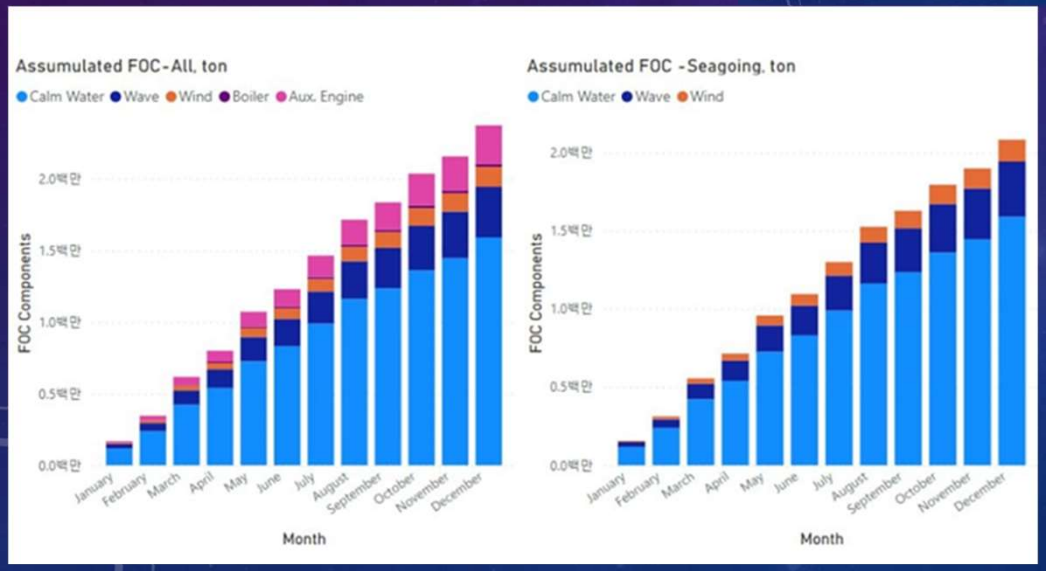


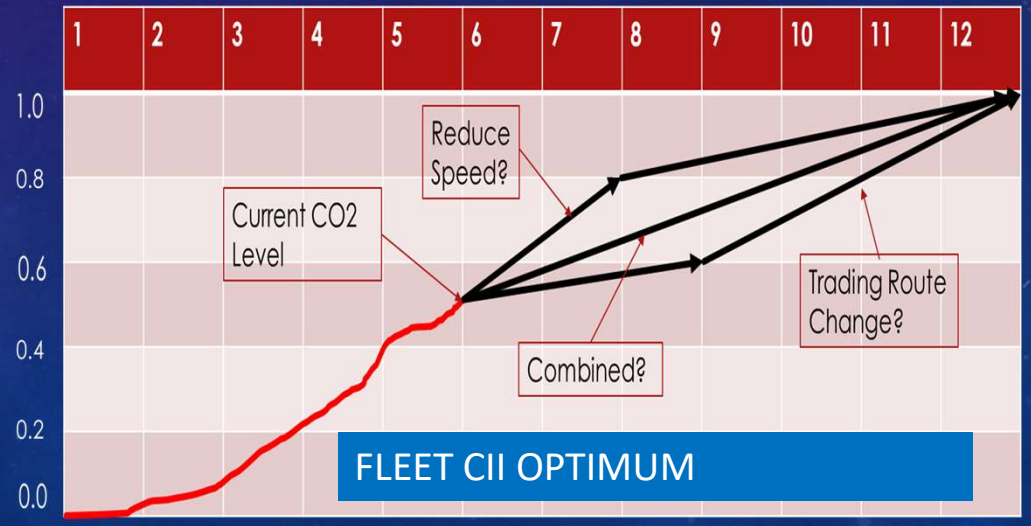
CII IMPROVEMENT BY ROOT CAUSE ANALYSIS

- Ship particulars and engine data
- Environmental loads
- AIS data
- Minimum CII, EEOI, Time, FOC, etc.
- Optimum fleet management strategy

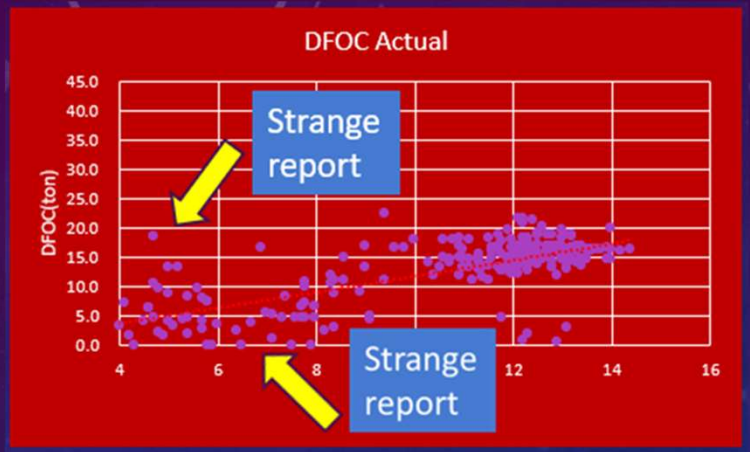


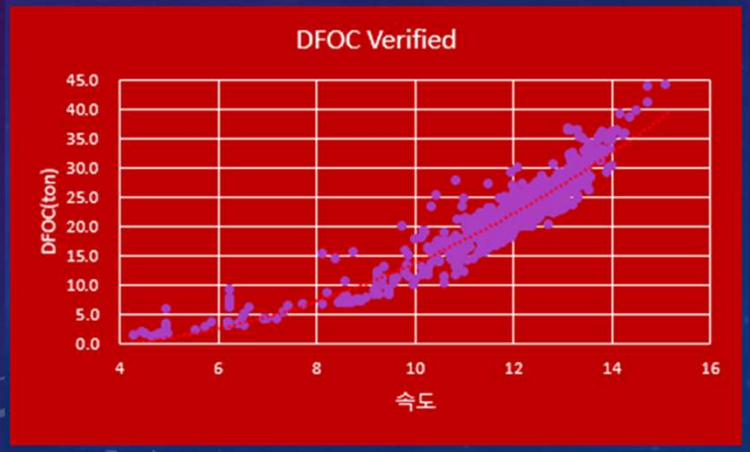


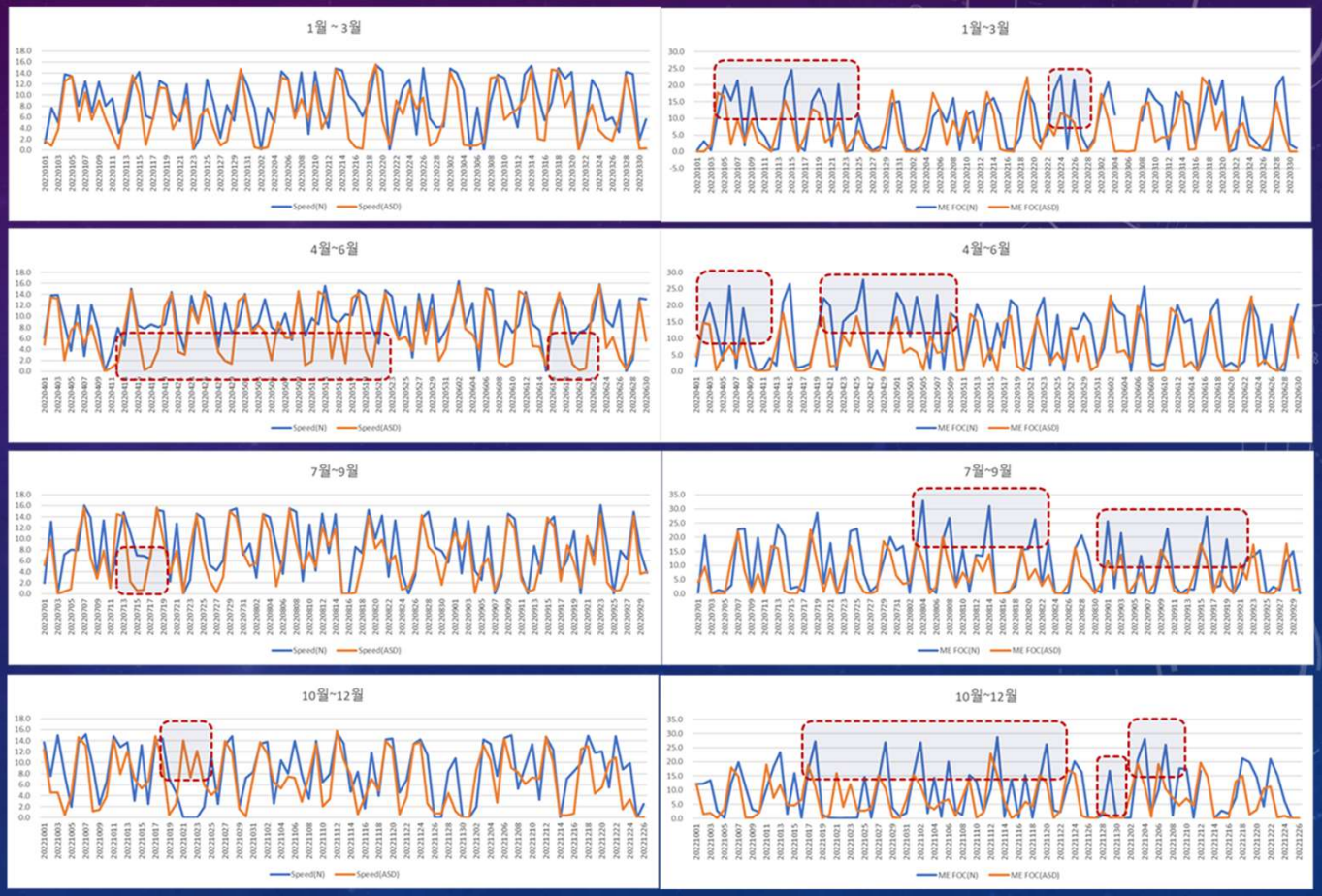




VERIFICATION OF FUEL OIL CONSUMPTION







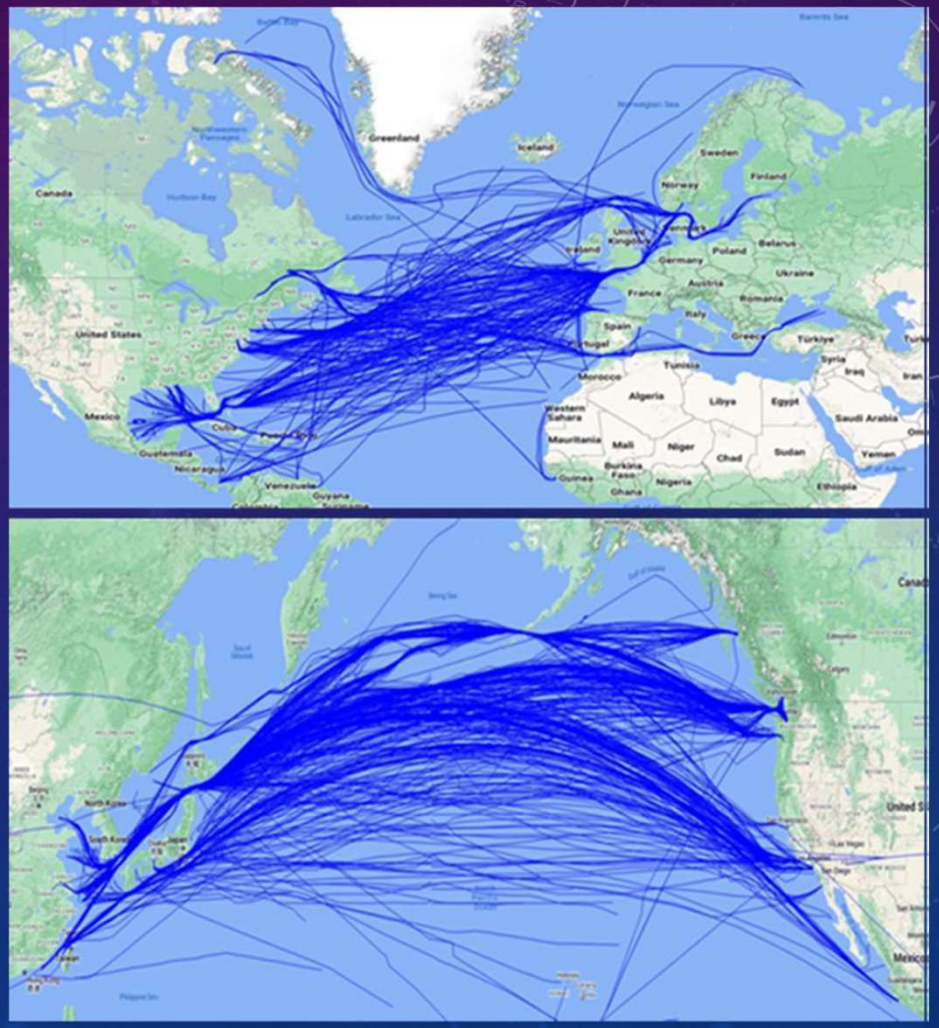
Multi-Objectives Route Selection (2.6+ Mil. Actual Routes)

Objective Functions

- Min. FOC
- Min. Time
- Min. CII
- Min. EEOI
- Min. CO2/TON
- Min. CO2/TEU
- Min. ETS Fee
- ESG Scope 3

Variables

- Ship type / Size
- Departure time (season effect)
- Speed
- Laden/Ballast
- Weather forecasting accuracy and period
- Typhoon probability
- ECA zones (NOx, SOx, Speed)



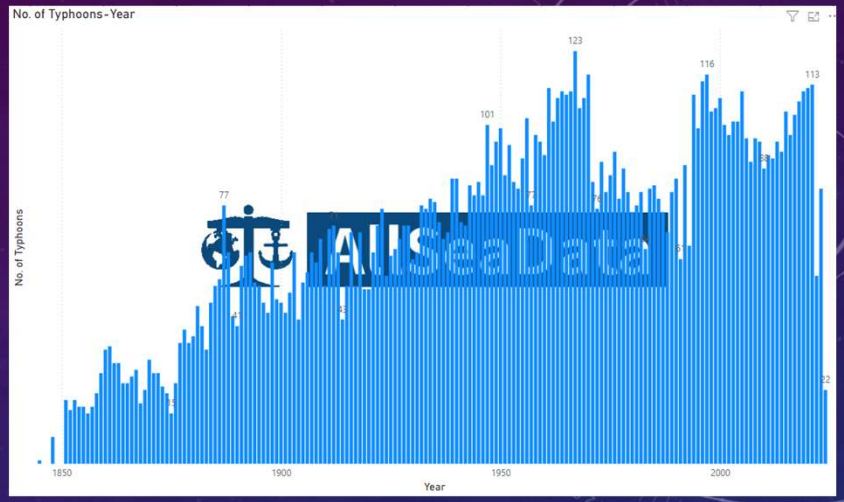
- Routing based on weather forecast gives only a local optimum
- Benchmarking of competitor's route selection ability

CO2 EMISSION: MR TANKERS SAMPLE

Max. 50% difference in FOC and CO2 emissions

Ship Type	DWT	Time from	Time to	Port from	Port to	Voyage_day	Distance_mile	Avg_speed	Avg_wave_h	Avg_wind_speed	CO2	CII	Ratio
Tanker(product oil)	49999	2021-04-27 7:51	2021-05-22 22:34	Onsan	Long Beach	25.6	5392.9	9.9	2.1	-13.2	1587.4	5.88712E-06	100.0%
Tanker(product oil)	49995	2022-05-05 8:27	2022-05-30 4:46	Onsan	Long Beach	24.8	5701.7	11.7	1.9	-13.0	1816.7	6.37312E-06	108.3%
Tanker(product oil)	50314	2021-07-11 2:47	2021-07-29 9:13	Onsan	Los Angeles	18.3	5252.9	12.0	1.5	-11.3	1766.4	6.68346E-06	113.5%
Tanker(product oil)	50550	2021-05-31 14:35	2021-06-19 0:22	Busan	Long Beach	18.4	5345.9	12.0	1.9	13.0	1887.8	6.98577E-06	118.7%
Tanker(product oil)	49999	2022-09-29 11:41	2022-10-27 9:52	Onsan	Long Beach	27.9	6031.7	10.6	2.4	-13.9	2108	6.98988E-06	118.7%
Tanker(product oil)	51218	2021-04-28 7:31	2021-05-25 6:16	Onsan	Wilmington Container Terminal - Los Angeles	26.9	6443.8	11.5	2.3	-15.1	2366.6	7.17068E-06	121.8%
Tanker(product oil)	46838	2021-04-23 0:01	2021-05-15 18:47	Onsan	Long Beach	22.8	5985.4	11.0	1.8	-14.5	2135.2	7.61635E-06	129.4%
Tanker(product oil)	45500	2020-07-16 22:09	2020-08-02 2:22	Keoje	Long Beach	16.2	5032.9	12.9	1.5	-10.3	1746.2	7.62543E-06	129.5%
Tanker(product oil)	49999	2021-03-29 19:00	2021-04-22 1:52	Busan	Long Beach	23.3	5516.0	10.8	3.0	-17.5	2103.7	7.62778E-06	129.6%
Tanker(product oil)	49999	2021-02-10 7:25	2021-03-02 0:55	Kamchon	Los Angeles - Container Terminal - Terminal Island	19.7	5297.0	11.2	3.1	-15.2	2030.6	7.66713E-06	130.2%
Tanker(product oil)	49999	2021-05-04 4:46	2021-05-23 5:22	Onsan	Long Beach	19	5487.0	12.5	2.5	-16.8	2291.8	8.35373E-06	141.9%
Tanker(product oil)	45634	2022-03-29 2:22	2022-04-26 9:15	Onsan	Long Beach	28.3	6498.1	10.3	2.3	-13.4	2497.6	8.42263E-06	143.1%
Tanker(product oil)	49768	2021-09-30 7:33	2021-10-24 22:52	Kamchon	Los Angeles - Container Terminal - Terminal Island	24.6	6276.5	12.3	3.1	-16.4	2660.3	8.51653E-06	144.7%
Tanker(product oil)	46925	2022-04-19 16:21	2022-05-09 16:35	Onsan	Los Angeles - VLCC Berth - Pier T	20	5467.2	12.3	2.9	-16.6	2211.6	8.6206E-06	146.4%
Tanker(product oil)	50342	2022-03-24 5:28	2022-04-11 9:21	Busan	Long Beach	18.2	5745.0	13.1	3.3	-17.4	2554.1	8.83115E-06	150.0%

TYPHOON PROBABILITY SINCE 1842



SAMPLE OF MULTI-OBEJCTIVE ROUTES

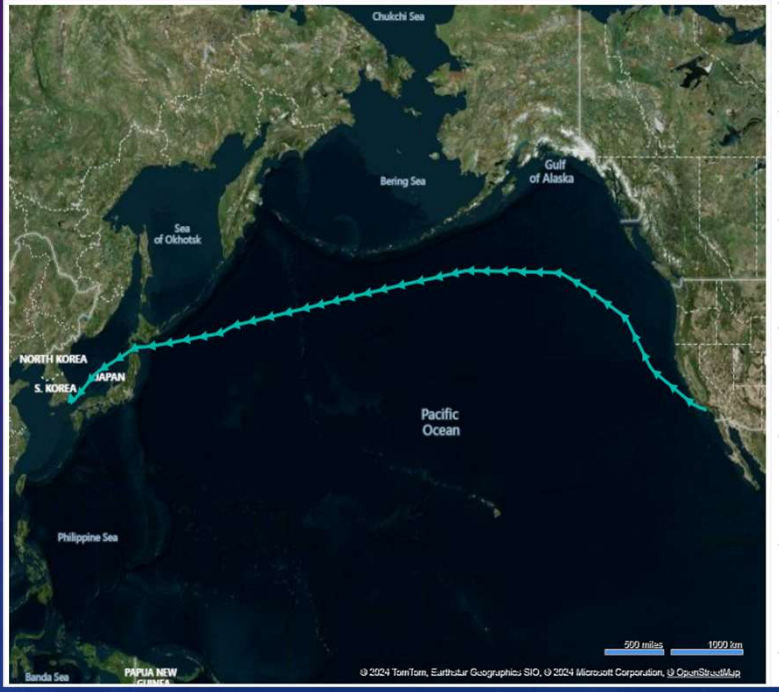
Min. CII

Route code 1	opti_index	lat	lng
US0430KR0002	CII	30.86	158.48
US0430KR0002	CII	30.86	-170.62
US0430KR0002	CII	30.86	-174.54
US0430KR0002	CII	30.86	153.36
US0430KR0002	CII	30.86	168.23

Route Coordinates

US0430KR0002	CII	30.87	-166.69
US0430KR0002	CII	30.87	154.88
US0430KR0002	CII	30.87	160.40
US0430KR0002	CII	30.87	-162.69
US0430KR0002	CII	30.87	172.11
US0430KR0002	CII	30.87	151.92
US0430KR0002	CII	30.87	-172.58
US0430KR0002	CII	30.87	164.28
US0430KR0002	CII	30.87	-178.44
US0430KR0002	CII	30.87	-164.67
US0430KR0002	CII	30.87	162.32
US0430KR0002	CII	30.87	177.74
US0430KR0002	CII	30.87	175.87
US0430KR0002	CII	30.87	170.15
US0430KR0002	CII	30.87	166.23
US0430KR0002	CII	30.87	149.36
US0430KR0002	CII	30.89	148.07
US0430KR0002	CII	30.91	146.76

Min. FOC



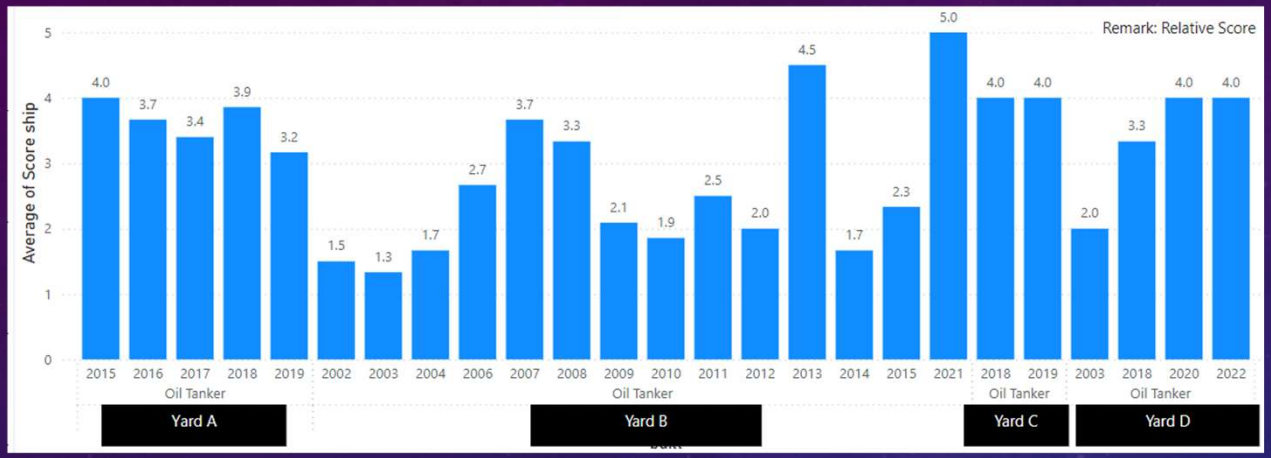
Route code 1	opti_index	lat	lng
US1251KR0002	FOC	33.96	-119.02
US1251KR0002	FOC	34.30	-120.28
US1251KR0002	FOC	34.77	-121.42
US1251KR0002	FOC	34.94	129.83
US1251KR0002	FOC	35.05	129.80

Route Coordinates

US1251KR0002	FOC	36.52	-124.29
US1251KR0002	FOC	37.10	-125.26
US1251KR0002	FOC	37.35	132.66
US1251KR0002	FOC	37.66	-126.22
US1251KR0002	FOC	38.13	133.52
US1251KR0002	FOC	38.23	-127.17
US1251KR0002	FOC	38.81	-128.16
US1251KR0002	FOC	38.83	134.63
US1251KR0002	FOC	39.42	135.95
US1251KR0002	FOC	39.44	-128.82
US1251KR0002	FOC	40.00	137.30
US1251KR0002	FOC	40.21	-129.37
US1251KR0002	FOC	40.56	138.67
US1251KR0002	FOC	40.93	-129.90
US1251KR0002	FOC	41.21	140.04
US1251KR0002	FOC	41.64	141.28
US1251KR0002	FOC	41.67	-130.45
US1251KR0002	FOC	41.68	142.83

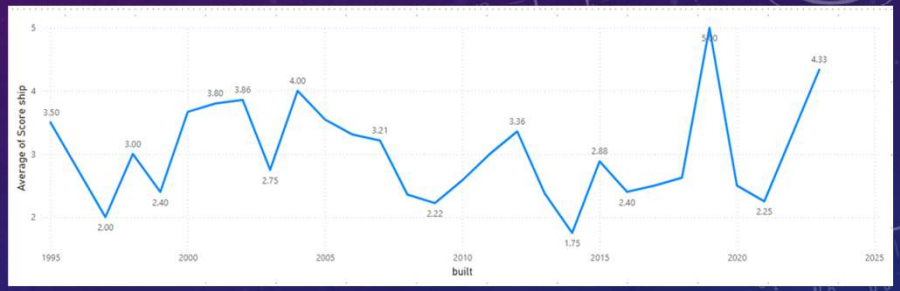
SELECTION OF A GOOD PERFORMANCE SHIP

(1: LOW, 5: HIGH)

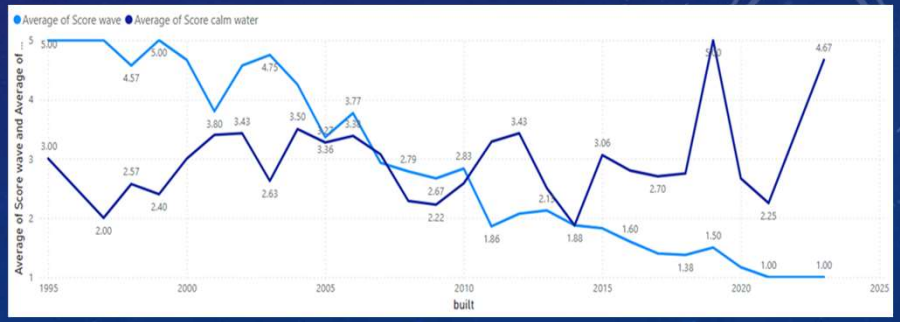


Built	Rank ship	Rank calm water	Rank wave	Score ship	Score calm water	Score wave
1995	171	326	16	5	4	5
1997	316	416	213	4	4	5
1997	549	661	159	3	3	5
1997	1,190	1,264	50	1	1	5
1997	607	700	198	3	3	5
1998	842	935	70	2	2	5
1998	995	1,096	45	2	1	5
1998	252	374	187	5	4	5
1999	937	1,034	55	2	2	5
1999	349	449	148	4	4	5
1999	1,289	1,330	105	1	1	5
2005	510	494	915	4	4	2
2005	806	826	506	2	2	4
2005	486	538	544	4	3	3

Ship Performance Trend of a Yard



Ship Performance in Calm Water and Wave

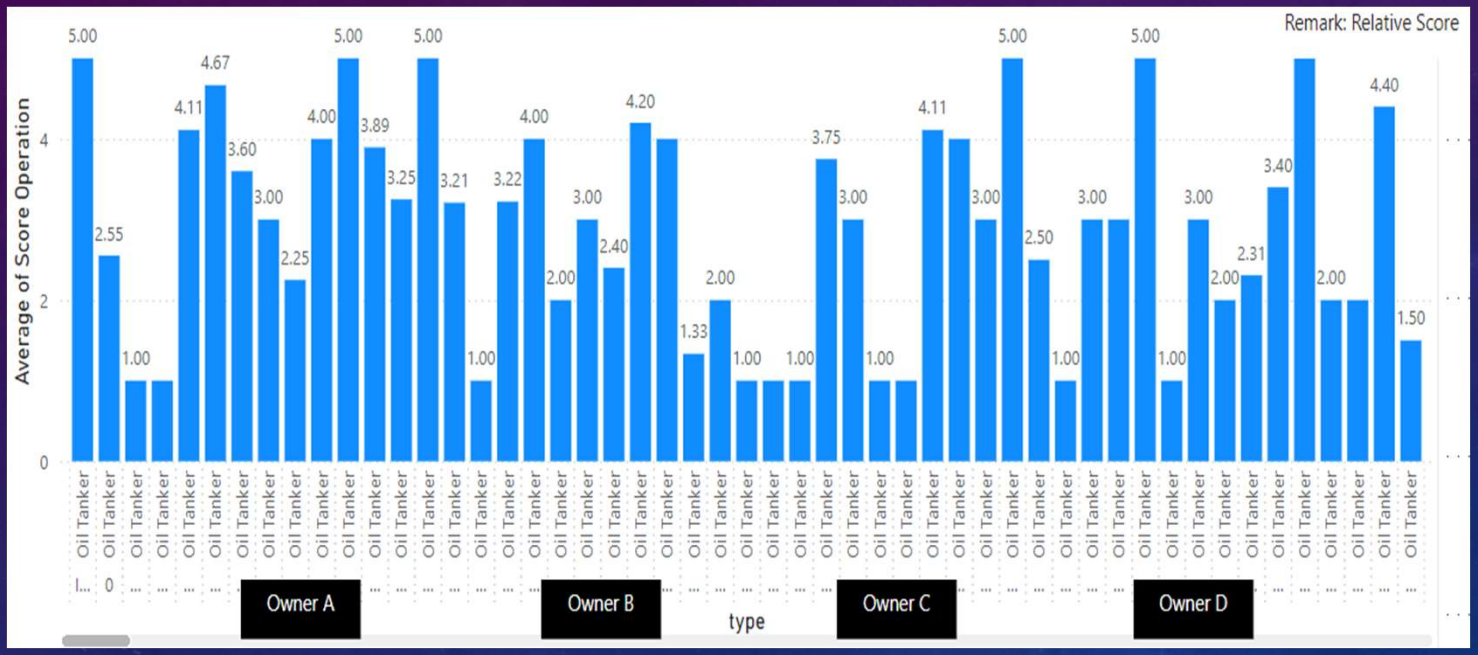


SELECTION OF A GOOD SHIP OF OPERATION EFFICIENCY

SCORE (1: LOW, 5: HIGH)

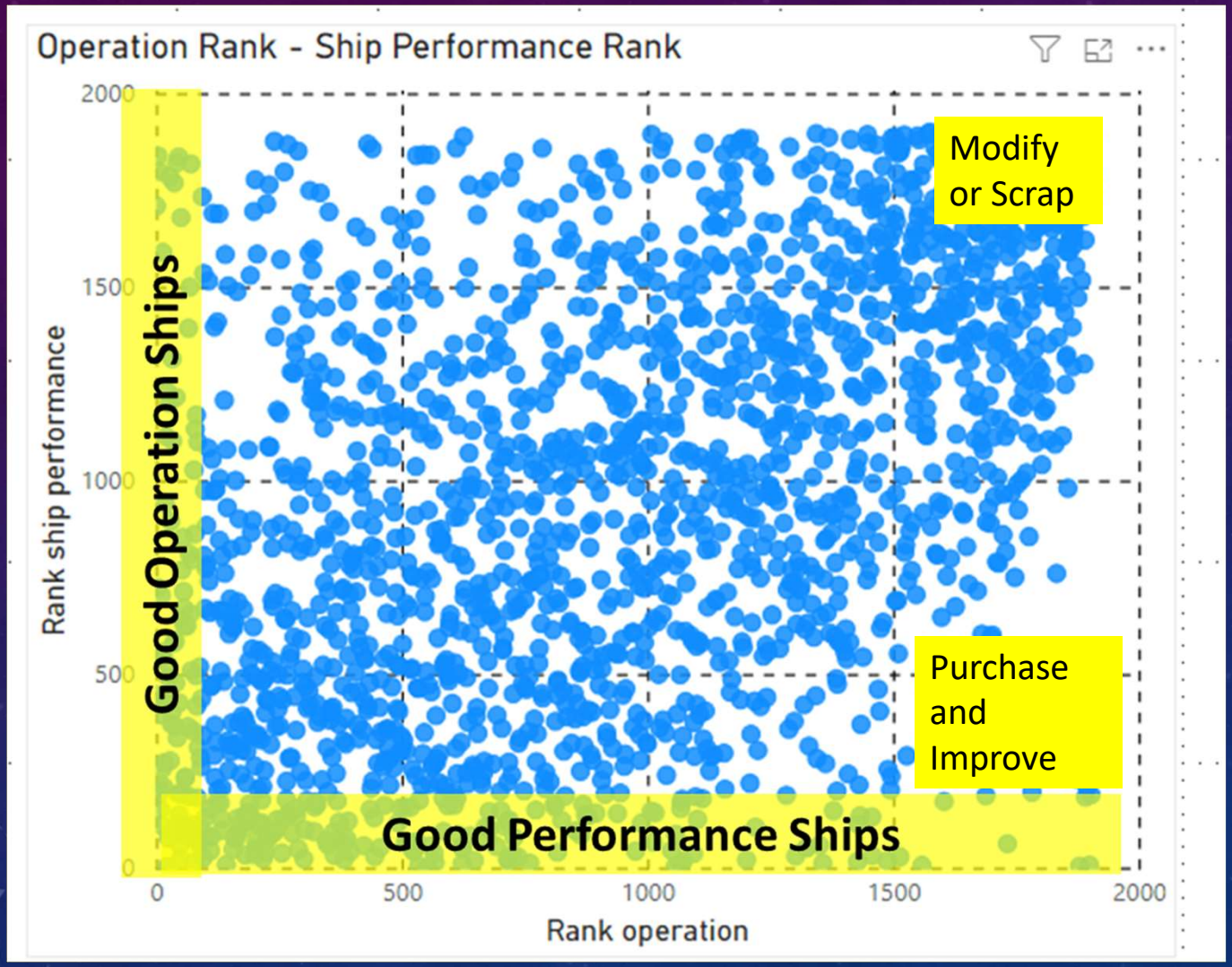
Relative Score of Operation Efficiency for Ship Owners, Oil Tankers

Score for CII, EEOI, anchor time, laden voyage time, route selection ability, and total operation efficiency



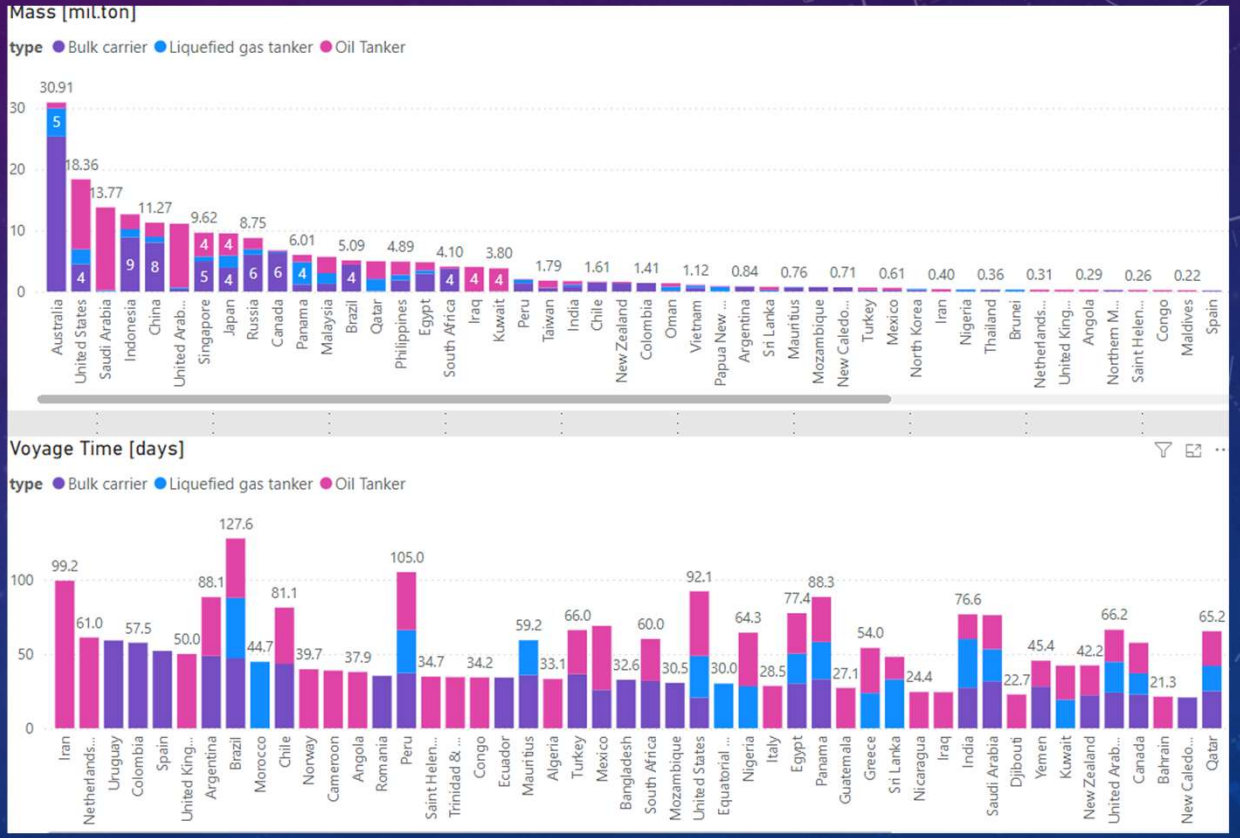
Built	Type	Category	IMO	CII grade	Peer group	Score CII	Score EEOI	Score anchor	Score loaded	Score route	Score Operation
2010	Oil tanker	LR1	*********	B	451	5	5	5	5	3	5
2011	Oil tanker	LR1	*********	A	451	5	5	5	3	2	5
2011	Oil tanker	LR1	*********	B	451	5	2	2	1	3	3
2011	Container	Feeder	*********	A	1341	4	4	5	5	5	5
2011	Container	Feeder	*********	A	1341	5	1	5	1	5	4
2011	Oil tanker	LR2	*********	B	1691	5	2	4	2	4	5
2011	Oil tanker	LR2	*********	B	1691	5	2	5	2	5	5
2021	Oil tanker	LR2	*********	C	1691	4	3	5	3	3	4
2021	Oil tanker	LR2	*********	B	1691	5	4	5	3	2	5
2020	Oil tanker	LR2	*********	B	1691	5	2	5	2	4	5
2021	Oil tanker	LR2	*********	B	1691	5	4	5	3	3	5
2021	Oil tanker	LR2	*********	B	1691	5	3	4	2	3	5
2021	Oil tanker	LR2	*********	C	1691	4	3	5	3	2	4
2010	Chemical tanker	Small	*********	E	1850	1	1	4	1	5	1
2011	Bulk carrier	Small	*********	C	1850	3	5	1	3	5	3
2011	Bulk carrier	Handymax	*********	D	1903	2	4	4	3	2	2
2011	Bulk carrier	Handymax	*********	D	1903	1	2	4	2	1	1
2011	Bulk carrier	Handymax	*********	C	1903	3	4	5	4	3	4
2011	Bulk carrier	Handymax	*********	D	1903	2	2	2	2	2	1

SELECTION OF GOOD SHIPS OF PERFORMANCE & OPERATION

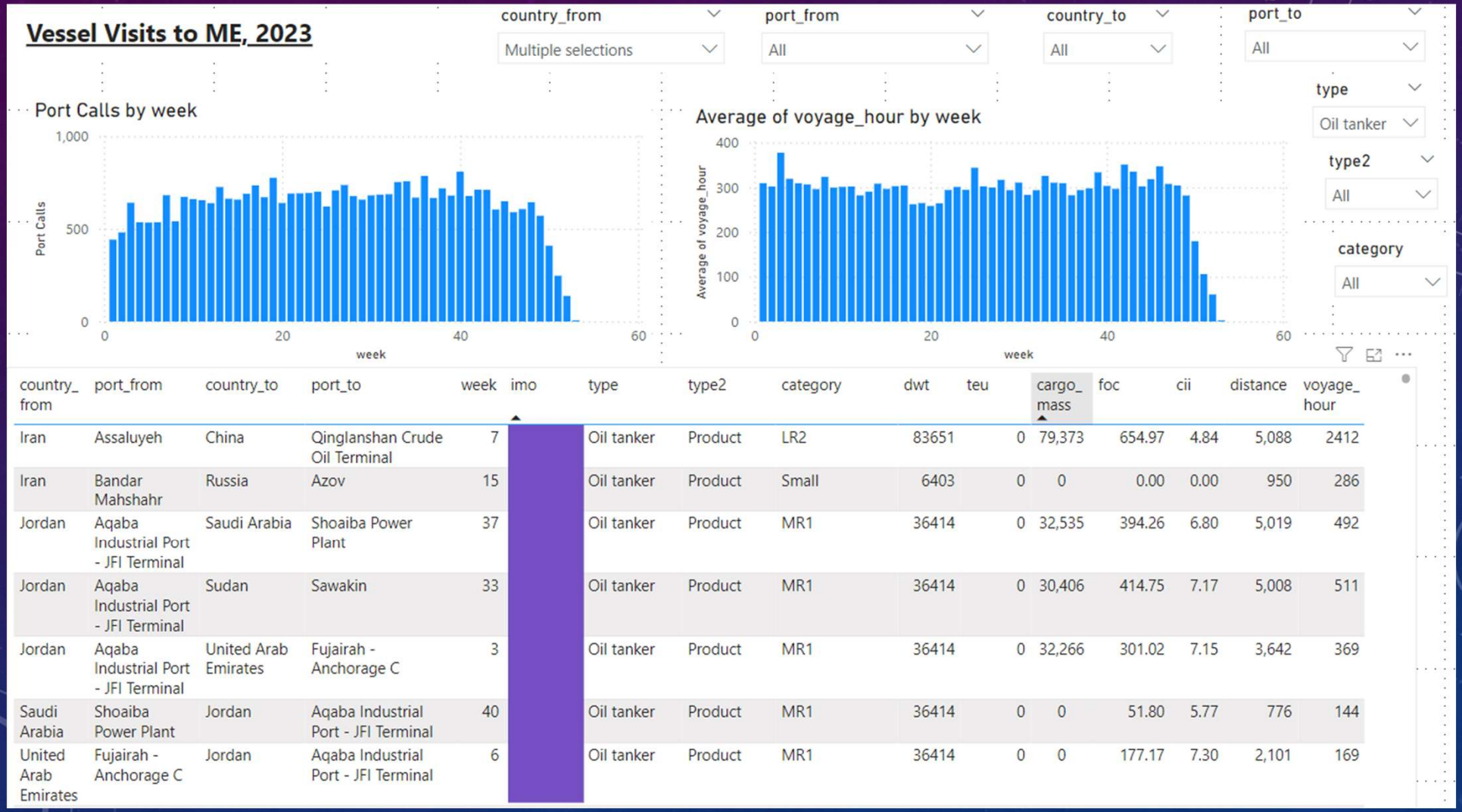


GLOBAL CARGO FLOW (PORTS/ROUTES/SHIPS)

Cargo Mass and Voyage Time to South Korea



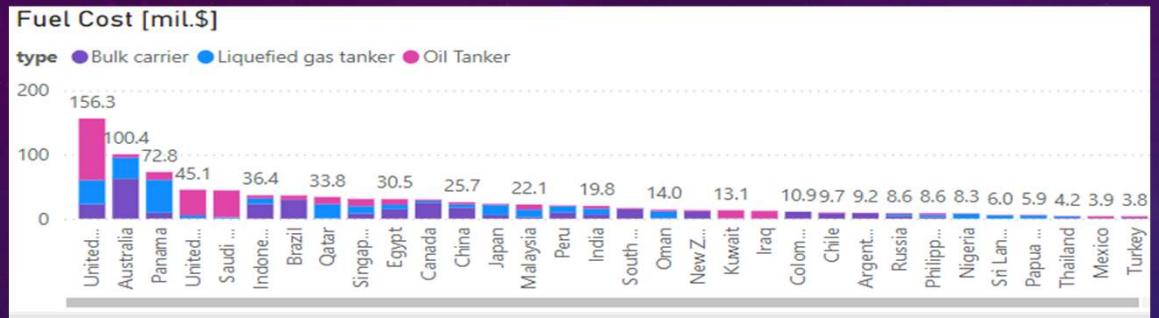
PORT CALLS AND BUNKER DEMANDS

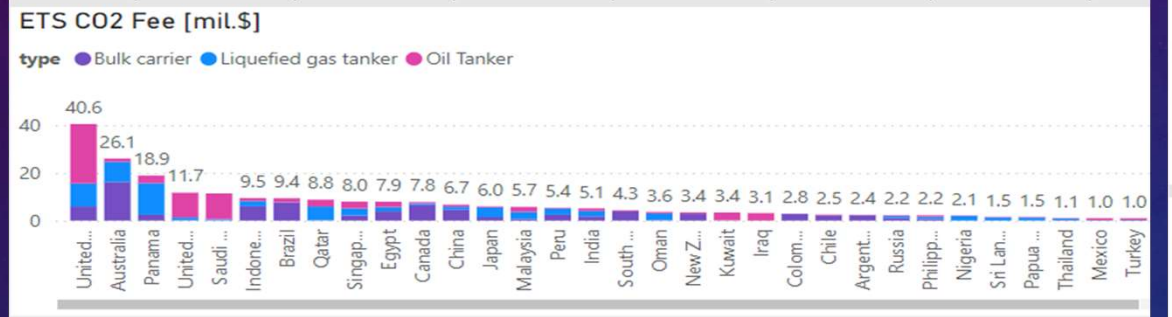


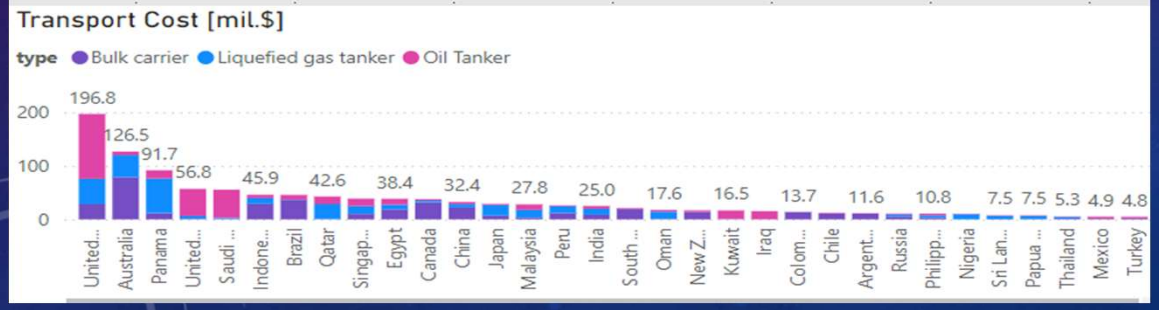
country_from	port_from	country_to	port_to	week	imo	type	type2	category	dwt	teu	cargo_mass	foc	cii	distance	voyage_hour
Iran	Assaluyeh	China	Qinglanshan Crude Oil Terminal	7		Oil tanker	Product	LR2	83651	0	79,373	654.97	4.84	5,088	2412
Iran	Bandar Mahshahr	Russia	Azov	15		Oil tanker	Product	Small	6403	0	0	0.00	0.00	950	286
Jordan	Aqaba Industrial Port - JFI Terminal	Saudi Arabia	Shoaiba Power Plant	37		Oil tanker	Product	MR1	36414	0	32,535	394.26	6.80	5,019	492
Jordan	Aqaba Industrial Port - JFI Terminal	Sudan	Sawakin	33		Oil tanker	Product	MR1	36414	0	30,406	414.75	7.17	5,008	511
Jordan	Aqaba Industrial Port - JFI Terminal	United Arab Emirates	Fujairah - Anchorage C	3		Oil tanker	Product	MR1	36414	0	32,266	301.02	7.15	3,642	369
Saudi Arabia	Shoaiba Power Plant	Jordan	Aqaba Industrial Port - JFI Terminal	40		Oil tanker	Product	MR1	36414	0	0	51.80	5.77	776	144
United Arab Emirates	Fujairah - Anchorage C	Jordan	Aqaba Industrial Port - JFI Terminal	6		Oil tanker	Product	MR1	36414	0	0	177.17	7.30	2,101	169

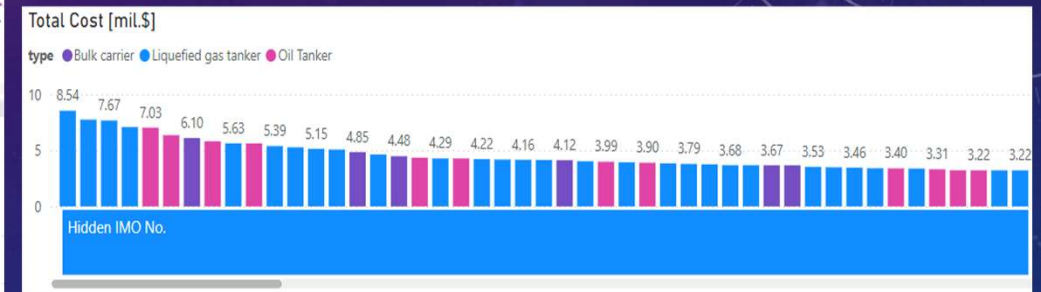
ESTIMATED COSTS AND INCOMES OF SHIPS

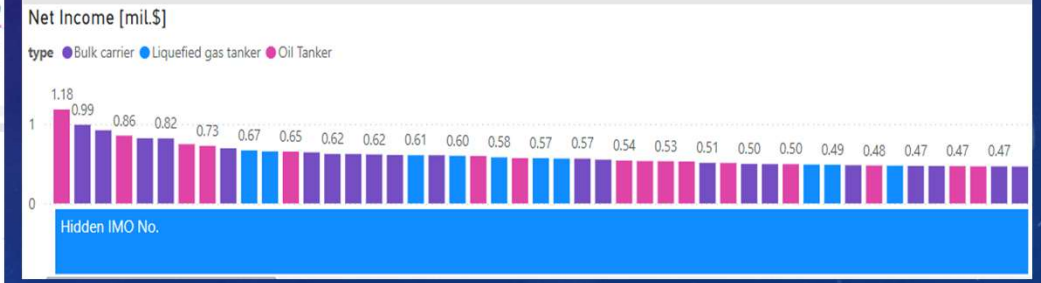
- FOC
- CO2 Emission
- ESG Scope 3 (DPP)
- ETS surcharge
- CBAM, CCA











DARK FLEET AND SANCTION

- Estimated dark fleet: about 670 vessels
- 8.0+ million data by All Sea Data
  - ✓Sanction/ Secondary Boycott
  - ✓Sanctioned ships, activities
  - ✓Irregular activity ships
  - ✓Terrorists, etc.

AIS Spoofing methods

Spoofing Technique	Description
GPS Spoofing	Manipulating GPS signals to create false vessel locations.
Data Manipulation	Altering AIS data like vessel name, MMSI, speed, and heading to mislead authorities.
AIS Ghost Ship Creation	Emitting signals for non-existent vessels, confusing monitoring authorities.
Replay Attack	Replaying AIS signals with altered data.
Man-in-the-Middle Attack	Intercepting and altering AIS data in transit.
Vessel Identity Spoofing	Using another vessel's MMSI and name to disguise illegal activities.
Signal Jamming	Overloading AIS frequencies to block communication.
AIS Signal Flooding	Sending multiple fake AIS signals to disrupt the system.
Course and Speed Alteration	Changing a vessel's course and speed to mislead authorities or nearby ships.
AIS Handshake	Switching identities between vessels to conceal illegal activities.
Zombie Vessel	Using the identity of decommissioned ships for illicit operations.
GNSS Manipulation	Falsifying a vessel's location with machine-generated coordinates.
Vessel Identity Laundering	Changing a vessel's identity to evade detection.

No AIS signal > 7 days
(18,175 Ships, 68,800+ cases in 2023)

imo	hour	near_port_name	port_distance
********	366	Pilar - Pacific Exit From Magellan Strait	2142.79
********	219	Pilar - Pacific Exit From Magellan Strait	2141.62
********	297	TA Rankin Inlet	1553.18
********	407	Pilar - Pacific Exit From Magellan Strait	2141.62
********	621	TA Rankin Inlet	1553.63
********	569	Pilar - Pacific Exit From Magellan Strait	2141.43
********	549	TA Rankin Inlet	1553.63
********	1298	Pilar - Pacific Exit From Magellan Strait	2141.62
********	440	TA Rankin Inlet	1553.66
********	267	TA Rankin Inlet	1553.21
********	1145	TA Rankin Inlet	1553.18
********	599	Pilar - Pacific Exit From Magellan Strait	2142.79
********	886	Pilar - Pacific Exit From Magellan Strait	2141.62
********	632	TA Rankin Inlet	1553.63
********	393	Pilar - Pacific Exit From Magellan Strait	2142.79
********	1131	TA Rankin Inlet	1553.63
********	254	Pilar - Pacific Exit From Magellan Strait	2142.79
********	551	Pilar - Pacific Exit From Magellan Strait	2142.79
********	209	Pitcairn Island	1377.12
********	1084	TA Rankin Inlet	1553.66
********	783	Pilar - Pacific Exit From Magellan Strait	2142.79
********	331	Pitcairn Island	1382.42

SUMMARY

- Stringent Regulations on Greenhouse Gas (GHG)
- More Trade Barriers
- Severe Competitions and Social Pressure
- High Costs and Fees for CO2 for Exporting Good
- Life Cycle Assessment (LC) of GHG: Big data on GHG
- Strategy on GHG is Necessary based on Big Data
- Various Business Potentials due to AI and Big Data