Future-proofing chemical tanker operations

13 September 2021 • 09:00-10:30 BST

Supporting organisation IPTA International Parcel Tankers Association

Presentation documents:
Page 2: Johan Kristensson, Furetank Rederi
Page 20: Janet Strode, IPTA
Page 41: David Pereira, Tristar Maritime Logistics

Part of **Tanker Shipping & Trade** Tech & Ops Webinar Day

13 September 2021

TANKER SHIPPING & TRADE

#tankers

VINGA – serie dual-fuel LNG Series

Tanker Shipping & Trade Tech & Ops Webinar 2021-09-13

Johan Kristensson COO Furetank Rederi

Furetank Group

- Furetank is focused on product & chemical tankers below 20,000 dwt and has been active in the North European petroleum products trade since the early 1950's
- Integrated ship owning company that provide technical, safety, crewing and commercial management services to own vessels and external partners
- Operating MS SIGRID for Swedish "Nuclear fuel Administration" SKB, to transporting all waste from Swedish and Finnish nuclear power industry.
- Owned by the Höglund family, which has been involved in shipping business since the 17th century
- Offices on Donsö, Gothenburg, Holbaek (Denmark) and Torshavn (Faroe Islands)
- Have invested in five dual fuel powered low emission 18,000 dwt new buildings from China Merchant "Dingheng" Shipyard in China. Together with partners Älvtank and Thun Tankers, the series will comprise a total of eight sister vessels
- Founding partner of commercial joint venture Gothia Tankers Alliance, covering 43 vessels in sizes of 6,000-37,000 dwt

Gothia Tanker Alliance

- Formed by Furetank and Thun in 2013
- Office in Gothenburg
- 9 Members
- 44 Vessels - 6,500 dwt to 37,000 dwt
- The fleet will eventually consist of 12 dual fueled LNG powered vessels
- In 2020 the GTA fleet performed more than 1900 voyages, made over 4500 port calls and transported 18,4 million tons of petroleum products, bio-fuels and chemicals
- The members in the Alliance cooperate on technical issues, vetting issues and operational best practices

Vessel	Built	Deadweight	Ice
FUREVIK	2005	37 000	1C
FURE FERDER	2003	18 736	1A
FURE FLADEN	2003	18 736	1A
FURE VINGA*	2021	17 999	1A
FURE VITEN*	2021	17 999	1A
FURE VEN*	2019	17 999	1A
FURE VALÖ*	2018	17 999	1A
RAMELIA*	2019	17 999	1A
RAMANDA*	2018	17 999	1A
THUN VENERN*	2018	17 999	1A
THUN LIDKOPING	2019	17 500	1C
THUN LONDON	2019	17 500	1C
THUN LIVERPOOL	2019	17 500	1C
THUN LIFFEY	2020	17 500	1C
THUN LUNDY	2020	17 500	1C
SELANDIA SWAN	2008	17 998	1A
JUTLANDIA SWAN	2008	17 998	1A
FURE WEST*	2006	17 557	1A
FURE NORD	2004	17 653	1A
RAMONA	2004	17 200	1A
ARSLAND	2008	16 791	1A
PATRAS	2008	16 744	1A
STAVFJORD	2009	16 635	1A
STAV VIKING	2009	16 628	1A
FIONA SWAN	2005	15 602	1A

Vessel	Built	Deadweight	Ice
THUN EOS*	2018	7 999	1A
THUN EVOLVE*	2019	7 999	1A
THUN EQUALITY*	2021	7 999	1A
THUN GREENWICH	2007	7 915	1C
THUN GALAXY	2001	7 550	1B
THUN GARLAND	2009	7 550	1A
THUN GAZELLE	2009	7 550	1A
THUN GEMINI	2003	7 550	1B
THUN GENIUS	2003	7 550	1B
THUN GLOBE	2001	7 550	1B
THUN GRANITE	2004	7 550	1B
THUN GRATITUDE	2003	7 550	1B
WISBY VERITY	2004	7 550	1A
WISBY WAVE	2009	7 550	1A
WISBY TEAK	2011	7 373	-
THUN GOLIATH	2004	7 100	-
THUN GOTHENBURG	2007	6 900	1A
THUN GRACE	1999	6 535	1B
THUN BLYTH	2021	4 250	NAABSA
Vessels under construction			
*THUN EMPOWER**	*2021*	*7 999*	*1A*
THUN TANKERS NB	*2022*	*4 250*	*NAABSA*

*= Dual fuel / LNG

FURETANK · THUN TANKERS · REDERI AB ÄLVTANK · WISBY TANKERS AB WISBY SHIP MANAGEMENT AB · UNI-TANKERS · DSD · OHM

GOTHIA TANKER ALLIANCE INCREASING EXCELLENCE TOGETHER · BESIKTASGROUP · NJORD Shipping

CoA's – Cornerstone in our Commercial Strategy

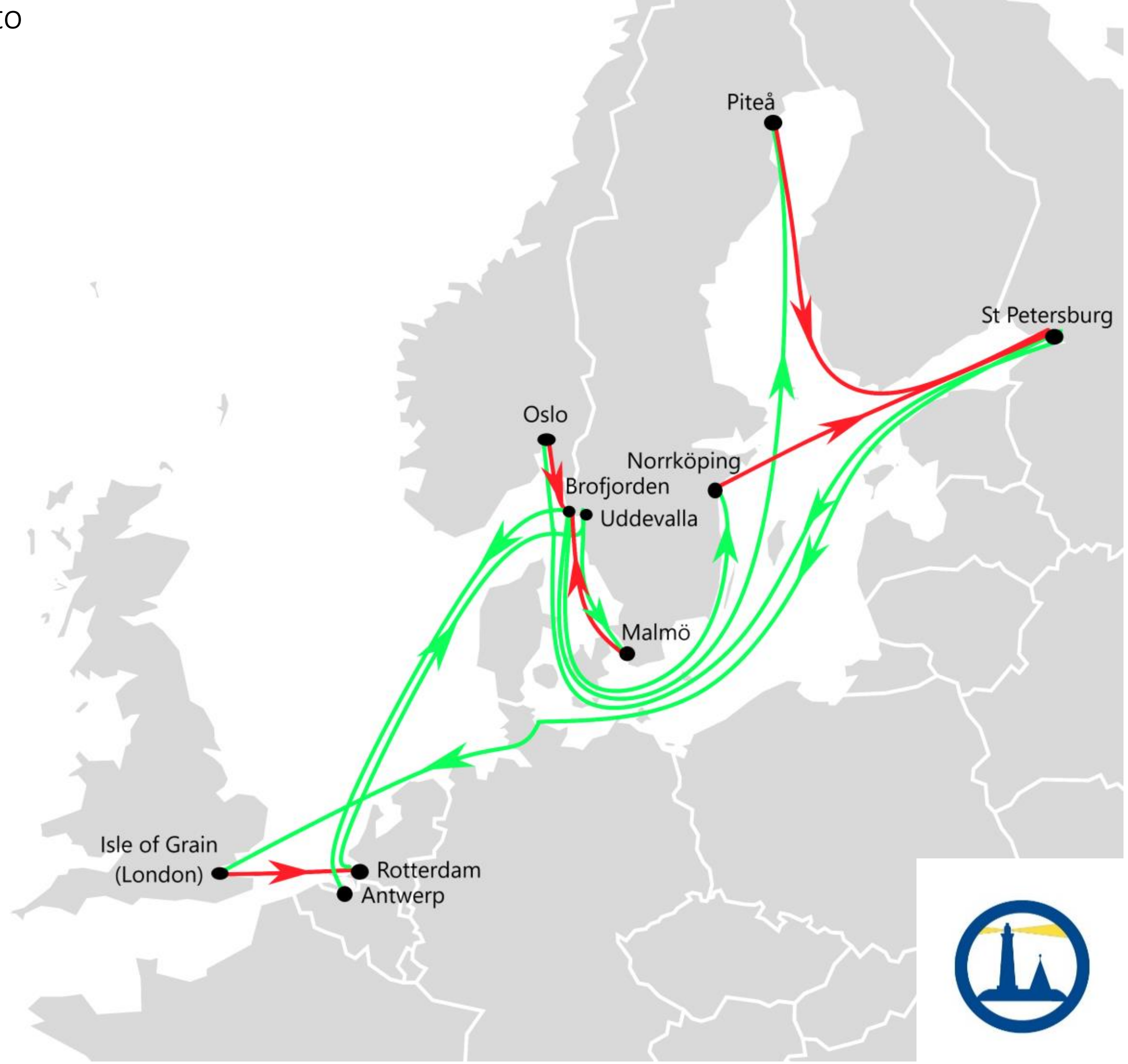
By offering a large fleet of similar size and type vessels, dedicated to the region, we can offer CoA customers;

- **Reliability** - Vessels of known performance, with officers and crew that are familiar to the trade and customers requirements
- **Flexibility** – A large fleet improves the service level and our opportunity to accommodate loading & delivery dates as well as handle unforeseen changes
- **Reduced environmental footprint** - By optimizing the trading pattern and shortening the ballast to next load port we reduce total emissions per transported unit

For the Partners in Gothia Tanker Alliance the CoA's provide;

- **Continuity** - Cargo volume throughout the year offer the continuity necessary to justify investments in new and improved vessels
- **Optimisation** – By combining matching voyages in order to minimize ballast to the benefit of both the environment and our competiveness
- **Efficiency** - Frequent calls to the same ports enable continuous improvement on efficiency and costs

Voyage	Cargo	Loadport	Dischargeport
1	Gasoline & Diesel	Brofjorden	Piteå
2	Kerosine	St Petersburg	Isle of Grain (London)
3	Jet Fuel	Rotterdam	Uddevalla & Malmö
4	Gasoline & Diesel	Brofjorden	Norrköping
5	Diesel	St Petersburg	Oslo
6	Diesel & Gasoil	Brofjorden	Antverpen



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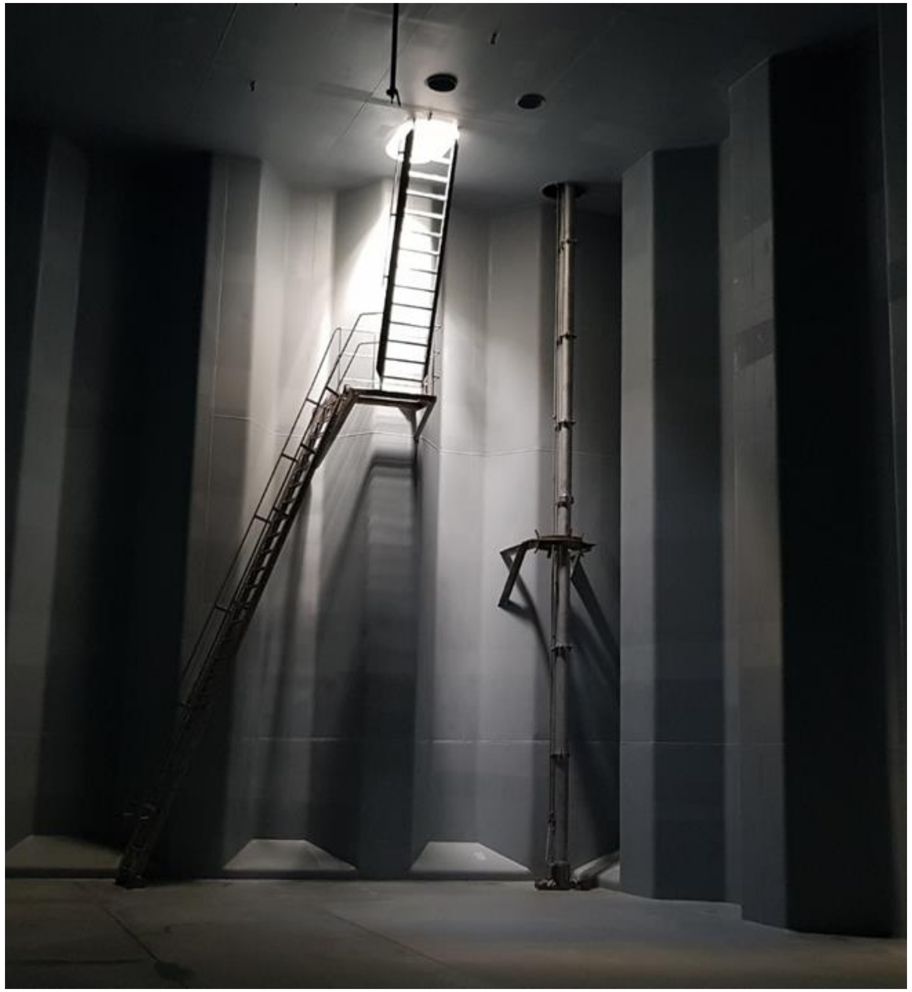
Efficient vessels offering benefits for our customers

Design developed together with naval architects FKAB building on our experience from the north European refined products trade

- 12 segregations with a tank and cargo-line layout that offers flexibility on parcel-size and load/discharge sequences - without compromising total performance
- Sigma Phenguard “Hot cured” epoxy coating
- Inert gas produced by LNG minimises soot in cargo tanks
- Nitrogen for padding and blowing lines instead of air for improved safety
- Svanehøj deepwell pumps, electrically driven.
- Super-strip system and separate drain tanks and for effective discharge and low ROB
- High capacity cargo tank ventilation with heated air to shorten tank preparation time
- Bow thruster, controllable pitch propeller and flap rudder for improved manoeuvring in port
- All mooring lines om winches for faster mooring/unmooring



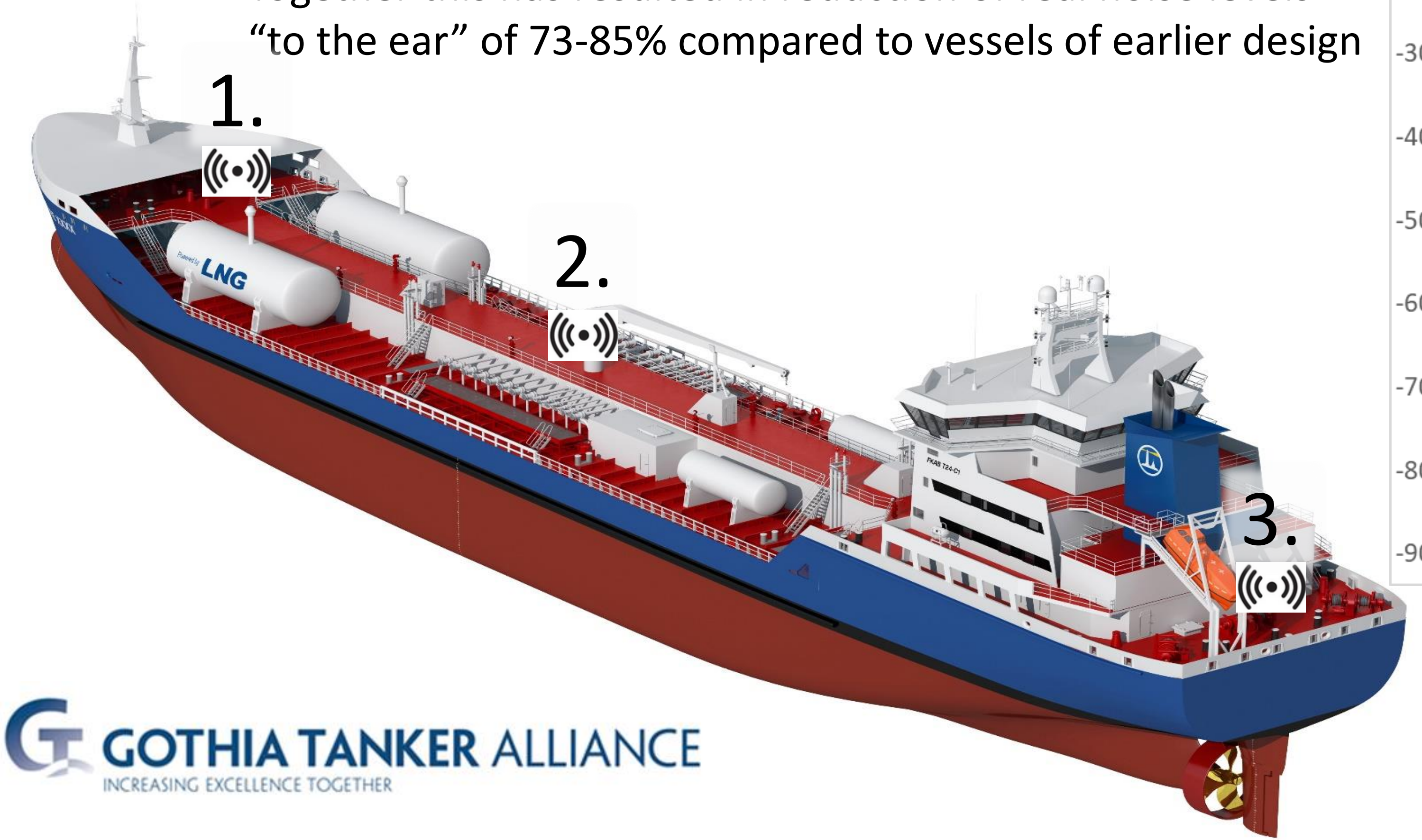
What is left in the cargo tanks after discharge of 20,000 m³?

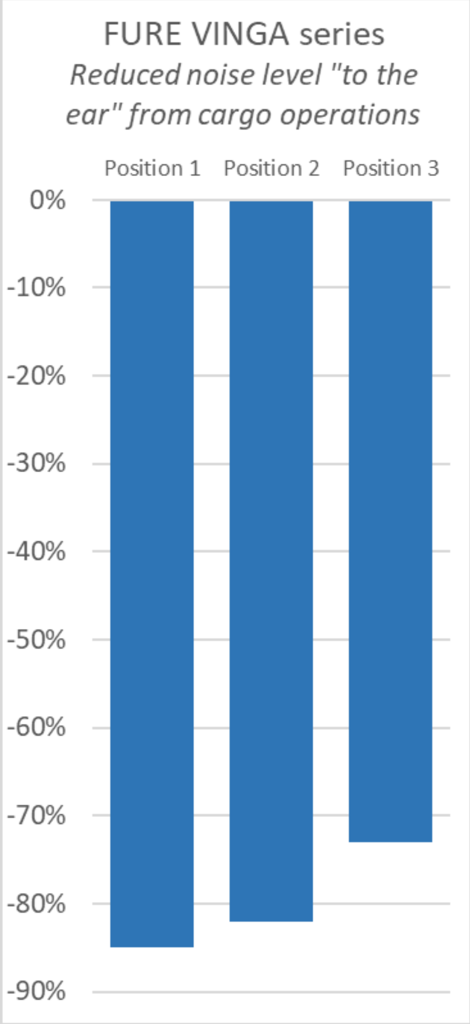
Low Noise Cargo Operations

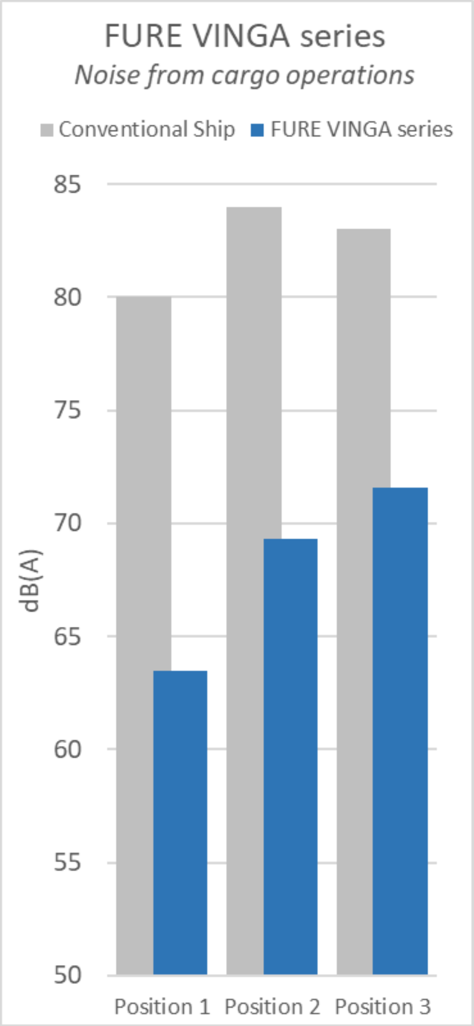
In order to reduce noise from cargo operations the FURE VINGA Series is equipped with;

- Low noise electric driven cargo pumps.
- Low noise compressors and engine room fans

Together this has resulted in reduction of real noise levels "to the ear" of 73-85% compared to vessels of earlier design







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Designed for trade in senstive areas

- The series fulfil the stringent US & Canadian regulations for trading in drinking water reservoirs
    - Using only Environmental Acceptable Lubricants (EAL) on all water interfaces and deck machinery
    - Aluminium anodes on hull and
    - Ultrasonic antifouling system in box coolers
- The combination of duct and a low-noise propeller also reduces underwater noise harmful to marine species
- The FURE VINGA design has been used by Sjöfartsverket (Swedish Maritime Administration) for the simulated navigation tests, performed to ensure navigational criteria's for lake Mälaren after completion of the new locks in Södertälje.
    - Intake on 7m freshwater draft is about 10,000 mt

Challenges when deciding next generation Furetank vessels ?

Factors behind the decision to convert the FURE WEST to dual-fuel 2014 and the design of the new vessels;

- Stricter rules for vessel design; EEDI, TIER III etc.
- Successively of tightening regulations of bunker specifications and the anticipation of higher fuel cost
    - 2005 - EU Sulphur Directive, ECA in the Baltic, max 1,5% sulphur
    - 2010 - Max 0,1% sulphur in EU ports
    - 2015 - SECA in the North Sea, max 0,1% sulphur
- Increased focus on sustainability, climate change and public health issues from the society
- Increased customers awareness to reduce emissions, stench and noise

After we made the decision;

- IMO2020 - max 0,5% sulphur in bunkers
- IMO targets to reduce CO_2 emissions from shipping by 2030 and 2050
- Increased focus on local health risks from emission of NOx and particles

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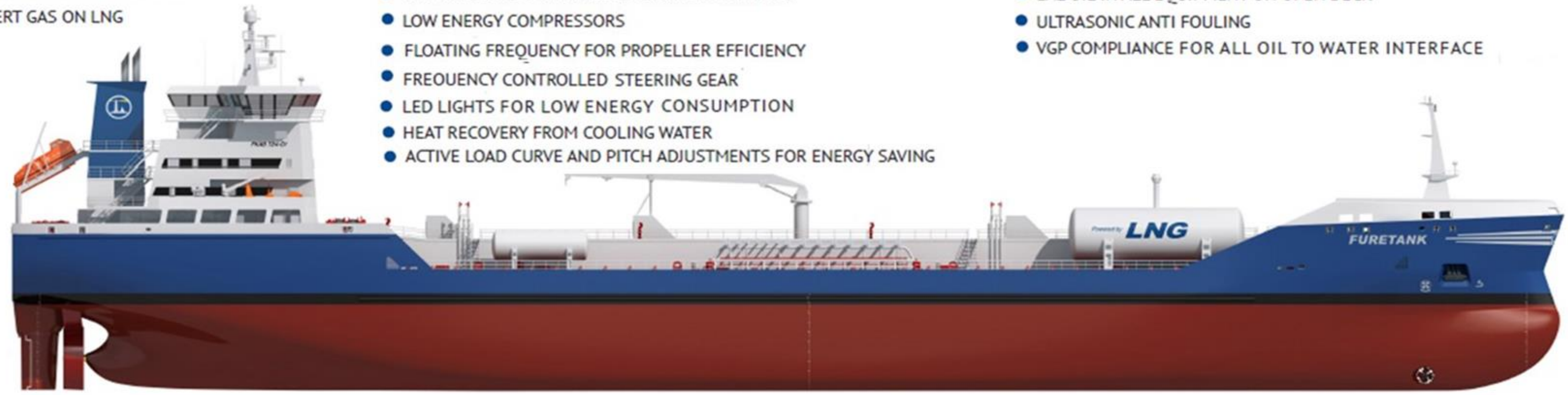
NEXT GENERATION - Design features for lower evironmental impact

FUEL
- LNG AS FUEL AT SEA AND IN PORT
- SCR ON AUXILIARY ENGINES
- INERT GAS ON LNG

ENERGY SAVING EQUIPMENT
- PROPELLER NOZZLE MINIMIZE REQUIRED ENGINE OUTPUT - ICE CLASS 1A
- VFD PRESSURE CONTROLLED ENGINE ROOM FANS
- LOW ENERGY COMPRESSORS
- FLOATING FREQUENCY FOR PROPELLER EFFICIENCY
- FREOUENCY CONTROLLED STEERING GEAR
- LED LIGHTS FOR LOW ENERGY CONSUMPTION
- HEAT RECOVERY FROM COOLING WATER
- ACTIVE LOAD CURVE AND PITCH ADJUSTMENTS FOR ENERGY SAVING

LUBRICANTS & FLUIDS
- CHEMICAL FREE BALLAST WATER TREATMENT
- EAL OIL IN ALL EQUIPMENT ON OPEN DECK
- ULTRASONIC ANTI FOULING
- VGP COMPLIANCE FOR ALL OIL TO WATER INTERFACE



SAFETY & REDUNDANCY
- UPS BACK UP ON ALL PROPULSION AND NAVIGATION
- CLASS NOTE AVM-APS ALTERNATIVE PROPULSION SYSTEM

NOISE REDUCTION
- ELECTRIC CARGO PUMPS MINIMIZE NOISE POLLUTION IN PORT
- PROPELLER NOZZLE REDUCE NOISE LEVEL

HULL PERFORAMNCE
- NEW LOW DRAG HULL DESIGN
- HIGH PERFORMANCE ANTI FOULING FOR LOW FRICTION

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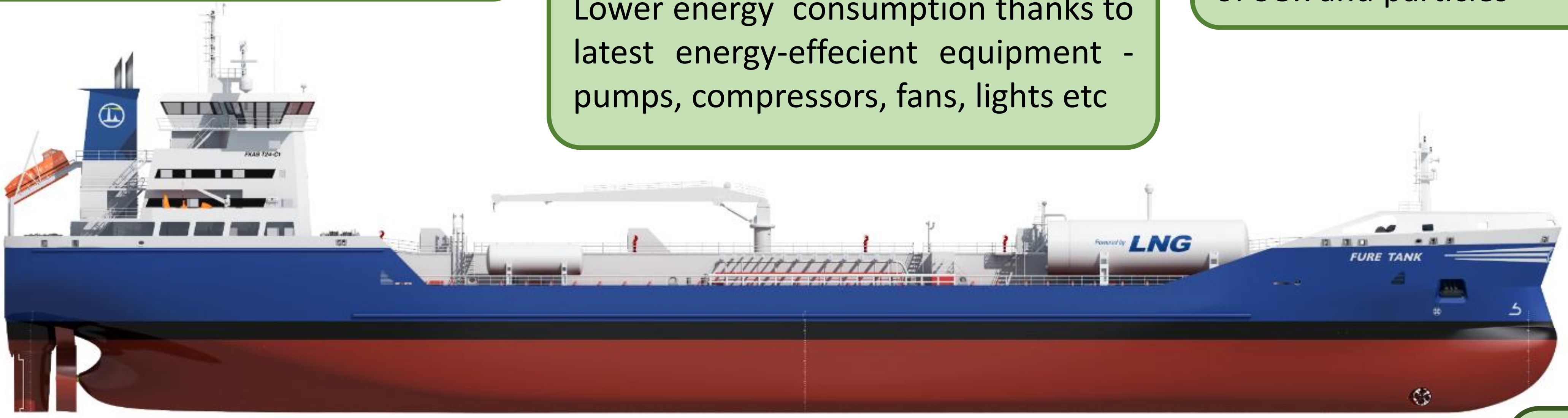
Furetanks’ solution to meet IMO’s emission targets for 2050

"Hybrid-power” - where batteries are used as often as possible instead of auxillary engines to supply power

Lower energy consumption thanks to latest energy-effecient equipment - pumps, compressors, fans, lights etc

LNG as fuel lowers emmissions of CO_2 & NOx and eliminates emissions of SOx and particles



Low drag hull design and high performance antifouling

A ducted propeller that increases thrust and reduces power requirement for main engine and still meeting criteria for ice class 1A. The smaller engine can thanks to “variable frequency” be used to power the vessels cargo pumps during discharge thus maximising time using the fuel with the lowest emissions in port - LNG

Hybrid/UPS Power Back-up & Shore Connection

The hybrid solution with an UPS Power supply system minimizes the use of auxiliary engines and can supply all 24/230/440V necessary to operate:

- Main engine
- One steering gear
- All navigation & communications equipment
- Emergency remote anchoring device
- Emergency switchboard
- All lights

Using the UPS as the backup power source makes it possible to navigate in narrow waters (port entrances, canals etc.) with only the main engine running – thereby maximising the use of LNG and reducing emissions

All vessels are prepared to perform cargo operations by electricity supplied from shore at full rate - 6,6 kV and 1,850kVA

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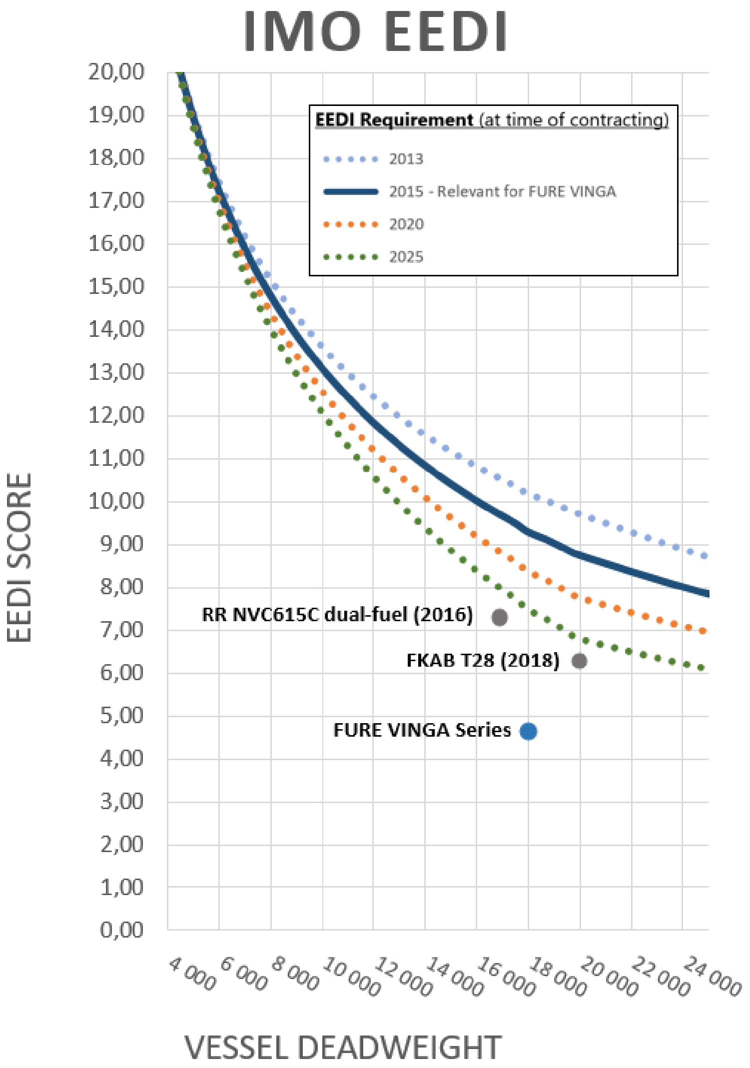
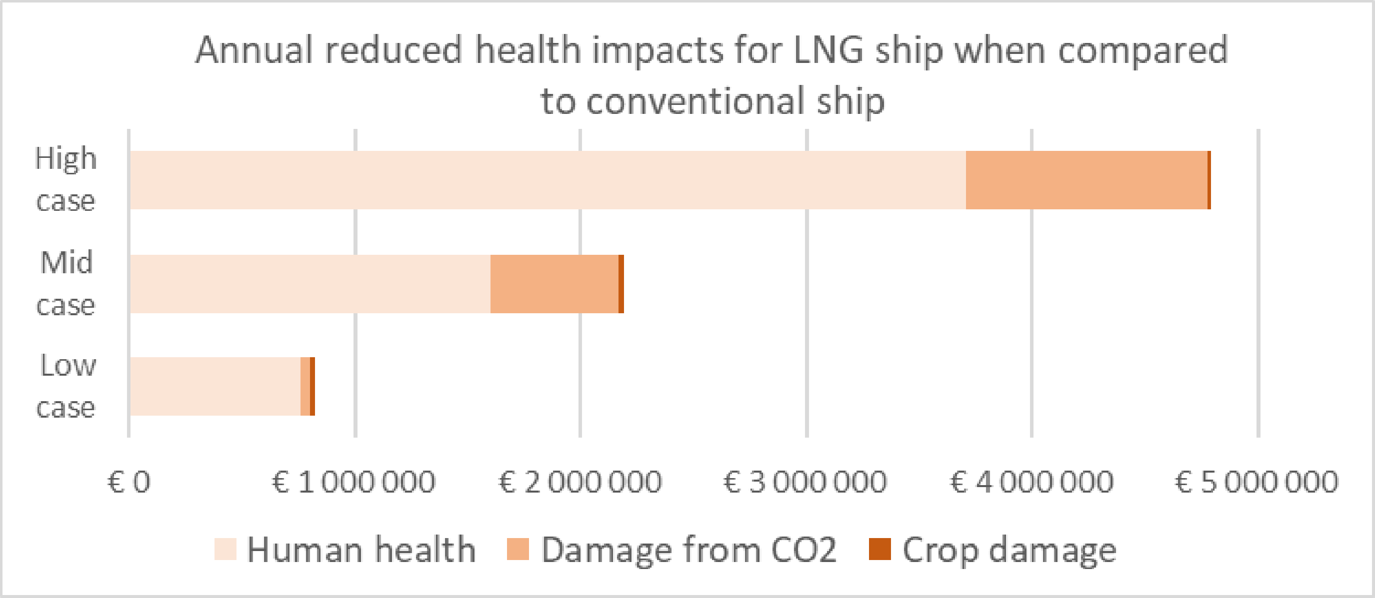
EEDI (Energy Efficiency Design Index)

- EEDI is a resolution under IMO Marpol Annex VI, adopted in 2013 and aims to promote the use of more energy efficient design and less polluting equipment and engines for new ships
- The score is calculated by a formula based on technical design parameters for a given ship, is non-prescriptive so it leaves the choice of technology to the industry
- Expressed in grams of carbon dioxide (CO_2) per ship's capacity-mile - the smaller the EEDI the more energy efficient ship design
- IMO EEDI Requirement for a 17,999 dwt tanker ordered in 2015 and delivered in 2018 is 9,37
- FURE VINGA EEDI score is 4,64 – a score which improved successively throughout the process; from design stage (6,09) via model test (5,44)
- The VINGA-series low score is a result of the unique combination with ducted propeller, floating frequency on main engine and hybrid technology where the batteries are used instead of the auxiliary engines – together this corresponds to about 3 EEDI points



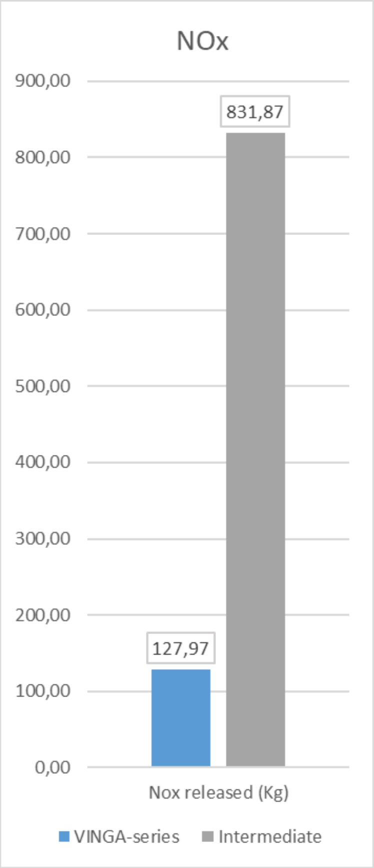
Environmental Assessment of LNG-Powered Tankers

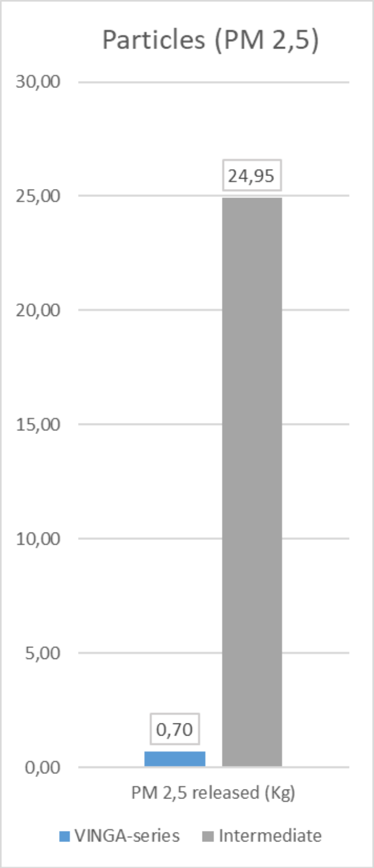
- The Swedish Environmental Research “IVL” Institute have done a independent study, using EU-guidelines, to quantify the economic benefits to society from the reduced environmental impact
- Annual economic values of reduced health impacts and crop losses associated with the LNG powered vessel compared to a conventional vessel is shown in the table

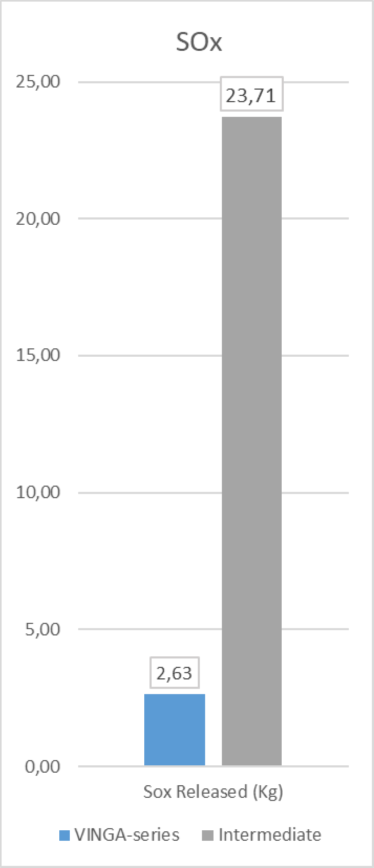


Reduced Environmental impact – Discharge operation Antwerp

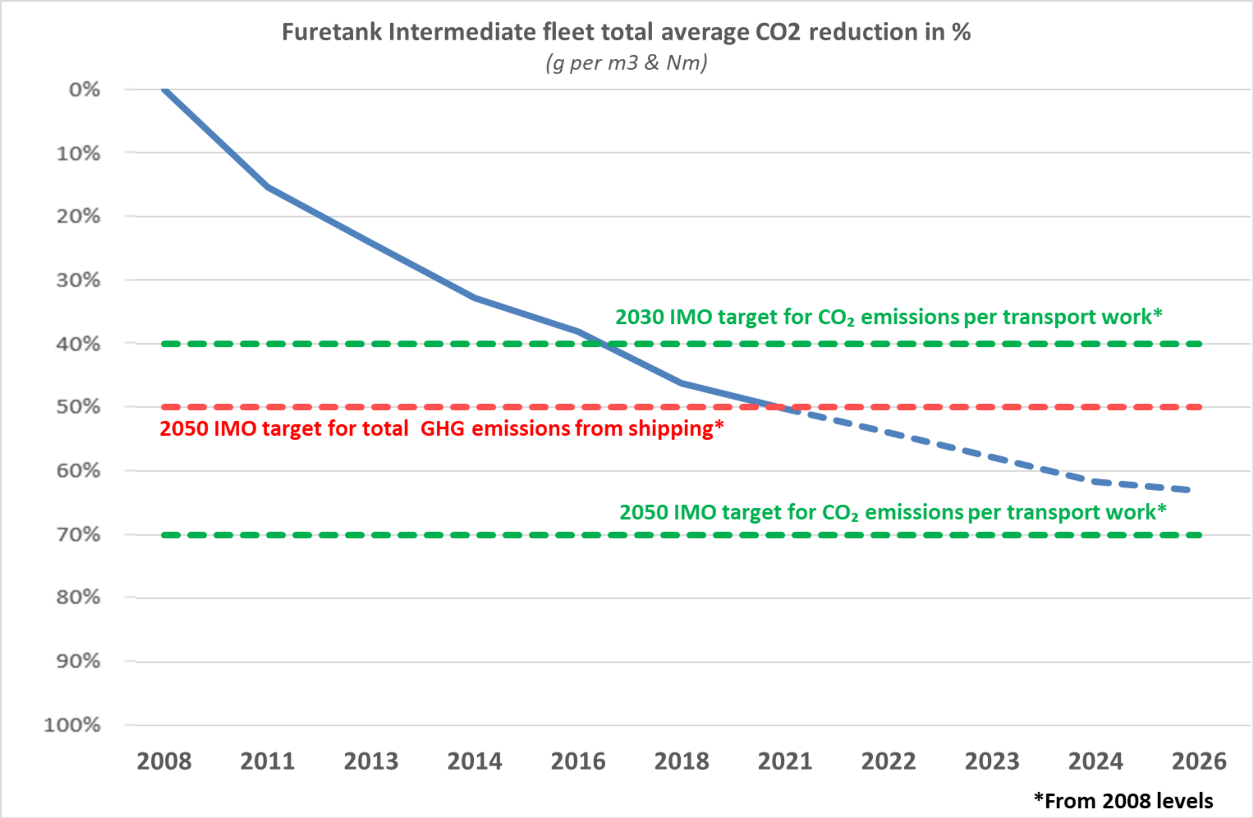
- FURE VINGA series total emissions in LNG <u>or</u> gasoil mode for passage in/out plus discharge operation in Antwerp







Furetank CO_2 Emissions – Drivers and Future Expectations



- Due to strong demand and busy shipyards limited focus was spent on energy saving features and design for vessels built 2000-2010
- 2009-2014 - Weaker freight market & high bunker prices resulted in better focus on energy management, both for existing vessels and the design of new ships. First step was to reduce average speed.
- 2013 - First installation of floating frequency, a device that enables better utilization of controllable pitch propellers at below design speeds
- December 2014 – decision to convert FURE WEST to dual fuel and LNG (in operation from 2016)
- 2015 - First orders placed for new 18,000 dwt vessels with dual fuel & LNG
- 2018 – Delivery FURE VINGA and FURE VALÖ
- 2019 – Delivery of FURE VEN (and sale of FURE VINGA)
- 2021 – Delivery FURE VINGA #2 and FURE TBN
- 2023, 2024 & 2026 – replacement of 20 year old vessels with VINGA-designs

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THUN VENERN
FURE VALÖ
FURE VEN
RAMELIA
FURE XXX
GOTHIA TANKER ALLIANCE
ENVIRONMENTAL CARE WITH QUALITY
FURE XXX
GOTHIA TANKER ALLIANCE
ENVIRONMENTAL CARE WITH QUALITY

FUTURE-PROOFING CHEMICAL TANKER OPERATIONS

13 September 2021

The Initial IMO GHG Strategy

- aims to ‘phase out GHG emissions from international shipping ‘as soon as possible in this century’;
- Sets the following levels of ambition:
  - Reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, *relative to 2008*; and
  - Reduce total annual emissions by at least 50% by 2050, relative to 2008 whilst pursuing efforts towards phasing them out

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MEPC 76

- Adopted amendments to MARPOL Annex VI to reduce GHG emissions from shipping
  - Technical – EEXI
  - Operational – Carbon Intensity Indicators
- EIF: 01 November 2022
- Effective date: 01 January 2023
- Review to be carried out by end of 2025

Existing Vessel Efficiency Index (EEXI)

- Reduction factor relative to EEDI reference line:
  - Tankers
    - 4,000 dwt – 19,999 dwt 0 – 20% below
    - 20,000dwt and above 20% below
- Prime method of reduction likely to be Engine Power Limitation
- Attained EEXI to be calculated for each ship and verified at *first annual, intermediate or renewal survey* after 01 January 2023
- Ships attaining required EEXI issued with certificate
- EEXI Technical file to contain information showing process of calculation
- Attained EEDI may be taken as attained EEXI if it is equal to or less than required EEXI

Operational Measures

- From 2023 ships of 5,000 gt and above required to measure their carbon intensity and verify it against required operational CII

Year	Reduction factor relative to 2019
2023	5%
2024	7%
2025	9%
2026	11%

- Reduction factors for 2027 to 2030 to be further strengthened and developed following the review

How will carbon intensity be measured?

AER

Grams C02	=	Fuel consumed x Cf
Transport Work		DWT x miles travelled

How is the baseline defined?

Reference lines developed for each sector and defined as "*a curve representing the median attained operational carbon intensity performance, as a function of Capacity, of a defined group of ships in year of 2019".*

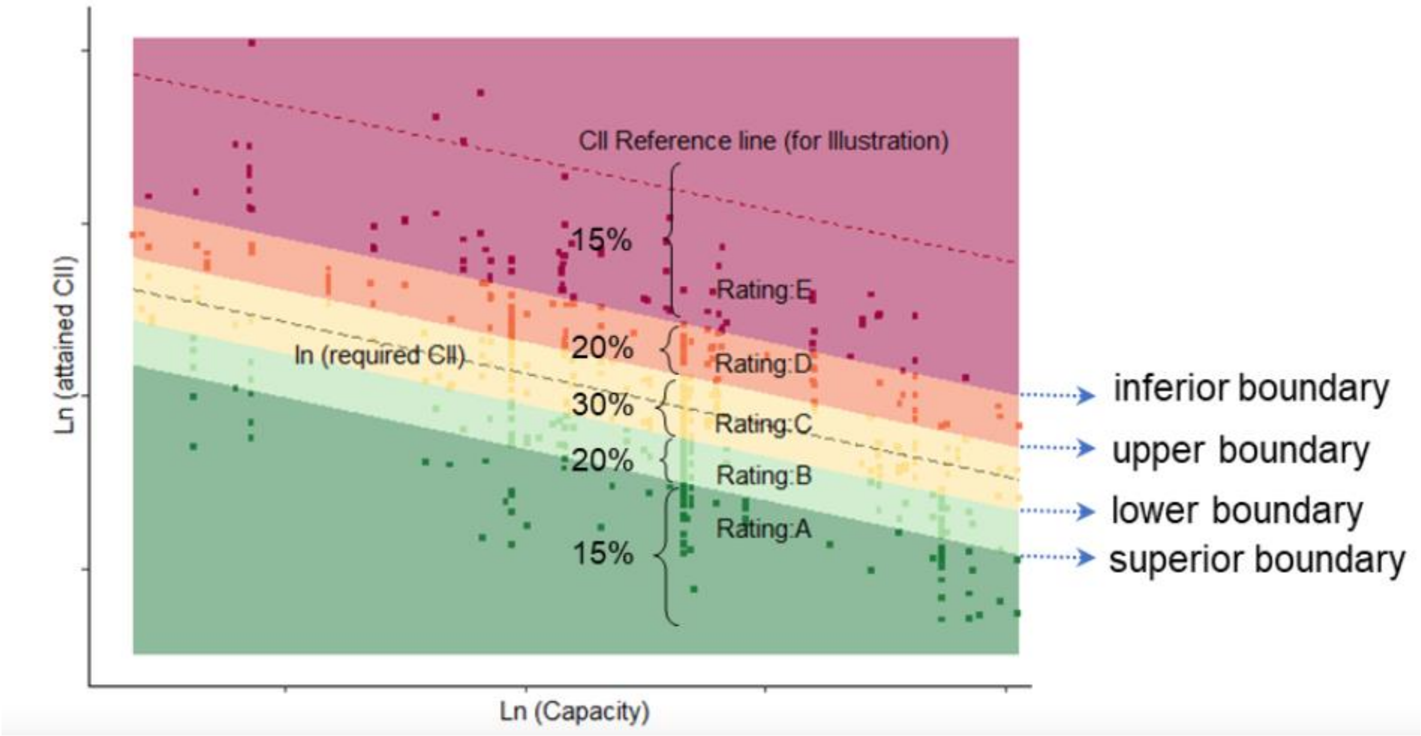
$$CII_{ref} = aCapacity^{-c}$$

where CII_{ref} is the reference value of 2019

For tankers:

- *Capacity* means DWT
- $a = 5247$
- $c = 0.610$

- Ships will be rated as A, B, C, D or E
  - C = required level, classed as Moderate
  - A and B = Major superior and Minor Superior
  - D and E = Minor inferior and Inferior
- A ship rated as D for 3 consecutive years or as E will have to develop plan of corrective actions to achieve the required annual operational CII



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SEEMP

- By 1 January 2023 SEEMP to include:
  - Description of methodology that will be used to calculate attained annual carbon intensity
  - Required annual operational CII for next three years and implementation plan documenting how it will be achieved
  - Procedure for self-evaluation and improvement
  - For ships rated D for 3 consecutive years or as E, a plan of corrective actions
- SEEMP to be subject to verification and company audits
- *Port State Control may inspect whether the SEEMP is being implemented*

IPTA comments to MEPC

- Flexibility that allows chemical tankers to carry wide variety of cargoes means sector is also very efficient
- Operational demands of different cargoes can mean that up to 30% of fuel consumed on a chemical tanker could be for purposes other than propulsion
- Nature of trade means that chemical tankers spend high proportion of time in port
- Using a measure of efficiency/carbon intensity that only takes into account distance travelled, rather than all uses of fuel, will give distorted picture
- Could result in:
  - Efficient ships being unfairly penalized
  - Less efficient ships being deemed to have reached a target simply through a change in trading patterns

Operational requirements

- Fuel consumption can be affected to greater or lesser extent by operational requirements of individual cargoes e.g.:
  - Operating nitrogen generator
    - For safety or quality control reasons
  - Heating – during voyage and/or for discharge
  - Tank cleaning
    - Depending on products being cleaned from and to

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Energy Consumption as a Function of Operational Mode

- Propulsion
  - 70 – 90% (highest % for the simple product tankers)
- Cargo temperature control
  - 0 – 10% (lowest % for the simple product tankers, highest for the parcel tankers)
- Tank cleaning
  - 5 – 15% (highest % for parcel tankers, lower for product tankers)
- Loading and discharging
  - < 5% (high % for the smaller vessels, lower for the larger vessels)
- Hotel load
  - Approx. 5%

Port Operations

- In some cases relatively simple (e.g. if carrying homogenous cargo)
- However, in many cases highly complex
  - Multiple berths
  - Discharging and backloading
  - Certain cargoes require prewash to be carried out before leaving port
  - Tank cleaning between cargoes
  - Tank inspections
- Means that chemical tankers spend high proportion of time in port
- Fuel being used throughout but very little mileage

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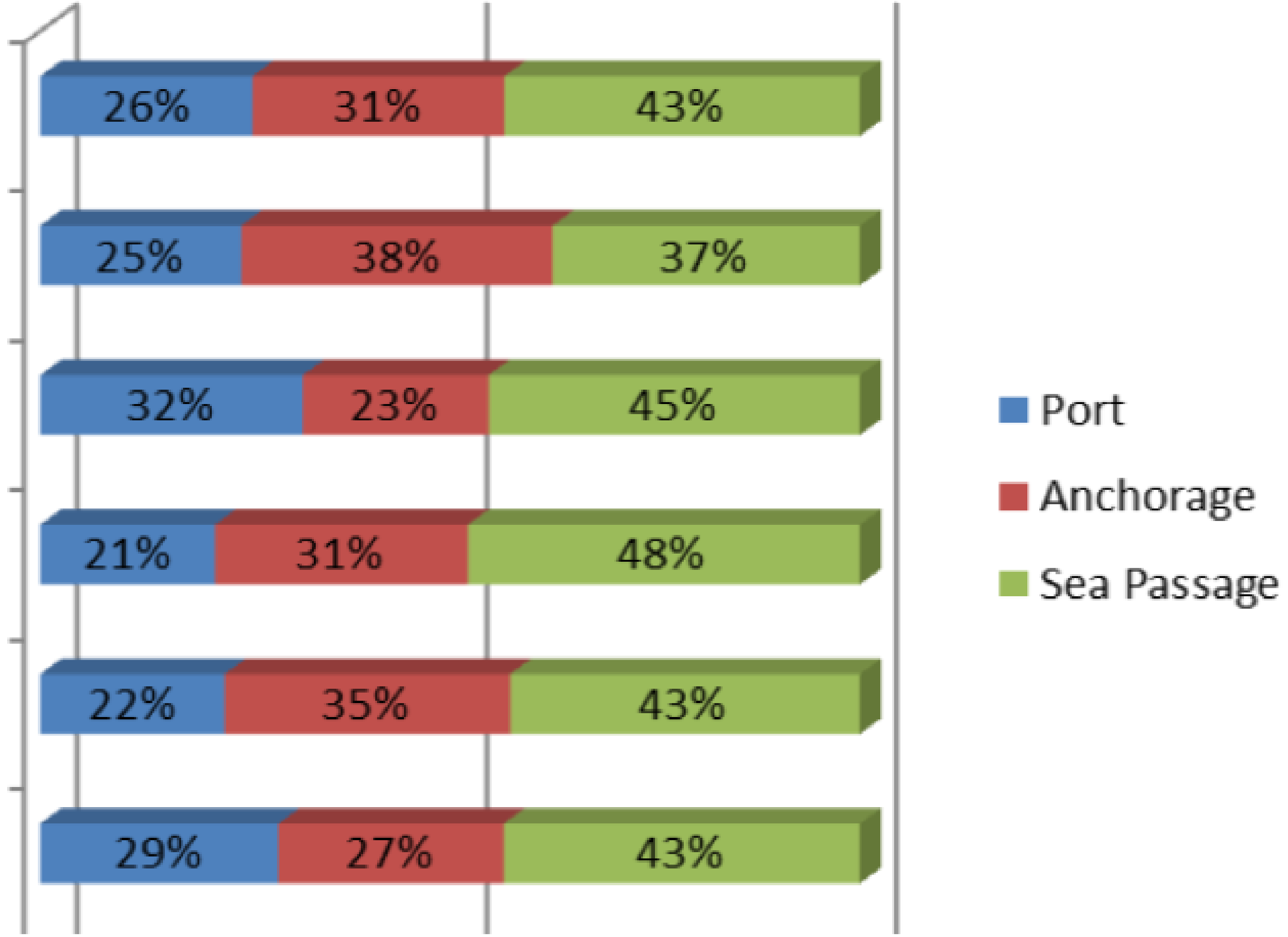
Operational Modes Distribution (%)



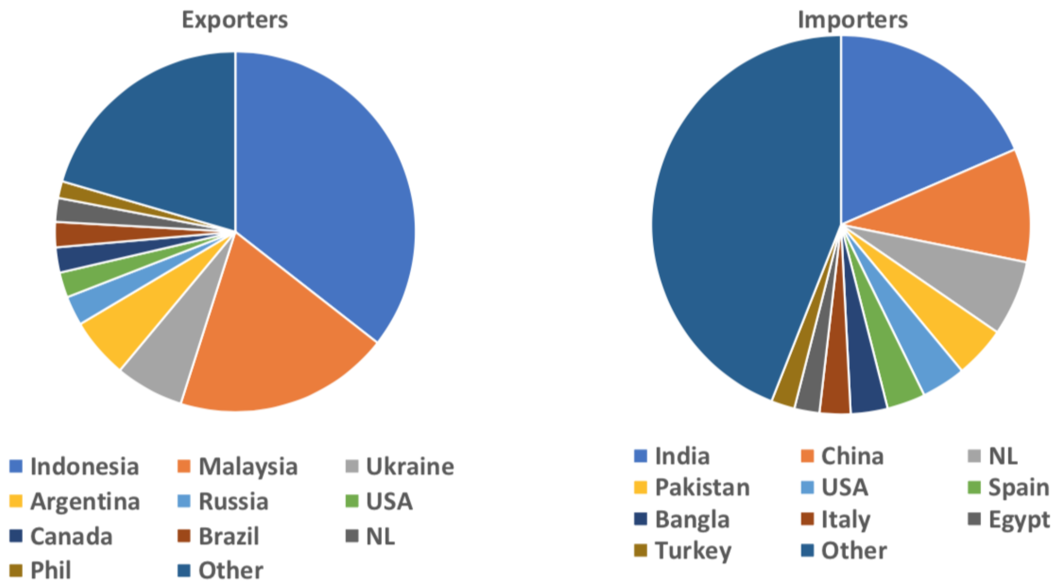
High carbon intensity cargoes?

Type of cargo carried can affect fuel consumption to a significant extent

e.g. Vegetable oils

- Approx 80 million tonnes shipped annually

Importers/Exporters, vegs & fats 2018



- Many require heating – during voyage and/or for discharge
  - Temperature required ranging from ambient to 72^0C
  - Fuel consumed will depend on
    - number of tanks
    - number of days heat applied
    - cargo temperature required
    - ambient temperature
- Tank cleaning / preparation for next cargo can be intensive

From January 2021

Amendments to MARPOL Annex II require ships discharging vegetable oils in certain European ports to perform prewash of tanks with discharge ashore prior to leaving the port

Increase in fuel consumption (and emissions) in port without corresponding increase in distance travelled

How much will attained CIIs fluctuate?

		2016		2017		2018		2019	
DWT	**Ref. AER**	**Att. AER**	**Difference**	**Att. AER**	**Difference**	**Att. AER**	**Difference**	**Att. AER**	**Difference**
19,998	12.54	15.07	**20.15%**	11.72	**-6.5%**	13.68	**9.07%**		
19,993	12.54	10.88	**-13.27**	9.55	**-23.87**	12.97	**3.39%**	14.47	**15.35%**
19,956	12.56			10.84	**-13.69%**	13.20	**5.10%**	10.55	**-16%**
16,553	14.08	15.85	**12.58%**	12.29	**-12.7%**	13.58	**-3.54%**	15.72	**11.66%**
16,111	14.30					10.39	**-27.34%**	11.764	**-17.74%**
15,945	14.39					17.22	**19.72**	11.32	**-21.28%**
14,701	15.12	15.83	**4.68%**	14.30	**-5.42%**	15.48	**2.39%**	17.04	**12.71%**
14,298	15.37					13.99	**-8.96%**	15.63	**1.67%**

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Possible reasons

- differences in total volumes of cargo carried
- differences in total distance travelled
- differences in volumes of heated cargoes carried
- switching between deep-sea and coastal trading
- market conditions leading to more port calls being needed to fill a ship before sailing trans-Atlantic or trans-Pacific
-

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Correction factors?

- IPTA proposed in respect of cargo heating/tank cleaning
- Other proposals include, inter alia:
  - Heavy weather
  - Ice class
  - Refrigerated cargoes
  - Shuttle tankers
  - Short voyages
  - Stationary periods

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Assessment Criteria

- Requests for correction factors to be subject to a series of assessment criteria, including:
  - justification of the negative impact of the CII measure;
  - demonstration of the accuracy of the proposed correction;
  - proof that that the correction factor would be easily verifiable without unreasonably increasing the administrative burden for states;
  - demonstration through analysis of the effects of the correction factor or exclusion on the carbon intensity reduction of the ships in question.

IPTA

Thank you for your attention

International Parcel Tankers Association

www.ipta.org.uk

TRISTAR

TRISTAR MARITIME LOGISTICS

Future Proofing Chemical Tanker Operations
by Mr. David Pereira

Future-Proofing Chemical Tanker Operations

TRISTAR MARITIME LOGISTICS IS PART OF THE TRISTAR GROUP WITH HEADQUARTERS IN THE UAE. WE OWN AND OPERATE 35 VESSELS OF WHICH 18 ARE CHEMICAL TANKERS.

Future-Proofing Chemical Tanker Operations

Just-in-time port calls and Slow Steaming:

Admiralty Coefficient or Admiralty Constant asserts that for the same displacement the shaft power, in Kilowatts, is proportional to the cube of the speed in knots.

So if reduce the speed by a factor of 2, ie. halve the speed, the required power would reduce by a factor of 8.

Power is also directly almost proportional to fuel consumption and therefore a reduction in speed would lead to an increase in voyage time, but a substantial reduction in fuel consumed.

The example below assumes that the SFC is constant at all engine power output. Though this is not the actually the case, we are trying to show the benefits on consumption by reducing speed, ie. Slow steaming.

eg. A vessel consumes 40 MT/day at 20 knot. She would consume 40 MT to cover 480 NM in 24 hours. If her speed were reduced to 10 knots she would consume 5 MT/day and for the same voyage take 48 hours and consume 10 MT. Double the time but a saving of 30 MT of fuel.

The fuel saved is offset by the cost to the charterers of the increased time taken on the voyage and therefore to ensure fairness proper regulations are required. The CII Regulations seems to be a step in the right direction, but we are not yet sure how exactly it will effect vessel operations and if all vessels will be similarly affected.

This shows the importance of voyage planning so that the vessel arrives when she has to and not before.

However the Master has to take care not to miss the window for tendering his NOR. In a lot of ports any NOR tendered after 1700 is only accepted at 0600 the next morning.

Future-Proofing Chemical Tanker Operations

Optimising cleaning intervals for hulls and propellers

Studies conducted by various antifouling paint makers has concluded that the speed of a vessel, drops by around 1 to 5 % over a 5 year period. This is provided there is no long idle period, which would allow fouling.

Therefore all going well there would be no benefits to cleaning the hull.

In practise this does not always happen and it is advisable to monitor the speed versus fuel consumption of vessels, so that one can decide if and when to carry out a hull cleaning.

Paint makers have started to provide this service at a cost, as have some third party performance monitoring companies.

On our fleet we use such monitoring to decide when to clean the hull.

Loss in speed can also be caused by propeller fouling. Since most propellers do not have a protective coating, which prevents fouling, in our fleet we arrange propeller polishing as a matter of routine, once every 6 to 9 months, or earlier if performance monitoring suggests the need for same to be done.

Future-Proofing Chemical Tanker Operations

Weather and trim optimisation

All our chemical tankers are weather routed. This is arranged either by the charterers or directly by us. The Master has the benefit of routing by a professional external party so that he can optimise the route based on weather, currents etc.

Trim optimisation is a method that seems to work well on container ships. However for our fleet we are in the process of investigating the benefits and how these can be practically achieved. The first requirement is for the data to be transmitted, preferably automatically ashore, where it is analysed and suggestions for change in trim are given to the vessel.

Would greatly appreciate any feed back from the audience.

Is sail assisted propulsion suitable for chemical carriers?

Power can be harnessed from the wind.

Rotating cylinders and windmills are some examples of power generated by the wind. We have investigated the fitting of these rotating sails on our MR tankers, but found two issues.

a. We have not yet found any practical positive reference where these sails have been fitted.
b. We feel actual benefits could be derived if the vessel is on a fixed run.

We have therefore concluded, that the present technology is not suitable for our chemical tankers.

Future-Proofing Chemical Tanker Operations

Cargo operations – shore / fuel cells and hybrid power provide the energy required

Cold ironing is catching on at some ports of the world. We fully support it.

It is up to the ports to provide this at a cost which is more economical to running the auxiliary engines.

Fuel cells and hybrid power solutions have to be cost effective. At present they are not.

We all know how much a Tesla costs. How many of us are prepared to take on the extra cost. We should also be aware of how the electricity that is used to charge the batteries is produced. If it is by fossil fuels then the purpose of reducing emissions is defeated.

We as a company are fully committed to sustainable operations and have been producing a Sustainability Report since 2012. We are actively engaged in looking at all methods to reduce emissions on our fleet. Some of these methods are shown in the coming slides.

Our motto is “Business for Purpose” but at the same time we have to remain competitive and therefore there is a need to choose the various emission reduction options carefully.

Future-Proofing Chemical Tanker Operations

<u>**The impact of reducing carbon intensity (CII) by at least 40 percent by 2030**</u>

A great idea

We look for guidance from the regulators on how this can be done in a manner that allows all stakeholders to continue to operate profitably, in spite of the increased costs that will have to be borne initially by ship owners.

AP Moeller-Maersk order for methanol fuelled ships has grabbed all the headlines. Most Owners do not have such purchasing power. The bill for decarbonisation is estimated at USD 50 to 60 billion annually. This would increase operating costs by around USD 20,000 per day. Someone needs to pay for this.

The next few slides will show the various ways that emissions can be reduced. However the ones which will allow the vessel to achieve the 40% reduction are presently very expensive and unless governments come around to fund the improvements required, ship owners will find it difficult to manage the additional costs themselves, unless they are also supported by the Charterers.

It is going to be an interesting few years till 2030

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RECOMMENDATIONS / ACTIONS FOR FLEET EMISSION REDUCTION

Operational Measures	CLAIMED SAVINGS	COST — ESTIMATED CAPEX	ROI
Propeller Polishing	3%	LOW	< 6 months
Hull Cleaning	10%	LOW	< 1 month
Slow Steaming	20-36%	LOW	N/A
Virtual Port Arrival	6%	NONE	N/A
Weather Routing/Software	5%	LOW	< 24 months
Port Turn-around Time	1%	NONE	N/A
Optimization of Ballast and Trim	1-4%	LOW	< 24 months
Speed Optimization	5%	LOW	< 12 months
Autopilot Adjustment	1%	LOW	< 18 months
Optimized Voyage Planning	5%	LOW	< 12 months
Optimum Use of Fans and Pumps	1%	NONE	N/A
Efficient Control of HVAC	2%	NONE	N/A
VFD for Pumps, Fans and Other Electrical Equipment	8% of AE fuel consumption	LOW	< 12 months
Cargo Heating and Temperature Control Optimization	10% of boiler consumption	LOW	< 12 months
Propulsion Efficiency Monitoring	3 to 5% over 5-year interval	MODERATE	< 24 months
Optimized Machinery Maintenance	4%	MODERATE	< 24 months

TRISTAR

RECOMMENDATIONS / ACTIONS FOR FLEET EMISSION REDUCTION

Energy Efficiency Technologies	CLAIMED SAVINGS	COST — ESTIMATED CAPEX	ROI
De-rated ME	<6%	LOW	< 60 months
Turbocharger Cut-Out	3 .5%	NONE	N/A
Rudder Surf Bulb	5%	MODERATE	< 36 months
Rudder Surf Fins	1%	MODERATE	< 132 months
PBCF	1-3%	MODERATE	< 14 months
Contra Rotating Propeller (CRP)	3%	MODERATE	< 132 months
Mewis Duct	3-7%	MODERATE	< 14 months
Propeller Duct	3%	MODERATE	< 24 months
Wake Equalizing Ducts	2%	MODERATE	< 18 months
Pres-Swirl Fins	2%	MODERATE	< 30 months
Part Load Optimization	3%	MODERATE	N/A
Contracted and Loaded Tip Propeller (CLT) or Kappel Propellers	6%	MODERATE	< 12 months
Grim Vane Wheel	3%	MODERATE	< 60 months
Silicon Anti-Fouling Paints	6%	HIGH	< 9 months
Air Lubrication	4%	HIGH Estimated capex: ± $2 Million (M) - 3 M (estimate based on an aframax design)	< 60 months
Waste Heat Recovery Generator	2-5%	HIGH	< 72 months
Installation of LED Lighting	1-2% of AE fuel consumption	HIGH	< 60 months
Solar Panels for Auxiliary Loads	5% of AE fuel consumption	HIGH	< 60 months
Rotor and Wind Sails	5 to 10%	HIGH : Rotor sail estimated capex: ± $1 .5 M Wind sail estimated capex: ± $3 .5 M (estimate based on 4 units systems)	> 60 months
PTO	3 to 5%	HIGH: Estimated capex: ± $1 .75 - 2 M (depending on engine manufacturer)	N/A
Onboard Carbon Capture System	N/A	HIGH	N/A
Battery Rack Hybrid System	10% of AE fuel consumption	HIGH	N/A

THANK YOU

IN PARTING WE WELCOME YOU ALL TO TRISTAR'S ANNUAL

"SAFETY AT SEA" CONFERENCE

VENUE AND DETAILS TO BE ANNOUNCED SHORTLY.

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