BIOFUELS:

ALTERNATIVE FUELS FOR IMMEDIATE USE

Greener Shipping Summit

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09 Nov 2021

BIOFUELS WITHIN THE SCOPE OF MARINE APPLICATIONS

VeriFuel
Understanding Marine Fuel

Bio-derived fuels and blends of bio-derived fuels with petroleum products are included within the range of potential alternative energy sources being considered by some sections of marine industry since they are renewable and can result in reduced greenhouse gases (GHGs) and Sulphur emissions (SOx).

ISO 8217:2017 Annex A

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BIOFUELS GENERATIONS

1st GEN	2nd GEN	3rd GEN	4th GEN
Made from the sugars and vegetable oils found in food crops using standard processing technologies	Production of biofuels manufactured from agricultural and forest residues and from non-food crop feedstocks	Specially designed engineered crops such as algae as the energy source.	Uses genetically modified (GM) algae to enhance biofuel production
Ethanol Based Sugar Starch Oil Based Corn Rapeseed Soybean Palm	Agriculture/food processing waste grasses and trees	Transgenic Materials, Low Lignin Eucalyptus, Poplar Trees and Sorghum e.g. higher yield feedstocks and algae	NOTE: Take into account the carbon capture and storage potential on the crops used to produce the required biomass, as well as the energy efficiency of the processing technology that generates the resulting fuel.
Fermentation (bioalcohol) Transesterification (biodiesel)	Fischer Tropsch Biomass-To-Liquid (BTL) Fermentation Gasification	Fischer Tropsch Biomass-To-Liquid (BTL) Fermentation Gasification Algae Processing	
Bio Alcohols Ethanol Biodiesel Fatty Acid Methyl Esther (FAME) Unprocessed Vegetable Oil as fuel	Cellulosic Ethanol Biogas Biohydrogen Fischer Tropsch Diesel	Cellulosic Ethanol Biogas Biohydrogen Fischer Tropsch Diesel Algal Oil	

BENEFITS OF BIOFUELS

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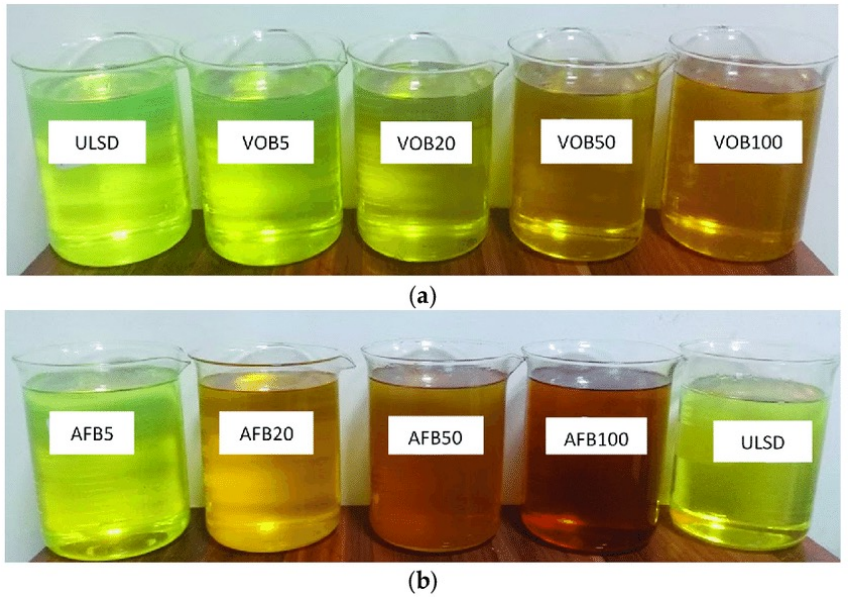
- Compatible with modern ship engines: No Retrofit / CAPEX required
- Reduced emission factor at about 2.8 – 2.9 (t CO_2/t fuel) versus the 3.114 of HFO but depends on formulation and blend
- Mix with fossil fuels (“drop-in”), without becoming fully dependent on biofuels
- Convenient alternative fuel source, no local production/distribution restrictions.



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TYPICAL LIFECYCLE CO2 EMISSIONS

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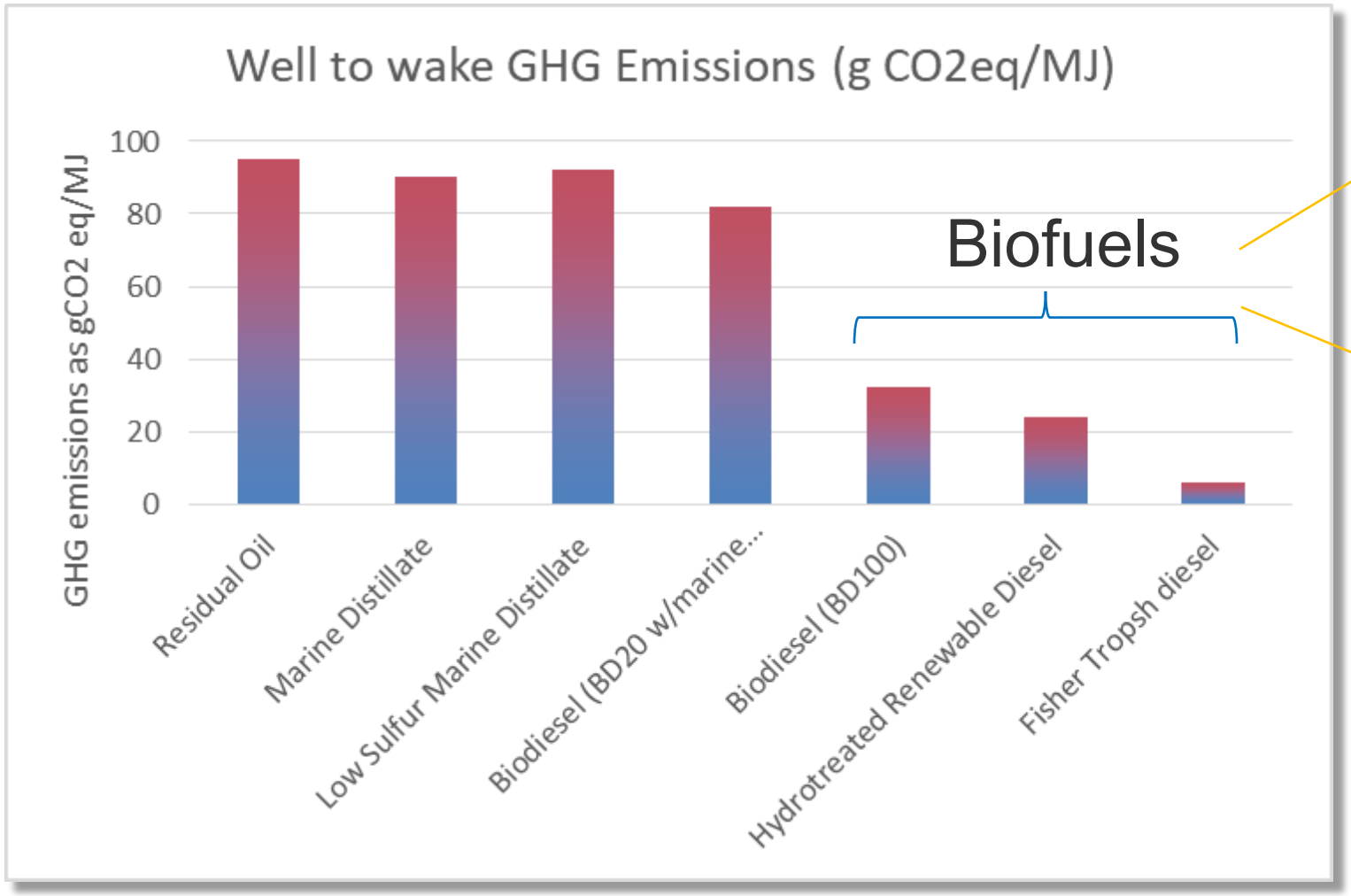

IMO, however, so far considers CO2 emissions as Tank-to-Wake

EU: For all BioFuels in life-cycle perspective emissions from the BioFuel use are accounted as **zero**.

Source: US ORNL Biofuels for Marine Shipping 2018

SUSTAINABILITY

ISCC International Sustainability & Carbon Certification

VeriFuel Understanding Marine Fuel

International Sustainability & Carbon Certification

- Implementation of zero-deforestation
- Protection of land with high biodiversity value & protection of soil, water and air
- Compliance with human, labour & land rights
- Measurement & reduction of GHG emissions
- Traceability throughout supply chains
- Ethics: must have no competition with food & no effect on wild life. Fields, forests and crops, may be needed to meet other, more basic human needs.

Bureau Veritas Certification that a biofuels supplier complies with EC Renewable Energy Directive and the ISCC scheme

Bureau Veritas Certification

Certificate

according to the
Renewable Energy Directive (RED)

(Directive 2009/28/EC on the promotion of the use of energy from renewable sources amended through Directive (EU) 2015/1513)

Certificate Number: EU-ISCC-Cert-PL214-99960321

Bureau Veritas Polska Sp. z o.o.
ul. Migdałowa 4, 02-796 Warszawa, Polska

certifies that

TFG MARINE B.V.
Evert van de Beekstraat 1-81, The Base, Tower B, 5th floor, 1118 CL Schiphol, The Netherlands

complies with the requirements of the RED and the certification system
ISCC EU
(International Sustainability and Carbon Certification)
which is approved by the European Commission.

This certificate is valid from 15.03.2021 to 14.03.2022.

The site of the system user is certified as:

Trader with storage

Warszawa, 15.03.2021
Place and date of issue

Bureau Veritas Polska Sp. z o.o. ul. Migdałowa 4
Stamp, Signature of issuing party

The issuing Certification Body is responsible for the accuracy of this document.
Version / Date: 1 (no adjustments) / 15.03.2021

Page 1 of 1

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BUNKERING CAPABILITIES TO GRADUALLY GROW

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- → Netherlands in place
- → Singapore in place
- → Fujairah announced
- → Skaw and Gothenburg announced

PORT OF ROTTERDAM – BUNKER SALES

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		FUEL OIL in tonnes [1]	MGO in tonnes [2]	MDO in tonnes [3]	Methanol in tonnes	LNG in m³	Lubes in m³	Bio-bunkers [5] Fuel Oil in tonnes	Bio-bunkers [5] Distillates in tonnes
2018	Q1	2,134,350	299,972	38,815		1,633	26,203		
	Q2	1,976,535	297,307	22,435		2,905	25,269		
	Q3	1,940,818	282,256	19,641		7,090	23,024		
	Q4	1,867,149	329,139	11,233		9,614	19,705		
	Total	**7,918,852**	**1,208,674**	**92,124**		**21,242**	**94,201**		
2019	Q1	1,900,776	323,597	19,131		12,103	19,722		
	Q2	1,802,538	304,500	67,215		14,043	16,749		
	Q3	1,693,136	322,133	38,830		24,808	16,887		
	Q4	1,777,649	357,145	53,029		20,601	19,929		
	Total	**7,174,099**	**1,307,375**	**178,205**		**71,555**	**73,287**		
2020	Q1	1,903,761	354,103	63,122		35,426	20,575		
	Q2	1,780,227	319,266	76,017		55,637	18,073		
	Q3	1,841,309	260,307	115,034		48,623	17,359		
	Q4	1,992,687	286,749	145,047		70,648	17,717		
	Total	**7,517,984**	**1,220,426**	**399,220**		**210,334**	**73,724**		
2021	Q1	1,864,820	250,449	174,938		139,489	20,327	49,120	3,305
	Q2	1,903,507	256,651	182,987	250	157,027	16,932	39,129	12,110
	Q3								
	Q4								
	Total								

Currently $5 to $15 / Mton **below / above** VLSFO (due to Dutch government price incentive)

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PILOT PROJECTS ON MARINE USE SINCE 2019

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- → CMA CGM, Stena, Jan De Nul, Oldendorff, Empire Navigation, MOL, Minship, etc.
- → Combustion & engine condition: business as usual.
- → Stable up to 3 months storage (as per testing).
- → Clear condition of engine cylinders via scavenge drain analysis while using the biofuel.

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BIOFUEL QUALITY (SO FAR)

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- → Function of blend (%, residual, distillate)
- → Low viscosity
- → Low to lower Sulphur content
- → Good stability
- → Low metals (Al + Si)
- → Good cold-flow properties
- → Lower Net Calorific Value

VLSFO + B50 (50:50)
ROTTERDAM

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Understanding Marine Fuel

Parameter	Method	Unit	Result
Viscosity @ 50°C	ASTM D7042	cSt	10.47
Density @ 15°C	ASTM D7042	kg/m³	908.9
Sulphur	ISO 8754	% (m/m)	**0.22**
Flash Point	ISO 2719 B	°C	>67
Acid Number	ASTM D664	mg KOH/g	0.11
Total Sediment Acc.	ISO 10307-2	% (m/m)	0.01
TSP	ISO 10307-2	% (m/m)	<0.01
P-Value (SMS 1600)	SMS1600	-	1.3
Micro Carbon Residue	ISO 10370	% (m/m)	4.01
WAT	IP 389	°C	21.4
Pour Point	ISO 3016	°C	-3
Water Content	ASTM D6304	% (V/V)	0.09
Ash	INT 1002	% (m/m)	0.01
Vanadium	IP 501 (mod)	mg/kg	4
Sodium	IP 501 (mod)	mg/kg	5
Calcium	IP 501 (mod)	mg/kg	3
Zinc	IP 501 (mod)	mg/kg	1
Phosphorus	IP 501 (mod)	mg/kg	<1

Stable

Parameter	Method	Unit	Result
Aluminium + Silicon	IP 501 (mod)	mg/kg	5
Silicon	IP 501 (mod)	mg/kg	3
Aluminium	IP 501 (mod)	mg/kg	2
Iron	IP 501 (mod)	mg/kg	11
Nickel	IP 501 (mod)	mg/kg	6
Magnesium	IP 501 (mod)	mg/kg	<1
Potassium	IP 501 (mod)	mg/kg	1
CCAI	CCAI	-	825
Net Specific Energy	NSE Calculated	MJ/kg	42.19
Net Calorific Value	ASTM D240	MJ/kg	**39.467**
Carbon	**ASTM D5291**	**% (m/m)**	**84.2**
Hydrogen	**ASTM D5291**	**% (m/m)**	**11.4**
Nitrogen	**ASTM D5291**	**% (m/m)**	**0.31**
Oxygen (calculated)	**ASTM D5291**	**% (m/m)**	**3.87**

BIOFUELS – NOV 2021

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CHALLENGES OF BIOFUELS

NO_X

→ Ask supplier (some may increase ~ 15%) and Administration. Exemption Reg 3.2 Annex VI, if on-board tests must be performed: 'Trials for Ship Emission Reduction and Control Technology Research'

→ An existing engine must demonstrate that it maintains its certification under regulation 13 and the NO_x Technical Code when using such a fuel

→ On-board trials performed are complicated and cannot fully reproduce bench condition in fuel (sea state, temperature, humidity, vessel loading condition, etc.)

CHALLENGES OF BIOFUELS

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→ **Cost & Availability:** Price incentives and logistics development

→ **Insurance**: Compliant with ISO 8217 or expensive extra insurances; the FAME used - at the time of blending - meets EN 14214

→ **Crew**: Training on on-board handling & management of change

→ **Cold flow properties**: Optimum storage/transfer temperatures for each BF parcel

→ **Microbial growth risk**: Frequent draining of tanks / application of biocides.

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CHALLENGES OF BIOFUELS

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→ **Storage:** Oxygen can degrade over time, (deposits in piping/engines). Shelf life and/or use of antioxidants

→ **Corrosion** (B80-B100): Hoses/gaskets/rubber sealings: loss of integrity / interaction with copper, brass, zinc. Verify components are endurable

→**Energy content**: Impact on performance due to lower calorific value? Then, reduction in carbon factor should outweigh the low calorific value.

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ENGINE MAKERS / SERVICE LETTERS

→ **MAN:** 100% biofuel & biofuel blended with ISO 8217 fuel / 06.02.2020

→ **WARTSILA:** Fuel oil specification for liquid biofuel WS02N203 / 23.11.2020

→ **HiMSEN**: Operation & Maintenance Guidelines with biofuel blends / 01.2021

→ **WinGD**: Validated cylinder oils / 10.2020

→ *Typically makers want to review the CoQ and/or a specific test slate prior to bunkering so as to issue the **letter of support**.*

WHEN WILL BIOFUELS MOVE BEYOND THE TRIAL PHASE AND SCALE UP?

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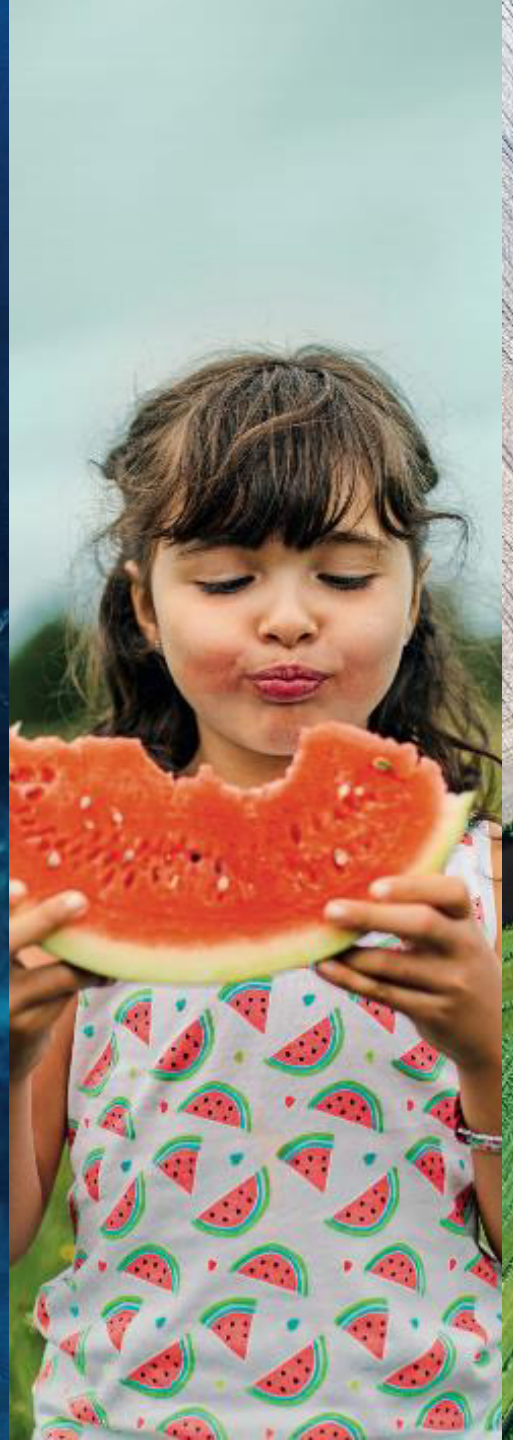
→ Suppliers need commitment of volume

→ Suppliers need to secure feedstocks

→ **Support from governments**

→ Industry needs to develop the competence

Though may never be the dominant fuel, they are an indispensable stepping-stone on the path to decarbonization. Very convenient especially for liners.



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