‘Scheepsbrandstof en de mondiale zwavelnorm 2020’

12 december 2018

PLATFORM SCHONE SCHEEPVAART

Partners Seminar

PLATFORM SCHONE SCHEEPVAART

Koninklijke Belgische Redersvereniging

Ministerie van Infrastructuur en Waterstaat

MARIN

KONINKLIJKE VERENIGING VAN NEDERLANDSE REDERS

Port of Amsterdam

NETHERLANDS MARITIME TECHNOLOGY

FOD Mobiliteit en Vervoer

Havenbedrijf Antwerpen

Stichting De Noordzee

TNO innovation for life

Port of Rotterdam

Hoe bereiden bunkerproducenten zich voor op 2020 ?

KVNR seminar (2018 12 12)

Anton Spierings

Brandstof opties per 1/1/2020

Wereld

- 0,50 %S destillaat (MGO)
- 0,50 %S stookolie (VLSFO)
- 3,50 %S stookolie (HSFO) met scrubber
- LNG

ECA

- 0,10 %S destillaat (MGO)
- 0,10 %S stookolie (ULSFO)

Belangrijk voor producent

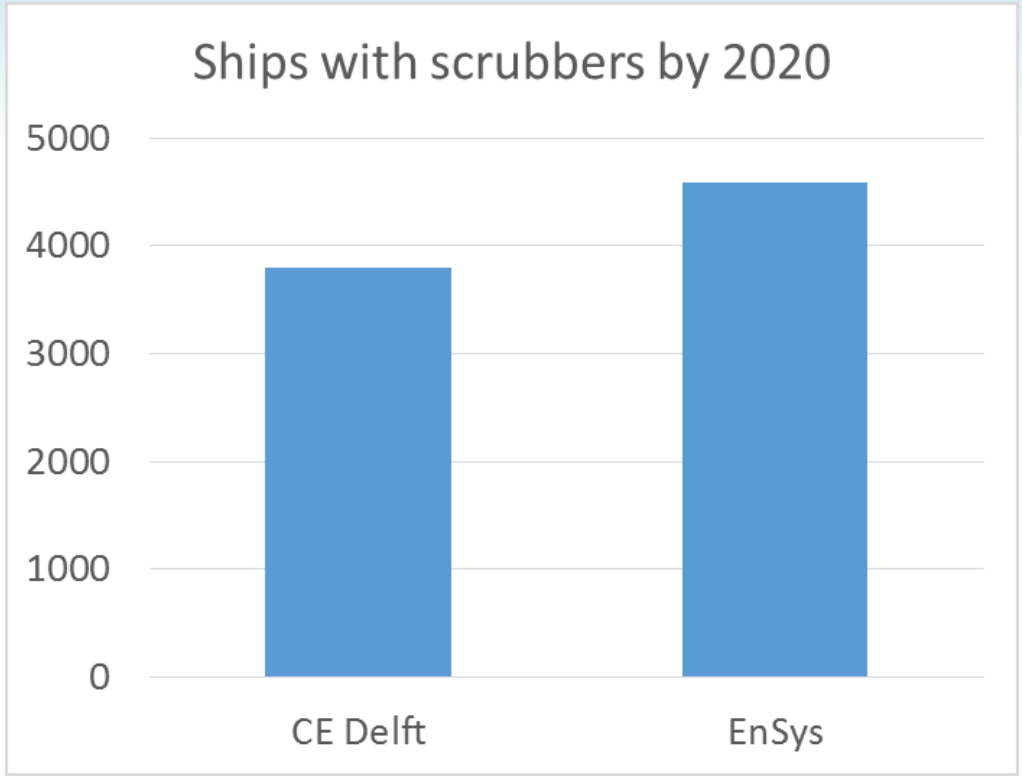
Uitgangspunten

- Ingangsdatum 1/1/2020
- Brandstof moet voldoen aan MARPOL, SOLAS en ISO8217, fit for purpose

Onzekerheden

- Vraag naar
    - 0,5%S destillaat & stookolie
    - 3,5%S stookolie
- Beschikbaarheid van laag zwavelige grondstoffen

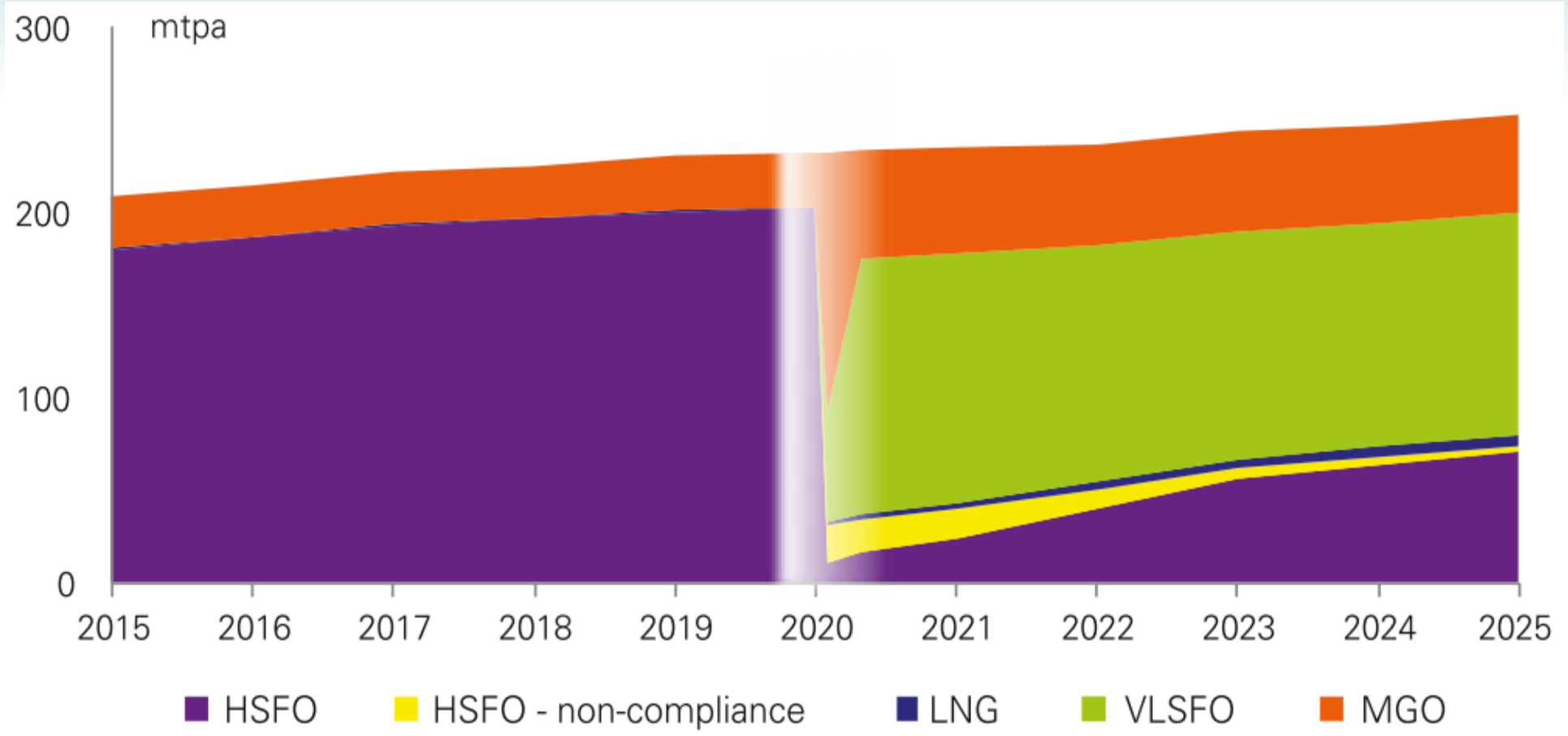
Vraag naar 3,5 %S



CE Delft en Ensys schatting (2016) ~ 4000 schepen wereldwijd; fractie van totale vloot

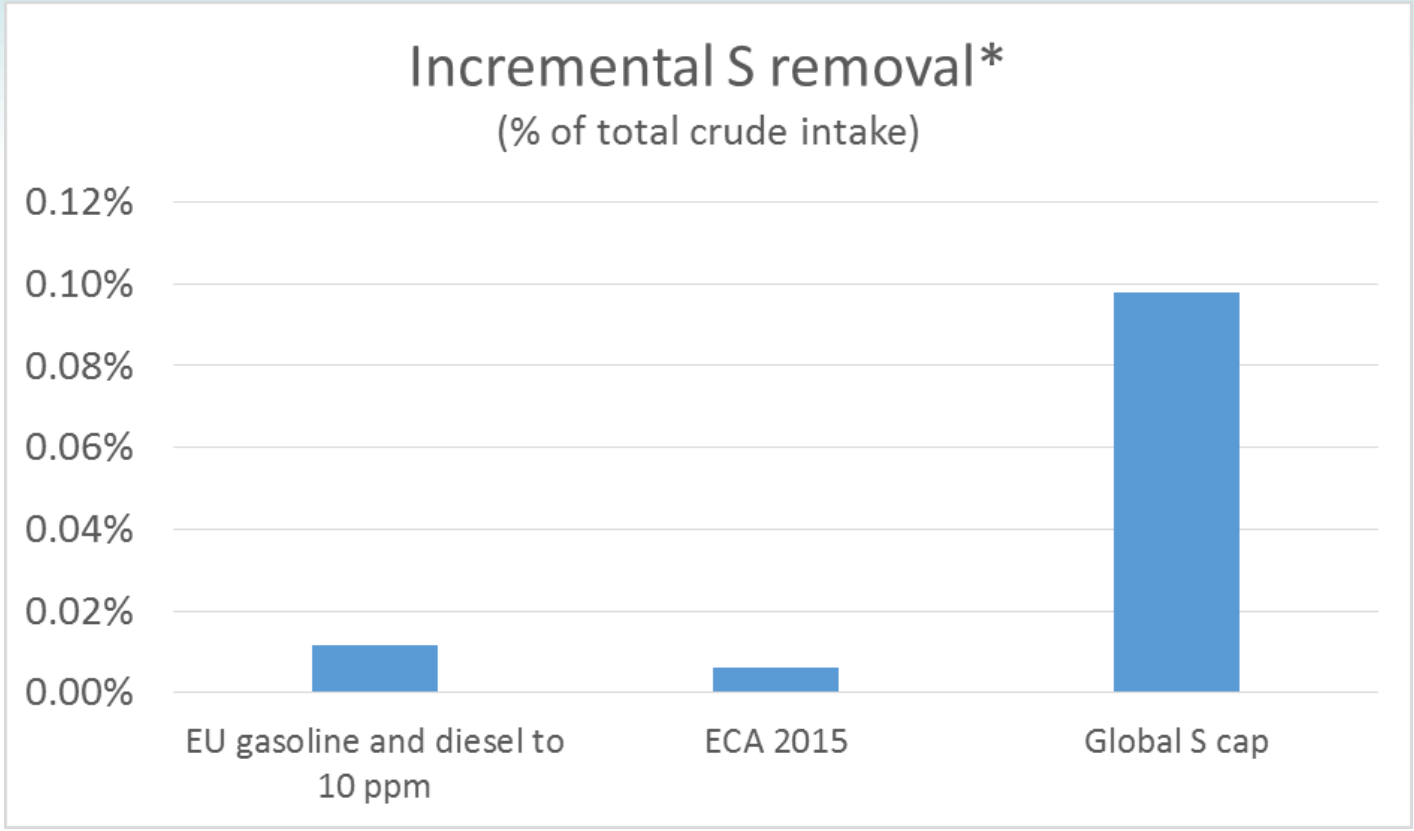
Data sources: CE Delft, Assessment of Fuel Oil Availability – Final Report, July 2016
EnSys/Navigist6cs, Supplemental Marine Fuel Availability Study, 15 July 2016

Brandstofmarkt



Data source: BP Marpol brochure Oct 2018

Hoe moeilijk is het?



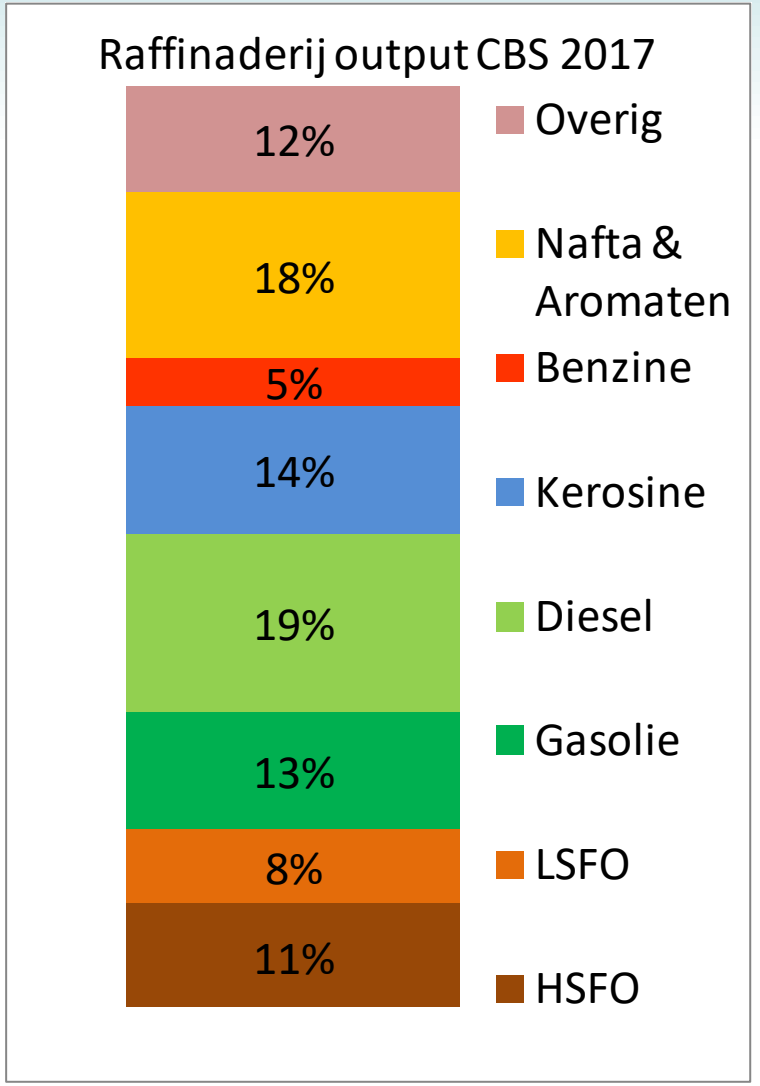
Te verwijderen hoeveelheid zwavel veel groter dan bij recente specificatie veranderingen

Data sources: CE Delft, Assessment of Fuel Oil Availability – Final Report, July 2016
EnSys/Navigist6cs, Supplemental Marine Fuel Availability Study, 15 July 2016

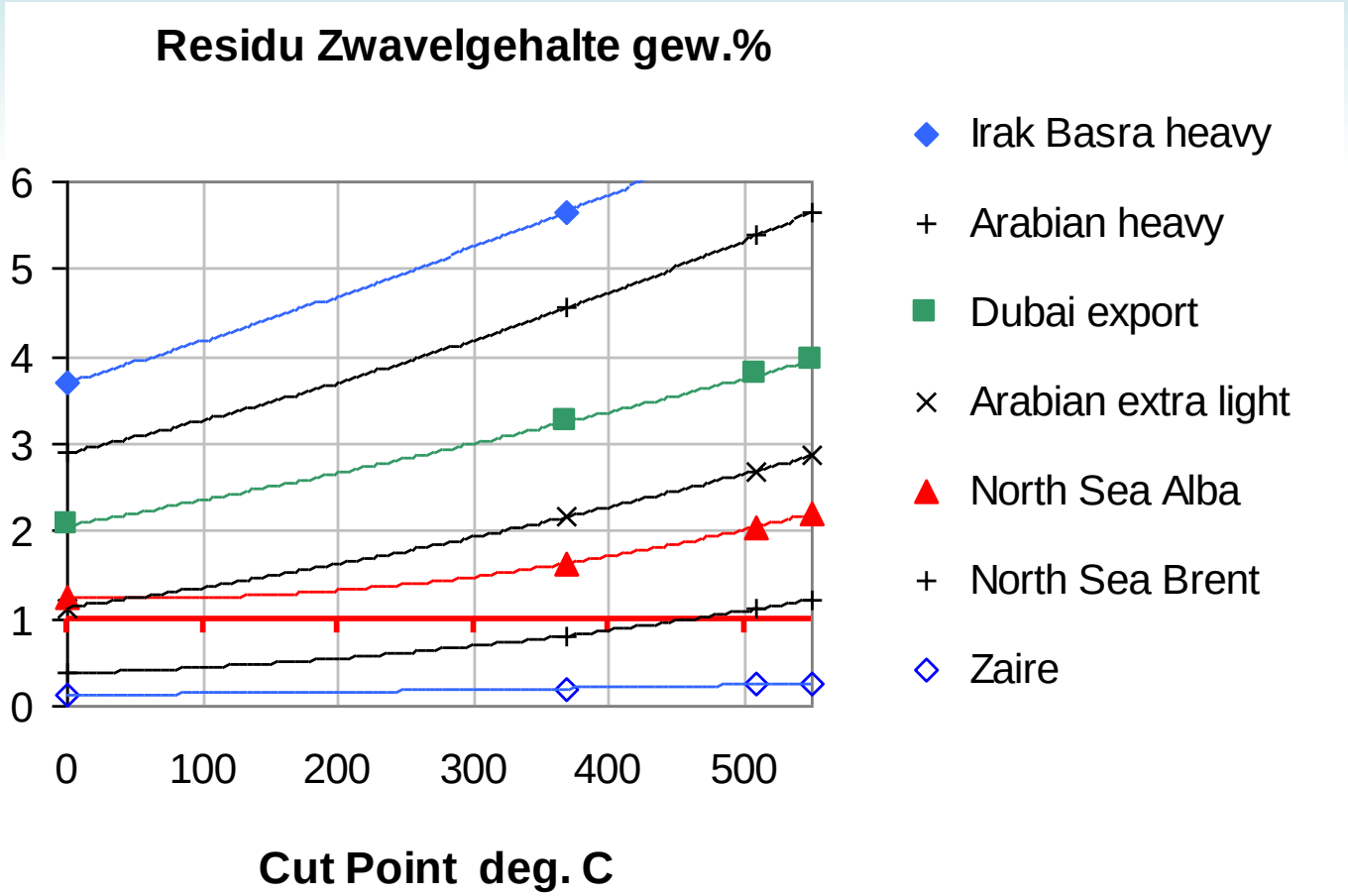
Raffinage opties

- Andere grondstoffen verwerken
- Andere optimalisatie van fabrieken
- Investering

- Iedere raffinaderij is anders en maakt eigen afweging
- Evenwicht nodig tussen vraag en aanbod van alle producten

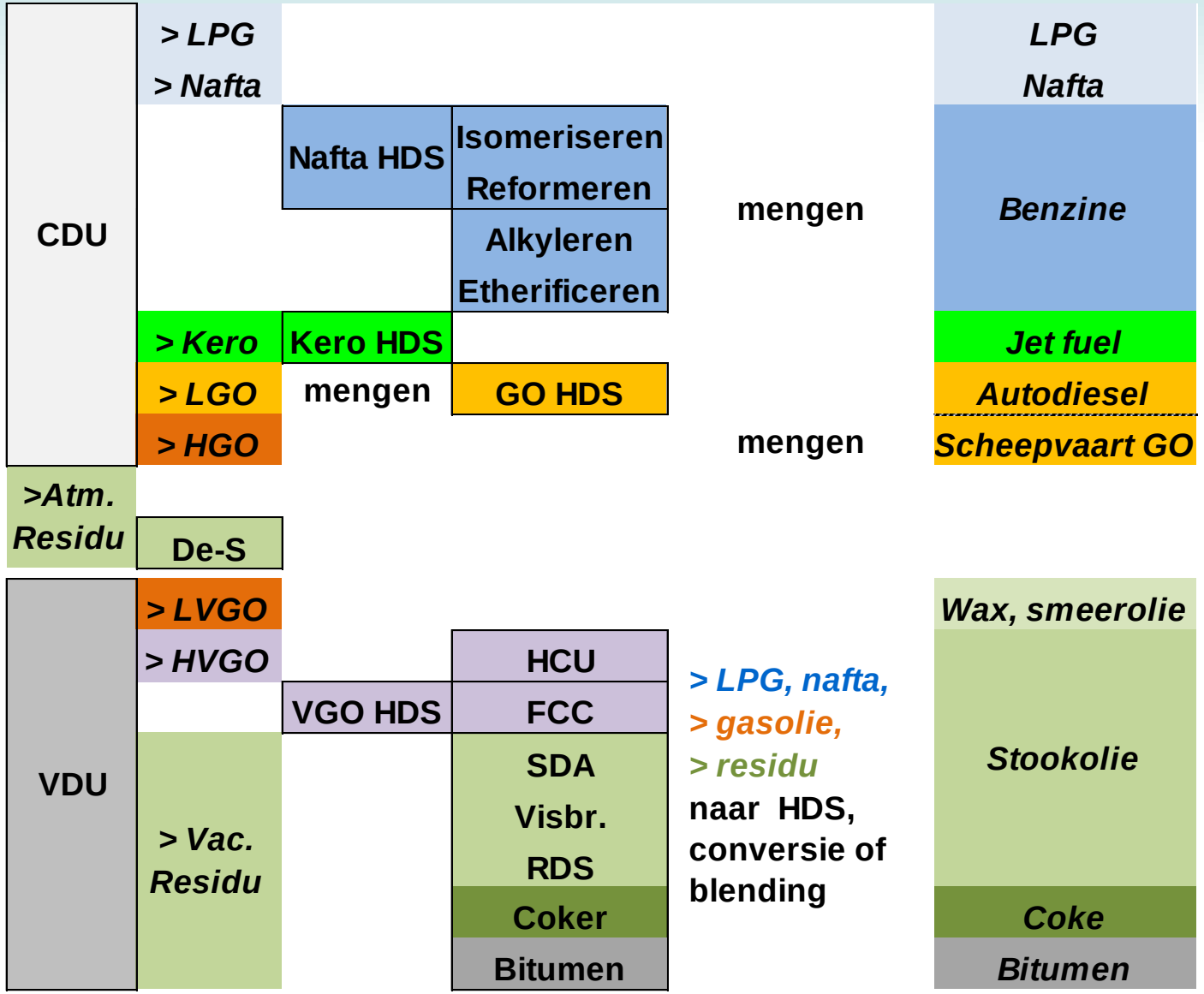


Zwavelgehalte



Ruwe olie bevat 0,1 - 3,5 %S ; een deel is zeer geschikt voor 0,5 %S

Raffinage


CDU
> LPG
> Nafta
Nafta HDS
Isomeriseren
Reformeren
Alkyleren
Etherificeren
mengen
LPG
Nafta
Benzine
> Kero
Kero HDS
Jet fuel
> LGO
mengen
GO HDS
Autodiesel
> HGO
mengen
Scheepvaart GO
>Atm. Residu
De-S
VDU
> LVGO
> HVGO
HCU
VGO HDS
FCC
> Vac. Residu
SDA
Visbr.
RDS
Coker
Bitumen
> LPG, nafta,
> gasolie,
> residu
naar HDS, conversie of blending
Wax, smeerolie
Stookolie
Coke
Bitumen

Beschikbaarheid

2016 studies:

- CE/Stratas: voldoende capaciteit wereldwijd, voornamelijk VLS stookolie
- Ensys: capaciteit krap, voornamelijk VLS destillaat

2018 info:

- Grote raffinage clusters zoals ARA goed toegerust
- Voldoende capaciteit wereldwijd
- Lokale onbalans tussen vraag en aanbod is ook na 2020 op te vangen door import/export

Kwaliteit

- Aandachtspunten
  - Stabiliteit
  - Compatibiliteit
  - Koude eigenschappen (destillaat)
- Ontwikkelingen
  - Nieuwe residuale 0,5 %S blends, gebruik makend van ECA ervaring
  - Verschillende soorten blends, afhankelijk van beschikbaarheid van laag zwavel componenten en processen

ECA ervaring (ARA)

- 0,1 %S stookolie ontwikkeld in samenwerking met afnemers
- Voorschriften voor behandeling en opslag hebben goed gewerkt
- Inmiddels geaccepteerd product, niet alleen termijn- maar ook spot contracten

- Zelfde aanpak voor 0,5 %S
- Praktijkproeven
- Duidelijkheid over type en voorschriften

Internationale voorbereiding

Voornaamste zorgen m.b.t. kwaliteit

- Stabiliteit
- Compatibiliteit
- Vlampunt (?)

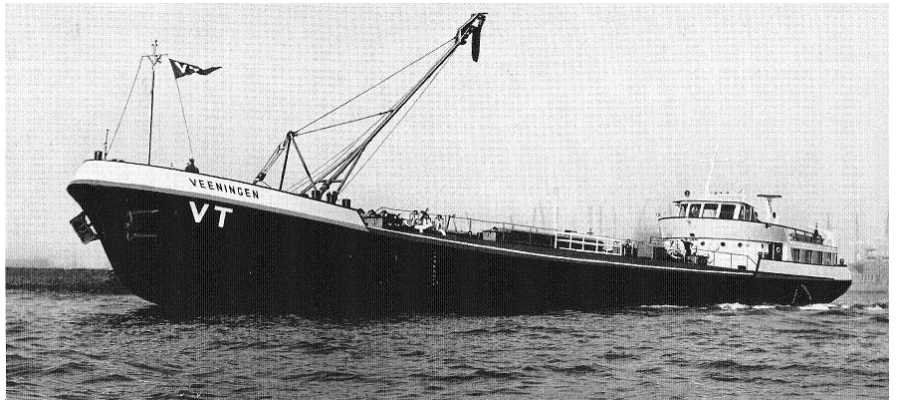
Respons

- Opstellen van best practice guidance (IMO, IBIA, CIMAC)
- Specificatie ontwikkeling (ISO)


We zijn op weg
Nog 385 dagen

Niels Groenewold
owner
VT Group

Vereenigde Tankreederij



Anno 1916

VT

MARITIME LOGISTIC SERVICES

Time for a clearer view

VT Group (Verenigde Tankrederij)

The VT Group is a reliable, self-sustaining maritime company with a healthy dose of pragmatism. We offer our clients innovative logistic products and safe, efficient, service oriented operations with attention for sustainability and corporate social responsibility. VT was founded in 1916 with the head office in Rotterdam, and at the moment we offer our specialized independent services in Europe and Central America (Panama).

VT Group (Verenigde Tankrederij)

VT is specialized in:

- Transport of clean and black minerals products, biofuels and chemicals
- Port & Sea bunkering and transport of fuels and lubricants
- Chartering activities for clean and black mineral products, biofuels and chemicals
- Fleet management for third parties
- Maritime Consulting

Clients


MAERSK


bp


BR
PETROBRAS


ExxonMobil


NORTH
SEA
GROUP

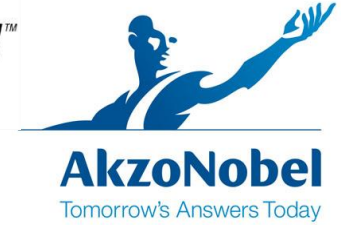

光滙石油
BRIGHTOIL


Shin-Etsu


BASF
The Chemical Company


TOTAL


Cargill


AkzoNobel
Tomorrow's Answers Today


SOLVAY


HEXION™
Specialty Chemicals

Cleanest Ship

- MTS Victoria
- Low sulphur fuel
- NOx -82%
- SOx -99%
- Particular matter -97%
- Equal to EURO V emissions for road

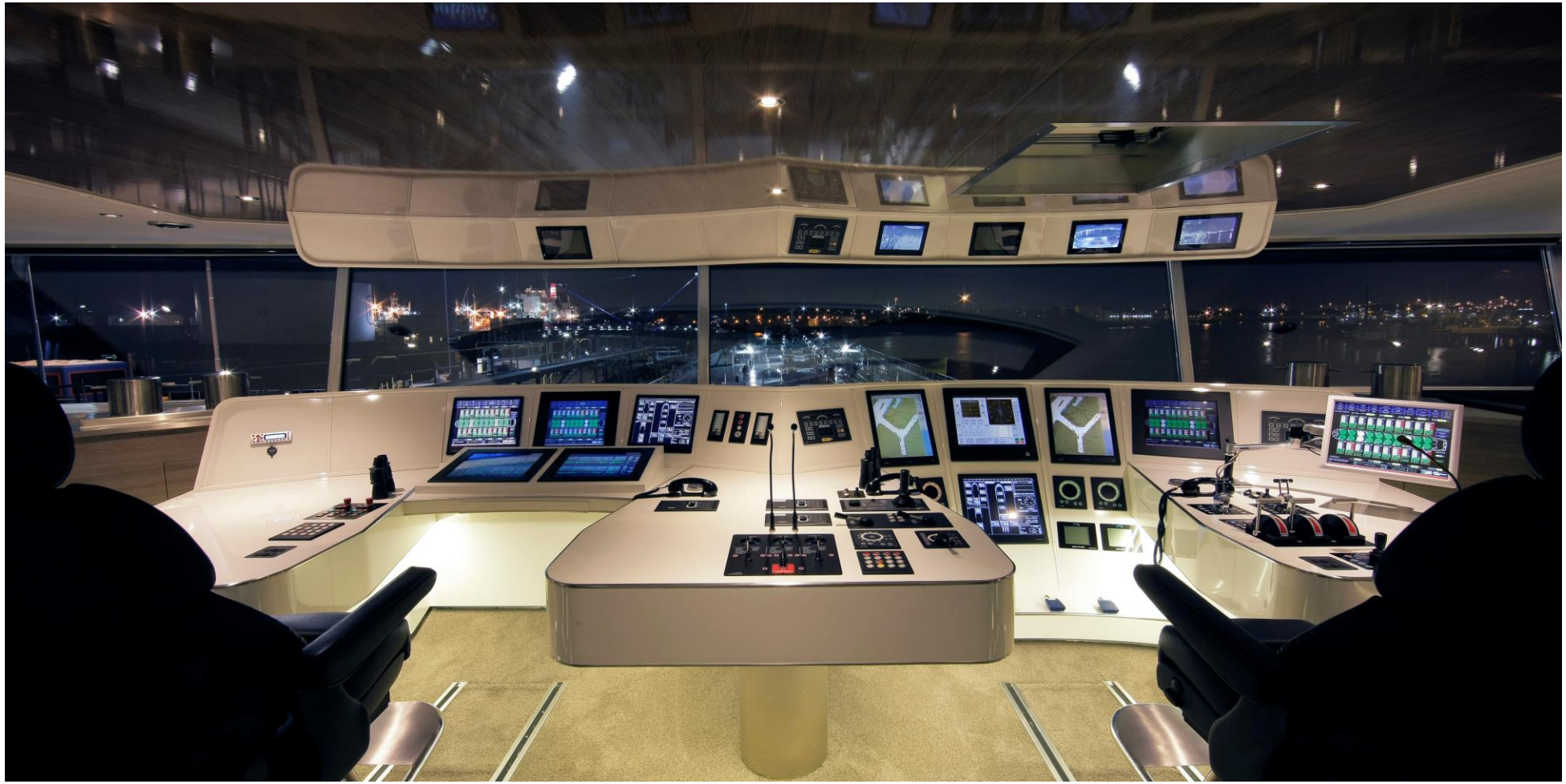
Cleanest Ship

- 1th, 2nd CO2 Competition 2012
- 1th,2nd,3rd CO2 Competition 2011
- Shipping Company Overall Winner CO2 Competition 2011

- Panama Maritime Green Shipping Award 2013
  8144 vessels/217,973,738MT in the Panama Registry

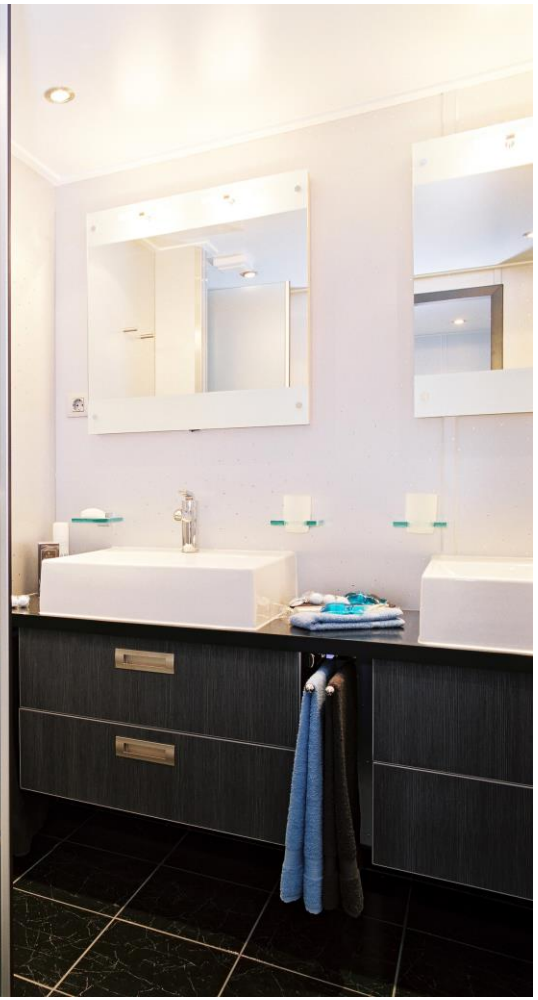
Europe & Panama

New Generation Ships



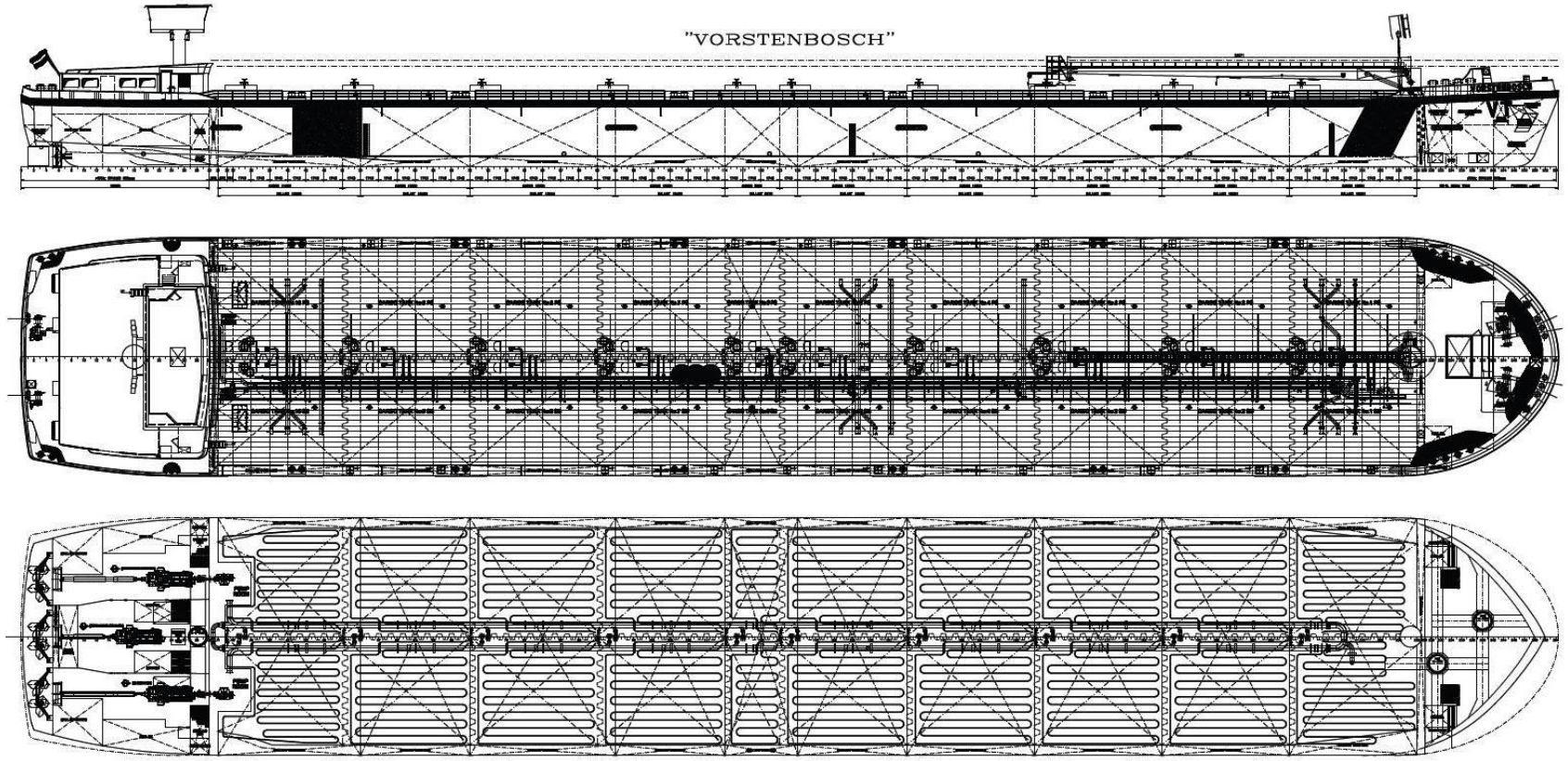
MTS Vorstenbosch

New Generation Ships

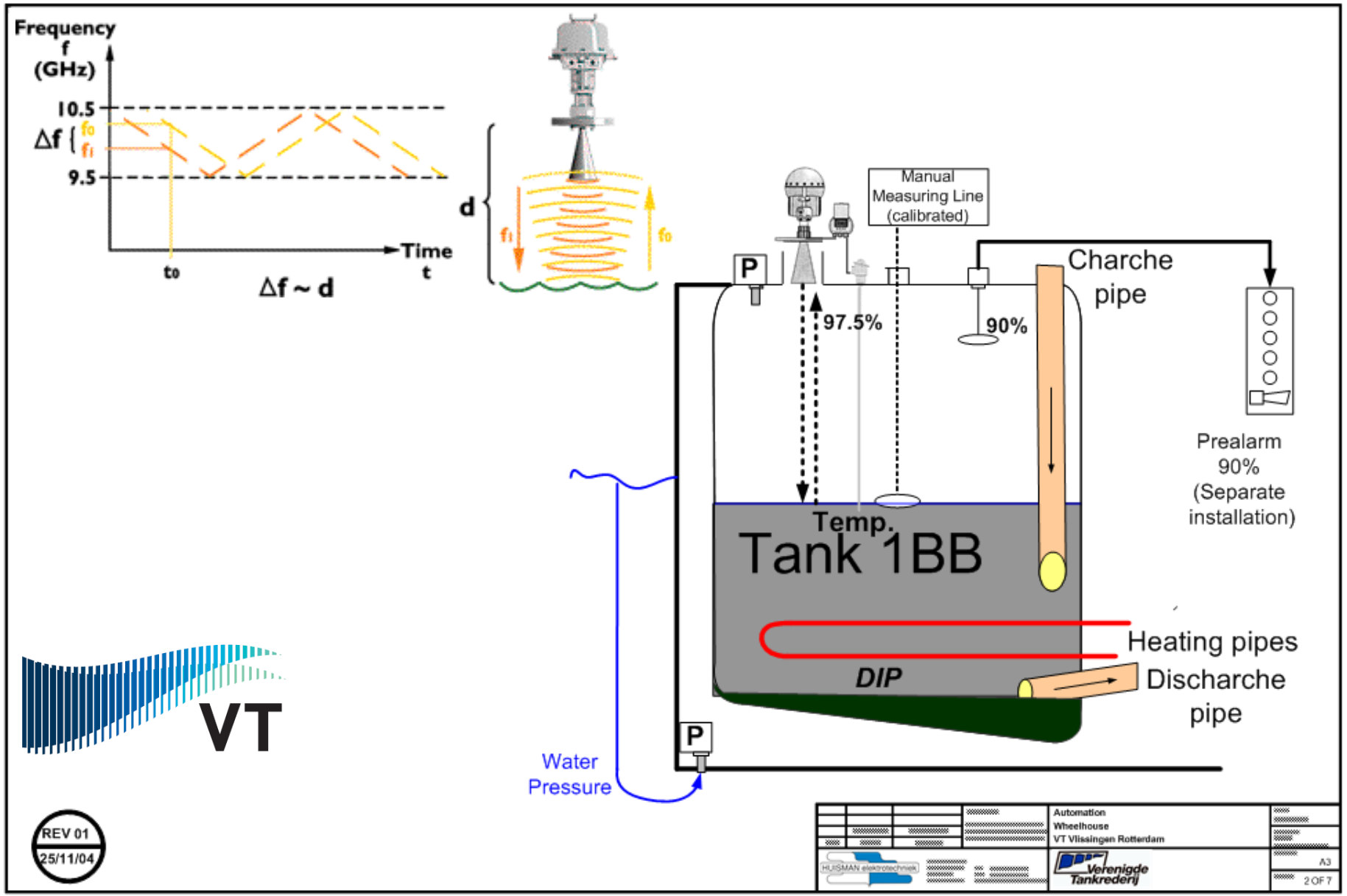


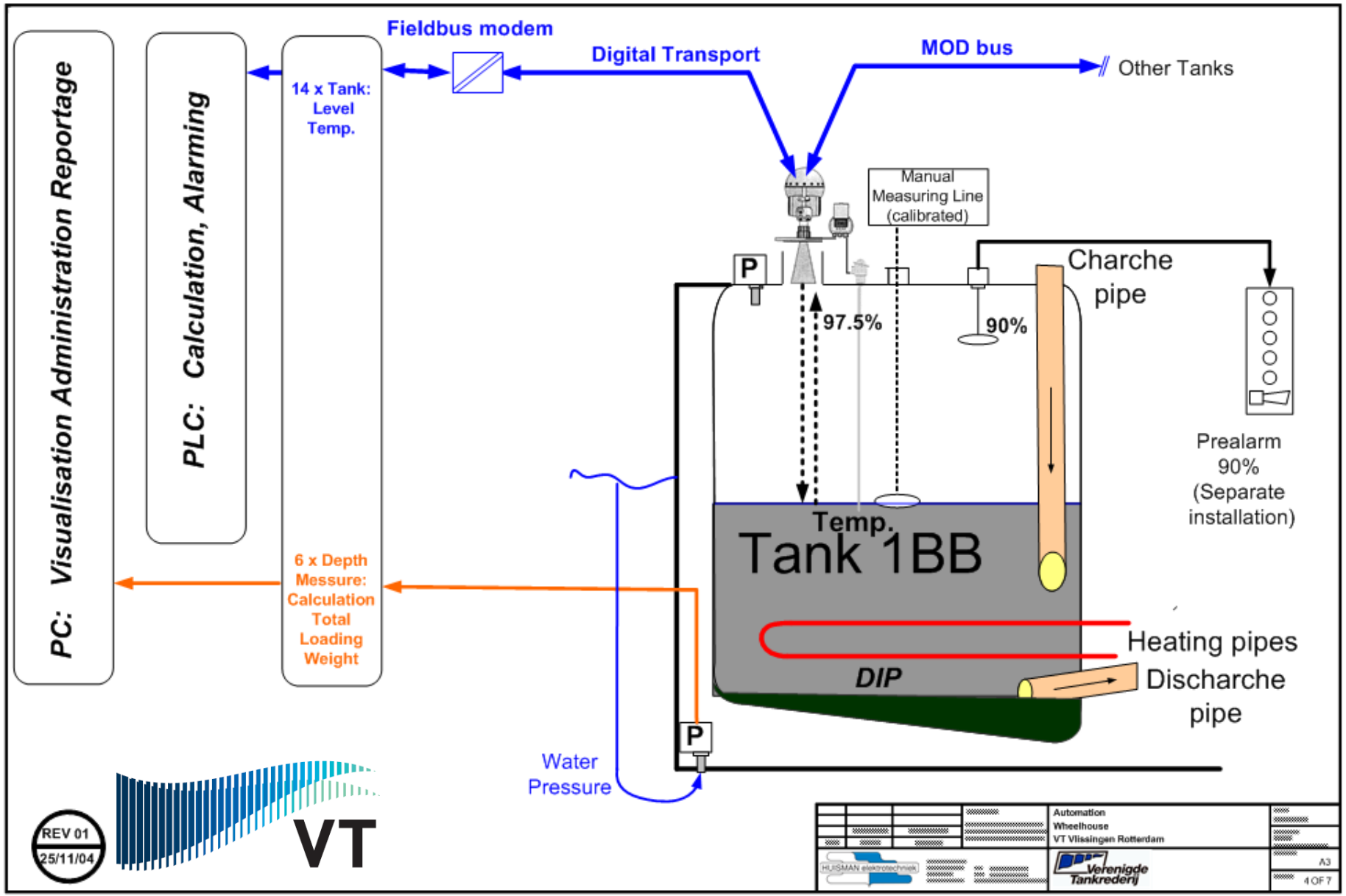

VORSTENBOSCH
VORSTENBOSCH

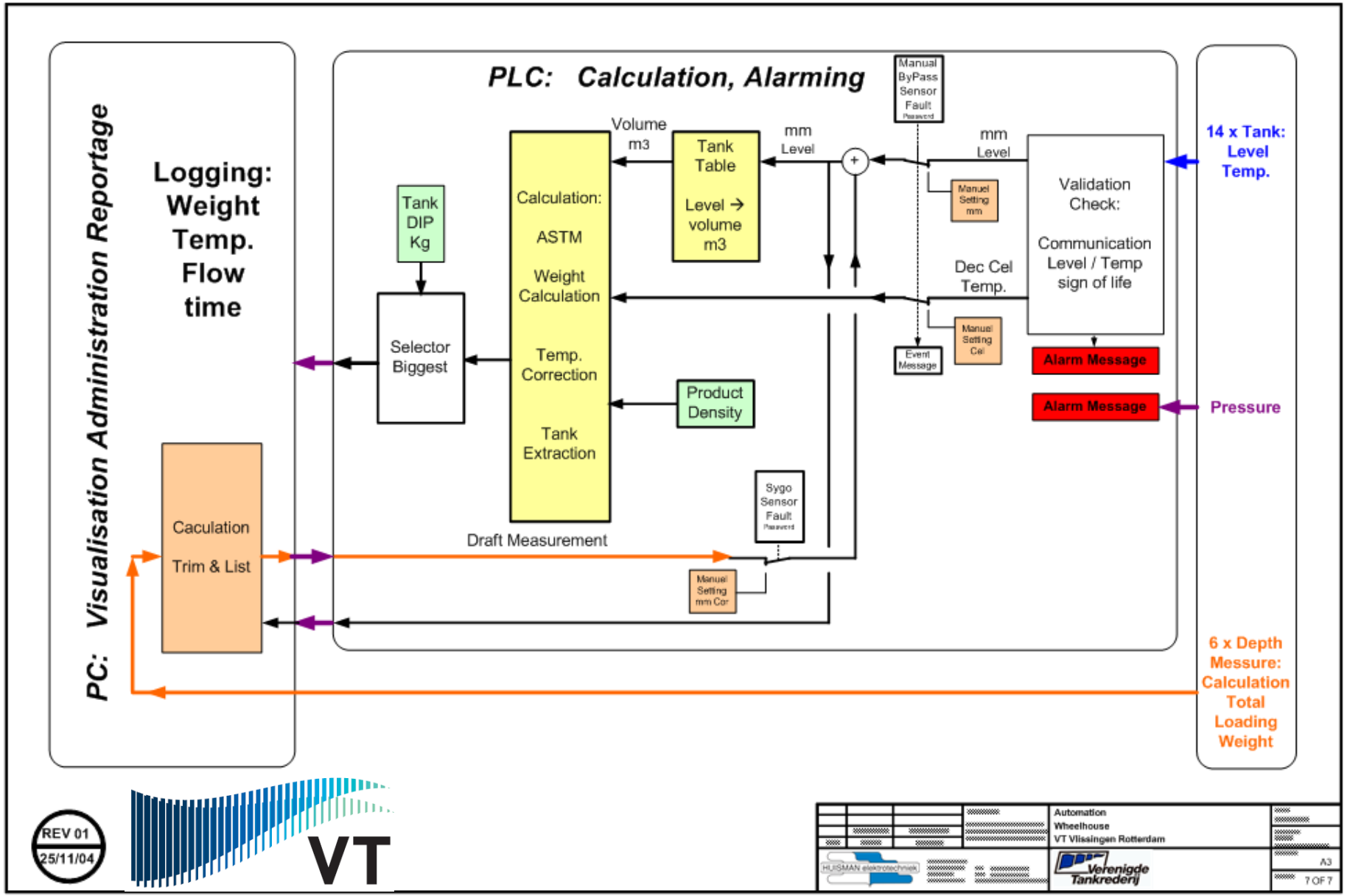
MTS Vorstenbosch; Efficiency, Economy of Scale & Sustainability



MT Vacamonte
6445MT
SIRE 1


Frequency
f
(GHz)
10.5
Δf
f0
f1
9.5
to
Time
t
Δf ~ d
d
f1
f0
Manual
Measuring Line
(calibrated)
P
97.5%
90%
Charche
pipe
Prealarm
90%
(Separate
installation)
Temp.
Tank 1BB
DIP
Heating pipes
Discharche
pipe
P
Water
Pressure
VT
REV 01
25/11/04
Automation
Wheelhouse
VT Vlissingen Rotterdam
HUISMAN elektrotechniek
Verenigde
Tankrederij
A3
2 OF 7


PC: Visualisation Administration Reportage
PLC: Calculation, Alarming
14 x Tank: Level Temp.
Fieldbus modem
Digital Transport
MOD bus
Other Tanks
Manual Measuring Line (calibrated)
P
97.5%
90%
Charche pipe
Prealarm 90% (Separate installation)
Temp.
Tank 1BB
DIP
Heating pipes
Discharche pipe
6 x Depth Messure: Calculation Total Loading Weight
Water Pressure
REV 01
25/11/04
VT
Automation
Wheelhouse
VT Vlissingen Rotterdam
HUISMAN elektrotechniek
Verenigde Tankrederij
A3
4 OF 7


PC: Visualisation Administration Reportage
Logging:
Weight
Temp.
Flow
time
PLC: Calculation, Alarming
Manual ByPass Sensor Fault
Volume m3
Tank Table
Level → volume m3
mm Level
mm Level
Validation Check:
Communication Level / Temp sign of life
14 x Tank: Level Temp.
Manuel Setting mm
Tank DIP Kg
Calculation:
ASTM
Weight Calculation
Temp. Correction
Tank Extraction
Dec Cel Temp.
Manuel Setting Cel
Event Message
Alarm Message
Alarm Message
Pressure
Selector Biggest
Product Density
Caculation
Trim & List
Sygo Sensor Fault
Draft Measurement
Manuel Setting mm Cor
6 x Depth Messure: Calculation Total Loading Weight
REV 01
25/11/04
VT
Automation
Wheelhouse
VT Vlissingen Rotterdam
HUISMAN elektrotechniek
Verenigde Tankrederij
A3
7 OF 7

VT Vlissingen Ullage Table Hand

DRAFT

M.T. "Vlissingen"
Certificate No : 2003.033.1

Main capacity table
Lading tank Nr 1 Bakboord

Ullage (mm)	Capacity (m^3)	Ullage (mm)	Capacity (m^3)	Ullage (mm)	Capacity (m^3)	Ullage (mm)	Capacity (m^3)
5971	2.604	5480	62.280	4980	125.323	4480	189.458
5970	2.672	5470	63.558	4970	126.588	4470	190.741
5960	3.346	5460	64.820	4960	127.869	4460	192.025
5950	4.089	5450	66.081	4950	129.152	4450	193.308
5940	4.907	5440	67.341	4940	130.435	4440	194.591
5930	5.802	5430	68.602	4930	131.718	4430	195.874
5920	6.767	5420	69.862	4920	133.001	4420	197.156
5910	7.785	5410	71.122	4910	134.284	4410	198.437
5900	8.875	5400	72.383	4900	135.567	4400	199.719
5890	10.034	5390	73.643	4890	136.850	4390	201.000
5880	11.243	5380	74.903	4880	138.133	4380	202.282
5870	12.482	5370	76.164	4870	139.416	4370	203.564
5860	13.732	5360	77.424	4860	140.699	4360	204.845
5850	14.982	5350	78.685	4850	141.982	4350	206.127
5840	16.233	5340	79.945	4840	143.265	4340	207.408
5830	17.484	5330	81.205	4830	144.548	4330	208.690
5820	18.735	5320	82.466	4820	145.831	4320	209.972
5810	19.986	5310	83.726	4810	147.114	4310	211.253
5800	21.242	5300	84.987	4800	148.397	4300	212.535
5790	22.522	5290	86.247	4790	149.680	4290	213.817
5780	23.804	5280	87.507	4780	150.963	4280	215.098
5770	25.086	5270	88.768	4770	152.246	4270	216.380
5760	26.369	5260	90.028	4760	153.529	4260	217.661

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VT Vlissingen Level Radar

SGS

M.T. "Vlissingen"
Certificaat Nr : 2003.033.2

Inhoudstabel
Lading tank Nr 1 Bakboord - Radar

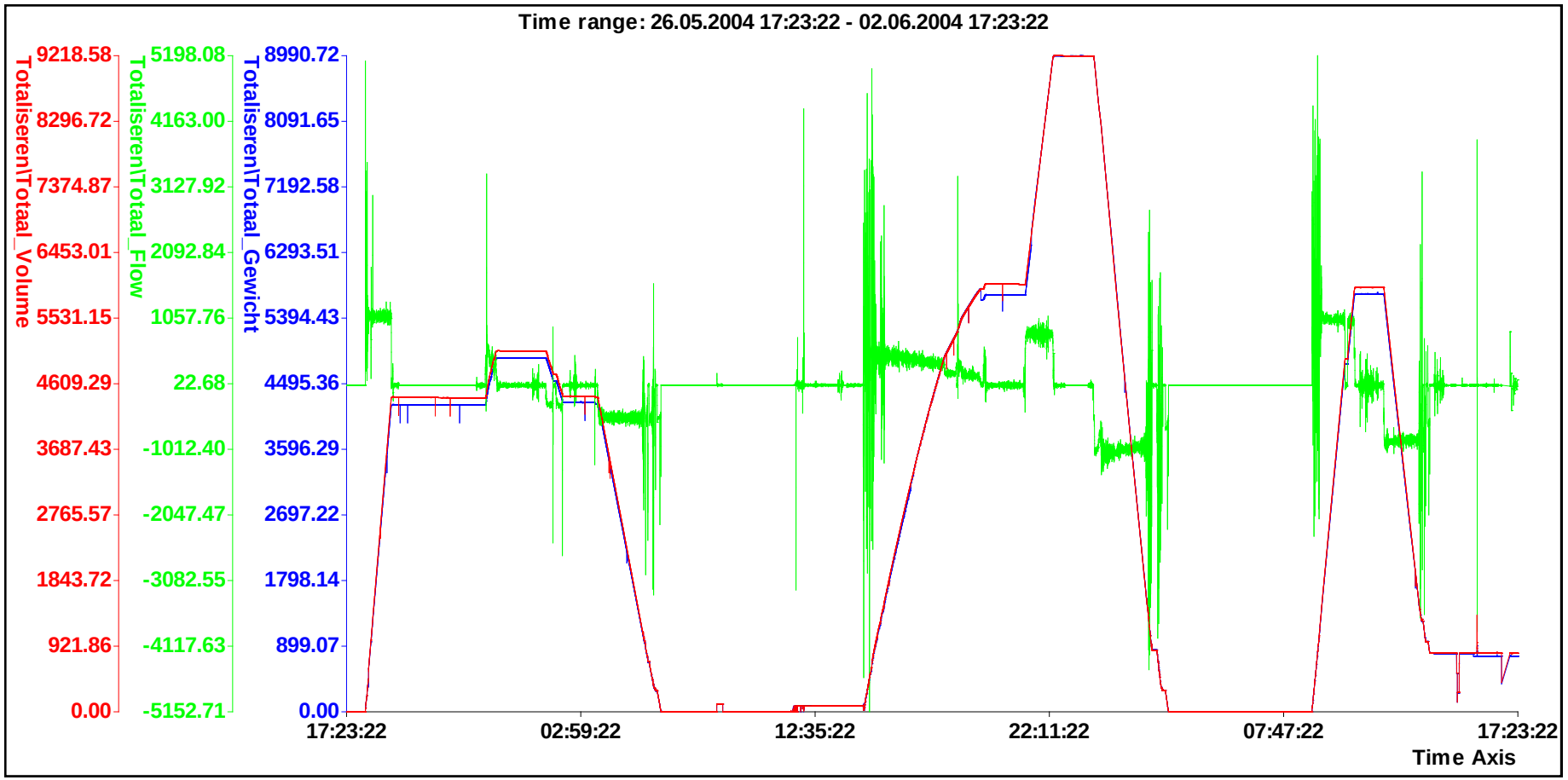
Hoogte (mm)	Inhoud (m^3)	Hoogte (mm)	Inhoud (m^3)	Hoogte (mm)	Inhoud (m^3)	Hoogte (mm)	Inhoud (m^3)
0	2.604	500	63.431	1000	126.461	1500	190.613
10	3.278	510	64.694	1010	127.740	1510	191.896
20	4.014	520	65.955	1020	129.023	1520	193.179
30	4.825	530	67.215	1030	130.306	1530	194.463
40	5.712	540	68.475	1040	131.589	1540	195.746
50	6.670	550	69.736	1050	132.872	1550	197.028
60	7.683	560	70.996	1060	134.155	1560	198.309
70	8.766	570	72.257	1070	135.438	1570	199.591
80	9.918	580	73.517	1080	136.721	1580	200.872
90	11.121	590	74.777	1090	138.004	1590	202.154
100	12.358	600	76.038	1100	139.287	1600	203.435
110	13.606	610	77.298	1110	140.571	1610	204.717
120	14.857	620	78.559	1120	141.854	1620	205.999
130	16.108	630	79.819	1130	143.137	1630	207.280
140	17.359	640	81.079	1140	144.420	1640	208.562
150	18.610	650	82.340	1150	145.703	1650	209.844
160	19.860	660	83.600	1160	146.986	1660	211.125
170	21.116	670	84.861	1170	148.269	1670	212.407
180	22.394	680	86.121	1180	149.552	1680	213.688
190	23.676	690	87.381	1190	150.835	1690	214.970

VT

NMi

MTS VLISSINGEN

TOTALEN



Time for a clearer view

Introducing the Mass Flow Meter System. Immediate results, heightened security, reassuring clarity.

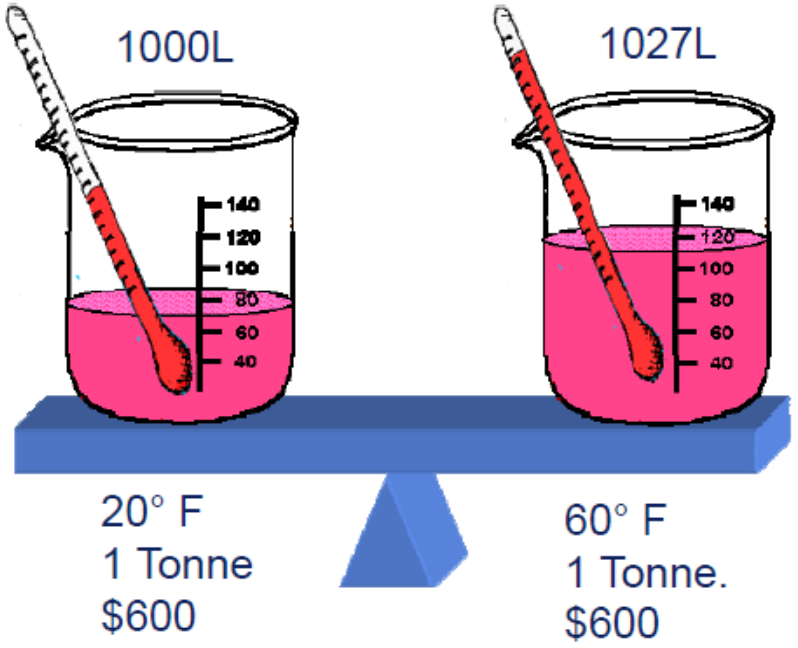
Good measurement practices	Mass Flow Meter System
Accurate	✓
Approved by the authorities and certified by standards body	✓
Secure	✓
Accountable	✓ Transparent
Operationally efficient	✓ Saves time
Cost effective	✓

Base measurement is mass.

Direct mass measurement is insensitive to fluid properties such as:

- Temperature
- Pressure
- Density

The same amount of fluid (1 Tonne) looks like 2.7% ($16) difference with volumetric measurement



$8,000 difference on a 500 Tn bunker

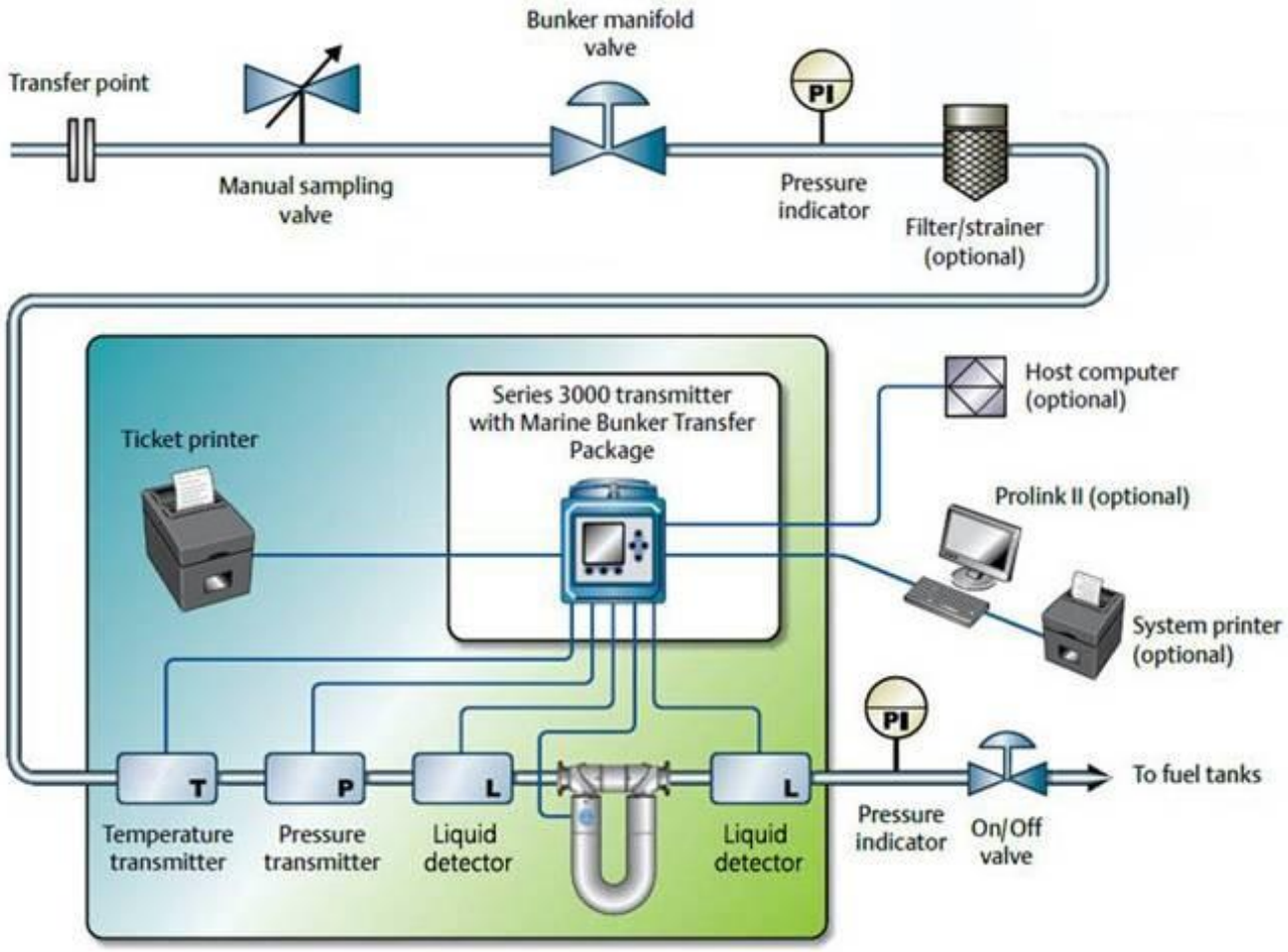
Bunkers sold on mass but measured by volume

Mass-Flow Meters

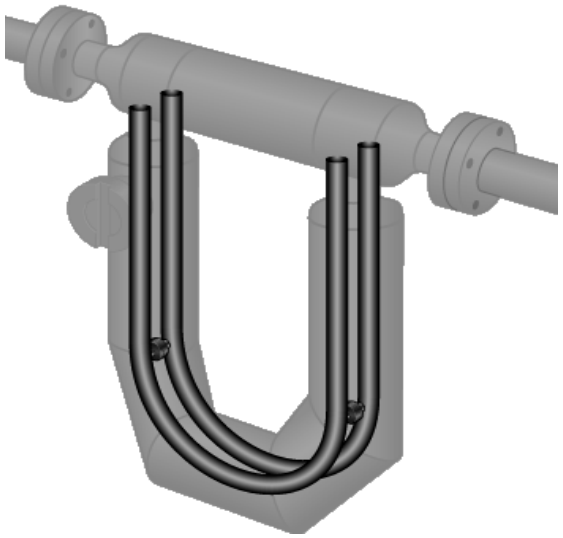
- ✓ Flowmeters ensure transparent and accurate measurements for all parties involved
- ✓ Flowmeters take the hassle and haggling out of the bunkering process
- ✓ Flowmeters ensure a level playing field for all suppliers and barge operators
- ✓ The technology is here – VT will use it

EMERSON Process Management

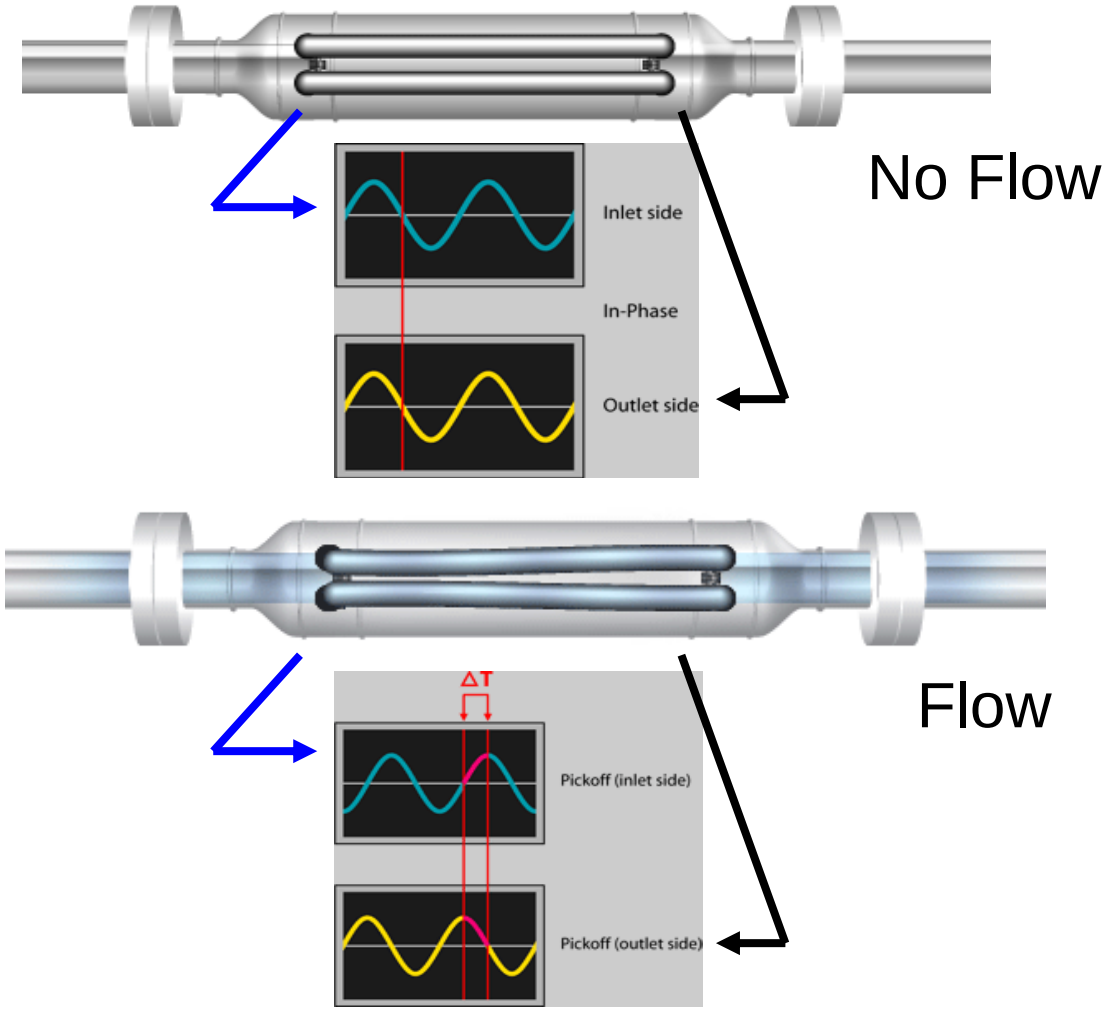
MAERSK



EMERSON
Process Management



No Flow


Inlet side
In-Phase
Outlet side
No Flow
ΔT
Pickoff (inlet side)
Pickoff (outlet side)
Flow

A global transparent and traceable mass based bunker measurement solution

Fuel Storage Terminal

Barge

Operating Vessel

Single phase

Dual phase

OIML-R117-1
(International Recommendation for dynamic measuring systems for liquids other than water)

The technology is here today that benefits the complete bunker supply chain

Mass-Flow System on MTS Vlaardingen

EMERSON
Process Management

NMi

Triple-E Mass-Flow System on MTS Vorstenbosch

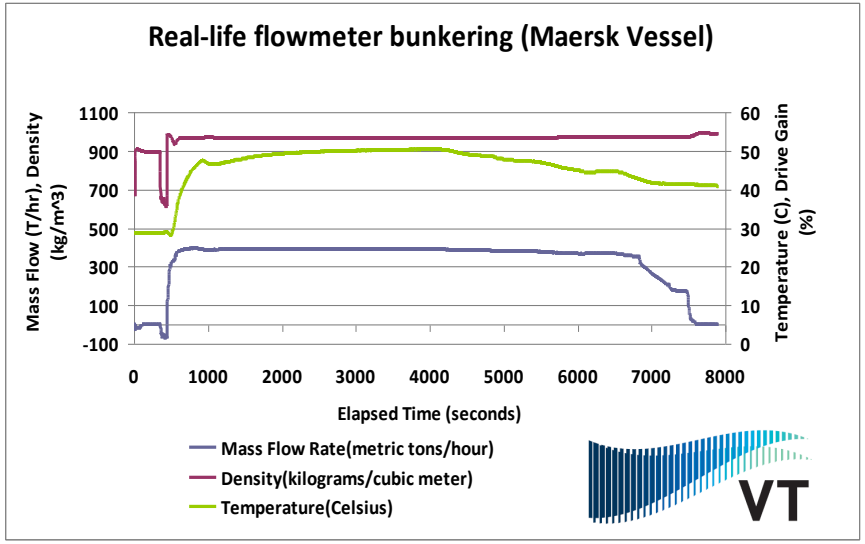
Mass Flow System Installations

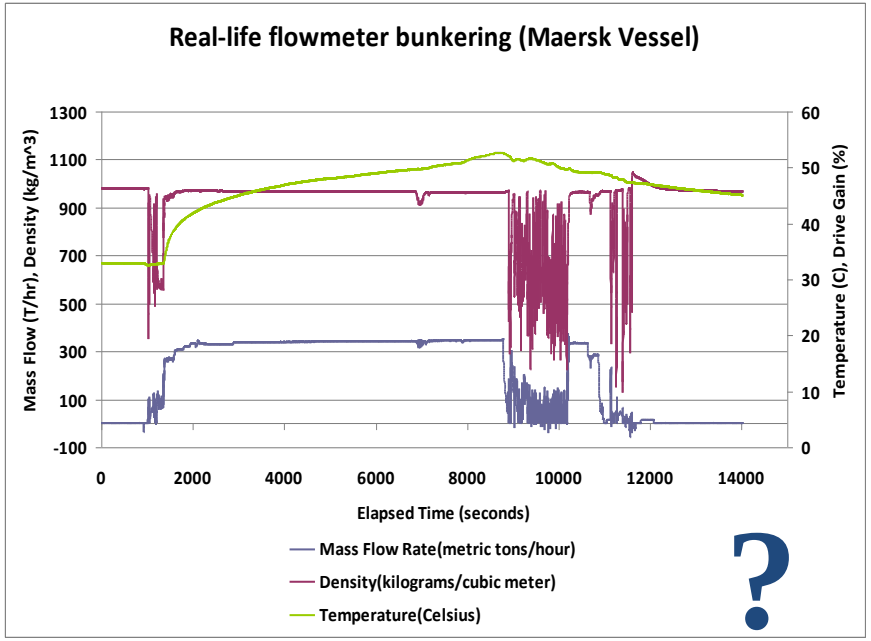
Flowmeters Providing Transparency

Detailed second-by-second data provides a clear picture of what goes on during a bunkering

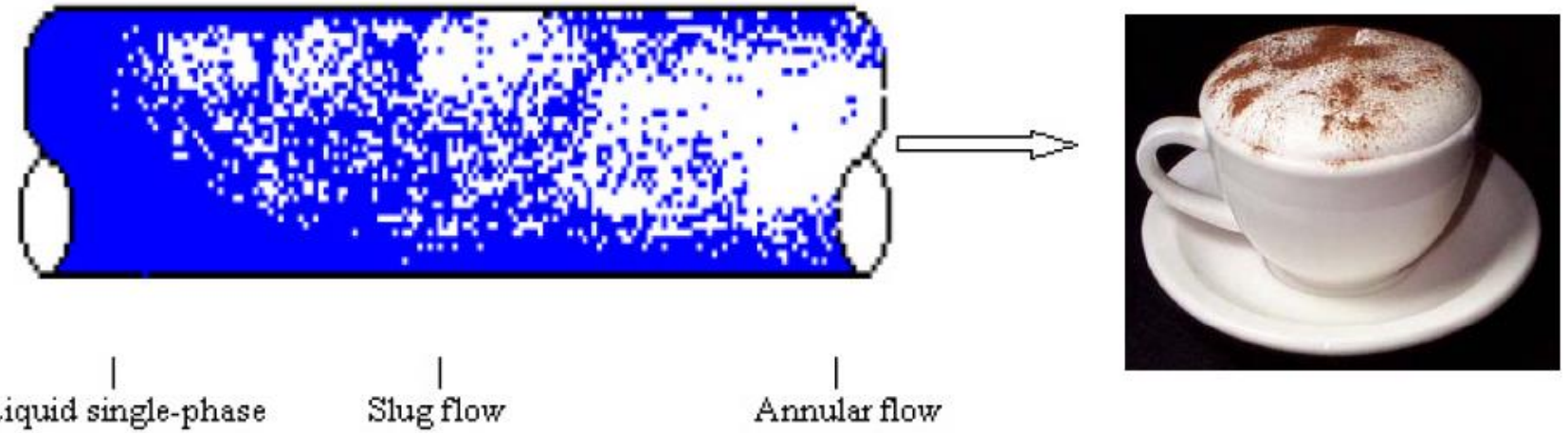
If a concerning amount of air is being pumped into the stream, alarm will sound, and vessel chief can contact barge operator to make him aware of the problem

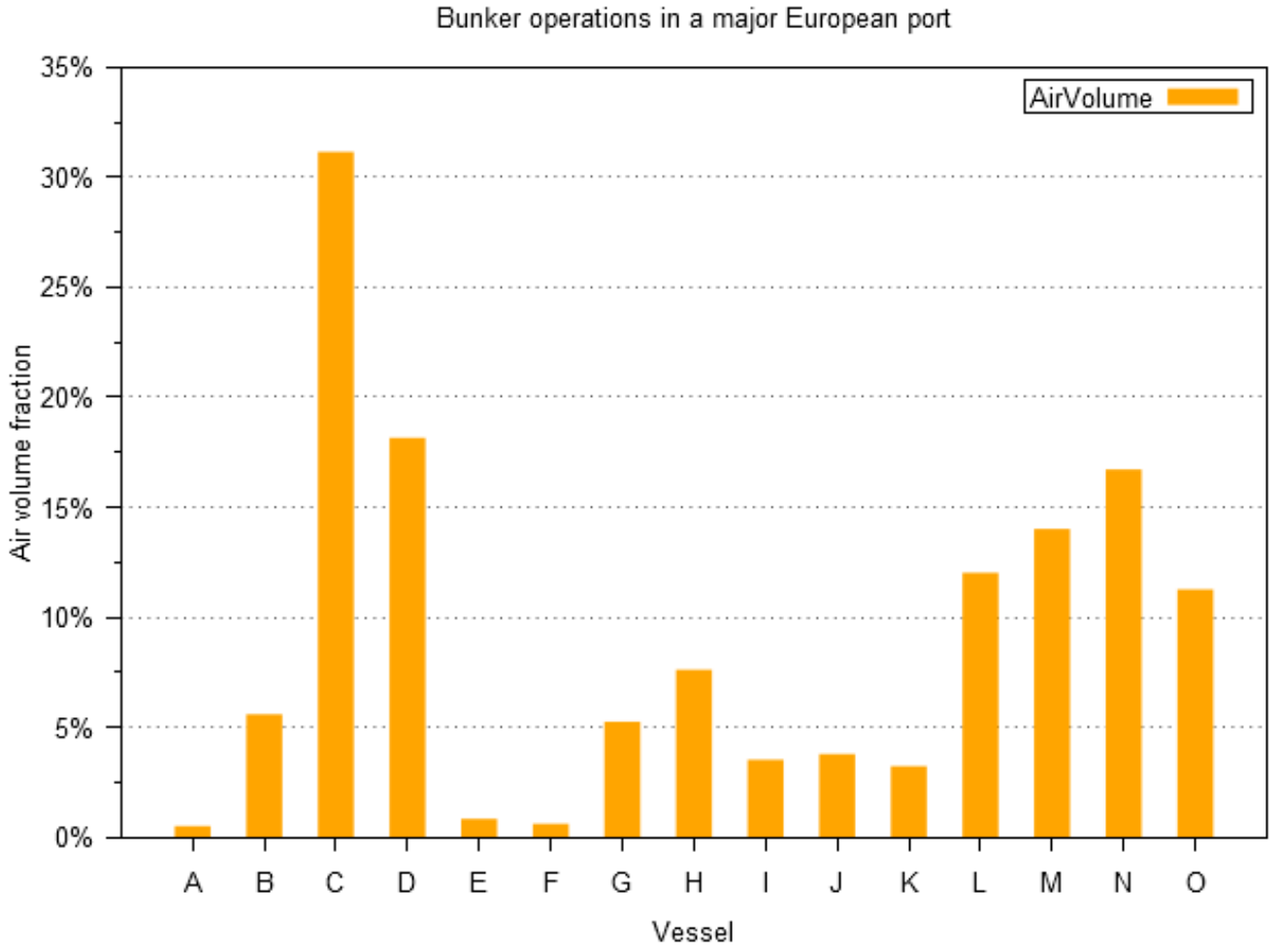
A time-efficient bunkering process benefits all stakeholders

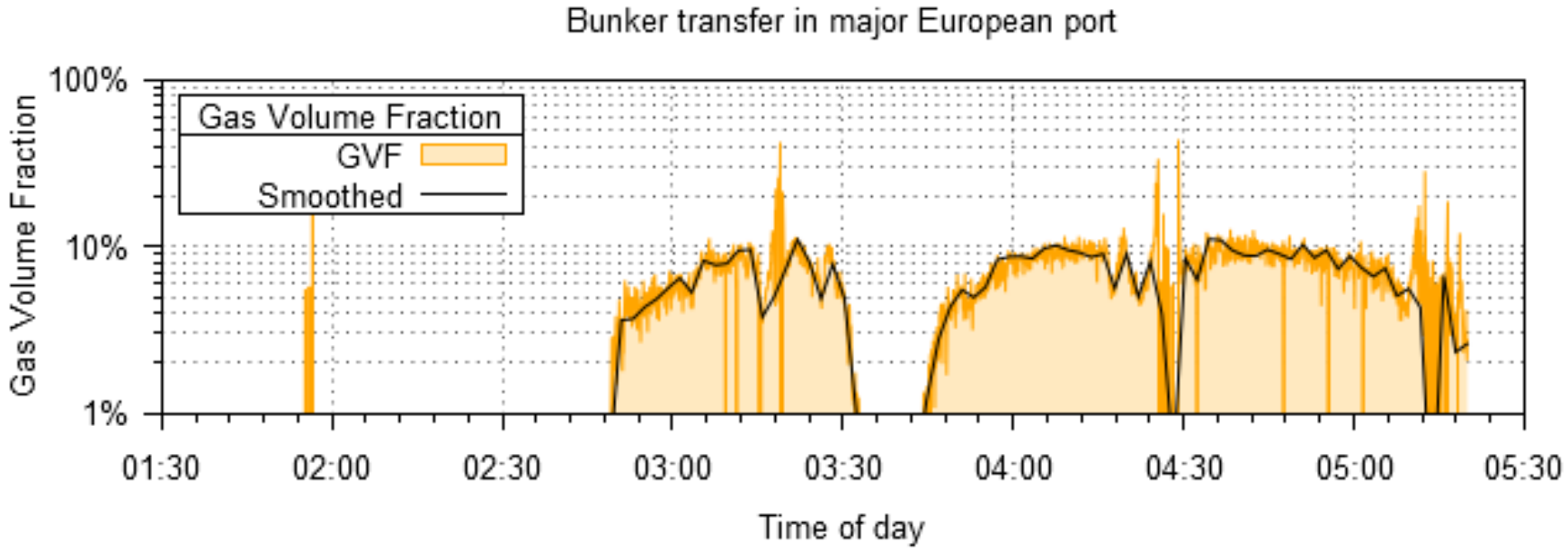




Cappuccino Effect




Bunker operations in a major European port
AirVolume
35%
30%
25%
20%
15%
10%
5%
0%
Air volume fraction
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
Vessel


Bunker transfer in major European port
Gas Volume Fraction
GVF
Smoothed
100%
10%
1%
Gas Volume Fraction
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
Time of day

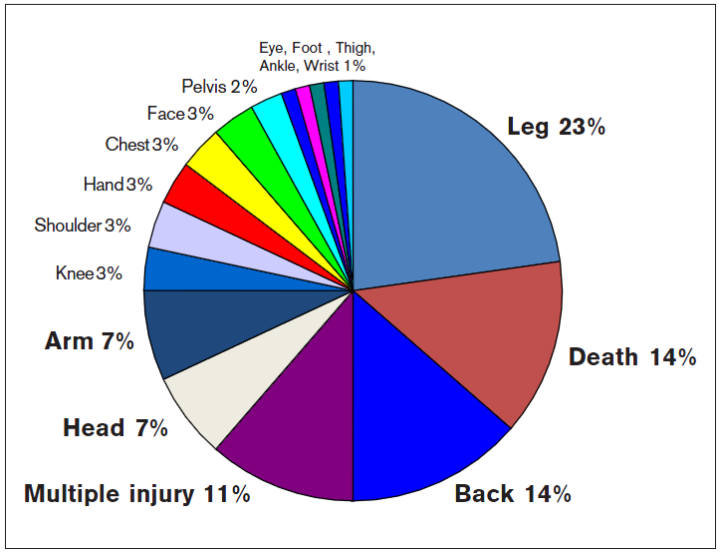
VT
MARITIME LOGISTIC SERVICES

Safety & Health: mooring

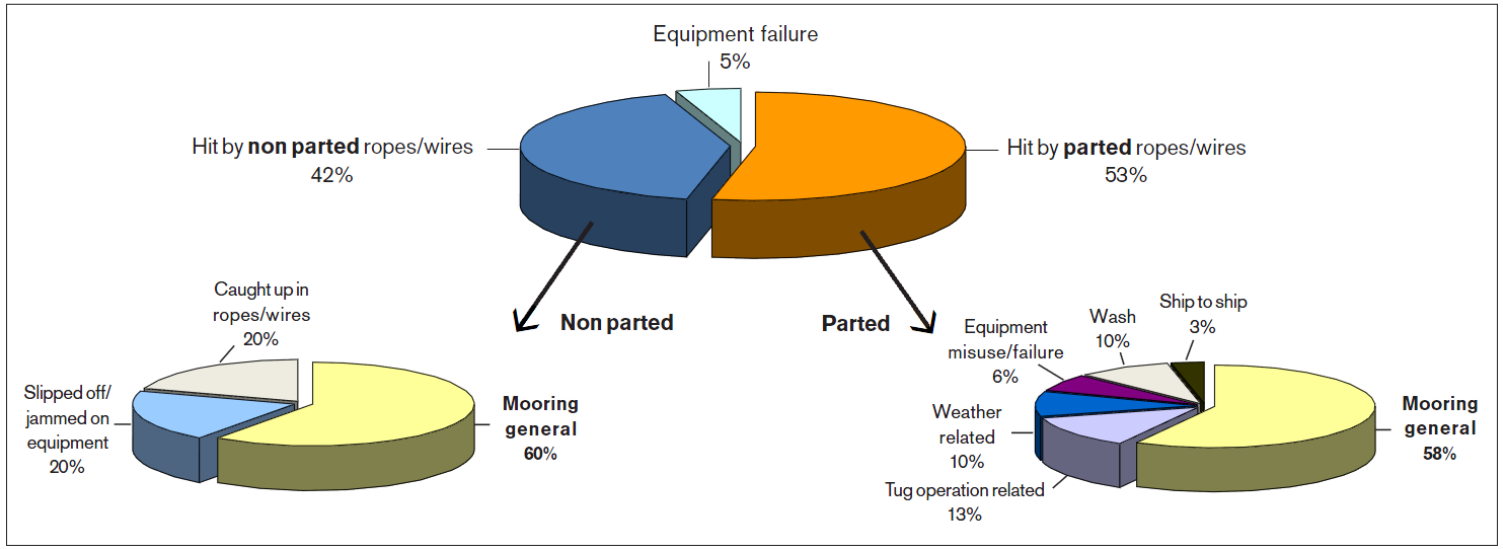
UK P&I CLUB

Risk Focus: Moorings

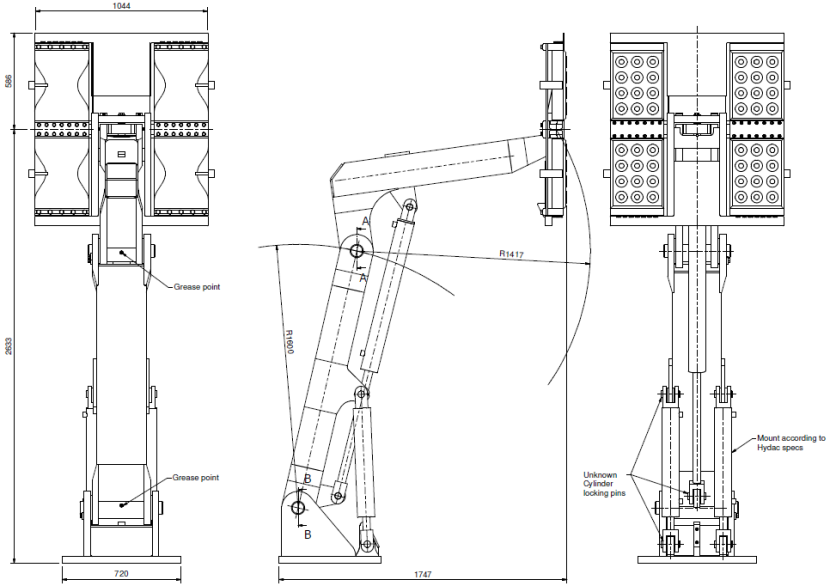
Injuries from mooring incidents

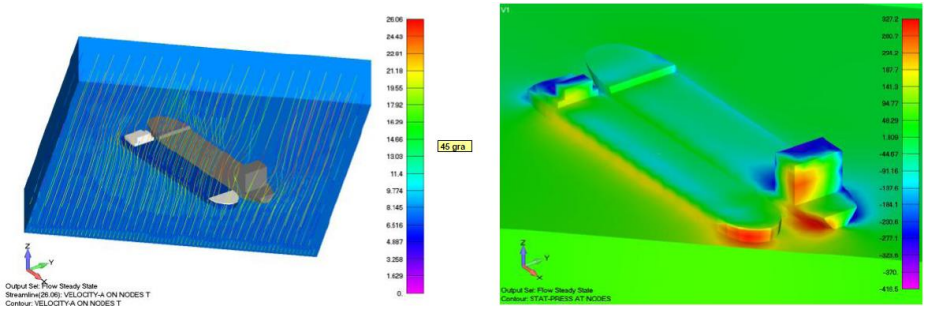


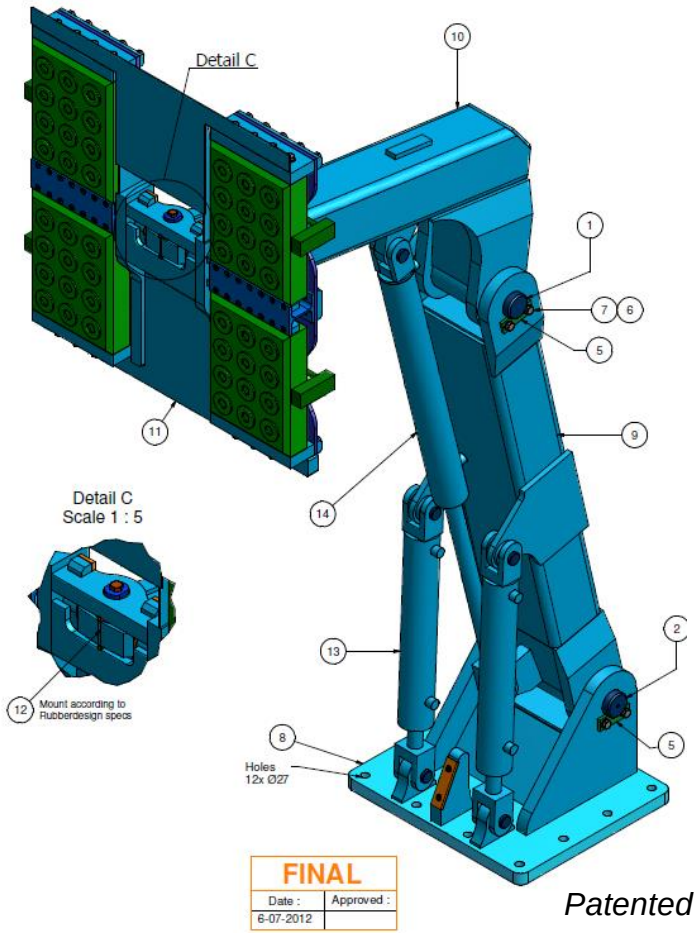
Types of incidents resulting in personal injury



Magnetic Mooring System

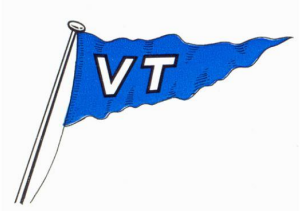






Patented

“The bitterness of poor quality remains long after the sweetness of low price is forgotten” – Benjamin Franklin



VT

VTGROUP.NL

Your Fuel Management Partner

Van Ameyde Marine

Seminar : “ Scheepsbrandstof en de mondiale zwavelnorm 2020”

WHO are we?

Walter Dekkers – Van Ameyde Marine

- Sailed 7 years as Marine Engineer
- Marine Surveyor/engineer within Van Ameyde Marine since 1990
- Last 12 years also Managing Director
- Fuel Oil quality-dispute specialist acting on behalf of Shipping Companies, P&I, Lawyers and Underwriters.

Ferry van Eykel – VPS

- Sailed 12 years as Marine Engineer
- Technical Superintendent for 5 years
- Technical Adviser DNV Petroleum Services Rotterdam for 4 years
- Director DNV Petroleum Services Rotterdam for 14 years
- Senior Customer Account Manager VPS last 7 years

Low Sulphur fuel oil in 2020:

Quality - Stability - Prevention

- Quality : Unknown
- Stability : Unknown
- Prevention : Impossible

What's different now in claims against 10 years ago?

Total 21 cases in 2008

1. Aluminium / Silicon (catfines) above limit
2. Sulphur content above limit
3. Water above limit
4. Density too high

Total 27 cases in 2018

1. **Chemical contamination**
2. Sulphur content above limit
3. Total sediment
4. Catfines

What are always two main questions ?
(when standard tests of ISO8217 has passed)

- **Is the fuel oil off spec?**
  Complicated / rely on clause 5 of ISO8217?

- **If off spec, can the fuel oil still be used?**
  Complicated / rely on specialists?

Confusion on ‘chemical screening’ results?

- Specialists and labs gets involved but the lack of clarity and data on acceptable limits (?) is causing confusion.
- Difficult (time-consuming) to pinpoint the cause other than originated from upstream in supply chain.
- Suppliers generally reject claims, often based on their terms & conditions, whilst holding opinion that Buyer has burden of proof that fuel is off spec and not fit for use.

More confusion in the dispute proces?

- Charterers often in the middle facing non-cooperative supplier and unwilling Owners? De-bunkering or not?
- Different samples and not same analysis results.
- Labs with different analysis methods. Bunker specialists with different opinions. Lawyers as well!
- Endless discussions about tests methods and which laboratory to use and who to pay.

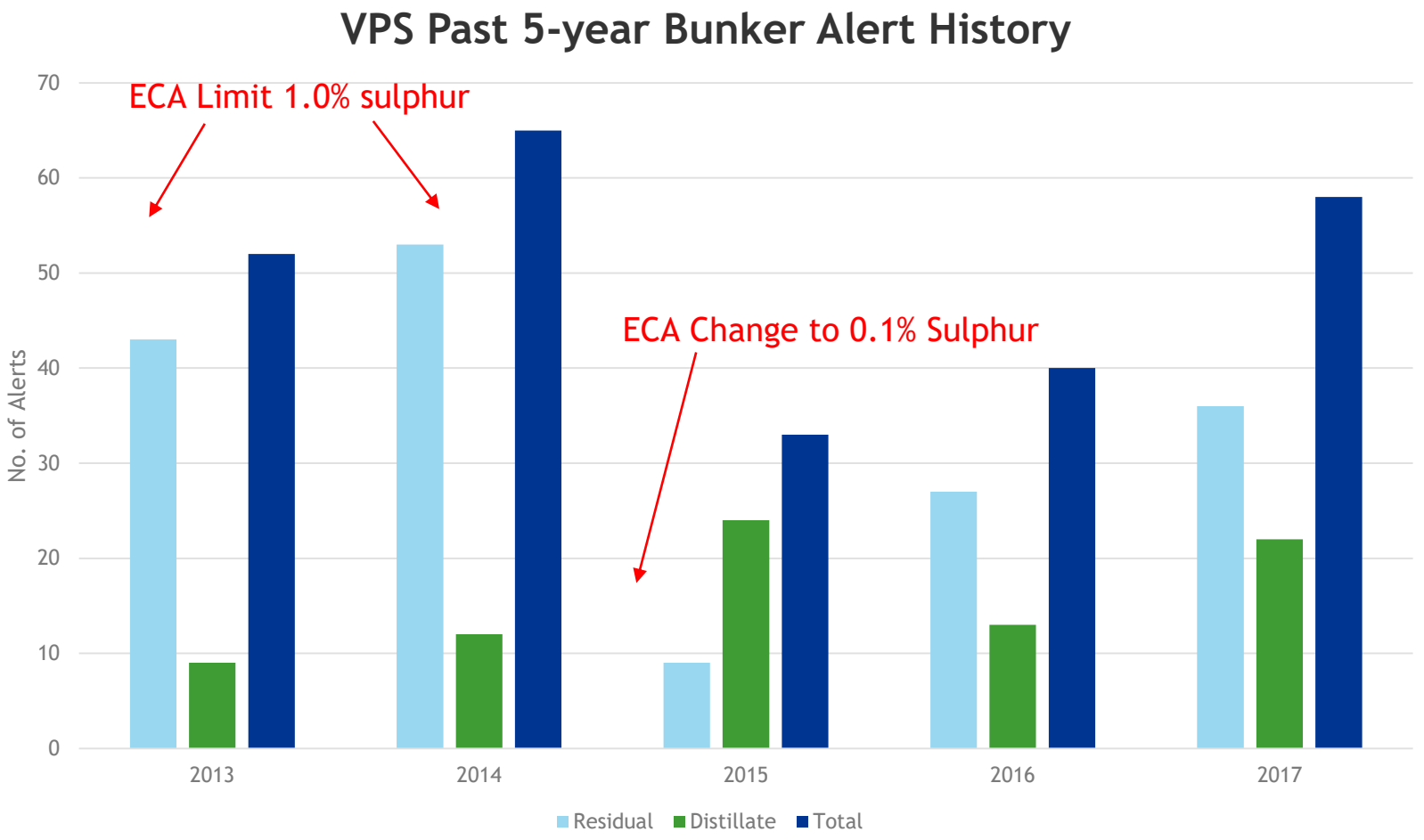
Technical ‘challenges’ on board

Barrels Require Forced “Jacking” To Remove

- Over the past decade evolving **Environmental Legislation** has had more impact on fuel quality than any other potential cause or effect.
- Decreasing Sulphur Limits have resulted in Off-specification fuel “Spikes” Immediately Before & Immediately After every Legislative Change:

- Decreasing sulphur limits have led to
  - The development of new fuel types & grades, new lubricant oils
  - Increased blending, greater use of cutter stocks, diluents & additives
  - Greater awareness of the need for fuel management and monitoring of fuel quality,
  - Causing increasing-rate of revisions of the Marine Fuel Quality Std (ISO8217)

Environmental Legislation Impact on Fuel Quality

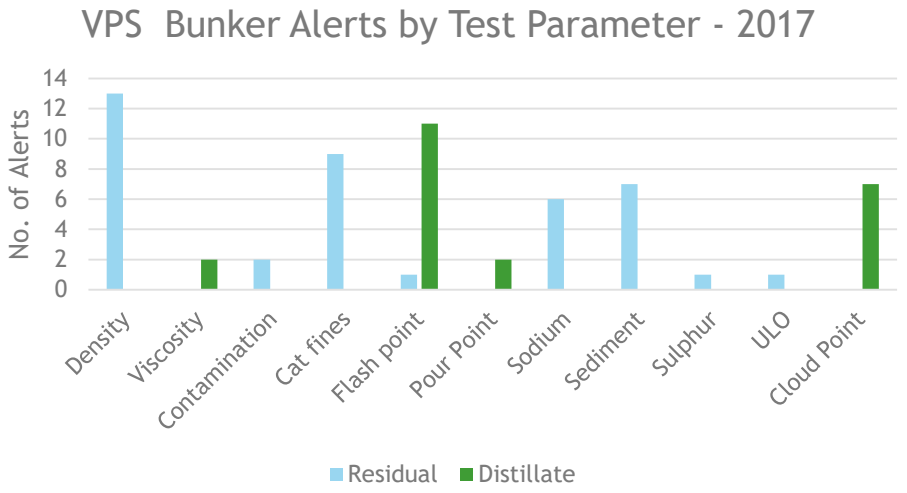


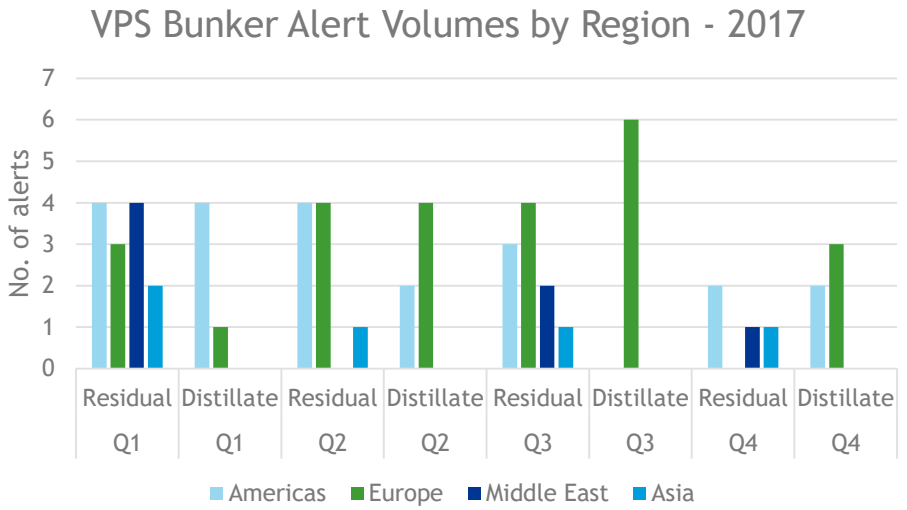
Current Global Fuel Quality

- Currently **15% of all residual fuels** and **9% of all distillates fuels** tested exceed the ISO8217 test specification for at least one parameter.

- In 2017 VPS released 58 "Bunker Alerts"
  - 36 (62%) related to Residual fuel
    - 30% increase on 2016
  - 22 (38%) related to Distillate fuel
    - 70% increase on 2016

- H1-2018: 33 Bunker Alerts
  - 18 x Residual, 15 x Distillate (55% : 45%)
  - 14 x Americas, 13 x Europe, 6 x Asia
  - Key Parameters: Contaminants, Cat-Fines, FP, cold flow properties





Bunker Alert(s) related to Houston Fuels

The phenolic compound of highest concentration in all samples was Cumyl Phenol (CAS No. 599-64-4), full name Phenol, 4-(1-methly-1-phenylethyl) in the concentration range of 300ppm to 1,000ppm. 4-Cumyl-Phenol has many industrial uses including, the manufacture of epoxy resins and as an emulsifier in pesticides, both of which utilise the adhesive (sticky) qualities 4-cumyl-phenol exhibits.

Latest Bunker Alerts

Chlorinated hydrocarbons detected in Singapore

Through new in-house GC-MS (Gas Chromatography - Mass Spectrometer) headspace analysis methodology as an additional quality control measure, Veritas Petroleum Services has detected chlorinated hydrocarbons on 15 samples representing residual fuel deliveries in Singapore.

The deliveries were made by multiple suppliers between 25 October and 18 November 2018.

The chlorinated hydrocarbons detected; Ethane, 1,2-dichloro, Tetrachloroethylene and 1,1,2- trichloroethane do not originate from normal refinery processes and are subsequently an indication of possible contamination. The impact such contamination can have is worn out fuel pumps, fuel valve problems and subsequently main- and/or auxiliary engines failing to start.

High abrasive fuels in Fujairah

Veritas Petroleum Services has tested several fuel oil samples representing HFO deliveries in Fujairah, UAE, with Aluminium and Silicon (Al+Si) concentrations ranging up to 398 mg/kg.

The deliveries were made by multiple suppliers from 24 to 27 November 2018.

Current Global Fuel Quality - Distillates

- The perception has always been, Distillates are “Problem Free”???
- Increasing issues with:
  - Flash Point – Blending with more volatile components
  - Cold-Flow Properties – PP, CP, CFPP, waxing of fuel.
- As demand increases, quality issues will become more common
- Fuel Change-over, low viscosity, poor lubricity, reduced stability, wax precipitation at low temperature, FAME or Microbial contamination.

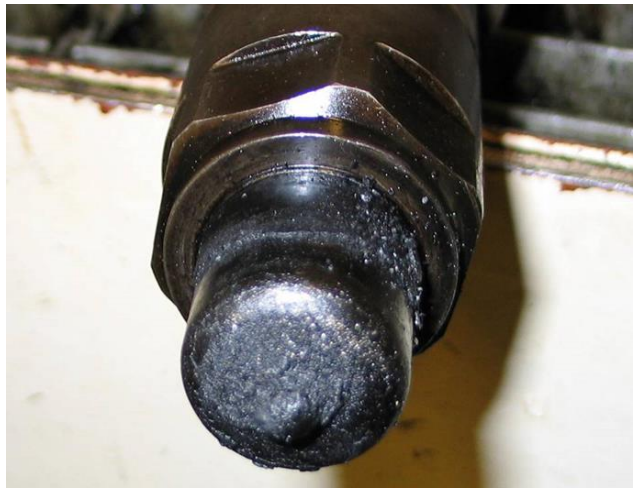
Current Global Fuel Quality - Residual Fuels

- At present Residual fuels remain the largest volume fuel used on board. Therefore generates the largest number of technical issues on ships

- Most common issues are high cat fines, sediment, sodium and density.

- Fuels may achieve the ISO8217 Specifications, ***but*** can still cause operational problems, due to the presence of materials not specifically covered by ISO8217.

- Issues with “contamination” are increasing.

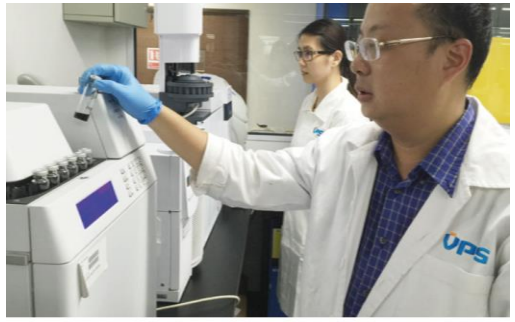


Where Do Contaminants Come From?

- Fuel Blending
  - Cutter Stocks to achieve Sulphur specifications
  - FAME
- Bio-Materials
  - Automotive fuels
  - Heating Fuels
  - FAME
  - Bio-Waste
- Cross-contamination
  - Fuel Supply Chain
- Adulteration
  - Waste Chemical Disposal

Current Quality Issues – A Sign of Things to Come?

- Original oil source and refining also influences fuel quality (Eg Crude type and region, Shale Oil, Tall Oil)
- 2020 will see an increase in types of fuel. Wider use of diluents, cutter stocks, additives, blending….
- The above can alter the fuels chemistry, potential destabilisation effect, or have a damaging side-effect.
- Laboratories are now having to use increasingly high-end analytical techniques to identify the cause.



0.5% VLSFO's for 2020?

- This fuel already has a name - Very Low Sulphur Fuel Oil!
- The principal purpose of these fuels will be to provide a lower cost alternative to 0.5% MGO.
- But we don't know for sure how they will look - it will be likely mid-2019 before we see these fuels in the market.
- We can assume, like ULSFO's :
  - these are likely to be blended products, with huge variances in approach, region to region, batch to batch.
  - with more sulphur content to play with, potentially allows higher residual-based materials may be used
  - higher density, viscosity and metal content.
  - even more risk of instability and incompatibility
  - segregation of fuel types will be more important than ever

Prevention by means of additional protection services

✓**Basic analysis:**

Test Marine Fuels according ISO 8217, preferable latest version(s)

✓**Additional Quality Control: Distillate Marine Fuels:**

Cold Flow Properties: Cloud Point (CP) and/or Cold Filter Plugging Point (CFPP)

Bacterial analysis: Bacteria / Yeast & Fungi

✓**Additional Quality Control: Residual Marine Fuels:**

Stability: TSA and Reserve Stability Number (RSN)

Organic Compounds (chemicals): by GC-MS analytic techniques

Prevention by the bunker industry

- More transparency (applying Block chain processes) of all parties (incl. clarity and traceability supply chain and blending),
- More data collection, more knowledge sharing, accessible for all?
- Bunkering license with registration number and audits by independent body like Singapore? Also to ensure a quality system is in place so that the delivered fuel meets in all respects the standard; which incl. clause 5 of ISO8217?
- Best practice guidance for suppliers of IBIA to be followed.

Prevention by Owners/Operators/Managers (1)

- Deal with reputable suppliers & traders only;
- Consider the Bimco bunker contract instead of Supplier's unfair terms and conditions;
- Check Charter Party carefully for correct clauses with regard to required fuel oil quality and new rules (check for instance at BIMCO or your P&I);
- Promote to buy as per latest fuel quality standard (now is basis ISO8217: 2017);
- Train engineers to follow up the bunker procedures with regard to representative on board sampling in accordance with the procedures given in ISO13739, witness sampling barge, signing labels and BDN as well as proper sealing the samples;

Prevention by Owners/Operators/Managers (2)

- During bunkering realize that lines are cleared by draining back into the tank(s) when HSFO and LSFO is delivered by same barge (first load LSFO).

- Follow up fuel change-over procedures means knowing what is bunkered, have adequate training of engineers with regard to load, viscosity, temperatures, timing, mixing etc.. Watch out for different properties of these new compliant VLSFO's.

- Storage considerations:
  - No mixing of different bunker deliveries on board;
  - Dedicated tanks and systems as much as possible;
  - Drain settl / serv tanks twice a day to remove water, incl. right temp;
  - Heating that temperature is sufficient above pour/cloud point;

Prevention by Owners/Operators/Managers (3)

- VLSFO's may be quite solvent in nature and tanks currently storing HFO will require inspection, and probably some cleaning (to remove impurities like sediment and catfines).
- Periodic assessment fuel treatment (FSC) by taking samples before/after purifiers for analysis;
- Don't start using the fuel before analysis results are known;
- Follow best practice guidelines of P&I clubs and Hull & Machinery Underwriters

Summary (Heading towards 2020 & Beyond)

- Wider range/choice of fuels available with many technical considerations.
- Today, we are seeing a major increase in fuel quality issues, and their complexity. This will only continue and may worsen.
- We can expect many more issues with contamination from fuel production and blending.
- Enhanced analysis by means of forensic techniques should be considered.
- Ship Owners / Managers should take preventive measures on board.

Quote by one of the major oil companies

"with so many different types of fuel potentially set to enter the bunker market, vessel operators are rightly concerned about **stability, compatibility** and quality issues, such as elevated levels of **cat fines**. It will therefore be more important than ever for operators to follow best practice when bunkering compliant fuels, including using laboratories to test fuel samples for potential issues"

Thank you for your attention

Walter Dekkers on behalf of Van Ameyde Marine
E-mail: walter.dekkers@ameydemarine.com

Ferry van Eykel on behalf of Veritas Petroleum Services
E-mail: ferry.van.eykel@v-p-s.com

2020 - Bunkerspecificaties

Monique Vermeire
Convenor ISO/TC 28/SC 4/WG 6
Classification and Specifications of Marine Fuels

Fuels Technologist, Chevron

Terug in de tijd ....

Table 2. Properties of marine fuels

Property	Class M1	Class M2	Class M3	Class M4	Class M5	Class M6	Class M7	Class M8	Class M9	Class M10	Class M11	Cla.
Density at 15 °C, g/mL, max.	–	0.9000	0.9200	0.9910	0.9910	0.9910	0.9910	0.9910	0.9910	–	–	–
Viscosity, kinematic, at 40 °C, cSt*, min.	1.50	–	–	–	–	–	–	–	–	–	–	–
max.	5.50	11.00	14.00	–	–	–	–	–	–	–	–	–
Viscosity, kinematic, at 80 °C, cSt*, max.	–	–	52 105	15.00 45	25.00 80	45.00 180	75.0 360	100.0 540	130.0 740	75.0	100.0	130.0
Cetane index, min.	45	35	–	–	–	–	–	–	–	–	–	–
Carbon residue, Ramsbottom, % (*m/m*), max.	–	0.25	2.5	–	–	–	–	–	–	–	–	–
Carbon residue, Ramsbottom on 10 % residue, % (*m/m*), max.	0.20	–	–	–	–	–	–	–	–	–	–	–
Carbon residue, Conradson, % (*m/m*), max.	–	–	–	12.0	14.0	20.0	22.0	22.0	22.0	–	–	–
Flash point, closed. Pensky-Martens, °C, min.	43.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Water content, % (*V/V*), max.	0.05	0.25	0.30	0.50	0.80	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sediment by extraction, % (*m/m*), max.	0.01	0.02	–	–	–	–	–	–	–	–	–	–
Ash, % (*m/m*), max.	0.01	0.01	0.05	0.10	0.10	0.15	0.20	0.20	0.20	0.20	0.20	0.20
Sulphur content, % (*m/m*), max.	1.00	2.00	2.00	3.50	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Cloud point, °C, max.	–16	–	–	–	–	–	–	–	–	–	–	–
Pour point, upper†, °C, max. (1 December to 31 March)	–	0	0	24	30	30	30	30	30	30	30	30
(1 April to 30 November)	–	6	6	24	30	30	30	30	30	30	30	30
Vanadium content, mg/kg, as V, max.	–	–	100	250	350	500	600	600	600	600	600	600

*1 cSt = 1 mm²/s.

†The word 'upper' does not apply to classes M2 and M3

Some history

- **BS MA 100:1982**

  Voor de allereerste keer kwaliteitscontrole, voornaamste bunker grades bepaald

- **1e editie ISO 8217:1987**

  Brandstofkwaliteit wordt nternationaal vastgelegd

- **2de editie ISO 8217:1996**

  Introductie limieten voor Al&Si en stabiliteit

- **3de editie ISO 8217:2005**

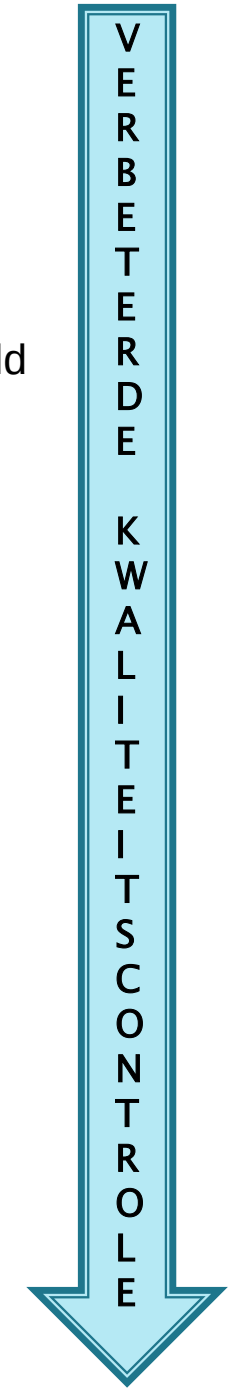
  Introductie limiet voor gebruikte smeerolie

- **4de/5de editie ISO 8217:2010**

  Significante kwaliteitsverbeteringen: lagere Al, Si; CCAI, min. Viscositeit voor distilaten

- **6de editie ISO 8217:2017**

  Introductie DF grades, rapportering van CP and CFPP



0,50 % S max. scheepvaartbrandstoffen

- Recentelijk, talrijke publicaties die wezen op het gebrek aan specificaties voor 0,50% S scheepvaartbrandstoffen en mogelijke problemen met brandstofkwaliteit en -veiligheid

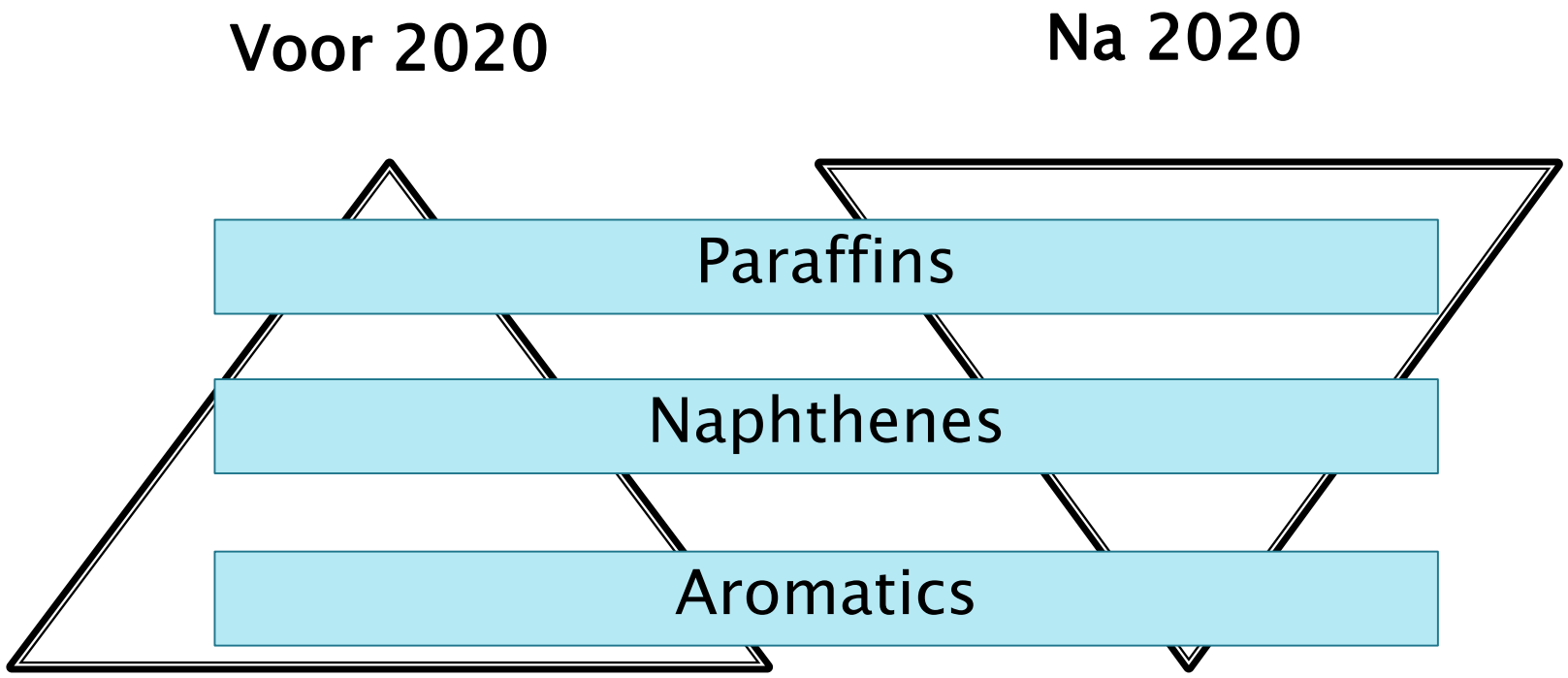
- **ISO 8217 is geldig voor alle scheepvaartbrandstoffen, ongeacht het zwavel gehalte en specificeert de vereisten voor brandstoffen voorafgaand aan conventionele behandeling aan boord (bezinken, centrifugeren, filtreren) voor gebruik**

- Ontwikkeling PAS 23263 opgestart : Publicly available specification
  - Tijdelijke oplossing omtrent specifieke overwegingen die van toepassing kunnen zijn op 0,50% S max. scheepvaartbrandstoffen
  - Gebruik van ISO 8217 voor 0,50 % S fuels

- Herziening van ISO 8217:2017 na 2020

0,50 % S max. scheepvaartbrandstoffen

- Conforme brandstoffen zullen een mix van distillaat- en residuele produkten zijn, kunnen geografisch verschillend zijn en verschillend in aard dan huidige brandstoffen



Source : Ref: KBC/Mel Larson

0,50 % S max. scheepvaartbrandstoffen

- Belangrijke parameters voor 0,50% S brandstoffen
  - Vloei-eigenschappen bij lagere temperaturen
  - Minimum viscositeit
  - Stabiliteit
  - CCAI
  - Catfines, Al&Si

- ISO 8217 is geldig voor alle scheepvaartbrandstoffen
  - Vloei-eigenschappen bij lagere temperaturen: Cloud point, CFPP (distillaten)
  - Vlampunt: min. 60 °C (SOLAS)
  - Stabiliteit: total sediment potential: 0,10 % m/m max.
  - Extreme densiteit/viscositeit verhoudingen worden opgevangen door max. CCAI
  - Al & Si : 60 ppm max.

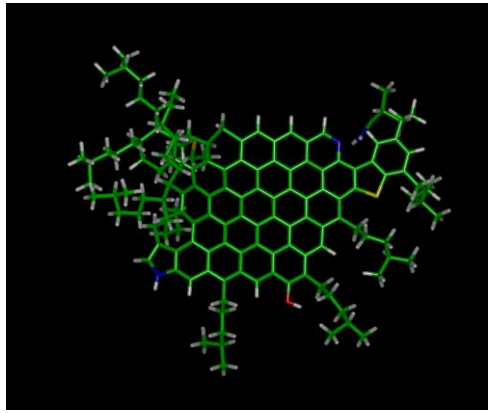
0,50 % S max. scheepvaartbrandstoffen

- Sommige brandstoffen kunnen meer paraffinisch zijn, minder aromatisch:
  - Risico tot uitzakken van wax in niet verwarmde tank
  - Wax: goede ontstekings-verbrandingskwaliteit
  - Paraffinen kunnen stabiliteit beïnvloeden

Source: CIMAC 01/2015

0,50 % S max. scheepvaartbrandstoffen

- Variatie in blend formulaties
  - “Geblende” brandstoffen moeten stabiel zijn en voldoen aan de total sediment potential vereiste van 0,10 % max.
  - Stabiliteit: weerstand van de brandstof om asfaltenisch sediment te precipiteren
    - Asphaltenen: sterk aromatische moleculen met een hoog moleculair gewicht die zich in colloïdale suspensie bevinden
    - Aromaten in de brandstof voorkomen dat asfaltenen agglomereren en neerslaan
    - Stabiliteit kan verstoord worden door:
      - Thermische stress
      - Toevoeging van paraffinische componenten
      - Daling van het aromaatgehalte
      - Vermenging met andere brandstof



Courtesy of Prof. J. Murgich

0,50 % S max. scheepvaartbrandstoffen

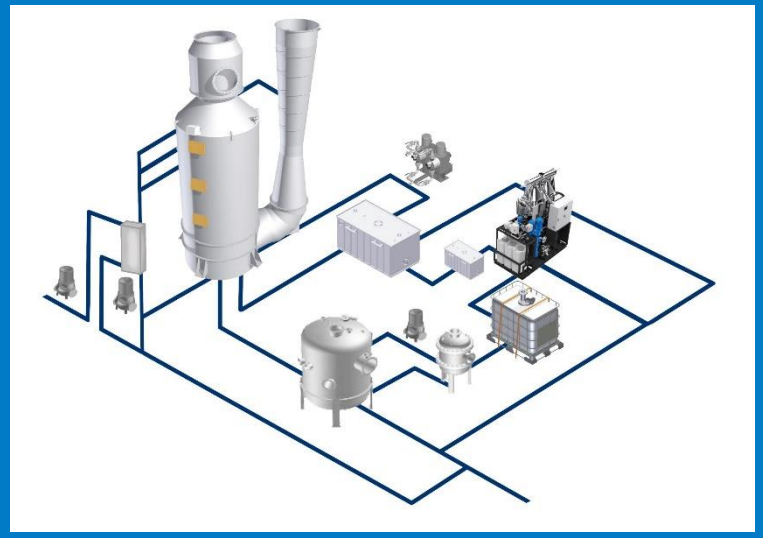
- Variatie in blend formulaties:
  - Compatibiliteit : maat voor de stabiliteit van een product bij menging met ander product➔ neiging om sediment te vormen bij samenvoegen van verschillende brandstoffen
    - Mogelijke problemen: blokkeren van filters, problemen bij het centrifugeren
  - Compatibiliteit : kan niet gegarandeerd worden door de leverancier
    - Spot test: resultaat niet altijd betrouwbaar
  - PAS 23263
    - Testprogramma om te onderzoeken of beproevingsmethoden die momenteel alleen routinematig door raffinaderijen worden gebruikt, aanvullende informatie kunnen verschaffen over de stabiliteit en mogelijke instabiliteit van verschillende brandstofformuleringen en mengsels daarvan.

0,50 % S max. scheepvaartbrandstoffen

- Let wel:
  - Mogelijke problemen bestaan ook vandaag reeds !!
    - Incompatibiliteit tussen brandstoffen bestaat ook vandaag
    - Goede ervaring met omschakeling brandstof naar 0,10 % S/ HSFO
      - Een zekere mate van menging bij overschakelen naar andere brandstof kan niet worden vermeden
- Aanbevelingen:
  - Begin tijdig met de voorberieidng: wanneer omschakelen, voorbereiding van de tanks (reiniging, flushen ??, tank segregatie, mogelijkheid om tanks te verwarmen, ,,,,)
  - Maak je vertrouwd met de brandstof die wordt geleverd, spreek met de leverancier
  - Training & alertheid van de bemanning

Fijne feestdagen !

Ministerie van Infrastructuur
en Waterstaat



Beleid scrubbers

Ontwikkelingen binnen de EU en IMO

Niels Lyklema

Ministerie van Infrastructuur en Waterstaat

Niels.lyklema@minienm.nl

‘Scrubbers’ in de pers

“Kies ik een open of closed loop scrubber?”

“Shipping companies preparing for tighter scrubber regulations”
– Shipping Watch, 4-12-2018

“Singapore bans open-loop scrubbers”
– Shipping Watch, 30-11-2018

China prepared to go further than IMO in terms of environmental regulations
– Shipping Watch, 10-12-2018

Beleidsontwikkelingen

Eisen aan waswater

Vervolg

Opkomst scrubbers

Onzekerheid brandstofbeschikbaarheid, prijs brandstoffen, positieve businesscase, etcetera.

- Voorafgaand aan SECA (b.v. Noordzee), ...
- idem voorafgaand aan 0,50% S norm wereldwijd

Lozingen waswater scrubbers vanaf begin onder aandacht IMO!

Toegestaan ‘alternatieve methode’

Onder Marpol Annex VI (regulation 4) en EU zwavelrichtlijn (1999/32/EC) een ‘alternatieve methode zwavelreductie’

Aandachtspunt : “... taking into account guidelines developed by the Organization (...)”

IMO ‘Guidelines for Exhaust Gas Cleaning Systems’

Guidelines zijn al 10+ jaar in ontwikkeling

- Oktober 2008 aanname tijdelijke guidelines
- Juli 2009 aanname guidelines
- Mei 2015 aanname gereviseerde guidelines
- April 2016, EU vraagt IMO amendering
- 2018-2019 amendering guidelines IMO

Implementatie in nationale wetgeving - Nederland

- Nederland bijgedragen aan aangenomen IMO discharge criteria
- EU zwavelrichtlijn verwijst naar IMO discharge criteria, richtlijn is geïmplementeerd in WVVS.
- Met de wijzigingen in de WVVS Nederland is het gerelateerde hoofdstuk 6 van de Waterwet over handelingen in watersystemen, niet van toepassing op lozingen van scrubbers.

Implementatie in nationale wetgeving – België/Vlaanderen

- IMO (Federaal): scrubberlozingen toegestaan in EEZ & kustwateren
- EU-regelgeving (Vlaanderen): Verbod op lozing in vlaanderen obv EU WFD (wet op bescherming van de oppervlaktewateren)
  - Landinwaarts vanaf de basislijn, omvat o.m. Schelde, binnenwateren en havens
  - Elke lozing: verbod op open loop scrubbing & bleed-off lozing

Beleidsontwikkelingen

Eisen aan waswater

Vervolg

Inhoud IMO ‘Guidelines for Exhaust Gas Cleaning Systems’

1 Introduction

2 General

3 Safety Note

4 Scheme A: Approval, Survey & Certification

5 Scheme B: Approval, Survey & Certification

6 Emission Testing

7 Data Recording & Processing

8 Onboard Monitoring Manual

9 Ship Compliance

10 Discharge Water

Appendices 1 - 5

Washwater Discharge criteria

IMO ‘Guidelines for Exhaust Gas Cleaning Systems’ criteria voor waswaterlozingen :

- PH (verzuring)
- PAH (olieachtige lozingen)
- Turbidity (deeltjes als zware metalen en as)
- Nitrates (‘voedselrijkdom’)
- Toevoegingen waswater, e.a.

Sludge moet afgegeven worden!

Waswater lozing-criteria

- Uit nu bekend onderzoek:

  - *It was found that compared to current environmental acceptability levels the releases from scrubbers can be expected to be considerably below the levels of ecological concern.* - Danish EPA
  - *"the results of some sampling trials suggest that additional criteria may be necessary to reinforce the requirement to minimize heavy metals in discharge water." – EU submissie MEPC71*

Lokale problematiek lozingen

Tijdelijke richtlijnen in 2008 maakten onderscheid tussen lozingen in havens, estuaria, open zee.

Advies aan IMO tijdens MEPC 59:

> "Bearing in mind that in the future many ships will be discharging not only SOx effluents but also treated ballast water, GESAMP recommends that a generalised marine environmental risk assessment should be developed, at least for some model harbours."

Toegenomen aandacht IMO

- Advies GESAMP, overgenomen door **IMO MEPC 59** juli 2009:

  "discharge criteria should be revised in the future as more data become available on the contents of discharge and its effects"

- EU lidstaten tijdens **IMO MEPC 71,** juli 2017:

  "recall that greater attention should be given to the cumulative effect of any pollutant discharges entering the water body per unit time at any location, originating from the EGCS."

- **IMO MEPC 73**, oktober 2018, werd herinnerd aan uitspraak MEPC 59

Beleidsontwikkelingen

Eisen aan waswater

Vervolg

Positie EU landen

Zorgen of voldaan wordt aan (EU) eisen waterkwaliteit.

- Discussie binnen European Sustainable Shipping Forum werkgroep EGCS
- EU onderzoek “... to better understand the comprehensive environmental impacts”
- Maatregelen door individuele landen

Vervolgstappen, volgordelijk:

- Agenderen inzichten binnen IMO
- Bijdrage ESSF werkgroep scrubbers
- Actief volgen EU/IMO onderzoek waswater
- Aanpassen discharge criteria

Advies: kies voor closed loop of ‘hybride’ scrubber (zero discharge modus)

Dank u

Inspectie Leefomgeving en Transport
Ministerie van Infrastructuur en Waterstaat

Handhaving zwavelnorm

Astrid Driesprong
Programma Schoon Schip
12 december 2018

WAT DOET ILT?

Europese Zwavelrichtlijn

- Zwavelinspecties aan boord
- Brandstof monsters

- Zwavelinspecties in de lucht

- Klachten over bunkers
- Lijst met suppliers

PROGRAMMA SCHOON SCHIP

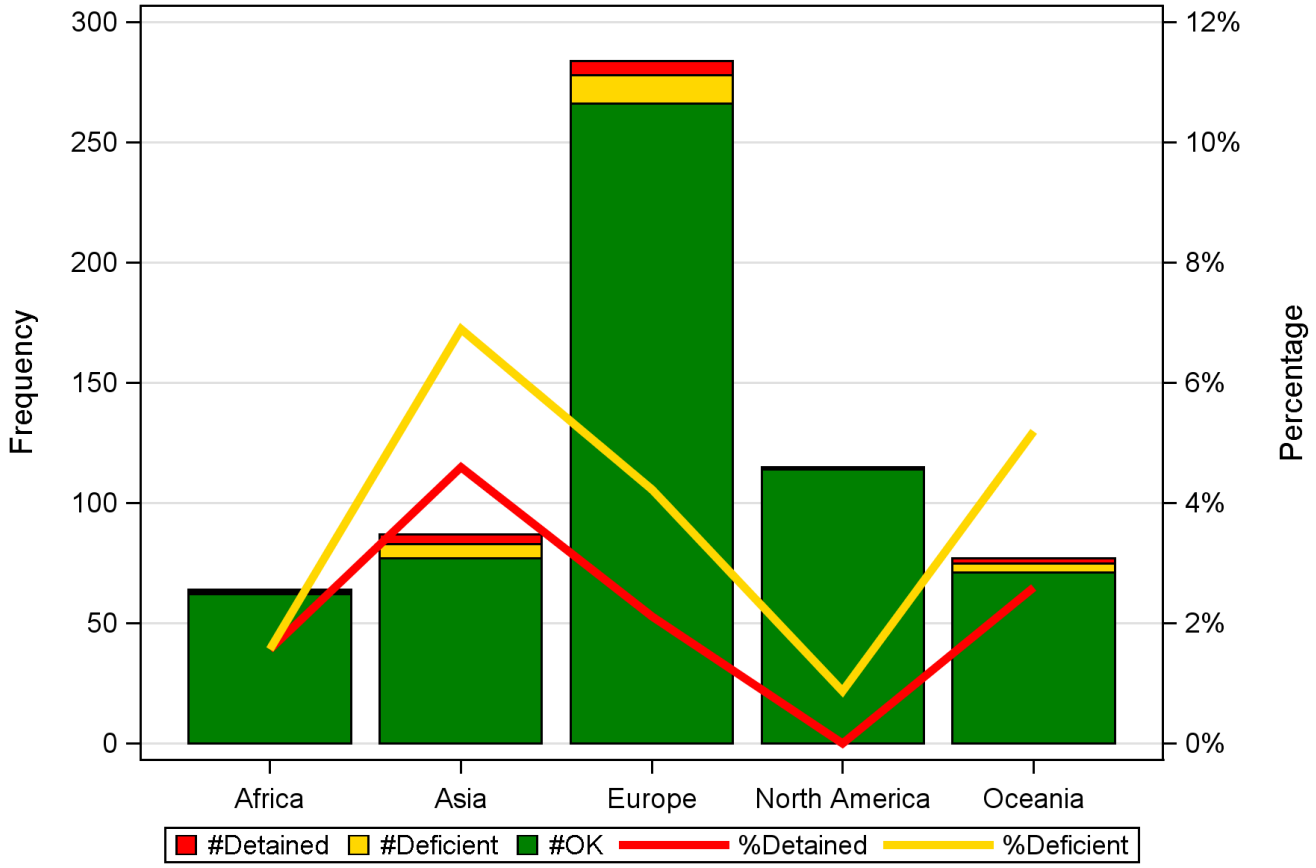
- 100% naleving zwavelnorm
- Internationaal koploper

- Verhogen pakkans
- Strafrecht
- Communicatie

OVERTREDINGEN BRANDSTOF 2017

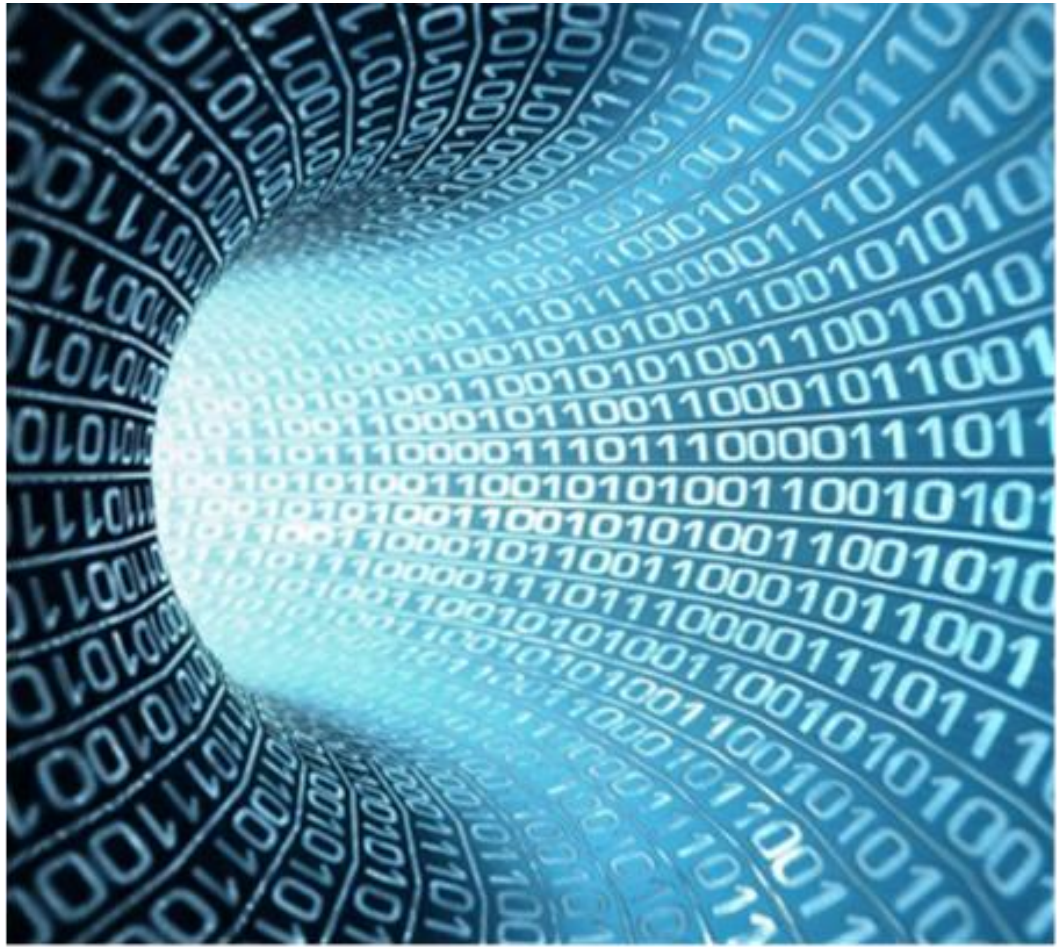
Vlag	inspecties	deficiencies	detentions
Greece	14	2	2
Gibraltar	13	2	1
Portugal	14	2	1
Denmark	14	1	1
Hong Kong	31	3	2
Norway	19	2	1
Singapore	40	3	2
Marshall Islands	69	4	2
Liberia	61	1	1
France	6	1	0
United Kingdom	13	1	0
Malta	56	1	0
Panama	60	1	0

OVERTREDINGEN: WERELDDEEL

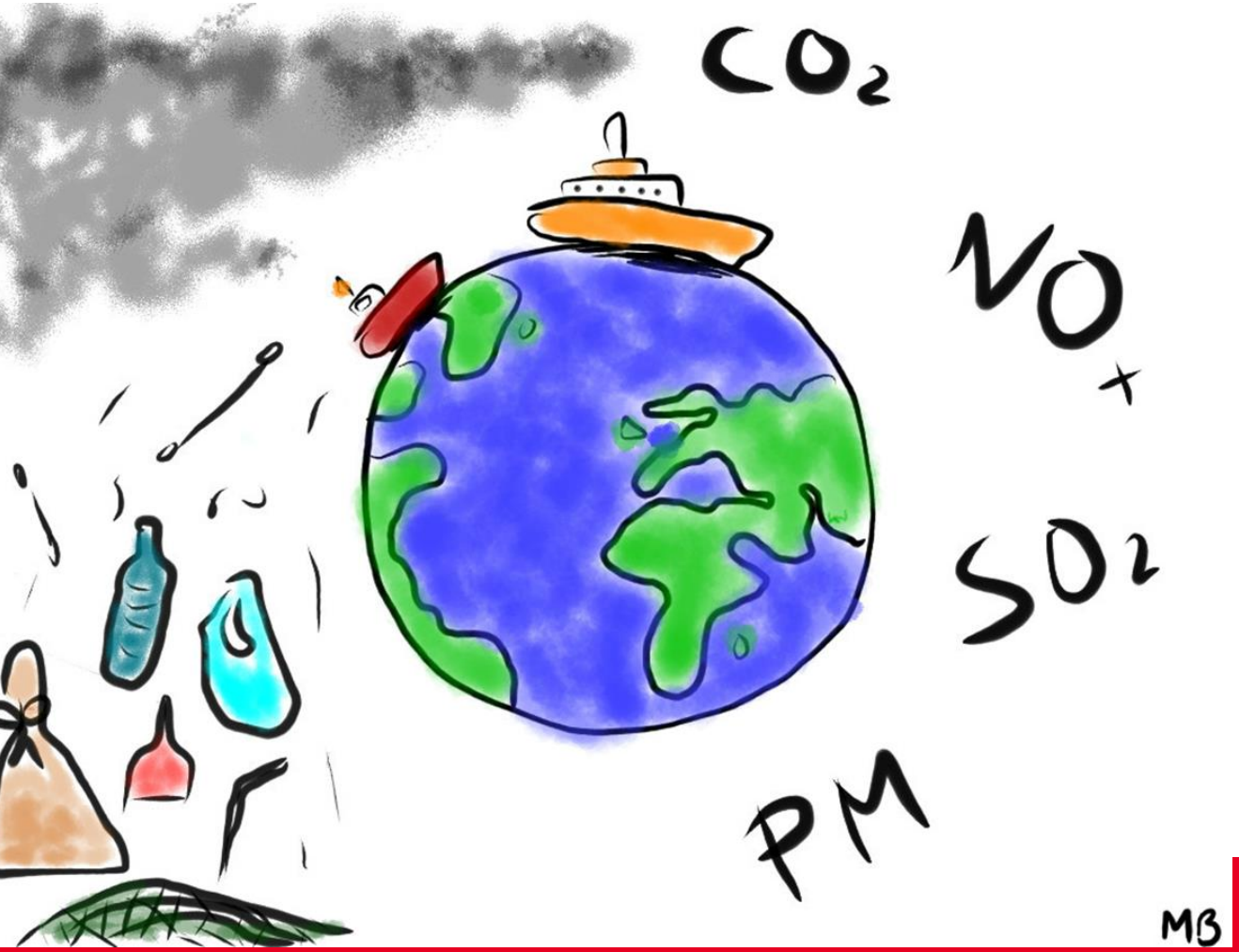


VERHOGEN PAKKANS

- Data analyse
- Remote sensing



MONDIAAL



- Internationaal gegevens uitwisselen
- Juridisch kader handhaving op volle zee

Marpol Annex VI Compliance Monitoring

Results, challenges and future prospects

Kobe SCHELDEMAN – SURV-BMM

Seminar ‘Scheepsbrandstof en de mondiale zwavelnorm 2020’ – Breda

12/12/2018

museum
Operational Directorate N
OD Nature | OD Nat

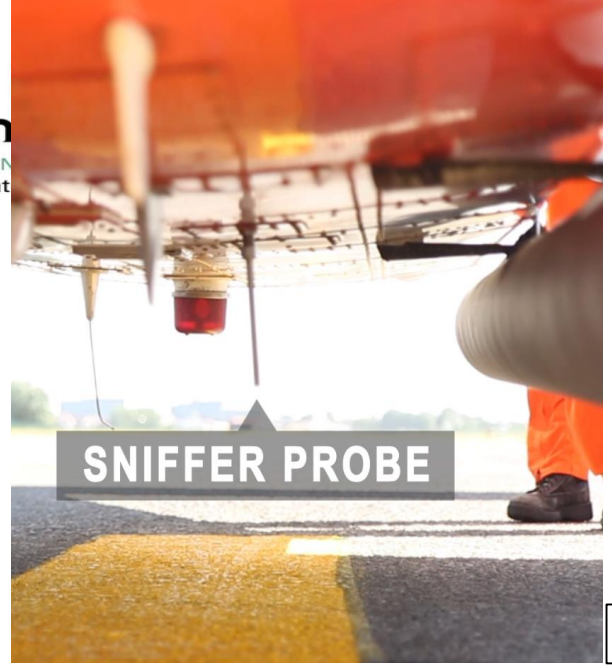
Marpol Annex VI compliance monitoring

Models
JGMM

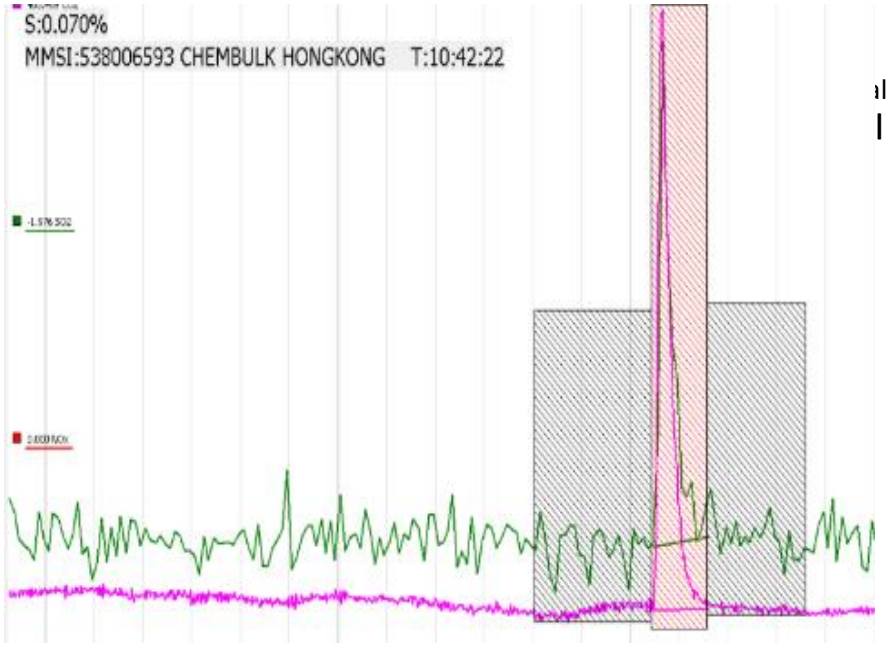
Monitoring vanuit de lucht met sniffer sensor
Resultaten
Uitdagingen en conclusies

FUEL CHANGE OVER

- Port State Controle: documents en fuel samples
- Situatie op zee?

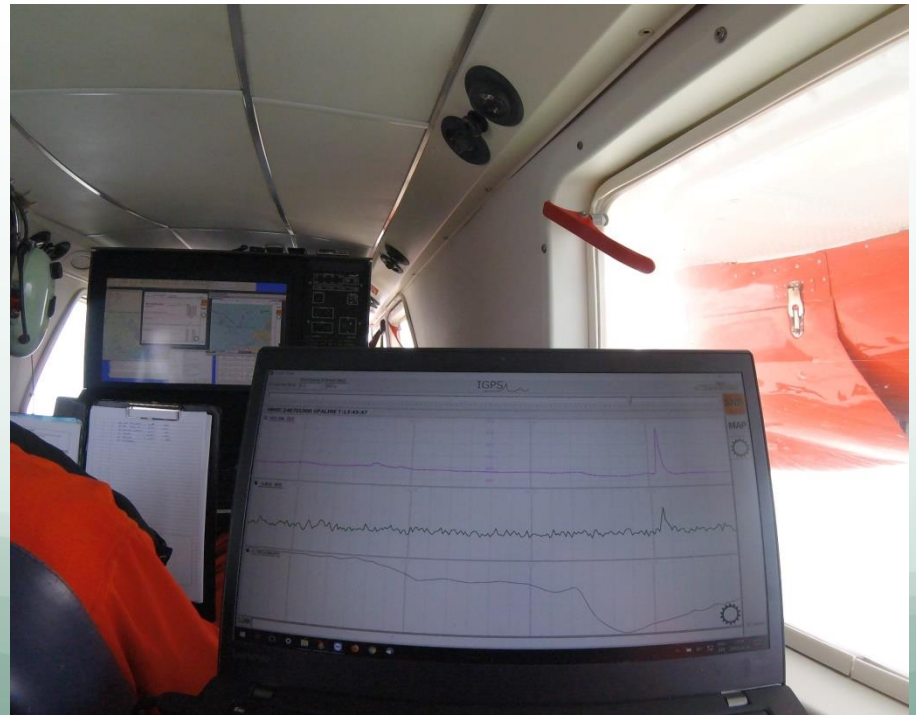


Co-financed by the European Union
Connecting Europe Facility

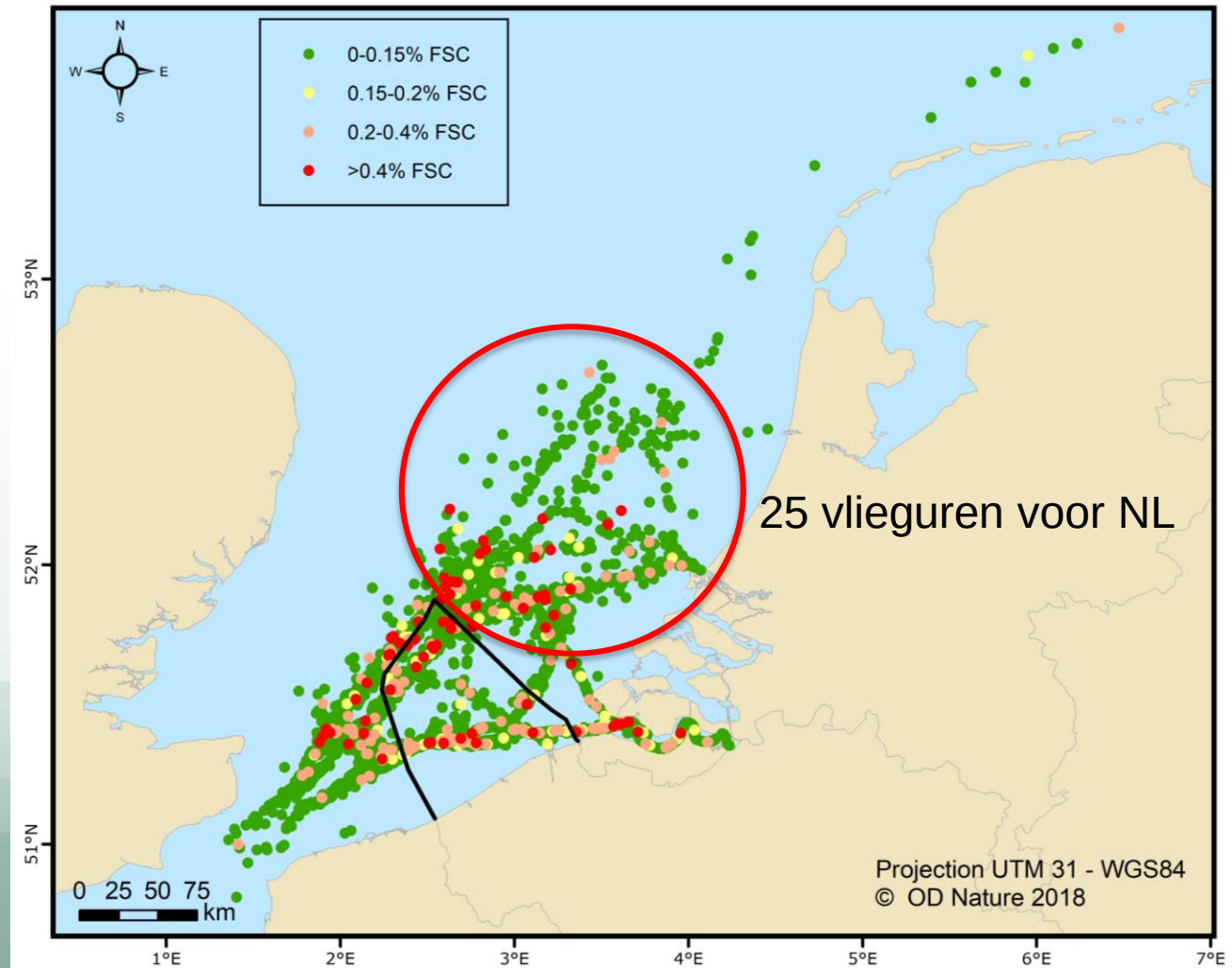


- Luchtmetingen met sniffer sensor
  - High accuracy innovatieve sensor (EU-steun: CompMon.eu)
  - Actieve sampling rookpluim schepen
  - Ratio CO2 en SO2 metingen → Fuel Sulfur Content gebruikte brandstof
  - Targetting verdachte schepen voor PSC
  - Internationale pioneersrol
  - Best practices + Capacity building

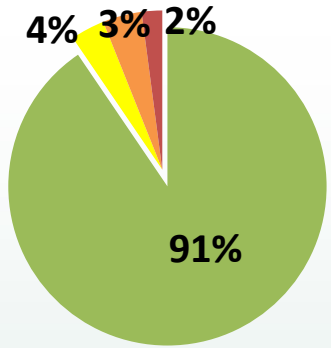

OO-MMM
COAS GUARD
M S C


IGPS

Monitoring Resultaten (2015-2018)

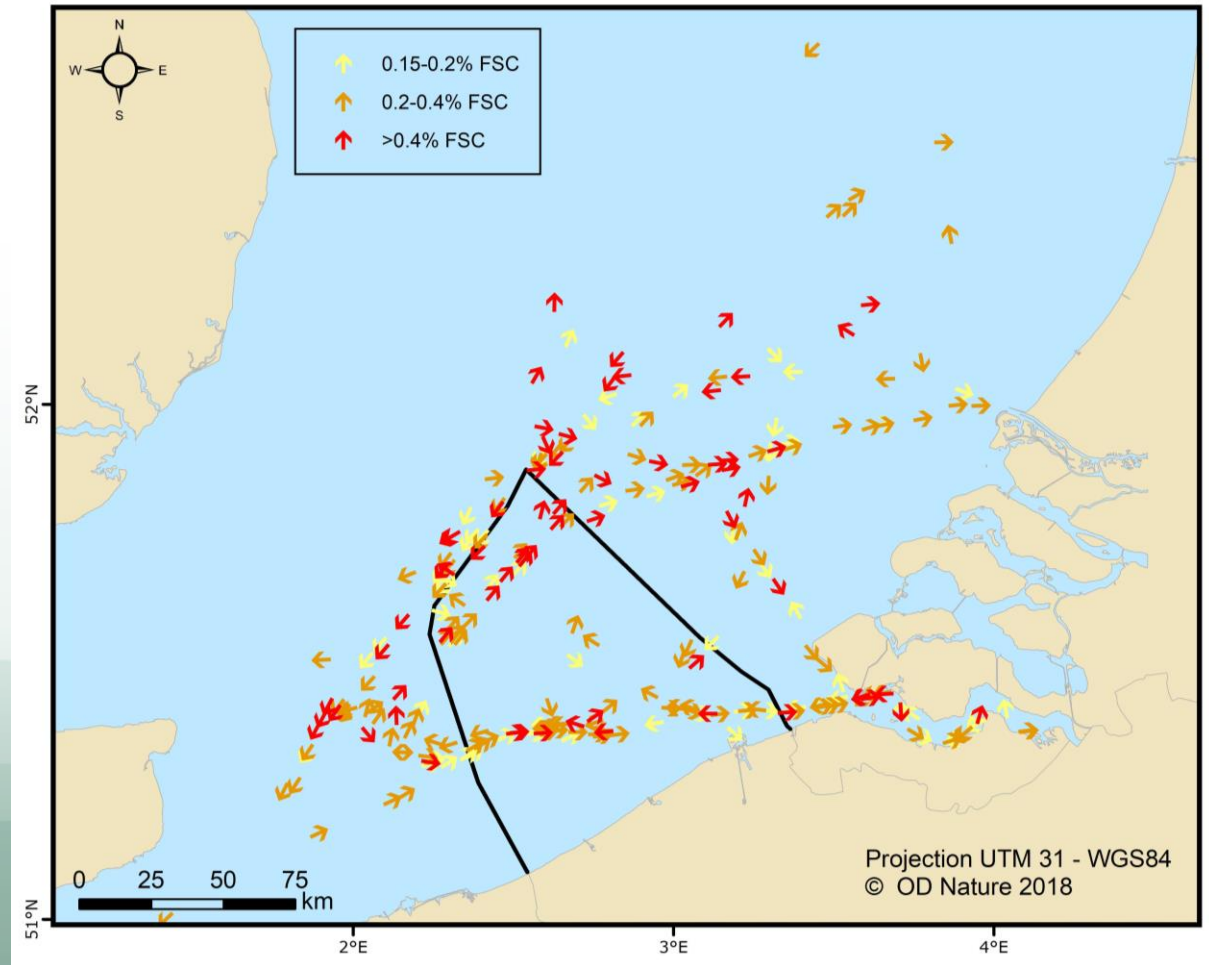


- >300 vlieguren
- >3200 schepen
- >300 incompliant (FSC>0.15%)



- NL 2018
  - 346 schepen
  - 24 incompliant
  - 9 overtredingen na staalname PSC

Analyse Monitoring resultaten



Geen significant verschil in:

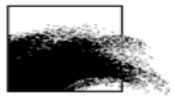
- Destination (in/out SECA)
- Ship size
- Ship type

Geen duidelijk profiel overtreders

<u>Aangepast gedrag schepen</u>

Meer non-compliance:

- Verder weg van havens
- Dichterbij SECA grens
- Onbekende schepen

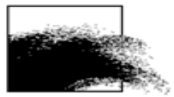


PSC Validatie

- Non-compliance in havens (fuel samples) = 3-5% (SECA)
- BE PSC non-compliance - fuel samples (2018)
  - → Zonder airborne alerts = 6.5%
  - → Met airborne alerts = 15% (↑ x2)

→ Sniffers verhogen PSC inspecties resultaten en efficiëntie drastisch

→ BE PSC bevestigd 50% alerts (2018)



Uitdagingen en conclusies

- Targetting via sniffers werkt: verhoogde efficientie PSC inspecties en handhaving door PSC

- Targetting v.s. Sniffer metingen als ‘evidence to court’?

- Ruimte voor verbetering:
  - Rapportering en opvolging resultaten (THETIS-EU link)
  - Kwaliteit metingen: NOx sensor, visualisatie rookpluim, validatie
  - Nieuw EU-project 2019: LIFE-ARCHES

Vragen?

kscheldeman@naturalsciences.be
www.odnature.naturalsciences.be/mumm/

BUNKERLICENTIESYSTEEM

Seminar Scheepsbrandstof en de mondiale zwavelnorm 2020

Breda, 12 december 2018

Henri van der Weide

- Transparantie en controle in de keten; imago
- Kwaliteitseisen brandstof en leveranciers
- Duidelijke procedures omtrent kwantiteit
- Vraag vanuit markt en (inter)nationale politiek
- Level playing field

WAAROM EEN LICENTIESYSTEEM

HOE DOEN WE DAT

- ARA Fuel Oil Quality overleg: stakeholders
- Bunkervergunning : in de havenverordening
- Conform EU regels (bunkeren=havendienst)
- Richtlijnen IMO, IBIA + andere havens

- Vergunning bunkerleverancier (5 jaar)
- Overige rollen in de keten / faciliteiten
- Te hanteren bunkerprocedure in de keten
- Kwaliteits- en kwantiteitseisen brandstof & leverancier
- Meldingen, formulieren en registratie

WAT REGELEN WE DAN (CONCEPT)

- Kwaliteitseisen: zwarte stoffen lijst REACH
- Welke brandstoffen en/of hulpstoffen:
  in ieder geval LNG & conventionele brandstoffen
- Handhavingsbeleid op de vergunning
- Streefdatum: operationalisering 1/07/2019

OPENSTAANDE ISSUES & PLANNING

DANK VOOR UW AANDACHT

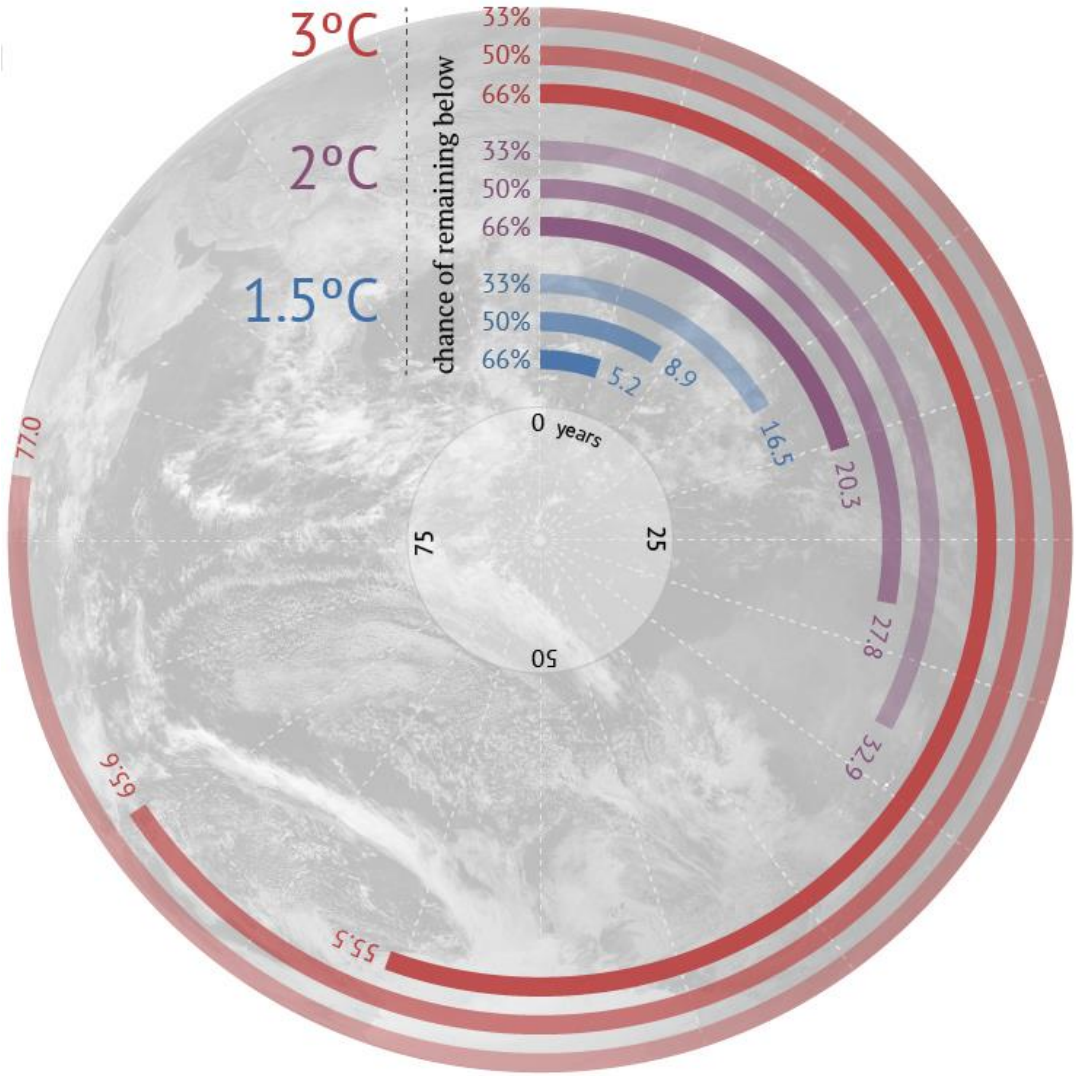
ENERGY TRANSITION

Pathway to marine fuels of the future | Richard Smokers

TNO innovation for life

PARIS AGREEMENT

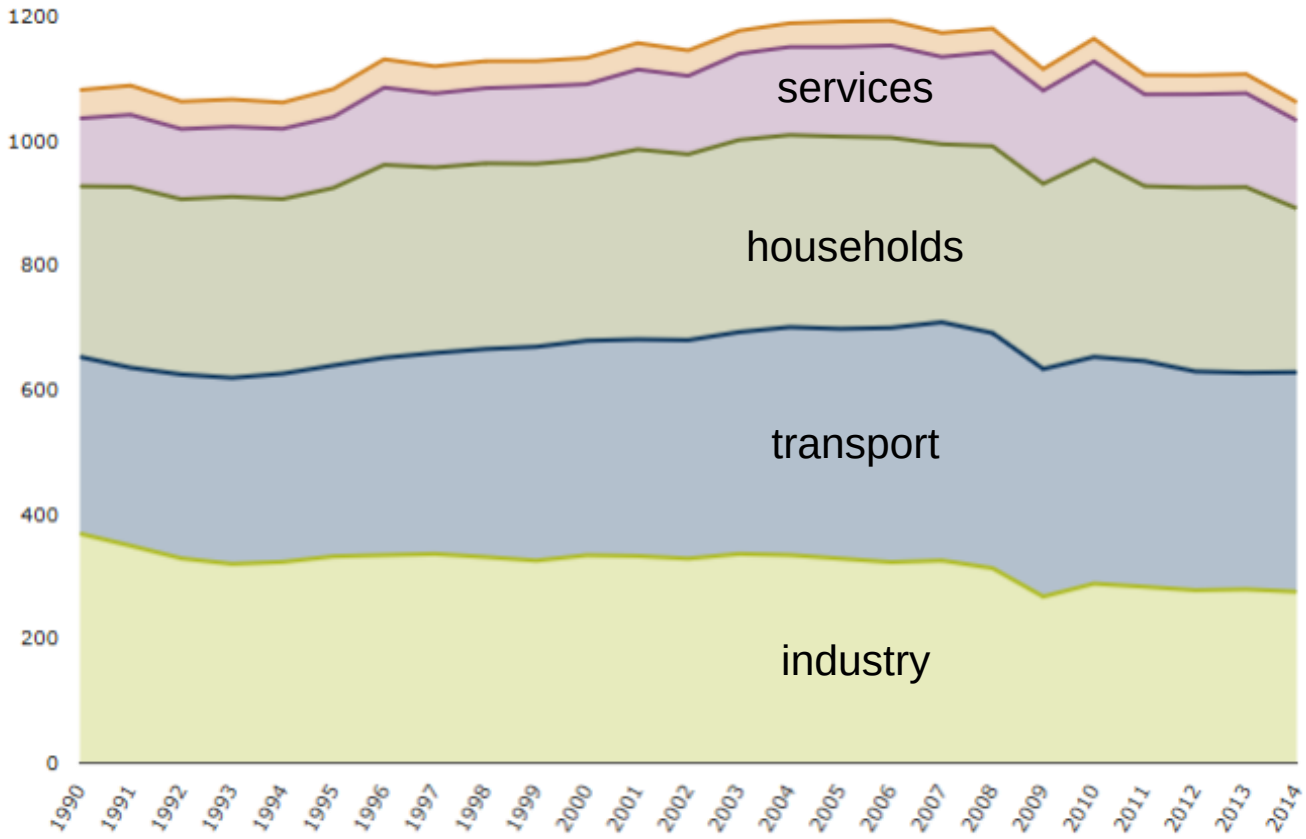
- **Limit global warming to max. 2˚C in 2100**
  - requires 80% CO_2 reduction in 2050 relative to 1990
    - 60% target for transport sector according to 2011 EU whitepaper
- **Strive for 1.5˚C in 2100**
  - requires 95% or more CO_2 reduction in 2050 relative to 1990
  - calls for quick reductions due to finite “carbon budget”
  - offers little room for lower reduction in transport sector
    - also transport sector should strive for 80 - 95% reduction



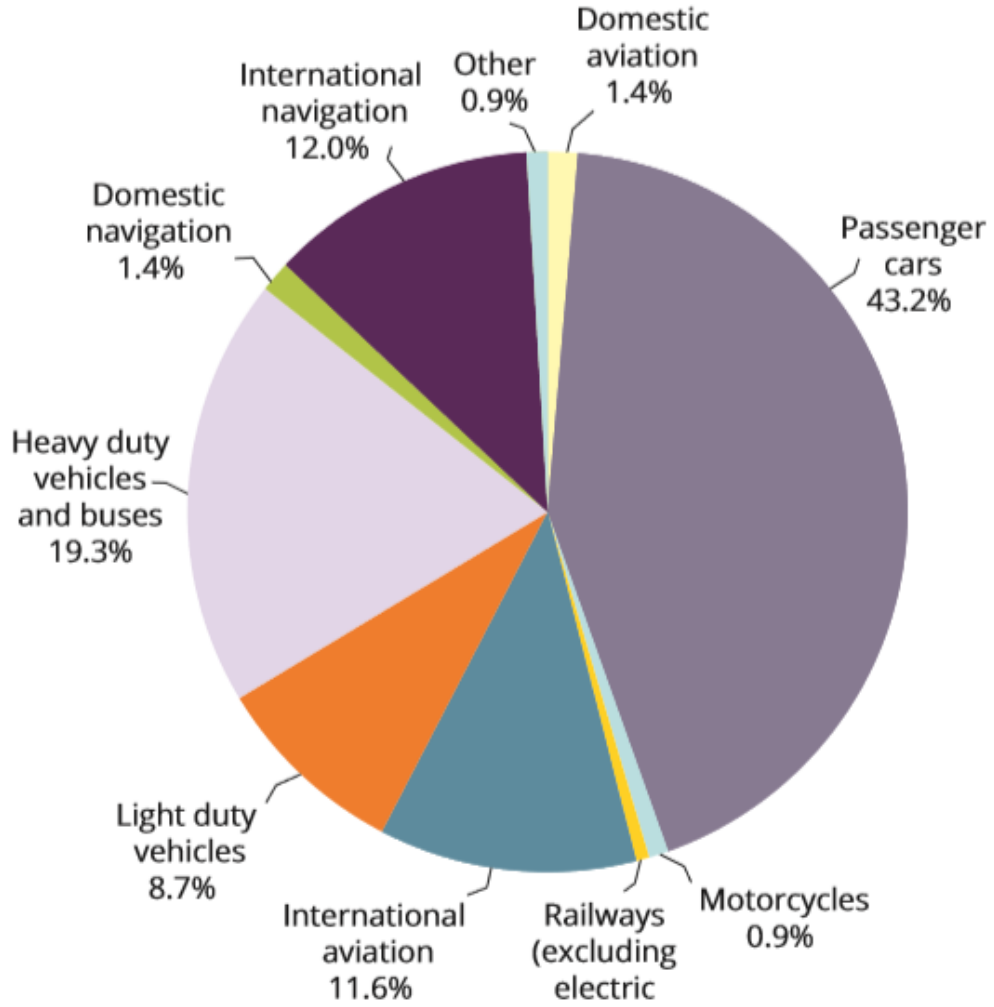
bron: www.carbonbrief.org

MARITIME EMISSIONS IN EU POLICY

Energy consumption per sector in EU (source EEA)



- Only short sea shipping included in CO_2 emissions that EU is held accountable for

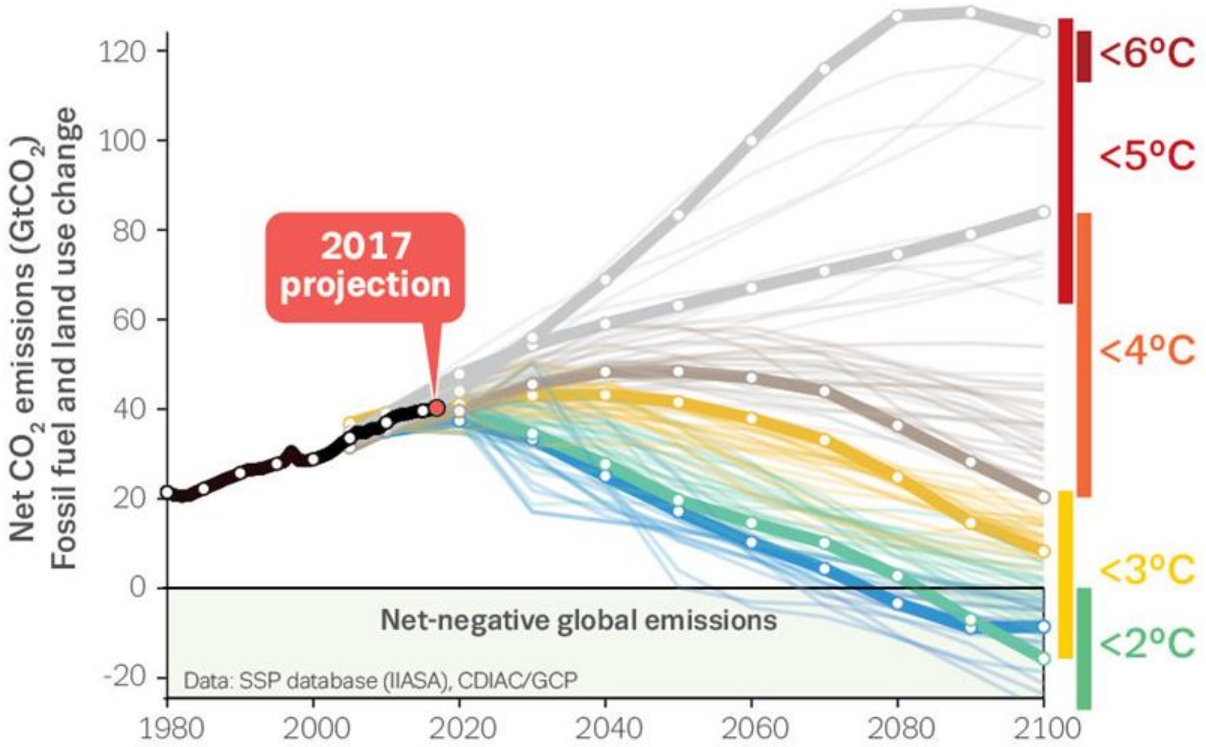


CO_2 emissions from transport in EU (source EEA)

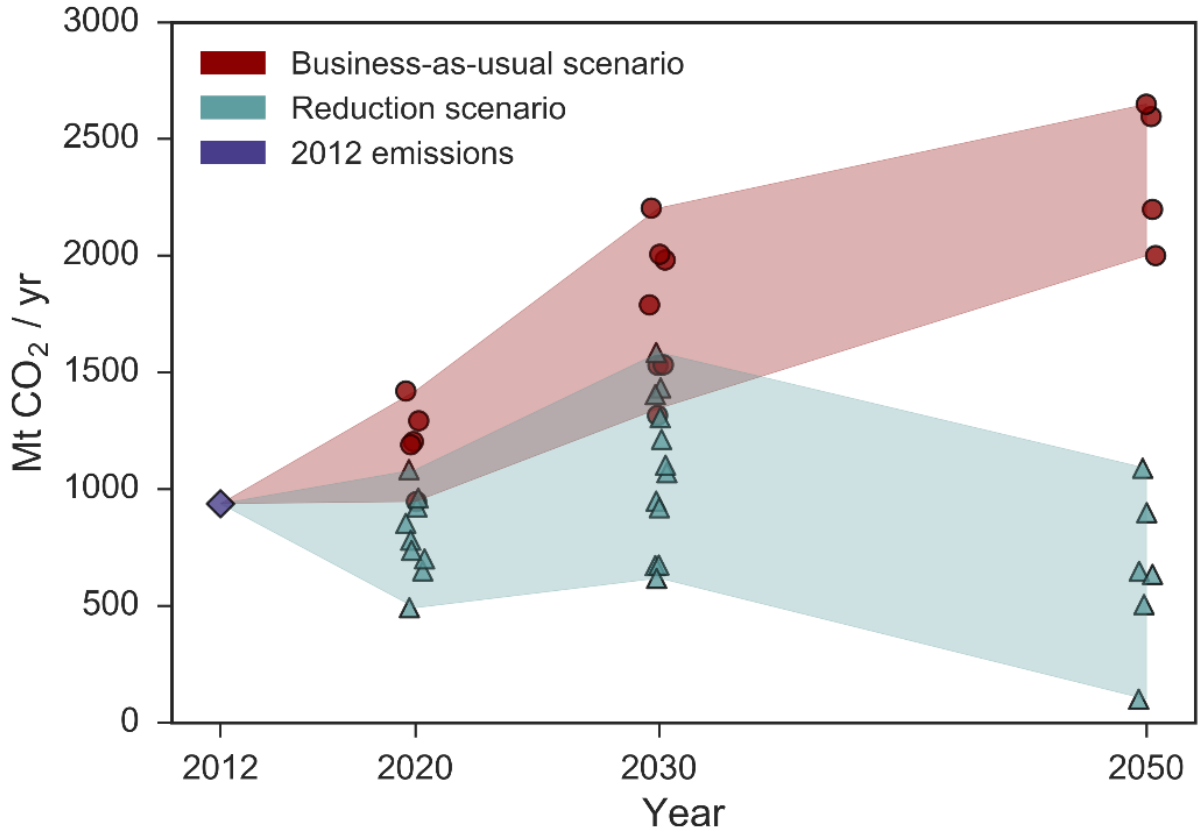
A GLOBAL PERSPECTIVE

REDUCTION GOAL FOR THE MARITIME SECTOR?

global economy



maritime sector



State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – A review

Evert A. Bouman [a,*], Elizabeth Lindstad [b], Agathe I. Rialland [b], Anders H. Strømman

IMO AGREEMENT 2018

- Decrease absolute CO_2 emissions: $2008 \xrightarrow{-50\%} 2050$

  1. Design: EEDI framework

  2. Operation: efficiency $\frac{gCO_2}{ton \cdot nm}$ $2008 \begin{cases} \xrightarrow{-40\%} 2030 \\ \xrightarrow{-70\%} 2050 \end{cases}$

- Focus up to 2030 - 2035:
  - Incremental technological improvements
  - Operational measures & slow steaming
- Focus long term:
  - Zero or low emission fuels
  - Transition in transport flows

LEVERS FOR CO_2 REDUCTION

transport demand

$$gCO_2 = \frac{gCO_2}{MJ} \times \frac{MJ}{v.km} \times \frac{v.km}{ton.km} \times \frac{ton.km}{ton} \times \frac{ton}{product} \times \#products$$

$\frac{gCO_2}{MJ}$	$\frac{MJ}{v.km}$	$\frac{v.km}{ton.km}$	$\frac{ton.km}{ton}$	$\frac{ton}{product}$	$\#products$
carbon intensity of energy carrier	vehicle efficiency	load factor	transport distance	product properties and packaging	size of production

efficient vehicles / vessels on renewable energy

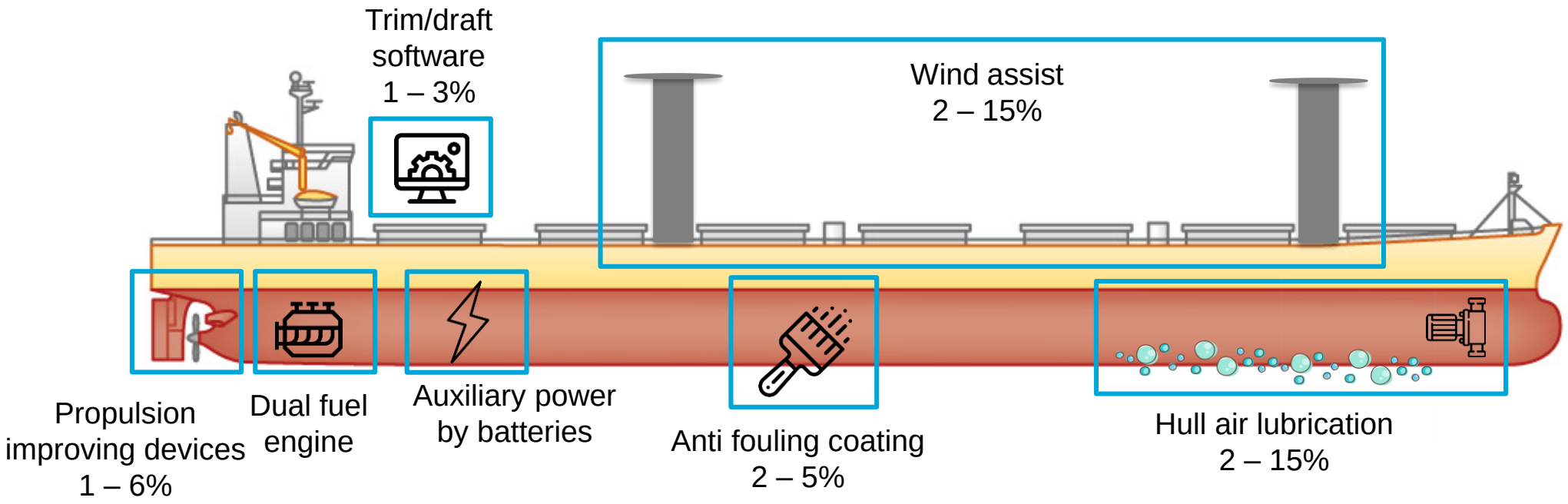
efficient logistics & supply chain

CASE STUDY SHORT TERM

CO_2 reduction:

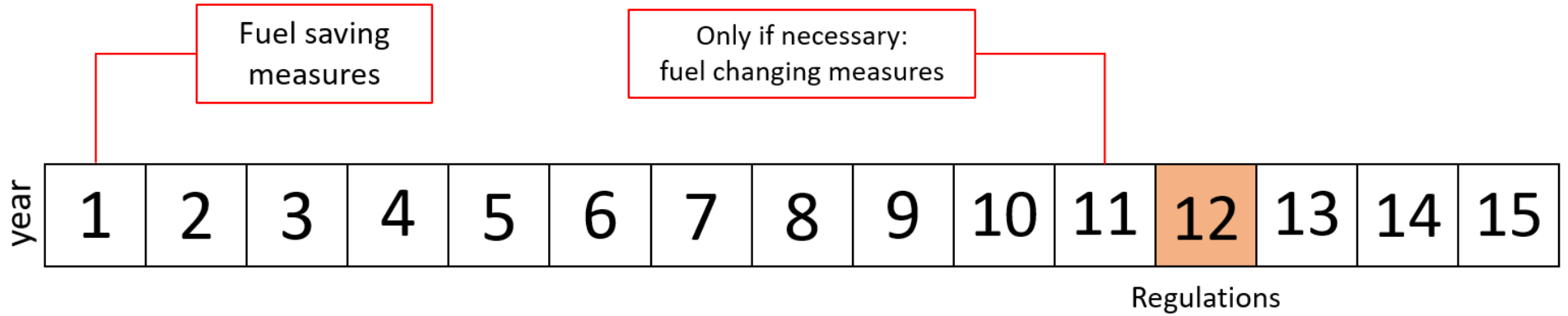
- Fuel saving measures
- Fuel changing measures

- Post-Panamax bulk carrier
- 93 000 DWT (length: 230m)
- Built in 2012
- Analysis: 15 years

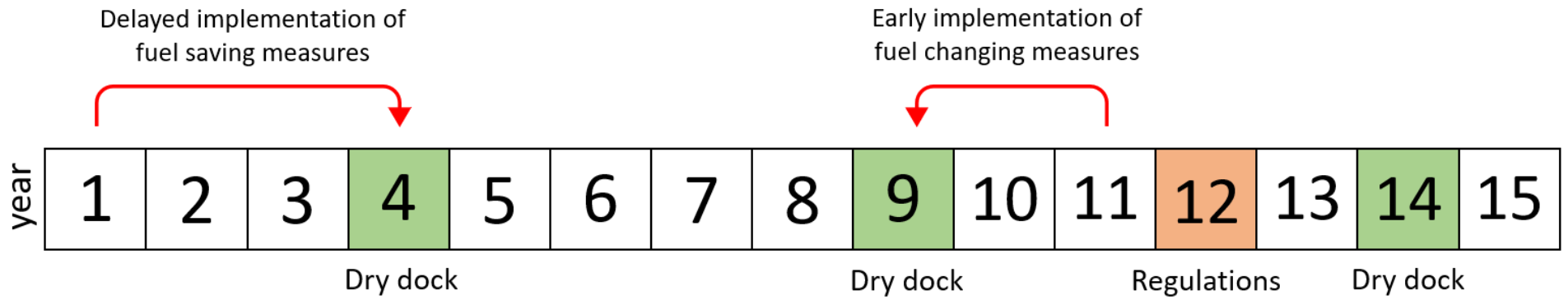


IMPLEMENTATION SCHEDULE

Baseline scenario

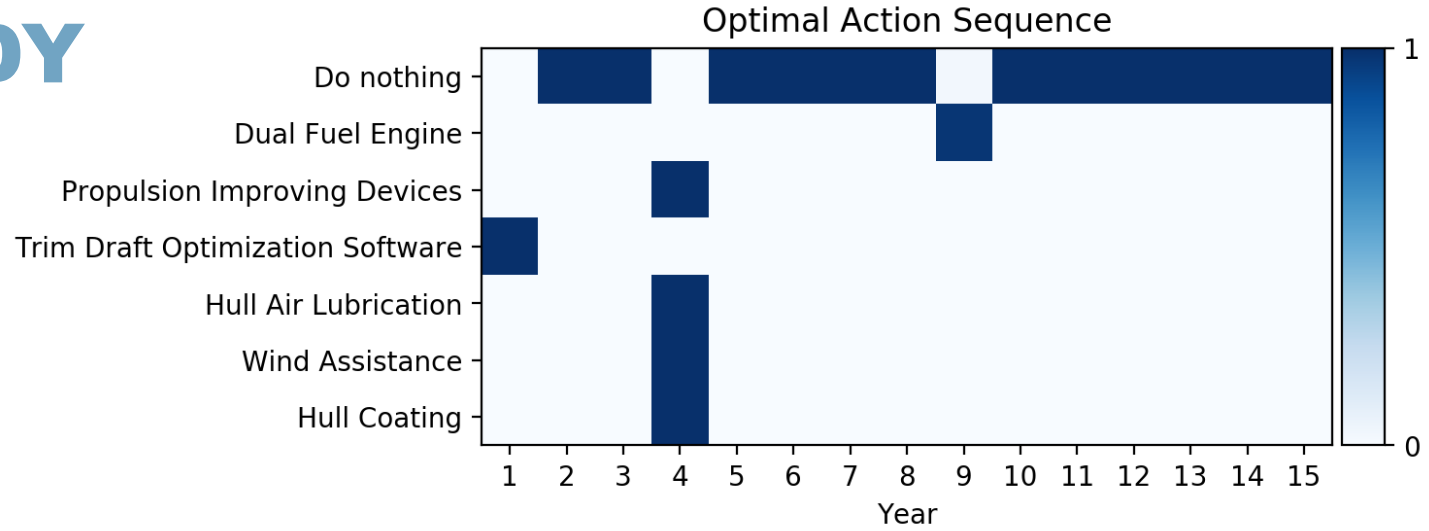


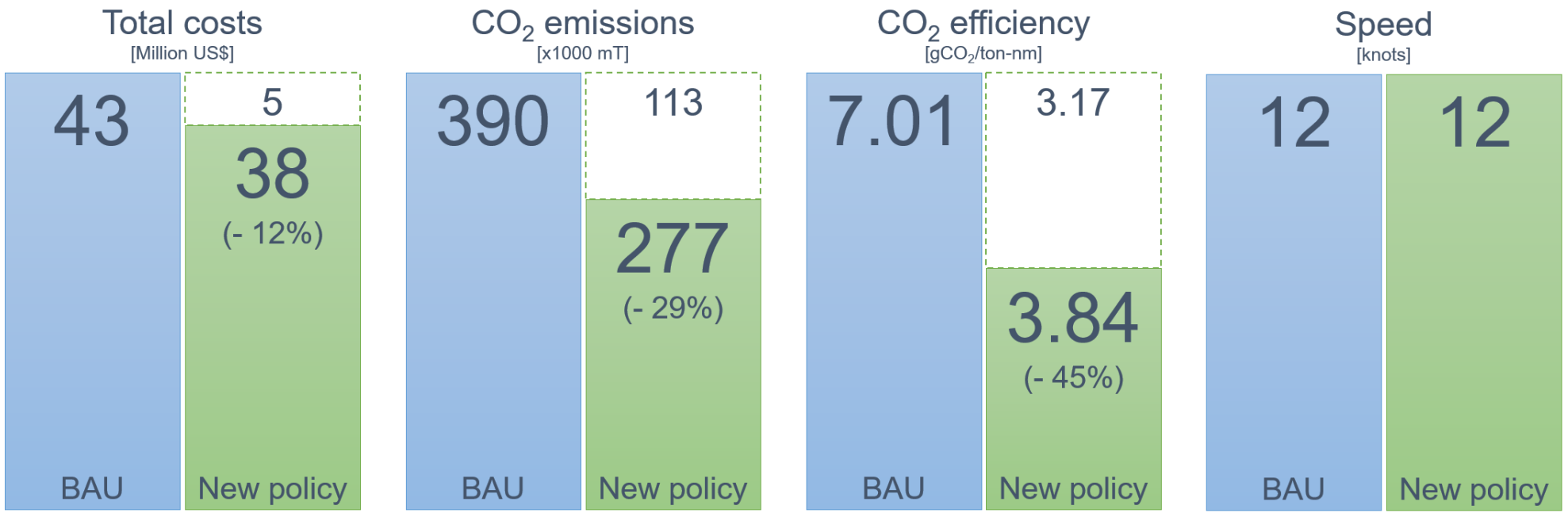
Docking schedule included



EFFICIENT VESSELS

RESULTS CASE STUDY





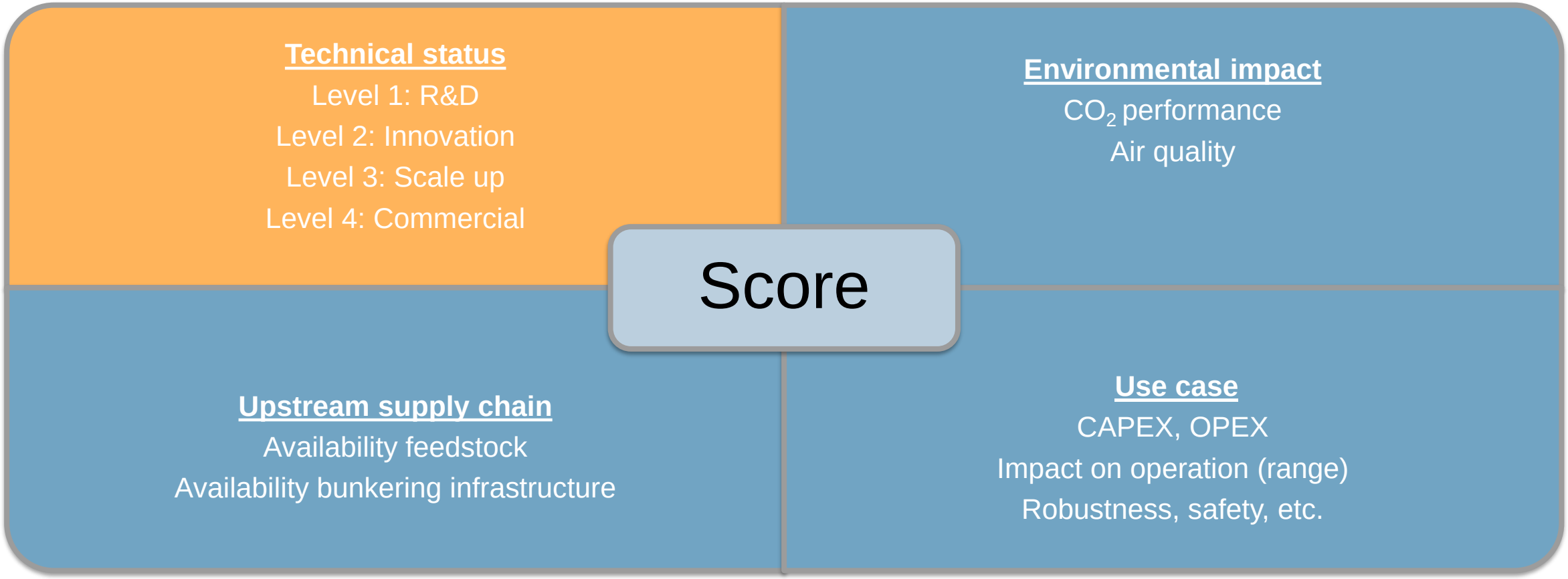
FUELS: PHASE OF DIVERGENCE

- Many fuel options available for the longer term future

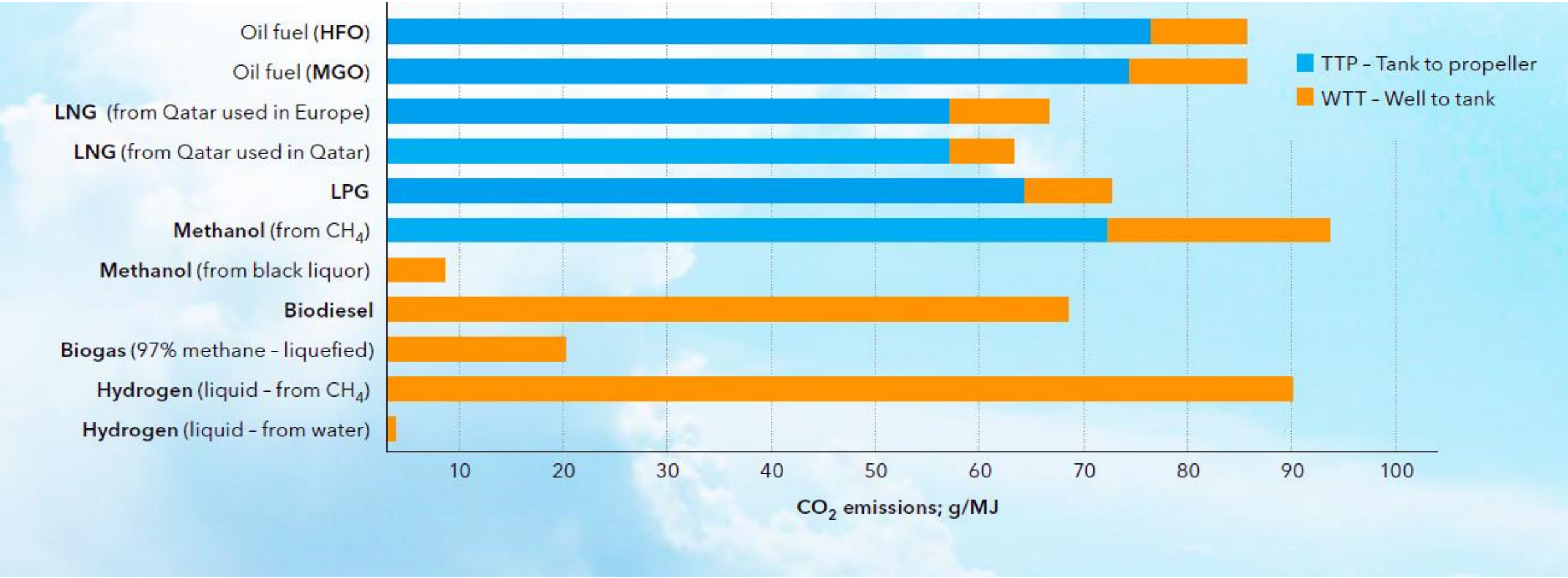
Feedstock	Energy carrier
alternative fossil	CNG / LNG
	methanol
	MTBE
	GTL
	ULSFO
	DME
	electricity
	hydrogen (thermal / electrolysis)
wind/sun Power-to-X	Power-to-DME
	Power-to-methanol
	Power-to-kerosine
	ammonia
	formic acid
	green electricity
	Power-to-H2 (electrolysis)
nuclear	electricity from on-board plant

Feedstock	Energy carrier
biomass/biogas	PPO (pure plant oil)
	FAME 100%
	HVO-diesel
	HVO-kerosine
	bio-ethanol
	bio-methanol
	bio-MTBE
	bio-DME
	compressed bio-methane (CBG)
	liquid bio-methane (LBG)
	electricity (wood)
	bio-H2 (thermal, wood)
	bio-H2 (electrolysis, wood)
biomass/algae	biodiesel algae

SCORING SYSTEM

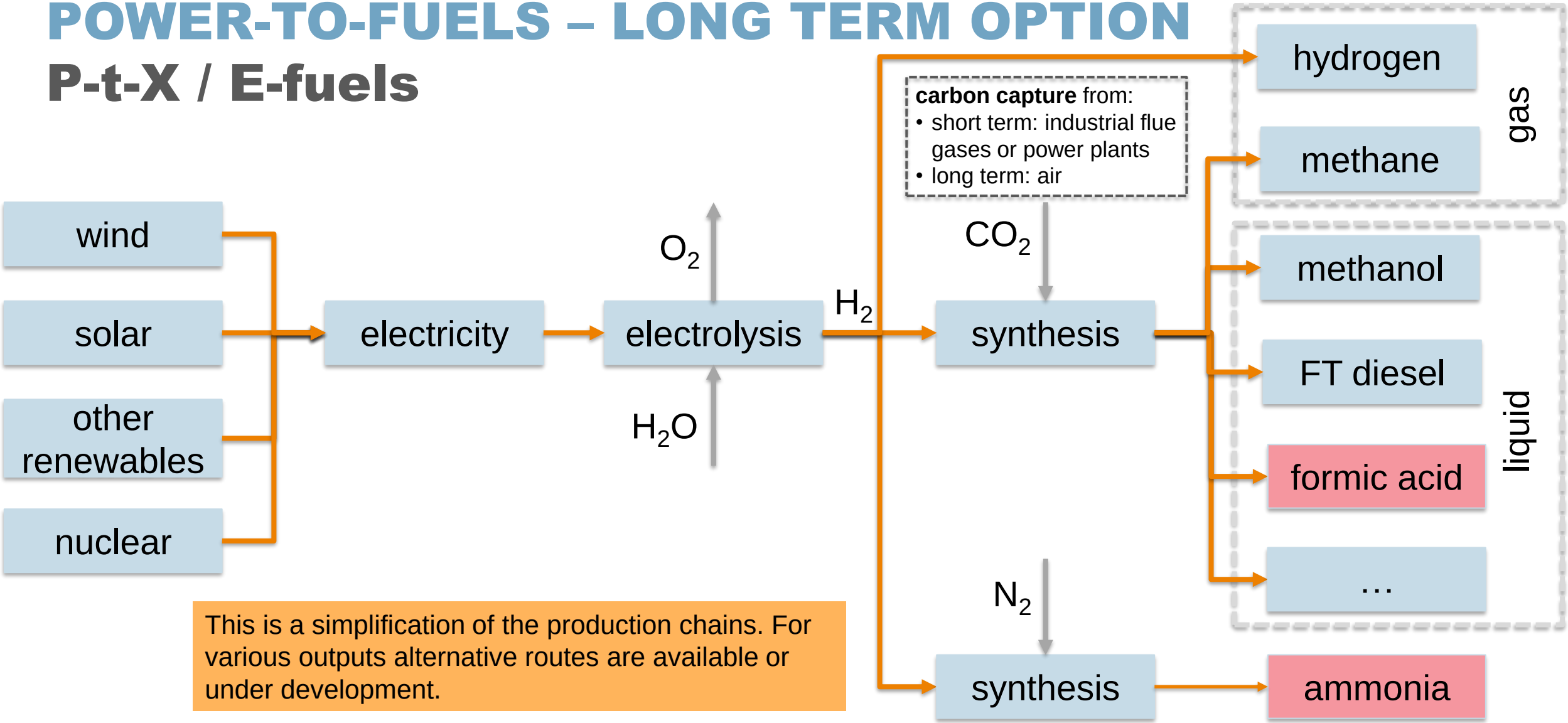


DIRECT & INDIRECT GHG EMISSIONS



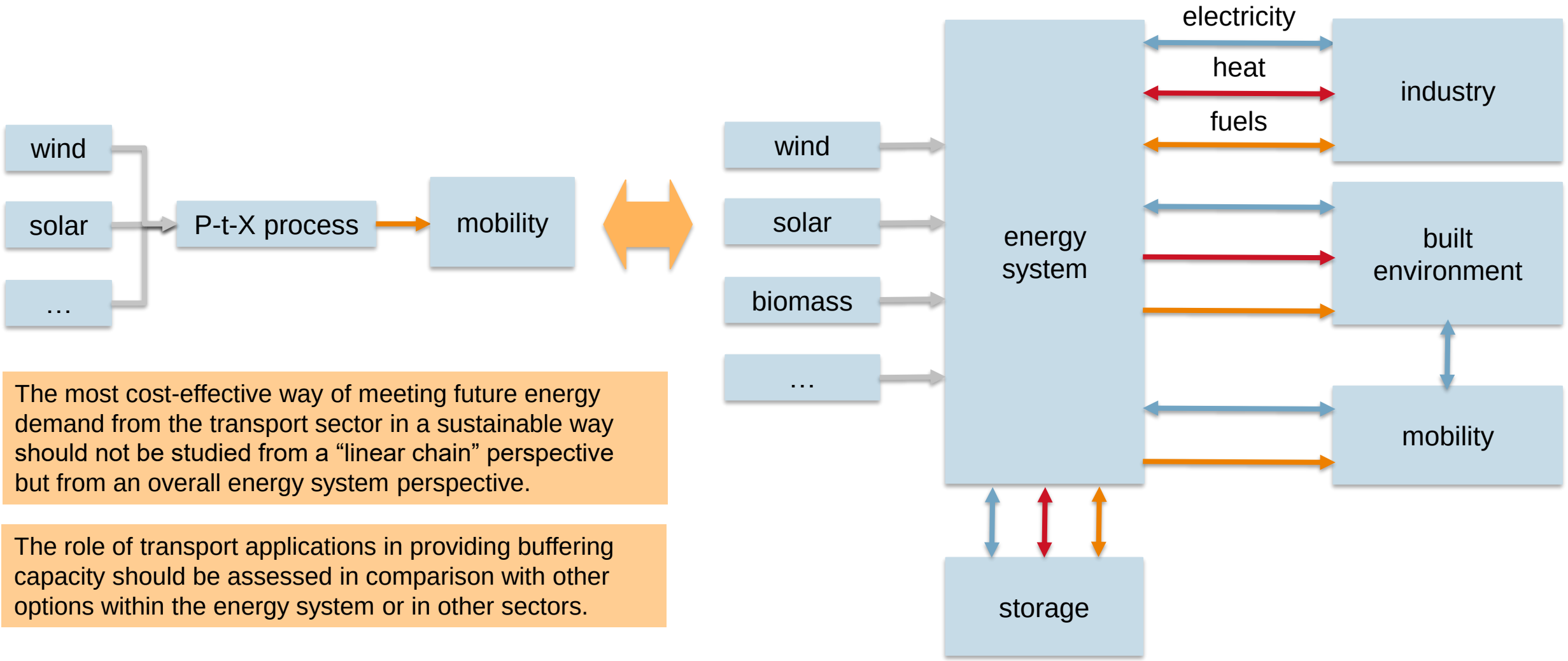
POWER-TO-FUELS – LONG TERM OPTION

P-t-X / E-fuels



This is a simplification of the production chains. For various outputs alternative routes are available or under development.

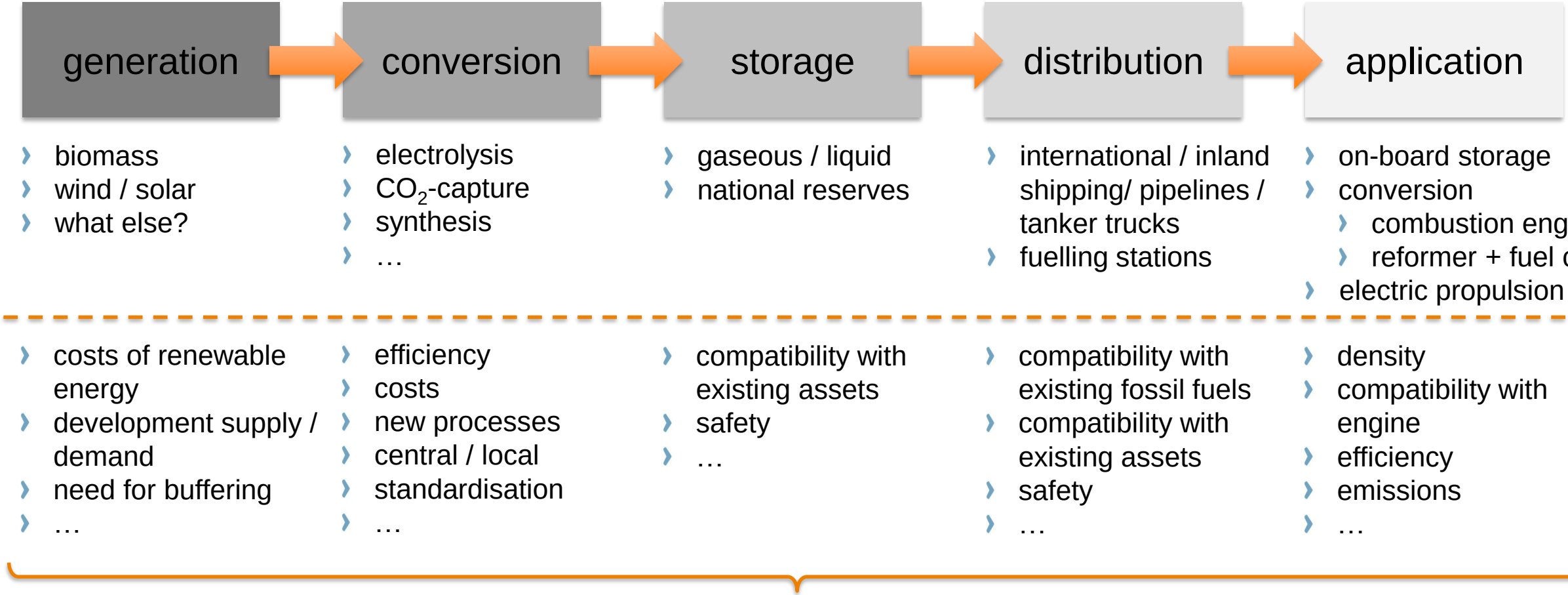
NEED FOR A SYSTEM APPROACH



The most cost-effective way of meeting future energy demand from the transport sector in a sustainable way should not be studied from a “linear chain” perspective but from an overall energy system perspective.

The role of transport applications in providing buffering capacity should be assessed in comparison with other options within the energy system or in other sectors.

CALL TO ACTION



Successful implementation of a new fuel requires a system approach.
Close collaboration between stakeholders in concrete use cases is needed.

CONCLUSIONS

- Urgency for CO_2 reduction in maritime sector has increased
  - More stringent global target requires quick reductions
  - But fleet renewal is slow in maritime sector
- Serious CO_2 reduction strategies for maritime sector are finally beginning to be developed
- Cost-effective potential available for efficient vessels
  - Cost-effectiveness of measures to existing ships can be improved with careful planning of vessel modifications
- The quest for future, renewable shipping fuels is in a “divergence phase”
  - Is there still a “bottom of the barrel” in the world of renewable fuels?
- Finding the right future fuel(s) requires a system perspective


THANK YOU FOR YOUR ATTENTION
TNO innovation for life