EU refiners Association perspective: 2020 Marine Fuels supply study

"Information day", Italian ship owner, operator & Class Society

20th February 2019, Rome, Confitarma

Damien Valdenaire, Science Executive

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Agenda

01 European Petroleum Refiners Association

02 Observations & stakes (Global S Cap in 2020)

03 Concawe LP Modelling study

04 Appendix

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01 European Petroleum Refiners Association

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Concawe Membership: 41 Member companies (100% EU ref.)

- Open to companies owning refining capacity in the EU

Europe (2017): 77 Mainstream refineries + 13 “Specialized” (14 mb/cd capacity)

Available on Concawe website

NAME	COUNTRY	OWNERS	P C [KBBL/CD]	P C [MT/A]	STATUS
AGHII THEODORI	Greece	Motor Hellas	110.0	5.5	Open
ANTWERP	Belgium	ExxonMobil	307.0	15.4	Open
ANTWERP	Belgium	TOTAL	338.0	16.9	Open
ANTWERP	Belgium	Gunvor	107.0	5.4	Open
ANTWERP	Belgium	ATPC	24.0	1.2	Open
ARPECHIM (PITESTI)	Romania		77.0	3.9	Closed
ASESA	Spain	CEPSA/REPSOL	20.0	1.0	Open
ASPROPYRGOS	Greece	Hellenic	146.5	7.3	Open
AUGUSTA	Italy	ExxonMobil	198.0	9.9	Open

NUMBER OF REFINEREIES	CAPACITY KB/CD	CAPACITY MT/A
90	13297	665

MAINSTREAM REFINERIES IN OPERATION	SPECIALISED BITUMEN, LUBE OR CONDENSATE REFINERIES	TOTAL
77	13	90

02 Observations & stakes (Global S Cap)

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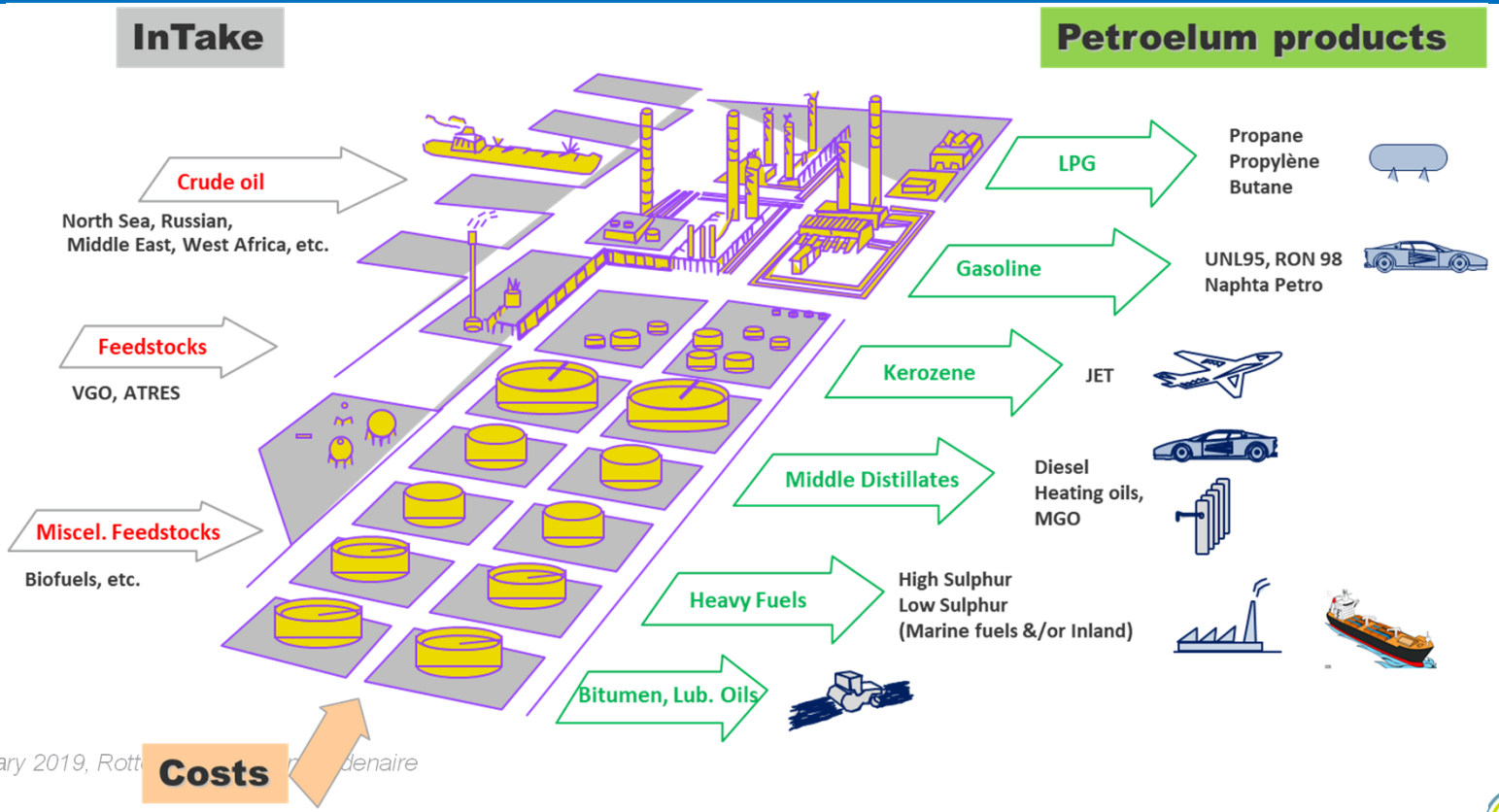
Oil refining: operating principle



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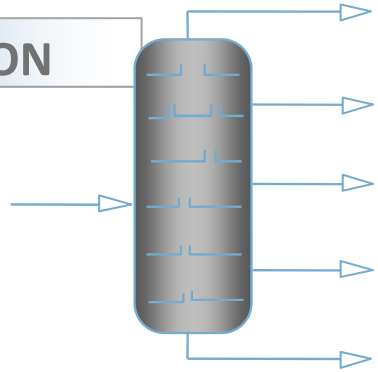
Crude oil refining

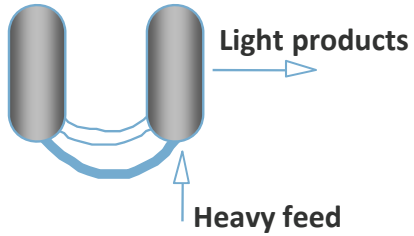
1 DISTILLATION

- Crude Oil (LS & HS)
- Condensate



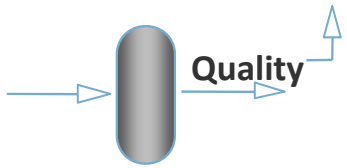
2 CONVERSION

- FCC
- Hydrocraking
- Coking
- Visbreacking

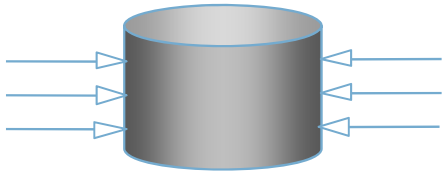


3 IMPROVEMENT

- Reforming
- Hydrotreating
- Alkylation
- Isomerisation



4 BLENDING



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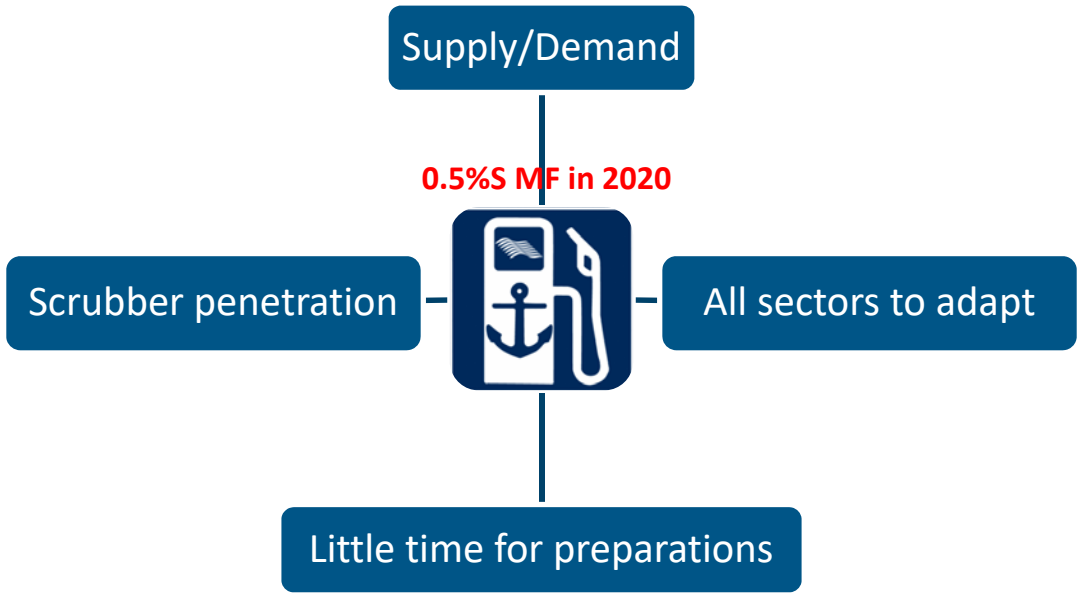
No transition period, only implementation measures and guidelines discussed at IMO ISWG & PPR

Items for Working Group:

- Ship Implementation plan,
- Standard format for FONAR (Fuel Oil Non Availability Reporting),
- Port state control guidelines,
- Safety issues and Industry guidance,
- Etc.

Industry challenges: 4 pillars



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Unprecedented product quality change

Marine Fuels producers

2020, what may go wrong for refiners ?

Reputational

Engine failure, losing control at sea …

Reputational

Market shortage (distillate) and over supply (other products)

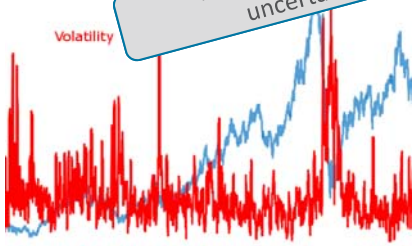
Level playing field

Non compliance!

Product quality

Non compatibility, sedimentation, un-stability

Investment



High volatility, high uncertainty

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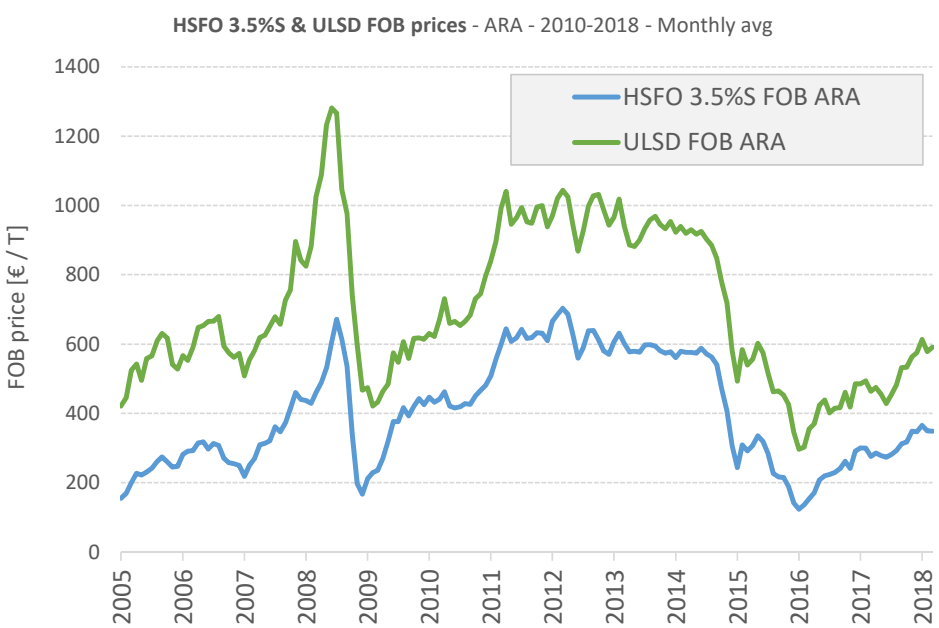
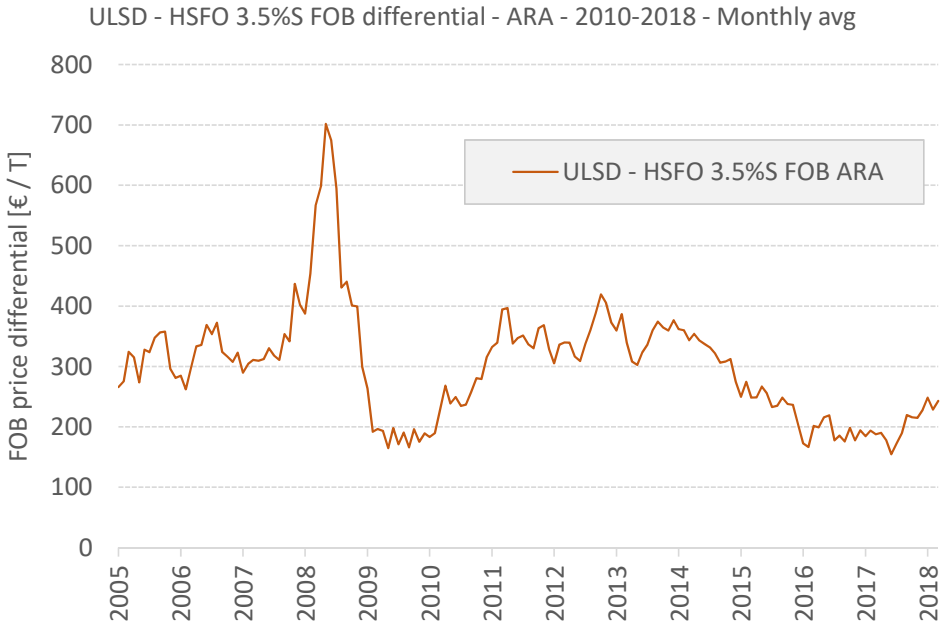
Historical price differentials: HS Bunker versus Diesel ULSD





Source: Thomson Reuters

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03 Concawe LP modelling study

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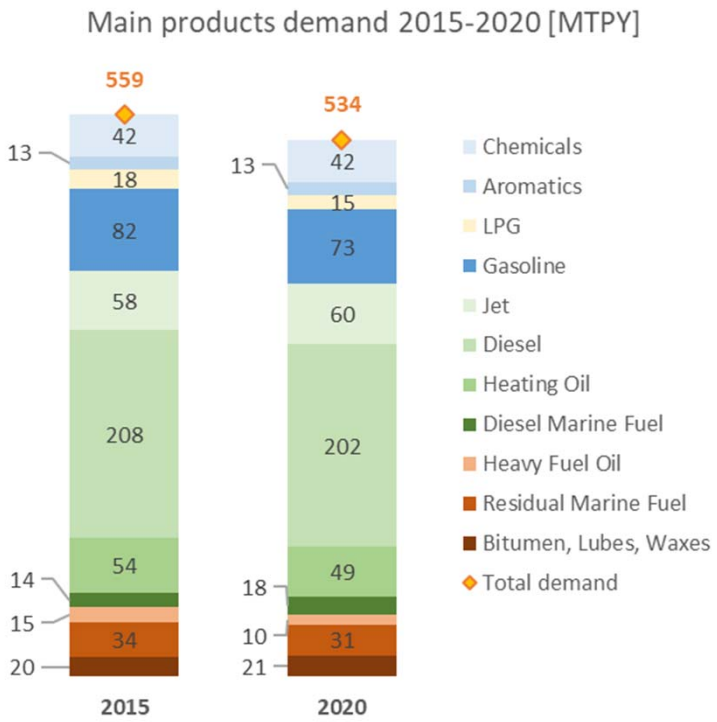
2020 base case hypothesis for Concawe LP simulations

Order book from scrubber suppliers getting full… (majority being « open-loops »)

Key hypothesis

- "Scrubbed" Marine Fuels: **7%** of demand (3 MTPY*)
- About 27 MTPY of Refinery Marine Fuel (RMF) to switch from ~2.9%S to 0.5%S
  - Switch to NGL not considered as will remain marginal (conservative approached)
- No "Non-compliance"
- Middle Distillates imports and High Sulphur Fuel Oil (HSFO) export allowed as per 2014 real data



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* MTPY: Million Tonnes Per Year

Typical routes to produce 0,50%S marine Fuels

Every refinery has different level of complexity … however

1. Ultra low Sulphur crude → Vacuum residue/Visbroken residue lower or close from 0.50wt%S
2. Atmospheric residue/Vacuum residue (HS) → through desulphurization process units
3. VGO LS (lower or close from 0.50%) or VGO HS → treated through desulphurization process units
4. Middle distillates, either straight run (<0.50%) or treated through desulphurization process units
5. Middle distillates from conversion units (LCO ex FCC, Gasoil ex Visbreaker, etc.)

Heavy Fuels (<50%)

« Light » Fuels (>50%)

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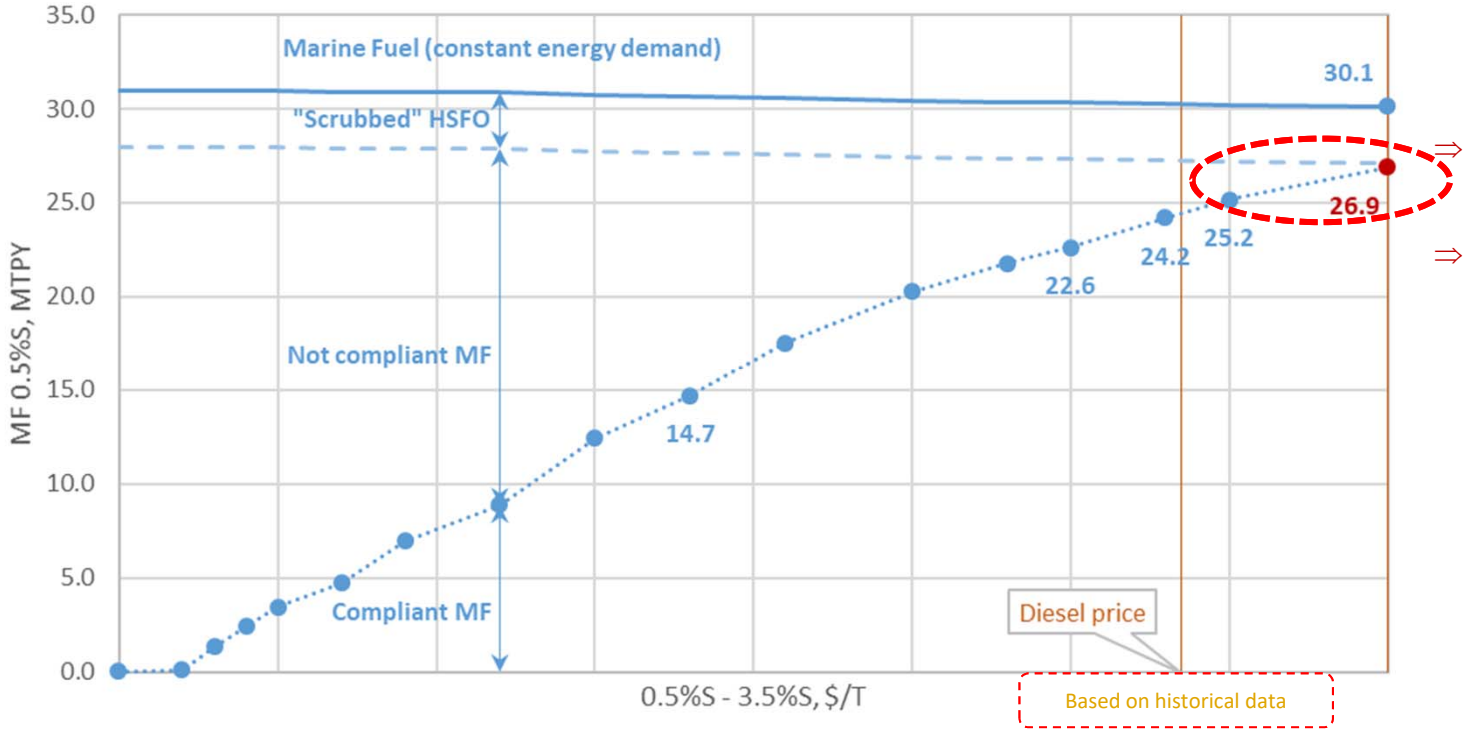
Modelling results – Marginal Supply of 0.5%S is taken from Middle distillate pool!

3.5%S-0.5%S RMF price differential study

- 12 runs: gradual change of 0.5%S – 3.5%S differential price
- **SRU and HMU investments** allowed

⚠ **LP modelling results**



⇒ Full compliance at middle distillate price for 0.5%S MF

⇒ 'Highly constrained' solution

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Modelling results – evolution towards Middle Distillates

HS Refinery Marine Fuels (3 MTPY in 2020)

- S content goes up from 2.9wt% (31MTPY) to potentially **4,2wt%** ("scrubbed HSFO")
- Viscosity and density remain a constraint (maximized)

Marine Fuel 0.5wt%S (27 MTPY in 2020)

Modelling shows a blending of multiple product, we split in 2 categories

1. Heavy fuel at 0.5%S
   - Will most likely represent 30 to 50% of the demand
   - Pour point (30°C) and S maximized
   - Density around 0.97 and viscosity ~25 cSt@100°C
2. Middle Distillate Marine Fuel
   - Will most likely represent 50 to 70% of the demand
   - Pour point around 0°c and S maximized
   - Density around 0.87 and viscosity ~6 cSt@100°C

CO2 emissions from refining

- In our mean scenario, **+4%** (+8 Mt/y)

* MTPY: Million Tonnes Per Year

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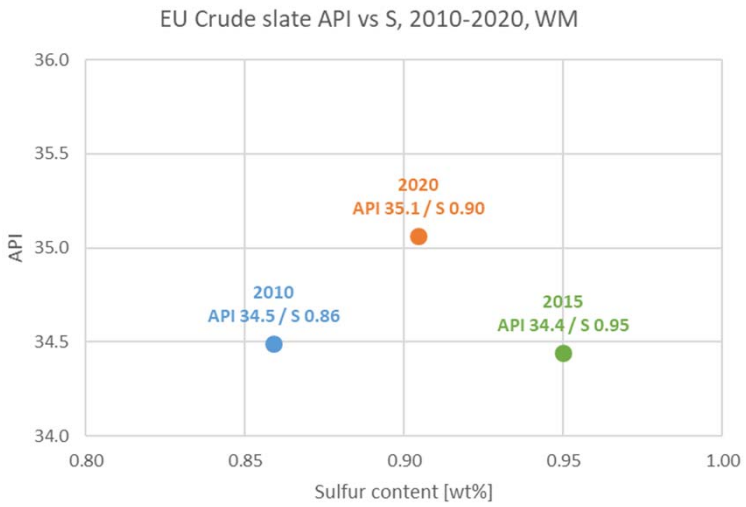
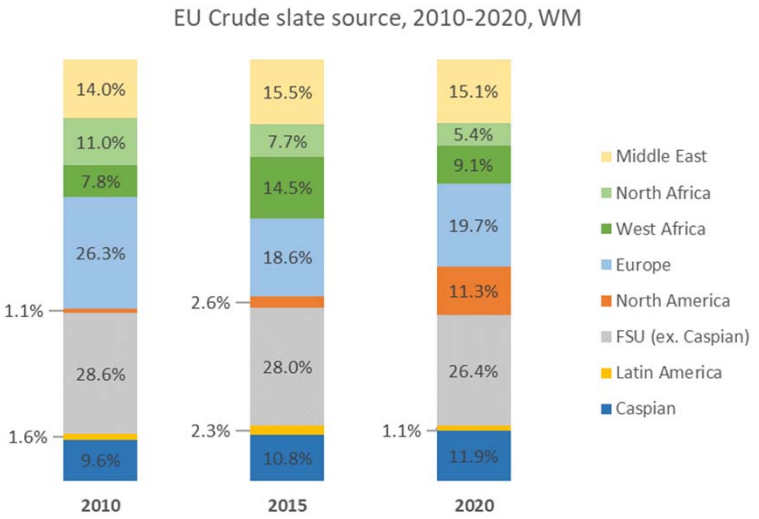
Sensitivity case: EU crude slate update

- **WoodMackenzie latest 2020 forecasts**
  - *In 2020 EU average crude slate is lighter and sweeter than in 2010 / 2015*
  - *Crude origins remain globally similar, but with a breakthrough North America supply*





Conclusions from Concawe study (preliminary)

On a whole EU28+3 refining system, full 0.5%S MF compliance by 2020 is not straightforward

- Main conversion and Hydro-treating units to be maintained at a high throughput
- Model needs strong incentive to supply the MF demand at 0.50%S
- A key **uncertainty is world region trade flows** (Middle distillates imports and HSFO exports)
  - HSFO export feasibility and alternative market remain key unknown

Crude slate

- Current investigation shows no significant changes for the average EU crude slate …
  - Major uncertainty at refinery level

Conclusions from Concawe study (preliminary)

Beyond refining…

- **New fuel formulation***, LP model being “blind” for:
  - Compatibility, lubricity, flash point, cold flow properties, sedimentation…
- Rate of **Scrubber installation post 2020?**

Compatibility:
Samples collected from refiners, testing on going.
Objective is to issue compatibility criterias
(ISO / CIMAC / Concawe)

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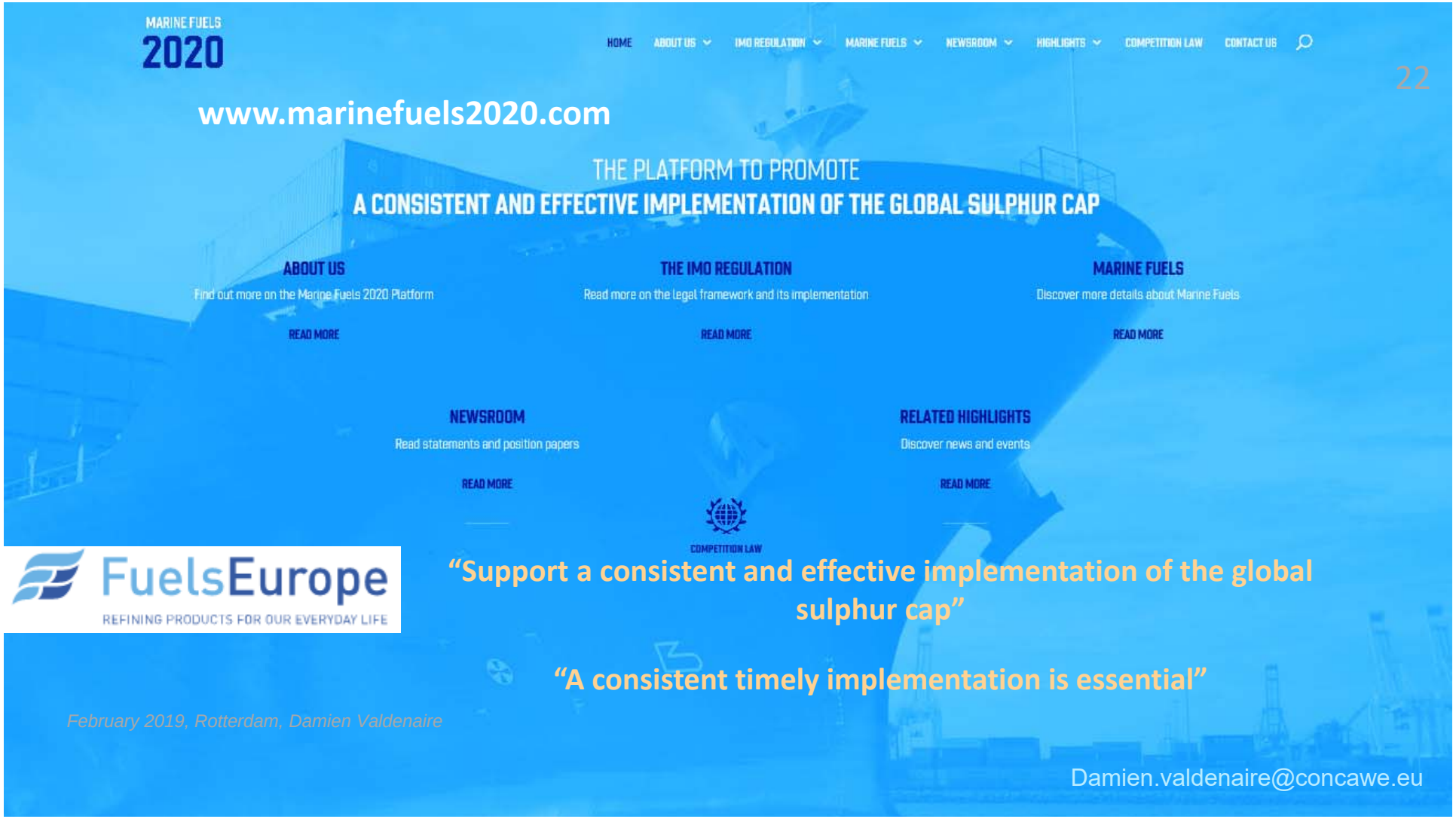
** See other reports, e.g. EnSys/Navigistics, VPS at Platts 7th MD conf*

www.marinefuels2020.com



FuelsEurope
REFINING PRODUCTS FOR OUR EVERYDAY LIFE

"Support a consistent and effective implementation of the global sulphur cap"

"A consistent timely implementation is essential"

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04 APPENDIX

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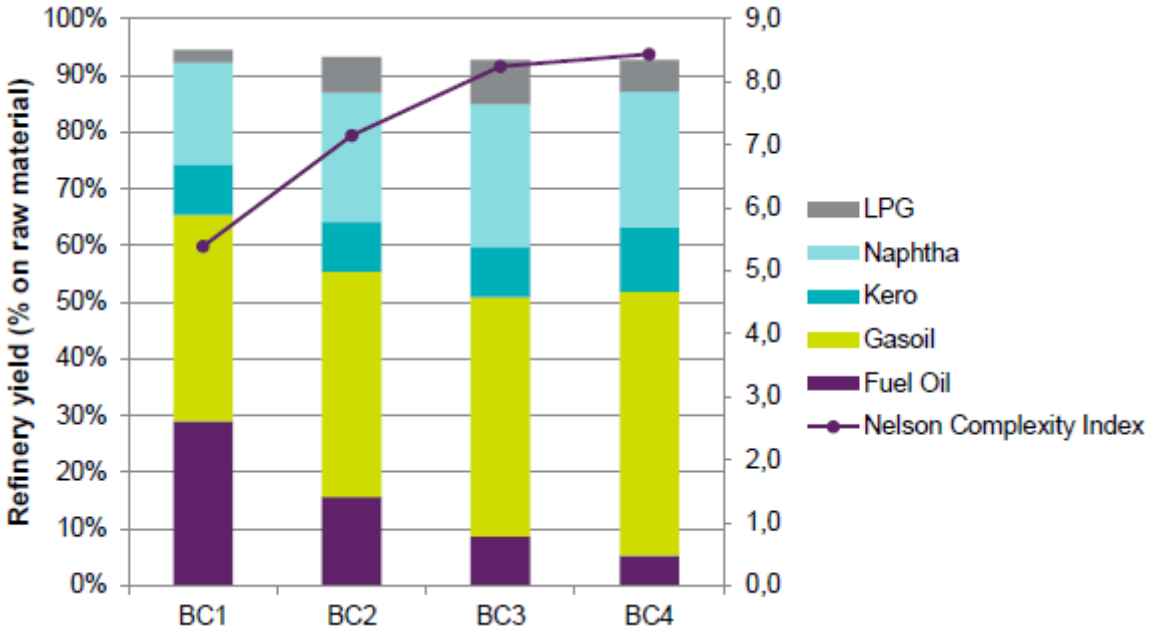
Sulphur content of crude oil distillation curves

Crude cuts	Sulphur, wt%					
	EKOFISK	BONNY	ARAB LT	URALS	ARAB HY	MAYA BL
Light Naphtha	0.00007	0.00232	0.06510	0.00085	0.00706	0.05547
Heavy Naphtha	0.00257	0.00786	0.03610	0.01310	0.01320	0.07052
Full Range Naphtha	0.00168	0.00619	0.04331	0.00916	0.01094	0.06660
Kero	0.018	0.027	0.086	0.183	0.280	0.268
Light Gasoil (LGO)	0.111	0.097	0.981	1.011	1.530	1.362
Heavy Gasoil (HGO)	0.242	0.201	2.175	1.590	2.385	2.366
Atmospheric Residue	0.481	0.298	3.399	2.451	4.440	3.990
Light Vacuum Gasoil (LVGO)	0.258	0.215	2.216	1.627	2.426	2.386
Heavy Vacuum Gasoil (HVGO)	0.379	0.280	2.764	2.010	2.768	2.866
Vacuum Residue	0.642	0.430	4.201	3.000	5.386	4.809

AMEC FOSTERWHEELER: **ReCAP Project, Evaluating the Cost of Retrofitting CO2 Capture in an Integrated Oil Refinery, February 2017**

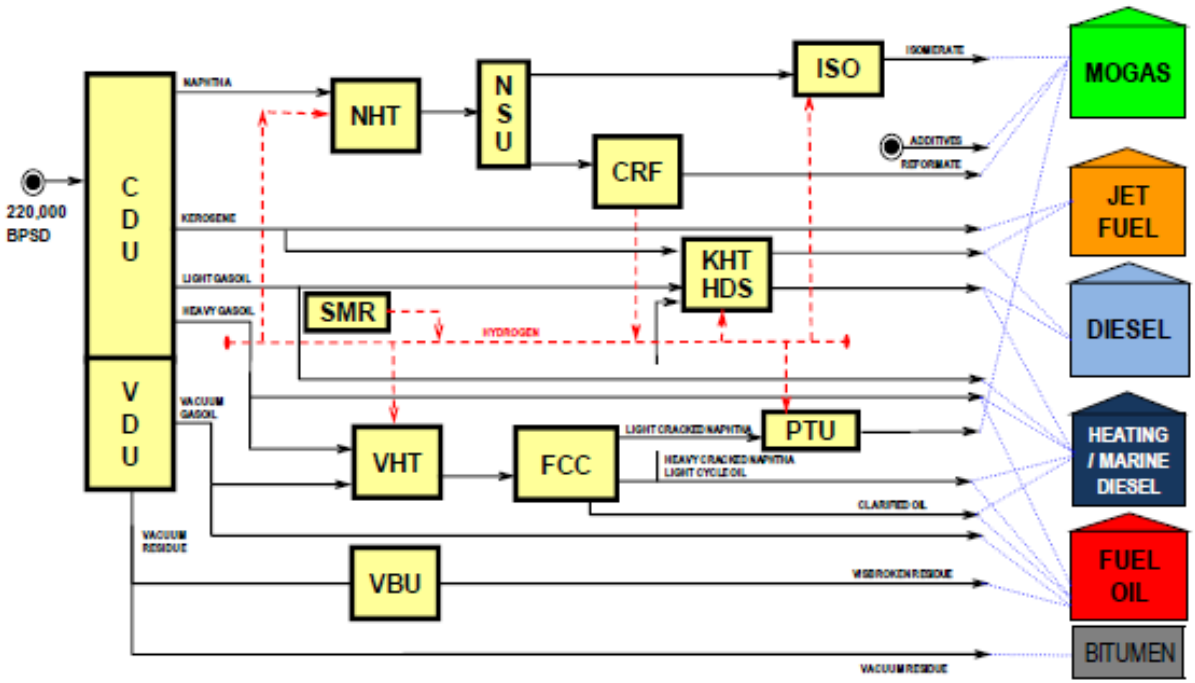
Refinery yields in different European Base Case configuration



BC1 = Hydroskimming (simple)
BC2 = Medium complexity
BC3 = Highly Complex (220kbbl/d)
BC4 = Highly Complex (350kbbl/d)

AMEC FOSTERWHEELER: **ReCAP Project, Evaluating the Cost of Retrofitting CO2 Capture in an Integrated Oil Refinery, February 2017**

Typical refinery scheme: Medium conversion



Crude Distillation Unit (CDU)
Saturated Gas Plant (SGP)
LPG Sweetening (LSW)
Kerosene Sweetening (KSW)
Naphtha Hydrotreater (NHT)
Naphtha Splitter (NSU)
Isomerization Unit (ISO)
Catalytic Reformer (CRF)
Reformate Splitter (RSU)
Kerosene Hydrotreater (KHT)
Diesel Hydro-desulphurisation Unit (HDS)
Vacuum Gasoil Hydrotreater (VHT)
Fluid Catalytic Cracker (FCC)
FCC Gasoline Post-Treatment Unit (PTU)
Vacuum Distillation Unit (VDU)
Steam Methane Reformer (SMR)
Visbreaker Unit (VBU)
Amine Regeneration Unit (ARU)
Sour Water Stripper Unit (SWS)
Sulphur Recovery Unit (SRU)
Waste Water Treatment (WWT)
Power Plant (POW)

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Refinery scheme: Highly Complex

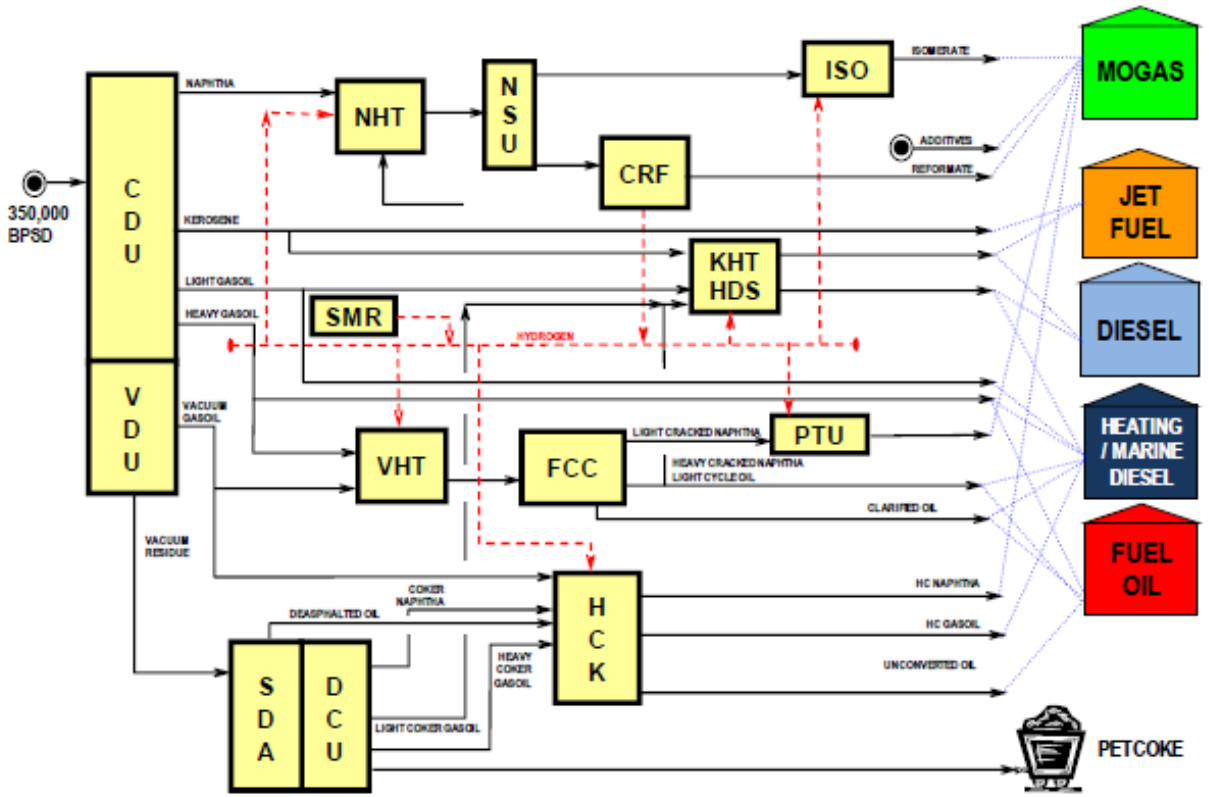

Figure 1-4: Simplified flow diagram for Base Case 4

Crude Distillation Unit (CDU)
Saturated Gas Plant (SGP)
LPG Sweetening (LSW)
Kerosene Sweetening (KSW)
Naphtha Hydrotreater (NHT)
Naphtha Splitter (NSU)
Isomerization Unit (ISO)
Catalytic Reformer (CRF)
Reformate Splitter (RSU)
Kerosene Hydrotreater (KHT)
Gasoil Hydro-desulphurisation Unit (HDS)
Vacuum Gasoil Hydrotreater (VHT)
Hydrocracker Unit (HCK)
Fluid Catalytic Cracker (FCC)
FCC Gasoline Post-Treatment Unit (PTU)
Vacuum Distillation Unit (VDU)
Steam Methane Reformer (SMR)
Solvent Deasphalting Unit (SDA)
Delayed Coker Unit (DCU)
Amine Regeneration Unit (ARU)
Sour Water Stripper Unit (SWS)
Sulphur Recovery Unit (SRU)
Waste Water Treatment (WWT)
Power Plant (POW)