A Refinery Strategy for the 0.5% Sulphur Bunker Fuel World
Bunker Fuel Sulphur Emissions Limits

- **Global**: Percent Fuel Sulphur Equivalent in Stack Emissions
- **ECA**: Emission Control Area
- **EEZ**: Exclusive Economic Zone
- **Global Alternative Scenario**

<table>
<thead>
<tr>
<th>Year</th>
<th>Global</th>
<th>ECA</th>
<th>EEZ</th>
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<td>3.5</td>
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<td>2015</td>
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<td>2017</td>
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<tr>
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<tr>
<td>2025</td>
<td>2.5</td>
<td>1.5</td>
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</tbody>
</table>
Global Fuel Oil Demand

Residual Heavy FO and GO Bunker

- Fuel Oil Other
- Fuel Oil Power
- Fuel Oil Bunker (ships)
- Gasoil Bunker

Marine 0.5% HFO demand - 2020

- North America: 230 mln t/y
- Africa: 4%
- ME: 8%
- Latin America: 10%
- Europe: 23%
- CIS: 3%
- Asia: 45%
- Total: 4.2 MMBD

Total Shipping: ~300 mln t/y

LNG: 12 mln t/y

CE Delft 2016
Heavy Marine Fuel Mix Shift

Current HFO mix
• 60-80% VR!

Impact on resid disposition
• EU resid bunkering: potentially 25m t/y lower (0.5MBD)
• exports to Singapore down

Global
~ 4 MBD/ 230m t/y
- VR 14%
- AR 42%
- Distillates 40%
- VGO 4%

Europe
~ 1 MBD /54m t/y
- VR 16%
- AR 10%
- Distillates 74%
- CE Delft 4%

2020: 0.5%S
Shipping response

>200mln t/y `0.5%S heavy fuel • Inaction

Scrubbing • LNG

<<20% in 2020

Non-Compliance

Euronav (CEO Paddy Rogers)

- “Our view is that this is primarily an issue for the refiners.”
- “Scrubbers are dependent on proper installation, operation, repair, and waste disposal, which raise questions of practicality.”
- “We believe the need for scrubbers is exaggerated, “
Poll Question

• What is the status of the IMO 2020 approach at your refinery?

1. We have decided what to do and will implement in 2020
2. We have decided what to do and will implement in 2021-2023
3. We are (about to start) developing a strategy
4. Haven’t thought about it yet or think it won’t affect us
5. Not relevant to me (I don’t work at a refinery)
Survival Strategy: the Refiners dilemma

- CRUDE SWITCH
  - HYBRID?
  - Repurposing
- DO NOTHING
  - Synergies
  - Partial crude switch
- RESID TREATING
  - Carbon rejection
  - Hydrocracking

Have you decided?
## Strategy: Step 1: Anticipate!

<table>
<thead>
<tr>
<th>Company</th>
<th>Site</th>
<th>Crude, MBD</th>
<th>Route</th>
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<td>Shell</td>
<td>R’dam,</td>
<td>404</td>
<td>SDA + gasify</td>
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<tr>
<td>Total</td>
<td>Antwerp</td>
<td>360</td>
<td>SDA</td>
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<td>DC</td>
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<tr>
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<tr>
<td>NIS/ Gazpromneft</td>
<td>Panccevo</td>
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<td>DC *</td>
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<td>NW-E</td>
<td>DC *</td>
<td>Crude Blending *</td>
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<td>Med / C- E</td>
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<tr>
<td></td>
<td>Med</td>
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<td>HS HFO*</td>
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</table>

* Under consideration / Study

Done
Strategy: Step 2: Know your markets

- Financial Model → Prices, volumes, 2020+

MACRO-ECONOMIC
- EU product demand

SUBREGIONAL / LOCAL
- EU product demand

Nearby markets
Saudia, Egypt, Kuwait?

LS/ Opty Crudes
Acidity, Compatibility

Refueling Facilities
Strategy: Step 2: Know your markets

• Knock-On Effects

  ▪ VGO
    - FCC/ HC feed vs VLSFO
      » LS crude atres blending
      » Gasoline?

  ▪ FCC Slurry
    - LS → up
    - HS → down → disposal?

VGO IMO BLENDING VALUE

- 0.5% VLSFO
- 1% FO
- HSFO
- Diesel

Current VGO
VGO blending value

S in VGO

0.0% 0.5% 1.0%
Poll Question

• What is the primary 2020 strategy at your refinery?
  1. Very low sulphur crude blending
  2. Continue high sulphur fuel oil production
  3. Resid hydrotreating – RDS, ebulating bed
  4. Carbon Rejection – Coking, SDA- or slurry cracking
  5. Not Yet defined
  6. Not relevant (I do not work at a refinery)
Strategy: Step 3: Understand your project

- Capex / Opex
- Yields model
  - Unit extrapolation / Spreadsheet
  - LP / (Kinetic) Process simulation
- Fast track?
Strategy: Step 3: Understand your project → Tools?

- **LP**
  - Optimisation
  - Availability
  - Good tool for day-to-day planning
  - Unit responses to be configured
    - Licensor
    - Unit process simulator
    - (Pilot) Plant

- **Refinery wide Process simulator**
  - Flexibility, detail, constraints
  - Fundamentals are built-in → Accuracy
  - Transparency
  - Extrapolation not unlimited
Strategy: Step 3: Understand your project: Case study

• Screening of 10 scenarios
  ▪ RDS, Eb bed, Slurry, Coker, SDA…
  ▪ Staged approach
Strategy: Step 4: Put it all Together : screening/selection

- Tools
- Method/procedures
- Also for low capex options

IMO 2020+ INVESTMENT STRATEGY

![Diagram]

- Identify Options
- (Pre)-Select
- Licensor Selection
- IMPLEMENT

**Tools**
- Linear Program Model (LP)
- Stand alone unit Process Simulator (PS)
- Refinery wide Process Simulator (RPS)

**Method/procedures**
- Tools
- Method/procedures
- Also for low capex options

**ACCURACY ↔ TIME?**

**Company Data**
- MS

**Licensor Data**
- MS
- RPS
- PS

**FM**
- Financial Model

**RPS**
- Refinery wide Process Simulator

**PS**
- Process Simulator

**LP**
- Linear Program Model

**MS**
- Market Study

**IMO 2020+ INVESTMENT STRATEGY**

- (Pre)-Select Licensor Selection
- MS FM MS RPS
- Company Data Licensor Data

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**Implementation**

- Identify Options
- (Pre)-Select
- Licensor Selection
- IMPLEMENT
Conclusion

• IMO 2020 will significantly affect refinery product value
• Develop and test strategy
  ▪ Financial model
  ▪ Synergies, Asset Integration, Partnerships
  ▪ Stress test your plan
    - Uncertainties remain
  ▪ Tools and Methods
    - Time! / accuracy