MARINE FUELS
MARPOL ANNEX VI 2020

Impacts on US and Canadian Crudes, Refining and Markets

EnSys Energy & Navigistics Consulting
Presented by Martin R. Tallett President EnSys

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Topics

• EnSys & Navigistics
• 0.5% Sulphur Rule Overview and Developments
• Assessments of Rule impacts 2020
• Implications for North American / Other Markets
• Summary
EnSys Energy

Specialists in:

- Strategic and regulatory issues in global refining, markets & logistics
- Refining economics and fuels assessments
- North America logistics
- Global focus has brought wide range of clients
- Global integrated modeling “WORLD”
Navigistics Consulting

Specialists in:

- Maritime Industry - issues in global and U.S. domestic shipping, markets, logistics, economics, energy efficiency, and regulations.

- Global marine fuel assessments (market, demand, efficiency, and emissions).

- North America marine/pipeline/terminal oil logistics specialists.


- Global and US domestic focus has brought wide range of clients including oil companies, tanker owners, financial institutions, governments, and industry associations.
IMO MARPOL Annex VI 0.5% Sulfur Rule

• Requires all ships starting Jan 1\textsuperscript{st} 2020 operating outside ECA’s (already 0.1%) to reduce SOx emissions by either:
  1) Burning 0.5% instead of 3.5% sulfur fuel
  2) Continuing to burn HS fuel but using onboard scrubber (EGCS) to reduce emissions
  3) Switching to an alternative low SOx fuel such as LNG, LPG

• Timing was finalized as 2020 (not 2025) at IMO MEPC70 meeting Oct 2016

• Responsibility for drawing up implementation guidelines/rules was designated to IMO Pollution Prevention and Response (PPR) sub-committee
  • Active – PPR5 meeting just held in London
  • But final recommendations not until 2019

• IMO has no enforcement ability
  • Currently only ‘port states’ or ‘flag states’
  • Momentum for a ‘carriage ban’ which would strengthen enforcement powers

• No delays beyond 2020 or phase in being entertained
For shipowners Annex VI is problematic

- Sector is poor financial condition and has to deal with ballast water rule
- Companies are split on path to follow
  - E.g. Carnival scrubbers/LNG, Maersk no scrubbers
- Few scrubber installations (only ~400 installations/orders to date)
  - So minor impact by 2020 (low volume of HS HFO scrubbed)
  - A ‘common’ view is that attractive economics in 2020 could lead to a surge of installations and partial reversion back to HS HFO demand post 2020
  - But concerns over operation, also longer term viability (NOx, GHG regulations)
  - So two scenarios: scrubbers succeed, scrubbers don’t
- LNG a longer term option
  - Lot of interest but ship installation confined to newbuilds
  - Impacts potentially start to become significant post 2025
For refiners Annex VI is not a typical fuel rule

• ‘Normal’ rules are precise in terms of geography, fuel type/specs and usually strategically essential
• Inherent regulatory uncertainties make Annex VI difficult for refiners and shipowners to prepare (i.e. invest)
  • Implementation date 2020 vs 2025 - now settled
    • Little/no incentive for refiners or shipowners to pre-invest - only 2 years left
  • But still
    • Three fuel compliance options
    • 0.5% fuel formulation options – any ISO 8217 grade – opportunities but also concerns
    • Plus prospect (short-term) of non-compliance (FONAR’s)
• Geography of production and purchasing potentially variable
  • International marine bunkers lifttings can ‘move’, e.g. Rotterdam ↓ versus Singapore ↑
• Marine fuels not a strategic product for many refineries
  • Hence the active blending / bunkering sector
• Potential for partial reversion to HSHFO = deterrent to invest
  • Plus longer term alternative fuels (LNG)

• For both refining and shipping, a mixture of proactive and ‘do nothing’ strategies evident
Net effect is neither sector fully investing to meet the Annex VI Sulfur Rule

- The ‘shipping’ solution of scrubbers likely to fill only 5-6% of compliance need in 2020 leaving the primary burden on refiners
- Navigistics projects a needed 2020 “switch volume” to 0.5% fuel of 3-4 mb/d (150-200 mtpa) to achieve full compliance
  - Level depends in part on vessel speed response
- “Only” 3-4% of global liquids demand but a shock to the system
  - Nearly halves total residual fuel demand
  - Being demanded ‘overnight’
  - Exacerbated if switch is mainly to distillate – likely early on
EnSys Approach – Integrated Analysis of Global Liquids System (WORLD) Model

- High degree of bottom up detail
- Needed to get realistic representation / avoid over optimisation
- Proven over nearly 30 years of use

- Recent increases in projected 2020 onstream refining capacity
  - Only limited instances of refiners investing for the Rule
- But also increases in global liquids demand (lower oil prices)
- Annex VI leads to expected very tight market especially 1H 2020
- Scrubber success could revert market after 3-4 years
- Scrubber none-success could extend tightness
2017 WORLD simulations indicate global refining industry likely able to meet ~3 mb/d initial switch at ~101.7 mb/d global liquids demand in 2020

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<tr>
<th>Market Differentials / Strains Under Different Scenarios</th>
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<tr>
<td>Capacity Addition mb/cd</td>
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<tr>
<td>High (5.0)</td>
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<td>Base (0)</td>
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<td>Low (2.0)</td>
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<td>Mid (3.0)</td>
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<td>High/Full (3.7)</td>
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Note: coloring/impacts based on gasoline/distillate versus HS HFO average differentials across 3 major-regions (USGC, Northwest Europe, Singapore). Left hand indicators are for High 0.5% MDO vs heavy 0.5% fuels (90:10) and right hand for Low MDO (50:50).

Source: EnSys-Navigistics Marine Fuels 2020 Assessment Service Q2 2017 Report
Refinery Processing Impacts

- Distillation – higher throughputs ✓
- Upgrading units to max ~
  - Cokers & hydrocrackers
- Desulphurization units to max ~
  - Increased feed sulfur load
  - Decreases catalyst life – may not be sustainable
- H2, sulphur recovery plant look inadequate ✗
  - Large increase in sulfur recovery load
  - Some additional sulfur goes into petroleum coke

- 2 – 4.5% increase in global refining CO₂ emissions
  - 7-10% if emissions from petroleum coke included
Refining / Trade Impacts

- Higher crude runs (+0.2 to 1 mb/d) – cokers & refinery fuel
  - US refinery throughputs increase moderately
  - US becomes a major supplier of 0.5% marine fuel
  - US crude and product exports and imports increase

- Wide changes in inter-regional crude oil and product marine trade

- Potential double/triple impacts on delivered costs:
  - Crude oils - higher world crude price, higher marine transport costs
  - Clean products - add effects of refining tightness

Source: EnSys-Navigistics Marine Fuels 2020 Assessment Service Q2 2017 Report
Market Impacts

- Refining is coproduct industry – production economics of all products closely inter-related
- The 0.5% Rule impacts all petroleum products across all regions
  - Major products: gasoline, jet, inland diesel, heating oil
  - Minor products: asphalt, lubes, anode & fuel grade coke
- Crude oil differentials correspondingly impacted
- Refining and oil trade adaptation will take months/year not days/weeks
  - No mechanism / incentive for starting early
Market Impacts

• Supply/demand balance will evolve over time

  • Initial – several weeks/months
    • Initially demand/supply inelastic, refinery operations and trade change
      • Impacts – potentially major - on supply costs / differentials

  • Short term – several months/year
    • Then price elasticities / adjustments kick in
      • Potential impacts on land fuels demands
      • Potential for expanded HS HFO outlets
      • Power / industrial boiler?
      • Storage (contango)?
      • Increasing use of heavy vs light 0.5% fuel formulations?
      • Crude supply impacts in economically sensitive regions?
        • E.g. US LTO versus Western Canada oil sands / heavy grades

  • Longer term – 2021 plus
    • Supply/demand move towards a new ‘equilibrium’
      Scrubber surge or flop?
Implications for North Am / Other Markets

- **Winners & losers**
  - Light sweet crude producers
  - Heavy sour crude producers
    - On top of logistics constraints for WCSB
  - Light sweet cracking refiners
  - Heavy sour deep upgrading refiners
  - Inspection and testing companies
    - More enforcement, more fuel grades/variations, compatibility concerns

- **Refining investments/technology**
  - High cost investments e.g. coking, resid HDS/HCR
  - Low cost investments/revamps e.g. catalyst change, revamps / debottlenecking
  - Novel partial upgrading and desulfurization processes
    - Could bring benefits medium to longer term
    - Potentially also impact logistics (reduced diluent)
Summary

- Global Sulphur Rule represents major challenges to refiners, bunkers suppliers, shipowners and charterers worldwide
  - A lot of “moving parts”
  - Key parameters still evolving
    - Crude slate, demand, scrubbers, alternative fuels, refinery capacity
  - Uncertainties will remain to and through 2020
- Immediate 100% implementation / compliance unlikely
  - Market strains – impacting crudes and all products not just marine
  - How IMO handles implementation important factor
    - Countries that have ratified Annex VI represent 96% of vessel tonnage
    - But over 100 countries have not ratified Annex VI and they possess 15 mb/d of refining capacity, plus 34 mb/d of refining capacity is inland
- Investment is needed for longer term resolution of the market
  - Refineries, ships (scrubbers), alternative fuels / LNG – ships and shore
    - The market will adapt but strains may linger
- Developments/dimensions can be tracked and evaluated
Questions?

David St. Amand
Navigistics Consulting
1740 Massachusetts Avenue
Boxborough, MA 01719 USA
978-266-1882
DaveSt@Navigistics.com
www.Navigistics.com

Martin Tallett
EnSys Energy
1775 Massachusetts Avenue, Suite 3A
Lexington, MA 02420 USA
781-274-8454
MartinTallett@EnSysEnergy.com
www.EnSysEnergy.com