Residual Fuel Market Issues

Crude Oil Quality Group Meeting
Long Beach, CA

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Kurt Barrow
Agenda

- Trends In Residue Demand
  - IMO Bunker Regulations
  - Implications for Shipping and Refining Industry
  - Influence on Product Markets
World marine bunker demand has been increasing as overall fuel oil demand declines.
Residual fuel oil demand for power generation has been falling in most, but not all regions.
The globalization of product manufacturing has driven bunker demand at a robust rate.

Residual Bunker Fuel Demand

GLOBAL DEMAND GROWTH, %CAGR

<table>
<thead>
<tr>
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<th>5 Years</th>
<th>10 Years</th>
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</thead>
<tbody>
<tr>
<td>Bunker</td>
<td>4.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Diesel</td>
<td>2.7%</td>
<td>2.6%</td>
</tr>
<tr>
<td>All Products</td>
<td>1.6%</td>
<td>1.5%</td>
</tr>
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Million Tons

1995 | 2000 | 2005

CIS
North America
Africa
Middle East
Latin America
Europe
Asia
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Proposed IMO regulations will significantly reduce sulfur emissions from bunker fuels

- In April 2008, the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) proposed and approved amendments to the MARPOL Annex VI regulations in order to reduce harmful emissions from ships
- MEPC proposal was adopted in October 2008
- National regulatory action now required to propagate requirements
- Global bunker fuel sulfur requirements reduced to 0.5% by 2020/2025
- SOx Emissions Control Areas, (S)ECAs, have lower limits
- Recently, the US Congress ratified Annex VI treaty agreement
IMO sulfur regulation timeline

Study in 2018 determines availability of LS fuel and start date for 0.5% S limit
Most immediate regulations relate to (S)ECAs

- Current (S)ECAs established in the North Sea and Baltic Sea
- U.S. EPA announced plans to establish a (S)ECA on both US coasts in conjunction with Canada
- Other (S)ECAs likely but must prove benefits
- California has moved ahead with separate regulations at this point
  - Specifies distillate fuel
- Moderate difficulty in meeting 2010 specification
  - Move to 1.0% sulfur from 1.5%
- Supplying 0.1% sulfur bunkers in 2015 means distillate
Political and industry focus is on global emissions reduction, not just SOx

- Emissions of SOx, NOx and PM is focus of proposed IMO regulations
- Greenhouse gas and other emissions being actively studied
- Shipping contribution to global sulfur and nitrogen emissions is estimated by some at around 15% of total petroleum
- Trade growth will drive emissions higher
- Development of Annex VI amendment was relatively rapid for an international body
- Both the EU and US EPA now support the IMO regulations and appear likely to adopt them directly, perhaps with an accelerated schedule (e.g. California)
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Reduction of bunker fuel emissions is an inter-industry issue

<table>
<thead>
<tr>
<th>Shipping Industry</th>
<th>Refining Industry</th>
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<tbody>
<tr>
<td>Desires low cost fuel</td>
<td>Considers bunker and residual fuels as low-value by-product</td>
</tr>
<tr>
<td>▪ Approx. 1/3 of voyage cost</td>
<td>▪ Difficult to envision investing for bunker markets</td>
</tr>
<tr>
<td>▪ Competitive, global industry</td>
<td>▪ Concerned with stranded investments if on-board scrubbing is widely adopted</td>
</tr>
<tr>
<td>▪ Trend to higher viscosity IFO grades is an example</td>
<td>▪ Concerned that if residual bunker markets wane, that further upgrading investments will be required</td>
</tr>
<tr>
<td>Resists capital and added complexity of scrubbers</td>
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<tr>
<td>▪ LS fuels are easier and more reliable</td>
<td></td>
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<tr>
<td>Phased SECAs and global requirements complicates decision</td>
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<tr>
<td>Needs security of supply and quality assurance</td>
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New technologies in vessel emission controls may aid in compliance, mitigating the fuel quality impact to some degree.

- IMO has approved the use of “equivalence technology”, such as flue gas treatment, in place of low sulfur fuel.
- On-vessel scrubbers are not proven commercially but several pilot testing programs report good results.
- Retrofitting cost and suitability is uncertain.
- Shifts regulation of air pollutants to regulation of water pollutants – marine impact not well understood.
- Technology reduces sulfur and perhaps PM emissions but not NOx and actually increases CO₂ emissions.
- On-vessel flue gas treating could provide a lower cost solution in some cases, if accepted.
  - Adoption will depend on route, service, vessel age and other factors.
Scenario analysis needed to understand impact on refining industry

- Seawater scrubbing of stack gases, while not commercially available, has the potential to reduce fuel compliance costs
  - Degree of adoption of onboard scrubbers will have an effect on refiners
  - The uncertainty of this variable could be examined through two scenarios:

- Scrubber Compliance – Broad adoption of after-treatment technologies for key ship types and routes which moderate need for fuel quality improvements
  - Moderate refining industry impact expected

- Fuels Compliance – More stringent and disruptive case for refining, suppliers and bunker consumers
  - Significant refining industry impact expected
Bunker fuel is just a part of the larger residual fuel markets which are complicated and poorly reported.
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Shipping industry may favor low sulfur fuels but costs are significant

- Profitability of shipping industry has been good over past five years
- Even so, switching to distillate fuels would have cost an oil tanker charterer about 15% more (assuming same owner margin)
- Cost would have been higher for faster steaming container, RORO vessels
- Who bears increased bunker cost?
  - Depends on charter type
  - Depends on type of cargo
  - Depends on freight market and degree of cost pass through
Potential to shift price relationships

Currently, LSFO-HSFO spread is small compared to diesel-HSFO.

Adding LS spec to bunker fuel (without scrubbing) would significantly increase LSFO-HSFO spread.

All distillate fuel option increases diesel pool demand and raises diesel prices.

LSFO might move from being a “HSFO plus” product to a “diesel minus” product.
CO2 emissions will play a role in final outcome

- Reducing sulfur emissions generally increases CO2 emissions
  - Increased refinery processing
  - Seawater scrubbing releases carbon from seawater and uses energy

- Slower sailing speeds and vessel design improvements can help reduce SOx and all emissions
  - Practical limits to reductions

- Expected growth in global trade results in higher emissions
Impact of regulations could have significant impact on refining and shipping industries

- Potential impact on fuel quality in the SECA areas is large
- Desulfurization has not historically been economic and much higher LS fuel oil prices are required to justify investments
  - Most refiners faced with declining fuel oil demand would choose conversion of residue over residue HDS
- Ship owners face fleet investment or significantly higher fuel costs through gasoil purchases
- Complex inter-industry issue
  - Who invests? What fuel quality is needed?
- Impact on price relationships extends beyond bunker fuels
  - Crude sweet/sour differentials
  - ULS diesel vs. marine gasoil pricing
  - Refinery CO₂ emissions
  - Conversion and light/heavy processing economics
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