A Multi-Client Study *November 2007*

Bottom of the Barrel: The Future for Residual Fuel Oil

OVERVIEW

The next 10 years will witness radical shifts in the supply/demand balance for residual fuel oil and other heavy products, which will have profound impacts on crude and product pricing and refining margins. On the demand side, the traditional demand sectors for fuel oil in power generation and industrial heating have been declining as substitution to coal and gas have taken market share in the industrialized world. However, these uses are nearing practical minimums in mature markets, limiting the potential for further reductions. Other residuum fuel demands — notably for bunkers, asphalt, and power/industrial demand in key areas of the developing world — are still growing. Consequently, **PIRA expects that in contrast with the last 20 years, global end-user demand for heavy products in total will grow in the future**, albeit much more slowly than for light products.

On the supply side of the equation, the story is also changing. A tremendous surge in refinery residuum conversion capacity is being built. This step change is more than what is needed to balance incremental crude supply with demand growth. Consequently, **over the next five years, this new coking, hydrocracking, and FCC capacity will largely eliminate today's overhang of residuum**. However, it will not be balanced: straight-run residuum and VGO supplies will tighten more than cracked stocks. Cracked fuel oil will still be the lowest priced product of last resort.

Together, these forces will impact product price spreads, crude differentials, and refining margins, reversing some of the trends of the last three years. **PIRA assesses the impact of these forces in its recently released multi-client study, BOTTOM OF THE BARREL: THE FUTURE FOR RESIDUAL FUEL OIL.**

This study includes:

- **An in-depth outlook of the factors driving each region's future fuel oil and other heavy product usage**. Demand trends by region/country and by sector show how decreases in some areas are being offset by increases in others, resulting in net positive growth for the future.
- **A detailed look at the production of heavy products, examining changes in crude slate, refinery runs, and refinery residuum conversion**. Refinery capacity trends will drive straight-run feedstock balances tighter, while cracked stocks remain more amply supplied.
- **Analysis of the trade flows for residual feedstocks and fuel oil and how they will evolve** as supply, demand, and product quality requirements change.
- **Regional price forecasts relative to crude and other products**, residual fuel oil quality differentials, prices relative to competing fuels, arbitrage opportunities, seasonality effects, and the key factors that will drive these relationships.
- **Regional reference case projections through 2020**, by year, as well as alternative scenarios that test the impact of key variables on those projections.

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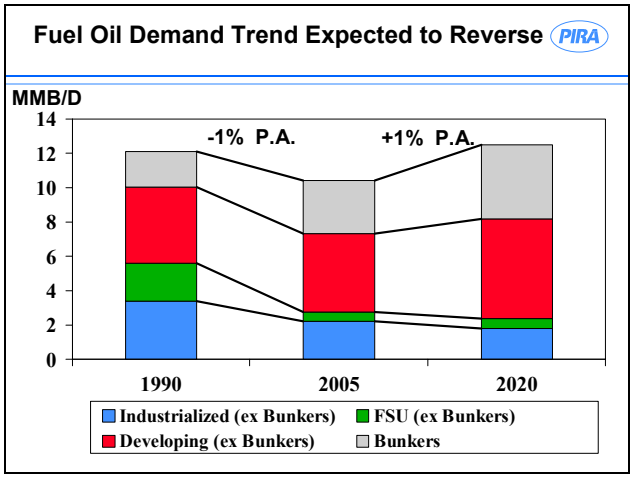
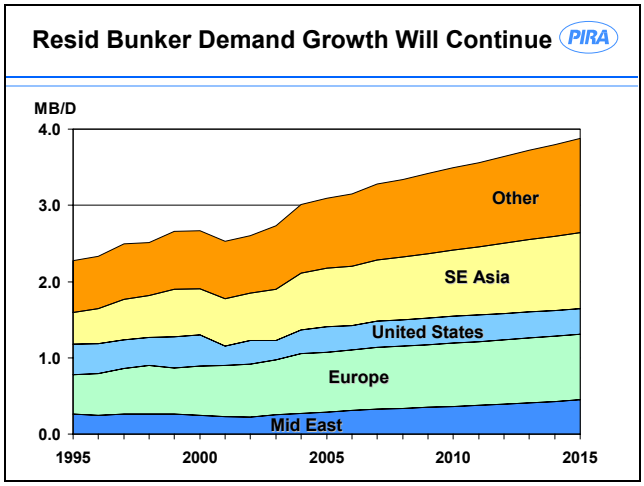
WHY THE TIME IS RIGHT FOR THIS STUDY

A Fresh Look at Demand Trends

The long historical decline in fuel oil demand is expected to reverse, changing to modest growth. Substitution to other fuels for power generation in the OECD, FSU, and other industrialized countries is nearing practical minimums. In the developing world, further growth in stationary uses is still likely, but not broadly based. Most expansions are concentrated in oil-exporting countries and in rapidly developing countries struggling to meet electricity demand growth.



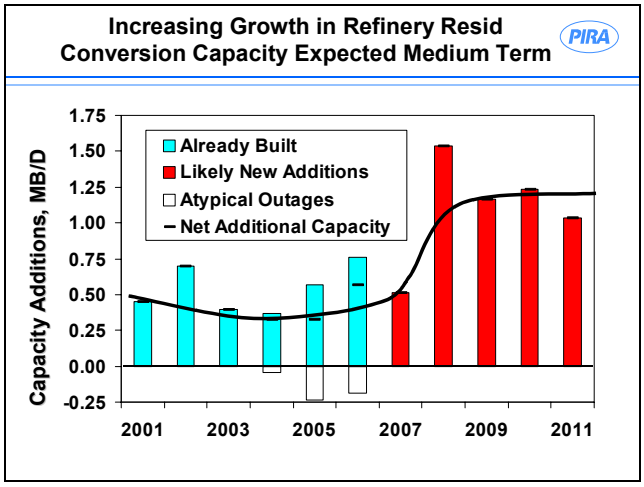
Bunker demand, on the other hand, continues to grow robustly as the vessel fleet grows to meet expanding trade, and it will represent an increasing share of total fuel oil demand.



BOTTOM OF THE BARREL examines demand trends for power generation, industrial use, bunkers, and asphalt/lubes/other specialties. Regional/country forecasts are included. Factors influencing these trends — including policy, substitution due to competitive prices, efficiency improvements, and quality specification requirements — are also addressed. Demand scenarios that test the impact for a range of possible economic and regulatory factors provide bounds around PIRA's Reference Case forecast.

A New Assessment for Residuum Supply

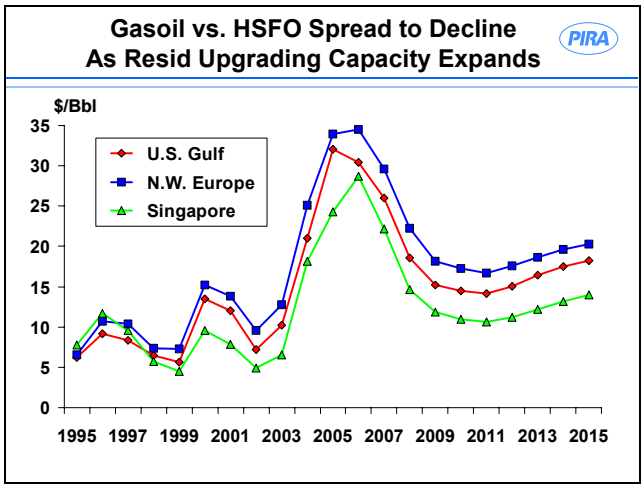
With demand for light products growing much more rapidly than that for fuel oil, ongoing additions to residuum conversion capacity are required to balance supply and demand. Over the last few years, capacity additions were limited, forcing fuel oil prices to soften relative to other products. However, with a step change expected in new capacity, balances will tighten and light-heavy product price spreads will narrow.



Rapidly Changing Price Relationships

With these changes in demand trends and refining capacity will come dramatic changes in pricing relationships. The study addresses these impacts. Changes in residual fuel oil prices relative to other products and crude are

quantified, and quality and regional differences are described.



These changes in product price spreads will fundamentally affect refinery margins, inter-regional arbitrage opportunities, and crude price differentials.

A simple extrapolation of recent trends in fuel oil demand, supply, and price will *not* give a reasonable forecast for future trends.

BOTTOM OF THE BARREL shows how a detailed and nuanced look at the underlying trends builds up to very different conclusions for the future.

The study also answers these important questions:

1) To what extent will the global balances for residuum tighten, and what will be the implications for price spreads, refining margins, and crude differentials?
2) How will the supply/demand and price relationships for straight-run feedstock versus cracked stocks change?
3) How are the balances for low-sulfur expected to be different from high-sulfur fuel oil?
4) How will these trends affect future refinery operations and margins?
5) What changes in trade patterns and arbitrage relationships can be expected?

THE WRITTEN REPORT: TABLE OF CONTENTS

As the key deliverable of the BOTTOM OF THE BARREL study (see page 6), the written report provides an in-depth, exhaustive analysis of the subject matter. Some 170 pages in length, it contains more than 300 charts and tables that support the analysis.

The Table of Contents:

Abstract / Executive Summary

Section I – Demand

1) Residual Fuel Oil and Other Heavy Product Demand Trends/Outlook to 2020
   a) Why Today Is Not Like the Early 1980s
   b) Regional Outlook
   c) Sectoral Outlook
2) Demand Outlook Drivers
   a) Bunkers
   b) Power Generation
   c) Industrial use
   d) Asphalt/Other
3) Alternative Demand Scenarios
   a) Lower Demand "Green" Scenario
   b) Higher Demand "Red" Scenario

Section II – Supply

4) Crude Quality
5) Refining Investment Trends
6) Resid Supply by Sulfur Level
   a) Regional Breakouts

7) Resid Supply: Straight-Run Resid, VGO, Cracked Stocks
   a) Regional Breakouts

Section III – Price

8) Price Forecast
   a) By Region, by Quality
9) Outlook for Key Price Spread Trends
10) Price Forecasts for Alternative Demand Scenarios

Section IV – Supply/Demand Balances and Trade

11) Resid Supply/Demand Balances
   a) Regional Breakouts
   b) Quality Breakouts
   c) Trends/Implications
12) Inter-Regional Residual Fuel Oil Trade
   a) Finished Products
   b) Feedstocks
13) Arbitrage and Trade
14) Implications
   a) Reference Case
   b) Alternative Demand Scenarios

Section V – Quality

15) Product Quality
   a) Bunkers: Reference Case and Alternative Scenarios
   b) Stationary Uses
   c) Feedstocks

Section VI -- Conclusions and Implications

16) Supply, Demand, Trade
17) Refinery Investment and Profitability
18) Policy Ramifications

CONTENTS OF THE ONLINE DATABASE

The data that underpin the analysis and feed into the charts and tables of the written report are available separately in spreadsheets via PIRA online. **The content includes:**

1) Residual Fuel Oil and Other Heavy Product Demand
   a) Annual: 1995 – 2020
   b) By Country
   c) By Sector
2) Refinery Resid Conversion Capacity Summary
   a) Annual: 1995 – 2020
   b) By Unit Type
   c) By Region
3) Resid Supply
   a) Annual: 1995 – 2020
   b) Crude Production by Type, by Region
   c) Straight-Run Resid, VGO, Cracked Stock Production by Region
4) Prices
   a) Annual: 1995 – 2020
   b) By Region
   c) By Quality
5) Trade
   a) Annual: 1995 – 2010, 2015, 2020
   b) Net Inter-Regional Trade

WHO BENEFITS FROM THIS STUDY

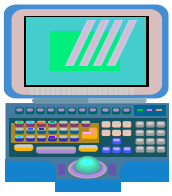
The stakes are high when it comes to making decisions regarding future residual fuel oil/other heavy product supply, demand, and pricing. Inevitably, market participants will end up on either side of multi-million-dollar gains or losses. **BOTTOM OF THE BARREL: THE FUTURE FOR RESIDUAL FUEL OIL** helps market participants keep ahead of the competition through a better understanding of the future interplay between regional residuum balances, regional pricing for different qualities, inter-regional trade, and the impact of these factors on refining margins. **The following market participants will all benefit from this study:**

- **Crude producers** know the importance of product supply/demand balances that set relative values for products and consequently impact crude-quality price differentials. This study helps them identify and evaluate the future refinery value for heavy versus light crudes and thus the potential value of heavy crude upgrading.
- **Refiners** need to plan capacity changes based on the outlook for product demand, feedstock supply, and relative pricing. By providing a firm basis in evaluating future changes in these factors, which define refinery residuum conversion margins, the study helps refiners evaluate the future profitability for different refinery configurations.
- **Trading companies** want to anticipate regional supply/demand changes and price dynamics. This analysis aids in planning terminal and shipping infrastructure needs to best capture future trading opportunities.
- **Shipping companies** know that their single largest expense is for bunker fuel, and they face uncertainty both on its price and regulations on quality. **BOTTOM OF THE BARREL** provides a residual fuel oil price basis under different demand and regulatory scenarios.
- **Policy makers** need timely insight into how proposed changes in product quality regulations will affect supply, demand, price, and industry profitability. This study enables them to better evaluate the impact of future regulatory changes.
- **Electric utilities and other end-users** constantly consider how changing fuel oil price dynamics will influence service choices and future capacity decisions. The study makes end-users better equipped to adapt to supply and price shifts, and it helps new project developers make more effective evaluations of fuel supply options and project viability.
- **Financial institutions** must make sound evaluations of how changing market conditions will affect the economics and financing of new refining and marketing ventures. This study allows for more informed decision-making on potential projects.

WHAT DO STUDY SUBSCRIBERS RECEIVE AND WHEN

For each study purchased, subscribing companies will obtain the following valuable set of services:

Written Report (August 2007 release). Clients receive three (3) copies of **the final report that spells out the findings of the study, the bases underlying those results, and a discussion of key uncertainties that impact the major findings.** Approximately 170 pages long, the report discusses the Reference Case results by region and contrasts this with alternative scenarios. **See pages 3-4 for a table of contents.**



Online Database. Clients receive unique passwords allowing them access (for 3 users and two years) to a section of PIRA online that **provides historical data back through 1995 and forecasts through 2020** in Excel spreadsheets for:

- **Country-level demand by sector,** with quality breakouts
- **Regional residuum supply,** with the impact of refinery capacity changes broken out
- **Inter-regional residuum trade flows**
- **Price forecasts,** both absolute and relative to crude/products, by region and quality

See page 4 for a complete list of spreadsheets.

Presentation of Study Findings (recorded September 18, 2007). Like the online database, a detailed workshop can be observed by watching a slide show and listening to the accompanying audio. It is an ideal accompaniment to the written report, as clients get a revealing look at the methodology and assumptions behind the study's conclusions.

FEES AND OPTIONS

BOTTOM OF THE BARREL: THE FUTURE FOR RESIDUAL FUEL OIL can be purchased by both PIRA retainer clients as well as non-clients. **Existing PIRA retainer clients receive a reduced price**. **Additional users (beyond three) — extra report copies, database/presentation passwords — can also be purchased.** For detailed service pricing options, see the Acceptance Form on page 8.

ABOUT PIRA ENERGY GROUP

The PIRA Energy Group, founded in 1976, is an international energy consulting firm, offering Retainer Client Services as well as customized consulting on a broad range of subjects in international oil, natural gas (and LNG), coal, electricity, biofuels, freight markets, and related environmental issues. PIRA provides evaluation of key U.S. and international energy issues that impact the behavior and performance of the industry and its various markets and sectors. Currently, more than 500 companies worldwide retain PIRA, including international and national integrated oil and gas companies, independent producers, refiners, marketers, oil and gas pipelines, electric and gas utilities, industrials, trading companies, financial institutions, and government agencies.

PIRA FUEL OIL STUDY TEAM

Richard Joswick (Study Leader; Managing Director, Global Oil Group) develops PIRA's outlook for crude and products pricing, refinery margins, and inter-regional supply balances. He authors PIRA's monthly European Oil Market Forecast and numerous special projects. He joined PIRA in 2004 after 20 years with ExxonMobil in supply logistics, planning, refining, and engineering. During his time at ExxonMobil, he had assignments developing near-term oil market forecasts, designing heavy oil upgrading processes, and evaluating refining economics. Rick has M.S. and B.S. degrees from Rutgers University in chemical engineering.

Dr. Mark Schwartz (President) works closely with PIRA's Global Oil and Natural Gas groups to evaluate the key assumptions underlying their outlooks and to develop plausible alternative assumptions and outcomes. Before joining PIRA in 2002, he was the Chief Economist of ExxonMobil Corp., where he was responsible for developing the company's long-range economic and energy outlook. During his 25 years at Exxon he also had assignments in Upstream Planning, Treasurers, and Corporate Planning functions. Mark holds a Ph.D. in economics from the University of Pennsylvania.

Doug Bulger (Managing Director) heads up the Project Consulting Group. Before joining PIRA in April 2005, Doug was Manager – Supply & Trading for Shell Canada Limited, and previously Manager – Refinery Supply for Deutsche Shell AG in Hamburg, Germany. In these positions, Doug led Crude and Products Supply, Supply Strategy and Optimization, Marine, Logistics and Risk Management teams. During his 29 years at Shell, Doug was also an Advisor in Corporate Strategies at Shell Canada undertaking studies in Strategy Development, Competitive Positioning, Acquisition and Corporate Restructuring. He holds a B.Eng. in chemical engineering from McGill University and an MBA from the University of Calgary.

David A. Zinamon (Managing Director, Refining and Environmental Affairs) specializes in refined products, refinery operations, NGLs, alternative fuels and environmental matters, particularly as they affect petroleum product markets. Among other activities he is responsible for PIRA's World Refinery Database. Dave also authors PIRA's monthly NGL market report. Dave joined PIRA in 1984 after seven years of international energy consulting experience with Chem Systems. This followed several years of manufacturing, marketing and planning positions with Celanese Chemical, GAF Corp., and Airco. He has a B.Ch.E. from City College of New York and an M.B.A. from Rutgers University.

F.W.A. (Bill) Fuller (Sr. Director, International Oil) had over 30 years of energy forecasting and analytical experience with Exxon International before joining PIRA in 1997. He now oversees PIRA's analysis and forecasting of near-term industry oil balances, with particular emphasis on international supplies, and monitors events impacting PIRA's oil market view. Bill has a B.S. in chemical engineering from Cornell University.

Kenneth M. Bogden (Director, Freight Markets) is responsible for PIRA's monthly Freight Market Outlook. Prior to joining PIRA in 2005, Ken worked for ExxonMobil for 27 years, primarily in its oil supply and trading and planning functions. He also served as Coordinator of Transportation Planning for Exxon International. Ken has a B.S. in chemical engineering from Lafayette College and an M.B.A. from Columbia University.

Joseph T. (Joe) Pezzino (Director) maintains PIRA's Worldwide Refinery Database, including capacity analysis, product quality implications, and margins. Before joining PIRA in 2000, he led refinery process tech services, economics, and planning during a 30-year career at Mobil. He also worked in Corporate Supply & Distribution and subsequently at Mobil Research specializing in supply chain optimization. Joe has an M.B.A. and B.S. in chemical engineering from S.U.N.Y. at Buffalo.

Dr. Naing Oo (Associate Director) joined PIRA's Global Oil Group in 1995. He focuses on quantitative and econometric analysis for forecasting oil demand and prices. He is also involved in analysis on crude and product balances and trade flows. Naing holds a Ph.D. in economics from the City University of New York.

Clayton Vernon (Director of Energy Modeling) is responsible for PIRA's global energy demand model. Clayton came to PIRA from Bank of America, where he was in charge of Fundamentals Analysis for their Commodities Trading group. Prior to joining B of A, Clayton was Director of Fundamentals Analysis for Enron in Houston. Clayton has an M.S. in econometrics from the University of Texas at Austin and a B.S. in mathematical physics from Rice University in Houston.

Su Hyung Ryu (Senior Analyst) focuses on crude and product price forecasts. Su maintains and develops integrated oil demand and pricing models and information systems. Since joining PIRA in 1998, she has participated in numerous benchmarking and competitive analysis projects, crude and product marketing assessments, and asset valuations. Prior to joining PIRA, Su worked at Citibank Global Banking, where she analyzed and developed investment database applications. She holds M.S. in business computer information systems from Baruch College in New York.

Neal Kumar (Senior Analyst) supports the on-going requirements of maintaining and expanding PIRA's global refinery database, as well as other key activities of the global oil group. Prior to Joining PIRA, Neal worked at Koch Industries in Washington, DC, where he provided economic, political, and legislative analysis for international investments, and domestic refining and policy issues. Prior to working for Koch, he worked as a Foreign Policy and Defense research intern at the American Enterprise Institute, with a focus on the Former Soviet Union. Neal holds a B.A. in economics and history from Northwestern University and an M.A. in Russian studies with a concentration in the political economy of emerging markets from the European University at St. Petersburg, Russia.

ACCEPTANCE FORM

My company wishes to subscribe to the PIRA Energy Group multi-client study THE BOTTOM OF THE BARREL: THE FUTURE FOR RESIDUAL FUEL OIL for access and usage by _____ users.

We understand and agree that the fees are as follows:

	PIRA Client, 3 Users	PIRA Client, Add'l Users	Non-Client, 3 Users	Non-Client, Add'l Users
Standard Fee*	$21,500	$1,000 each	$25,000	$1,250 each

* New York City-based companies, please add 8.375% sales tax; Long Island-based companies, please add 8.625% sales tax; all other New York State companies, please add the county appropriate sales tax.

The bill-to party is as follows (the user names will be gathered later):

First Name: _____ **Last Name:** _____

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Total Fee: _____ **Signature:** _____

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Note: ***Bottom of the Barrel: The Future for Residual Fuel Oil*** will contain no confidential technical information, to the best knowledge of PIRA. However, except for information that is or becomes available to the public in printed publication, or is already in the possession of subscriber or developed independently by subscriber, or is received by subscriber in good faith from a third party, any information in the study is for the sole and confidential use of the subscriber. Subscribers agree to use reasonable efforts to protect the confidential nature of the information supplied to them as part of this study.