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# ***Bunker and Residual Fuel Oil Conference***

*An Assessment of the Global Market for the Bottom of the Barrel*

*June 22-23, 2004*

*Hotel Monaco • New Orleans, Louisiana*

## ***Residual Fuel Supply and Demand From a Refiner's Perspective***

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**June 22, 2004**

Slide 1

I've been asked to speak to you today from a refiner's perspective on the subject of the "disappearing bottom of the barrel". As was mentioned in the introduction, I've spent 33 years working in the refining industry. So trying to make the bottom-of-the-barrel disappear is an old subject to me. In fact, during my tenure with operating companies, it seemed like I spent about half my time explaining why we made so much of the stuff. As you know, the bottom of the crude barrel is the lowest valued product that comes out of the refinery. And its impact on the bottom line is negative since it sells for less than crude cost.

# Discussion Topics

- ◆ **Worldwide RFO supply/demand**
  - » **Regional changes**
  - » **Changes in U.S. supply**
- ◆ **Coking capacity additions**
  - » **Regional breakdown**
  - » **Major U.S. projects**
  - » **Major Latin American and Caribbean projects**
- ◆ **Future coker additions**
- ◆ **U.S. refinery crude slate changes**
- ◆ **Coking vs. cracking economics – Arab Heavy on USGC**
- ◆ **Summary**

Slide 2

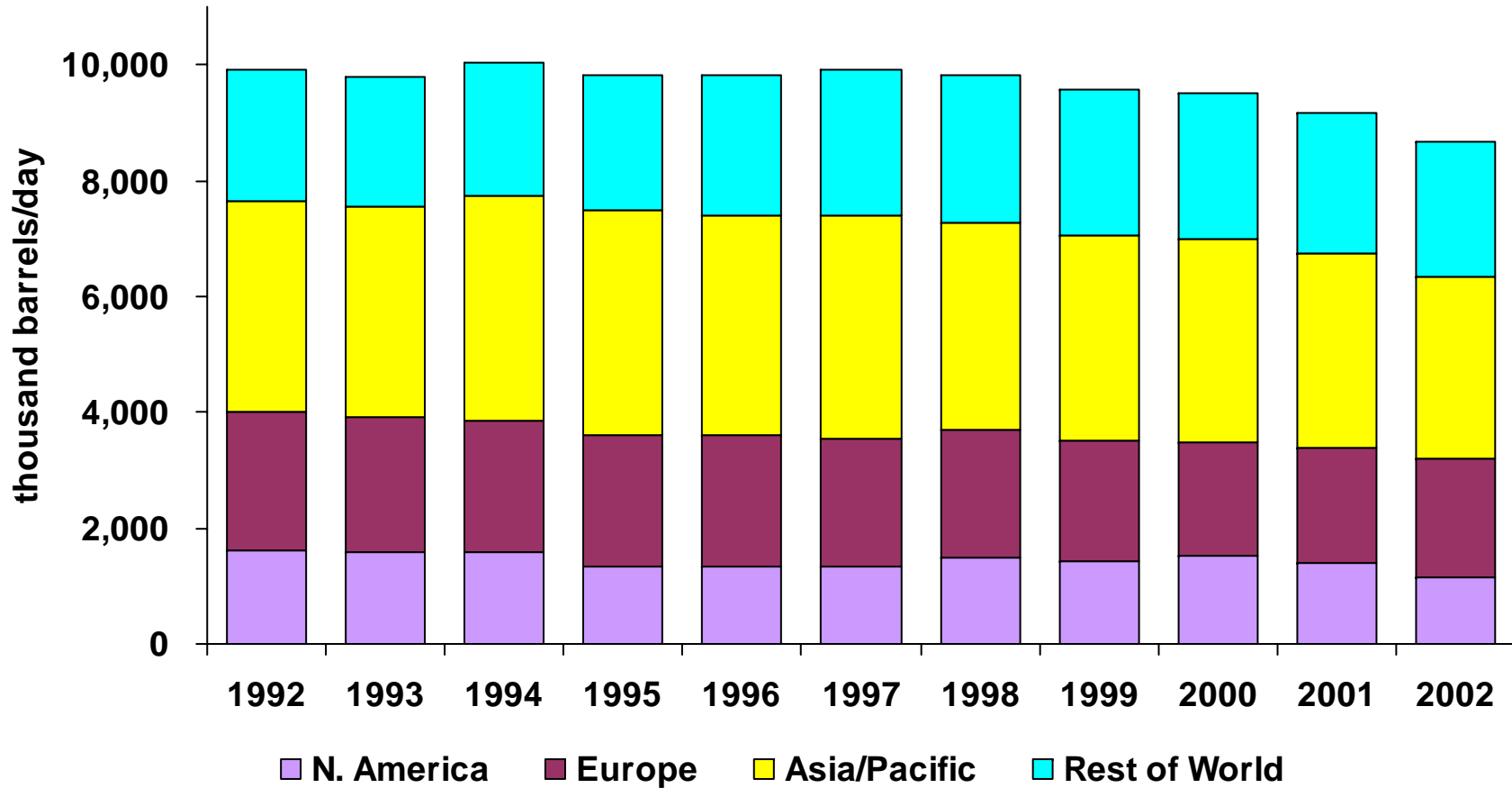
So here's what I had planned for our little discussion. To orient us a bit to the numbers, I have some slides that show the trends in RFO consumption worldwide for the past decade or so. I'm sure it comes as no surprise to you that the trend has been a gradual decline due an emphasis on natural gas and environmental limitations on RFO. We'll take a look at the U.S. supply situation and how it's changed since 1997.

Next, we'll look at some numbers on coking capacity additions over that same period of time, plus what the outlook is for additional cokers being built.

The driving force behind all these coker additions in the U.S. has been the heavying up of the refinery crude slate. We'll see how this has changed in the U.S. (where most of the cokers have been added) and the net impact on bottoms yield.

Finally, we'll look at coking versus cracking economics for a typical USGC refinery with Arab Heavy crude oil.

# Residual Fuel Oil Consumption



Slide 3

This slide shows the trend of RFO consumption worldwide over the past decade or so. As the graph illustrates, total worldwide RFO consumption dropped about a million BPD over this time period from about 10 million BPD to slightly less than 9 million BPD. The drop occurred in all three of the major RFO consuming regions. The Asia Pacific region consumes slightly more than 3 million BPD of RFO, North America and Europe ~ 2 million BPD each and the rest of the world a little more than 1 million BPD.

# Change in Residual Fuel Oil Consumption

	<u>1994-2002</u>	
	<u>Avg. Annual</u>	
	<u>% Change</u>	<u>Delta, MB/D</u>
North America	(3.7)	(410)
Europe	(1.4)	(250)
Asia/Pacific	(2.6)	(748)
Rest of World	Nil	<u>23</u>
<b>Total</b>	<b>(1.8)</b>	<b>(1,385)</b>

Slide 4

This slide makes it a little easier to see the regional changes and I've focused here on the period 1994-2002. Note that the largest reduction was in the Asia Pacific where the decrease was almost 750 thousand BPD. The reduction in North America was over 400 thousand BPD, and in Europe it was 250 thousand BPD. Note that the total reduction was about 1.4 million BPD between 1994 and 2002.

## Change in U.S. Residual Fuel Oil Supply

	<u>M Barrels/Day</u>			<b>Delta</b>
	<u>1994</u>	<u>1997</u>	<u>2003</u>	<u>(2003-1994)</u>
<b>Refinery Production</b>	826	708	663	(163)
<b>Imports</b>	314	194	325	11
<b>Stock Change</b>	6	15	(18)	(24)
<b>Exports</b>	<u>(125)</u>	<u>(120)</u>	<u>(197)</u>	<u>(72)</u>
<b>Net Supply</b>	1,021	797	773	(248)

Slide 5

Focusing on the U.S. specifically, this slide highlights the change in RFO supply since 1994. Note that U.S. refinery production of RFO dropped ~160 thousand BPD between 1994 and 2003 but that demand was dropping even faster, requiring additional exports of U.S. refinery produced RFO to other regions.

## Coking Capacities/Additions

	<u>M Barrels/Day</u>				
	<u>Capacities</u>			<u>Additions</u>	
	<u>1994</u>	<u>1997</u>	<u>2004</u>	<u>2004- 1994</u>	<u>2004- 1997</u>
<b>United States/Canada</b>	<b>1,699</b>	<b>1,888</b>	<b>2,324</b>	<b>625</b>	<b>436</b>
<b>Caribbean/Latin America</b>	*	<b>247</b>	<b>605</b>	*	<b>358</b>
<b>Europe and FSU</b>	*	<b>635</b>	<b>614</b>	*	<b>(21)</b>
<b>Middle East and Africa</b>	*	<b>97</b>	<b>129</b>	*	<b>32</b>
<b>Asia/Pacific</b>	*	<b>507</b>	<b>535</b>	*	<b>28</b>
	<b>1,699</b>	<b>3,374</b>	<b>4,207</b>	<b>625</b>	<b>833</b>

\* Not available.

Slide 6

This slide summarizes coking capacity additions in the major regions of the world, generally since 1997 - but I've included the data since 1994 for the U.S. and Canada to compare to our previous slide. Note that since 1994, ~625 thousand BPD of new coking capacity has been added in the U.S. and Canada (mainly in the US). This list excludes the Canadian syncrude cokers. You may recall from the previous slide that over this same time period U.S. production of RFO decreased on 163 thousand BPD, or a little more than 25% of the volume of coking capacity additions.

Also note that coker additions in Latin America and the Caribbean were over 350 thousand BPD between 1997 and 2004 and that there were additions in most of the other regions (except Europe and the FSU), but the net increases elsewhere were small.

# Coking Capacity Additions Refineries with $\geq 100\%$ Increase

	<u>M Barrels/Day</u>		
	<u>1997</u>	<u>2004</u>	<u>Additions</u>
<b><u>United States</u></b>			
<b>MAP – Garyville</b>	-	33	33
<b>Valero – Norco</b>	-	56	56
<b>ConocoPhillips – Sweeny</b>	-	59	59
<b>ExxonMobil – Baytown</b>	31	81	50
<b>Lyondell-CITGO – Houston</b>	42	87	45
<b>Premcor – Port Arthur</b>	33	80	47
<b>Valero – Texas City</b>	<u>-</u>	<u>45</u>	<u>45</u>
	<b>106</b>	<b>441</b>	<b>335</b>

Slide 7

This slide shows which refineries made large coker additions in the U.S. since 1997. Note that several, namely MAP Garyville, Valero Norco (old Orion) and Texas City, and ConocoPhillips Sweeny, Texas didn't have coking capacity at all prior to these additions. ExxonMobil-Bayton, LyondellCitgo-Houston and Premcor-Port Arthur each more than doubled previous capacity. All seven of these refineries are on the Texas and Louisiana Gulf Coast and added cokers as part of heavy crude projects.

## Coking Capacity Additions (cont.) Refineries with $\geq 100\%$ Increase

	<u>M Barrels/Day</u>		
	<u>1997</u>	<u>2004</u>	<u>Additions</u>
<b><u>Caribbean and Latin America</u></b>			
<b>Valero – Aruba</b>	-	64	64
<b>Petrobras – Betim</b>	-	22	22
<b>Petrobras – Paulina</b>	-	33	33
<b>Pemex – Cadereyta</b>	-	50	50
<b>Pemex – Salina Cruz</b>	-	50	50
<b>PDVSA – Cardon/Judibana</b>	52	145	93
<b>HOVENSA – St. Croix</b>	<u>-</u>	<u>58</u>	<u>58</u>
	<b>52</b>	<b>422</b>	<b>370</b>

Slide 8

Slide 8 shows the specific refineries that added coking capacity since 1997 in the Caribbean and Latin America. Note that six out of the seven, including HOVENSA-St. Croix, Aruba (additions were really made under Coastal/EI Paso ownership), the two Petrobras and the two Pemex refineries had no coking capacity prior to these projects. The huge PDVSA refining complex at Cardon/Amuay almost tripled its coking capacity.

I should point out that all of these are refinery coker projects. Again, we have not included in this tabulation the syncrude cokers at José, for example.

## Coker Projects

		<u>B/D</u>	<u>Comments</u>
<u>U.S./Canada</u>	Premcor – Port Arthur	25,000	Expansion
	United – Warren	10,000	New
	Petro-Canada – Edmonton	<u>?</u>	Expansion
	Total United States/Canada	35,000+	
<u>Brazil</u>	Petrobras – Canoas	12,000	New
	Petrobras – Rio de Janeiro	29,000	New
	Petrobras – Paulina	33,000	New?
<u>Chile</u>	RPC – Concon	20,000	New
<u>Germany</u>	Deutsche BP – Lingen	3,000	Expansion
<u>Russia</u>	Rosneft – Komsomolsk	?	New
<u>China</u>	CPC – Nanjing	16,000	New
	Zhenhai – Zhenhai	20,000	New
<u>India</u>	Indian Oil – Paradip	<u>41,000</u>	New
	Total Non-U.S.	174,000+	

Slide 9

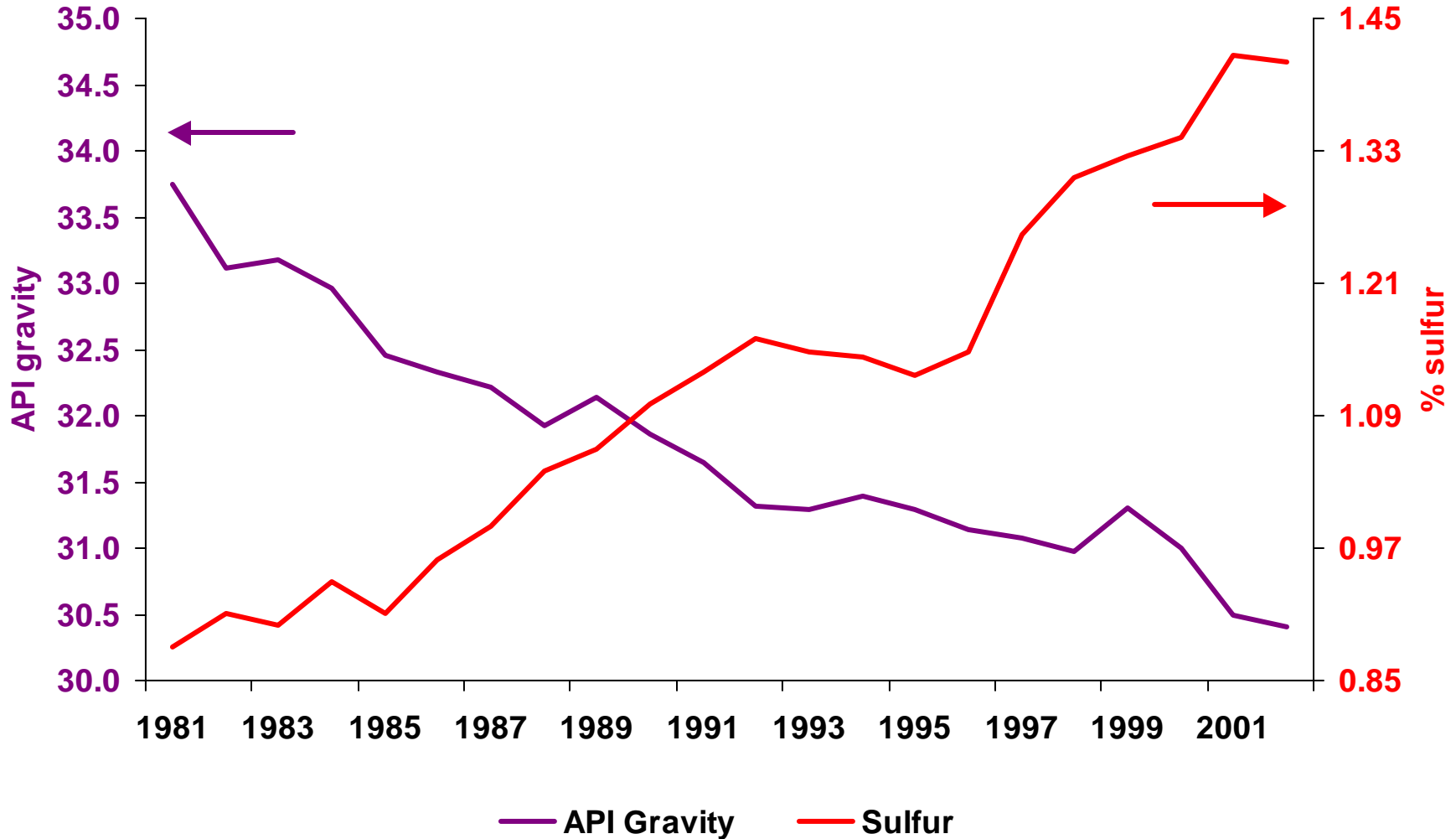
This slide summarizes the new coker projects that have been announced to compare with the flurry of activity we've seen in the last 5-10 years. As shown here, I'm only aware of plans for two small U.S. projects, one to add a 10 MBPD coker at the United Refinery in Warren and another to add a 25 MBPD expansion at Premcor Port Arthur. An expansion at Petro-Canada's Edmonton coker is also planned but the capacity has not been publicized. Again, we've not listed any of the syncrude cokers.

Outside the U.S. and Canada, there's more activity. Three new cokers are planned for Brazil, one small one in Chile and another in Germany, two in China and one each in Russia and India. Total coker additions outside the U.S. and Canada total about 175 MBPD.

So the trend seems to be more cokers outside the U.S. for the next five years.

# U.S. Refinery Input Quality

## Gravity Down, Sulfur Up



Source: EIA

Slide 10

This slide shows how the crude slates at U.S. refineries have changed in the last 20 years. It illustrates the drop in gravity and increase in sulfur associated with these heavier slates. We expect the slope of these curves to flatten a bit in ensuing years so that the changes won't be as dramatic in the U.S. The changes outside the U.S. may be a bit more.

# Coking vs. Cracking Economics

## U.S. Gulf Coast – 2003 Average

	<u>\$/Barrel</u>	
	<u>Coking</u>	<u>Cracking</u>
<b>Arab Heavy Crude Yield Value</b>	<b>29.18<sup>(1)</sup></b>	<b>27.40<sup>(2)</sup></b>
<b>Arab Heavy Crude Acquisition Cost</b>	<b>24.99</b>	<b>24.99</b>
<b>Variable Margin</b>	<b>4.19</b>	<b>2.41</b>
<b>Net Margin</b>	<b>2.79</b>	<b>1.11</b>

- (1) Includes RFO yield of 2.3%.
- (2) Includes RFO yield of 34.8%  
 RFO Value = \$24.02/barrel

Slide 11

This slide shows the relative economics to a U.S. Gulf Coast refiner processing Arab Heavy crude in a cracking versus a coking mode. Using average prices for all of 2003, the coking mode produced \$1.78/barrel better margin than yielding RFO.

## Coking Value Parity

- ◆ **What 2003 RFO price would have been necessary to drive the Arab Heavy cracking value to parity with its coking value?**
- ◆ **Answer: \$29.20/barrel, or \$5.18/barrel higher**

Slide 12

So, what RFO price would have resulted in the same economics for the refiner as coking the bottoms? Well, the RFO price would have had to be over \$5 per barrel higher. Hardly feasible. This means the refiner was always motivated to fill the coker.

## Summary

- ◆ **The “disappearing bottom of the barrel” from refineries is due to declining demand and generally poor economics for RFO**
- ◆ **Increased coking capacity has been driven by increasing supply of heavy sour crude oil and has not resulted in a corresponding decline in RFO supply**
- ◆ **Future coker additions going forward are expected to be less than in recent years**
- ◆ **Refineries that install cokers generally preserve the capacity to produce RFO when economical**
- ◆ **Refineries equipped with cokers are almost always motivated to fill their capacity; RFO production rarely competes with coking**

Slide 13

So let me summarize.

The disappearing bottom of the barrel does not represent a conspiracy on the part of the refining industry. It is merely the result of an increase in the supply of heavy sour crude oils that have caused refiners to make investment in their facilities to upgrade the disproportionate amount of bottoms in the crude yield to make certain the yield of more economic transportation fuels is consistent with demand.

RFO supply from refining centers like the U.S. where there have been large increases in coking capacity has not declined proportionately. During the ~10 year period from 1994 when about 625 MBPD of new coking capacity was added in the U.S., refinery supply of RFO only declined about 160 MBPD. Coking capacity additions in the U.S. are slowing down while new/expanded cokers in Europe, Latin America and the Far East are heating up a bit.

Building a coker does not “burn the bridge” for a refinery to produce RFO. The economics will almost always dictate filling the coker first, then possibly producing incremental RFO. There will always be some amount of RFO yield from the FCC unit (decant/slurry oil) equivalent to about 5-10% of the FCC capacity, but some of this gets siphoned off to specialty needle cokers.

**For more information,  
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