

REFINING INDUSTRY IN FOCUS

Baker & O'Brien, Inc.

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Q3 2021

Q3 2021: U.S. Refining Margins Continue Making a Comeback

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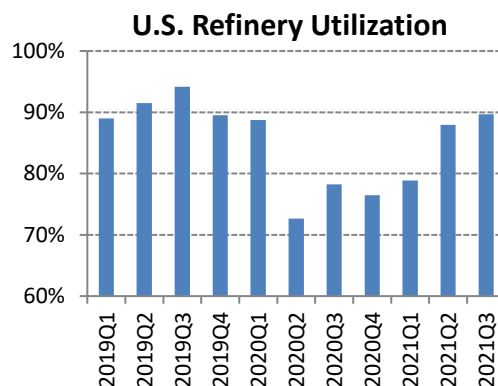
Baker & O'Brien, Inc.'s 2021 Q3 *PRISM*[™] update shows that U.S. refining margins continue their recovery towards pre-COVID levels. Average U.S. refining cash margins for the quarter were \$4/Bbl. to \$7/Bbl., above the breakeven levels for all U.S. PADDs and improving by as much as \$8/Bbl. in PADD 1 compared to the same quarter a year ago.

Improving demand and refinery utilization are driving the margin recovery. Aggregate U.S. gasoline, jet fuel, and diesel consumption increased almost 4% over last year, driven largely by jet fuel recovery.

As we reported in the Baker & O'Brien/RBN Energy **U.S. Refinery Billboard** weekly newsletter, refinery utilization also approached pre-COVID levels. Even though Hurricane Ida impacted PADD 3 utilization in August 2021, U.S. refinery utilization averaged almost 90% for 2021 Q3, versus a dismal 78% for the same quarter last year.

Most of the Key Refining Margin Metrics shown in the table below improved slightly during the quarter. Product crack spreads remain strong and well above the pre-pandemic levels in 2019. As discussed in our **2021 Q2 Newsletter**, Renewable Identification Number (RIN) costs for compliance with the Renewable Fuel Standard remain high, contributing to a lower recovery of product cracks as cash margin than in 2019 when RIN costs were comparatively low. The light-heavy crude oil price spread (WTI -WCS) has recovered to pre-COVID levels strengthening margins of USGC coking refineries that process heavy sour crude oil.

<i>PRISM Cash Margins (\$/Bbl.)</i>		
	2021: Q3 vs. Q2	Q3: 2021 vs. 2020
PADD 1	2.78	8.33
PADD 2	1.43	7.14
PADD 3	2.76	7.17
PADD 4	2.98	6.31
PADD 5	1.77	6.57
U.S. Overall	2.34	7.09

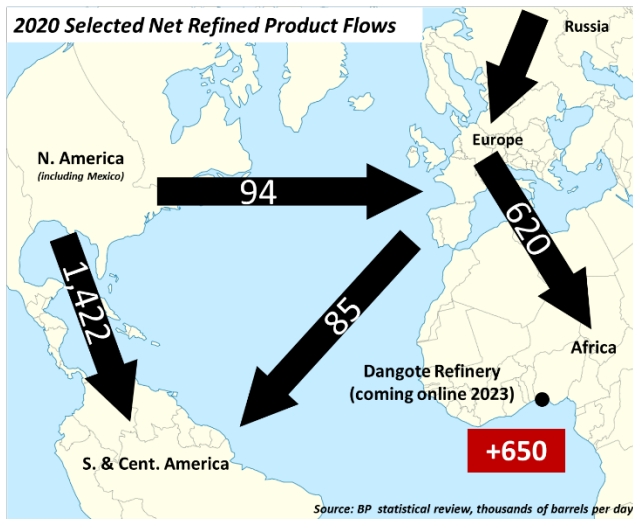


Key Refining Margin Metrics, \$/Bbl.							
	Q-to-Q Comparison		Quarters			Full Year	
	2021: Q3 vs Q2	Q3: 2021 vs. 2020	2021 Q3	2021 Q2	2020 Q3	2020	2019
PRISM Cash Refinery Margins (\$/Bbl.)							
PADD 1	2.78	8.33	6.60	3.82	-1.73	-0.20	6.78
PADD 2	1.43	7.14	6.78	5.35	-0.36	0.19	11.70
PADD 3	2.76	7.17	5.29	2.53	-1.88	-0.16	7.59
PADD 4	2.98	6.31	7.67	4.70	1.37	2.08	16.16
PADD 5	1.77	6.57	5.75	3.97	-0.82	0.54	8.64
Total U.S.	2.34	7.09	5.86	3.52	-1.23	0.11	8.91
Feedstock Indicators (\$/Bbl.)							
Brent	4.61	30.42	73.43	68.82	43.02	41.50	64.29
Brent - WTI	0.18	0.77	2.87	2.69	2.11	2.20	7.27
Brent - LLS	1.15	1.41	1.96	0.81	0.55	0.30	1.62
WTI – WCS USGC	1.31	3.19	6.01	4.70	2.82	3.71	6.25
Product Crack Margin Indicators (\$/Bbl.)							
PADD 1 - NYH Brent 3-2-1	0.88	10.53	17.65	16.77	7.12	7.44	9.67
PADD 2 - Chicago WTI 3-2-1	-0.14	12.70	21.84	21.98	9.14	8.36	17.54
PADD 3 - USGC LLS 3-2-1	1.83	11.95	18.67	16.83	6.71	7.09	10.82
PADD 5 - CA ANS 321	0.41	10.01	22.00	21.59	11.99	12.04	18.06
U.S. Utilization and Demand Indicators (% change)							
Refinery Utilization %	1.9%	14.6%	89.7%	88.0%	78.2%	79.0%	91.0%
Total Product Demand, 1,000 B/D	6.5%	14.7%	20,826	19,554	18,152	18,357	20,826
Gasoline Demand, 1,000 B/D	4.0%	8.6%	9,418	9,052	8,674	8,149	9,340
Jet Fuel Demand, 1,000 B/D	18.0%	51.9%	1,514	1,283	997	1,081	1,776
Diesel Demand, 1,000 B/D	-1.8%	10.6%	3,949	4,021	3,569	3,687	4,007

- 1) WTI – WCS USGC (WTI price at Magellan East Houston - Western Canadian Select (WCS) price at Nederland) is the price difference between a light sweet crude oil and a heavy sour crude oil and is an indicator of coking margin.
- 2) USGC LLS 321 deemed conversion to 33% CBOB gasoline, 33% RBOB gasoline, and 33% ULSD.
- 3) Chicago WTI 321 deemed conversion to 33% CBOB gasoline, 33% RBOB gasoline, and 33% ULSD.
- 4) NYH Brent 321 deemed conversion to 33% CBOB gasoline, 33% RBOB gasoline, and 33% ULSD.
- 5) CA ANS 321 deemed conversion to 67% CARBOB gasoline and 33% CARBOB diesel.

Special Topic: Nigeria's Dangote Refinery: Making Waves in the Atlantic Basin

The Dangote Group, headed by Africa's wealthiest individual, Aliko Dangote, is building the world's largest single-train refining complex in Nigeria. Despite its considerable crude oil production, Nigeria and the surrounding West African region rely on imported supplies of refined fuels to meet their energy needs. However, the 650,000 B/D Dangote Petroleum Refinery will have sufficient capacity to supplant all of West Africa's product imports and, once complete, it is likely to have a substantial impact on refined product flows throughout the Atlantic Basin. Although beset by cost overruns and delays, the Dangote Group expects the refinery to be online in 2023.



This new refinery is set to take a commanding position in the Atlantic Basin as it has all of the key strategic attributes shared by the world's most profitable refineries: 1) large scale; 2) a sophisticated configuration that includes a mild hydrocracker, a residual fluid catalytic cracker, and an alkylation unit; 3) close proximity to crude oil sources; 4) local refined product markets; and 5) limited local competition.

In August 2021, Dangote secured the all-important supply of at least 300,000

B/D of crude oil for the refinery by selling a 20% stake in the project to state oil company Nigerian National Petroleum Corporation. Additional crude supply requirements could come from other West African sources, given the high levels of crude production in the region, or from other locations.

The refinery is designed to process a range of light and medium grades of crude oil, including three specific Nigerian grades: Escravos, Bonny Light, and Forcados. Once operations begin, the refinery is expected to yield 327,000 B/D of gasoline, 244,000 B/D of gasoil/diesel, 56,000 B/D of jet fuel/kerosene, and 290,000 metric tonnes per year of propane/LPG (approximately 1,300 B/D). Finished gasoline and diesel fuel will meet Euro-V quality specifications for clean fuels.

The Dangote refinery's production will likely displace European imports to Nigeria and the greater West African region. Europe exported an estimated 937,200 B/D of products to Africa (as a whole) in 2020, roughly 40% of European exports and 40% of all African imports. From a net trade flow perspective Europe exports over 600,000 B/D of refined products to Africa. These barrels will need to find a new home.

The Atlantic Basin refineries face some challenging headwinds due to increased competition, the rebalancing of refined product trade-flows, and reduced availability of light, sweet Nigerian crude oils. The latter is likely to increase feedstock costs for refineries that depend on these premium grades of crude oil.

Even though Europe is a net importer of refined products, it is structurally long on gasoline. For coastal European refineries, the West African markets have historically provided a convenient outlet for their surplus and often lower quality gasoline that cannot be placed locally. As marginal coastal European refiners are unlikely to invest to address their long running imbalance with their market requirements, they will be forced to find new export markets for their low-grade gasoline products or they will reduce production.

In the U.S., PADD 1 coastal refineries are most likely to suffer from startup of the Dangote refinery because they generally depend on light, sweet West African crude oil. Some of these less-complex East Coast refineries, like their European counterparts, are marginal suppliers that are more likely to reduce production during tougher trading conditions. While PADD 3 (USGC) exports to Europe are considerably greater than those from PADD 1, USGC refineries are generally more complex, more competitive, and better positioned to compete in alternative export markets.

The end result from the completion of the Dangote refinery is likely to be further pressure on Atlantic Basin refining margins, with hard-pressed European refiners likely facing the brunt of the impact. Although increased competition may be unwelcome by Atlantic Basin oil refiners, consumers should benefit, especially those in West Africa.

Contact:

Aaron Calder

(832) 358-1453

aaron.calder@bakerobrien.com

About Baker & O'Brien

Baker & O'Brien is an independent professional consulting firm specializing in technology, economics, and management practice for the international oil, gas, chemical, and related industries. With offices in Dallas, Houston, and London, the firm assists clients with strategic studies, mergers and acquisitions, and technology evaluations. The firm also provides expert services to support insurance claims, investigate operating incidents, and support a wide range of commercial and construction disputes in the energy industry.

About *PRISM*

Baker & O'Brien's *PRISM* software is used to perform detailed analyses of individual refineries and the refining value chain from crude oil load port to products truck rack. The system combines a large historical database with a robust refinery simulator to provide analytical support to competitive assessments, strategic planning, crude oil valuation and delivered cost of supply. The *PRISM* database currently includes operational and economic performance details for all refineries in the U.S. and Canada, most refineries in Europe, and over 50 refineries in the Asia Pacific region. The *PRISM* system is available for license and is used in consulting assignments for Baker & O'Brien clients.

About U.S. Refinery Billboard

The **U.S. Refinery Billboard**, jointly published with RBN Energy, provides a one-of-a-kind weekly update on the U.S. refining industry, including key market insights on refinery activity, individual refinery performance, product markets, and economics. The comprehensive report includes regional crude and refined product price spreads, crude oil netbacks, refinery-specific indicative margins leveraging Baker & O'Brien's *PRISM* refinery modeling system, and highlights of weekly news of importance to the sector.

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