April 2021

# PETROLEUM WATCH

CALIFORNIA ENERGY COMMISSION

## INSIDE



## REFINERY NEWS

- **Chevron Richmond:** On March 11, an equipment malfunction resulted in an ongoing flaring event at the refinery. A Community Warning System (CWS) Level 1 was issued (Cal OES).
- **Valero Benicia:** On March 8, the refinery notified the fire department of an oil sheen in Suishun Springs Creek. Refinery personnel deployed a boom and the sheen was contained (Cal OES, Patch).

## CALIFORNIA GASOLINE RETAIL PRICES BY BRAND

**March 2021 vs. 2020**
(Percentage Change)

| | |
|---|---|
| 76 | 16% higher |
| ARCO | 18% higher |
| Chevron | 16% higher |
| Hypermart | 18% higher |
| Shell | 15% higher |
| Unbranded | 17% higher |
| Valero | 17% higher |

**March 2021 Averages**

| | |
|---|---|
| 76 | $3.90 |
| ARCO | $3.64 |
| Chevron | $4.00 |
| Hypermart | $3.52 |
| Shell | $3.95 |
| Unbranded | $3.70 |
| Valero | $3.79 |


Source: California Energy Commission (CEC) analysis of Oil Price Information Service (OPIS) data

## CALIFORNIA DIESEL RETAIL PRICES BY REGION

**March 2021 vs. 2020**
(Percentage Change)

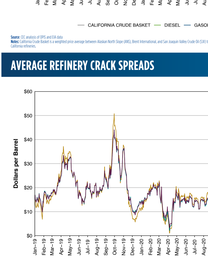
| | |
|---|---|
| Northern CA | 14% higher |
| Central CA | 11% higher |
| Southern CA | 10% higher |

**March 2021 Averages**

| | |
|---|---|
| Northern CA | $3.94 |
| Central CA | $3.79 |
| Southern CA | $3.93 |


Source: CEC analysis of OPIS data

## ANNUAL REFINERY PRODUCT SLATES



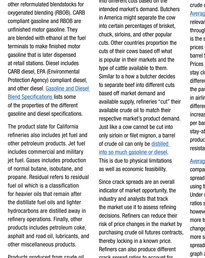

Source: CEC analysis of Petroleum Industry Information Reporting Act (PIIRA) and U.S. Energy Information Administration (EIA) data

### GASOLINE AND DIESEL PRODUCT SPECIFICATIONS

| | |
|---|---|
| California Air Resources Board (CARB) Diesel | Diesel fuel with sulfur content less than 0.0015 percent. |
| Environmental Protection Agency (EPA) Diesel | Diesel fuel with sulfur content between 0.0015 and 0.05 percent and diesel fuel with sulfur level no higher than 0.0015 percent. |
| CARB Gasoline | A product that will constitute California gasoline upon the addition of a specified type and percentage of oxygenate to the product after the product has been supplied from the production or import facility at which it was produced or imported. |
| Conventional Gasoline | Types of finished gasoline that do not contain any oxygenates (not classified as oxygenated or reformulated gasoline). Includes Arizona Conventional Gasoline and Nevada Conventional Gasoline. |
| Reformulated Gasoline | Finished gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the EPA. |

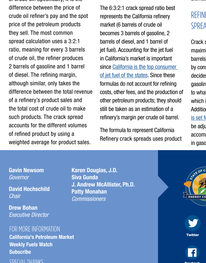
Source: California code of regulations, (CCR), title 13 https and california Air Resources Board Chapter 5, Article 1, Subarticle 2, § 2260

## PADD 5 AVERAGE SPOT PRICES




Source: CEC analysis of OPIS and EIA data.
Note: California Crude Basket is a weighted price average between Alaskan North Slope (ANS), Brent International, and San Joaquin Valley Crude Oil (SJV) to represent the price of crude oil processed by California refineries.

## AVERAGE REFINERY CRACK SPREADS




Source: CEC analysis of OPIS and EIA data.
Note: Crack Spread ratios are used to denote how many barrels of refined product are made from a barrel of crude oil. 3-2-1 means 3 barrels of crude oil produce 2 barrels of gasoline and 1 barrel of diesel. Not to the Hubbert Peak: provides more information on the other ratios.

## FEATURED TOPIC

### REFINERY PRODUCT SLATES AND CRACK SPREADS

#### CALIFORNIA REFINERY PRODUCT SLATE

California refineries produce nearly all of the transportation fuels needed to meet statewide demand as well as producing other types of refined products and coproducts. In addition, California refineries produce enough refined product to export roughly 138 million barrels of refined products annually to neighboring states. Annual Refinery Product Slates illustrate the refined petroleum products of statewide refinery output (CEC data) 2020, referred to as a product slate.

Gasoline includes *California Air Resources Board (CARB)* compliant gasoline, conventional gasoline, and other reformulated blendstocks for oxygenated blending (RBOB). CARB compliant gasoline and RBOB are unfinished motor gasoline. They are blended with ethanol at the fuel terminals to make finished motor gasoline that is later dispensed at retail stations. Diesel includes CARB diesel, EPA (Environmental Protection Agency) compliant diesel, and other diesel. Gasoline and Diesel Blend Specifications list some of the properties of the different gasoline and diesel specifications.

The product slate table in California refineries also includes jet fuel and other petroleum products. Jet fuel includes commercial and military jet fuel. Gases includes production of normal butane, isobutane, and propane. Residual refers to residual fuel oil which is a classification for heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. Other products includes petroleum coke, asphalt and road oil, lubricants, and other miscellaneous products.

Products produced from crude oil sold for different prices on the market and have different margins for refiners. For example, even though gasoline has a large margin it would not be economically feasible for a refinery to produce only gasoline. This is because the products extracted from crude oil have different chemical makeups and densities. Crude Oil Distillation Units and Refined Product Boiling Ranges displays the different temperature ranges for distilling crude oil input into the different refined products. Thick residual fuel oil would need to be heavily processed to turn it into a light gasoline. The extra processing is more expensive and cuts into the refiner's margins making it more feasible to sell the product as is.

#### CRACK SPREADS VERSUS REFINING MARGIN

Crack spreads are the estimated refiner margins of refining a barrel of crude oil. Specifically, it is the difference between the price of crude oil refiner's pay and the sales price of the petroleum products they sell. The most common spread calculation used is a 3-2-1 ratio, meaning for every 3 barrels of crude oil, the refiner produces 2 barrels of gasoline and 1 barrel of diesel. The refining margin, although similar, only takes the difference between the total revenue of a refinery's product sales and the total cost of crude oil to make such products. The crack spread accounts for the different volumes of refined product by using a weighted average for product sales.

CRUDE OIL DISTILLATION UNITS AND REFINED PRODUCT BOILING RANGES




Source: EIA

#### HOW CRACK SPREADS SIGNAL MARKET OPPORTUNITY

To use an analogy, butchers in the beef industry separate cow meat into different cuts based on the different market's demand. Butchers in America might separate the cow into certain percentages of brisket, chuck, sirloins, and other popular cuts. Other countries proportion the cuts of their cows based off what is popular in their markets and the type of cattle available to them. Similar to a how a butcher decides to separate beef into different cuts based off market's demand and available supply, refineries "cut" their available crude oil to match their respective market's product demand. Just like a cow cannot be cut into only sirloin or filet mignon, a barrel of crude oil can only be distilled into so much gasoline or diesel. This is due to physical limitations as well as economic feasibility.

Since crack spreads are an overall indicator of market opportunity, the industry and analysts that track the market use it to assess refining decisions. Refiners can reduce their risk of price changes in the market by purchasing crude oil futures contracts, thereby locking in a known price. Refiners can also produce different crack spread ratios to account for changes in consumer demand. For example, jet fuel may be selling for less than the equivalent crude oil plus refining cost (producing at a loss) but refiners continue to produce because the average crack spread is still positive. Instead of shutting down their facilities, they would adjust their production ratios to match a crack spread that yields higher margins. This type of shift occurred last year when the margins for gasoline and jet fuel shrank as reduced demand brought down the prices for those products. However, diesel demand remained relatively constant throughout, so prices and margins remained steady. Refiners redirected fuel inputs to produce greater quantities of diesel in place of jet fuel. These changes in refinery operations successfully allowed the refiners to respond to the market and avoided supply shortages.

#### CALIFORNIA REFINERY CRACK SPREADS

The 6-3-2-1 crack spread ratio best represents the California refinery market (6 barrels of crude oil becomes 3 barrels of gasoline, 2 barrels of diesel, and 1 barrel of jet fuel). Accounting for the jet fuel in California's market is important since California is the top consumer of jet fuel of the states. Since these formulas do not account for refining costs, other fees, and the production of other petroleum products; they should still be taken as an estimation of a refinery's margin per crude oil barrel.

The formula to represent California Refinery crack spreads uses procedural spot prices for products sold within Petroleum Administration Defense District 5 (PADD 5) and a California Crude Basket (weighted average of local San Joaquin Valley, Alaskan North Slope, and Brent International crude oil prices). PADD 5 Daily Average Spot Prices shows the relevant product spot prices for 2019 through March 2021. Cents per gallon is the standard metric for these spot prices but are converted to dollars per barrel for the crack spread formula. Prices for jet fuel and diesel normally stay close to each other, averaging a difference of $0.01 per barrel prior to the pandemic. With the large reduction in airline travel since March 2020, the difference between the two products increased to an average of $4.57 per barrel. Demand reduction from stay-at-home orders affected all three products, but diesel was the most resistant to the reduced consumption.

Average Refinery Crack Spreads compares three different possible crack spread ratios for California refineries using the above spot price history. Under normal conditions the different ratios stay relatively close together, however the 3:2:1 spread is weighted more towards gasoline production as changes in the gasoline spot price are more severe. The 6:3:2:1 and 4:2:1:1 spreads are nearly identical on the graph as they both include jet fuel in their product ratios. The 4:2:1:1 split is also a better fit for California's refinery profile under pre-pandemic conditions, when the diesel proportion of the refinery slate was about the same as the jet fuel portion.

The 2019 average crack spread for California refineries was $21 per barrel. During significant refinery outages in April 2019 and October 2019, the crack spreads jumped into the $30 and $40 range. April 2020 was when refinery crack spreads dropped significantly (below $5 per barrel), sparking a reduction in refinery utilization. Compared to 2019, the average crack spreads spread was 47 percent lower in 2020, averaging $14 per barrel using the 6:3:2:1 spread. So far in 2021, the crack spreads returned to the $20 per barrel level and will continue to rise as product spot prices trend upward as well. When crude oil prices increase, so do the spot prices for gasoline and other refined products, which ultimately raises the crack spreads.

#### REFINERY IMPLICATIONS OF CRACK SPREADS AND PRODUCT SLATES

Crack spreads serve as a gauge for maximizing refiner returns on crude oil barrels, however the product demand by consumers determines how a refiner decides to "cut their cow." Retail gasoline prices have already returned to what they were pre-pandemic, which is a signal for rising demand. Additionally, California's reopening goal is set for June 15, so refineries should be adjusting their production slates to accommodate the expected increase in gasoline and jet fuel demand.



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