STUDY OVERVIEW: AN ECONOMIC ASSESSMENT OF THE INTERNATIONAL MARITIME ORGANIZATION SULPHUR REGULATIONS ON MARKETS FOR CANADIAN CRUDE OIL

BACKGROUND & STUDY SCOPE

A recent regulation by the International Maritime Organization (IMO) sets a global limit for sulphur in fuel oil used to power ships at 0.5% (by mass) from the current 3.5% starting in January 2020. This more stringent regulation restricting emissions from ships plying international waters could significantly change the crude oil landscape at regional and global levels. The regulation would require the removal of up to 12,000–16,000 tonnes per day of sulphur contained in the 3–4 million barrels/day of high sulphur bunker fuel used for marine transport. This change will propagate through the value chain; from the marine industry that will seek replacement fuels to refiners that produce bunker fuel, and to upstream oil producers who produce crudes that generate high sulphur residues used in bunkering.

Canada is one of the major producers of high sulphur heavy crude oil with production growing steadily since 2008. Bitumen production is expected to reach 3 million bbl/day by the end of 2018 and continue increasing. Canadian heavy sour crude is refined primarily in Canada and the United States (US) where there are sufficient capacities of complex refineries to handle this type of crude. With the reduction in demand for high sulphur residual oil (resid), the demand for Canadian crudes will decrease.

CERI developed a refinery modelling and optimization approach to investigate the impact of the IMO regulation on Canadian crude production and price. Our results show that a reduction in the refinery profit margins in the US will lead to a higher prices discount for Western Canadian crude from a historical average of $13/bbl to $31–$33/bbl.

CERI USED A REFINERY OPTIMIZATION MODEL TO DETERMINE THE MARGIN CHANGE

CERI’s model accounts for US refinery configurations and their operating costs, capital investments, crude oil blending, and the associated refinery acquisition costs of crude blends, product slates and their market values, thus requiring the development of revenue forecasts from the sales of refinery products. Results show that optimization of US refineries at a Petroleum Administration Defense District level (PADD-level) can lead to potential displacement of some volumes of Western Canadian heavy crude that have historically been processed in some PADDs. The analysis is complicated by the degree of refining of the feedstock crudes. Complex refineries can take the heavy crudes and produce more lighter distillate products, generating higher margins. Medium and simple refineries cannot and must market the higher percentage of low priced high sulphur residual oil they produce.

NON-COMPLIANCE SCENARIOS EFFECT THE DEMAND FOR HEAVY SOUR CRUDE

Non-compliance with the new regulation is a serious concern for the IMO and will effect the demand for heavy sour crude. CERI developed scenario and price outlooks for various crudes and refinery products for 2020, 2025 and 2030. This facilitated the analysis of future prices for middle distillates. Three non-compliance scenarios are assessed, each leading to a different demand impact and therefore a different Western Canadian crude price discount. The scenarios include:

- Low non-compliance (Low NC) – assumes 80% compliance (20% non-compliance) by 2020 given up to 80% of global trade occurs between regions where ECA is in force and other regions of the world
- Moderate non-compliance (Moderate NC) – assumes 75% compliance (25% non-compliance) by 2020
- High non-compliance (High NC) – assumes 70% compliance (30% non-compliance) by 2020

These scenarios consider the fact that non-compliance will differ across geographical regions, for example in regions known for strict enforcement versus those known for less rigid enforcement.

These scenarios consider the fact that non-compliance will differ across geographical regions, for example in regions known for strict enforcement versus those known for less rigid enforcement. Higher enforcement means a lower demand for low sulphur resid and middle distillates.
IMO REGULATION: IMPACT ON US REFINERY MARGINS

Changes in resid and distillate prices will reduce refinery margins to a notable degree, particularly those of simple and medium refineries (Figure E.1). Under some scenarios the complex refiners actually increase their margins because they produce and sell the higher priced distillates. This option is not available for medium and simple refineries.

Figure E.1: Refinery Margin Impacts Due to IMO 2020 Regulation

Our analysis indicates a general trend of decreasing refinery netbacks in the years after 2020 in all the non-compliance (NC) scenarios for medium refineries; complex refineries enjoy increased margins in the Low NC scenario. Under the Low NC and Moderate NC scenarios, which are considered the plausible scenarios, the IMO regulation will bring about a refinery margin loss of $16/bbl to $20/bbl between 2020 and post-2025 relative to average 2017 margins.

Although some PADDs will have low margin reductions and even an increase in margins for some by 2020, we expect the highest margin reduction refineries, in this case, the medium refineries in the US, to set the prices for heavy sour crudes and determine the light-heavy crude price differentials.

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KEY IMPACTS ONCE REGULATIONS ARE IN PLACE

CERI considered how the market for marine fuel might change as a result of the regulation and potential substitution options. There are three principle options including 1) addition of scrubbers so the existing resid can be used, 2) blending of high sulphur resid with low sulphur resid, 3) substitution with other fuels (methanol, LNG or distillates), and 4) non-compliance. Based on our assessment of the price impacts and the options available, the following impacts are likely:

- ~60% of shipping industry fuel currently using high sulphur resid will need to switch to either marine gasoil or a blend of high sulphur and ultra-low sulphur middle distillate marine fuels
- Adoption of scrubbers is likely to increase moderately and peak by 2025 where ~5% of the resid bunker demand is consumed in tandem with scrubbers
- LNG will replace ~1.9% to 7% of resid bunker fuel volume during the study period
- About 240,000 bbl/day resid hydrotreating capacity can be assumed to contribute to low sulphur fuel oil by 2020, increasing going forward as the increase in the light-heavy product differentials is expected to motivate investments in desulphurization, which will capture up to 14% planned additional refinery resid hydrosulphurization capacity by 2025
- Increasing refinery utilization capacities will be part of the solution to the bunker fuel availability problem but will equally add to the problem of resid glut as more resid will be produced as refiner’s process more crude
- Large amounts of distillates that can bridge the gap of cleaner bunker fuel demand can be produced, thereby keeping high sulphur fuel oil prices low
- Markets are expected to rebalance in a couple of years, discouraging significant capital investments in complex refining units, which have payback periods of at least two decades
- Slow-steaming of ships is another approach the shipping industry may employ to save fuel costs. Our analysis shows that reduction in speed can achieve a 25-50% reduction in fuel consumption if compliant fuel prices skyrocket.
IMPACTS ON CANADIAN HEAVY OIL

The price discount on Western Canada Select (WCS) crude with respect to the West Texas Intermediate (WTI) price point will expand significantly due to the IMO regulation. Figure E.3 illustrates how the refinery margin loss affects the WCS (heavy sour) pricing relative to WTI (light sweet). The dotted lines represent the WCS pricing that is historically discounted at $13/bbl plus the discounts resulting from the IMO regulation for the three scenarios considering a medium refinery in the US.

Figure E.3: WTI and WCS Price Differential (2017 US$)

A refinery margin loss of $16/bbl to $20/bbl between 2020 and post-2025 is expected to be directly transferred to a light-heavy differential. The cumulative differential which includes the historical WTI-WCS discount of $13/bbl sums up to $31/bbl-$33/bbl of WTI-WCS differential within the study period.

As a result, new Steam Assisted Gravity Drainage (SAGD) projects with SORs of less than 3 m3/m3 are likely to break even when the IMO regulation is introduced whereas those with Steam-Oil Rations (SORs) greater than 3 m3/m3 will operate at a loss. A significant volume of SAGD-derived bitumen production could be affected. Based on SAGD production data, about 574,000 bbl/day of bitumen produced in Alberta has an SOR of more than 3 m3/m3 (CanOIl, 2017).

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