Economic Analysis of The South Texas Energy Complex

Daniel J. Pastor*

June 20, 2017

Prepared on behalf of the South Texans Against the Refinery (STAR) Coalition.

*College of Business Administration, The University of Texas at El Paso, 500 W. University Ave., El Paso, TX 79968, e-mail: djpastor@utep.edu, phone: (915) 747-7472

1 Summary

The STEC is a proposed 55,000 bpcd oil refinery with up to 4 million barrels of storage capacity in Duval County, Texas. RP has stated that the STEC will create 1,800 construction jobs and 350 permanent jobs. RP states that construction for the STEC will begin in 2017 and cost $500 million, with operations beginning in late 2018. This study evaluates economic feasibility of the proposed facility in context of the public statements about the details of the project.

Table 1 summarizes the results of this analysis. The total costs of building the STEC are estimated to be over $1.9 billion. The annual operating costs of the STEC, including the costs of financing, are estimated to be $15.07 per barrel of crude and the cost of complying with the RFS2 mandates is estimated to be $3.08 per barrel. Combining the two, the total annual operating costs are $18.15 per barrel. As of June 19, 2017 the crack spread, the difference between the cost of acquiring crude oil and the revenue from selling refined products, is $12.99 per barrel. This results in an annual loss of $5.16 per barrel, or about $103 million. The number of jobs per year created during construction are estimated at 2,071, with 126 permanent jobs required for operations.

Because of the lack of final details about this project, the costs of building a geothermal energy plant, advanced pollution control costs, and potential costs of building rail lines to connect to KCS have not been included in this study and could add to the costs of construction and operations. Other costs not included in this study are state or local taxes. While it is expected that the STEC will have to pay some taxes, there are two main reasons why taxes are not included in this analysis. First, the project is in the early stages of planning and final details about the refinery, and thus the final value of the project, could change. Second, RP could negotiate a lower tax rate or tax subsidies with the local tax authorities. However the taxes are structured, any tax levied would decrease the profits of the STEC.

Table 1: Total Costs and Job Estimates for The South Texas Energy Complex

The South Texas Energy Complex	
Year Construction Starts	2017
Construction Period (Months)	48
Crude Oil Charge Rate (BPCD)	55,000
Crude Storage Capacity (Days)	25
Finished Product Storage Capacity (Days)	42
Total Storage Capacity (Barrels)	3,955,985
Project Construction Cost (Million Dollars)	$1,962
Annual Operational Expenses (Million Dollars)	$113
Annual Cost of Financing - debt and equity (Million Dollars)	$190
Jobs	
During construction period	2,071
During operating years (annual)	126
Annual Operating Cost per barrel	$5.61
Annual Cost of Financing per barrel	$9.46
Annual RIN Cost per barrel	$3.08
Total Cost per barrel	$18.15
Crack Spread per barrel	$12.99
Profit (Loss) per barrel	$ (5.16)

Note: JEDI estimates for The South Texas Energy Complex. Construction period related jobs are per-year full-time equivalent (FTE) for the 48 months. Costs of financing assumes 70% of the cost of construction will be financed for twenty years at 5.5% with the remaining 30% financed from corporate investors with a 10% return for ten years. RIN costs are based on RIN pricing as of June 16, 2017 and are included because this analysis assumes the final products will be sent to U.S markets. Crack spread as of June 19, 2017. Profit (Loss) is calculated by subtracting Total Cost per barrel from the Crack Spread per barrel.

The STEC faces substantial risks including, but not limited to, producing products only for the Mexican market to avoid U.S. pollution regulations and renewable standards for fuel, exposing STEC to possible changes to trade policies of USA and Mexico; restricted ability to react to market conditions due to size, scale issues, and the independent nature of the refinery; relying on rail for transportation of feedstock and refined products exposes STEC to risks of higher costs from changing market conditions of the railroad. If Mexico is the target market for finished products, then the STEC will also be vulnerable to the saturated downstream infrastructure capacity and the Dollar-Peso exchange rate.[1] An appreciation of the Dollar versus the Peso would make it more expensive for Mexico to purchase U.S. products. If the STEC doesn't build a refinery that can produce fuels for the U.S. as well as Mexico, it is at a competitive disadvantage relative to the larger refineries in the Gulf Coast region. Thus, this analysis estimates the cost of operating a refinery that produces finished products which can be sold in U.S. markets. If one or more of these risks materialize, then the profitability of STEC could certainly be lower.

[1]For example, after the U.S. presidential elections the Peso briefly depreciated about 12% versus the Dollar.

2 The South Texas Energy Complex

2.1 Introduction

Raven Petroleum L.L.C. (RP) is proposing to build a 55,000 barrel per calendar day (bpcd) oil refinery in Duval County, Texas called The South Texas Energy Complex (STEC). The proposed refinery is projected to cost $500 million (Druzin, 2016), with construction beginning in 2017, and operations beginning by the end of 2018 (Emsi, 2017a). RP estimates that 1800 temporary construction jobs (Emsi, 2017a) and 350 permanent jobs will be created as a result of this development (Emsi, 2017b).

An oil refinery is a capital intense facility that processes crude oil into finished products such as gasoline and diesel fuel. The ability to convert heavy products such as crude oil, into lighter products such as gasoline, is related to the complexity of the refinery, and is determined by how many and which type of processing units are used. The more complex the refinery, the higher the costs of construction and operating, and the more finished products are produced. The South Texas Energy Complex (STEC) plans to produce the following refined products: gasoline, diesel, jet fuel, naphtha, and LPG products (Raven Petroleum, L.L.C., 2017).

This study uses the National Renewable Energy Laboratory's (NREL) Jobs and Economic Development Impacts (JEDI) tool to estimate the construction and operating costs of an oil refinery in Texas.[2] The estimates are calculated using project specific characteristics such as the crude oil charge rate in barrels per calendar day, the location of the project, the complexity of the refinery, as well as industry specific data and default inputs. The estimates include the costs of building and operating a refinery, as well as the number of jobs created, both during construction and ongoing operations. The default data used

[2] The reader is referred to the JEDI users manual for details on the formulas and methodology used by this tool (Goldberg, 2013).

in the JEDI analysis tool are obtained from the Minnesota IMPLAN Group[3] (Goldberg, 2013). Each refinery is unique and since few refineries have been recently built[4] and companies regard the details as proprietary, it is difficult to get information about specific projects. The JEDI tool provides reasonable estimates for construction costs and jobs for building a refinery based on discussions with industry and government sources (Goldberg, 2013).

The costs of the process units used in refinery operations are based on the crude oil capacity, the complexity of the refinery, and the location. A refinery capable of producing the products STEC has announced include distillation units, catalytic reforming units, sulfur processing units, fluid catalytic crackers, and hydrocrackers (Goldberg, 2013). Storage capacity for crude oil and finished products is also included in the JEDI tool estimates. The STEC has stated that there will be up to 4 million barrels of storage onsite (Raven Petroleum, L.L.C., 2017), corresponding to 25 days of storage for crude oil and 42 days for finished products.

2.2 Construction

The timeline for the STEC proposes starting construction in 2017, with construction completing and operations beginning by the end of 2018 (Emsi, 2017a). This timeline is difficult to confirm since the data on the construction timelines from two recently completed refineries are not readily available.[5] However, the JEDI tool, based on NREL interviews with industry experts and project managers, sets the default time frame to

[3]Original sources include The U.S. Department of Labor, The Bureau of Labor Statistics, and others.

[4]Several relatively small refineries have been built in the United States since 1977, when the last large scale refinery started operating. Two recently built refineries have similar capacities to the proposed STEC: Buckeye Partners' refinery in Corpus Christi, TX has a capacity of 46,250 bpcd; Kinder Morgan's Galena Park, TX refinery started with a capacity of 42,000 bpcd and has since upgraded to 84,000 bpcd; both projects were completed in 2015. Source: Energy Information Administration.

[5]Buckeye Partners' refinery in Corpus Christi, TX, and Dakota Prairie Refining's Dickinson, ND refinery. Source: Energy Information Administration.

be 48 months. For comparison, the Davis Refinery proposed in Billings County, North Dakota projects that mechanical construction will be completed within two years, with an additional six to 12 months before operations begin (Meridian Energy Group Inc., 2016b). Thus, for the purposes of this study, 48 months will be used as a reasonable timeframe for construction.

Jobs are reported in full time equivalents (FTE), or 2,080 hours per year. The number of jobs created during construction partially depends on the complexity of the refinery, the crude oil charge rate, and the amount of storage capacity. Table 2 contains the JEDI estimates for the costs of construction and the number of jobs. The number of jobs estimated for the construction of the STEC is 2,071 jobs per year, and the estimated cost of construction for the STEC is over $1.9 billion. Again comparing the Davis Refinery, estimates for the cost of construction are $900 million for an initial capacity of 27,500 bpcd (Monke, 2016). Another recently completed project is the 20,000 bpcd Dakota Prairie Refinery in North Dakota. Dakota Prairie cost $430 million, lost $7.2 million in the first quarter of 2016, and was sold at a loss in June 2016 (Scheyder, 2016).

Table 2: Construction Costs and Job Estimates for The South Texas Energy Complex

The South Texas Energy Complex	
Year Construction Starts	2017
Construction Period (Months)	48
Crude Oil Charge Rate (BPCD)	55,000
Crude Storage Capacity (Days)	25
Finished Product Storage Capacity (Days)	42
Total Storage Capacity (Barrels)	3,955,985
Project Construction Cost (Million Dollars)	$1,962
Jobs	
During construction period	2,071

Note: JEDI estimates for construction costs and jobs for The South Texas Energy Complex. Construction period related jobs are per-year full-time equivalent (FTE) for the 48 months.

2.3 Operations

Once the refinery is completed and operations begin, JEDI estimates that the refinery would require 126 FTE jobs. There is no requirement that the STEC hire local workers (Lavín-Castillo, 2017). Additionally, it is difficult to predict who will be offered jobs at the STEC as firms keep that information confidential. The costs of operations include chemicals and catalysts, utilities, labor, maintenance, insurance, and miscellaneous supplies. The yearly operating costs presented in Table 3, not including the cost of crude oil, are estimated to be about $113 million per year, or about $5.61 per barrel of crude. The total annual operating costs include the operating costs and the financing costs. RP has previously stated that the STEC will be self financed (Blum, 2016). At this time, there is no independent verification of this statement and a reasonable estimate of the cost of financing is included in this analysis. The costs of financing the construction of the refinery are an additional cost of operations and amount to $190 million annually, or about $9.46 per barrel or crude.[6] Total annual operating costs do not include estimates of the acquisition costs of crude or the revenue from the sale of refined products. Those estimates will be discussed in section 2.5.

Table 3: Operating Costs and Job Estimates for The South Texas Energy Complex

The South Texas Energy Complex	
Annual Operational Expenses (Million Dollars)	$113
Annual Cost of Financing (Million Dollars)	$190
Jobs	
During operating years	126
Annual Operating Cost per barrel	$5.61
Annual Cost of Financing per barrel	$9.46

Note: JEDI estimates for operating costs and permanent jobs for The South Texas Energy Complex. Operating costs include chemicals and catalysts, utilities, labor, maintenance, insurance, and miscellaneous supplies, but do not include costs of meeting RFS2 mandates. Costs of financing assumes 70% of the cost of construction will be financed for twenty years at 5.5% with the remaining 30% financed from corporate investors with a 10% return for ten years.

[6]This study assumes that 70% of the cost of construction will be financed for twenty years at 5.5%. The remaining 30% is financed from corporate investors with a 10% return for ten years.

2.4 Renewable Fuel Standards

The Energy Independence and Security Act (EISA) was passed in 2007 and included an expansion of the Renewable Fuel Standard (RFS2) program. RFS2 requires blending biofuels into the fuel supply for U.S. surface vehicles. Varying percentages of renewable fuels are required to be blended into each gallon of gasoline or diesel produced for the U.S. market. There are four nested mandates for the RFS2 program (Lade et al., 2015):

1. **Cellulosic** - Biofuel produced from non-edible portion of plants, woods, or grasses;
2. **Biomass Based Diesel (BBD)** - Biofuel commonly produced from oilseed such as soybean or canola oil;
3. **Advanced** - Biofuel meeting conditions set forth under EISA, including cellulosic and BBD, excluding ethanol produced from cornstarch;
4. **Total Biofuel** - All approved biofuel, including ethanol.

Each of these categories has a volumetric requirement under the EISA and the Environmental Protection Agency (EPA) translates these requirements into fractional percentages annually.

Renewable Identification Numbers (RINs) are generated by the production of renewable fuels. Table 4 lists each of the four categories nested under RFS2 corresponding to a RIN: cellulosic fuels generate D3 RINs, BBD fuels generate D4 RINs, advanced biofuels generate D5 RINs, and conventional fuels that are not advanced biofuels generate D6 RINs (Knittel et al., 2015). Since the cellulosic biofuels account for a negligible size of the market, this analysis focuses on D4, D5, and D6 RINs.

To demonstrate compliance with the RFS2 program, each gallon of petroleum fuel produced must be blended with a minimum fraction of renewable fuel and the corresponding RINs must be turned in to the EPA (Knittel et al., 2015). The nested system allows obligated parties multiple ways to comply with the mandate (Figure 1). For example, a D4 RIN can be used to comply with the BBD mandate, the Advanced mandate, or the Total Biofuel mandate. A D5 RIN can be used to comply with either the Advanced or Total Biofuel mandates. A D6 RIN can only be used to comply with the Total Biofuel mandate (Knittel et al., 2015). An obligated party may also comply by generating their own RINs through production or blending biofuels themselves, or by purchasing RINs from other parties (Lade et al., 2015).

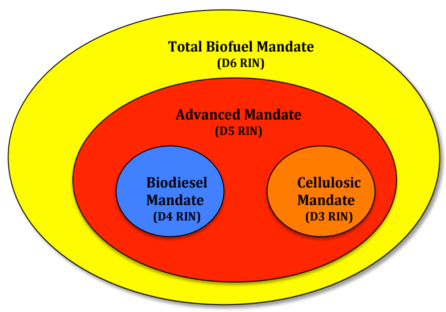

Figure 1: Illustration of the nested structure of the RFS2 mandates and the corresponding RINs. Source: Lade et al. (2015).

Obligated parties include oil refineries and blenders, among others (Lade et al., 2015). The point of obligation for RFS2 compliance is with the obligated parties; in this case, the STEC.[7] Given that the RFS2 mandates are nested, an obligated party can comply by purchasing a combination of RINs. Each gallon of gasoline or diesel sold in 2017 requires 0.0167 D4 RINs to meet the BBD standard, 0.0238 D4 or D5 RINs to meet the Advanced standard, and 0.107 D4, D5, or D6 RINs to meet the Total Biofuel standards (Federal Register, 2016b). The RFS2 mandates can be reached by turning in 0.0167 D4 RINs,

[7]Under perfect conditions, the refiner would simply increase the price of their final product to fully pass through the cost of the RIN to the consumer. However, there is empirical evidence of imperfect pass through of the cost burden associated with RINs. See (Knittel et al., 2015); (Pouliot et al., 2017); (Li and Stock, 2017).

0.0071 D5 RINs, and 0.0832 D6 RINs.[8] Thus, the resulting price of a bundle of RINs that would meet the obligation is given by:

$$P_{Bundle} = 0.0167P_{D4} + 0.0071P_{D5} + 0.0832P_{D6}$$

Where, P_{D4}, P_{D5}, and P_{D6} are the prices of D4, D5, and D6 RINs, respectively. According to Progressive Fuels Limited, the 2017 price for a D4 RIN is \$1.069, a D5 RIN is \$1.0565, and a D6 RIN is \$0.7548 (Progressive Fuels Limited, 2017). Considering the crude oil charge rate of 55,000 bpcd, this results in a P_{Bundle} of about \$0.08 per gallon of gasoline or diesel produced by the STEC.

Table 4: RINs and RFS2 Mandates

RIN	Price	RFS2 Mandate
D4	$1.069	BBD, Total Advance, or Total Renewable
D5	$1.0565	Total Advance or Total Renewable
D6	$0.7548	Total Renewable

Note: Renewable Identification Numbers, prices, and the mandates each RIN can be used for compliance. Prices obtained from ProgressiveFuelsLimited.com as of June 16, 2017

Most independent refineries are not capable of processing ethanol because their systems have been designed to process petroleum products. Ethanol absorbs water and causes corrosion in pipelines and storage units. High costs of adding ethanol processing capabilities make it financially infeasible for independent refiners to invest in the production of biofuels (Krauss, 2016). RP has not publicly addressed RFS2 mandates, possibly because their target market is Mexico (Tobben, 2017) and exported surface transportation fuels are not required to comply with the RFS2 mandates. Considering the refinery yield from Texas inland refiners in 2016,[9] and the price for a RIN bundle, the costs associated with

[8]Due to the nested structure of RFS2, 0.0071 = (0.0238-0.0167) D5 RINs and 0.0832 = (0.107-0.238) D6 RINs.

[9]According to the EIA, inland Texas refineries' average yield per unit of crude oil in 2016 for gasoline is 53.4%; diesel is 29.7%. These yields are used to calculate the RIN bundle price because assuming all the crude oil is distilled into gasoline or diesel, as the commonly accepted 3:2:1 ratio does, excludes other refined products that are not subject to the RFS2 and overestimates the costs of RFS2 compliance.

complying with the RFS2 mandates are about $3.08 per barrel of crude oil processed.[10]

2.5 Crack Spreads

The crack spread is a measure of overall profitability of an oil refinery; the larger the spread the larger the potential profits for the refinery. The crack spread represents the difference between the costs of acquiring a barrel of crude and the revenue generated by selling the finished products in the U.S. For each barrel of crude, a fraction can be refined into the various finished products, such as gasoline and diesel. A common crack spread used is the 3:2:1 spread which approximates the U.S. refinery yield. For every three barrels of crude refined, two barrels of gasoline and one barrel of distillate fuel are produced. Distillate fuel can be diesel fuel or heating oil. As of June 19, 2017 the crack spread is $12.99 per barrel (Energy Information Administration, 2017b).

The 3:2:1 crack spread may not be appropriate for all refiners since it is based on light, sweet crude oil such as Louisiana Light Sweet (LLS) and refiners may choose to process heavier crude oil or specialize in gasoline (Energy Information Administration, 2002). At this point, final details about the STEC such as the quantities of gasoline and diesel that will be produced and where the refined products will be sold - the U.S., Mexico, or both - are not available. Thus, the 3:2:1 crack spread gives a reasonable approximation of the ability of the STEC to manage the major source of uncertainty: the cost of crude oil (Energy Information Administration, 2002).

2.6 Feedstock

RP states that 2 incoming trains would transport the feedstock (Raven Petroleum, L.L.C., 2017). The capacity of a tank car is around 30,000 gallons or crude oil, or about 715 barrels

[10] Note that this analysis does not include the possible effects of new demand for RINs on the prices. RINs are publicly traded and a number of factors contribute to the market price, including future decisions by the EPA, precluding RIN price forecasting at this time.

(Birn et al., 2014). In order to receive 55,000 barrels of crude per day, at least 77 tank cars per day would be required. RP has indicated that STEC will have about 20 miles of internal rail lines and the capacity to load and unload two inbound and two outbound trains per day (Raven Petroleum, L.L.C., 2017).

Construction cost estimates include onsite infrastructure such as roads and rail lines, but not the costs of building track necessary to connect with the nearest main rail line, the Kansas City Southern (KCS) line. Should additional rail lines need to be constructed to access the KCS mainline, that would add to the cost of this project. Generally, shipping by rail could offer flexibility to the STEC since rail companies are more willing to enter into short-term agreements (1 or 2 years versus 10 to 15 years) than pipeline companies (Fritelli et al., 2014). However, relying completely on rail could expose the STEC to higher shipping costs, about $10 to $15 per barrel for rail transport versus about $5 per barrel for a pipeline (Fritelli et al., 2014). There is also a possibility that the increased demand for the rail lines caused by the two incoming and two outgoing trains per day could lead to delays in shipping or lead to increased costs. Any disruption in the delivery of crude that causes delays in processing could reduce profitability.

2.7 Geothermal

Special laws govern geothermal energy in Texas because it is produced below the surface (Hunt Institute, 2016). If geothermal resources have not been previously discovered, both exploratory drilling and well development require a drilling permit from the Railroad Commission of Texas (Hunt Institute, 2016). RP has an agreement with Thermal Energy Partners to provide geothermal energy to power the STEC (Thermal Energy Partners, 2017). Estimates of the cost of building a geothermal power plant are about $2500 per kilowatt (Energy.gov, 2017). RP has publicly said that the plant built for the STEC would provide up to 20 megawatts (Ramirez, 2017). Thus a conservative estimate of the cost of the geothermal plant is about $50 million. With additional coordination, permitting, and financing required, building a geothermal plant specifically to supply power to the STEC would add significant cost and complexity to the project.

2.8 Emissions and Water Usage

Petroleum refineries produce emissions through normal operations. The cost of the STEC is estimated assuming industry standard pollution control. RP states that STEC will be clean with zero emissions (Druzin, 2017), although no specific information is available (Trevino, 2017). To achieve a goal of zero emissions, the costs of construction and operation would be higher than estimated here due to the additional costs of installing and operating advanced pollution control systems. The proposed Davis Refinery states that the refinery will meet stringent air quality standards (Monke, 2016) but will be producing low emissions (Meridian Energy Group Inc., 2016a). Due to the limited details of the STEC project available at this time, cost estimates of emission control are not available.

Oil refineries use about 1 to 2.5 gallons of water for each gallon of product (Environmental Protection Agency, 2017). Based on the stated charge rate of 55,000 bpcd, the STEC will use between 20 and 50 million gallons of water per year. It is not clear at this time where the STEC will be obtaining the water for operations. RP states that the STEC will not be using water from the public supply or individual wells (Raven Petroleum, L.L.C., 2017), however, RP has not filed any permits with the state at this time (Druzin, 2017).

3 Mexico

Gasoline demand in Mexico is expected to increase by about 3% per year until 2029 and Mexico depends on imports to meet this demand (Wood, 2016). Mexico has six oil refineries, all owned by the state-owned oil company Pemex, and is unable to produce enough gasoline or diesel to meet current demand (Hunt Institute, 2016). Mexican oil refineries operated at 66% capacity in 2015 and Pemex has pledged to invest billions of dollars for upgrades (Wood, 2016). Since domestic production is unable to meet demand Mexico has been increasing the imports of U.S. produced gasoline and diesel. From 2013 to 2016, annual US exports of gasoline to Mexico rose from about 67 million barrels to about 120 million barrels, and annual diesel exports increased from 42 million barrels to almost 67 million barrels (Energy Information Administration, 2017a). This increase is partly due to the deregulation of Mexican markets in 2016, allowing private companies to compete against Pemex (Hunt Institute, 2016). Existing downstream infrastructure to transport the imported fuels to market, such as port access and pipelines, is saturated and inadequate to meet the projected demand (Wood, 2016). This is an additional constraint on the STEC supplying refined products to Mexico.

According to the EIA, there was a decrease in exports of gasoline to Mexico from 15 million barrels in December 2016 to 8 million barrels in March 2017. Diesel exports also decreased over the same time period, from 8 million barrels to 6 million barrels. (Energy Information Administration, 2017a). This is likely due to the increase in retail prices for gasoline made by Mexico increasing the price ceiling of gasoline and diesel. The increase in retail prices is expected to have a limited effect on U.S. refiners because the wholesale price is set by the international market (Seba, 2016). However, an increased retail price will lead to a decrease in consumer demand and could be an explanation for the drop in exports from December to March. Any decrease in demand puts pressure on smaller refiners who may not be able to adjust their production accordingly, or shift the sales of their refined products to other markets.

A possible reason Mexico could be the target market for the STEC refined products is lower fuel standards for gasoline and diesel. The standard for gasoline is a maximum sulfur content of 80 ppm and standard for diesel is less than 500 ppm, whereas the US standards are 10 ppm for gasoline (Federal Register, 2016a) and less than 15 ppm for diesel (Hunt Institute, 2016). Refined fuels exported from the U.S. to Mexico are not required to comply with the RFS2 mandates. However, a significant disruption in access to the Mexican markets could force the STEC to incur RFS2 compliance costs in order to provide refined fuels to the U.S. markets.

3.1 NAFTA

If either the United States or Mexico withdraws from the North American Free Trade Agreement (NAFTA) without a replacement, then trade between the U.S. and Mexico would be ruled by the World Trade Organization (WTO) (Vejar, 2017). Each country would be able to set tariffs according to the most favored nation (MFN) rates. For Mexico, the simple average MFN rate is 7.5% and the simple average bound tariff rate is 36.1% (World Trade Organization, 2017). This means that Mexico could apply an immediate tariff of 7.5% and increase it up to 36.1% without violating WTO rules. For comparison, the tariff rate for the U.S. is 3.5%.

3.2 Tariffs

If the United States imposes an import tax or other punitive trade policy, one possible response from Mexico could be to impose tariffs on exports from the U.S. A tariff is a charge for each unit of product imported and increases the costs of shipping goods between two countries (Krugman and Obstfeld, 2009). For example, under WTO rules, Mexico could be allowed to charge a 7.5% to 36.1% tariff on gasoline imported from the United States. If a tariff is imposed, the costs of the U.S. products are increased. In this case, the demand for U.S. gasoline would decrease. The demand elasticity for gasoline, or price sensitivity, has been estimated to be around -0.117 (Crôtte et al., 2009).

That means if the price of gasoline is increased by a tariff, the demand decrease for gasoline could range from about 0.88% to 4.27%, depending on the rate set by Mexico. That relatively small percentage decrease in demand would put pressure on small and independent refiners. That is, those refiners without the flexibility to ship to another market, alter their production in response to changing international trade conditions, or who are producing with small profit margins.

3.3 Import Quotas

Another potential Mexican response could be to impose import quotas. An import quota is a restriction on the quantity of a good that may be imported and raises the domestic price of the imported good (Krugman and Obstfeld, 2009). In the case of gasoline where domestic supply is less than the domestic demand, Mexico meets this demand by importing gasoline from the US and other countries. If Mexico were to impose import quotas on gasoline from the United States, the supply of gasoline imported would initially decrease, exacerbating the supply shortage and resulting in higher prices for Mexican consumers. Since Mexico sets prices for gasoline and diesel, the effects are more complex, but whether the retailer or the consumer is bearing the higher cost due to the import quotas, the effects on the U.S. are the same: a lower quantity of the U.S. product exported to Mexico. The effects of a tariff or import quota are the same, a higher price and lower quantity for the U.S. products.

There has also been a border tax proposed as a possible legislative action. As currently proposed, the border tax would be a tax on imports, but not exports (McGill and Rubin, 2017). Thus, the refined products STEC exports to Mexico should not be affected. However, exports are still subject to fluctuations in the Dollar-Peso exchange rate.

References

Birn, Kevin, Juan Osuna, Carmen Velasquez, Jeff Meyer, Steven Owens, and Michael Cairns, "Crude by Rail: The new logistics of tight oil and oil sands growth," Technical Report, IHS Energy 2014.

Blum, Jordan, "Raven Petroleum aims to build first new Texas refinery in decades," *FuelFix.com*, 07 Dec 2016. `http://fuelfix.com/beaumont/2016/12/07/raven-petroleum-aims-to-build-first-new-texas-refinery-in-decades/` 2016. [Online; accessed 10-April-2017].

Crôtte, Amado, Robert Noland, and Daniel Graham, "Estimation of road traffic demand elasticities for Mexico City, Mexico," *Transportation Research Record: Journal of the Transportation Research Board*, 2009, *38* (2134), 99–105.

Druzin, Rye, "Raven Petroleum head: Mexico's energy demand is 'already pulling us' in," *Expressnew.com*, 23 Nov 2016. `http://www.expressnews.com/business/eagle-ford-energy/article/Raven-Petroleum-head-Mexico-s-energy-demand-is-10633764.php` 2016. [Online; accessed 11-April-2017].

_ , "South Texas refinery says it's going 'green' to win over opposition," *Expressnew.com*, 13 Feb 2017. `http://www.expressnews.com/business/eagle-ford-energy/article/South-Texas-refinery-says-its-going-green-10929636.php` 2017. [Online; accessed 11-April-2017].

Emsi, "Duval County Petroleum Refinery Construction: Phase 1 Input-Output Draft Analysis," `http://media.wix.com/ugd/381e39_0d5e93e18ce74a2bbf75762d59927215.pdf` 2017. [Online; accessed 10-April-2017].

_ , "Duval County Petroleum Refinery Construction: Phase 2 Input-Output Draft Analysis," `http://media.wix.com/ugd/381e39_c03da34a6ba843679a0ff25a0faade3b.pdf` 2017. [Online; accessed 10-April-2017].

Energy Information Administration, "Derivatives and Risk Management in the Petroleum, Natural Gas, and Electricity Industries," Technical Report, Energy Information Administration 2002.

_ , "Exports by Destination," `https://www.eia.gov/dnav/pet/pet_move_expc_dc_NUS-NMX_mbbl_a.htm` 2017. [Online; accessed 13-April-2017].

_ , "Today in Energy," `https://www.eia.gov/todayinenergy/prices.php` 2017. [Online; accessed 10-April-2017].

Energy.gov, "Geothermal FAQs," `https://energy.gov/eere/geothermal/geothermal-faqs` 2017. [Online; accessed 10-April-2017].

Environmental Protection Agency, "Water and Energy Efficiency by Sectors," https://www3.epa.gov/region9/waterinfrastructure/oilrefineries.html#water 2017. [Online; accessed 11-April-2017].

Federal Register, "Amendments Related to: Tier 3 Motor Vehicle Emission and Fuel Standards," *Federal Register: The Daily Journal of the United States*, 2016, *81* (78), 23642. [Online; accessed 13 Apr 2017].

_ , "Renewable Fuel Standard Program: Standards for 2017 and Biomass- Based Diesel Volume for 2018," *Federal Register: The Daily Journal of the United States*, 2016, *81* (238), 89751. [Online; accessed 10 Apr 2017].

Fritelli, John, Paul W Parfomak, Jonathan L Ramseur, Anthony Andrews, Robert Pirog, and Michael Ratner, "US rail Transportation of Crude Oil: Background and Issues for Congress," Technical Report, Congressional Research Service 2014.

Goldberg, Marshall, "Petroleum Refinery Jobs and Economic Development Impact (JEDI) Model User Reference Guide," Technical Report, National Renewable Energy Laboratory (NREL), Golden, CO. 2013.

Hunt Institute, "Paso Del Norte Energy Sector Review," Technical Report, The Hunt Institute for Global Competitiveness 2016.

Knittel, Christopher R, Ben S Meiselman, and James H Stock, "The pass-through of RIN prices to wholesale and retail fuels under the renewable fuel standard," Technical Report, National Bureau of Economic Research 2015.

Krauss, Clifford, "High-Price Ethanol Credits Add to Refiners' Woes," *The New York Times*, 22 Aug 2016. https://www.nytimes.com/2016/08/23/business/energy-environment/high-price-ethanol-credits-add-to-refiners-woes.html?_r=0 2016. [Online; accessed 10-April-2017].

Krugman, Paul R and Maurice Obstfeld, *International Economics: Theory and Policy 8/E*, Pearson Addison-Wesley, 2009.

Lade, Gabriel, C-Y Cynthia Lin Lawell, and Aaron Smith, "Ex post costs and renewable identification number (RIN) prices under the Renewable Fuel Standard," Technical Report, Resources for the Future's Regulatory Performance Initiative, 2015.

Lavín-Castillo, Melva, "Webb County Judge: I'm not comfortable with refinery project," *Rio Grande Guardian*, 25 Feb 2017. http://riograndeguardian.com/webb-county-judge-i-am-not-comfortable-with-refinery-project/ 2017. [Online; accessed 18-April-2017].

Li, Jing and James H Stock, "Cost Pass-Through to Higher Ethanol Blends at the Pump: Evidence from Minnesota Gas Station Data," 2017.

McGill, Brian and Richard Rubin, "Border Adjustment: Explained," *The Wall Street Journal*, 07 Feb 2017. http://www.wsj.com/graphics/border-tax/ 2017. [Online; accessed 10-April-2017].

Meridian Energy Group Inc., "Davis Refinery," *davisrefinery.com*, 2016. http://www.davisrefinery.com 2016. [Online; accessed 01-May-2017].

_ , "Davis Refinery FAQ Document," http://www.meridianenergygroupinc.com/wp-content/uploads/2016/10/Davis-Refinery-FAQ-Fall-2016.pdf 2016. [Online; accessed 10-April-2017].

Monke, Dustin, "CEO of company building $900 million Davis Refinery emphasizes environment," *thedickinsonpress.com*, 24 May 2016. http://www.thedickinsonpress.com/energy/oil/4040081-ceo-company-building-900-million-davis-refinery-emphasizes-environment 2016. [Online; accessed 01-May-2017].

Pouliot, Sebastien, Aaron Smith, and James H Stock, "RIN Pass-Through at Gasoline Terminals," 2017.

Progressive Fuels Limited, "PFL Weekly Recap," http://progressivefuelslimited.com/web_data/PFL_RIN_Recap.pdf 2017. [Online; accessed 13-April-2017].

Ramirez, Chris, "Raven: Duval County Refiner will use 'cleaner ' power," *Caller.com*, 08 Feb 2017. http://www.caller.com/story/news/2017/02/08/raven-duval-county-refinery-use-cleaner-power/97588896/?from=global&sessionKey=&autologin= 2017. [Online; accessed 11-April-2017].

Raven Petroleum, L.L.C., "South Texas Energy Complex, Duval County, Texas," http://www.ravenpetro.com/south-texas-project 2017. [Online; accessed 10-April-2017].

Scheyder, Ernest, "Dakota Prairie Refinery sold to Tesoro at a loss, hurt by oil price slump," *thedickinsonpress.com*, 28 June 2016. http://www.thedickinsonpress.com/energy/bakken/4063779-dakota-prairie-refinery-sold-tesoro-loss-hurt-oil-price-slump 2016. [Online; accessed 01-May-2017].

Seba, Erwin, "Mexico gasoline hike impact marginal for U.S. refiners: analysts," *reuters.com*, 30 Dec 2016. http://www.reuters.com/article/us-gasoline-exports-mexico-impact-idUSKBN14J1VD 2016. [Online; accessed 14-April-2017].

Thermal Energy Partners, "TEP Signs Agreement to Co-Locate Geothermal Power with Raven Petroleum for "The Cleanest Refinery in the World"," http://www.

thermalep.com/tep-signsagreement-with-raven-petro 2017. [Online; accessed 10-April-2017].

Tobben, Sheela, "Newest Texas Refineries Plan to Turn Shale Into Fuel for Mexico," *Bloomberg.com*, 29 Mar 2017. https://www.bloomberg.com/news/articles/2017-03-28/newest-texas-refineries-plan-to-turn-shale-into-fuel-for-mexico 2017. [Online; accessed 11-April-2017].

Trevino, Melissa Cantu, "Community meeting addresses concerns with Raven Petroleum refinery," *RecordStar.com*, 03 Feb 2017. http://www.recordstar.com/news/20170203/community-meeting-addresses-concerns-with-raven-petroleum-refinery 2017. [Online; accessed 11-April-2017].

Vejar, Carlos, "What's Next for US-Mexico Bilateral Trade Under Trump?," *The Wall Street Journal*, 15 Nov 2016. https://www.law360.com/articles/861996/what-s-next-for-us-mexico-bilateral-trade-under-trump 2017. [Online; accessed 10-April-2017].

Wood, Alex, "A Look at the Mexican Petroleum Industry After Energy Reform," *Wilson Center*, 25 Oct 2015. https://www.wilsoncenter.org/sites/default/files/a_look_at_the_mexican_petroleum_industry_after_energy_reform.pdf 2016. [Online; accessed 14-April-2017].

World Trade Organization, "International Trade and Market Access Data," https://www.wto.org/english/res_e/statis_e/statis_bis_e.htm?solution=WTO&path=/Dashboards/MAPS&file=Tariff.wcdf&bookmarkState={%22impl%22:%22client%22,%22params%22:{%22langParam%22:%22en%22}} 2017. [Online; accessed 10-April-2017].