Westhom Spur State-Owned Rail Improvement Project
Westhom, Custer County, Oklahoma

2012 TIGER Grant Application
Benefit Cost Analysis Technical Memo

March 19, 2012

Project Summary

The Westhom Spur State-Owned Rail Improvement Project involves the rehabilitation of a currently unused 8-mile rail spur near Thomas in Custer County, Oklahoma. The rehabilitation is intended to increase rail capacity and competitiveness in western Oklahoma to help relieve the very high demand for truck travel, as well as the capacity constraints on pipelines and other rail facilities, due to energy extraction activities taking place in the Anadarko Basin.

The project that the TIGER funds are being requested for only includes the cost to re-open this 8-mile out of service rail spur and its conversion to industrial track weight (115 lb). These improvements will allow for long-term use with very low maintenance needs.

Anticipated benefits are summarized in the project matrix, **Table BCA-1**, on the following page.

There are two "associated" components of the project that will be built using private funds, including the conversion of an old refinery to an oil storage site, and the re-activation of a pipeline linking this site with the railhead (transloading site) proposed for Thomas, OK. Neither is included in the benefit-cost analysis (BCA) for the reasons noted below:

- The refinery/storage site will likely be built regardless of the TIGER project (in the Build and the No Build).
- The privately-funded reactivation of the pipeline, and the installation of pipeline-to-rail transloading equipment at the new railhead in Thomas would likely take place only if the project was built. The cost of this activity was also not included in the BCA due to the fact that (1) there is no data available on the costs, and (2) the cost of the pipeline reactivation and transloading equipment would be offsetting for projects that would be built without the project, including new yard and truck-to-rail transloading facilities along the Grainbelt line near Thomas, as well as upgrades (or additional maintenance) on the Grainbelt line.

Due to the right-of-way issues the cost of the privately-funded facilities in the No Build would be higher than the cost of the privately-funded facilities proposed for the Build, so the decision to not include these costs is a conservative assumption. The benefits of the pipeline construction (from the removal of truck trips that would occur in the No Build) are included in the BCA.

Table BCA-1: Project Matrix

Current Status/Baseline & Problem to be Addressed	Change to Baseline	Type of Impact	Population Affected by Impacts	Economic Benefits and Summary of Results (Present Value at 7% discount rate)	Page Reference in BCA Tech Memo
Large volume of crude oil being transported out of western Oklahoma by truck due to limited rail capacity	Rail spur will be rehabilitated to carry 4.1 million barrels of oil per year (2.05 million above assumed No Build baseline improvements), resulting in a reduction of 23,500 truck trips (2.6 million truck VMT) annually.	Reduced truck VMT leading to: • Reduced pavement damage • Reduced emissions • Safety benefits (reduced accidents)	• Pavement damage – highway agencies (taxpayers) • Reduced emissions – state and local residents • Safety benefits – state and local residents and other drivers on Oklahoma roads	• Pavement damage reduction ($4.2 million) • Emissions reductions ($0.5 million) • Accident reduction ($4.1 million)	• Pavement damage, pages 8-9 • Emissions reductions, pages 9-13 • Safety benefits, pages 13-14
High cost of truck transportation due to high demand/labor shortage	Rail and pipeline improvements will allow shippers to get oil from the ground to refineries in other states by modes other than truck	• Reduced shipping costs • Slight reduction in labor demand for truck drivers • Increase in rail traffic on existing lines (Grainbelt, BNSF, UPRR, etc.) will reduce per-railcar shipping costs	• Oil shippers • Rail companies	• Reduced cost to oil shippers ($34.6 million) • Other benefits were not qualitatively assessed in the BCA	• Cost savings to shippers, page 9 • Other benefits are included in the "Non-Quantifiable Benefits" discussion on page 15.

A note on independent utility: It is important to understand that given the vast amount of oil flowing out of the Anadarko Basin, this project will be used regardless of whether the associated pipeline is re-activated. It is conservatively estimated by Chesapeake Energy that by 2015, the Anadarko will be producing 200,000 barrels of oil per day – over 11,000 daily truckloads (or 300 daily railcar-loads). Whatever rail capacity exists will likely be used, especially considering that the demand for truck drivers has already created a labor shortage in the region. This project is assumed to carry 4.1 million barrels per year – just 5.7% of the Basin's expected production.[1]

Benefit Cost Analysis

A formal benefit-cost analysis (BCA) was conducted for this project using best practices for BCA in transportation planning, and reflecting all current TIGER grant application guidelines. As noted in the application, it is important to understand that a formal BCA is not a comprehensive measure of a project's total economic impact, as many benefits cannot be readily quantified or occur under conditions of uncertainty. This broader set of economic benefits and impacts on local and regional economic well-being and competitiveness are described in various sections of the application, particularly section IV.A.ii Economic Competitiveness.

However, to the maximum extent possible given available data, the formal BCA prepared in connection with this TIGER grant application reflects quantifiable economic benefits. It covers four of the five primary long-term impact areas identified in the TIGER grant application guidelines:

- **State of Good Repair:** The project funds will be spent on rehabilitating 8 miles of a state-owned rail spur in Custer County. In addition to improving rail track, the project is expected to result in the removal of 1.4 million miles of heavy truck travel from Oklahoma highways each year, which should greatly reduce maintenance costs for state and local transportation agencies.
- **Economic Competitiveness:** This project will have an impact on local, regional and national economic competitiveness by reducing shipping costs for oil shippers, allowing them to improve their logistics practices while reducing our nation's dependence on foreign oil sources. The BCA only calculates the cost savings for moving oil on the Westhom Spur, but the rail line could be used for other types of freight. In addition, the fact that this project will provide local shippers with access to two Class I railroads (UPRR and BNSF) will keep prices competitive for all shippers.
- **Environmental Sustainability:** The project will annually shift a conservatively-estimated 2 million barrels of oil from truck to rail. Rail is much more fuel efficient than truck travel, and produces anywhere from 30% to as little as 8% of the emissions of trucks per ton-mile carried.
- **Safety:** By shifting freight movements of crude oil, a hazardous material, from truck to rail, this project will reduce the number of vehicle accidents and spills. Trucks

[1] The application document states that the project will carry less than three percent (2.8%) of total Anadarko Basin production. It should say that the project will handle an *additional* 2.8% of Basin production *above* what is expected to be carried by rail from Custer County under the No Build.

transporting hazardous materials have nearly 16 times more hazmat releases than railroads[2].

Given the caveats, the computed benefit-cost ratio for the Westhom project is 7.68 to 1.0 using a 7% discount rate. The quantified project benefits are:

1. Reduced cost of oil shipments
2. Reduced pavement damage to highways
3. Emissions reductions
4. Safety benefits (reduced crashes)

Table BCA-2 summarizes the cost and the quantifiable benefits of the project in terms of Present Value. As shown in the table, the present value of the project's capital and maintenance costs is valued at $5.6 million. The benefits have an estimated present value of $43.4 million over the 25-year period, yielding the 7.68 BCA ratio.

While the BCA assesses the project for the 25 years during which the repair/rehabilitation work is expected to yield benefits, the project's annual assessed benefits are projected to cover the total project costs by the end of 2015, after only 2.5 years of operation.

Table BCA-2: Benefit Cost Analysis Summary Table
Figures in thousands of 2011$, discounted to 2011

Category	**Present Value at 7%**
Costs	
Construction Cost	$5,077
Maintenance Costs	$573
TOTAL COSTS	**$5,649**
Evaluated Benefits	
Reduced Cost of Oil Shipments	$34,565
Reduced Damage to Roadway	$4,192
Emissions Savings*	$576
Net Safety Benefits	$4,071
Total Evaluated Benefits	**$43,404**
NET PRESENT VALUE	**$37,755**
BENEFIT/COST RATIO	**7.68**

** The social cost of carbon was broken out from the other benefits and assessed at a 3% discount rate as per TIGER guidance.*

Benefit Calculation Assumptions

Discount Rates

Federal TIGER guidance recommends that applicants discount future benefits and costs to 2012 present values using a real discount rate of 7% to represent the opportunity cost of money in the

[2] http://nationalatlas.gov/articles/transportation/a_freightrr.html

private sector. TIGER guidance also allows for present value analysis using a 3% discount rate when the funds currently dedicated to the project would be other public expenditures.[3] This is largely the case for this project, which is 9.5% privately funded.

The project benefits are presented in this analysis primarily using the more conservative 7% discount rate to demonstrate that the project's long-term benefits clearly outweigh the project's costs.

Length of Analysis

The BCA compares the capital construction costs to the quantifiable benefits of the project for 25 years following construction. After 25 years, the railroad will need to again be rehabilitated, so no residual project value was assumed past 2037.

Project Schedule

The Westhom project, if funded, will be constructed in 2012-2013, and will be in operation by the middle of 2013. Project benefits for 2013 were therefore calculated to be half of the annual project benefits of 2014 and beyond.

Year 2011 Dollars

This analysis was computed in 2011 dollars. Where benefit values were developed in terms of previous year dollars, the values were converted to 2011 dollars using the Bureau of Labor Statistics Inflation Calculator (http://www.bls.gov/data/inflation_calculator.htm).

Build/No Build Assumptions

This Benefit Cost Analysis is based on the difference between an assumed Build scenario and an assumed No Build scenario. Both of these scenarios were developed to present potential project benefits in a conservative manner. It would have been simple to assume that if the project wasn't built, all the oil being shipped through this part of Oklahoma would continue to be shipped by truck, the most expensive method. But this would have been unlikely over the long term because of the high cost of trucking, the truck driver labor shortage, and the limits on the capacity of the pipelines heading out of the state to refineries in the Gulf Coast (to which the trucks bring the oil). Instead, it was assumed that a nearby Grainbelt rail line would take some of the oil by rail.

- The Build Scenario includes the $5,397,280 capital cost of rehabilitating the eight-mile Westhom Spur, and incorporates an annual maintenance cost of $47,670 per year. Traffic on the rail line is conservatively assumed to be one train movement per week in each direction, carrying 120 rail cars. An additional feature of the Build is the rehabilitation of

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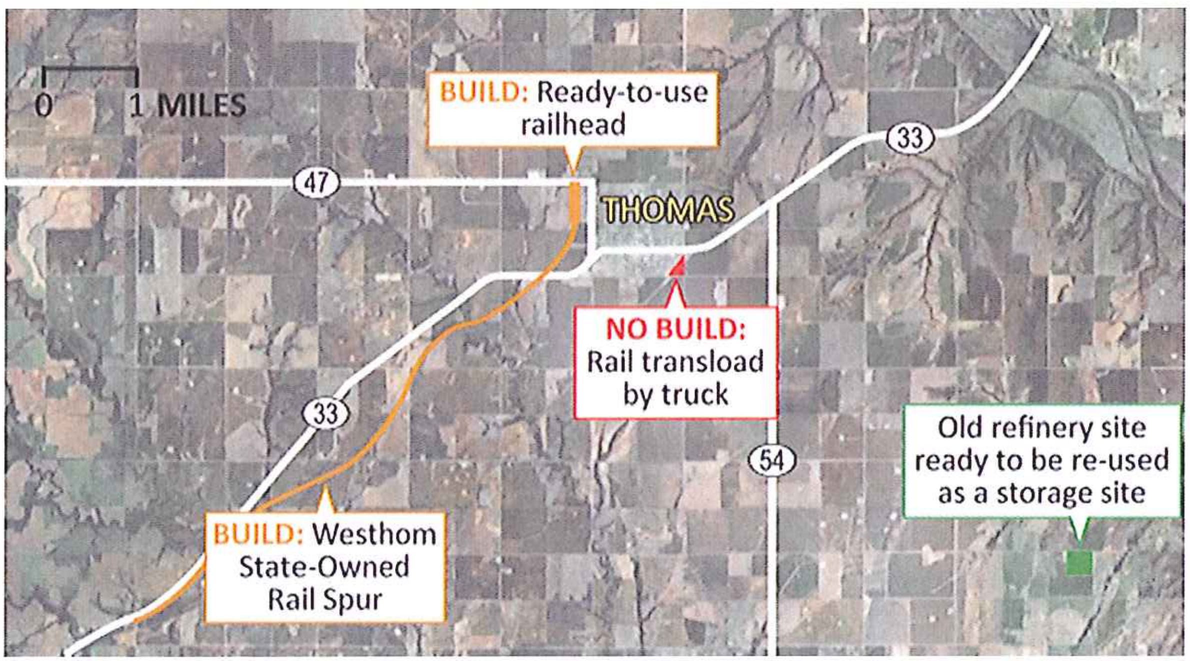
[3] Source: TIGER Notice of Funding Availability (Federal Register/Vol 77, No. 20, 3/31/2012, page 4878):
Applicants should discount future benefits and costs to present values using a real discount rate (i.e., a discount rate that reflects the opportunity cost of money net of the rate of inflation) of 7 percent, following guidance provided by OMB in Circulars A–4 and A– 94 (http://www.whitehouse.gov/omb/circulars_default/). Applicants may also provide an alternative analysis using a real discount rate of 3 percent. They should use the latter approach when the alternative use of funds currently dedicated to the project would be for other public expenditures, rather than private investment. In presenting these year-by-year streams, applicants should measure them in constant (or ''real'') dollars prior to discounting. Applicants should not add in the effects of inflation to the estimates of future benefits and costs prior to discounting.

an existing pipeline which would carry oil from a storage site at an old refinery southeast of Thomas (**Figure BCA-1**) directly to the new rail line without the use of trucks. A pipeline-to-rail transloading facility would be constructed on the northwest side of Thomas.

- The No Build Scenario assumes that a transloading facility would be built alongside the Grainbelt line which passes through the southeast corner of Thomas. Because this rail line is currently in use, a new yard would need to be built to allow for storage of railcars at the transloading facility as they wait to be filled and formed into trains. The proposed location of this truck-to-rail transloading facility in Thomas has a limited footprint which would limit car lengths for trains, and it is estimated that this scenario could only handle 60 carloads per week (12 railcars per day to be added to trains already traveling along this line). Trucks would be required to move the oil 9.5 miles from the refinery storage site to the Grainbelt railhead.

Figure BCA-1: Location of Project



- With the No Build rail capacity only able to handle half of the 120 railcar-loads of oil anticipated with the Build, the No Build further assumes that the remaining 60 carloads of oil that are being shipped out of the refinery site would be transported by truck to Cushing, Oklahoma, where it would be sent by pipeline to refineries along the Gulf Coast.
- Associated private construction:
  - Build – as noted above, the Build includes the rehabilitation of an existing pipeline which would carry oil from the storage site directly to the new rail line without the use of trucks. A pipeline-to-rail transloading facility would be constructed on the northwest side of Thomas.

- In the No Build, yard facilities including storage tracks and a truck-to-rail oil transloading facility would be constructed at a site on the southeast side of Thomas.

The capital and maintenance costs for this privately-funded associated construction was not included in the either the Build or the No Build for two reasons – first, the lack of available cost data, and second, the fact that these costs would likely be offsetting in the Build vs. No Build. It is believed that the omission of these costs is a conservative assumption, as it is more likely that the Build, which re-uses an existing pipeline and does not require a yard (railcars can be stored directly on the otherwise unused Westhom spur), would have lower "associated private construction" costs than the No Build.

Oil Shipment Assumptions

The benefits described in detail below were all derived from comparing the cost and impacts of moving the assumed 120 weekly railcar-loads of oil (4.1 million barrels per year) by rail from the Westhom Spur (in the Build), to the costs and impacts of moving it by rail, truck and pipeline as indicated above for the No Build. These movements are summarized in **Table BCA-3.**

Table BCA-3: Annual Crude Oil Shipment Assumptions, Build vs. No Build

Movement	No Build	Build
Total Barrels Assumed to be coming from Refinery Storage site	4,138,754	4,138,754
Barrels to be shipped on Improved Westhom Spur	0	4,138,754
Barrels to be shipped on Improved Grainbelt	2,069,377	0
Barrels to be shipped via Truck to Cushing and then via Pipeline	2,069,377	0
Yearly Railcar Trips	3,120 (on Grainbelt)	6,240 (on Westhom Spur)
Yearly truck trips (round trip) from the Refinery Storage site to the Grainbelt Thomas Railhead, a distance of 9.5 miles	11,746	0
Yearly truck trips (round trip) from the Refinery Storage site to Cushing, a distance of 110 miles	11,746	0

Railcar and Tanker Truck Capacity Calculations

One barrel is equal to 42 gallons. Railcars that are designed to transport crude oil have a practically holding capacity of 27,857 gallons (663 barrels). Tanker trucks vary in size, but the typical truck used to transport crude oil in southwestern Oklahoma holds 7,400 gallons (176 barrels). By weight, a gallon of crude oil is 7 pounds, so the weight (cargo only) of a crude oil tanker truck is 26 tons. The weight of a loaded railcar of crude oil is 97 tons (130 tons if the car itself is included).

Project Costs

The capital cost of the project is estimated at $5,397,280 in 2011 dollars. It was assumed that $494,000 would be spent in 2012, with the remainder expended in 2013. Rail maintenance schedules were developed using data from Farmrail staff that assumed annual costs of $47,670 for the 25 years following completion of construction.

Using a 7% discount rate, the present value of the capital cost is $5,076,500, and the present value of the ongoing maintenance costs is $572,800.

Reduced Pavement Damage to Highways

One of the "State of Good Repair" benefits of this project is the reduced wear and tear on the roadways that would result from removing truck travel from the highway under the Build scenario. There are two sets of truck trips that would occur in the No Build that would be eliminated in the Build:

- The 9.5 mile (each way) trip between the old refinery/storage site southeast of Thomas and the (future) Grainbelt rail transloading site in Thomas (See **Figure BCA-1**) via local rural roads.
- The 110-mile (one-way) trip from the old refinery/storage site southeast of Thomas to the pipeline facilities in Cushing, via State Highways (SH) 54 and SH 33.

While tanker trucks are driven round trip for each delivery to the rail and pipeline heads, because they are driven back empty, only the loaded portion of the trip is counted in this analysis of pavement damage. Multiplying the trips shown in **Table BCA-3** by these distances results in a reduction in truck travel in Oklahoma of 1.4 million loaded (one-way) miles per year (1.3 million between Cushing and Custer County, and 0.1 million locally between the refinery site and the railhead in Thomas).

According to Fraire, et al.[4], it is estimated that trucks cause 25.9 cents of damage per mile to principal arterials such as SH 33 and SH 54), and 35.9 cents for every mile traveled on local roads like those between Thomas and the refinery site[5].

Annual benefits are thus $375,000 annually (**Table BCA-4**), yielding a present value over the life of the project of $4.2 million.

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[4] Fraire, Francisco, Stephen Fuller, John Robinson and Sharada Vadali. "Feasibility of Containerized Transport in Rural Areas and its Effect on Roadways and Environment: A Case Study," Agribusiness, Food, and Consumer Economics Research Center (AFCERC), Commodity Market Research Report No. CP-03-11 (March 2011). Texas A&M University, page 13. College Station, TX. (http://afcerc.tamu.edu/publications/Publication-PDfs/Cotton%20fINAL%20VERSION%20fOR%20CENTER%206-14-2011.pdf)

[5] According to Fraire, et al.:

> *"After consideration of federal and state fuel taxes (44.4 cents per gallon) and an estimated 5.5 miles per gallon fuel efficiency, the uncompensated marginal costs per loaded truck-mile were estimated for an 80,000 pound, five-axle truck on the (1) interstate ($0.059), (2) principal arterial ($0.259), (3) minor arterial ($0.359), and (4) collector ($0.876) roadways."*

This BCA assumed that these figures are in 2011 dollars, and that SH 54 and SH 33 are "principal arterials." To be conservative, the local roads in Custer County were assumed to be minor arterials and not collector roadways.

Table BCA-4: Annual Pavement Damage, (2011 $)

Trip	Trips/year	Miles/trip (one-way)	Total VMT	Cost Per mile	Total Annual Pavement Damage
Refinery Site to Cushing	11,746	110	1,292,060	$ 0.259	$ 334,644
Refinery Site to No Build Railhead in Thomas	11,746	9.5	111,587	$ 0.359	$ 40,060
TOTAL	**23,492**		**1,403,647**		**$ 374,703**

Reduced Cost of Oil Shipments

The costs charged for shipping oil via rail are cheaper than the costs charged to ship by truck. This is not surprising given the cost-efficiency of rail in moving products that are heavy, and that are not particularly time-sensitive. Crude oil can be particularly expensive to ship by truck, as it is carried in oil tanker trucks which need to be driven back empty, leading to high costs, as a trucker's day can consist of no more than two 220-mile round trips to carry about 7,400 gallons (each) of oil. As noted elsewhere, a single train can carry 376 times the volume of a single tanker truck, and only requires three operators.

It has been estimated that the cost of moving oil by the rehabilitated Custer County pipeline, and then by rail to the Gulf Coast refineries where Anadarko oil is typically sent for refining, is under $6 per barrel. In comparison, shipping it by truck and then by rail via Grainbelt would cost $6.33 per barrel, and shipping the oil that can't move by rail to Cushing Oklahoma by truck, and then by pipeline to the Gulf Coast, would cost over $7 per barrel.

The total annual cost savings for shippers was calculated at $4.1 million (**Table BCA-5**). Present value for the savings over the entire 2013–2037 analysis period is $34.6 million.

Table BCA-5: Annual Rail Shipper Cost Savings Calculations

Scenario	Pipeline + Truck		Rail		Total Shipping Costs
	Cost per Barrel	Barrels Shipped	Cost per Barrel*	Barrels Shipped	
No Build	$ 7.30	2,069,377	$ 6.33	2,069,377	$ 28,205,610
Build	$ 7.30	0	$ 5.83	4,138,754	$ 24,128,937
				Difference (Savings with Build)	**$ 4,076,673**

* Note that the cost to ship via rail is cheaper in the Build due to the use of a pipeline (instead of short-haul trucking) to bring oil from the refinery storage site to Thomas.

Emissions Reductions

The truck miles removed from the roads would also remove a substantial volume of pollutants from the air, an estimated 3,600 metric tons of CO, CO_2, NO_x, SO_x, volatile organic chemicals (VOC) and particulate matter (PM_{10}) each year. Over the 25-year life of the project, total truck pollutant reductions are estimated to be 194.3 million pounds.

Project emissions impacts also have to account for increased rail emissions (it is assumed that the pipeline portion of the truck-to-Cushing trips have negligible emissions). While rail produces a fraction of the emissions per ton-mile as truck travel, the trip from Oklahoma to the Gulf Coast refineries is around 690 miles, much longer than the truck trips under analysis.

The additional rail travel (Build vs. No Build) is estimated at 2.2 million railcar miles annually (690 miles X 3,120 railcar movements[6]), generating an estimated 168.0 million pounds over the 2013-2037 analysis period.

The net emissions reduction (reduced truck emissions minus increased rail emissions) is thus in the range of 500 tons per year. Using TIGER guidance to evaluate emissions reductions, the present value of the net emissions reductions over the life of the project is $576,000.

Assumptions Used

Truck Emissions

Per-mile emissions rates were derived from the California Department of Transportation's California Lifecycle Benefit-Cost Analysis Tool (CAL B/C) assuming an average speed of 55 miles per hour (mph) on SH 33 and SH 54, and speeds of 45 mph on the local roads between the refinery storage site and the Grainbelt railhead that would be built under the No Build[7]. This tool provides emissions rates for exactly two different years: 2007 and 2027. In order to develop emissions rates for years within this interval as well as beyond 2028, it was necessary to use certain growth rate assumptions.

The CAL B/C documentation[8] indicates that growth rates for CO, NO_X, PM_{10}, and VOC are exponential, so the 2007 to 2027 compound annual growth rate was used to interpolate and extrapolate as necessary. Growth for SO_X and CO_2 were shown by CAL B/C to exhibit linear growth. Thus, a linear rate is used for these two emissions categories.

Finally, after 2027, emissions rates are assumed "flat-line." The flat-line represents both a leveling out of emissions rates, as well as a prudent observation of the uncertainty in estimating rates that far into the future.

The resulting factors used are shown in **Table BCA-6**.

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6 The 3,120 railcar movements are derived from the 6,240 railcars moved in the Build scenario minus the 3,120 railcar movements on Grainbelt in the No Build (**Table BCA-3**).

7 California Department of Transportation (2010) California Life-cycle Benefit/Cost Analysis Model v4.1 [Microsoft Excel]. http://www.dot.ca.gov/hq/tpp/offices/eab/benefit_files/Cal-BCv4-1.xls

8 California Department of Transportation. (2009). California Life-cycle Benefit/Cost Analysis Model, Technical Supplement to User's Guide (Vol. 3). Sacramento: California Department of Transportation.

Table BCA-6: Emissions Factors for Trucks Traveling at 45 mph and 55 mph

Year	TRUCK Emissions Factors for 45 mph Grams of pollutant emitted per VMT						TRUCK Emissions Factors for 45 mph Grams of pollutant emitted per VMT					
	CO	CO2	NOX	PM10	SOX	VOC	CO	CO2	NOX	PM10	SOX	VOC
2012	3.3184	1,268.0	7.5613	0.2858	0.0123	0.6259	3.2224	1,246.7	7.8249	0.3074	0.0121	0.6102
2013	3.1088	1,270.1	6.9749	0.2690	0.0123	0.5922	3.0333	1,248.6	7.2013	0.2900	0.0122	0.5750
2014	2.9123	1,272.2	6.4341	0.2533	0.0123	0.5603	2.8553	1,250.6	6.6274	0.2735	0.0122	0.5418
2015	2.7283	1,274.3	5.9351	0.2385	0.0123	0.5302	2.6878	1,252.6	6.0992	0.2580	0.0122	0.5105
2016	2.5560	1,276.4	5.4749	0.2245	0.0123	0.5016	2.5300	1,254.6	5.6131	0.2433	0.0122	0.4810
2017	2.3945	1,278.6	5.0504	0.2113	0.0123	0.4746	2.3816	1,256.5	5.1658	0.2295	0.0122	0.4533
2018	2.2432	1,280.7	4.6587	0.1990	0.0124	0.4491	2.2418	1,258.5	4.7541	0.2165	0.0122	0.4271
2019	2.1014	1,282.8	4.2975	0.1873	0.0124	0.4249	2.1103	1,260.5	4.3752	0.2042	0.0122	0.4024
2020	1.9687	1,284.9	3.9642	0.1764	0.0124	0.4020	1.9865	1,262.5	4.0265	0.1926	0.0122	0.3792
2021	1.8443	1,287.1	3.6568	0.1660	0.0124	0.3804	1.8699	1,264.5	3.7056	0.1816	0.0122	0.3573
2022	1.7278	1,289.2	3.3733	0.1563	0.0124	0.3599	1.7602	1,266.5	3.4103	0.1713	0.0122	0.3367
2023	1.6186	1,291.4	3.1117	0.1472	0.0124	0.3405	1.6569	1,268.5	3.1385	0.1616	0.0123	0.3173
2024	1.5163	1,293.5	2.8704	0.1385	0.0125	0.3222	1.5597	1,270.5	2.8884	0.1524	0.0123	0.2989
2025	1.4205	1,295.7	2.6478	0.1304	0.0125	0.3048	1.4681	1,272.5	2.6582	0.1438	0.0123	0.2817
2026	1.3308	1,297.8	2.4425	0.1228	0.0125	0.2884	1.3820	1,274.5	2.4464	0.1356	0.0123	0.2654
2027	1.2467	1,300.0	2.2531	0.1156	0.0125	0.2729	1.3009	1,276.5	2.2514	0.1279	0.0123	0.2501
2028	1.1679	1,302.1	2.0784	0.1088	0.0125	0.2582	1.2246	1,278.5	2.0720	0.1206	0.0123	0.2357
2029	1.0941	1,304.3	1.9172	0.1025	0.0125	0.2443	1.1527	1,280.6	1.9068	0.1138	0.0123	0.2221
2030	1.0250	1,306.4	1.7686	0.0965	0.0125	0.2312	1.0851	1,282.6	1.7549	0.1073	0.0123	0.2092
2031	0.9602	1,308.6	1.6314	0.0908	0.0126	0.2187	1.0214	1,284.6	1.6150	0.1012	0.0123	0.1972
2032	0.8996	1,310.8	1.5049	0.0855	0.0126	0.2069	0.9615	1,286.6	1.4863	0.0955	0.0124	0.1858
2033	0.8427	1,313.0	1.3882	0.0805	0.0126	0.1958	0.9050	1,288.7	1.3679	0.0901	0.0124	0.1751
2034	0.7895	1,315.2	1.2806	0.0758	0.0126	0.1853	0.8519	1,290.7	1.2588	0.0849	0.0124	0.1649
2035	0.7396	1,317.3	1.1813	0.0713	0.0126	0.1753	0.8019	1,292.7	1.1585	0.0801	0.0124	0.1554
2036	0.6929	1,319.5	1.0897	0.0672	0.0126	0.1658	0.7549	1,294.8	1.0662	0.0756	0.0124	0.1465
2037	0.6491	1,321.7	1.0052	0.0632	0.0127	0.1569	0.7106	1,296.8	0.9812	0.0713	0.0124	0.1380

VMT = Truck vehicle miles traveled.
Source: CAL B/C and Parsons Brinckerhoff.

Rail Emissions

Data on rail emissions was limited, so the most conservative of the following sources was used to assume that rail emissions are 30% of truck emissions per ton-mile.

- Trucks emit 6 to 12 times more pollutants per ton-mile than trains, and 3 times more NO_X and PM. (http://nationalatlas.gov/articles/transportation/a_freightrr.html)
- Rail produces 70% less CO_2 than trucks per ton-mile http://www.freightonrail.org.uk/FactsFigures-environmental.htm
- Moving freight by rail reduces greenhouse gas emissions by 75% http://www.aar.org/~/media/aar/Background-Papers/Freight-RR-Help-Reduce-Emissions.ashx

It was assumed that due to the efficiency of rail, the transport of empty railcars returning to Thomas would have very low emissions.

Estimation of rail emissions required calculating the emissions that would be produced by the trucks that would be required to transport the oil between Thomas and the various Gulf Coast Refineries, and then multiplying that by 30%. Depending on the railroads used and the destination, the distance from Thomas. OK to Galveston, TX, Corpus Christi, TX, Lake Charles, LA, and Beaumont, TX range from 598 miles to 814 miles. An average of 690 miles was used in these calculations. Applying the assumed 30% emissions savings from rail travel to the 55 mph truck emission factors above, rail emissions would then be in the range of 6,800 tons per year.

Cumulative additional (Build vs. No Build) rail emissions over the 25-year analysis period are shown in **Table BCA-7.**

Table BCA-7: Rail Emissions Calculations (2013-2037 Totals) in Thousands of Pounds

Pollutant >	**CO**	**CO_2**	**NO_X**	**PM_{10}**	**SO_X**	**VOC**	**TOTAL**
Truck (Build vs. No Build)	239.9	193,570.6	467.0	23.2	1.9	46.2	194,348.9
Rail (Build vs. No Build)	208.1	167,357.7	404.7	20.3	1.6	39.8	168,032.2
Net Savings with Build (vs. No Build)	31.9	26,212.9	62.3	3.0	0.3	6.4	26,316.7

Value of Emissions Benefits

Values were assigned to the emissions levels using current TIGER guidance as shown in **Table BCA-8** and **BCA-9**. Specifically, for non-CO_2 pollutants, the National Highway Traffic and Safety Administration's CAFE standards for MY2012-MY2016[9] were used.

[9] National Highway Traffic and Safety Administration (March 2010), *Corporate Average Fuel Economy for MY2012-MY2016 Passenger Cars and Light Trucks,* page 403, Table VIII-8, "Economic Values for Benefits

The per-ton costs of carbon emissions were derived from the Interagency Working Group on the Social Cost of Carbon[10] as well as the analysis conducted by the US DOT in the TIGER Benefit Cost Analysis Resource Guide.[11]

Table BCA-8: Value of Non-CO_2 Emissions per long ton (2011 $)

Pollutant	CO	NO_X	PM_{10}	SO_X	VOC
Value	$ 0	$ 5,660	$ 309,697	$ 33,106	$ 1,3589

Source: National Highway Traffic Safety Administration (NHTSA), 2010.

The social cost of carbon was converted from 2007 dollars to 2011 dollars using a CPI adjustment.[12] The table below shows the social cost of carbon for selected years as used in this analysis.

Table BCA-9: Social Cost of Carbon per metric ton (2011 $)

Year	2013	2020	2030	2037
Social Cost of CO2	$24.74	$28.53	$38.58	$40.47

Source: U.S. EPA, 2010; Parsons Brinckerhoff

As recommended by the TIGER guidance,[13] the values used for the CO_2 reduction were discounted at a 3% rate. The resulting present value of the net emissions reductions over the 2015-2054 analysis period is $576,300 using a 7% discount rate for non-CO_2 pollutants and the 3% rate for CO_2.

Safety Benefits

As with emissions, safety benefits were evaluated separately for rail and truck travel.

Reduced Truck Accidents

The reduced truck miles traveled in both directions (loaded and unloaded) will have a direct impact on reducing highway crashes. The crash rate per mile travelled was calculated from statewide Oklahoma crash data from 2010 (shown in the first two rows of **Table BCA-10**). The table also shows accident cost values derived from the TIGER guidance. The resulting cost of crashes per million miles traveled is $129,638 in 2011 dollars.

The value for each crash type is derived from the Maximum Abbreviated Injury Scale (MAIS) scale using the KABCO-to-MAIS conversion table in the TIGER Notice of Funding Availability

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Computations (2007 Dollars)", (http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/CAFE_2012-2016_FRIA_04012010.pdf)

[10] U.S. Environmental Protection Agency, Interagency Working Group on Social Cost of Carbon (2010), *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* p.2., Table 19, (http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf).

[11] U.S. Department of Transportation, *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.6. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

[12] U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Motor Fuel. Series CUUR0000SETB. 1982-1984=100, 2010=239.178; 2011=302.619.

[13] U.S. Department of Transportation (2011), *Tiger Benefit-Cost Analysis (BCA) Resource Guide*, p.7-9. (http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

(NOFA). The MAIS values are also from the NOFA, which cites the original source as *Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses – 2011 Revisions* (http://ostpxweb.dot.gov/policy).

Table BCA-10: Calculation of Safety Costs per Million Vehicle Miles Traveled (VMT)

	1 Non-injury	2 Possible Injury (minor injury)	3 Non-Incapacitating Injury	4 Incapacitating Injury	5 Fatal Injury	TOTAL
2010 crashes, statewide	44,746	12,354	9,134	2,957	616	**69,807**
2010 crash rate, statewide, (accidents per million VMT*)	0.94	0.26	0.19	0.06	0.01	**1.46**
Value of accident type	$5,225	$42,034	$81,044	$296,632	$6,200,000	
Cost of accidents per million VMT	$4,897	$10,876	$15,504	$18,371	$79,990	**$129,638**

* Total statewide VMT was 47.7 billion in 2010.

Source: Data on Oklahoma Accidents and VMT is from "2010 Oklahoma Crash Facts," Oklahoma Department of Public Safety, August 2011.

Using the total truck miles removed from the roadway (2.8 million miles annually), the annual value of reduced accidents is estimated at $364,000. The present value of the truck related safety benefits over the 2013-2037 analysis period is therefore $4.1 million.

True accident costs might be much higher, as these trucks are filled with hazardous crude oil. This cost effect was not estimated for the BCA, except to the extent it is included in the insurance component of the No Build truck shipping costs.

Rail Safety Impacts

Because most rail-vehicle accidents occur on a per train basis (cars rarely hit the back or middle cars of a long train), the rail accident analysis looked at growth in train traffic, as opposed to growth in railcar traffic.

Currently, the accident rate for rail lines managed by Farmrail and Grainbelt[14] (the proposed operator of the Westhom spur) in this part of Oklahoma is very low – one accident in the past ten years. In addition, the project as proposed in the BCA is projected to add one train trip per week to current traffic levels. The No Build, depending on how Grainbelt chooses to ship the 60 railcar loads each week, would add at least one train trip weekly, and could add more. It was thus assumed that there would be no increase in rail accident costs resulting from the project.

[14] Farmrail is the name of the operator of state-owned rail lines in Oklahoma. Grainbelt is a sister company to Farmrail. The Westhom spur would be operated by Farmrail, and Farmrail has trackage rights over the Grainbelt to Clinton, OK where both Farmrail and Grainbelt converge. Both Farmrail and Grainbelt can access Class I rail carriers (BNSF or UPRR). In the No Build, Grainbelt would handle all operations in Custer County.

Other Non-Quantifiable Costs and Benefits

There are a number of other project benefits as well as costs that could not be reasonably quantified for the benefit-cost analysis. Among these are:

- **Benefits to other rail shippers:** While the benefits of expanded rail capacity (which is cheaper than truck transport) for crude oil shippers are accounted for in the BCA, the impact of this cost reduction for other potential future shippers is not counted. These future users could include agricultural or manufacturing concerns that currently use truck transport, or who now only have access to the national rail network via one Class I rail line (and are thus at the mercy of that company's cost decisions). With the Westhom Spur Rail Improvement project, these shippers would have access to two Class I railroads, and would thus be assured of more competitive pricing. Other potential future users would be additional oil shipments above the assumed 120 cars per week. As noted elsewhere, this part of the Anadarko Basin is expected to be producing over 300 railcars of oil per day by 2015, so it is not inconceivable that the Westhom Spur would transport a larger share of the region's production than is assumed by this analysis.
- **Benefits to truck shipping:** There is currently a labor shortage affecting truck transport in western Oklahoma due to the high demand for moving crude oil, as well as drilling equipment and supplies, to and from the Anadarko Basin. This increased demand has driven up trucking costs for all businesses and farms in the region. While this project would have a relatively small impact (reducing labor demand by 25 to 30 drivers), it would help to reduce the upward pressure on truck transport to some extent by shifting trips to rail.
- **Noise and Traffic impacts:** Because Westhom is an unused spur, the track length can be used to store and build long trains without having to build siding tracks or yard facilities. Railcars could simply be left on the track until a unit train is formed. The Proposed No Build Grainbelt yard would be operating in a limited footprint between local roads, and would cause greater impacts to local traffic. This site is located near a nursing home, and also near a more densely-populated part of Thomas.
- **Regional Economic Impact:** As described in the application, the project is critical in making it possible to fully exploit the region's resources and maximize economic development potential for the region. The dampening effect of limiting rail traffic, while the truck driver labor shortage and the limitations on pipeline capacity make non-rail transportation more difficult and more expensive, could greatly reduce the potential number of jobs and other benefits that would be possible if the project was in place. These benefits are not just the jobs of those drilling and monitoring the wells, or working at transloading facilities, but jobs at restaurants and grocery stores that will serve these new energy-industry employees, the teachers that educate their children, the builders who construct their homes, etc.

Public Benefits

While much of the calculated value of this project will accrue to businesses involved in the oil extraction industry, it should be stressed that the purely public benefits of this project exceed the project costs *on their own.* As shown in **Table BCA-11**, the net present value of the benefits of reduced pavement damage, reduced emissions, and avoided accidents and chemical spills exceed the project costs by over $3 million when assessed at a 7% discount rate, resulting in a benefit-cost ratio of 1.56 to 1.00. Using a 3% discount rate, which is closer to the public sector time value of money, the discount rate is even higher – at 2.16 to 1.0.

Table BCA-11: Public Sector BCA

Category	Present Value at 7%	Present Value at 3%
Costs		
Construction Cost	**$5,077**	**$5,254**
Maintenance Costs	**$573**	**$861**
TOTAL COSTS	**$5,649**	**$6,115**
Evaluated Benefits		
Reduced Cost of Oil Shipments	**zeroed out**	**zeroed out**
Reduced Damage to Roadway	**$4,192**	**$6,343**
Emissions Savings*	**$576**	**$693**
Net Safety Benefits	**$4,071**	**$6,161**
Total Evaluated Benefits	**$8,839**	**$13,196**
NET PRESENT VALUE	**$3,190**	**$7,081**
BENEFIT/COST RATIO	**1.56**	**2.16**

* *The social cost of carbon was broken out from the other benefits and assessed at a 3% discount rate in both the 3% and the 7% columns.*