Benefit-Cost Analysis

Rural Industrial Park
Rail Switching Enhancement Project
Discretionary Grant Application

Prepared by TranSystems

February 2020

Table of Contents

Project Overview

In the 1970's, the American Electric & Power Public Service Company of Oklahoma intended to develop the project site in Inola, Oklahoma, as a nuclear power plant. That vision was never realized and the site has stood vacant since 1982, except for occasional storage of Union Pacific (UPRR) empty railcars on the railroad spur.

City of Tulsa-Rogers County Port Authority ("Tulsa Port of Catoosa" or "Tulsa Port") is pleased that Sofidel America ("Sofidel"), a global consumer products manufacturing company, has built a new, two million square foot manufacturing and distribution facility at the site, making the site (the Inola River-Rail Park) productive and bringing 300 much needed jobs to this economically distressed area. Sofidel broke ground on the facility in 2018 and construction is complete. Limited plant operations began in late 2019 and Sofidel expects to be operating at 100% in May 2020. See **Figures 1 and 2**.

Figure 1: Flags outside Sofidel facility show its global reach.

Image credit: Sofidel

Figure 2: Sofidel's Inola facility under construction.

Image credit: Tulsa World

The existing rail spur was one feature that attracted Sofidel to the Inola site, but in its current condition the spur cannot accommodate loaded railcars. Furthermore, without some additional new rail infrastructure, UPRR will not serve the facility because it would significantly disturb existing traffic on its Wagoner Subdivision. The proposed Rural Industrial Park Rail Switching Enhancement project will provide these needed improvements.

Tulsa Port of Catoosa is seeking U.S. Department of Transportation (USDOT) grant monies to help fund this project which will productively use underutilized rail assets currently existing at the Inola site, as well as construct new rail infrastructure. When the Project is complete, rail will be a viable mode of transportation for shipments in and out of Inola River-Rail Park, not only for Sofidel, but also for future tenants of the industrial park. This Benefit-Cost Analysis, a component of the discretionary grant application, will describe and monetize the costs and benefits of the proposed industrial rail project.

The Rural Industrial Park Rail Switching Enhancement Project entails the following improvements:

- Two (2) drop and pull tracks of 4,456 and 4,517 track-feet,
- A wye track of 1,926 track-feet,
- One (1) loop track with 7,794 clear (usable) track-feet,
- Upgrades to the spur track (see **Figure 3**),
- Replacement of an existing main line turnout with a #15 power turnout,
- Safety improvements for three (3) at-grade crossings, including flashing signals and roadway markings, and
- Signaling.

Figure 1: Existing spur track unused and in disrepair.

When Sofidel begins full operations later this year, its raw material, eucalyptus wood pulp, will be delivered via a multimodal (train and truck) shipment because the existing rail infrastructure at Inola River-Rail Park is inadequate for accommodating loaded railcars. Sofidel's eucalyptus wood pulp provider will load the raw material in railcars in Mobile, Alabama on the Gulf of Mexico—estimated at 1,672 railcars every year—and the railcars will make their way north and west. UPRR will transport the railcars on its Wagoner Subdivision—passing the Inola rail spur—to Coffeyville, Kansas, where it will interchange with South Kansas & Oklahoma Railroad (SKOL), one of the Watco Companies rail lines. See **Figure 4.**

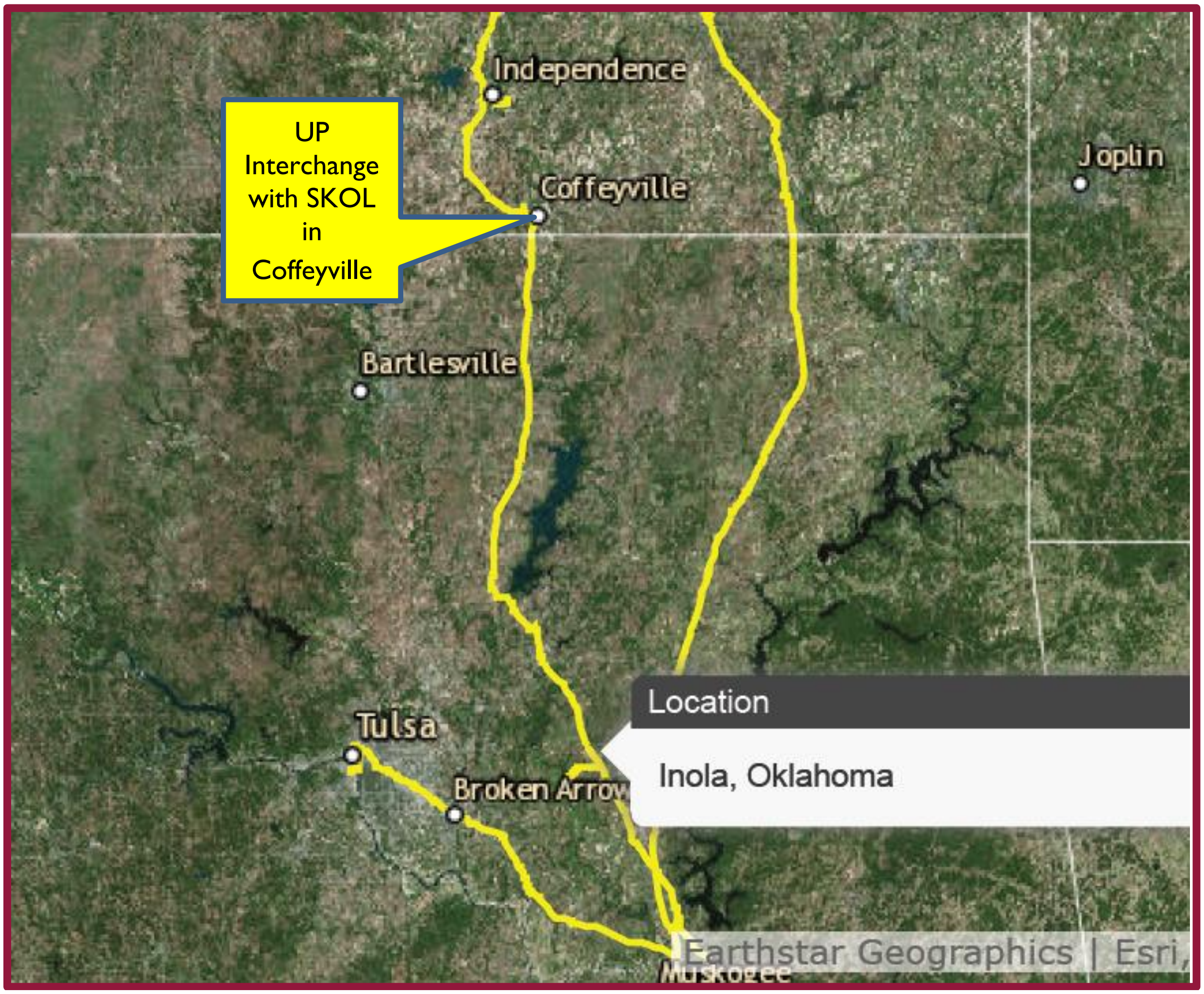

Figure 4: Coffeyville is 65 miles north of Inola on UPRR main track.

Image credit AWC Railway Co.

SKOL will take the railcars to Catoosa, Oklahoma, on a route that first goes north to Cherryvale, Kansas, before heading south. See **Figure 5**. In Catoosa, the eucalyptus wood pulp will be transloaded to into trucks.

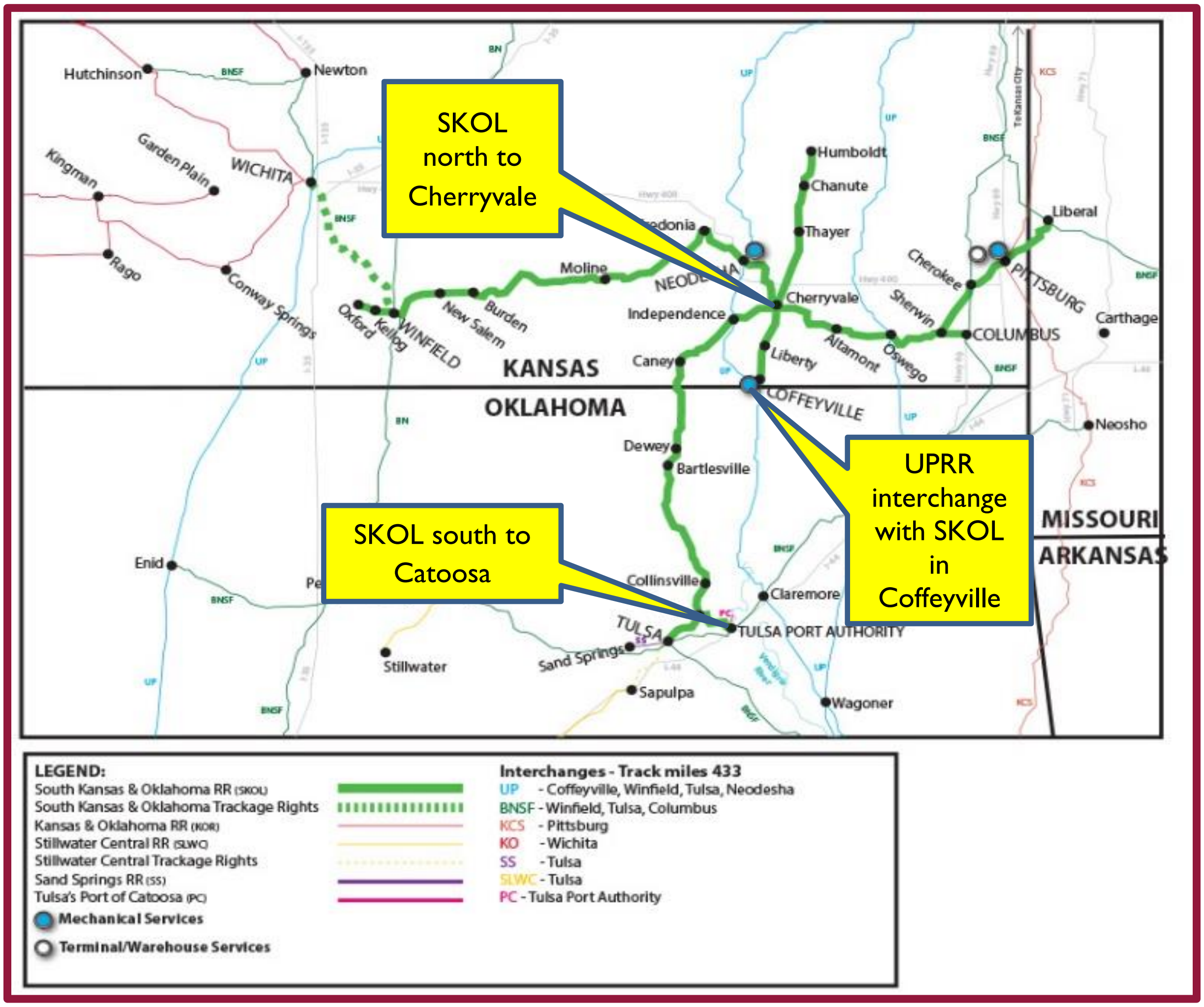

Figure 5: SKOL route to Catoosa, 120 miles

Image credit: Watco Companies

From Catoosa, the eucalyptus wood pulp will be trucked the last 21.6 miles for delivery to Sofidel in Inola. See **Figure 6**. Sofidel's logistics team has negotiated service agreements with UPRR, Watco, SKOL and the Port of Catoosa and is finalizing negotiations with trucking companies regarding shipping services and rates for its inbound shipments. The multimodal shipment will entail approximately 185 out-of-route rail miles, an interchange from UPRR to SKOL, and material handling to transload the raw materials onto trucks, taking approximately two (2) to three (3) days longer than a direct rail delivery to Inola River-Rail Industrial Park.

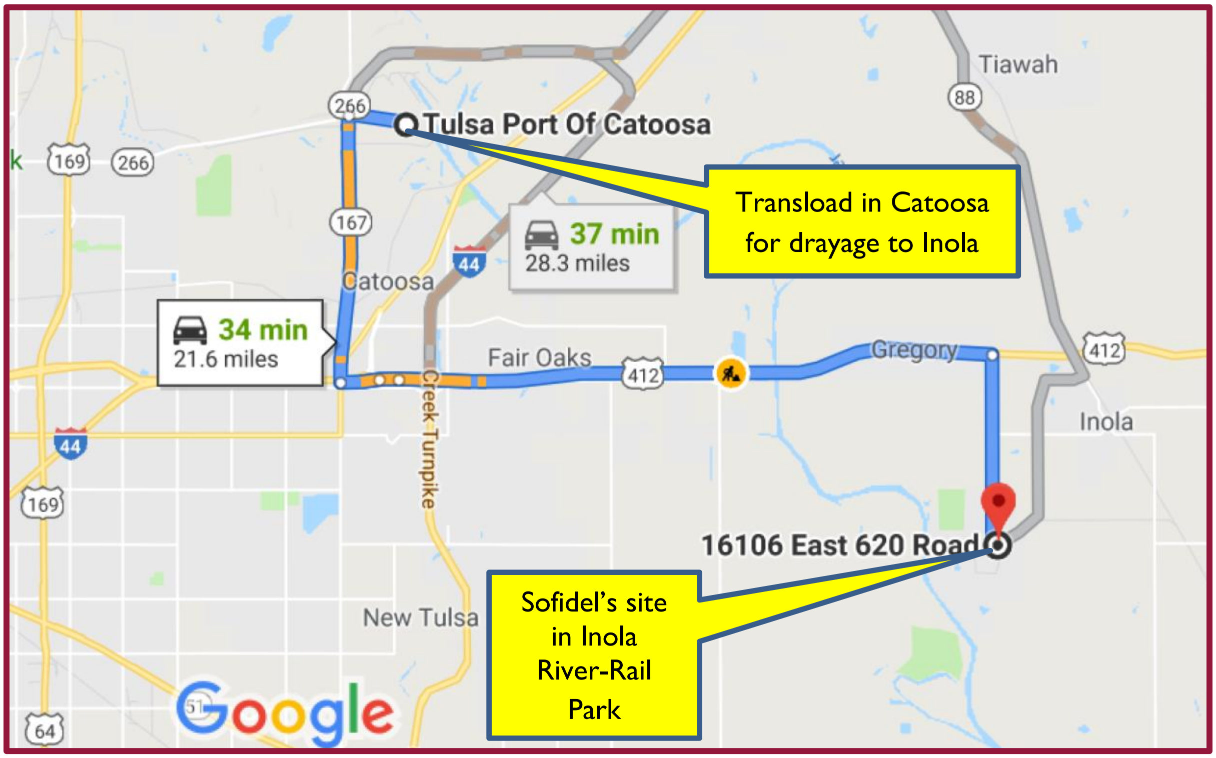

Figure 6: Drayage Catoosa to Inola, 22 miles (Google Maps)

When the spur is upgraded and other rail infrastructure is constructed, UPRR would drop the inbound railcars off in Inola, avoiding the circuitous route and extra material handling described above.

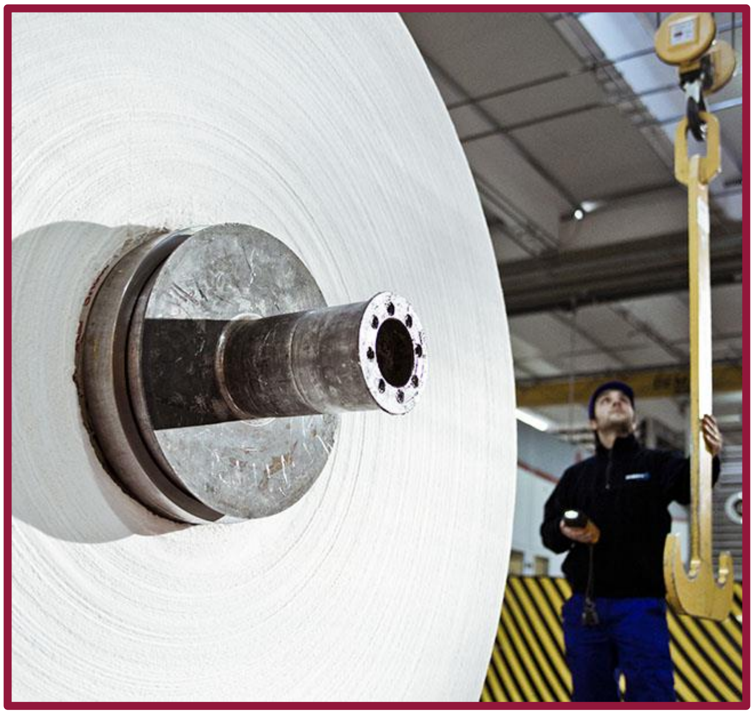

Figure 7: Jumbo reels to send to Sofidel conversion plants.

Image credit: Sofidel

Sofidel will produce both final consumer products and work-in-process (WIP) for two of the company's converting plants. The WIP will be in the form of "jumbo reels" of paper, huge, 4,000-pound rolls, 7.2 x 7.2 x 9.2 feet. See **Figure 7.** Material handling increases the risk of damaging the jumbo reels. Sofidel's quality control measures require the jumbo reels be loaded on the transportation equipment—be it truck or railcar—which will carry them the entire trip to Sofidel's conversion plants in Henderson, Nevada, and Hattiesburg, Mississippi, to avoid double-handling. While its modal preference is rail, unless and until the Rural Industrial Park Rail Switching Enhancement Project is complete, Sofidel will ship its jumbo reels via truck. Accordingly, the Rural Industrial Park Rail Switching Enhancement Project could minimize truck miles, not only locally in Oklahoma, but also in Texas, New Mexico, Arizona, and Nevada along Interstate 40 to Henderson, and in Arkansas and Mississippi on Interstates 40, 530, and 59, as well as various U.S., state, and county roadways to Hattiesburg.

The company plans to produce 14,154 jumbo reels annually to ship to its plants in Nevada (5,516) and Mississippi (8,638). Seven (7) reels can be loaded on a railcar, while only three (3) can be loaded in a 53-foot truck trailer, so the annual outbound shipments will be via 4,718 trucks in the "No Build" scenario and via 2,022 railcars in the "Build" scenario. Sofidel anticipates that the volume of its WIP shipments will remain flat for the first 10 years, then decrease to half its original volume over the second ten-year period.

Fewer truck miles create a host of benefits for the manufacturer and for the public at large. Freight rail transportation is both fuel and labor efficient, so benefits include reduced fuel consumption, lower transportation labor and equipment costs, and lower greenhouse gas emissions. Additional benefits include fewer highway accidents, lower infrastructure maintenance, and less highway congestion and noise. Lower logistics costs improve Sofidel's economic competitiveness and may trickle down to lower prices for its customers.

The Project introduces rail service to Inola River-Rail Park, which will help it attract additional industries along the rail spur. See **Figure 8**. In fact, the Tulsa Port has generated keen interest in the sites at Inola River-Rail Park with a number of potential prospects. Furthermore, Sofidel has its own long-term plans for more expansion. It will consider expanding its Inola facility if Inola River-Rail Park is rail-served. Without the Project and the rail service it makes possible, the remainder of the Inola River-Rail Park would likely remain vacant (i.e., unproductive). But with the Project, additional tenants are likely and all will have modal options for their shipping needs. With every new tenant, more economic opportunities are brought to this distressed area; every time rail is chosen over truck, the benefits of the Rural Industrial Park Rail Switching Enhancement Project will grow.

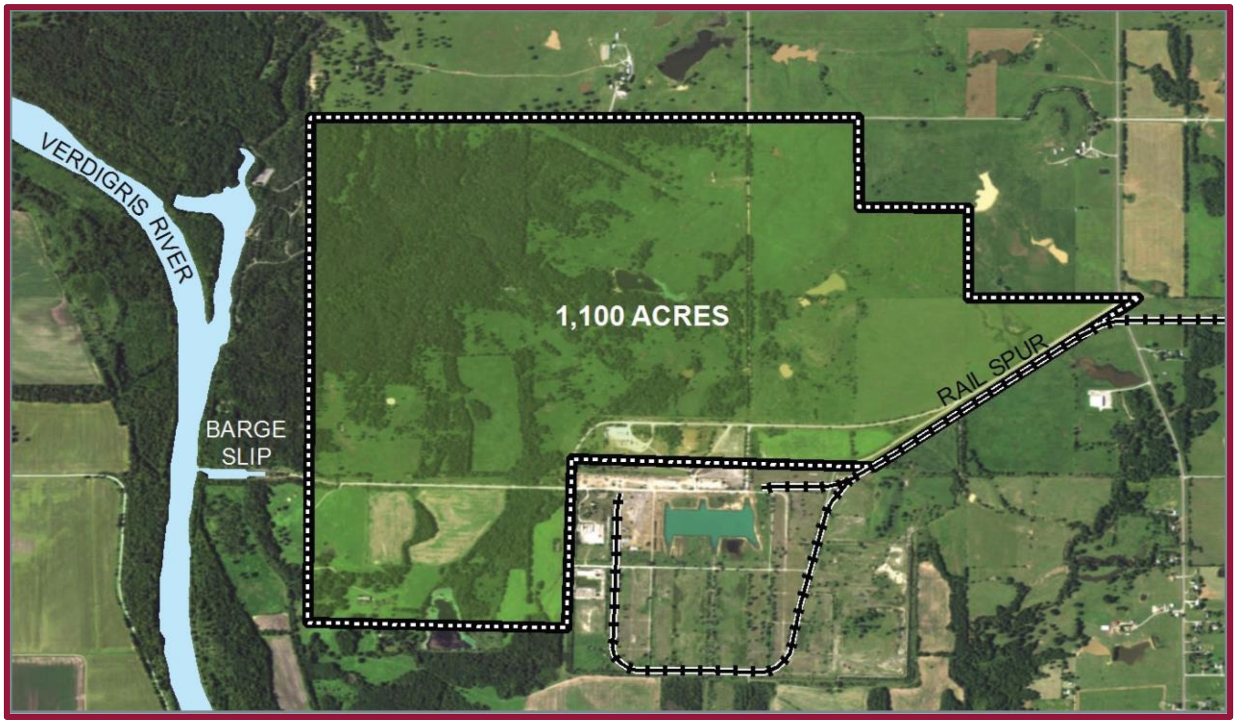

Figure 8: Inola River-Rail Park's is poised for future productivity.

Image credit: American Electric Power Economic Development

Purpose

This Benefit-Cost Analysis (BCA) addresses the requirements of USDOT discretionary grant applications for identification of project costs and comparison to expected benefits.

The BCA outlines the Project conditions under "Build" and "No Build" scenarios, describes and calculates the benefits, project costs, and the resulting overall benefit-cost ratio. Also included is a discussion of additional qualitative benefits of the project that are not readily quantified or converted to dollar equivalents (i.e., monetized).

Net Benefits

"Freight railroads have proven to be vital in maintaining the nation's and the state's economy. The efficiency of steel wheel on steel rail is unmatched by either highway or air transport."[1] See **Figure 9**.

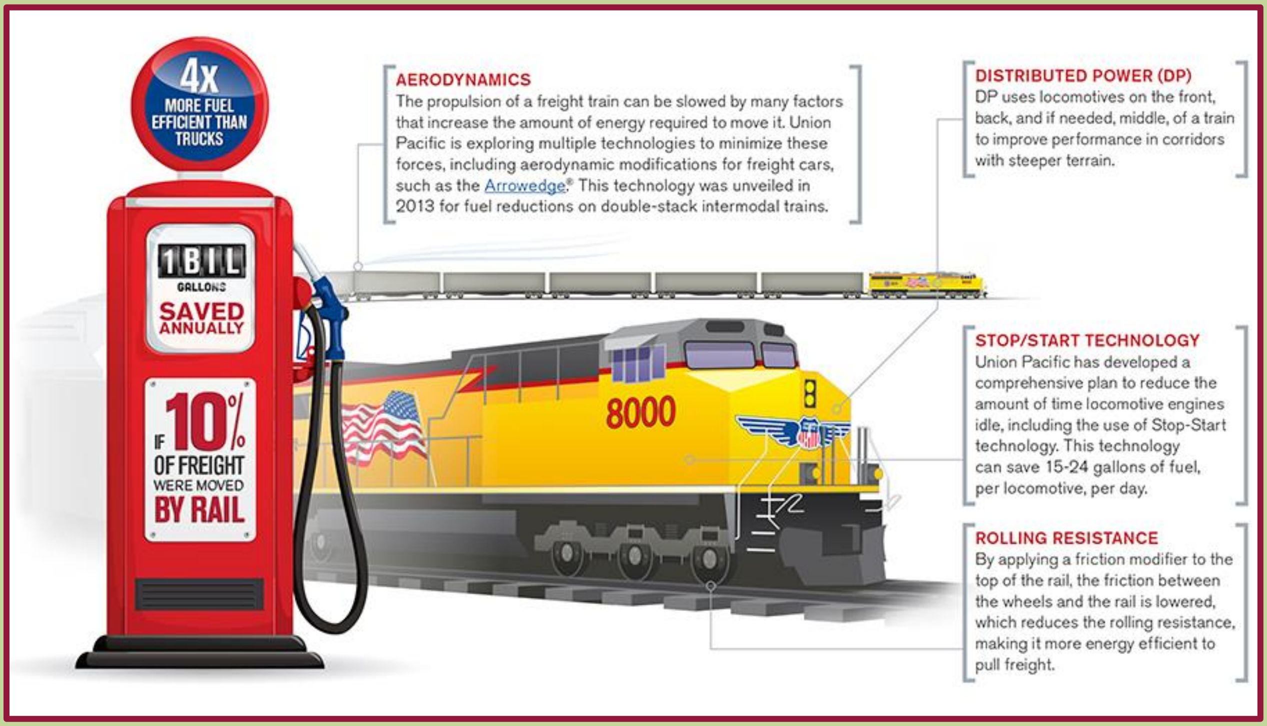

Figure 9: Rail transportation is fuel- and labor-efficient.
Image credit: Union Pacific

The benefits calculated in this report—many which stem from rail's efficiency—focus both on the public benefits derived from the Rural Industrial Park Rail Switching Enhancement Project and also benefits to Sofidel and its customers.

The following sections describe each benefit and provides the relevant values used to calculate the BCA results. **Table 2** at the end of this section summarizes the value of each benefit.

To the extent possible, all monetary values were brought to 2018 dollars. Costs are expected to be incurred July 2020 through September 2021 (Upfront years 1 and 2 of the analysis) and benefits were calculated beginning in the fourth quarter 2021 when rail service is expected to commence at Inola River-Rail Park and over a 20-year time horizon. Since the infrastructure is expected to have a useful life longer than 20 years, the final benefit is a residual value for the Project assets. No inflation rate was applied to future cash flows, as per USDOT's *Benefit-Cost*

[1] Oklahoma Department of Transportation (May 2012), *Oklahoma Statewide Freight and Passenger Rail Plan*, Executive Summary, p. ES-1, www.okladot.state.ok.us/rail/rail-plan/pdfs/2012_RailPlan.pdf accessed 2/1/20.

Analysis Guidance for Discretionary Grant Programs, January 2020. For valuation rates stated in dollars earlier than 2018, the Gross Domestic Product (GDP) Deflator was applied to convert to 2018 dollars. A discount rate of 7% was used to calculate the present value (PV) of cashflows, as directed by the BCA guidelines.

The benefits of the project are partially offset with additional operating costs of the rail spur (i.e., maintenance and railcar switching) that would not be incurred if the rail improvements were not built. As per USDOT guidance, this BCA nets such "disbenefits" against the benefits of the Project.

Reduced Fuel Consumption (Rail Fuel Efficiency).

The Rural Industrial Park Rail Switching Enhancement Project will enable Sofidel to maximize use of fuel efficient freight rail transportation to and from its facility at Inola River-Rail Park, minimizing truck-miles. The project will allow 1,672 annual railcar shipments of raw material to be delivered directly to the new plant, avoiding about 185 out-of-route rail-miles (Inola to Coffeyville, Coffeyville to Cherryvale, and Cherryvale to Port of Catoosa) for each inbound railcars, as well as truck-miles between the Tulsa Port of Catoosa and Inola. The project improvements will also allow Sofidel to load 2,022 annual railcars of WIP (jumbo reels of paper) at the plant for outbound transport to its facilities in Henderson, Nevada, and Hattiesburg, Mississippi. Otherwise, Sofidel would ship the WIP via truck the entire distance because transloading jumbo reels is not feasible. The plant's volumes are expected to be stable for the first ten (10) years of operation, but outbound shipments of WIP are expected to decrease after ten (10) years. The analysis conservatively assumes no growth rate in inbound material shipments over the entire 20-year analysis period.

The fuel benefit estimate is based on the difference between fuel consumption for train shipments in and out of Inola River-Rail Park ("Build" scenario) and that of multimodal movement (train and truck) for raw material shipments and truck movements for the entire outbound shipment of work-in-process inventory (WIP) from Inola to the company's Nevada and Mississippi plants ("No Build" scenario). Fuel calculations entailed the volume of railcars (and the capacity equivalence in truckloads), the number of rail and highway miles between locations, average fuel consumption for freight trains and combination trucks, and 2018 diesel fuel prices.

Fuel Costs can be calculated using the following information:

- Anticipated initial volume of annual inbound and outbound railcar loads is 1,672 and 2,022, respectively, with outbound shipments decreasing in analysis years 10-19 to 1,011 annual railcars by year 19.[2]
- Finished goods will be shipped via truck in both scenarios, so are excluded from BCA calculations.
- Drayage miles from Tulsa Port of Catoosa to Sofidel's Inola site via Highway 412 is 21.6 miles; Roadway miles from Inola to the Henderson, Nevada, facility via I-40 is 1,234 miles; from Inola to Hattiesburg, Mississippi is 613 miles.[3]
- UPRR track miles from the Inola spur switch to Sofidel's Inola site is 3.1 miles;[4] rail network miles from the Inola spur switch on UPRR's main track to Coffeyville, Kansas, is 65 miles[5], SKOL network miles from Coffeyville to Tulsa Port of Catoosa is about 120 miles[6], for a total of 185 out-of-route rail miles;[7] rail network miles from Sofidel's Inola site to its Henderson, Nevada, and Hattiesburg, Mississippi facilities, are approximately 1,700 and 920, respectively.[8]
- A railcar load is equivalent to three (3) truckloads[9], used for raw material shipments.
- A railcar and a truck trailer can accommodate seven (7) and three (3) jumbo reels, respectively.[10]
- Average mileage rate for a combination truck is 6.0 miles per gallon (mpg).[11]
- Average mileage for a train is 457 freight ton-miles per gallon.[12]
- Average load limit for a 50-foot railcar is 180,750 pounds,[13] or 90.4 tons.
- Average load for loaded railcar with jumbo reels is 14 tons, seven (7) reels at two (2) tons each.
- 2018 cost of diesel fuel is $3.110.[14]

---

[2] Sofidel's estimates relayed to Indian Nation Council of Governments (INCOG).
[3] Google Maps.
[4] TranSystems' engineering estimate.
[5] UPRR Timetable for Wagoner Subdivision.
[6] Google Earth.
[7] INCOG's estimate.
[8] Sofidel's estimate relayed to INCOG.
[9] Railtec, University of Illinois Railroad Engineering Program (2009), *Railroad Transportation Energy Efficiency*, p.16, www.istc.illinois.edu/UserFiles/Servers/Server_427403/File/20091118.pdf, accessed 1/31/20.
[10] Sofidel's estimate relayed to INCOG.
[11] Bureau of Transportation Statistics, *Combination Truck Fuel Consumption and Travel*, https://www.bts.gov/combination-truck-fuel-consumption-and-travel-0, accessed 1/31/20.
[12] Railtec, University of Illinois Railroad Engineering Program (2009), *Railroad Transportation Energy Efficiency*, p.4-5, www.istc.illinois.edu/UserFiles/Servers/Server_427403/File/20091118.pdf, accessed 1/31/20.
[13] UPRR, *Boxcars, 50 Foot Plain Boxcar*, www.up.com/customers/all/equipment/descriptions/boxcars/index.htm, accessed 1/31/20.
[14] U.S. Energy Information Administration, Independent Statistics and Analysis, *Weekly Retail Gasoline and Diesel Prices*, for 2018 for Midwest, www.eia.gov/dnav/pet/pet_pri_gnd_a_epd2d_pte_dpgal_a.htm, accessed 1/31/20.

For the "No Build" scenario and the "Build" scenario before the Project is placed in service:

 # Inbound Trucks = # Inbound Railcars x 3 trucks/railcar
 # Outbound Trucks = # Outbound Railcars (planned) x 7 reels/railcar ÷ 3 reels/truck
Truck Vehicle Miles Traveled (TVMT) = # Inbound Trucks x Drayage Route (21.6 miles) + # Outbound Trucks$_{NV}$ x Roadway Miles$_{NV}$ (1,234 miles) + # Outbound Trucks$_{MS}$ x Roadway Miles$_{MS}$ (613 miles)
Truck Fuel Usage = TVMT ÷ Mileage Rate (6.0 mpg)

Railcar Miles Traveled = # Inbound Railcars x Out-of-route Rail Miles (185 miles)
Freight Ton-miles = Railcar Miles Traveled x Average Load Limit (90 tons)
Train Fuel Usage = Freight Ton-miles ÷ Average Mileage Rate (457 freight ton-miles/gallon)

Total Fuel Usage = Truck Fuel Usage + Train Fuel Usage
Fuel Cost = Total Fuel Usage x Cost per Gallon ($3.110)

After the Project is placed in service, estimated to be September 2021 or Upfront Year 2, the "Build" scenario has no truck-miles because both raw materials and WIP will be transported via rail from origin to destination.

Railcar Miles Traveled$_{\text{Inbound}}$ = # Inbound Railcars x Inola Industrial Lead Miles (3.1 miles)
Railcar Miles Traveled$_{\text{Outbound}}$ = # Outbound Railcars$_{NV}$ x Rail Miles$_{NV}$ (1,700 miles) + # Outbound Railcars$_{MS}$ x Rail Miles$_{MS}$ (920 miles)
Freight Ton-miles = Railcar Miles Traveled$_{\text{Inbound}}$ x Average Load Limit (90 tons) + Railcar Miles Traveled$_{\text{Outbound}}$ x Average Load Limit (14 tons)
Train Fuel Usage = Freight Ton-miles ÷ Average Mileage Rate (457 freight ton-miles/gallon)

Fuel Cost = Train Fuel Usage x Cost per Gallon ($3.110)

The "No Build" and "Build" scenarios entails truck and train fuel, but the "Build" scenario entails only train fuel after construction is complete. Annual Fuel Savings is the difference between the fuel cost for the "No Build" scenario and the train fuel cost in the "Build" scenario and stems from better fuel efficiency of steel wheel on steel rail trains, as well as the difference in route miles.

Reduced Transportation Labor Costs (Rail Labor Efficiency).
The modal difference between truck and rail will also save transportation worker hours since every truck needs a driver, while a 2-man train crew moves many railcars at a time and each railcar can hold as much as three (3) trucks. (Of course, if and when driverless trucks are prevalent, labor costs of trucking will drop significantly.) Furthermore, the transload of inbound materials at the Tulsa Port of Catoosa requires additional labor of material handlers.

Both the "Build" and "No Build" scenarios have train crews (i.e., engineer and conductor) as transportation workers. Transportation Worker Costs for rail can be calculated using railcar miles traveled and the following information:

- Average train length for a manifest train is 81 railcars[15]
- Average train speed is 25.4 mph[16]
- Train crew size of two (2)[17]
- Value of Time (VOT) for locomotive engineers of $45.70[18] (used for both members of the train crew).

Train-miles = Railcar Miles ÷ Train Length
Train-hours = Train-miles ÷ Speed
Train Crewman Hours = Train-hours x Crew Size
Rail Crew Cost = Train Crewman Hours x VOT

[15] Lovett, etal (2015), *Determining Freight Train Delay Costs on Railroads in North America*, p. 11, http://railtec.illinois.edu/wp/wp-content/uploads/2019/01/Lovett-et-al-2015-IAROR.pdf.
[16] Statistica, *Union Pacific's Average Train Speed from FY 2013 to FY 2017 (in miles per hour)* www.statista.com/statistics/547745/average-train-speed-union-pacific-railroad/, accessed 6/8/18.
[17] Lovett, etal (2015), *Determining Freight Train Delay Costs on Railroads in North America*, p. 2, http://railtec.illinois.edu/wp/wp-content/uploads/2019/01/Lovett-et-al-2015-IAROR.pdf.
[18] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, page 31.

Transportation Labor Costs for the "No Build" scenario also entail earnings of truck drivers and material handlers and can be calculated using the TVMT and the following information:

- Average speeds of 45 and 68[19] miles per hour (mph) for the short movements between the Tulsa Port of Catoosa and Inola and for the long-haul movements to Nevada and Mississippi, respectively.
- Average vehicle occupancy for a commercial truck is 1.00.[20]
- Estimated time (in man-hours) to transload materials from a railcar to trucks (or vice versa) is two (2) hours.[21]
- VOT for truck drivers and material handlers of $29.50[22] and $12.48,[23] respectively

Truck Driver Hours = TVMT ÷ Average Speed x Occupancy
Truck Driver Cost = Truck Driver Hours x VOT
Material Handler Hours = # Inbound Railcars x Hours per Railcar
Material Handler Cost = Material Handler Hours x VOT

Total Transportation Labor Cost = Rail Crew Cost + Truck Driver Cost + Material Handler Cost

Annual Transportation Labor Savings is the difference between labor costs for train crews, truck drivers and material handlers for "No Build" scenario and the train crew costs of the "Build" scenario. The savings stem from the labor efficiency of rail transportation, partially offset with higher pay rates.

[19] Google Maps, calculated using miles and estimated trip duration.
[20] USDOT (December 2018), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, page 30. (The January 2020 version did not address this statistic.)
[21] TranSystems' estimate.
[22] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, page 31.
[23] Bureau of Labor Statistics (May 2018), *Occupational Employment Statistics*, (average rate northeast Oklahoma nonmetropolitan area, occupation code 53-7062, laborers and freight stock, and material movers, hand), https://www.bls.gov/oes/current/oes_4000001.htm#53-0000, accessed 1/31/20.

Reduced Transportation Equipment Costs (Rail Equipment Efficiency).
Just as there are transportation worker savings, the modal difference between truck and rail also generates transportation equipment savings.

Transportation Equipment Costs for the "No Build" scenario and upfront years in the "Build" scenario entail ownership and maintenance costs for the tractor-trailers. Truck Equipment Costs are calculated using the TVMT and the following information:

- Vehicle operating costs per mile, including truck/trailer lease or purchase payments, repairs, maintenance, insurance, permits, licenses, and tires, but excluding tolls (transfers) and driver costs, of $0.96 per mile.[24]
- Fuel cost per mile of $0.518 per mile (calculated diesel fuel cost of $3.110/gallon ÷ truck mileage rates of 6.0 mpg, previously noted).
- Truck equipment costs of $0.442 per mile (calculated vehicle operating cost $0.96 less fuel cost $0.518 per mile, above).

Truck Equipment Cost = TVMT x Truck Rate

Transportation equipment in both the "No Build" and "Build" scenarios include railroad equipment (i.e., locomotives and railcars). Rail Equipment Costs can be calculated using data mentioned previously and the following information:

- Average number of locomotives per train of three (3)[25]
- Ownership and operating costs (excluding fuel) for locomotives of $26.36 and $66.73 per locomotive-hour, respectively,[26] for a total of $93.09 (2012$)
- Railcar cost per hour of $0.84[27] (2012$)
- Inflation factor of 1.1042 for 2012[28]

Locomotive-hours = Train-hours x # Locomotives per Train (3)
Railcar-hours = Train-hours x Train Length (81)
Equipment Rate$_{2018}$ = Equipment Rate$_{2012}$ x Inflation Factor$_{2012}$
Locomotive Cost = Locomotive-hours x Locomotive Rate$_{2018}$
Railcar Cost = Railcar-hours x Railcar Rate$_{2018}$

Rail Equipment Cost = Locomotive Cost + Railcar Cost
Total Transportation Equipment Cost = Truck Equipment Cost + Rail Equipment Cost

[24] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, page 32.
[25] Lovett, etal (2015), *Determining Freight Train Delay Costs on Railroads in North America*, p. 6, http://railtec.illinois.edu/wp/wp-content/uploads/2019/01/Lovett-et-al-2015-IAROR.pdf.
[26] Lovett, etal (2015), *Determining Freight Train Delay Costs on Railroads in North America*, p. 3, http://railtec.illinois.edu/wp/wp-content/uploads/2019/01/Lovett-et-al-2015-IAROR.pdf.
[27] Lovett, etal (2015), *Determining Freight Train Delay Costs on Railroads in North America*, p. 11, http://railtec.illinois.edu/wp/wp-content/uploads/2019/01/Lovett-et-al-2015-IAROR.pdf.
[28] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, page 35.

Annual Transportation Equipment Savings is the difference between the total transportation equipment costs for the "No Build" scenario and the locomotive and railcar costs of the "Build" scenario. The equipment benefit of rail stems from the greater cubic/weight capacity of railcars and differences in equipment rates, partially offset with slower speeds and sometimes longer route-miles on the freight rail network versus highways.

Reduction in Highway Truck Crashes.
Reducing truck miles, as the Rural Industrial Park Rail Switching Enhancement Project will, leads to a reduction in the number of highway truck crashes. Crash Costs—which are only calculated for the "No Build" scenario in the analysis—can be calculated using the TVMT previously calculated and the following information:

- Fatalities in large truck crashes per 100 million TVMT of 1.60[29]
- Persons injured in large truck crashes per 100 million TVMT of 49.70 [30]
- Property damage only (PDO) crashes per 100 million TVMT of 115.50[31]
- Value of statistical life (VSL, KABCO level "K") of $9.6 million (2018$)[32]
- Economic value of injury, severity unknown (KABCO level "U"), of $174,000 (2018$)[33]
- Value of a property damage only (PDO) crash estimated at $4,400 (2018$)[34]

Fatality Costs = TVMT ÷ 100 million x Fatality Rate x VSL
Injury Costs = TVMT ÷ 100 million x Injury Rate x Injury Value
PDO Costs = TVMT ÷ 100 million x PDO Rate x PDO Value

Total Crash Cost = Fatality Costs + Injury Costs + PDO Costs

Annual Crash Savings related to the reduction of truck miles driven is the difference between the crash costs for "No Build" and "Build" scenarios. (Note: While there will actually be truck-miles incurred for outgoing shipments of finished goods, they would be the same for both scenarios. Accordingly, it was not deemed necessary to calculate those TVMT nor the associated crash costs.)

---

[29] Federal Motor Carrier Safety Administration (FMCSA) (May 2019), *Large Truck and Bus Crash Facts 2017*, FMCSA-RRA-18-018, Trends Table 4. Large Truck Fatal Crash Statistics, 1975-2017, https://cms8.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts-2017, accessed 1/31/20.
[30] FMCSA (May 2019), *Large Truck and Bus Crash Facts 2017*, FMCSA-RRA-18-018, Trends Table 7. Large Truck Injury Crash Statistics, 1995-2017, https://cms8.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts-2017, accessed 1/31/20.
[31] FMCSA (May 2019), *Large Truck and Bus Crash Facts 2017*, FMCSA-RRA-18-018, Trends Table 10. Large Truck Property Damage Only (PDO) Crash Statistics, 1995-2017, https://cms8.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/safety/data-and-statistics/461106/trends-tbl7-2017.xlsx, accessed 1/31/20.
[32] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, page 30.
[33] Ibid.
[34] Ibid.

Reduction in Transportation Infrastructure Maintenance. Both highway maintenance and railroad maintenance costs fluctuate with the volume of traffic handled. The county roads and bridges serving Inola River-Rail Park, in particular, are not prepared for the volume of heavy trucks Sofidel and future tenants' operations will inflict upon them. See **Figure 10**.

Figure 10: Maintenance on Oklahoma Roadway

Image credit: Oklahoma DOT

Highway maintenance costs are calculated using TVMT and the following information:

- 2000 pavement costs of 3.3 and 10.5 cents[35] per truck-mile for 60 kip combination trucks in rural and urban areas, respectively, average of 6.9 cents per truck-mile
- GDP deflator factors of 78.82 and 111.26 for 2000 and 2018,[36] respectively

$$\textbf{Pavement Rate}_{\mathbf{2018}} = \text{Pavement Rate}_{2000} \div \text{GDP Deflator}_{2000} \times \text{GDP Deflator}_{2018}$$

$$\textbf{Highway Maintenance Cost} = \text{TVMT} \times \text{Pavement Rate}_{2018}$$

Railway maintenance costs are calculated using train-miles, calculated previously, and the following information to calculate maintenance per train-mile:

- Maintenance of way (MOW) costs, excluding depreciation, for Class I railroads in 2018 of $5,225,048,000[37]
- Total freight train-miles in 2018 of 476,522,312[38]

$$\textbf{MOW/Train-Mile} = \text{MOW Cost} \div \text{Total Train-miles}$$

$$\textbf{Railway Maintenance Cost} = \text{Train-miles} \times \text{MOW/Train-mile}$$

$$\textbf{Transportation Infrastructure Maintenance Cost} = \text{Highway Maintenance Cost} + \text{Railway Maintenance Cost}$$

[35] Federal Highway Administration (FHWA), *Cost Allocation Study Final Report, Table ES-6*, https://www.fhwa.dot.gov/policy/hcas/final/execsum.cfm, last modified 11/7/14.
[36] GDP Deflator by Year, http://www.multpl.com/gdp-deflator/table, accessed 1/31/20 (source is U.S. Bureau of Economic Analysis).
[37] Association of American Railroads (AAR), *Analysis of Class I Railroads, 2018*, line 148.
[38] AAR, *Analysis of Class I Railroads, 2018*, line 650.

Annual Transportation Infrastructure Maintenance Savings related to the Rural Industrial Park Rail Switching Enhancement Project is the difference between the combined highway and railway maintenance for the "No Build" and the "Build" scenarios.

Reduction in CO_2 and Other Emissions.

The Rural Industrial Park Rail Switching Enhancement Project will reduce the amount of greenhouse gases (CO_2), volatile organic compounds (VOC), nitrogen oxides (NOx), and particulate matter (PM) because it reduces fuel consumptions, avoids out-of-route miles, and minimizes rail miles on smaller railroads, whose locomotives generally produce more emissions.

CO_2 emissions benefits are calculated using fuel usage calculated previously and the following information:

- Social Cost of Carbon (SCC) per metric ton of $1 for years 2020 through 2034, increasing to $2 for years 2035 through 2050[39]
- A gallon of diesel fuel consumed generates 10.1 kg of CO_2.[40]

CO_2 Emissions (in metric tons) = Gallons of diesel x 10.1 kg/gal x .001 metric ton/kg

Value of CO_2 Emissions = CO_2 Emissions (in metric tons) x SCC

Emissions values for other emissions are calculated using the following information:

- Value of Emissions (VOE) Reductions per short ton (in 2018 dollars):
  - VOC Emission Reduction = $2,100[41]
  - NOx Emission Reduction = $8,600[42]
  - PM Emission Reduction = $387,300[43]
- A metric ton is equivalent to 1.1015 short tons[44]

VOE ($/metric ton) = VOE ($/short ton) x 1.1015 conversion

[39] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, p. 34.

[40] Environmental Protection Agency (EPA) (February 2005), *Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel, EPA420-F-05-001*.

[41] USDOT (January 2020), *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, p. 33.

[42] Ibid.

[43] Ibid.

[44] Ibid.

Combination diesel truck emissions of VOC, NOx and PM are calculated similarly using TVMT and the following data from the Federal Highway Administration (FHWA) website, *Freight Movement & Air Quality, Appendix B: Estimation of Future Truck Emissions*:

- Truck miles are estimated to be 13% on local roads, 35% on minor arterial roads, 30% on urban freeways and 22% on rural freeways
- Local road emissions of VOC, NOx and PM_{10} in 2020 are 0.56, 1.29 and 0.07 grams/mile, respectively.
- Arterial road emissions of VOC, NOx and PM_{10} in 2020 are 0.28, 1.03 and 0.07 grams/mile, respectively.
- Urban freeway emissions of VOC, NOx and PM_{10} in 2020 are 0.20, 1.28 and 0.073 grams/mile, respectively.
- Rural freeway emissions of VOC, NOx and PM_{10} in 2020 are 0.19, 1.97 and 0.07 grams/mile, respectively.
- Conversion Factor: 1 g = .000001 metric ton

Emissions (g) = (TVMT x Local Road % x Local Road Emission Rate) +
(TVMT x Arterial Road % x Arterial Road Emission Rate) +
(TVMT x Urban Freeway % x Urban Freeway Emission Rate) +
(TVMT x Rural Freeway % x Rural Freeway Emission Rate)
Emissions Cost = Emissions (g) x Conversion Factor (grams to tons) x VOE

Figure 11: Trucks produce 3 times the GHG emissions of trains.
Image credit: Go By Truck News

Locomotive emissions standards have been getting more stringent so newer locomotives generate lower levels of emissions. The Environmental Protection Agency (EPA) projects future emissions for large line-haul locomotives in years 2020 through 2040 as follows in **Table 1**:

Table 1: Emissions Factors for Locomotives (g/gal)[45]

Year	Large Line-haul Locomotives			Small Railroad Locomotives		
	HC	NOx	PM_{10}	HC	NOx	PM_{10}
2020	3.6	99	2.3	11.7	231	5.3
2021	3.4	94	2.2	11.7	228	5.3
2022	3.2	89	2.0	11.7	225	5.3
2023	3.0	84	1.9	11.7	223	5.2
2024	2.8	79	1.7	11.7	220	5.2
2025	2.6	74	1.6	11.7	217	5.1
2026	2.5	69	1.5	11.7	215	5.1
2027	2.3	65	1.4	11.7	212	5.1
2028	2.1	61	1.3	11.7	209	5.0
2029	2.0	57	1.1	11.7	206	5.0
2030	1.9	53	1.0	11.7	203	4.9
2031	1.7	49	1.0	11.7	200	4.8
2032	1.6	46	0.9	11.7	197	4.8
2033	1.5	43	0.8	11.7	193	4.7
2034	1.4	40	0.7	11.7	190	4.6
2035	1.3	37	0.7	11.7	187	4.6
2036	1.2	35	0.6	11.7	184	4.5
2037	1.2	33	0.6	11.7	180	4.4
2038	1.1	31	0.5	11.7	177	4.4
2039	1.1	29	0.5	11.7	174	4.3
2040	1.0	28	0.4	11.7	171	4.2

Locomotive emissions are calculated using diesel gallons consumed, emissions rates and VOE above. VOC emissions are 1.053 times hydrocarbons (HC) emissions,[46] so the HC emissions factors above must be multiplied by 1.053 to derive the VOC emissions factors. Because the emissions rates differ for large line-haul locomotives, like those used on UPRR's main track, and for locomotives of small railroads, like SKOL, the split between diesel gallons consumed by UPRR and SKOL in the "No Build" scenario was estimated based on the split of 185 out-of-route miles for inbound shipments, 65 miles and 120 miles, respectively. After the Project is placed in service in the "Build" scenario, it is assumed all rail miles are incurred by large line-haul locomotives.

Emissions (g) = Train Fuel Usage x Emissions Factor

Emissions Cost = Emissions (g) x Conversion Factor (grams to tons) x VOE

[45] EPA (April 2009), *Emission Factors for Locomotives*, EPA-420-F-09-025.
[46] Ibid.

Annual Emissions Savings is the difference between the emissions costs for the "No Build" and the "Build" scenarios**.** The fuel efficiency of rail movements and the lower emissions of large line-haul locomotives lead to lower emission in the "Build" scenario for all emissions evaluated.

Residual Value.
With ongoing maintenance, the new Inola rail infrastructure will have an estimated useful life of 100 years. The land itself has an infinite life and will not depreciate. For simplicity's sake, one can assume the project's value will depreciate linearly over its life, so that at the end of the 20-year analysis period, 80% of the project's initial value remains. The residual value of the investment is deemed to be a final benefit of the project in the final year of the analysis.

$$\textbf{Rail Value}_{\textbf{Year 20}} = \text{Rail Value}_{\text{Year 0}} \div \text{Useful Life (100 years)} \times \text{Remaining Life (80 years)}$$

$$\textbf{Residual Value}_{\textbf{Year 20}} = \text{Land Value}_{\text{Year 0}} + \text{Rail Value}_{\text{Year 20}}$$

Operations (Disbenefit).
After the rail infrastructure is placed in service, estimated to be in the fourth quarter of 2021, it and the rail spur will incur ongoing operations costs. These costs include ongoing track maintenance and a switch crew (and locomotive) to serve Sofidel and future industries at Inola River-Rail Park. These costs of the "Build" scenario are avoided in the "No Build" scenarios and become negative benefits (or "disbenefits") of the project.

Annual project maintenance costs have been estimated using total maintenance of way (MOW) costs, excluding depreciation, for Class I railroads in 2018, mentioned previously, and the following information:

- Track miles operated by Class I railroads in 2018 of 198,544[47]
- 5,280 feet per mile
- Project track-feet of 34,855

MOW/Track-mile = MOW Cost ÷ Track-miles
MOW/Track-foot = **Cost/Track-mile** ÷ 5,280 feet/mile
Project Maintenance Cost = Project Track-feet x MOW/Track-foot

Annual switching costs can be estimated using the locomotive rate previously calculated, VOT for train crews previously cited, and the following information and assumptions:

- Switch service 260 days per year with costs incurred eight (8) hours per day, even though actual daily hours are likely to be less than eight
- A two-man switch crew using one locomotive

Locomotive-hours = 260 days/year x 8 hours/day
Locomotive Cost = Locomotive-hours x Locomotive Rate
Switch Crewman-hours = Locomotive-hours x 2 men/crew
Switch Crew Cost = Switch Crewman-hours x VOT
Total Switch Costs = Locomotive Cost + Switch Crew Cost

Total Project Operations Cost = Project Maintenance Cost + Total Switch Costs

Public Costs During Construction (Disbenefit).
The project site is over two (2) miles from the heart of Inola, a town of fewer than 2,000 residents, and is surrounded by farmland. Accordingly, the project site is "off the beaten path" in Rogers County and the costs to the public during the construction period are expected to be minimal. No highways, arterial or local roads are expected to be closed during construction, so traffic delays will be negligible. Construction noise and congestion is not expected to impact the residents significantly. Accordingly, no public costs have been added to the benefit-cost analysis.

[47] AAR, *Analysis of Class I Railroads, 2018*, line 341.

Summary of Net Benefits.
Table 2 illustrates the value of each benefit over the entire 20-year analysis period. **Table 5** shows the value of all costs and benefits by year. (A detail of the specific benefits by year is found in the Appendix to the report.)

Table 2: Net Benefit Analysis Summary
($ in Thousands)

Description	No Build Scenario	Build Scenario	Benefit
Fuel Consumption	($43,657)	($7,210)	$36,447
Transportation Labor	($34,826)	($4,383)	$30,443
Transportation Equipment	($34,951)	($10,368)	$24,583
Highway Crashes	($18,707)	($1,357)	$17,350
Infrastructure Maintenance	($8,349)	($6,294)	$2,054
Emissions (CO_2, VOC, NOx, PM)	($7,369)	($1,912)	$5,458
Residual Value	$0	$9,891	$9,891
Operating Costs	$0	($11,289)	($11,289)
Total Net Benefits:	**($147,859)**	**($32,921)**	**$114,937**
PV, Discounted (7%):	**($83,502)**	**($24,848)**	**$58,654**

Costs

Construction.
The cost to prepare the final design plans and specifications and to construct the Rural Industrial Park Rail Switching Enhancement Project is estimated to be $11.986 million and are estimated to occur within a 15-month period (Upfront Years 1 and 2 of the analysis). The property needed for the Project and approximately $0.2 million of the $0.8 million estimated for engineering and construction management has already been incurred for preliminary engineering design. Since these costs have already been expended, they are ineligible for USDOT reimbursement.

Administration and Miscellaneous Costs.
In addition to the cost of the infrastructure itself, the Tulsa Port has estimated an additional $0.15 million of administration and miscellaneous costs will be incurred, bringing the total cost of the project to $12.136 million.

Components of the cost estimate are detailed in **Table 3** while **Table 5** shows the value of all costs and benefits by year.

Table 3: Project Cost Estimates
($ in Thousands)

Item #	Task Name/Project Component	Cost
1	Sitework – Site Preparation and Demolition	$276
2	Earthwork/Grading and Drainage	$1,633
3	Trackwork, including CTC and At-grade Safety Improvements	$7,004
4	Property Acquisition	$800
5	Engineering and Construction Management	$800
6	Contingencies	$1,473
	Project Construction Cost	$11,986
7	Administration and Miscellaneous	$150
	Total Project Cost	**$12,136**

Net Present Value and Benefit-Cost Ratio

Details of the costs and various benefits by year related to the "No Build" and "Build" scenarios over the 20-year analysis period can be seen in the Appendix to this analysis. The difference in the present values of these cash and cash equivalent flows is the basis of the net present value (NPV) and benefits-cost (B-C) ratio for the project. The project's NPV and B-C ratio both meet the threshold for viability (i.e., NPV greater than $0 and B-C ratio greater than 1.0).

Table 4 summarizes the costs and benefits of the baseline ("No Build") and the "Build" scenarios. Present values (PV) are calculated using a 7% discount rate.

Table 4: Benefit-Cost Analysis Summary
($ in Thousands)

Description	PV Net Benefits	PV Costs	NPV = Benefits + Costs	B-C Ratio
No Build Cashflows	($83,502)	$0	($83,502)	
Build Scenario Cashflows	($24,848)	($11,670)	($36,518)	
Difference	**$58,654**	**($11,670)**	**$46,984**	**5.03 : 1**

Table 5: Project Costs and Benefits by Year
($ in Thousands)

Analysis Year	Year	Costs	Benefits	Net Cash Flows	PV (7% Discount Rate)
Upfront 1	2020	($5,008)	$0	($5,008)	($5,008)
Upfront 2	2021	($7,128)	$1,525	($5,603)	($5,236)
1	2022	$0	$6,127	$6,127	$5,352
2	2023	$0	$6,129	$6,129	$5,003
3	2024	$0	$6,135	$6,135	$4,681
4	2025	$0	$6,138	$6,138	$4,376
5	2026	$0	$6,142	$6,142	$4,093
6	2027	$0	$6,145	$6,145	$3,827
7	2028	$0	$6,147	$6,147	$3,578
8	2029	$0	$6,153	$6,153	$3,347
9	2030	$0	$6,154	$6,154	$3,129
10	2031	$0	$5,855	$5,855	$2,782
11	2032	$0	$5,558	$5,558	$2,468
12	2033	$0	$5,259	$5,259	$2,182
13	2034	$0	$4,960	$4,960	$1,923
14	2035	$0	$4,660	$4,660	$1,689
15	2036	$0	$4,364	$4,364	$1,478
16	2037	$0	$4,062	$4,062	$1,286
17	2038	$0	$3,762	$3,762	$1,113
18	2039	$0	$3,459	$3,459	$956
19	2040	$0	$3,156	$3,156	$816
20	2041	$0	$13,047	$13,047	$3,151
Totals:		**($12,136)**	**$114,937**	**$102,801**	**NPV = $46,984**
Present Value:		**($11,670)**	**$58,654**	**$46,984**	

Additional Qualitative Benefits

Construction Job Creation.

Job creation is not the type of benefit USDOT is looking for in BCA according to its January 2020 *Benefit-Cost Analysis Guidance for Discretionary Grant Programs;* so has been excluded from BCA calculations. On the other hand, good paying construction jobs in an area with per capita incomes averaging just $24,327 and experiencing unemployment rates well above the national average—6.6%[48] compared to 3.5%[49]—is a favorable impact that should not be overlooked. The number of construction jobs estimated to be created by the Rural Industrial Park Rail Switching Enhancement Project is about 70 full-time equivalent jobs over a 1-year construction period.

In addition to direct construction jobs, construction activity tends to generate a number of indirect positions. These indirect jobs are for the production of building materials and various professional services, such as accounting. In addition to direct and indirect jobs, additional jobs are induced when workers spend their earnings.[50]

Permanent Job Creation.

Sofidel has plans for a $400 million second phase expansion of its manufacturing facility in Inola which would employ an additional 400 workers, for a total of 700. These plans are contingent upon the facility being rail-served.

Reduction in Other Transportation Costs.

Increased highway traffic generates other highway costs in addition to maintenance, specifically congestion and noise.

Congestion costs include, but are not limited to, the value of individuals' time that could otherwise be spent at work or leisure, excess fuel usage and emissions, more accidents and greater wear and tear on vehicles. Freight rail traffic can also impact roadway congestion (due to delays at at-grade crossings, for instance), but the analysis team suspects rail traffic inflicts lower congestion costs than does truck traffic. USDOT discourages inclusion of congestion benefits without a regional travel model, which is not available to support this BCA.

Noise costs include impacts to health, productivity, quality of life and the natural environment. While both trucks and railcars would increase noise, the analysis team believes that trucks' impact would be greater since the railcar movements generated by the project would be accommodated by existing trains.

---

[48] INCOG.
[49] U.S. Bureau of Labor Statistics for December 2019.
[50] U.S. Bureau of Economic Analysis (December 2013), *RIMS II, An Essential Tool for Regional Developers and Planners*, page 3-5.

Cost Savings to Sofidel's Customers.
Reducing Sofidel's logistics costs will result in a lower cost of goods. Should the company elect to pass on these savings, consumers may be able buy products at a lower cost. A lower cost of consumer products will benefit a much wider area than merely Rogers County, Oklahoma, but the magnitude of the benefit is difficult to quantify.

Further Economic Development.
Developing the rail infrastructure for Inola River-Rail Park will facilitate future development in the area. The site could accommodate and may attract additional manufacturers, distribution centers, and/or warehousing facilities to this economically distressed area.

Safety Improvements to At-grade Crossings.
The three at-grade crossings at South 4200 Road, South 4210 Road and South 4220 Road do not currently pose a safety hazard since trains do not travel the Inola spur. When rail traffic is introduced to these grade crossings, there will be a new potential for conflicts between trains and passenger vehicles. The Project includes adding flashing light signals and roadway markings as safety improvements to the at-grade crossings on these roadways, thereby minimizing the chance for accidents.

Appendix