Appendix N

Energy

This appendix provides technical information on the approach and results used in the analysis of energy resources *(Chapter 3, Section 3.8)*.

N.1 Approach

Based on the Board's environmental regulations, 49 C.F.R. § 1105.7(e)(4), there are four factors for considering energy resources in NEPA analyses: (1) effects on transportation of energy resources; (2) effects on recyclable commodities; (3) increases or decreases in overall energy efficiency; and (4) effects on freight diversions from rail to motor carriage. The approach for each of these factors is described below. OEA did not analyze the effect of the Proposed Acquisition on recyclable commodities and freight diversions from rail to motor carriage because the Applicants' Operating Plan did not indicate any changes in those two areas.

Below are the approaches for the various analyses conducted for energy resources:

- Effects on Transportation of Energy Resources: OEA considered the Applicants' proposed Operating Plan and traffic studies, commodities transported by CP and KCS in 2019 during a normal operational year, gross ton miles (GTM) for 2019, and other data sources as necessary.
- Increases or Decreases in Overall Energy Efficiency: Energy efficiency and fuel consumption effects of the Proposed Acquisition were estimated for single-line service; truck-to-rail diversions; operations at intermodal facilities; and vehicle delays at roadway/rail at-grade crossings (grade crossings). Effects on freight diversions were evaluated as part of the energy efficiency analysis. The energy analysis is consistent with data, approaches, and assumptions used in *Section 3.4, Truck-to-Rail Diversions, Section 3.5, Intermodal Facility Traffic, and Section 3.7, Air Quality and Climate Change.*
- Single-Line Service: To determine the impact of single-line service on energy efficiency, OEA followed the data and methodology for rail segment divisions as described in *Section 3.7, Air Quality and Climate Change*, and used information provided in the Applicants' Operating Plan. Note that single-line service was estimated, but not included in the overall energy efficiency analysis because the increase in fuel consumption on the CPKC rail lines would likely be offset by a decrease in fuel consumption on the rail lines of competing railroads.

- Truck-to-Rail Diversions: To determine the impact of truck-to-rail diversions on energy efficiency, OEA followed the data and methodology for truck-to-rail diversions as described in *Section 3.7, Air Quality and Climate Change*. Annual reduction in truck vehicle miles traveled (VMT) was provided by the Applicants and is consistent with the transportation analysis. Using the energy consumption factor of 0.018452369 metric million British thermal units (MMBtu) of energy used per mile, the VMT reduction was converted to a reduction in diesel energy consumption (MMBtu) per year. This energy value for diesel consumption was then converted to gallons of diesel using the conversion factor of 137,381 Btu per gallon as provided by the U.S. Energy Information Administration (2021).

  To account for the increase in rail operations as a result of the anticipated mode shift from truck to rail, and therefore accurately offset the substantial decrease in fuel use from truck VMT reduction, OEA used accepted fuel efficiency factors for truck and rail transport to determine the increase in rail fuel consumption that would correspond to a truck fuel reduction of 10,795,150 gallons per year. To do this, OEA used a truck to rail fuel efficiency ratio of 4:1, indicating that rail transport is approximately four times more fuel efficient than trucks transporting the same amount of material. The resulting increase in fuel consumption on the CPKC rail line as a result of truck-to-rail diversions would be 2,698,787 gallons per year compared to the No-Action Alternative. Therefore, truck-rail-diversions would comprise 7.3 percent of the total increase (36,909,385 gallons per year) in fuel consumption on the combined CPKC rail lines, with the remaining 92.7 percent resulting from rail-to-rail diversions. The 2,698,787 increase was combined with the decrease in truck fuel consumption (-10,795,150 gallons) for an overall change of -8,096,362 gallons.

- Intermodal Facilities: OEA used the data and assumptions described below to estimate the change in fuel consumption from intermodal facility vehicles, including dray trucking and the use of lift equipment and yard trucks. Changes in fuel consumption from operational changes at intermodal facilities were analyzed with focus on operational changes that would result from truck-to-rail diversions of intermodal freight. The increased energy use at the Applicants' intermodal facilities from rail-to-rail diversions of freight would be offset by a corresponding reduction in energy use at intermodal facilities operated by other railroads.

  OEA used the following Over-the-Road (OTR) truck data:

  - The Applicants' estimated changes in OTR trucks per day at intermodal facilities.
  - The Applicants' estimated average time that an OTR truck is present in an intermodal facility, derived from market research and used in the Air Quality analysis.
  - OTR trucks' energy consumption of 0.0965 MMBtu per hour (0.7 gallons per hour) while in an intermodal facility, based on the Air Quality analysis.
  - Operating days per year for each intermodal facility based on current operating schedules.
  - Truck-to-rail diversions would account for 22.8 percent of the total change in intermodal freight on the integrated CPKC rail system. This ratio was developed

using Applicant information on the number of diverted rail-to-rail containers and diverted truck-to-rail containers.

OEA used the following lift equipment data:

- The estimated change in the annual operating hours of lift equipment, which was derived from the estimated change in the number of primary lifts per year. The change in primary lifts per year was calculated from the change in primary lifts (origin/destination [O/D]+ switch lifts) per day that was provided by the Applicants and the operating days per year for each intermodal facility. The ratio of primary lifts to total lifts was estimated using an average of available data.
- Average lifts per hour, which were estimated for each intermodal facility based on 2019 handling data from the Applicants and current facility operating hours.
- Average fuel efficiency of lift equipment adapted from *Section 3.7, Air Quality and Climate Change* and converted to gallons per hour.
- Truck-to-rail diversions would account for 22.8 percent of the total change in intermodal freight on the integrated CPKC rail system.

OEA used the following yard truck data:

- Average fuel efficiency of yard trucks adapted from *Section 3.7, Air Quality and Climate Change* and converted to gallons per hour.
- Yard trucks make an average of 1.2 moves for each primary lift, using conservative values chosen for the Air Quality analysis.
- Yard trucks make an average of 4.5 moves per hour, based on yard work and rail work completed in an 8-hour shift in existing guidelines.
- Truck-to-rail diversions would account for 22.8 percent of the total change in intermodal freight on the integrated CPKC rail system.

- Vehicle Delays at Roadway/Rail At-Grade Crossings: The grade crossing analysis is consistent with the approach used in *Section 3.7, Air Quality and Climate Change*. OEA calculated total energy consumption (MMBtu) per year using the average vehicle delay and number of vehicles delayed per day for each Federal Railroad Administration crossing ID associated with the Proposed Acquisition. The total hours of delay were used to calculate total energy consumption based on the idle energy consumption conversion factor of 0.065596 MMBtu per hour, which was then converted to gallons of gasoline per year.

N.2 Results

Table N.2-1 through **Table N.2-4** below provide additional detailed information on changes in energy consumption.

Table N.2-1. Energy Changes from Truck-to-Rail Diversions

State	**Annual Truck Reduction (VMT)[1]**	**Diesel Energy Reduction (MMBtu/year)[2]**	**Diesel Energy Reduction (gallons/year)[3]**
Arizona	-606,268	-11,187	-81,431
Arkansas	-3,094,745	-57,105	-415,672
California	-257,799	-4,757	-34,626
Colorado	-225,090	-4,153	-30,233
Idaho	-91,499	-1,688	-12,290
Illinois	-8,637,622	-159,385	-1,160,165
Indiana	-2,393,629	-44,168	-321,501
Iowa	-5,243,207	-96,750	-704,243
Kansas	-3,204,537	-59,131	-430,418
Kentucky	-2,347,935	-43,325	-315,364
Michigan	-3,818,716	-70,464	-512,912
Minnesota	-2,099,572	-38,742	-282,005
Missouri	-12,228,607	-225,647	-1,642,489
Montana	-581,672	-10,733	-78,127
Nebraska	-130,578	-2,409	-17,539
Nevada	0	0	0
New Mexico	-1,206,426	-22,261	-162,041
New York	0	0	0
North Dakota	0	0	0
Ohio	-1,315,116	-24,267	-176,640
Oklahoma	-11,392,073	-210,211	-1,530,130
Oregon	-69,499	-1,282	-9,335
Pennsylvania	0	0	0
South Dakota	0	0	0
Tennessee	-768,071	-14,173	-103,164
Texas	-20,096,753	-370,833	-2,699,301
Utah	-13,853	-256	-1,861
Vermont	0	0	0
Washington	-77,567	-1,431	-10,418
Wisconsin	0	0	0
Wyoming	-470,876	-8,689	-63,246
Truck Reductions	-80,371,710	-1,483,048	-10,795,150
Rail Increases	-	-	2,698,787
TOTAL	-	-	**-8,096,362**

[1] Annual Truck VMT Reduction was provided from the transportation study which adapted analysis from the Verified Statement of Bengt Muten (2021).
[2] Diesel energy reduction calculated as part of *Section 3.7, Air Quality and Climate Change.*
[3] Conversion factor used for gallons of diesel from British thermal units (Btu) was 137,381 Btu for 1 U.S. gallon (U.S. Energy Information Administration 2021).

Table N.2-2. Changes in Energy Consumption at Intermodal Facilities, OTR Trucks

Facility	County	State	Change in OTR Trucks per Day	Operating Days/Year[1]	Average Time Truck Spends at Intermodal Facility (minutes/ truck)[2]	Hour/ Minute Conversion	OTR Truck Fuel Consumption at Intermodal Facility (MMBtu/ hour)[3]	OTR Truck Fuel Consumption at Intermodal Facility (gallons/ hour)[4]	Percentage of Total Change in Intermodal Freight from Truck-to-Rail Diversions[5]	Change in Fuel Consumption from OTR Trucks at Intermodal Facilities (gallons/ year)
Bensenville IMS	Cook	IL	315	365	34	0.0167	0.0965	0.7025	22.8%	10,439
Detroit Container Terminal	Wayne	MI	87	313	34	0.0167	0.0965	0.7025	22.8%	2,472
Minneapolis IMS	Hennepin	MN	53	313	34	0.0167	0.0965	0.7025	22.8%	1,506
Schiller East IMS	Cook	IL	134	365	34	0.0167	0.0965	0.7025	22.8%	4,441
Intl Freight Gateway	Jackson	MO	53	313	34	0.0167	0.0965	0.7025	22.8%	1,506
Wylie	Collin	TX	148	365	34	0.0167	0.0965	0.7025	22.8%	4,905
Total Change in Fuel Consumption from OTR Trucks at Intermodal Facilities (gallons/year)										25,269

[1] Annual Operating Days at each intermodal facility estimated based on the current operating schedules.
[2] Each truck assumed to dwell 34 minutes at the intermodal facility, based on Lindhjem (2008) and Souten and Lindhjem (2006).
[3] OTR Truck Fuel Consumption at Intermodal Facilities (MMBtu/hour) adapted from *Section 3.7, Air Quality and Climate Change* where MOVES total energy consumption rate used for combo long haul vehicles.
[4] Conversion factor used for gallons of diesel from Btu was 137,381 Btu for 1 U.S. gallon (U.S. Energy Information Administration 2021).
[5] Percentage of Total Change in Intermodal Freight from Truck-to-Rail Diversions calculated based on “Estimated Volume of Existing 2019 Rail Traffic Flows Diverted to CP/KCS” found in Table 1[3]: Summary of 2019 Rail-to-Rail Diversions Likely to Occur Due to CP/KCS Combination in the Applicants’ Operating Plan (216,675 intermodal containers) and estimate from the Verified Statement of Bengt Muten (2021) regarding diverted truck-to-rail containers (64,018 intermodal containers). This total only considers truck-to-rail and rail-to-rail diversion effects on intermodal freight, not post-Acquisition changes in traffic patterns or investments by CPKC in growth opportunities made available by a combined CPKC network.

Table N.2-3. Changes in Energy Consumption at Intermodal Facilities, Lift Equipment

Facility	State	Lift Equipment Types	Change in Primary Lifts per Day	Operating Days/ Year[1]	Change in Primary Lifts per Year	Total Lifts per Primary Lift[2]	Avg Hourly Lifts (Lifts/ hour)[3]	Fuel Efficiency of Avg Lift Equip-ment (grams/ hour)[4]	Fuel Efficiency of Avg Lift Equip-ment (gallons/ hour)[5]	Percentage of Total Change in Intermodal Freight from Truck-to-Rail Diversions[6]	Change in Fuel Consumption from Lift Equipment at Intermodal Facilities (gallons/ year)
Bensenville IMS	IL	Forklifts/ Sideloaders	421	365	153,665	2.14	28.6	5,880.62	1.76	22.8%	4,626
Detroit Container Terminal	MI	Forklifts/ Sideloaders	92	313	28,796	2.14	9.1	5,880.18	1.76	22.8%	2,725
Minneapolis IMS	MN	Forklifts/ Sideloaders	86	313	26,918	2.14	15.5	5,879.47	1.76	22.8%	1,495
Schiller East IMS	IL	Forklifts/ Sideloaders	166	365	60,590	2.14	28.6	5,880.62	1.76	22.8%	1,824
Intl Freight Gateway	MO	Forklifts/ Sideloaders	101	313	31,613	2.14	6.8	5,880.70	1.76	22.8%	4,003
Wylie	TX	Aerial Lift Gantries	263	365	95,995	2.14	23.5	469.77	0.14	22.8%	281
Total Change in Fuel Consumption from Lift Equipment at Intermodal Facilities (gallons/year)											14,954

[1] Annual Operating Days at each intermodal facility estimated based on the current operating schedules.
[2] Ratio of Primary (O/D+Switch) Lifts to Total lifts estimated using an average of available data.
[3] Average Hourly Lifts estimated based on 2019 handling data in application and current facility operating hours.
[4] Fuel Efficiency of Average Lift Equipment (grams/hour) adapted from nonroad fuel consumption rate used at part of *Section 3.7, Air Quality and Climate Change*.
[5] Conversion factor used for gallons of diesel from grams was 100 grams Btu for 0.03 U.S. gallons (U.S. Department of Energy).
[6] Percentage of Total Change in Intermodal Freight from Truck-to-Rail Diversions calculated based on "Estimated Volume of Existing 2019 Rail Traffic Flows Diverted to CP/KCS" found in Table 1[3]: Summary of 2019 Rail-to-Rail Diversions Likely to Occur Due to CP/KCS Combination in the Applicants' Operating Plan [216,675 intermodal containers] and estimate from the Verified Statement of Bengt Muten (2021) regarding diverted truck-to-rail containers [64,018 intermodal containers]. This total only considers truck-to-rail and rail-to-rail diversion effects on intermodal freight, not post-Acquisition changes in traffic patterns or investments by CPKC in growth opportunities made available by a combined CPKC network.

Table N.2-4. Changes in Energy Consumption at Intermodal Facilities, Yard Trucks

Facility	**County**	**State**	**Change in Primary Lifts per Year**	**Moves per Primary Lift[1]**	**Moves per Hour[2]**	**Fuel Efficiency of Avg Yard Truck/Terminal Tractor (grams/hour)[3]**	**Fuel Efficiency of Avg Yard Truck (gallons/hour)[4]**	**Percentage of Total Change in Intermodal Freight from Truck-to-Rail Diversions[5]**	**Change in Fuel Consumption from Yard Trucks at Intermodal Facilities (gallons/year)**
Bensenville IMS	Cook	IL	153,665	1.2	4.5	9,726.60	2.918	22.8%	27,271
Det Con Term	Wayne	MI	28,796	1.2	4.5	9,726.40	2.918	22.8%	5,110
Minneapolis IMS	Hennepin	MN	26,918	1.2	4.5	9,729.39	2.919	22.8%	4,778
Schiller East IMS	Cook	IL	60,590	1.2	4.5	9,726.60	2.918	22.8%	10,753
Intl Freight Gateway	Jackson	MO	31,613	1.2	4.5	9,729.87	2.919	22.8%	5,612
Wylie	Collin	TX	95,995	1.2	4.5	9,727.03	2.918	22.8%	17,037
Total Change in Fuel Consumption from Yard Trucks at Intermodal Facilities (gallons/year)									70,561

[1] Truck moves per primary lift assumed to be 1.2 using conservative value in the range provided by Lindhjem (2008).
[2] Truck moves per hour assumed to be 4.5, estimated based on yard work and rail work completed in an 8-hour shift (The Port of Long Beach and The Port of Los Angeles 2017).
[3] Fuel Efficiency of Average Yard Truck (grams/hour) adapted from nonroad fuel consumption rate used at part of *Section 3.6, Air Quality and Climate Change*.
[4] Conversion factor used for gallons of diesel from grams was 100 grams Btu for 0.03 U.S. gallons (U.S. Department of Energy).
[5] Percentage of Total Change in Intermodal Freight from Truck-to-Rail Diversions calculated based on "Estimated Volume of Existing 2019 Rail Traffic Flows Diverted to CP/KCS" found in Table 1[3]: Summary of 2019 Rail-to-Rail Diversions Likely to Occur Due to CP/KCS Combination in the Applicants' Operating Plan [216,675 intermodal containers] and estimate from the Verified Statement of Bengt Muten (2021) regarding diverted truck-to-rail containers [64,018 intermodal containers]. This total only considers truck-to-rail and rail-to-rail diversion effects on intermodal freight, not post-Acquisition changes in traffic patterns or investments by CPKC in growth opportunities made available by a combined CPKC network.

References

Lindhjem, Christian. 2008. "Intermodal Yard Activity and Emissions Evaluations." *ENVIRON International Corporation*. 1-15. https://www3.epa.gov/ttn/chief/conference/ei17/session11/lindhjem.pdf.

Mutén, Bengt. 2021. "Verified Statement of Bengt Mutén." In Docket No. FD 36500, Canadian Pacific Railway Limited et al. Control – Kansas City Southern et al. Railroad Control Application Volume 2 of 4. Mutén V.S., page 1-32.

Souten, Dave and Christian Lindhjem. 2006. "Los Angeles – Hobart Railyard TAC Emissions Inventory." ENVIRON International Corporation. 1-1-8.2. https://ww2.arb.ca.gov/sites/default/files/classic/railyard/hra/env_hob_ei122006.pdf.

The Port of Long Beach and The Port of Los Angeles. 2017. "Zero/Near-zero Emissions Yard Tractor Testing & Demonstration Guidelines." The Port of Long Beach and the Port of Los Angeles. https://sustainableworldports.org/wp-content/uploads/CAAP-Yard-Tractor-testing-and-demonstration-document.pdf.

U.S. Energy Information Administration. 2021. "Units and calculators explained: Energy conversion calculators." Last modified May 12, 2021. https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php.