ATTACHMENT A

EXPERT REBUTTAL REPORT OF JILL STEINER (APR. 8, 2022)

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF WISCONSIN

BAD RIVER BAND OF THE LAKE SUPERIOR TRIBE OF CHIPPEWA INDIANS OF THE BAD RIVER RESERVATION *Plaintiff,* v. ENBRIDGE ENERGY COMPANY, INC., and ENBRIDGE ENERGY, L.P. *Defendants*	Case No. 3:19-cv-00602-wmc Judge William M. Conley Magistrate Judge Stephen L. Crocker
ENBRIDGE ENERGY COMPANY, INC., and ENBRIDGE ENERGY, L.P. *Counter-Plaintiff,* v. BAD RIVER BAND OF THE LAKE SUPERIOR TRIBE OF CHIPPEWA INDIANS OF THE BAD RIVER RESERVATION and NAOMI TILLISON, in her official capacity *Counter-Defendants*	

EXPERT REBUTTAL REPORT OF

JILL STEINER

April 8, 2022

Note: Portions of this report may contain information designated as confidential by Enbridge pursuant to the stipulated protective order in *Bad River Band of the Lake Superior Tribe of Chippewa Indians of the Bad River Reservation v. Enbridge Energy Company, Inc.*, Case No. 3:19-cv-00602-wmc (Dkts. 49, 50).

1. My name is Jill Steiner. I am Founder and Lead Researcher at Saldo Research, L.L.C., which I founded in 2020. Saldo Research is a consulting practice that provides facilitation, quantitative and qualitative analysis, training, and evaluation for the clean energy industry.
2. From 2016 to 2020, I held the position of Director of Evaluation and since then have worked as an Affiliated Consultant at Public Sector Consultants (PSC). At PSC, I led a program to support objective-driven program and policy development, overseeing project evaluators, providing oversight on methodology and metrics, and guiding data collection and development of actionable recommendations. My projects included, among others, the evaluation of the impact of Michigan's energy bill assistance program and rate design for low-income customers; market assessment of demand response and time-of-use rates for large commercial and industrial customers; determination of propane supply adequacy and risk mitigation strategies for the State of Michigan; and energy needs assessment for rural and agricultural communities.
3. I previously held positions as Economic Analyst for the Michigan and Maryland Public Service Commissions (1988-1993); Planning and Evaluation Lead/Senior Program Manager for the Tennessee Valley Authority (1993-2001); Project Director for Quantec, now known as Cadmus (2001-2006); Manager of Planning and Economic Analysis for Energy Trust of Oregon (2006-2007); Manager of Planning and Evaluation for Snohomish County Public Utility District (2007-2011); and Principal for Cadmus (2012-2016).

4. While at PSC, I authored a technical report titled "Analysis of Propane Supply Alternatives for Michigan," which was prepared for the Michigan Department of Environment, Great Lakes, and Energy (EGLE). That report can be found in Appendix III to EGLE's April 17, 2020 "Upper Peninsula Energy Task Force Recommendations: Part I – Propane Supply."

In the report, I explained available options for supplying required propane volumes should any potential supply disruptions occur in the State of Michigan, the impacts of any disruptions, and how Michigan can prepare for such disruptions. Multiple scenarios were studied, including a scenario in which Enbridge's Line 5 pipeline was disrupted.

5. I earned a Bachelor of Arts (B.A.) degree in Economics with emphasis in Industry Organization from Michigan State University, and a Master of Science (M.S.) in Applied Economics with emphasis in Public Policy from Johns Hopkins University. I also hold certificates in Mixed Methods Research from the University of Michigan and in Diversity and Inclusion from Cornell University.

6. I am a current member of the Michigan State University Institute of Public Utilities Advanced Regulatory Studies Faculty and have been a member since 2015.

7. My past professional associations include that I was the Certified Energy Manager for the Association of Energy Engineers (1999); a member of the Northwest Energy Efficiency Alliance Resource Cost and Impact Advisory Committee (2007-2012); a voting member of the Regional Technical Forum of the Northwest Power and Conservation Council (2007-2012); a member of the Michigan Senate Energy Efficiency and Renewables Legislative Workgroup (2014-2016); and a member of the Roadmap to Implementing Michigan's Energy Future Stakeholder Workgroup (2015-2016).

8. A list of all articles I have authored for third-party publications in the past ten years is included in my CV at Exhibit 1.

9. Within the previous four years, I have not served as an expert witness at trial or by deposition.

10. I am being compensated at $292 per hour for my research and $358 per hour for my testimony on this matter. My compensation in no way depends on the outcome of this case.

11. The Bad River Band of the Lake Superior Tribe of Chippewa Indians of the Bad River Reservation (the “Band” or “Plaintiff”) has filed a suit seeking a declaratory judgment that Enbridge’s continued use of Line 5 across the Bad River Reservation constitutes a public nuisance and a trespass, and an order of ejectment and an injunction requiring Enbridge to cease the operation of Line 5 on the Reservation and to remove it safely from the Reservation.[1]

12. I have been asked by the Band to review the expert reports submitted on January 31, 2022, by Neil Earnest from Muse Stancil, Dr. Corbett Grainger from the University of Wisconsin, and William J. Rennicke from Oliver Wyman Inc. and to provide any rebuttal opinion with respect to Mr. Earnest’s, Dr. Grainger’s and Mr. Rennicke’s analysis of the impacts on the propane and butane markets served by natural gas liquids (NGLs) from Enbridge’s Line 5 in the event of a closure of the pipeline.

13. A complete statement of the opinions that I will express in this matter and the basis and reasons for them can be found in Exhibit 2. I have been assisted in my work on this matter by PSC consultants.

14. The exhibits that I will use to summarize or support them can also be found in Exhibit 2.

15. A list of materials that I have considered in forming the opinions for this report can be found in Exhibit 2 (References).

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[1] Third Amended Complaint at 60, *Bad River Band of the Lake Superior Tribe of Chippewa Indians of the Bad River Reservation v. Enbridge Energy Company, Inc.*, Case No. 3:19-cv-00602-wmc (W.D. Wisc.).

16. My Expert Rebuttal Report, and the opinions expressed in it, are based on my analysis of the information and materials available to me as of April 8, 2022. As new information becomes available, I reserve the right to supplement and amend my opinions as necessary.

I declare under penalty of perjury that the foregoing is true and correct.

Jill Steiner

April 8, 2022

EXHIBIT 1

Jill Steiner

Education

Michigan State University, BA in Economics
Johns Hopkins University, MS in Applied Economics

Professional Experience

2020–present **Founder and Lead Researcher,** *Saldo Research LLC.* Founder of a consulting practice that provides facilitation, quantitative and qualitative analysis, training, and evaluation for the clean energy industry. Focus on assisting clients to create clear program and policy objectives, develop meaningful metrics to track progress toward objectives, collect and analyze data, and determine appropriate investments in research and organizational learning to support strategic decision making and effective action. Supports development of regulatory strategies; prepares regulatory filings, testimony, and discovery responses; engages stakeholders to build consensus on policies and practices to ensure reliable, affordable, and environmentally responsible energy resources.

2016–present **Director of Evaluation/Affiliated Consultant,** *Public Sector Consultants,* Lansing, MI. Led an emerging practice area designed to support objective-driven program and policy development through strategic planning, identification and tracking of meaningful metrics, and commitment to continuous improvement. Oversaw project evaluators, provided oversight on methodology and metrics, and guided data collection and development of actionable recommendations. Selected projects include evaluation of the impact of the Michigan's energy bill assistance programs and rate design for low-income customers; market assessment of demand response and time-of-use rates for large commercial and industrial customers; needs assessment for Deaf, DeafBlind, and Hard of Hearing residents across Michigan; evaluation of community development activities in Detroit; determination of propane supply adequacy and risk mitigation strategies for the State of Michigan; energy needs assessment for rural and agricultural communities.

2012–2016 **Principal,** *Cadmus*, Lansing, Michigan. Led a policy team that tracked trends in the utility regulatory environment related to energy efficiency, changing infrastructure, distributed resources, expansion of advanced metering, and increasing climate regulation. Managed multiyear evaluations for energy-efficiency and demand response portfolio offerings of a large dual-fuel utility in Michigan to assess compliance with regulatory targets, impact on customers, environmental impacts, and opportunities for improvement. Active participant and frequent presenter at the Michigan Public Service Commission stakeholder meetings to set research agendas, engage stakeholders, and promote common understanding of clean energy policies and practices

2007–2011 **Manager of Planning and Evaluation,** *Snohomish County Public Utility District*, Everett, Washington. Managed analytical staff to provide program planning and evaluation for the

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district's energy-efficiency and customer renewable programs. Assessed the available energy-efficiency and conservation resources available within Snohomish County based on development of new technologies, programmatic focus, and market response. Supported the development of a biannual integrated resource plan and strategic plan. Represented the District in regional policy-making forums related to development of clean energy resources, planning for improved environmental performance, and resource adequacy. Provided tracking, analysis and reporting to demonstrate compliance with state regulations and contributions to regional goals and objectives.

2006–2007 **Manager of Planning and Economic Analysis**, *Energy Trust of Oregon*, Portland, Oregon. Managed the trust's processes and policies for resource forecasting as well as cost-effectiveness analysis of energy-efficiency and renewable resources. Acted as liaison with utilities to integrate the Trust's impacts in resource plans and to determine cost-effective levels of investment above the legislated systems benefits charge. Coordinated reporting of projected and achieved impacts to utilities, regulators, and other stakeholders.

2001–2006 **Project Director,** *Quantec (now Cadmus)*, Portland, Oregon. Assessed energy-efficiency potential, developed energy-efficiency program/portfolio plans, and evaluated energy-efficiency program delivery and impacts for dozens of clients. Led multi-year evaluations for utilities, program implementers, state agencies, and regional associations.

1993–2001 **Planning and Evaluation Lead/Senior Program Manager**, *Tennessee Valley Authority*, Nashville, Tennessee. Developed and implemented evaluation plans designed to assess market performance, refine delivery processes, and measure impacts of the Tennessee Valley Authority's (TVA) customer service, conservation, and renewable programs. Designed and launched new energy services business initiative for TVA. Developed internal systems to manage and measure new business performance. Managed stakeholder input process for TVA's integrated resource planning process and worked with diverse groups to determine appropriate investments in energy efficiency, demand response, and renewable energy.

1988–1993 **Economic Analyst**, *Michigan and Maryland Public Service Commissions*, Lansing, Michigan and Baltimore, Maryland. Reviewed utility energy efficiency plans and integrated resource plans. Developed staff position on resource selection, cost-effectiveness screening, cost allocation and recovery, rate design, and monitoring and evaluation of impacts. Testified as an expert witness on the reasonableness of program plans, cost recovery, appropriate financial incentives to encourage utility investment in clean energy technologies.

Professional Associations and Certifications

- Roadmap to Implementing Michigan's Energy Future Stakeholder Workgroup, 2015 to 2016
- Michigan Senate Energy Efficiency and Renewables Legislative Workgroup, 2014 to 2016
- Voting Member of the Regional Technical Forum for the Northwest Power and Conservation Council, 2007 to 2012
- Northwest Energy Efficiency Alliance Resource Cost and Impact Advisory Committee Member, 2007 to 2012

- Michigan State University Institute of Public Utilities Advanced Regulatory Studies Faculty, 2015 to present
- Association of Energy Engineers—Certified Energy Manager, 1999
- University of Michigan—Certificate in Mixed Methods Research, 2017
- Cornell University—Diversity and Inclusion Certificate, 2021

Selected Publications and Presentations

- “The Start of the Journey: Keys to Developing a DEI Strategy.” with Quinn Parker. Training delivered October 2021 for EUCI.
- “Quantifying Health Impacts from Weatherization and Home Improvement.” Presentation delivered June 2021 at the Michigan Sustainability Conference, Lansing, MI.
- “Energy Efficiency Markets and Evaluation. Michigan State University.” Training delivered annually for the Institute of Public Utilities Advanced Regulatory Studies: East Lansing, MI.
- “DSM in the Rate Case,” with Brian Hedman. January 2013. Public Utilities Fortnightly.
- “Bridging the Gap: Moving from Planning to Programs.” Presentation delivered September 2009 at the American Council for an Energy Efficient Economy National Conference on Energy Efficiency as a Resource, Chicago, IL.

EXHIBIT 2

The Impact on Propane and Butane Supplies, Regional Economy, and Environment from the Shutdown of Line 5

April 8, 2022

PSC

PUBLIC SECTOR CONSULTANTS

Prepared by

Public Sector Consultants
www.publicsectorconsultants.com

In partnership with

Jill Steiner
Saldo Research

Prepared for

Bad River Band of the Lake Superior Tribe of Chippewa Indians of the Bad River Reservation

Table of Contents

Introduction

The Bad River Band of the Lake Superior Tribe of the Chippewa Indians retained Public Sector Consultants (PSC) to analyze certain portions of the expert witness reports submitted by Mr. Neil K. Earnest, Mr. William Rennicke, and Dr. Corbett Grainger on behalf of the Enbridge defendants in a dispute over the continued operation of Enbridge's Line 5 on the Bad River Reservation. The Enbridge experts offer opinions regarding the effects on the propane and butane markets were Line 5 to shut down as well as on corresponding implications for the regional economy, and it is those opinions to which PSC responds.

Line 5 carries natural gas liquids (NGLs), of which propane and butane are the primary components, and crude oil from Superior, Wisconsin, to Sarnia, Ontario, and in doing so, traverses the Bad River Reservation in northern Wisconsin. PSC's conclusions about the opinions on the propane and butane markets offered by the Enbridge experts are based on analysis of public information and their expert reports. In addition, PSC has analyzed Dr. Grainger's analysis of the impacts of a Line 5 shutdown on the regional economy and jobs using IMPLAN, a nationally recognized input-output model that measures economic impacts and job levels based on industry activities.

Where appropriate, PSC acknowledges areas of agreement and differences in analytical methods, results of analyses, and opinions with Mr. Earnest, Mr. Rennicke, and Dr. Grainger.

Section One: Summary of Conclusions

- In contrast to the reports of Mr. Earnest and Mr. Rennicke, PSC concludes that there exist viable propane supply alternatives for Wisconsin, Michigan, and Ontario at a modest cost increase in the short term and minimal cost increase in the long term.
    - In addition to supply options that originate from alternate locations, there are alternate modes of transportation for propane originating in Edmonton (currently transported by Line 5).
    - Transporting propane or butane to the region rather than NGLs will streamline the supply chain and offer retailers more options for procuring propane.
    - PSC estimates cost impacts that are lower than or comparable to those presented by Mr. Earnest across scenarios considered, and PSC finds those impacts to be minimal or modest when considered in the context of the regional market and historical price variation.
- In contrast to Mr. Rennicke's report, PSC concludes that rail and trucking are feasible modes of transportation for propane and butane with appropriate planning and infrastructure investments.
    - While Mr. Rennicke assumes shipping destination is concentrated in Sarnia (and other fractionators), finished propane and butane can be shipped to various locations, often closer to where products are used.
    - Supply and transportation diversity can address some of the transportation constraints posited by Mr. Rennicke.
- Dr. Grainger overstates the economic impact of closing any of the fractionators that currently draw NGLs from Line 5 by using improper inputs for the IMPLAN model. He also fails to offset the impacts

from closure of fractionators with the positive impacts from labor associated with rail and truck transport.

- While PSC is able to conclude that the greenhouse gas emissions associated with truck transportation vastly exceed those associated with rail, it is not able to compare rail or truck to the emissions associated with pipeline transportation due to lack of publicly available data. However, PSC is able to conclude that the emissions associated with any of these modes of transportation are overshadowed by the emissions associated with consumption of the product being transported.

PSC has organized this report as follows:

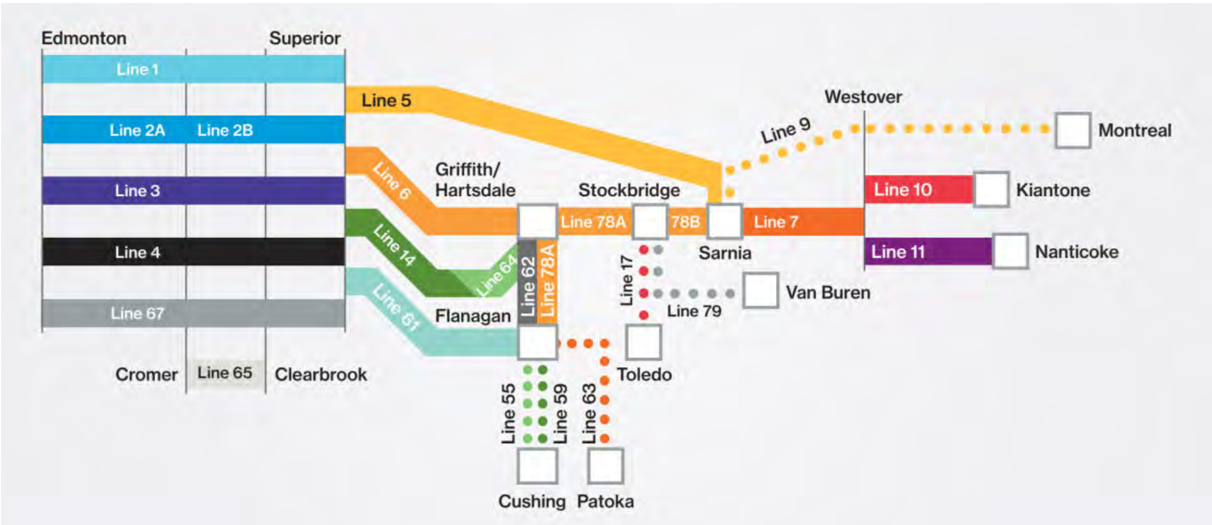
- Assessment of the National, Regional, and Local Propane and Butane Markets
- Identification and Costing of Alternative Supply and Transportation Options
- Considerations of Rail and Trucking Feasibility
- Review of Economic Impacts from Fractionator Closures
- Environmental Impacts of Transportation Options

Section Two: Assessment of the National, Regional, and Local Propane and Butane Markets

Background

Line 5 forms part of Enbridge's Mainline System, which originates in Edmonton, Alberta, and transports crude oil, NGLs, and other refined products to the Midwest. Exhibit 1 illustrates the Enbridge Mainline System.

EXHIBIT 1. Enbridge Mainline System



Source: Enbridge 2019

Line 5 has a rated capacity of 540,000 barrels per day (b/d). According to Mr. Earnest's expert report, Line 5 transported approximately 446,000 b/d of crude oil and 80,300 b/d of NGLs in 2019, indicating operation at 97 percent of capacity. NGLs accounted for just over 15 percent of the total amount transported during that period. Line 5 delivers NGLs to fractionators in Rapid River, Michigan, and Sarnia, Ontario, and Line 5 also supports operation of a fractionator in Superior, Wisconsin by receiving butane once propane has been separated from NGLs delivered by Line 1, part of the Mainline System that runs from Edmonton, Alberta to Superior. All three of the fractionator facilities are owned and operated by Plains Midstream Canada; Mr. Earnest states that all three of the fractionators will close if Line 5 is shutdown. Exhibit 2 shows the output at each facility.

EXHIBIT 2. Propane and Butane Production at Fractionators Served by or Adjacent to Line 5 (2019)

Fractionator	Output
Superior, WI	[redacted]
Rapid River, MI	[redacted]
Sarnia, ON	[redacted]
Totals	[redacted]

Source: Earnest, Expert Report, 17–19.

Sarnia propane production is directly tied to Michigan through a series of pipelines that cross the Detroit River into the state, supplying propane and other products to storage capacity in Marysville and St. Clair, Michigan. Because propane deliveries from Sarnia flow through designated pipelines, it is possible to track how much propane is imported into Michigan. The average annual volume shipped into Michigan from Sarnia amounts to approximately [redacted] b/d.[1,2] Overall, Line 5 contributes [redacted] b/d of propane to the U.S. and [redacted] b/d of Canadian supply.

In his expert report, Mr. Earnest states that closure of Line 5 will have significant or severe consequences for the Upper Midwest and Ontario. While he does not define what he means by significant or severe impacts, PSC disagrees about (1) the level of impact consumers in these areas will face, and/or (2) that the level of impact Mr. Earnest projects would be significant or severe. PSC identifies supply alternatives for propane and butane and estimates the cost impacts as modest (less than 5 percent impact on prices or temporary impacts that occur while long-term supply arrangements are made to replace Line 5) or minimal (less than 2 percent impact on prices).

In assessing Mr. Earnest's opinion through analysis of NGL supply alternatives and the capacity of the market to respond to closure of Line 5, PSC examined NGL production; propane and butane production

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[1] Public Sector Consultants. March 2020. *Analysis of Propane Supply Alternatives for Michigan*. Lansing: Public Sector Consultants. Accessed April 6, 2022. https://www.michigan.gov/documents/egle/egle-psc-upetf-Report_Analysis_of_Propane_Supply_Alternatives_for_Michigan_683751_7.pdf

[2] Mr. Earnest states on page 19 of his expert report that Plains West Canada, majority owner of the fractionator, reported sales of [redacted] b/d but acknowledges that this does not include sales from other companies with ownership interest in Sarnia or sales from marketers. In the report for the Upper Peninsula Energy Task Force (PSC, Analysis of Propane Supply Alternatives, 47), PSC estimated sales from Sarnia to Michigan based on volume from designated pipelines. Since the PSC estimate is higher and hence more conservative, and since Earnest indicates the estimate from Plains is understated, PSC uses the higher value for this analysis.

and consumption in the U.S., Canada, and the Upper Midwest; and fractionation capacity in North America.

Propane Supply and Consumption

Natural Gas Liquids

NGLs are a group of hydrocarbons that includes ethane, propane, butane, isobutane, and natural gasoline. NGLs are extracted as a byproduct of natural gas and oil production, with natural gas production accounting for approximately 90 percent of NGL extractions. Field production, generally, refers to production of NGLs from natural gas processing, and refinery production occurs as part of oil production.[3] When extracted from a well, natural gas is mixed with other hydrocarbons, including NGLs that must be separated from the natural gas for the natural gas to be marketable. The separated NGLs are sometimes discarded, or they can be further processed.[4] The components of NGLs have a wide variety of uses as shown in Exhibit 3.[5]

EXHIBIT 3. Composition and Uses of NGLs

	NGLs	Chemical Formula	Uses	Product End Use	End-use Sectors
Lighter	**Ethane**	C_2H_6	Petrochemical feedstock for ethylene production, power generation	Plastics, antifreeze, detergents	Industrial
	Propane	C_3H_8	Fuel for space heating, water heating, cooking, drying, and transportation; petrochemical feedstock	Fuel for heating, cooking, and drying; plastics	Industrial (includes manufacturing and agriculture), residential, commercial, and transportation
	Butanes (normal butane and isobutane)	C_4H_{10}	Petrochemical and petroleum refinery feedstock, motor gasoline blending	Motor gasoline, plastics, synthetic rubber, lighter fuel	Industrial and transportation
Heavier	**Natural gasoline (pentanes plus)**	Mix of C_5H_{12} and heavier	Petrochemical feedstock, additive to motor gasoline, diluent for heavy crude oil	Motor gasoline, ethanol denaturant, solvents	Industrial and transportation

Source: U.S. EIA April 2012

[3] U.S. Energy Information Administration (EIA). n.d.a. "Definitions, Sources, and Explanatory Notes." *Petroleum & Other Liquids.* Accessed April 4, 2022. https://www.eia.gov/dnav/pet/TblDefs/pet_pnp_gp_tbldef2.asp

[4] Michael Ratner. October 26, 2018. "Natural Gas Liquids: The Unknown Hydrocarbons." *EveryCRSReport.com.* Accessed April 4, 2022. https://www.everycrsreport.com/reports/R45398.html#:~:text=NGLs%20are%20extracted%20as%20byproducts,them%20NGLs%E2%80%94and%20various%20impurities.

[5] U.S. Department of Energy. December 2017. *Natural Gas Liquids Primer: With a Focus on the Appalachian Region.* Accessed April 4, 2022. https://www.energy.gov/sites/prod/files/2017/12/f46/NGL%20Primer.pdf

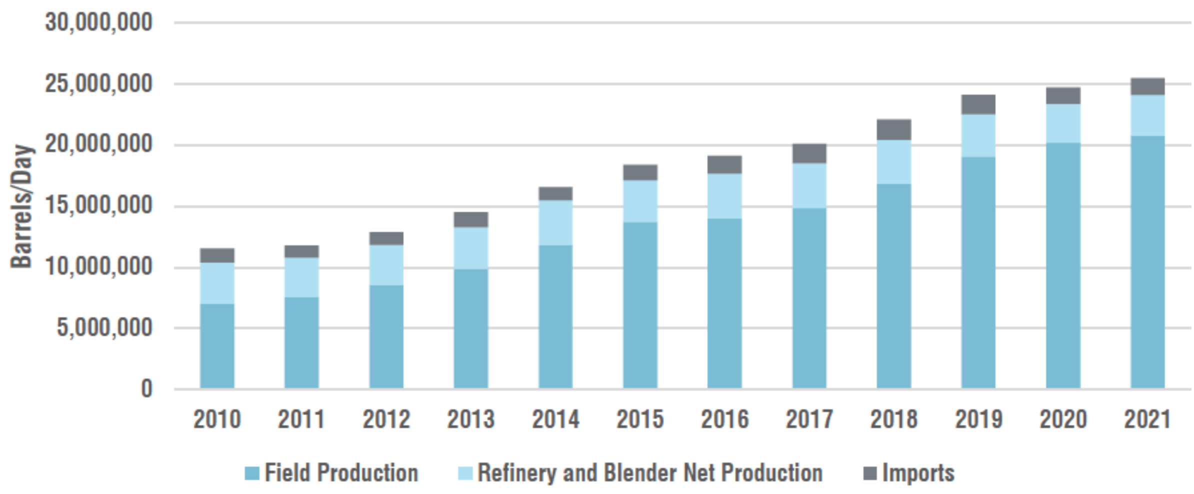
Once separated from natural gas, NGLs are further processed or separated into the various components. Fractionation is one of the processes used to separate NGLs into distinct products, or fractions, such as propane, butane, and ethane.[6]

Ethane typically makes up the highest percentage of NGLs, but the NGLs transported by Line 5 are composed of approximately 70 percent propane, 26 percent butane, 3 percent ethane, and 1 percent natural gasoline.[7,8]

U.S. Propane Supply and Consumption

From 2000 to 2020, NGL production in the United States grew by 170 percent.[9] Consistent with the growth in NGL production, U.S. propane production has more than doubled since 2010, growing from 900,000 b/d in 2010 to over 2 million b/d in 2021. This growth has been driven in large part by a substantial increase in natural gas processing.[10] Natural gas processing accounted for 86 percent of propane production nationwide in 2021. In addition to production, U.S. propane supply includes imports, though imports as a percentage of supply have declined from 9.6 percent in 2010 to 5.3 percent in 2019. Annual propane supply (encompassing production and imports) is shown in Exhibit 4.[11]

EXHIBIT 4. U.S. Propane Production and Imports, 2010–2021



Source: U.S. EIA March 31, 2022a

[6] U.S. Energy Information Administration. n.d.b. "Fractionation." *Glossary*. Accessed April 4, 2022. https://www.eia.gov/tools/glossary/index.php?id=fractionation

[7] Anne Keller. June 6, 2012. "NGL 101—The Basics." Presentation. Accessed March 30, 2022. https://www.eia.gov/conference/ngl_virtual/EIA-NGL_workshop-Anne-Keller.pdf

[8] Earnest, Expert Report, 27.

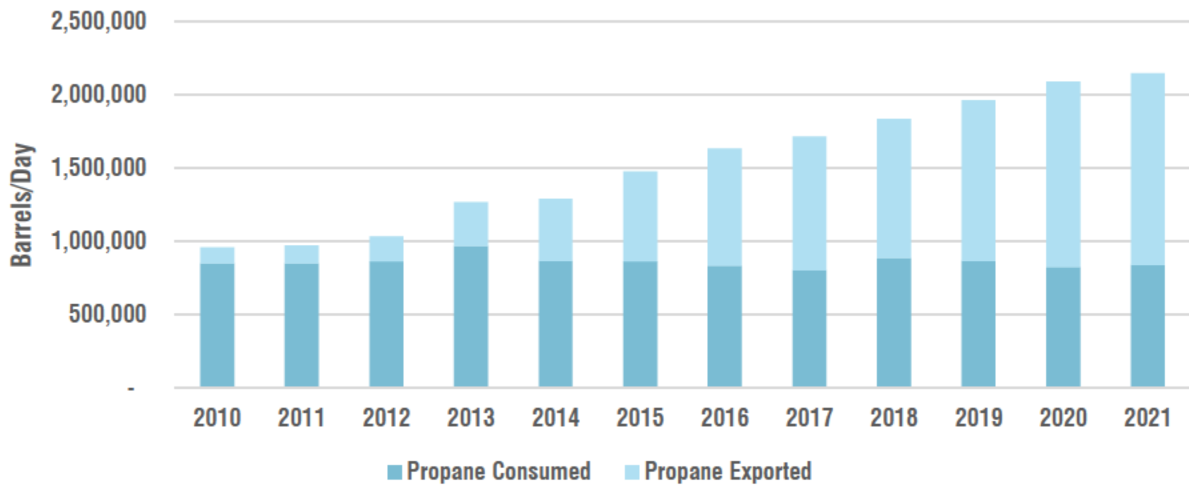
[9] U.S. EIA. January 11, 2021. "U.S. Natural Gas Plant Liquids, Reserves Based Production." *Natural Gas*. Accessed April 4, 2022. https://www.eia.gov/dnav/ng/hist/rl2r55nus_1a.htm

[10] Field production includes production of NGLs from natural gas processing plants.

[11] U.S. EIA. March 31, 2022a. "Product Supplied." *Petroleum & Other Liquids*. Accessed April 4, 2022. https://www.eia.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_a.htm

While production of propane has increased, the amount of propane consumed has remained steady since 2010.[12] The increased production has allowed for a nearly 12-fold increase in exports. Since 2017, propane exported has exceeded the amount of propane consumed by U.S. consumers and businesses. Exhibit 5 shows propane consumption and exports.

EXHIBIT 5. U.S. Propane Consumption and Exports, 2010–2021



Source: U.S. EIA March 31 2022a

Propane produced by Line 5 sources accounts for 0.3 percent of domestic production, and the total supply (production plus imports) attributable to Line 5 is 1 percent of U.S. supply (production plus imports) as shown in Exhibit 6.

EXHIBIT 6. Line 5-related Sources as a Percentage of U.S. Production and Supply, 2019 (Barrels/Day)

	Line 5 Related	Total U.S.	Line 5-related Resources as a Percentage of Total
Production	[redacted]	1,877,000	[redacted]
Total Supply (Production Plus Imports)	[redacted]	2,010,000	[redacted]

Source: PSC calculations

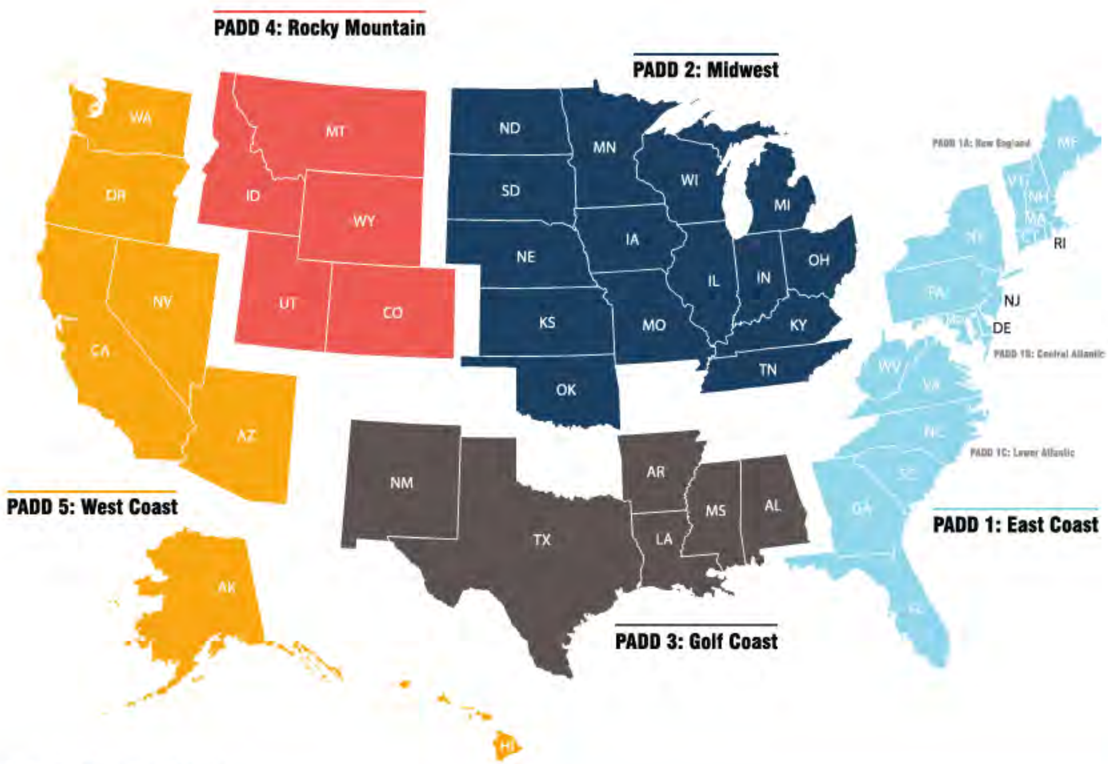
Regional Propane Production and Consumption

Within the U.S., propane production and use are often reported at the regional level for the five Petroleum Administration for Defense Districts (PADDs). Michigan and Wisconsin are part of PADD 2, or the Midwest region, which also includes Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri,

[12] The U.S. EIA refers to propane delivered to residential, commercial, industrial, or agricultural entities for the various end uses as "propane supplied." To not confuse this with propane production, PSC refers to propane supplied to end users as "consumption."

Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Tennessee.[13] A map of these districts is provided in Exhibit 7.

EXHIBIT 7. Petroleum Administration for Defense Districts



Source: U.S. EIA February 2012

In 2019, PADD 2 produced 164,000 b/d of propane, or 23.9 percent of U.S. production, the second-highest volume of the five PADDs. Only PADD 3 (the Gulf Coast region) produced more propane, accounting for 53.4 percent of total U.S. production. Of the five PADDs, PADDs 2, 3, and 4 produced more propane than customers consumed in 2019. While much of the excess production in PADD 3 is exported internationally, propane from PADDs 2 and 4 is transferred to other PADDs.[14] As noted above, the majority of U.S. propane production comes from field production at natural gas plants.[15] Propane supplies and consumption by PADD are shown in Exhibit 8.[16]

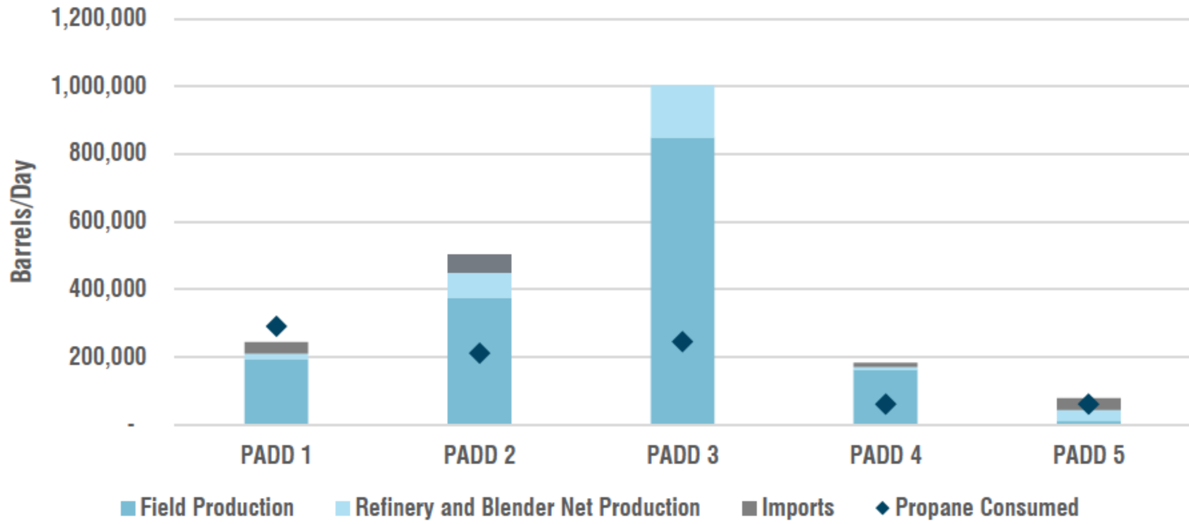
[13] U.S. EIA. February 7, 2012. "PADD Regions Enable Regional Analysis of Petroleum Product Supply and Movements." *Today in Energy*. Accessed April 4, 2022. https://www.eia.gov/todayinenergy/detail.php?id=4890

[14] U.S. EIA. May 14, 2018. "Most of America's Propane Exports Go to Countries in Asia." *Today in Energy*. Accessed April 4, 2022. https://www.eia.gov/todayinenergy/detail.php?id=36192

[15] U.S. EIA. March 31, 2022. "Product Supplied." *Petroleum & Other Liquids*. Accessed April 4, 2022. https://www.eia.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_a.htm

[16] While trend data are shown through 2021 where available, comparisons of production and consumption are made based on 2019 data. The COVID-19 pandemic had significant impacts on energy consumption, including propane.

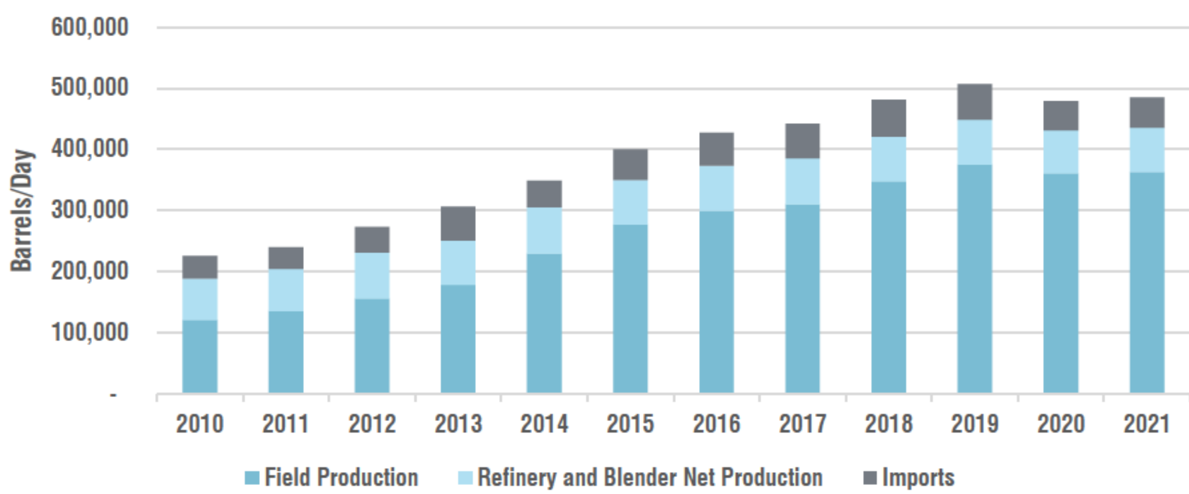
EXHIBIT 8. Propane Supplies by Source and Propane Consumption by PADD, 2019



Source: U.S. EIA March 31, 2022a

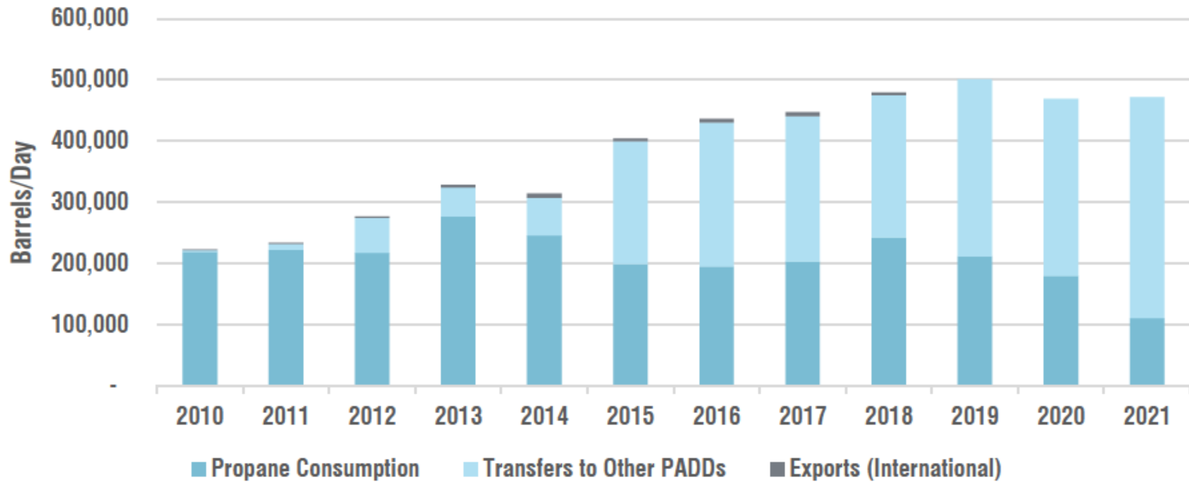
Review of propane supplies and uses for PADD 2 over time reveals market changes. In 2010, PADD exports and shipments to other regions were just over 1 percent of total product supplied and the region's propane production and imports aligned with the amount consumed. In 2021, PADD 2 production was nearly three times 2010 production and imports were 22 percent higher. Imports peaked in 2018 at 63 percent higher than 2010. The increased volume of propane in PADD 2 is not serving increased demand. Instead, the main change has been in the flow of propane from PADD 2 to other regions (see Exhibits 9 and 10).

EXHIBIT 9. PADD 2 Propane Production and Imports, 2010–2021



Source: U.S. EIA March 31, 2021a

EXHIBIT 10. PADD 2 Propane Consumption, Transfers, and Exports, 2010–2021



Source: U.S. EIA March 31, 2021a

To assess the significance of propane supplied by Line 5-related resources, PSC calculated the percentage of regional production and supply those resources account for. Propane produced by Line 5 sources within PADD 2 accounts for [redacted] percent of PADD 2 production. Propane produced or imported from sources attributable to Line 5 account for [redacted] percent of PADD 2 supply (production plus imports) as shown in Exhibit 11.

EXHIBIT 11. Line 5-related Sources as a Percentage of PADD 2 Production and Supply, 2019 (Barrels/Day)

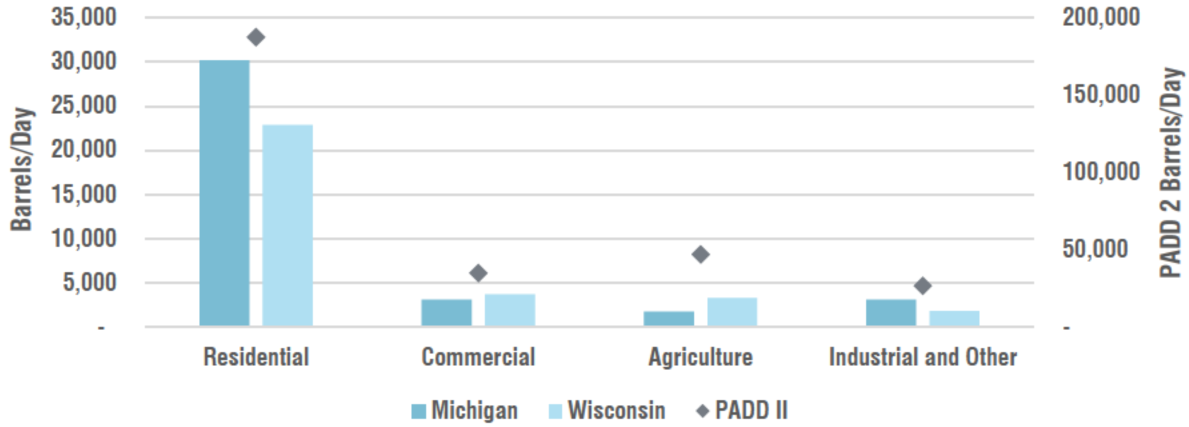
	Line 5 Related	Total PADD 2	Line 5-related Sources as a Percentage of Total
Production	[redacted]	448,800	[redacted]
Total Supply (Production Plus Imports)	[redacted]	503,300	[redacted]

Source: PSC calculations

Propane Production and Consumption in Michigan and Wisconsin

The fractionators associated with Line 5 at Superior, Wisconsin, and Rapid River, Michigan, represent a more significant portion of the propane production capacity for Wisconsin and Michigan, and both states rely on imports or transfers from other states to meet their high demand for propane. Michigan had the highest propane consumption of all the states in 2019 and Wisconsin ranked sixth, driven by the use of propane for residential space and water heating. Propane consumption by sector is shown in Exhibit 12 for Wisconsin, Michigan, and PADD 2.[17,18]

EXHIBIT 12. Propane Consumption by Sector, 2019



Source: ICF & PERC 2020

According to the *Annual Retail Propane Sales Report*, the residential sector accounts for 72 and 76 percent of propane consumption in Wisconsin and Michigan respectively, and 63 percent of consumption in PADD 2. Commercial consumption makes up 12 percent of consumption in PADD 2 and Wisconsin and 8 percent in Michigan. Agriculture use accounts for 12 percent of consumption in PADD 2—higher than in either Wisconsin (10 percent) or Michigan (5 percent). Industrial and other uses (including cylinder markets, transportation, and internal combustion) make up the balance and range from 6 to 9 percent. Wisconsin and Michigan 2019 propane consumption made up 10.7 and 12.9 percent of PADD 2 consumption respectively. Total 2019 consumption of propane in Michigan was 38,000 b/d and 32,000 b/d.

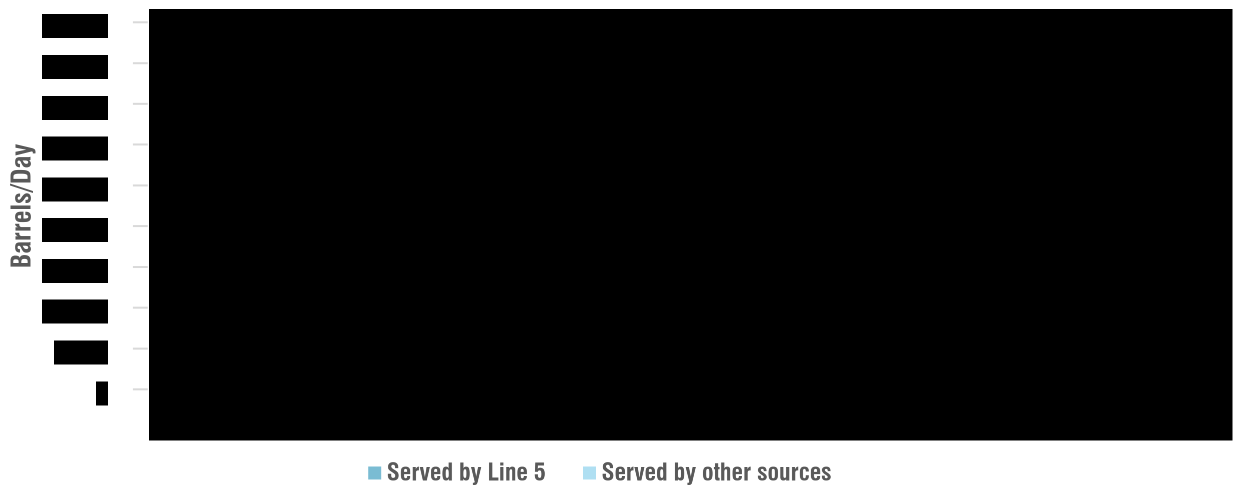
Exhibit 13 shows the proportion of propane demand in Wisconsin and Michigan estimated to be served by the fractionators related to Line 5. This assumes that all of the production at the Superior and Rapid River fractionators stays within the respective state and that imports from Sarnia are used in Michigan. This is a simplified assumption because the retail suppliers served by these fractionators often cross state or national borders. However, because the regional market will be affected by closure of these fractionators the full output of the fractionators is considered when identifying alternate resources. Not included in this comparison is propane produced by refineries that currently receive crude oil from Line 5 or additional sales by marketers that purchase propane from Sarnia for sale in Michigan. Enbridge has stated that Line

[17] ICF and Propane Education & Research Council (PERC). December 2020. *Annual Retail Propane Sales Report: U.S. Odorized Propane Sales by State and End-use Sector*. Accessed April 8, 2022. https://cloudinary.propane.com/images/v1608647918/website-media/2019-Annual-Retail-Propane-Sales-Report-Final/2019-Annual-Retail-Propane-Sales-Report-Final.pdf

[18] PERC's *Annual Retail Propane Sales Report* is one of the only sources that breaks down odorized propane sales/consumption for each state by sector. This report is compiled through an annual survey of participating retail propane companies as well as other publicly available sources.

5 supplies 55 percent of Michigan's propane needs.[19] In considering the impacts of a Line 5 closure, PSC does consider the totality of Line 5-related production at the Sarnia fractionator whether consumed in Michigan or Ontario.

EXHIBIT 13. Proportion of Statewide Demand Met by Line 5-related Resources



Source: PSC calculations

As a percentage of PADD 2 production, Wisconsin's 2019 propane consumption was 7.1 percent and Michigan's was 8.5 percent. Wisconsin's 2019 consumption was equal to 1.7 percent of U.S. propane production and Michigan's was 2.0 percent. The average annual growth in U.S. propane production since 2010 has been 8 percent, or nearly double the consumption of Wisconsin and Michigan combined. The rapid growth in production of propane in the U.S. relative to the consumption of propane in Wisconsin and Michigan assures adequate supply will be available in the event of a Line 5 closure.

Propane Production and Consumption in Canada and Ontario

As is the case in the U.S., propane production in Canada has grown significantly in the past decade and is expected to continue to grow.[20] The most recent data available, shown in Exhibit 14, portrays the historical propane supply through 2018 and projected supply through 2021. Propane supply in 2019 was estimated at 270,000 b/d, with 88 percent coming from gas processing and 3 percent from oil sands (represented together as field production), 7 percent from refineries, and 2 percent from imports.[21] Exhibit 15 shows propane consumption in Canada and exports from Canada. Exports to the U.S. in 2019

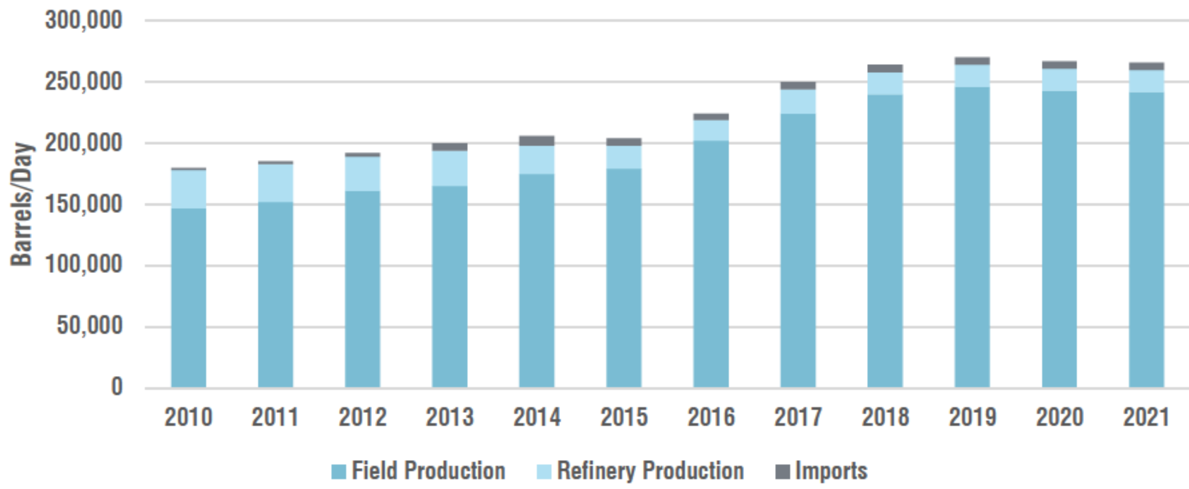
[19] Enbridge. n.d.a "About Line 5." *Enbridge*. Accessed April 4, 2022. https://www.enbridge.com/projects-and-infrastructure/public-awareness/line-5-michigan/about-line-5#:~:text=Line%205%20supplies%2065%25%20of,which%20are%20refined%20into%20propane.

[20] Canada Energy Regulator. July 24, 2019. "Market Snapshot: The NEB Projects Increased Propane Production from Natural Gas Processing." *Canada Energy Regulator*. Accessed April 4, 2022. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2019/market-snapshot-neb-projects-increased-propane-production-from-natural-gas-processing.html

[21] It is not clear where the [redacted] b/d produced at Sarnia is accounted for, but PSC assumes it is included in production from gas processing.

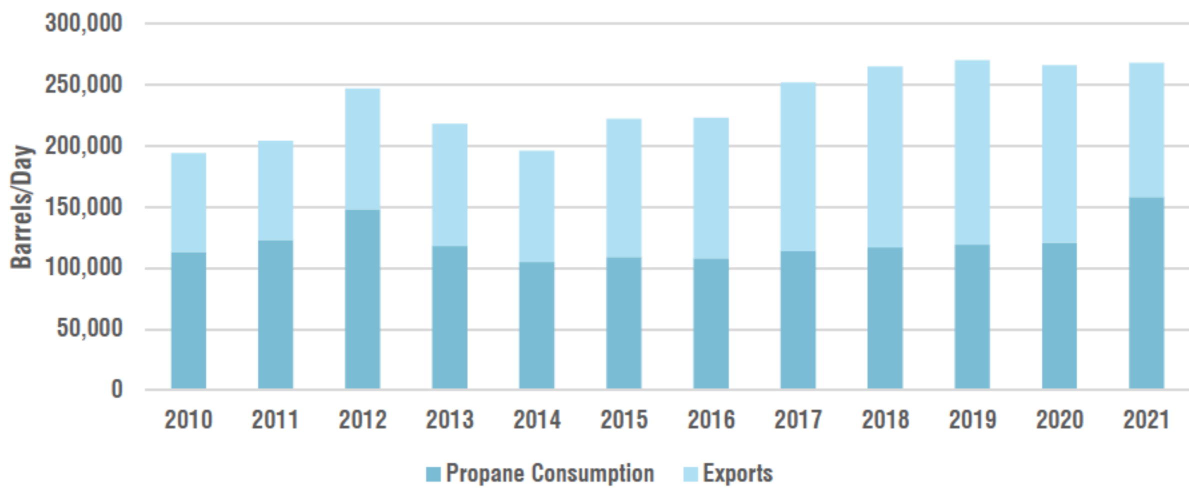
are estimated at a 150,000 b/d, or 56 percent of production. This includes 30,000 b/d exported from Ontario.

EXHIBIT 14. Propane Supply (Production and Imports) in Canada, 2010–2021



Source: Canada Energy Regulator 2019

EXHIBIT 15. Canadian Propane Consumption and Exports in Canada, 2010–2021

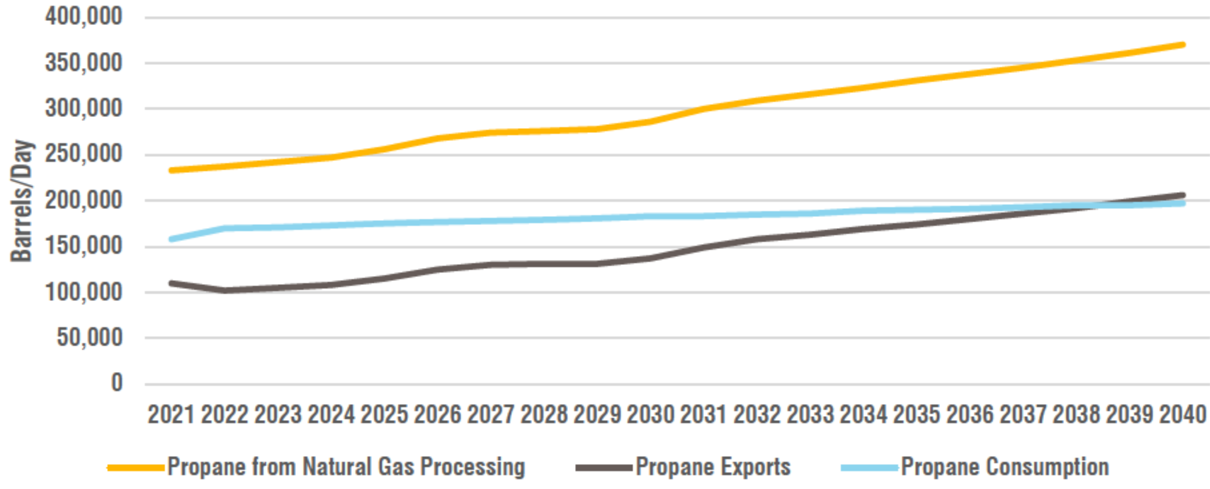


Source: Canada Energy Regulator 2019

Canadian production is projected to grow to 400,000 b/d by 2040, with nearly all of that growth coming from production from natural gas processing. Canada projects some growth in consumption of propane for petrochemical end uses, but its domestic consumption is otherwise projected to be flat. Exports are expected to grow to 200,000 b/d by 2040 (Exhibit 16).[22]

[22] Canada Energy Regulator, "Market Snapshot"

EXHIBIT 16. Projected Propane Production, Exports, and Demand in Canada, 2021–2040



Source: Canada Energy Regulator 2019

As shown in Exhibit 17, Line 5-related production in Canada accounts for 21.7 percent of the total. Accounting for the propane exported from Sarnia to Michigan and other imports of propane to Canada, Line 5 accounts for 15.8 percent of total Canadian supply.

EXHIBIT 17. Line 5-related Sources as a Percentage of Canada and Ontario Production and Supply, 2019 (Barrels/Day)

	Line 5 Related	Total Canada	Line 5-related Sources as a Percentage of Total	Total Ontario	Line 5-related Sources as a Percentage of Total
Production	[redacted]	264,000	[redacted]	67,600	[redacted]
Total Supply (Production Plus Imports)	[redacted]	270,000	[redacted]	71,900	[redacted]

Source: PSC calculations
Note: * Known transfers from Canada to Michigan (14,600 b/d from Sarnia to Michigan through designated pipelines) are counted as negative imports.

Ontario accounts for 40 percent of propane consumption in Canada, or approximately 44,000 b/d. That consumption is projected to grow slightly to 47,000 b/d by 2025.[23]

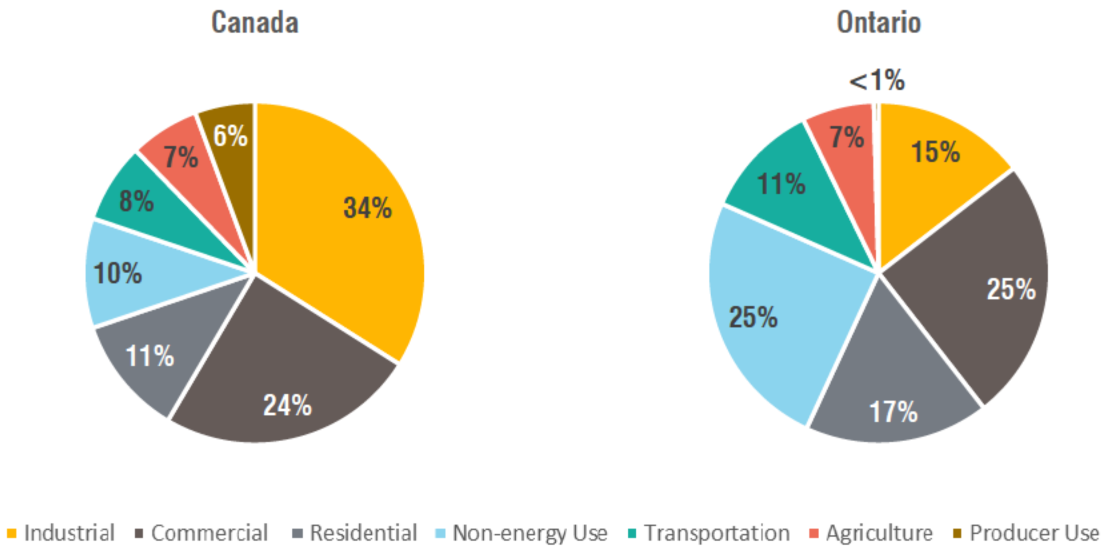
Unlike the U.S., where residential customers account for 56 percent of propane consumption, the largest use of propane in Canada is by industry.[24] Canadian and Ontario consumption by sector and end use is shown in Exhibit 18. Only 11 percent of the 107,000 b/d propane consumption in 2016 was by residential

[23] The Conference Board of Canada. December 2018. *Fuelled up: An Updated Overview and Outlook of Canada's Propane Market and Industry*. The Conference Board of Canada. Accessed April 4, 2022. https://propane.ca/wp-content/uploads/2018/12/CPA_Propane_Market_Study_OVERVIEW_CBoC_EN_2018.pdf

[24] The Conference Board of Canada, *Fuelled Up*.

customers. Industrial consumption and petrochemical use accounted for 44 percent of consumption in Canada (and 40 percent in Ontario) compared to 3 percent in the U.S.[25,26] This difference in consumption by sector is an important consideration. As stated by Dr. Grainger, residential propane consumption is relatively inelastic, that is, changes in demand are smaller than changes in price.[27] This is because of lack of availability of substitutes or ability to change consumption in the short term.[28] However, industrial, and petrochemical users generally have higher elasticity of demand because of the ability to choose alternate fuels or feedstock, improve process efficiency, or adjust production scheduling or otherwise modify processes to be more efficient.[29,30]

EXHIBIT 18. Propane Consumption by Sector in Canada and Ontario, 2016[31]



Source: The Conference Board of Canada 2018
Note: * Non-energy use includes petrochemical processing and plastics production.

Propane Summary

While the propane produced by Line 5-related resources is not insignificant, especially with the states and province served, it is small when compared to the overall regional and North American markets. As is explored further below, the growing production in the U.S. and Canada provides a number of options for procuring alternate propane supply to meet the needs of consumers in the Upper Midwest and Ontario.

[25] Most recent available data on consumption by sector in Canada.

[26] ICF & PERC, *Annual Retail Sales Report*, 15.

[27] Grainger, Expert Report, 25.

[28] Over the long term, households may be able to replace propane-fired heating or water heating systems or improve the efficiency of their homes to reduce use; however, in the short-term, those options are limited.

[29] U.S. EIA. October 9, 2014. "Lower Petrochemical use of Propane Driven by Wider Price Spread Between Propane and Ethane." *Today in Energy*. Accessed April 4, 2022. https://www.eia.gov/todayinenergy/detail.php?id=18331

[30] Dave Costello. May 9, 2006. *Reduced Form Energy Model Elasticities from EIA's Regional Short-term Energy Model (RSTEM)*. Accessed April 4, 2022. https://www.eia.gov/outlooks/steo/special/pdf/elasticities.pdf

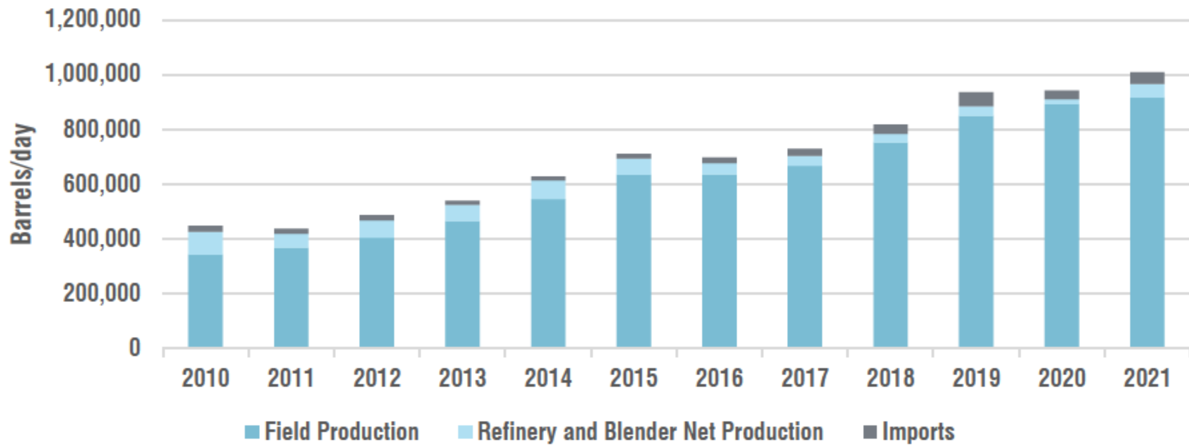
[31] Latest year these data are available.

Butane Production and Consumption

Two types of butane are produced from NGLs: normal butane and isobutane. Butane has some consumer uses, including heating fuel, lighters, refrigerants, and propellants. Isobutane is used as refinery fuel or as an additive to make high-octane gasoline.[32] Propane and butane are sometimes mixed to create liquified petroleum gas (LPG) which is used for commercial applications, industry, transportation, agriculture, power generation, cooking, heating, and recreational purposes.[33]

Exhibit 19 shows the dynamic nature of the butane market in the U.S.[34] Like propane, field production of butane has expanded nearly threefold, while refinery production has remained steady. Consumption (product supplied) has been consistent over time.

EXHIBIT 19. U.S. Normal Butane and Isobutane Supply and Imports, 2010–2021



Source: U.S. EIA March 31, 2022b

Exhibit 20 documents the consumption of butane and exports. Butane consumption and use of butane as a refinery fuel has remained steady over the last decade.[35] Exports of butane were 18 times higher in 2021 than in 2010. In 2021, butane exports from the U.S. were widely distributed, with the greatest amount going to South Korea. Exports to Canada were about 4,000 b/d (about 1 percent of all butane exports), down from a high of 18,000 b/d.[36]

[32] McKinsey&Company. n.d. "Butane." *Energy Insights*. Accessed April 8, 2022. https://www.mckinseyenergyinsights.com/resources/refinery-reference-desk/butane/

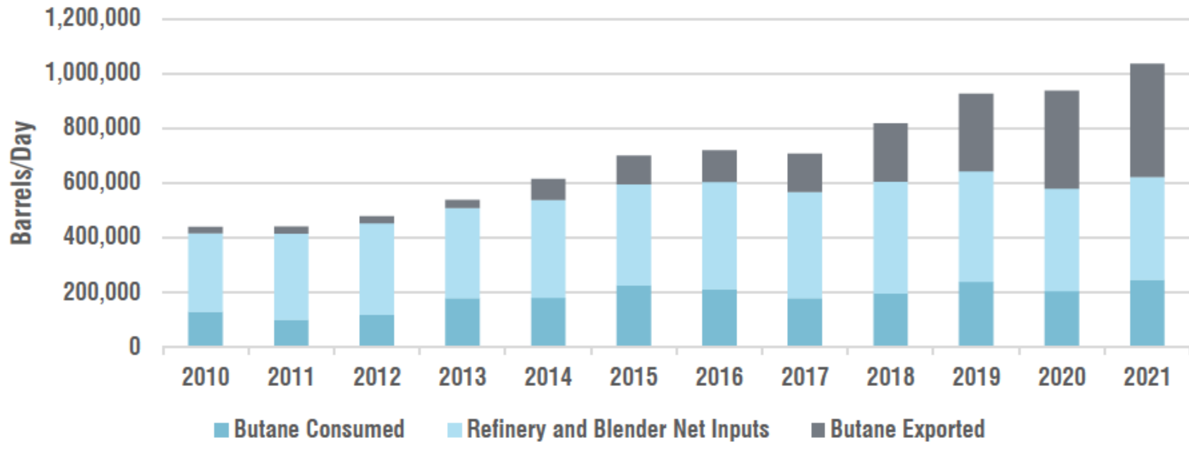
[33] World LPG Association. n.d. "About LPG." *WLPGA*. Accessed April 8, 2022. https://www.wlpga.org/about-lpg/what-is-lpg/#:~:text=LPG%20stands%20for%20%E2%80%9CLiquefied%20Petroleum,particularly%20suited%20to%20specific%20uses.

[34] https://www.eia.gov/dnav/pet/PET_SUM_SND_A_EPLLBAN_MBBLPD_A_CUR.htm

[35] While butane is produced through the refining process, it can also be used as an input to the refining process. For more information, see McKinsey&Company, "Butane."

[36] U.S. EIA. n.d.c. "U.S. Exports to Canada of Normal Butane." *Petroleum & Other Liquids*. Accessed April 6, 2022. https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MBUEX_NUS-NCA_2&f=A

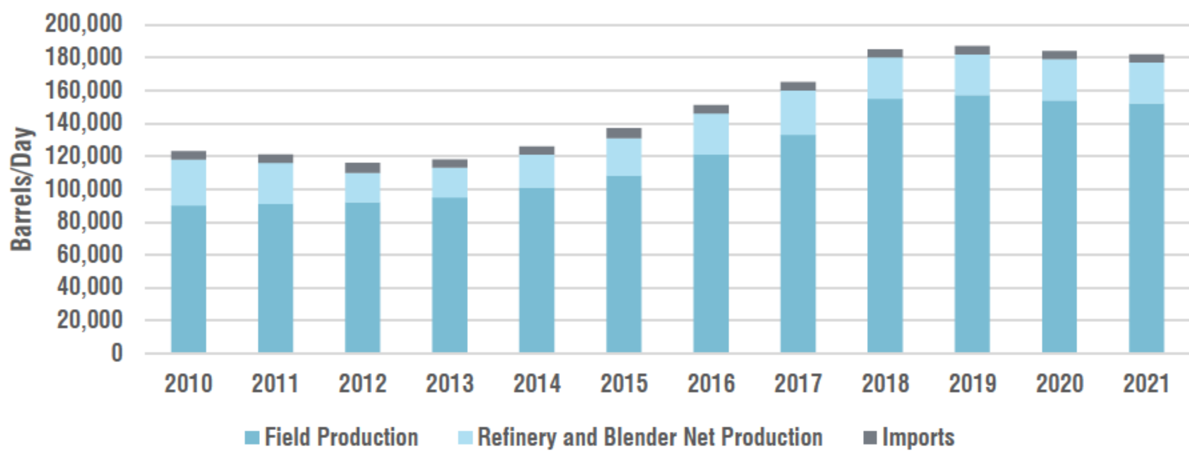
EXHIBIT 20. U.S. Normal Butane and Isobutane Consumption and Exports, 2010–2021



Source: U.S. EIA March 31, 2022b

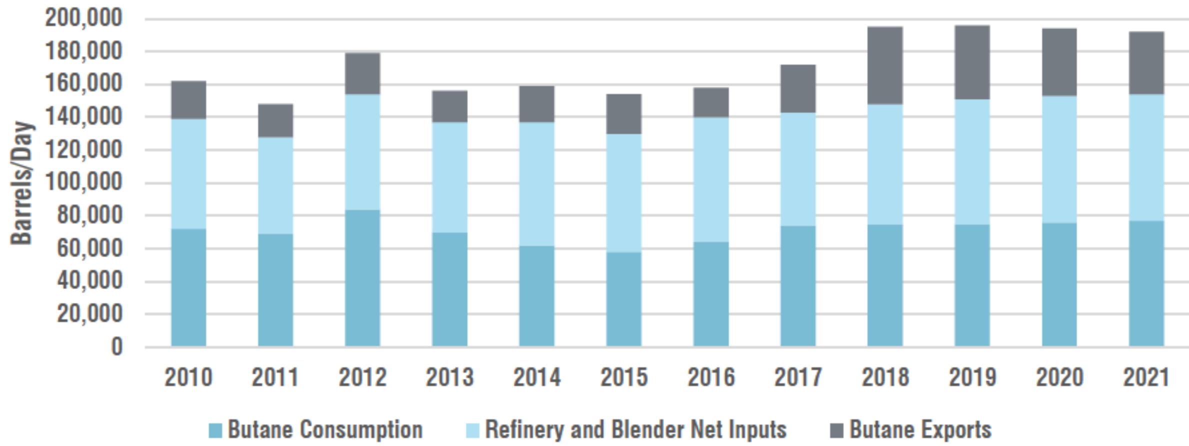
The supply of and demand for butane in Canada are somewhat similar to the U.S.; however, domestic use and refinery inputs utilize more of the supply (Exhibits 21 and 22). Exports have grown since 2010, but not at the same rate as those in the U.S.

EXHIBIT 21. Canada Butane Supply and Imports, 2010–2021



Source: U.S. EIA March 31, 2022b

EXHIBIT 22. Canada Butane Consumption and Exports, 2010–2021



Source: U.S. EIA March 31, 2022b

Butane Summary

The butane production at Sarnia of 20,900 b/d accounts for less than 2 percent of total U.S. and Canadian production.[37,38] The rapid growth of production in the U.S., as well as growth in Canadian production, provide sufficient options for procuring alternate butane supply to meet the needs of consumers in the Upper Midwest and Ontario.

Conclusion

The potential loss of propane and butane supply from the three fractionators that rely on Line 5 for operation represents a relatively small fraction of the national and regional production. As propane and butane production has grown significantly since 2010, there is ample supply to meet demand throughout the nation, in PADD 2, and in Michigan, Wisconsin, and Ontario.

PSC has identified the following options for replacing propane supplies currently relying on Line 5. These options include, but would not be limited to:

- Transportation of propane and butane from Edmonton, Alberta, via rail to Superior, Wisconsin; Rapid River, Michigan; and Marysville; Michigan
- Transportation of propane from Conway, Kansas, via rail to Superior, Rapid River, and Marysville
- Transportation of propane and butane from Mont Belvieu, Texas, via rail to Superior, Rapid River, and Marysville

[37] Earnest, Expert Report, 19.

[38] While both the U.S. and Canada import some butane, much of the respective imports represent exchanges between the two countries, so PSC measures the production at Sarnia against production rather than supply (production plus imports).

- Transportation of propane via truck from one of several intermediate locations in the Midwest, either procuring propane at a "rack" price from the intermediate location or arranging delivering of propane from a major hub via pipeline to the intermediate location[39]
- Continued operation of the Sarnia fractionator with NGLs from the Marcellus/Utica Shale play in the Appalachian region

A key to securing adequate supplies will be to identify multiple supply alternatives that can be used as needed. Use of multiple supply alternatives will mitigate risks of overreliance on a single source where supply disruptions or pricing changes could impact the availability or cost of propane. Expanded supply diversity would also likely reduce any price impacts by increasing competition between propane suppliers.

In section three, PSC calculates the cost of the identified supply options and the impact on the per-gallon price of propane at the wholesale and retail levels and the resulting cost impacts for a typical household that uses propane for space and water heating and for states and regions currently served by Line 5.

Section Three: Identification and Costing of Alternative Supply and Transportation Options

Alternative Propane Supply in Michigan and Wisconsin

In Mr. Earnest's expert report, he estimates minimum price impacts for the various locations impacted by a Line 5 closure:

- $4.3 million in increased propane costs in Wisconsin[40]
- $8.3 million in increased propane costs in the Upper Peninsula of Michigan[41]
- $75.0 million in increased propane costs in the Lower Peninsula of Michigan[42]
- $83.1 million in increased propane costs in Ontario[43]
- $53 million increase in regional costs for butane[44]

PSC's analysis shows much lower cost impacts for Wisconsin and Michigan residents and in some cases, potential savings. Only under "worst-case" scenarios do PSC cost impact estimates compare to Mr. Earnest's. The methodology and results of the PSC analysis are described below.

Approach

PSC developed an Excel-based model to estimate the cost of alternative propane supplies. The model calculates the cost of a wide range of alternative routes and delivery options based on inputs comprising commodity cost; pipeline, rail, and trucking transportation costs; and storage needs and costs. The advantage of the model developed is that it provides transparent and consistent calculations, a central

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[39] Prevailing wholesale prices are not readily available information. PSC obtained 2020 rack prices from **OPIS/IHS Markit** as a proxy for wholesale prices for Rapid River and Marysville. The rack price incorporates the commodity costs and transportation to the rack location, as well as terminal fees and other undisclosed costs.

[40] Earnest, Expert Report, Workpaper 1.

[41] Earnest, Expert Report, Workpaper 2.

[42] Earnest, Expert Report, Workpaper 3.

[43] Earnest, Expert Report, Workpaper 4.

[44] Earnest, Expert Report, Workpaper 5.

repository for all calculation inputs with appropriate references, and the ability to scale key assumption for consideration of multiple scenarios. PSC modeled supply alternatives for several scenarios, including:

- Reference case
- High rail costs
- Sudden disruption
- Sudden disruption with higher trucking costs[45]

PSC selected these scenarios to understand the sensitivities of key model inputs and to estimate the impact of unforeseen or extreme circumstances. For each scenario considered, PSC identified the three lowest-cost alternative supply options for delivery to three locations—Rapid River in the Upper Peninsula, Marysville in the Lower Peninsula, and Superior, Wisconsin. These locations were selected because they are major distribution centers and because data were available to determine the prevailing wholesale price in 2020 for those locations, which serves as a comparison to determine the expected impact of alternate propane supply options.[46] While these locations were used to calculate the incremental cost of propane supply alternatives, PSC expects that propane could be delivered at comparable cost to other distribution centers in the region.

PSC uses a portfolio approach (i.e., selection of multiple options) in this analysis to calculate the cost of supply alternatives for each scenario. The portfolio approach assumes 50 percent of the new supply is sourced from the lowest-cost alternative, 30 percent from the second lowest-cost alternative, and 20 percent from the third lowest-cost alternative to calculate a weighted average cost of supply alternatives. The portfolio approach is used to mitigate risks of overreliance on a single source where supply disruptions or pricing changes could impact the availability or cost of propane. A description of PSC's model is included in Appendix A.[47]

In addition to identifying the top alternatives for each scenario and the weighted average cost of the supply alternatives, the tables presented for each alternative include:

- The expected wholesale cost impact of the alternative supply options—calculated as the difference between the weighted average cost of the supply alternatives and the prevailing wholesale cost for the delivery point
- The expected retail price impact based on the change in wholesale prices—calculated as 70 percent of the wholesale price increase based on PSC's analysis of the relationship and of wholesale and retail prices, described in Appendix B
- The expected impact on a typical household—calculated as the estimated change in retail prices multiplied by average annual household propane consumption of homes in Wisconsin, the Upper Peninsula, and the Lower Peninsula, as appropriate[48]

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[45] PSC analyzes higher trucking costs only with the sudden disruption because most of the low-cost options in the reference case, and even the high-cost rail scenario, utilize rail transport. PSC assumes trucking would be used to meet demand in the short term in the case of a sudden disruption.

[46] Prevailing wholesale prices are not readily available information. PSC obtained 2020 rack prices from **OPIS/IHS Markit** as a proxy for wholesale prices for Rapid River and Marysville. The rack price incorporates the commodity costs and transportation to the rack location, as well as terminal fees and other undisclosed costs.

[47] This model was developed for analysis of options for Michigan's Upper Peninsula Energy Task Force and has been further developed for other analyses.

[48] Estimates of average household consumption are described in Appendix D.

- The expected regional cost impact—calculated as the estimated change in retail prices multiplied by the propane supply impact of the Line 5 closure in Wisconsin, the Upper Peninsula, and the Lower Peninsula[49]

In the sections below, the scenarios are defined and results are presented in summary tables. The top three alternatives are described in the narrative for each scenario and are shown in the tables using an alternative code. The format for the code is origination point, intermediate point (if applicable), and final destination; the transportation mode(s); and the acquisition pattern (i.e., whether monthly propane acquisition is based on consumption [referred to as "normal weather"] or flat demand [delivering equal amounts each month]). The code EA_RR_R_NW indicates propane supply originating in Edmonton, Alberta (EA), transported to Rapid River (RR) by rail (R) with monthly shipments that align with expected monthly consumption based on normal weather (NW). A key to the codes is included in Appendix A: Model Description.

PSC used a similar analytical approach to calculate costs of alternate butane supplies, but because there are fewer supply options and less certainty about the location of butane consumption, PSC did not build a model for this analysis.

Scenario: Reference Case

PSC used the best available information or midrange input estimates to calculate the cost of each supply alternative for a reference case. The lowest-cost alternatives for each location include shipment of propane by rail from hub locations. One of the low-cost alternatives for Superior would include shipment by pipeline to an intermediate terminal and shipment by truck to the destination. PSC considered the alternate supply patterns of just-in-time delivery based on monthly consumption patterns with normal weather and flat demand. Shipping propane based on monthly consumption reduces the need for storage but does not fully utilize the delivery infrastructure. A delivery infrastructure sized to meet demand during the peak heating month would operate only at 60 percent capacity, with lower delivery volume in spring and summer during which time trucks or rail cars would not be in full use. In 2020, the lowest-cost alternatives assume propane shipped in a just-in-time pattern. In the reference case, the PSC model shows a wholesale price increase of $0.07/gallon and a retail price increase of $0.05/gallon at Rapid River, which corresponds to a $56 annual increase for an average Upper Peninsula household and less than a one dollar increase for an average Lower Peninsula household. Compared to an estimated average annual household propane cost of $2,200 in 2020, the increases are modest in the Upper Peninsula (3–4 percent) and minimal in the Lower Peninsula (less than 1 percent). In Wisconsin, the model projects a reduction in overall cost driven based on the cost of obtaining propane by rail from Edmonton, Alberta. The estimated reduction in wholesale cost is $0.05/gallon wholesale and retail cost would be reduced by $0.3/gallon. The estimated cost reduction per household using the portfolio approach is $37 per year and the savings to the state is $1.82 million. Reference case results are shown in Exhibit 23.

49 [redacted]

EXHIBIT 23. Reference Case Results

Scenario	Reference	
Delivery location	Superior	
Top three alternatives		
	Alternative code	Cost per gallon
1	EA_SUP_R_NW	$0.5033
2	CK_SUP_R_NW	$0.6419
3	CK_IGM_P_SUP_T_NW	$0.6663
Weighted average cost of alternatives		$0.5775
Prevailing wholesale cost		$0.6234
Cost difference		-$0.0459
Retail price impact		-$0.0322
Annual household impact	**-$37.42 per household**	
Annual regional cost impact	**-$1,823,601**	
Delivery location	Rapid River	
Top three alternatives		
	Alternative code	Cost per gallon
1	EA_RR_R_NW	$0.5794
2	CK_RR_R_NW	$0.6574
3	MBT_RR_R_NW	$0.7692
Weighted average cost of alternatives		$0.6408
Prevailing wholesale cost		$0.5714
Cost difference		$0.0694
Retail price impact		$0.0486
Annual household impact	**$56.52 per household**	
Annual regional cost impact	**$1,563,387**	
Delivery location	Marysville	
Top three alternatives		
	Alternative code	Cost per gallon
1	EA_MRY_R_NW	$0.6210
2	CK_MRY_R_NW	$0.6731
3	MBT_MRY_R_NW	$0.7422
Weighted average cost of alternatives		$0.6608
Rack price		$0.6605
Cost difference		$0.0003
Retail price impact		$0.0002
Annual household impact	**$0.30 per household**	
Annual regional cost impact	**$53,866**	

Source: PSC analysis

Scenario: Higher Rail Costs

In the reference case, nearly all lowest-cost alternatives rely on rail transportation. In the estimation of rail costs, PSC includes rail car leasing, freight charges, investment in transloaders and storage, and labor associated with loading and unloading of rail cars.[50] In addition, increased utilization of rail transportation may result in cost increases from increased demand. To understand the potential impact of higher rail costs on the ranking of supply alternatives and on the potential cost impact of alternate supply, PSC calculated the impact of a 25 percent increase in all costs associated with rail transportation.

As shown in Exhibit 24, even with the assumption of higher rail costs, rail options continue to be a low-cost alternative. The impact on wholesale prices in this scenario is approximately $0.11/gallon in the Upper Peninsula and $0.05/gallon in the Lower Peninsula, with retail price impacts of $0.08/gallon and $0.04/gallon, respectively. In Wisconsin, wholesale and retail prices would be approximately $0.01 lower. Household and regional cost impacts would be as follows:

- In Wisconsin, household costs would be about $9.50 lower and regional costs would drop by approximately $463,000
- Upper Peninsula households that use propane would experience a cost increase of around $93 per year, or 4.4 percent, and regional costs would increase by about $2.5 million
- In the Lower Peninsula, household propane costs would increase by about $47, or 2.2percent, and regional costs would increase by approximately $8.6 million

Even assuming higher rail costs, the estimated impacts are lower than Mr. Earnest's and are modest to minimal given propane cost variability and overall household and regional expenditures.

[50] Surface Transportation Board. n.d. "Uniform Rail Costing System." *Surface Transportation Board.* Accessed April 7, 2022. https://www.stb.gov/reports-data/uniform-rail-costing-system/

EXHIBIT 24. High Rail Cost Scenario Results

Scenario	High Rail Costs	
Delivery location	Superior	
Top three alternatives		
	Alternative code	Cost per gallon
1	EA_SUP_R_NW	$0.6383
2	CK_SUP_R_NW	$0.7030
3	CK_IGM_P_SUP_T_NW	$0.7769
Weighted average cost of alternatives		$0.6118
Prevailing wholesale cost		$0.6234
Cost difference		-$0.0116
Retail price impact		-$0.0082
Annual household impact	**-$9.49 per household**	
Annual regional cost impact	**-$463,396**	
Delivery location	Rapid River	
Top three alternatives		
	Alternative code	Cost per gallon
1	EA_RR_R_NW	$0.6383
2	CK_RR_R_NW	$0.7030
3	CK_RM_P_RR_T_NW	$0.7769
Weighted average cost of alternatives		$0.6854
Prevailing wholesale cost		$0.5714
Cost difference		$0.1140
Retail price impact		$0.0798
Annual household impact	**$92.90 per household**	
Annual regional cost impact	**$2,539,442**	
Delivery location	Marysville	
Top three alternatives		
	Alternative code	Cost per gallon
1	EA_MRY_R_NW	$0.6974
2	CK_MRY_R_NW	$0.7226
3	MBT_CO_P_MRY_T_FD	$0.7490
Weighted average cost of alternatives		$0.7153
Rack price		$0.6605
Cost difference		$0.0548
Retail price impact		$0.0383
Annual household impact	**$47.13 per household**	
Annual regional impact	**$8,581,700**	

Source: PSC analysis

Scenario: Sudden Disruption

PSC estimates that arranging procurement of propane from a major hub; arranging rail transportation; and ensuring adequate loading, unloading, and storage facilities will take four to 12 months. With advance notice, those preparations could be made, but in the case of a sudden disruption—especially during the heating season—there may be a need to procure propane quickly and conveniently. Propane would likely be purchased from one of several terminals throughout the Midwest and transported by truck to locations most directly impacted by closure of Line 5. Similar to the prevailing wholesale prices obtained for Superior, Rapid River, and Marysville, PSC obtained 2020 price data for three locations from which propane might be procured: Dubuque, Iowa; Janesville, Wisconsin; and Inver Grove Heights, Minnesota.

The cost impacts of sudden disruption are higher but would not be expected to endure as longer-term solutions will be put in place. Exhibit 25 shows the cost of procuring propane from each location and transporting it by truck. Using the portfolio approach to determine weighted average cost, the estimated impact on wholesale prices in the event of a short-term disruption is approximately $0.15/gallon in Wisconsin, $0.24/gallon in the Upper Peninsula, and $0.30/gallon in the Lower Peninsula, with retail price impacts of approximately $0.11/gallon, $0.17/gallon, and $0.21/gallon, respectively. PSC calculated a range of impacts that considers a disruption that would last from four months (or impacting one-third of the average annual household consumption) to a full year (or the entire heating season). Based on the length of time needed to implement longer term solutions, the household and regional impacts would be:

- $43 to $125 per household in Wisconsin and $2.0 to $6.1 million regionally—this equates to a 2.0 to 5.7 percent increase in household expenditure
- $65 to $195 per household in the Upper Peninsula and $1.8 million to $5.4 million regionally—this equates to 3 to 8 percent increase in household expenditure
- $85 to $254 per household increase in the Lower Peninsula and $15.4 to $46.5 million regionally—this equates to a 3.6 to 10.8 increase in household expenditure

EXHIBIT 25. Sudden Disruption Scenario Results

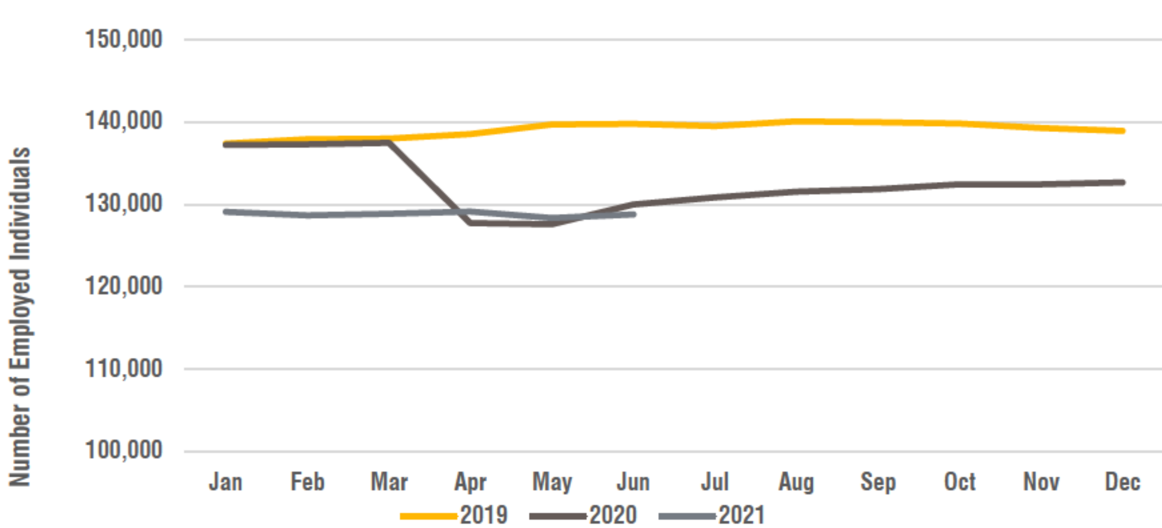
Scenario	Short-term or Sudden Disruption	
Delivery location	Superior	
Top three alternatives		
	Alternative code	Cost per gallon
1	IGM_SUP_T_NW	$0.7365
2	DI_SUP_T_NW	$0.8104
3	JW_SUP_T_NW	$0.8290
Weighted average cost of alternatives		$0.7771
Prevailing wholesale cost		$0.6234
Cost difference		$0.1537
Retail price impact		$0.1076
Annual household impact	**$42.75 to $125.26 per household**	
Average regional impact	**$2,034,793 to $6,104,379**	
Delivery location	Rapid River	
Top three alternatives		
	Alternative code	Cost per gallon
1	IGM_RR_T_NW	$0.7940
2	JW_RR_T_NW	$0.8116
3	DI_RR_T_NW	$0.8539
Weighted average cost of alternatives		$0.8112
Prevailing wholesale cost		$0.5714
Cost difference		$0.2398
Retail price impact		$0.1679
Annual household impact	**$65.14 to $195.41 per household**	
Average regional impact	**$1,801,648 to $5,404,943**	
Delivery location	Marysville	
Top three alternatives		
	Alternative code	Cost per gallon
1	JW_MRY_T_NW	$0.8878
2	IGM_MRY_T_NW	$1.0227
3	DI_MRY_T_NW	$1.0305
Weighted average cost of alternatives		$0.9568
Rack price		$0.6605
Cost difference		$0.2963
Retail price impact		$0.2074
Annual household impact	**$84.99 to $254.97 per household**	
Average regional impact	**$15,474,876 to $46,494,627**	

Source: PSC analysis.

Scenario: Sudden Disruption—High Trucking Costs

PSC has used conservative assumptions for labor and fuel costs (at the highest end of the range of estimates found for these inputs). However, as mentioned in Mr. Rennicke's testimony, labor shortages have existed since the COVID-19 pandemic that began in 2020.[51] The labor shortage has hit the trucking industry particularly hard as shown in Exhibit 26. The number of individuals employed nationally in the trucking industry is now 10,000, or 8 percent lower in 2020 and 2021 than in 2019.

EXHIBIT 26. U.S. Specialized Long-distance Trucking Employment, January 2019–June 2021



Source: U.S. Bureau of Labor Statistics 2022

Transportation fuels have been increasing in price as economic activity resumes postpandemic, and war between Ukraine and Russia has accelerated that rise.[52] To assess the potential impact of higher labor and fuel costs during a short-term or sudden disruption of propane supply, PSC analyzed a scenario with labor and transportation costs increased by 20 percent. This results in somewhat higher cost impacts than the sudden disruption scenario using reference case trucking costs and would represent a high-cost scenario. Again, these costs would not be expected to persist as longer-term solutions are put in place. In addition, use of propane in storage can help to mitigate sudden price increases. Based on recommendations of the Upper Peninsula Energy Task Force, Michigan has begun to put policies in place to encourage development of centralized storage capacity and utilization of customer-sited storage (through encouragement of prefilling tanks before the heating season). The recommendations are designed to improve reliability and affordability of propane, regardless of the status of Line 5. The impacts of the Sudden Disruption—High Trucking Cost scenario are summarized in Exhibit 27.

[51] William J. Rennicke, January 31, 2022, Report of William J. Rennicke, 58.

[52] Scott Patterson and Sam Goldfarb. April 1, 2022. "Why Are Gasoline Prices So High? Ukraine-Russia War Sparks Increases Across U.S." *The Wall Street Journal*. Accessed April 7, 2022. https://www.wsj.com/articles/why-gas-prices-expensive-11646767172

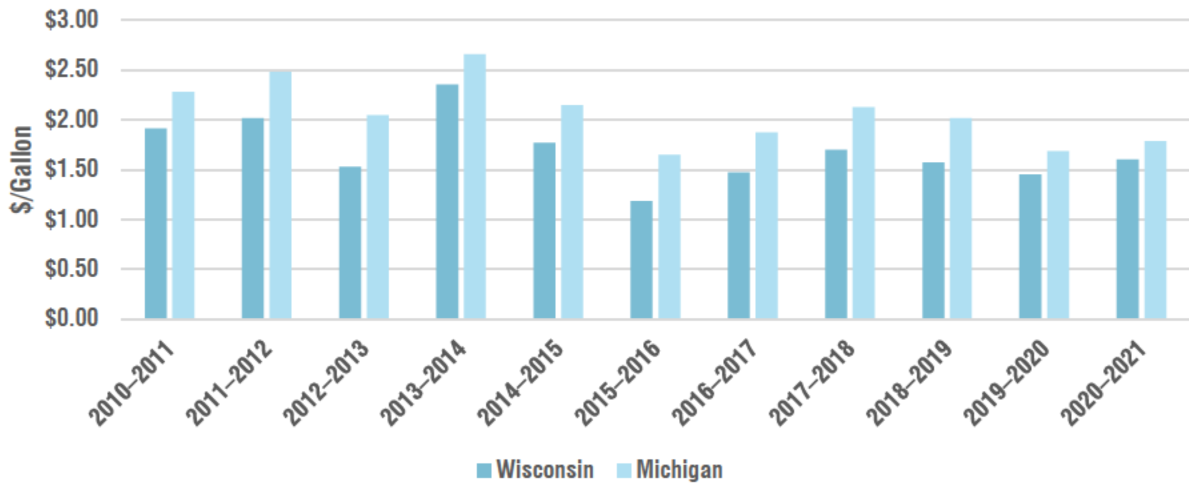
EXHIBIT 27. Sudden Disruption—High Trucking Cost Scenario Results

Scenario	Short-term or Sudden Disruption	
Delivery location	Superior	
Top three alternatives		
	Alternative code	Cost per gallon
1	IGM_SUP_T_NW	$0.7477
2	DI_SUP_T_NW	$0.8330
3	JW_SUP_T_NW	$0.8518
Weighted average cost of alternatives		$0.7941
Prevailing wholesale cost		$0.6234
Cost difference		$0.1707
Retail price impact		$0.1195
Annual household impact	**$46.36 to $139.08 per household**	
Average regional impact	**$2,259,242 to $6,777,727**	
Delivery location	Rapid River	
Top three alternatives		
	Alternative code	Cost per gallon
1	IGM_RR_T_NW	$0.8129
2	DI_RR_T_NW	$0.8344
3	IGM_RR_T_NW	$0.8778
Weighted average cost of alternatives		$0.8323
Prevailing wholesale cost		$0.5714
Cost difference		$0.2609
Retail price impact		$0.1827
Annual household impact	**$70.87 to $212.60 per household**	
Average regional impact	**$1,960,103 to $5,880,311**	
Delivery location	Marysville	
Top three alternatives		
	Alternative code	Cost per gallon
1	JW_MRY_T_NW	$0.9191
2	IGM_MRY_T_NW	$1.0669
3	DI_MRY_T_NW	$1.0740
Weighted average cost of alternatives		$0.9944
Rack price		$0.6605
Cost difference		$0.3339
Retail price impact		$0.2337
Annual household impact	**$95.77 to $287.31 per household**	
Average regional impact	**$17,437,653 to $52,312,960**	

Source: PSC analysis

In this high-cost scenario, PSC projects wholesale prices that increase from $0.17 to $0.34 per gallon and retail price impacts ranging from $0.12 to $0.24 per gallon. These price increases are moderate and if sustained, significant. However, propane prices can vary significantly from year to year and propane users have had to accommodate far greater price fluctuations. Exhibit 28 shows the average retail prices in Wisconsin and Michigan over the past heating seasons. As shown, prices can fluctuate as much as $0.50/gallon from year to year.[53] It is notable that Wisconsin propane prices are consistently lower than Michigan's despite lower reliance on Line 5 for propane supply.

EXHIBIT 28. Retail Propane Prices in Wisconsin and Michigan



Source: U.S. EIA March 30, 2022b

Summary of Alternative Propane Supply Cost in Wisconsin and Michigan

Exhibit 29 compares the cost impact of alternate supplies for Wisconsin and Michigan for each scenario as modeled by PSC to the cost estimates provided by Mr. Earnest.

[53] U.S. EIA. March 30, 2022a. "Weekly Heating Oil and Propane Prices (October–March): Residential." *Petroleum & Other Liquids*. Accessed April 4, 2022. https://www.eia.gov/dnav/pet/pet_pri_wfr_a_EPLLPA_PRS_dpgal_w.htm

EXHIBIT 29. Comparison of Estimates of PSC and Earnest Impact on Regional Propane Costs if Line 5 Closes

		Reference Case	High Rail Case	Sudden Disruption	Sudden Disruption—High Trucking Cost	Earnest Expert Report[54]
Wisconsin	Per Gallon	-$0.0322	-$0.0082	$0.1076	$0.1195	$0.0765
	Regional	-$1.8M	-$0.46M	$2.0–6.1M	$2.3–6.8M	$4.3M
Michigan—Upper Peninsula	Per Gallon	$0.0486	$0.0798	$0.1679	$0.1827	$0.2607
	Regional	$1.6M	$2.5M	$1.8–5.4M	$2.0–5.9M	$8.3M
Michigan—Lower Peninsula	Per Gallon	$0.0002	$0.0383	$0.2074	$0.2337	$0.2137
	Regional	$0.05M	$8.6M	$15.4–46.5M	$17.4–52.3M	$75.0M

Source: PSC calculations and Earnest Expert Report

Key differences between the analysis performed by PSC and Mr. Earnest by location are described below.

Superior, Wisconsin

For Superior, Mr. Earnest analyzed the cost of trucking from a combination of six intermediate locations with rail terminals that range from eight to 291 miles from Superior. He calculated the cost of trucking using a per-mile cost and an average distance of 185 miles. That cost is divided by the volume of a propane tanker truck and is assumed to be the incremental cost of propane delivery to Superior.[55]

PSC calculated the cost of multiple supply alternatives using the following formula:

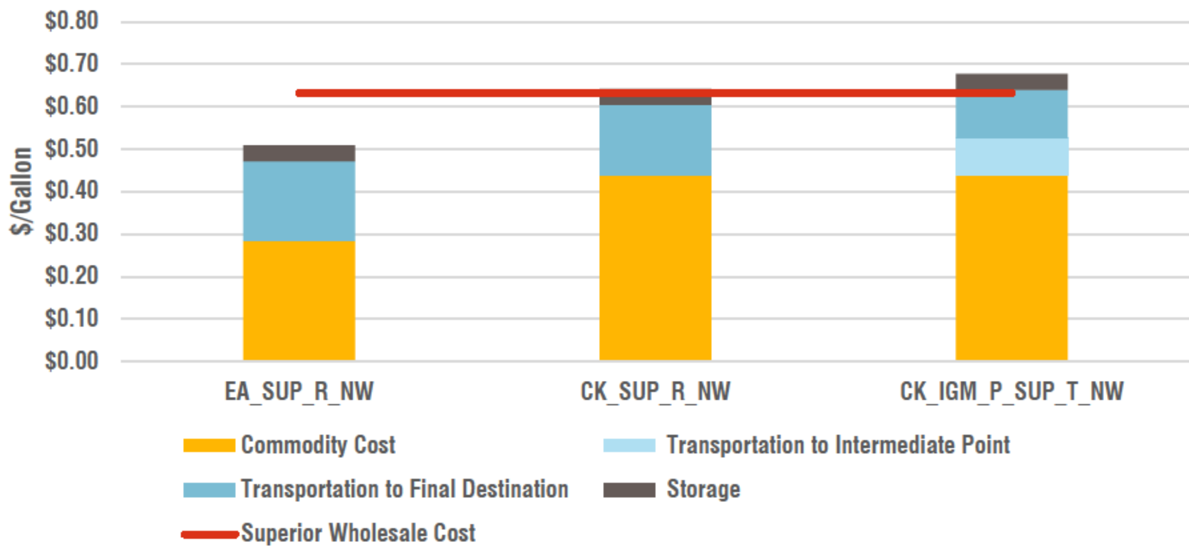
$$\begin{aligned} &\textit{Supply alternative cost} \\ &\quad = \textit{Commodity cost (hub price)} + \textit{transportation to intermediate point (if applicable)} \\ &\quad + \textit{Transportation from intermediate point to final destination} \\ &\quad + \textit{Incremental storage investment} \end{aligned}$$

In the reference case for Superior, the cost components of each of the three low-cost options is shown in Exhibit 30. Also shown is the prevailing market price for Superior to which PSC compared alternatives to determine the cost impact. Propane transported by rail to Superior is estimated to cost less than the average cost of propane for the time period analyzed.

[54] Earnest, Expert Report, Workpapers 1–5.

[55] Earnest, Expert Report, Workpaper 1

EXHIBIT 30. Low-cost Options for Alternative Propane Supply in Wisconsin



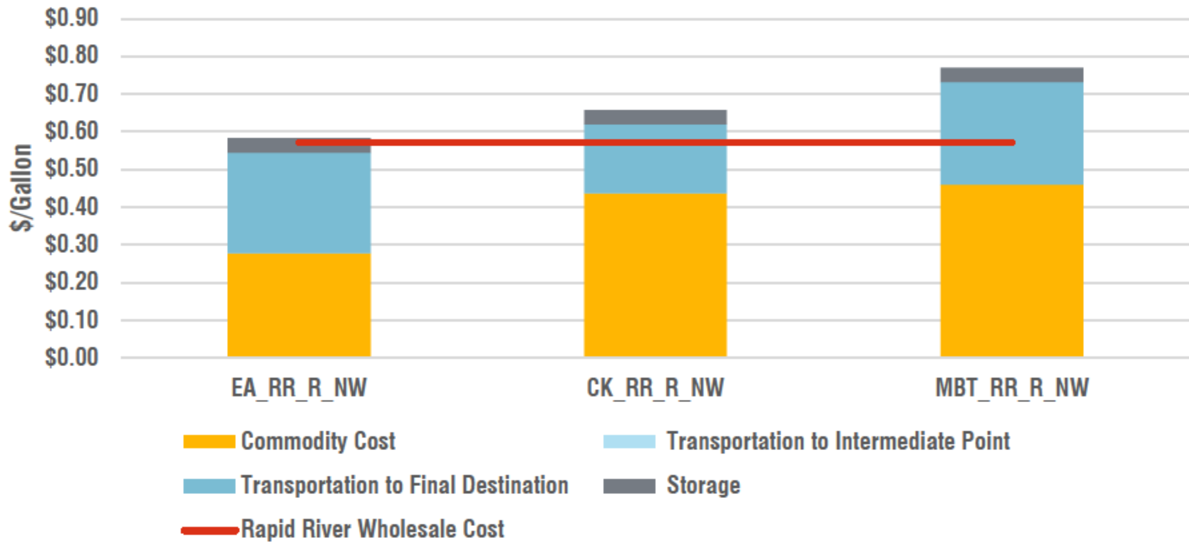
Source: PSC calculations

Upper Peninsula

For alternate supply to the Upper Peninsula of Michigan, Mr. Earnest assumes that propane is trucked from Marysville to Rapid River using the same trucking cost per mile assumption. In addition, Mr. Earnest adds a cost premium of $0.09/gallon assuming that Michigan's wholesale prices will rise to the level of propane prices in Indiana and Ohio. PSC estimates a much smaller impact on price and believes that adding a price increase to achieve parity may be double counting the impact of a Line 5 closure, i.e., the incremental cost of transportation assumed by Mr. Earnest will increase the cost of propane in Michigan, closing any price differential between states.

Using the same approach described for assessing options for Wisconsin, PSC modeled supply alternatives for the Upper Peninsula. Exhibit 31 shows the cost of three lowest-cost alternatives compared to the prevailing wholesale cost for the period analyzed.

EXHIBIT 31. Low-cost Options for Alternative Propane Supply for the Upper Peninsula



Source: PSC calculations

Note that while transportation costs are higher from Edmonton to Rapid River, the lower commodity cost more than offsets it, so propane transported by rail from Edmonton, Alberta, is the lowest-cost option. In addition, double counting is embedded in the price parity factor, Mr. Earnest's cost estimates are higher than PSC's because he fails to consider the advantage of lower commodity costs from other propane supply hubs and only considers trucking transportation rather than rail.

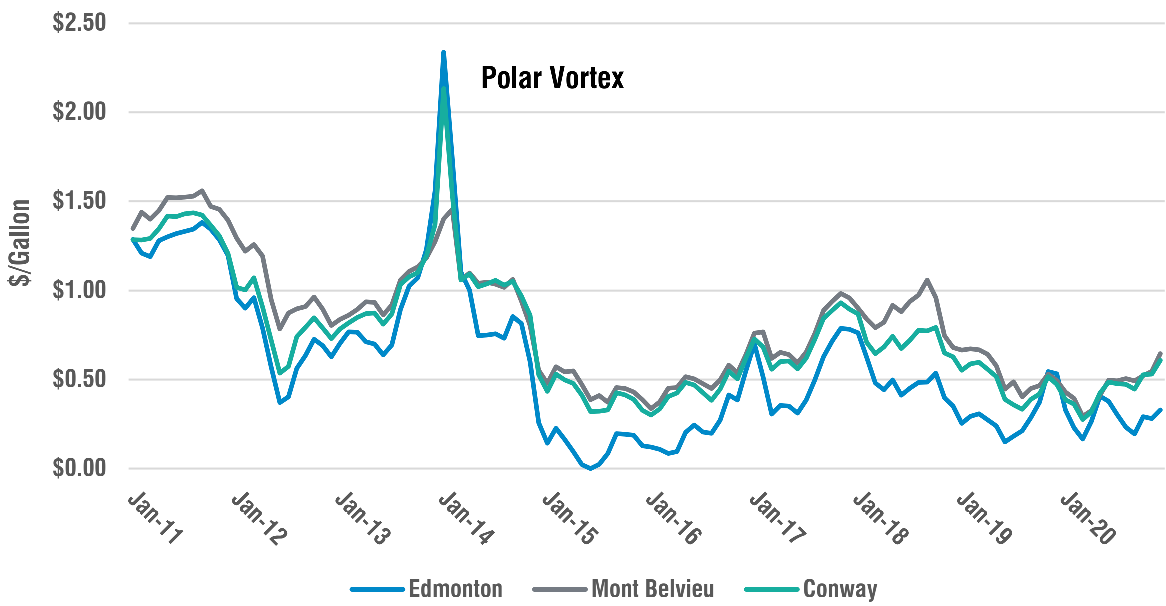
Lower Peninsula

To estimate the cost of alternate propane supply in the Lower Peninsula, Mr. Earnest calculates the cost of rail transportation from Mont Belvieu to Marysville minus costs that would have been incurred to bring propane to the Midwest region by pipeline. He adds to that cost the same cost premium to achieve price parity with neighboring states as he did for the Upper Peninsula cost estimates. Again, PSC disagrees with the addition of this component of his cost calculation.

PSC notes that there are significant differences in commodity costs at different hubs throughout North America. PSC procured propane spot price data from OPIS/IHS Markit for 2011–2020 at three major North American hubs: Mont Belvieu, Texas; Conway, Kansas; and Edmonton, Alberta.[56] Prices from these three hubs have differed historically, as shown in Exhibit 32, with the cost of propane from Edmonton consistently offered at lowest cost.

[56] Oil Price Information Service. n.d. "Spot Market Pricing Overview." *OPIS.* Accessed April 7, 2022. https://www.opisnet.com/product/pricing/spot/

EXHIBIT 32. Historical Propane Spot Prices at Selected North American Hubs



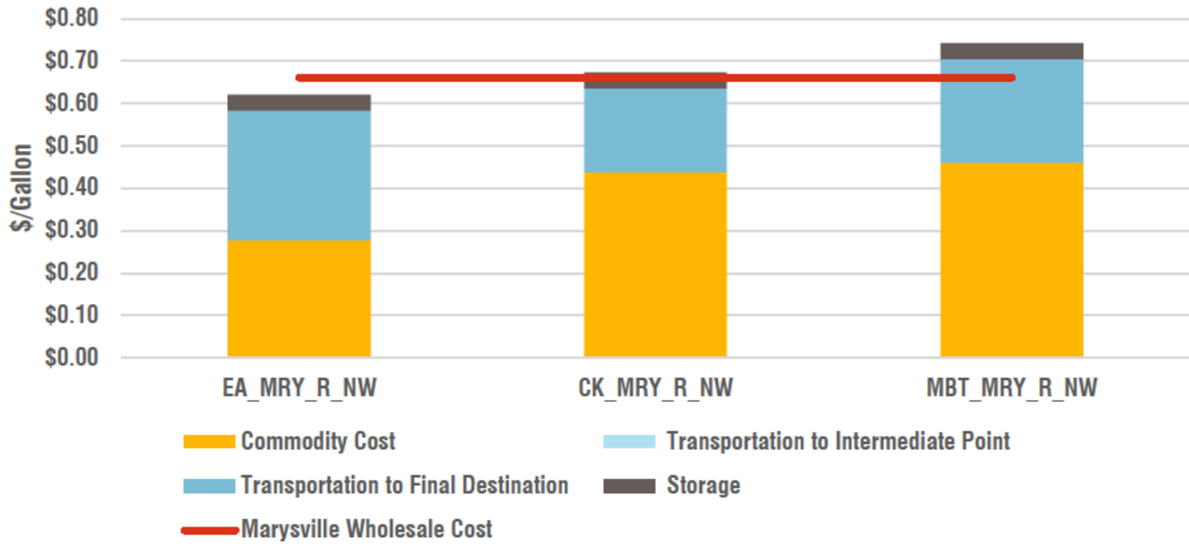
Source: OPIS n.d.

PSC's modeling approach allows for comparison of commodity costs, costs for different transportation options, and varying storage needs.[57] PSC modeling found supply options originating in Edmonton to consistently be the lowest-cost option; higher transportation costs are offset by lower commodity costs. Relying solely on propane from Mont Belvieu, as Mr. Earnest suggests, overestimates the cost impact to the Lower Peninsula.

The three lowest-cost options identified by PSC are shown in Exhibit 33.

[57] More storage is needed if propane is procured during nonheating months but buying "off peak" can provide cost advantages.

EXHIBIT 33. Lowest-cost Options for Alternative Propane Supply for the Lower Peninsula



Source: PSC calculations

Alternative Propane and Butane Supply in Ontario

Propane

Because of the lack of available pricing data, PSC did not perform the same detailed analysis of propane supply alternatives in Ontario. However, given the proximity of Marysville and Sarnia, extending the analysis conducted for the Lower Peninsula that included supply alternatives provides a reasonable proxy. PSC added costs to reflect transportation of propane from Marysville to Sarnia by truck. The additional truck transportation costs include transloading of propane from rail cars to trucks and unloading of propane in Sarnia. This is a conservative assumption because pipelines connect Marysville and Sarnia and may provide a lower-cost option for transporting propane between the two locations. Of the total [redacted] b/d of propane production in Sarnia, approximately [redacted] b/d or 650 million gallons are assumed to be consumed within Ontario.[58]

In the reference case, PSC estimates a $0.0002/gallon cost increase for propane delivered to Marysville. Applying that price increase to the volume of propane estimated to be replaced in Sarnia, PSC estimates an overall cost increase of just over $130,000 USD. Exhibit 34 shows the expected increase in propane costs over the scenarios PSC considered.

Similarly, Mr. Earnest used the per-gallon cost impacts for Marysville to calculate the total annual propane cost increase for Ontario; however, Mr. Earnest does not account for transportation costs from Marysville to Sarnia.[59] Still, Mr. Earnest's costs estimates are higher than PSC's for two primary reasons:

[58] As noted earlier, Mr. Earnest mentions, but does not quantify, additional sales from marketers of propane from Sarnia into Michigan. He estimates direct sales from Sarnia to Michigan at 13,000 b/d (Earnest, Expert Report, 19). PSC uses an estimate of 14,600 b/d which is higher than the amount identified by Mr. Earnest, but may not include all sales into Michigan.

[59] Earnest, Expert Report Workpaper 4. Note: This workpaper indicates the final calculation is "the total annual propane cost increase for the Lower Peninsula." PSC believes this was meant to be labeled "the total incremental cost increase for Ontario."

1) reliance on a single higher-cost supply alternative from Mont Belvieu and 2) application of a price parity factor to align prices with Indiana and Ohio.

In the most likely scenario, the reference case, the increased propane cost is less than one-fourth of what Mr. Earnest estimates. Even assuming 25 percent higher rail costs, PSC's estimate of cost impact in Ontario is lower than the regional cost impact of $83.1 million per year projected by Mr. Earnest.

EXHIBIT 34. Propane Cost Impacts in Canada by Scenario

Scenario	Per-gallon Price Impact in Marysville	Truck Transportation to Sarnia	Total Per-gallon Price Impact	Regional Cost
Reference	$0.0002	$0.0315	$0.0317	$20,750,535
High Rail Cost	$0.0383	$0.0315	$0.0698	$45,690,452
Short-term Disruption*	$0.2074	$0.0315	$0.2389	$52,127,263
Short-term Disruption with High Trucking Costs*	$0.2337	$0.0315	$0.2652	$57,865,844

Source: PSC calculations
Note: * Calculated as partial year impact.

Continued Operation of the Sarnia Fractionator

Mr. Earnest claims that the Sarnia fractionator will inevitably shut down in the face of a Line 5 closure. While PSC believes, as we have described, that the market would find alternative supplies of propane and butane for Sarnia, PSC is not convinced of Mr. Earnest's premise. PSC sees potential for continued operation of the Sarnia fractionator with NGLs from the Marcellus/Utica Shale Play. Mr. Earnest points to the different composition of NGLs that come from Western Canada and the more typical Y-grade, or raw and unseparated, NGLs that come from the Marcellus/Utica Shale as shown in Exhibit 35.

EXHIBIT 35. NGL Composition[60]

	Western Canada NGLs	Y-grade NGLs
Ethane	3.1%	38.9%
Propane	70.2%	35.1%
Butane	26.1%	16.0%
Natural Gasoline	0.6%	10.0%
Total	100%	100%

Source: Earnest, Expert Report, 21.

Mr. Earnest states that the capacity of the fractionator would need to double to be able to yield the same amount of propane and butane with Y-grade NGLs.[61] However, Sarnia has been processing about

[60] Earnest, Expert Report, 21.

[61] Earnest, Expert Report, 21.

80,000 b/d of NGLs, and the fractionator has capacity to process 130,000 b/d.[62] Utilizing the full capacity of the facility to process Y-grade NGLs would yield 81 percent of the current propane supply and 100 percent of the butane currently produced (Exhibit 36).

EXHIBIT 36. Production Potential Using Y-grade NGLs at Sarnia (B/d)

	Western Canada NGLs	Y-grade NGLs	Percentage of Current Production
Ethane	2,480	50,570	
Propane	56,160	45,630	81%
Butane	20,880	20,800	100%
Natural Gasoline	480	13,000	
Total	80,000	130,000	

Source: PSC Calculations

Currently, the Utopia pipeline delivers 50,000 b/d of ethane to Sarnia petrochemical plants and has the capacity to be expanded to 75,000 b/d.[63] If the pipeline were reconfigured to carry NGLs instead of ethane, the fractionator could serve the displaced ethane demand. Additional NGLs would be needed to operate the plant at full capacity, but this would significantly lessen the quantity of NGLs or propane and butane that would need to be shipped by truck or rail.

Butane by Rail

Mr. Earnest estimates the incremental cost of butane supply based on the cost to transport butane by rail to Marysville from Mont Belvieu, Texas, minus the cost that otherwise would be incurred to ship propane on the Texas Eastern Products Pipeline Company (TEPPCo) pipeline to the region. [64] Again, PSC's modeling approach allows comparison of the full cost of acquiring alternate supply, including the commodity cost and transportation.[65] Like propane, butane commodity costs from Mont Belvieu have historically been higher than the commodity cost from Alberta, as shown in Exhibit 37. [66,67]

[62] Sarnia-Lambton Economic Partnership. 2019. *Sarnia-Lambton Petrochemical & Refining Complex*. Accessed April 5, 2022. https://33sgq1wqdn71n18qv11fgblh-wpengine.netdna-ssl.com/wp-content/uploads/2019/11/SLEP-Petrochemical-and-Refining-Complex-Booklet.pdf

[63] Kinder Morgan. January 23, 2018. "Kinder Morgan Begins Operation of the Utopia Pipeline System." *Kinder Morgan*. Accessed April 7, 2022. https://ir.kindermorgan.com/news/news-details/2018/Kinder-Morgan-Begins-Operation-of-the-Utopia-Pipeline-System/default.aspx#:~:text=HOUSTON%2D%2D(BUSINESS%20WIRE)%2D%2D,%2C%20Canada%2C%20has%20commenced%20operation.

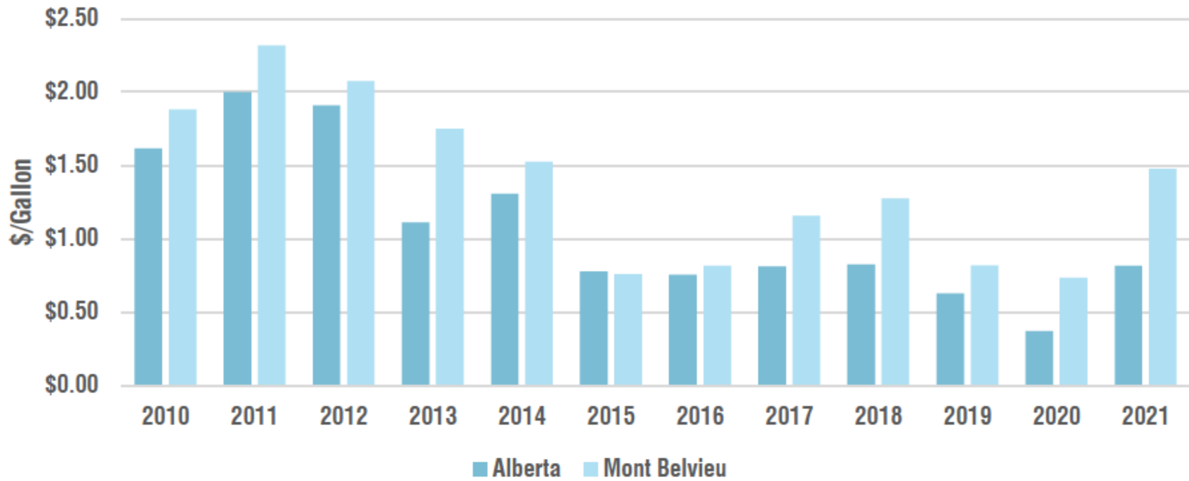
[64] Earnest, Expert Report, Workpaper 5.

[65] PSC did not consider storage for butane supplies because butane consumption is not seasonally driven like propane.

66 https://apps.cer-rec.gc.ca/CommodityStatistics/Statistics.aspx?language=English

[67] Prices for hydrocarbon gas liquids - U.S. Energy Information Administration (EIA)

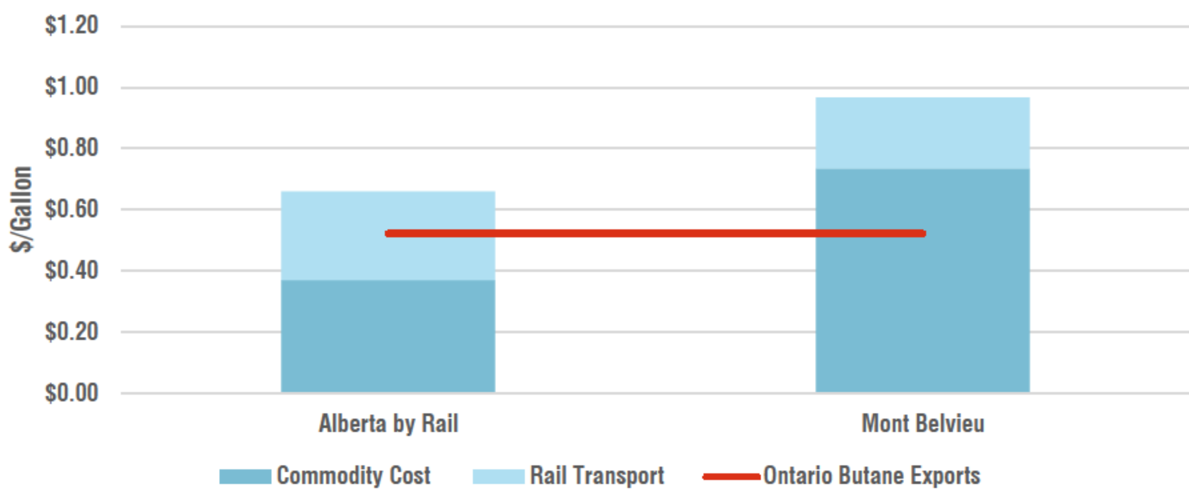
EXHIBIT 37. Butane Commodity Costs



Source: Canada Energy Regulator and EIA.

Using 2020 rail and butane commodity costs, PSC compared the cost of butane supplies from Alberta and Mont Belvieu by rail. These costs are compared to the average cost of butane exports from Ontario to estimate the cost impact from Line 5 closure.[68]

EXHIBIT 38. Cost of Butane Supply Alternatives



Source: PSC calculations

[68] Surface Transportation Board, Uniform Rail Costing System.

Exhibit 39 compares the per-gallon and regional cost impacts calculated by PSC and by Mr. Earnest.[69] Mr. Earnest's estimates are higher than PSC's because he fails to consider lower-cost butane supplies from Edmonton, Alberta.

EXHIBIT 39. Comparison of Estimates of Impact on Regional Butane Costs If Line 5 Closes

	Cost of Alternatives	Per-gallon Increase	Regional Cost Increase
Alberta by Rail	$0.6597	$0.1379	$45,275,629
Mont Belvieu by Rail	$0.9661	$0.4443	$145,843,263
Mr. Earnest's Expert Report	N/A	$0.1628	$53,435,947

Source: Earnest Expert Report and PSC calculations
Note: PSC believes Mr. Earnest's estimate may be understated based on the alternative source he has identified because it does not account for the higher cost of butane from Mont Belvieu compared to butane from Edmonton, Alberta.

Section Four: Considerations of Rail and Trucking Feasibility

In the testimony of William J. Rennicke from Oliver Wyman, Inc., Mr. Rennicke concludes that "shutting down Line 5 for any period of time would have substantial adverse impacts on the transportation and delivery of essential petroleum products in the affected region and elsewhere," and that "demand will remain the same if it is shut down."[70] Mr. Rennicke then goes on to argue that "this shortfall could not be satisfied by any alternate means of transportation, including rail, barge, or truck."[71]

As discussed in the opening sections of this report, PSC disagrees with the statement that the shortfall of NGLs could not be satisfied by any alternative means of transportation. According to PSC's analysis, both rail and truck could replace the NGL capacity of Line 5 with modest increases to the price for consumers. PSC understands that the Bad River Band has retained logistics experts who will address this issue in more detail, but offers here a few conclusions arrived at in the course of formulating its cost estimates, which counter to the assumptions and statements made by Mr. Rennicke.

Assumptions

In providing his report, Mr. Rennicke makes certain assumptions that which PS concludes are not fully supported.

Demand for Line 5 products—According to Mr. Rennicke, demand for Line 5 products will continue. He cites the report of Neil Earnest. While PSC does not dispute the assumption about demand for Line 5 products continuing, Mr. Rennicke does not attach any time parameters to his statement. In fact, experts currently disagree about the extent to which crude oil and NGLs will be in demand by 2050.[72]

[69] Earnest, Expert Report, Workpaper 5.

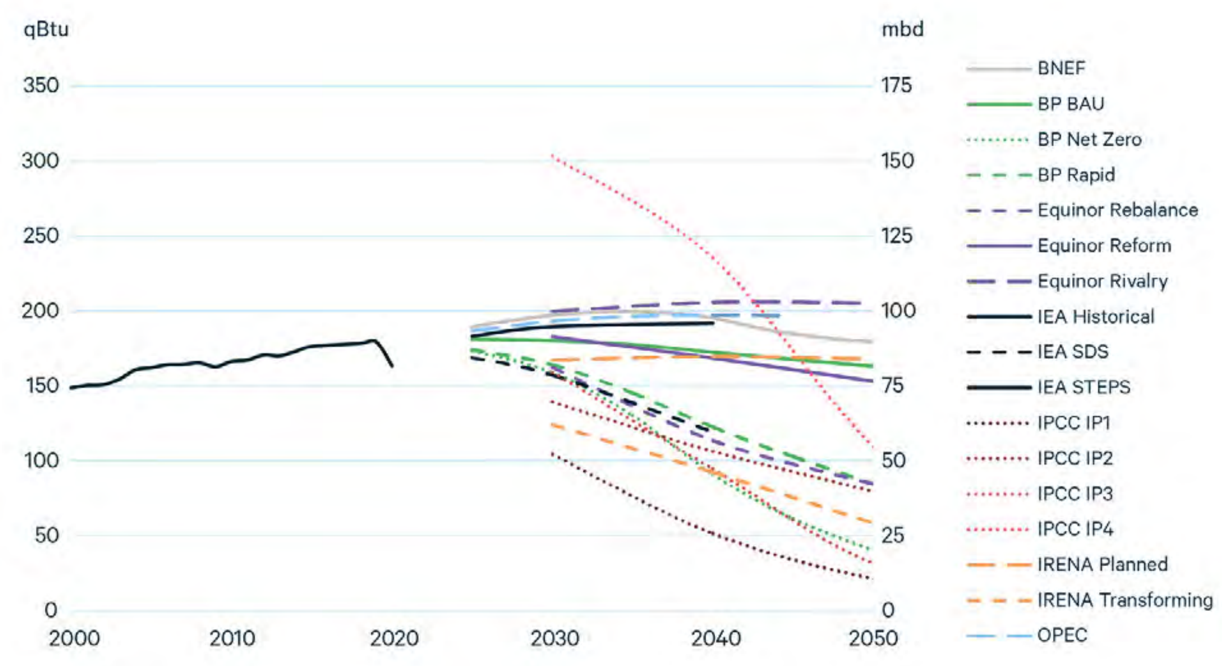
[70] Rennicke, Expert Report, 2.

[71] Rennicke, Expert Report, 2.

[72] Richard Newell, Daniel Raimi, Seth Vallanueva, and Brian Priest. June 2021. *Global Energy Outlook 2021: Pathways from Paris.* Accessed April 5, 2022. https://media.rff.org/documents/RFF_GEO_2021_Report_1.pdf

Exhibits 40 and 41 show projections for global oil and natural gas demand, respectively, to 2050 from a wide variety of organizations, including the International Energy Agency (IEA), British Petroleum, the Organization of the Petroleum Exporting Countries (OPEC), and the Intergovernmental Panel on Climate Change (IPCC). These projections take into consideration different scenarios, including scenarios that consider policy actions to address climate change. The scenarios for both oil and natural gas show that there are different perspectives on projected demand for these fuels through 2050. Organizations and sources contributing to these projections are shown in Exhibit 42.

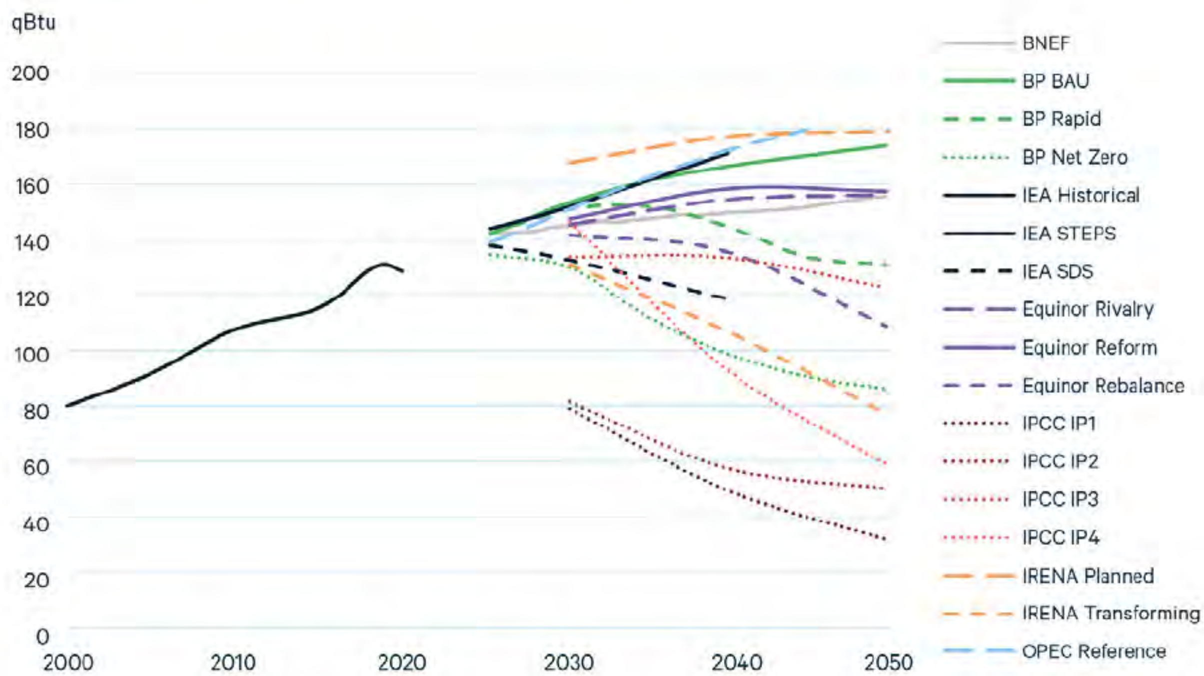
EXHIBIT 40. Global Oil Demand Projections to 2050[73]



Source: Newell, Raimi, Vallanueva, and Priest 2021

[73] Richard Newell, Daniel Raimi, Seth Vallanueva, and Brian Priest. June 2021. *Global Energy Outlook 2021: Pathways from Paris.* Accessed April 5, 2022. https://media.rff.org/documents/RFF_GEO_2021_Report_1.pdf

EXHIBIT 41. Global Natural Gas Demand Projections to 2050[74]



Source: Newell, Raimi, Vallanueva, and Priest 2021

EXHIBIT 42. Organizations and Sources of Oil and Natural Gas Demand Projections[75]

Acronym	Source	Dataset	Scenario	Years*
BNEF	Bloomberg New Energy Finance (BNEF)	New Energy Outlook 2020	Economic Transition Scenario	To 2050
BP BAU	British Petroleum (BP)	Energy Outlook 2020	Business-as-usual	To 2040
BP Rapid			Rapid transition	
BP Net Zero			Net Zero	
IEA Historical	International Energy Agency (IEA)	Historical (2018, 2021)	-	1970-2015, 2020
IEA STEPS		World Energy Outlook 2020	Stated Policies Scenario (STEPS)	To 2040
IEA SDS			Sustainable Development Scenario (SDS)	To 2040

[74] Newell, Raimi, Villanueva, and Priest, *Global Energy Outlook 2021.*

[75] Newell, Raimi, Villanueva, and Priest, *Global Energy Outlook 2021.*

Acronym	Source	Dataset	Scenario	Years*
Equinor Reform	Equinor	Energy Perspectives 2020	Reform	To 2050
Equinor Renewal			Renewal	To 2050
Equinor Rivalry			Rivalry	To 2050
IPCC IP1	Intergovernmental Panel on Climate Change	Special Report on 1.5°C	Illustrative Pathway 1	To 2100
IPCC IP2			Illustrative Pathway 2	
IPCC IP3			Illustrative Pathway 3	
IPCC IP4			Illustrative Pathway 4	
IRENA Planned	International Renewable Energy Agency (IRENA)	Global Renewables Outlook	Planned Energy Scenario	To 2050
IRENA Transforming			Transforming Energy Scenario	
OPEC Reference	Organization of the Petroleum Exporting Countries	World Oil Outlook 2020	Reference	To 2045

Source: Newell, Raimi, Vallanueva, and Priest 2021; BloombergNEF 2020; IEA 2020; Equinor 2020; IPCC 2020; IRENA 2020; OPEC 2021

Focus on the rerouting of Line 5 and its impact on investment in alternatives—Mr. Rennicke focuses his report on the projected rerouting of Line 5 for 41 miles around the Bad River Reservation, and he uses the estimated time it would take to permit and construct this route to make claims about the feasibility of investment in alternatives. More specifically, Mr. Rennicke argues that the uncertainty around the time it would take for permitting and construction would make "capital investments in any alternate transportation mechanisms and/or any alternate route extremely unlikely."[76] While he does not offer a projected time frame to accomplish any reroute, he does at different points cite between three and five years. He does not consider permanent Line 5 closure as an option, and he does not say whether long-term or permanent closure of Line 5 would increase the feasibility of private or public investment in alternatives.

Even accepting Mr. Rennicke's premises as correct for the moment, his conclusions do not follow. On the feasibility of investment within a three- to five-year time frame, for example, PSC engaged three different rail car providers to discuss leasing rail cars for the purpose of shipping NGL. The companies were identified through a basic internet search, and PSC reached them by both phone and email. These companies were willing to cite prices and availability of rail cars for three- to five-year leases. While PSC engaged these providers for research purposes, it is unclear why an investor would not be able to, or would be unlikely to, identify and engage these same companies for the sake of an investment opportunity.

[76] Rennicke, Expert Report, 8.

Diversification of supply and transportation options—In his analysis, Mr. Rennicke focuses on single transportation options for replacing Line 5 volumes, rail or truck, and he considers these from a limited number of locations. He does not discuss if and how transportation options could be combined, using rail and truck together, to mitigate feasibility issues associated with any one transportation method or supply origin point. His suggestion that a competitive marketplace would settle on only one mode of transportation from one region of North America to replace Line 5's supply of NGLs is highly unrealistic.

Feasibility of Trucking

Mr. Rennicke argues that trucking is not a feasible option for transporting Line 5 products. More specifically, he argues that trucking would not be able to transport the 226.7 thousand barrels per day (kbd) of crude oil and the 83.9 kbd of NGLs now transported by Line 5 that, according to Mr. Rennicke, could not be diverted to other pipelines. While Mr. Rennicke does not break out his analysis by crude oil and NGLs, he estimates that 1,531 trucks would be needed to leave and return to Superior each day, and he assumes that one tanker truck can haul 190 barrels of crude or 248 barrels of NGLs.[77] Using Mr. Rennicke's same assumptions, PSC calculates that this would equate to approximately 1,193 trucks (78 percent) needed to transport the crude oil and 338 trucks (22 percent) needed to transport the NGL. Again, this is based on the highly unrealistic assumption that the market would work to replace Line 5 feedstock in only one way. Based on this assumption, Mr. Rennicke provides arguments against the feasibility of trucking, and PSC addresses those arguments related to the need to construct loading/unloading facilities and storage and limitations of tanker fleet and drivers in the following section.

Need to construct loading/unloading facilities and storage—Mr. Rennicke argues that transloading facilities would need to be built at Superior for loading and Sarnia and other refineries for unloading at a cost approaching $1 billion. He states that this investment would be unlikely because of the long lead times for permitting and construction and the impracticality of operating the necessary volume of trucks.

In citing long lead times for permitting and construction, Mr. Rennicke assumes time constraints related to the construction of a potential 41-mile rerouting of Line 5 around the Bad River Band reservation. These time constraints would not hold if the permanent closure of Line 5 were under consideration. When it comes to transloading specifically, there is also the possibility of using portable transloading equipment, which would not require the same permitting and construction time as permanent facilities. Portable equipment could be provided at a similar or lesser cost, and these transloaders could be repurposed to other locations if supply or demand requirements were to change in the future. The Michigan Department of Transportation (MDOT) also discusses the benefits of portable transloaders in their Propane by Rail report, and, according to PSC interviews with transloading manufacturers, the portable NGL transloaders used for rail can also be used for transloading to and from tanker trucks.[78]

Feasibility of Rail

In Section I of his report, "Introduction, Qualifications, and Key Findings," Mr. Rennicke states that "rail is not a viable option to transport the crude oil or NGL shortfall for numerous reasons."[79] In Section III of

[77] Rennicke, Expert Report, 21.

[78] Michigan Department of Transportation, Office of Rail. November 30, 2021. *Propane by Rail in Michigan's Upper Peninsula*. Accessed April 8, 2022. https://www.michigan.gov/documents/mdot/Propane_by_Rail_in_Michigans_Upper_Peninsula_745595_7.pdf

[79] Rennicke, Expert Report, 3.

his report, Mr. Rennicke changes his emphasis, stating that "rail transportation of Line 5 products would face serious hurdles."[80] Mr. Rennicke also discusses how "rail often provides transportation to refineries where pipelines are not available or have insufficient capacity."[81] As of December 2019, according to Mr. Rennicke, rail in North America transported an average of 314.7 kbd of crude oil from the Midwest.[82]

According to Mr. Rennicke, a Line 5 shutdown would create a sudden influx of volume, and this would create a "range of problems that are unlikely to be resolved during the uncertain period during which Line 5 would be shut down."[83] Thus, he is not arguing that rail is not feasible per se, but, as with the feasibility of truck, Mr. Rennicke is focusing his attention on a limited time frame, the time he suggests it would take to construct an alternative route around the Bad River Reservation.

PSC disagrees with Mr. Rennicke's statement on the feasibility of rail overall, as shown in the first section of this report. According to PSC analysis, NGL can be delivered to Superior, Wisconsin (or other sites in Wisconsin), and sites in Michigan at modest cost to the consumer.

PSC addresses some of the problems with rail outlined by Mr. Rennicke as they relate to the cost modeling conducted for this report.

Lack of sufficient rail cars—Mr. Rennicke estimates that a fleet of 1,103 high-pressure tank cars on a ten-day cycle time or 1,324 high-pressure tank cars on a 12-day cycle time would be required to move the approximately 83.9 kbd of NGLs from Edmonton to Sarnia over the most direct rail route.

PSC was unable to replicate Mr. Rennicke's estimates on the total rental cost for rail cars. Mr. Rennicke quotes an average cost of $850 per month per rail car, and he states that it would cost over $52 million for 4,000 rail cars at that price. Using the same estimates of $850 multiplied by 4,000 rail cars over 12 months, PSC came to $40.8 million. PSC researchers were unable to determine if there was a reason for Rennicke's $11.2 million overestimation beyond that of mathematical error. Note that in the appendix on page 69 of his report, he cites $1,000 for the cost per month per rail car. PSC attempted the calculations using this figure as well and, at $48 million, was still short of the $52 million Mr. Rennicke estimated.[84]

In developing assumptions for NGL, PSC interviewed three private rail companies to estimate a monthly rental fee for railcars of $712.50 per month per car for a five-year operational lease. This fee was used to calculate the total railcar cost per month depending on the number of cars used. If applied to Mr. Rennicke's 4,000 rail car assumption, the overall cost would be approximately $34.2 million, which is $18 million, or 34 percent, lower than Mr. Rennicke's estimate.

Insufficient rail terminal loading and unloading capacity along the Edmonton-Sarnia Corridor—Mr. Rennicke states that there are currently "no facilities to unload NGLs from rail at Sarnia," and "no crude oil or NGL facilities have ever been built there to serve local refineries."[85] He also states that "additional storage tanks would need to be constructed to allow uninterrupted flow of gas liquids to the fractionation plant," and these investments in unloading and storage would be "expensive and take years to complete,

[80] Rennicke, Expert Report, 31.

[81] Rennicke, Expert Report, 31.

[82] Rennicke, Expert Report, 31.

[83] Rennicke, Expert Report, 30–31.

[84] Rennicke, Expert Report, 69.

[85] Rennicke, Expert Report, 39–40.

given the time required for permitting and construction, and therefore it is highly unlikely that rail could serve as an alternative to transporting NGLs to fractionators by pipeline."[86]

In this objection to the feasibility of rail, Mr. Rennicke is focused on the use of rail to serve local refineries and fractionators, which is a different issue than the feasibility of supporting these areas and the residents of these areas with the delivery of propane and butane directly from Edmonton or other markets.

In citing long lead times for permitting and construction as a barrier to feasibility, Mr. Rennicke assumes time constraints related to the construction of a potential 41-mile rerouting of Line 5 around the Bad River Band reservation. These time constraints would not hold if the permanent closure of Line 5 were under consideration.

When it comes to transloading specifically, there is also the possibility of using portable transloading equipment, which would not require the same permitting and construction time as permanent facilities. Portable equipment could be provided at a similar or lesser cost, and these transloaders could be repurposed to other locations if supply or demand requirements were to change in the future. According to MDOT's Propane by Rail report, mobile transloading equipment would transfer propane directly from railcar to truck, and the "transload operation could be established using existing rail infrastructure."[87] The report goes on to explain that "because transloaders are mobile, no fuel handling infrastructure would need to be constructed, reducing the capital cost. Transloaders would not represent a sunk cost. If pipeline service were disrupted and then restored in several years and the need for rail unloading capacity were to decrease, the transloading equipment could be repurposed elsewhere."[88]

While storage for the purpose of providing an uninterrupted flow of gas liquids to the fractionation plant could require additional investment, Mr. Rennicke does not discuss the use of existing NGL storage capacity in the Sarnia area. According to MDOT, there are 582 million gallons of storage available (13.9 million barrels) in the Lower Peninsula and another 785 million gallons (18.7 million barrels) in the Sarnia-Windsor area.[89]

When it comes to the feasibility of investment in rail terminals, there is funding and financing available through the Bipartisan Infrastructure Law that could facilitate investment by private and public entities. According to the White House Build Back Better Framework, there is $66 billion in total rail funding available, and there is also financing available through the Railroad Rehabilitation & Improvement Financing (RRIF) program.[90]

Higher rail transportation costs compared to pipeline—According to Mr. Rennicke, rail is not a feasible alternative to pipeline because it is more expensive, and he estimates that rail costs 3.4 times more to transport one barrel of NGL from Edmonton, Alberta, to Sarnia, Ontario. More specifically, he estimates

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[86] Rennicke, Expert Report, 41.

[87] Office of Rail, *Propane by Rail*, 26.

[88] Office of Rail, *Propane by Rail*, 26.

[89] Office of Rail, *Propane by Rail*, 19.

[90] The White House. 2021. *Building a Better America: A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners.* Accessed April 8, 2022. https://www.whitehouse.gov/wp-content/uploads/2022/01/BUILDING-A-BETTER-AMERICA_FINAL.pdf; U.S. Department of Transportation, Build America Bureau. February 25, 2022. "Railroad Rehabilitation & Improvement Financing (RRIF)." *Build America Bureau.* Accessed April 8, 2022. https://www.transportation.gov/buildamerica/financing/rrif

the rail price at $18.31 per barrel compared to $5.46 per barrel, which he quotes as the Enbridge tariff for NGL.

EXHIBIT 43. NGL Transportation Price Comparison, Edmonton to Sarnia/Marysville

Source	Product	Route	Pipeline cost ($ per bbl)	Rail cost ($ per bbl)	X Higher
Rennicke	NGL	Edmonton to Sarnia Terminal	5.46	18.31	3.4
PSC	NGL	Edmonton to Marysville Terminal	5.46	11.79–12.84 depending on capacity utilization	2.2–2.4

Source: Rennicke, Expert Report, 63; PSC calculations

PSC's estimate for a similar route, from Edmonton, Alberta to Marysville, Michigan, is $11.79 per barrel, which would be just 2.2 to 2.4 times the cost of the Enbridge tariff.[91] PSC can not specify why Mr. Rennicke's cost estimate is so much higher than PSC's. As noted in Section 3, PSC's rail car estimates include rail car leasing, freight charges, investment in transloaders and storage, and labor associated with loading and unloading of rail cars.[92]

Feasibility of Alternative Transportation of Propane/Butane During Fractionator Closure

In the last section of his report, Mr. Rennicke states that "the Superior, Rapid River, and Sarnia fractionators will close if Line 5 shuts down, and there is no feasible alternative to supply them with the required volumes of NGLs."[93]

Edmonton to Superior—For truck and rail to Superior, Mr. Rennicke acknowledges that the relatively low volume "makes it feasible that sufficient rail or truck fleets could be acquired to ship propane from Edmonton" in order to replace the supply of propane provided by the Superior fractionator.[94] However, he argues that the 2,400-mile round trip would make trucking "an unlikely move for economic reasons."[95] He then goes on to say that rail would be more "economically viable," but at low volumes it would be "unlikely that railroads would place a high priority on such a low volume movement."[96]

Mr. Rennicke does not define economically viable, and he does not cite evidence for why these different approaches would not be economically viable. Paradoxically, he argues that low volumes would make it unlikely that railroads would prioritize this movement, which would imply that larger volumes transported by rail would be more likely to be prioritized, and therefore feasible, if rail cars could be

[91] Enbridge. September 29, 2021. *Interim CER No. 492, FERC No. 45.27.0.* Accessed April 8, 2022. https://www.enbridge.com/~/media/Enb/Documents/Tariffs/2021/CDMN%20CER%20492%20FERC%2045270%20LKH.pdf

[92] Surface Transportation Board. n.d. "Uniform Rail Costing System." *Surface Transportation Board.* Accessed April 7, 2022. https://www.stb.gov/reports-data/uniform-rail-costing-system/

[93] Rennicke, Expert Report, 63.

[94] Rennicke, Expert Report, 64.

[95] Rennicke, Expert Report, 64.

[96] Rennicke, Expert Report, 64.

secured. PSC's rebuttal focuses on the fact that alternative transportation of NGLs or propane is feasible, including at higher volumes as needed to replace the transportation by Line 5. PSC agrees that it would be feasible to transport NGLs or propane by rail, which is argued in this report, and has also argued that truck is feasible at a modest cost increase to consumers.

Edmonton to Rapid River—With regard to Edmonton to Rapid River, Mr. Rennicke makes similar arguments—that it would be feasible to supply Rapid River with propane directly from Edmonton at low volumes because trucks and drivers could be located, but the 3,000 round trip would make it economically "infeasible" for trucking.[97] Mr. Rennicke does not define economically infeasible. PSC argues in this report that it would be feasible to supply Rapid River at a modest increase in the cost of propane to consumers. Mr. Rennicke further states that it would be infeasible to supply Rapid River by rail from Edmonton, since the terminal is not rail served. He does not discuss the possibility of investing in alternative rail transloading facilities.

According to a recent MDOT report, there are potential sites in the Upper Peninsula where additional investment in rail unloading capacity has been planned or proposed.

- Sawyer rail terminal—A new rail unloading facility has been proposed for the K.I. Sawyer Airforce Base in Marquette County. The site could unload 700 rail cars of propane per year and store 450,000 gallons of propane. The estimated project costs are $6.5 million.[98]
- Rapid River rail terminal—MDOT also discussed the possibility of extending rail service to the Rapid River fractionator facility via a 1.75-mile rail spur, which they estimate could cost approximately $25 million. If rail served, Rapid River could distribute propane that arrives by rail, and fractionation would not be needed.[99]
- Other potential sites exist in Humboldt, Ishpeming, Negaunee, Escanaba, Menominee, and Iron Mountain.[100]

As discussed above, there is also funding and financing available through the Bipartisan Infrastructure Law that could facilitate investment in terminals by private and public entities. According to the White House Build Back Better Framework, there is $66 billion in total rail funding available, and there is also financing available through the Railroad Rehabilitation & Improvement Financing (RRIF) program.[101]

He does not discuss the possibility of alternative approaches for providing NGLs to parts of the Upper Peninsula by rail by transporting to intermediate points such as Superior or Kincheloe and then trucking NGLs from these locations to destinations in the Upper Peninsula, including Rapid River. Kincheloe is currently completing a $2.7 million rail facility enhancement, and according to MDOT, "once completed, the propane unloading facility in Kincheloe along with other rail unloading locations will have enough capacity to meet the needs of the eastern portion of the Upper Peninsula."[102]

Edmonton or Superior to Sarnia—Mr. Rennicke argues that it would not be feasible for trucks or rail to deliver NGLs to Sarnia. For trucks, he argues that delivery would not be feasible due to the number of

[97] Rennicke, Expert Report, 64.

[98] Office of Rail, *Propane by Rail*, 29.

[99] Office of Rail, *Propane by Rail*, 29.

[100] Office of Rail, *Propane by Rail*, Page 29–31.

[101] The White House, *Building a Better America*; U.S. Department of Transportation, "Railroad Rehabilitation."

[102] Office of Rail. November 30, 2022. Propane by Rail in Michigan's Upper Peninsula. *Michigan Department of Transportation.* Page 26.

trucks required (300 per day), and the distance, quoting 700 miles in each direction.[103] This again depends on his highly unrealistic assumption that all Line 5 NGL supply would be made up from one region using one mode of transportation. PSC discussed these objections in the trucking material above regarding how diversity of supply from different sites could mitigate the number of trucks and distance for any given site, using Superior, Wisconsin as an example. Sarnia communities are also partnering on an oversized load corridor, a dedicated transportation route that will facilitate the movement of freight in the area.[104]

Mr. Rennicke argues that rail is not viable for Sarnia because of a lack of unloading facilities. Among other things, this ignores the possibility of investing in portable transloaders as a means of addressing increased supply. These transloaders could be repurposed to other locations if supply or demand requirements were to change in the future. Sarnia rail facilities currently have a normal working capacity of 1,100 rail cars per day, with capacity to handle up to 1,600 rail cars per day.[105]

Section Five: Review of Economic Impacts from Fractionator Closures

In this section, PSC responds to the fractionator shutdowns in Rapid River, Michigan, and Superior, Wisconsin, as a result of a Line 5 closure modeled in the testimony titled *Report of Dr. Corbett Grainger January 31, 2022.* The section begins with an overview of input-output (IO) models and the IMPLAN software that both Dr. Grainger and PSC used in their testimonies. The section discusses the modeling results summary from IMPLAN, the different values provided by the software, and what each of the values means. PSC's results for value added, a measure of gross regional product (GRP), are much less than the total impact in Dr. Grainger's report, but the figures are a better representation of the total loss that will result from the fractionator shutdowns.

After an introduction to IO analysis and IMPLAN, PSC attempts to recreate Dr. Grainger's model of the fractionator shutdowns using the oil and gas extraction industry in IMPLAN and discusses why it is impossible to recreate his model without additional information on the methods and inputs. PSC then models the fractionator shutdown using the petroleum refineries sector at the state and county levels using a more appropriate sector for analysis and compares the firm's results to Dr. Grainger's.

PSC also discusses the economic benefit attributed to the fractionator purchases of natural gas and crude petroleum, the supply and demand for propane, and the additional economic benefit created by the purchase of rail and truck transportation that would replace Line 5. The remaining sections focus on the impacts to surrounding states in the Midwest, the tax impacts of a Line 5 shutdown, and the Canadian IO software used in Dr. Grainger's model.

[103] Rennicke, Expert Report, 65.

[104] Sarnia-Lambton Economic Partnership. 2019. *Sarnia-Lambton Petrochemical & Refining Complex.* Accessed April 5, 2022. https://33sgq1wqdn71n18qv11fgblh-wpengine.netdna-ssl.com/wp-content/uploads/2019/11/SLEP-Petrochemical-and-Refining-Complex-Booklet.pdf

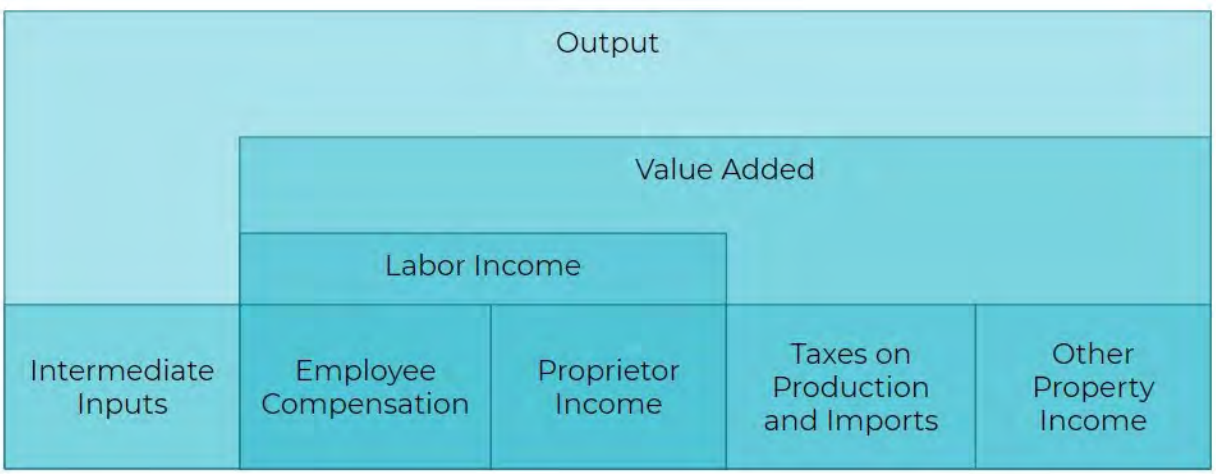
[105] Sarnia-Lambton Economic Partnership, *Sarnia-Lambton Petrochemical,* 5.

Overview of Input-output Models

IO analysis examines the relationships between industries within an economy and uses those relationships to determine the impacts of a change in economic activity or to measure the overall contribution of an industry or industries to a region.[106] Models are a collection of data and relationships used to describe an economic change to the best of our ability using the information available. The information available are often referred to as inputs and can represent aspects such as job loss or an increase in production of a given good. The relationships between inputs and model results (outputs) are determined by a given production function.

In PSC's review of Dr. Grainger's testimony, researchers utilized IMPLAN, a widely used economic IO model that focuses on interdependence among various producing and consuming sectors in the economy. IMPLAN uses the Leontief production function (LPF) to determine how each industry allocates total output. Traditionally, the LPF denotes output as a function of fixed proportions of capital and labor. IMPLAN modifies the LPF formula to consist of additional variables beyond just capital and labor when estimating output. These are intermediate inputs, employee compensation, proprietor income, taxes, and other property income.[107] The relationship between output and the other portions of the production function is highlighted in Exhibit 44.

EXHIBIT 44. IMPLAN Formula for Total Output[108]



Source: Lucas 2020

The data used in IMPLAN come from various government agencies, including the U.S. Census Bureau, the U.S. Bureau of Labor Statistics, and the U.S. Bureau of Economic Analysis. IMPLAN utilizes the standard key assumptions of IO analysis, which are summarized in greater detail on their website.[109]

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[106] Analysis can be performed at the firm level as well.

[107] Commonly referred to as profit.

[108] Maria Lucas. February 26, 2020. "Understanding Output." *IMPLAN*. Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/360035998833-Understanding-Output

[109] Candi Clouse. April 16, 2021. "Overview of Assumptions of Input-output Analysis." *IMPLAN*. Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/360044458734-Overview-of-Assumptions-of-Input-Output-Analysis

IMPLAN Modeling

IMPLAN Results Summary

The IMPLAN software provides four primary economic indicators to summarize the modeled effects: employment, labor income, value added, and output.[110] For each of these indicators, IMPLAN summarizes the direct, indirect, and induced effects of the modeled scenario. These effects can be summarized using the following:

- Direct effects: The economic activity supported directly by a facility.[111] This includes employees, wages and benefits paid, value added generated, economic output, taxes paid, etc.
- Indirect effects: The economic activity supported through business-to-business purchases of goods and services in a region, such as key supply chain inputs.
- Induced effects: The economic activity supported through direct and indirect employee spending in their local communities, such as on housing, restaurants, and retail stores.
- Total effects: The sum of direct, indirect, and induced economic effects.

See Exhibit 46 for an example of a complete summary results table. Employment is a mix of full-time, part-time, and seasonal employment and includes wage and salary employees and proprietors. Labor income is the sum of the total wages and benefits paid to employees and any income generated by proprietors.[112] These two summary indicators are easily understood when reported and commonly used to estimate economic impact on a given region. The next section summarizes value added and output and how to appropriately report IMPLAN results using those values.

Output Compared to Value Added

Value added is the difference between output and intermediate inputs and is equivalent to gross regional product, gross state product (GSP), or gross domestic product depending on the region evaluated.[113,114] Value added includes employee compensation, proprietor income, taxes, and profits. Output includes all of the pieces of value added plus intermediate inputs, represents the total annual production value for each industry, and is equal to revenue plus net change in inventory.[115] Selling out of inventory does not generate indirect and induced impacts because the commodity was produced in a prior year and would overstate total output if included in the summary results.[116] Conceptually, output can be thought of as total revenue for nonretail industries.

When reporting IMPLAN modeling results, it is important to conceptualize what the summary results mean. For example, when estimating the impact of a new factory opening or closing, value added represents the factory's addition to or subtraction from gross regional product and is an accurate overall measure of the facility's benefit to or loss from a region. Output will be greater because it includes value

[110] IMPLAN provides additional detailed results on various topics, such as taxes, other sectors affected, etc.

[111] In the case of a factory shutdown or loss of industry in a region, the activity supported would be lost (i.e., the economic activity supported directly by a factory that was lost as a result of a shutdown).

[112] The sum of total wages and benefits to employees is also referred to as employee compensation.

[113] The BEA defines intermediate inputs as "goods and services that are used in the production process of other goods and services and are not sold in final-demand markets.

[114] Gross regional product is similar to GSP but for a given region, such as a county or set of counties.

[115] Net change in inventory is the difference between additions to inventory and sales out of inventory.

[116] Lucas, "Understanding Output."

added in addition to intermediate inputs (goods and services not sold in final-demand markets); however, output is likely a less accurate estimate of the facility's total impact on a region because it represents total revenue rather than the addition or subtraction from gross regional product. According to IMPLAN, "Output is simply a measure of the total value of all goods produced—value added is a subset of output and is a useful measure of wealth created by an economy."[117] Furthermore, output is duplicative in nature because calculating output requires output from other industries and double counts if used as a measure of aggregate production.[118] In summary, value-added is a more appropriate metric to use when reporting economic impact results and, at the very least, should be reported with output to provide context for the results.

Dr. Grainger does not discuss valued added in his report even though typical industry practice is to report value added if output is also reported. Instead, he relies on output for describing the economic impacts.[119] Accordingly, he overstates the economic loss of the fractionator shutdowns due to a Line 5 closure throughout his opinion. Specific consequences of such overstatement are discussed below, but this leads to an overestimate of the economic loss due to the shutdown of over four times the impact to GSP. IMPLAN would have reported the value-added figure in the summary results, and this figure would have provided additional context for the analysis if provided by Dr. Grainger. IMPLAN notes that, "while output is an essential statistical tool needed to study and understand the interrelationships of the industries that underlie the overall economy, because of its duplicative nature it may not be a good stand-alone indicator of the overall health or contribution of an industry."[120] Exhibit 45 provides a summary table highlighting the summary results table in IMPLAN and the figures that Dr. Grainger did not report in his analysis that would have allowed for additional comparison and discussion of modeling results.

Fractionator Shutdown Model of Oil and Gas Extraction

Dr. Grainger notes that, in the event of a Line 5 shutdown, it is likely that fractionators in Superior, Wisconsin (Douglas County) and Rapid River, Michigan (Delta County) would close.[121] He then models the impact of the fractionator shutdown using an industry output event in IMPLAN. PSC attempted to recreate Dr. Grainger's model to the extent possible given the information and modeling inputs provided in his testimony: *Report of Dr. Corbett Grainger January 31, 2022*.[122]

The first step in IMPLAN is selecting the regions where the impact will take place. IMPLAN allows users to select down to the county level, but Michigan and Wisconsin may have been selected for Dr. Grainger's model given the size of the total impact noted in his testimony—Dr. Grainger does not explain which regions he selected in his testimony. PSC attempted to set up the initial fractionator shutdown model at both the state and county levels using an industry output event, IMPLAN sector 20—oil and gas extraction, and the following figures, which were provided in Dr. Grainger's testimony at page 12: [123,124]

[117] In terms of a shutdown, this would be loss of wealth.
[118] Clouse, "Output, Value-added, & Double-counting."
[119] Grainger, Expert Report, 3 and 13.
[120] Candi Clouse, "Output, Value Added, & Double-counting."
[121] Grainger, Expert Report, 12.
[122] Grainger, Expert Report, 12–15.
[123] Michigan and Wisconsin
[124] Delta County, Michigan, and Douglas County, Wisconsin

- A loss of $25.4 million in output and six jobs for the Rapid River facility
- A loss of $45.0 million in output and ten jobs for the Superior facility

In his report, Dr. Grainger notes that he utilized Multi-Regional Input-Output (MRIO), which allows users to estimate the effect of an economic impact in one region on a different region.[125,126]

While IMPLAN will produce modeled results at the state and county levels using these inputs, the results do not accurately represent the fractionator shutdowns because, according to the underlying region data in IMPLAN, Wisconsin does not have any wage and salary employees in sector 20, only proprietors. IMPLAN does allow users to create customized regions and add nonexistent sectors to a region in the event that the underlying data that IMPLAN relies on is not accurate in a given situation.[127] However, Dr. Grainger does not discuss creating wage and salary employment in sector 20 for Wisconsin for this analysis.

PSC researchers believe that IMPLAN is accurate in estimating zero-wage and salary employees for the oil and gas extraction industry in Wisconsin and that, as discussed in the next section, sector 154—petroleum refineries is a better representation of the fractionator operations in Michigan and Wisconsin. Given the absence of employees at the state level in Wisconsin, it is not surprising that Douglas County (where the Superior, Wisconsin, fractionator is located) also does not contain any nonproprietor wage and salary employees in sector 20. Michigan, however, does have employees in the oil and gas extraction industry. A more detailed description of Dr. Grainger's inputs and methodology would have allowed PSC researchers to re-create an analysis for comparison and discussion. Exhibit 45 summarizes the results presented in Dr. Grainger's testimony in the IMPLAN summary indicator format and can be compared to Exhibit 46, a completed example of the IMPLAN summary indicators. Dr. Grainger's labor income and value-added figures also would have allowed researchers to better understand his modeling results and compare them; however, they were not reported in his testimony.

EXHIBIT 45. Combined Dr. Grainger Impact Summary Results—IMPLAN Sector 20

Impact	Employment	Labor Income*	Value Added*	Output
1—Direct	16	Not reported	Not reported	$70,400,000.00
2—Indirect	198	Not reported	Not reported	$42,100,000.00
3—Induced	61	Not reported	Not reported	$8,800,000.00
Total	**275**	**Not reported**	**Not reported**	**$121,300,000.00**

Note: *Labor income and value added are not reported in Dr. Grainger's testimony.
Note: The model data and dollar year are not reported in Dr. Grainger's testimony.
Note: The analysis region(s) are not reported in Dr. Grainger report.

The numbers for the direct, indirect, and induced effects in the narrative of Dr. Grainger's report do not directly match those reflected in his exhibits. The basis for this discrepancy is unclear, but PSC

[125] Candi Clouse. May 18, 2021. "MRIO: Multi-Regional Input-output Analysis FAQ." *IMPLAN*. Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/115009510987-MRIO-Multi-Regional-Input-Output-Analysis-FAQ

[126] Grainger, Expert Report, 12.

[127] Maria Lucas. November 2, 2021. "Adding an Industry that Doesn't Exist Yet by Customizing a Region." *IMPLAN*. Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/360025897334-Adding-an-Industry-that-Doesn-t-Exist-Yet-by-Customizing-a-Region

researchers believe it to be an error in the report. Exhibit 45 above represents the economic impact summary results in the body of the testimony rather than in the exhibits in Dr. Grainger's report.[128,129] PSC used the direct results reflected in Exhibit 45 as model inputs for both county and statewide models.

Fractionator Shutdown Model of Petroleum Refineries

IMPLAN utilizes 546 sectors to model economic scenarios, and users choose the sector they believe accurately represents the real-world impacts being modeled. These sectors are based off of, and often aggregate, multiple six-digit North American Industry Classification System (NAICS) codes, which provide additional information on the industries represented by a given IMPLAN sector.[130,131,132] It is essential to select the correct sector(s) in order to produce accurate results in IMPLAN.

Dr. Grainger models the fractionator shutdown in Superior and Rapid River using IMPLAN sector 20—oil and gas extraction, which includes NAICS code 211120—crude petroleum extraction and 211130—natural gas extraction.[133,134] These industries focus on the extraction of crude petroleum and natural gas rather than the fractionation process. While NAICS code 211130 does include fractionating natural gas liquids, this is likely at the extraction site rather than at a separate refinery.

IMPLAN sector 154—petroleum refineries is a more accurate sector to use when modeling the shutdown of the fractionators because it is based on NAICS code 324110—petroleum refineries, which includes one or more of the following activities "(1) fractionation; (2) straight distillation of crude oil; and (3) cracking." Furthermore, that sector 154—petroleum refineries is the more accurate sector is further supported by the fact that IMPLAN includes no employees statewide in Wisconsin for sector 20—oil and gas extraction, but includes 92 employees for sector 154 in Wisconsin and 522 employees for sector 154 in Michigan.[135,136] Some level of employment in the sector chosen for analysis or some discussion of creating that sector in Wisconsin to accurately reflect the fact that there are employees at the Superior fractionator would be expected.

PSC re-created Dr. Grainger's model with sector 154—petroleum refineries (instead of Dr. Grainger's selected sector 20—oil and gas extraction) using industry output event and MRIO in IMPLAN. Researchers used all other aspects of Dr. Grainger's model given the information in his testimony and to the extent it is possible to ascertain his modeling methods. PSC modeled the impacts of the fractionator shutdown at both the state and county levels using Michigan and Wisconsin and Delta, Michigan, and Douglas, Wisconsin, Counties (i.e., the counties in which the Rapid River and Superior fractionators are

[128] Grainger, Expert Report, 12–15.

[129] Grainger, Expert Report ,14–15.

[130] The current list of 546 IMPLAN industries crosswalk with 2017 NAICS codes: https://support.implan.com/hc/en-us/articles/360034896614-546-Industries-Conversions-Bridges-Construction-2018-Data

[131] 2022 NAICS codes were released in 2021, but a crosswalk between IMPLAN sectors and the 2022 codes has not been released.

[132] Certain 546 codes represent a single six-digit NAICS code.

[133] U.S. Census Bureau. n.d.a. "211120 Crude Petroleum Extraction" *North American Industry Classification System.* Accessed April 5, 2022. https://www.census.gov/naics/?input=211120&year=2017&details=211120

[134] U.S. Census Bureau. n.d.b. "211130 Natural Gas Extraction." *North American Industry Classification System.* Accessed April 5, 2022. https://www.census.gov/naics/?input=211130&year=2017&details=211130

[135] U.S. Census Bureau. n.d.c. "324110 Petroleum Refineries." *North American Industry Classification System.* Accessed April 5, 2022. https://www.census.gov/naics/?input=324110&year=2017&details=324110

[136] These figures include wage and salary employees as well as proprietors, but the presence of employee compensation shows that a portion of these employees are not proprietors.

located, respectively) and also utilized the same model inputs for the state- and county-level models that Dr. Grainger used in his testimony:

- A loss of $25.4 million in output and six jobs for the Rapid River facility
- A loss of $45.0 million in output and ten jobs for the Superior facility

Dr. Grainger does not specify the data year or dollar year of his model, but all of PSC's results were calculated using IMPLAN data year 2019 and reported in 2021 dollars. IMPLAN suggests using the data year that looks most like the year being modeled. The most recent year of IMPLAN data is 2020, which presents additional economic considerations due to stimulus checks and other pandemic-related factors [137]

Statewide Model

Using the information available in Dr. Grainger's report, sector 154 rather than sector 20, and the same modeling method (to the extent it is possible to ascertain Dr. Grainger's methods from his testimony), Exhibit 46 summarizes the impacts of the fractionator shutdown at the state level (Michigan and Wisconsin). A detailed methods section in Dr. Grainger's testimony would have allowed PSC to better understand his model and compare his results to our own.

EXHIBIT 46. PSC Combined Statewide Impact Summary Results—IMPLAN Sector 154

Impact	Employment	Labor Income	Value Added	Output
1—Direct	16	$2,357,428.60	$22,442,170.78	$70,400,000.00
2—Indirect	110	$6,634,917.48	$10,709,130.18	$29,667,683.22
3—Induced	51	$2,556,912.45	$4,490,785.81	$7,929,993.16
Total	**177**	**$11,549,258.53**	**$37,642,086.76**	**$107,997,676.38**

Source: PSC calculations in IMPLAN.
Note: Totals may not sum due to rounding.

PSC's re-creation of the model estimates that the total economic output from the shutdown event is approximately $108.0 million, compared to $121.3 million in the Dr. Grainger report. As described above, PSC researchers used a different sector to model the impacts of the shutdowns because sector 154 likely better represents the activities performed in Rapid River and Superior. However, there are other reasons the modeled results could be different. IMPLAN allows users to make detailed updates to the model in various ways, allows different data and dollar years to be selected, allows for different types of analysis, and allows for specific region creation and alteration. PSC's results represent researchers' attempt to re-create Dr. Grainger's model given the information in his report; however, he does not provide a detailed methodology of his model creation, so the change in sector may not be the only difference between the models.

As discussed earlier, value added is a better representation of the economic loss caused by fractionator shutdowns than total economic output because it represents additions to and subtractions from GSP.

[137] Michael Nealy. December 7, 2021. "2020 Data Release Notes." *IMPLAN*. Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/4412244641179-2020-Data-Release-Notes

Again, Dr. Grainger's report does not include the value-added figure. In PSC's model, the statewide loss in value added (GSP) is $37.6 million or approximately 0.004 percent of the Michigan and Wisconsin combined GSP in 2020.[138,139] Additionally, 177 jobs would be lost in Michigan and Wisconsin or approximately 0.002 percent of the total civilian labor force in those states.[140] The direct effects of the fractionator shutdowns lead to an additional loss in value added of $10.7 million in business-to-business spending and $4.5 million in household spending supported by the fractionators, both of which are captured in the total value added. Using the loss to GSP of $37.6 million, PSC estimates a 69 percent reduction in the total loss to the economy compared to Dr. Grainger's $121.3 million in output.

County Model

Using the information available in the Dr. Grainger report, the corrected sector (sector 154 rather than sector 20), and the same modeling method (to the extent it is possible to ascertain Dr. Grainger's methods from his testimony), Exhibit 47 summarizes the impacts of the fractionator shutdown at the county level (Douglas County, Wisconsin, and Delta County, Michigan). Again, a detailed methods section in Dr. Grainger's testimony would have allowed PSC researchers to better understand his model and compare his results to our own. It is unclear at what level Dr. Grainger modeled the fractionator shutdowns, but given the size of his impacts, it appears that he did not complete a county-level model.

EXHIBIT 47. PSC Combined Countywide Impact Summary Results—IMPLAN Sector 154

Impact	Employment	Labor Income	Value Added	Output
1—Direct	16	$2,454,568.87	$24,831,009.74	$70,400,000.00
2—Indirect	33	$2,127,023.68	$4,954,348.51	$9,787,216.90
3—Induced	15	$531,557.00	$1,034,332.55	$1,938,698.70
Total	**64**	**$5,113,149.55**	**$30,819,690.81**	**$82,125,915.59**

Source: PSC calculations
Note: Totals may not sum due to rounding.

Delta County did not include any employment for sector 154—petroleum refineries, but employment and value added were present in Michigan. Douglas County did include employment for 154—petroleum refineries. A model should reflect direct employment in Delta County, so PSC revised the region to include sector 154 using the statewide per-worker output, employee compensation, proprietor income, other property income, and taxes on production and imports. It is not uncommon for the county-level industry results in IMPLAN to vary from what is known to be true. Much of the underlying data that IMPLAN relies on, such as the quarterly census of employment and wages, is self-reported by individual companies. Additionally, the Bureau of Labor Statistics will report some establishments under federal information processing standards (FIPS) code 999 at the county level for various reasons—this code is

[138] U.S. Bureau of Economic Analysis. n.d.a. "Gross Domestic Product: All Industry Total in Michigan." *Federal Reserve Economic Data (FRED)*. Accessed April 5, 2022. https://fred.stlouisfed.org/series/MINGSP

[139] U.S. Bureau of Economic Analysis. n.d.b. "Gross Domestic Product: All Industry Total in Wisconsin." *Federal Reserve Economic Data (FRED)*. Accessed April 5, 2022. https://fred.stlouisfed.org/series/WINGSP

[140] U.S. Census Bureau. n.d.d. "DP03: Selected Economic Characteristics (Employment and Labor Force Status, Wisconsin, Michigan), 2020: ACS 5-Year Estimates Data Profiles." *American Community Survey*. Accessed April 5, 2022. https://data.census.gov/cedsci/table?t=Employment%20and%20Labor%20Force%20Status&g=0400000US26,55

used to represent any given state without selecting a specific county.[141,142] Furthermore, some of the data sources used for inputs to IMPLAN will redact data if it would result in an individual business's confidential information becoming public. For example, if there is one furniture store in Delta County, Michigan, then reporting the total employees in the furniture industry for Delta County would provide the public with the employment figures for that single store in the county. In summary, the results at the state level may be correct but self-reporting or data processing standards can skew data at the county level for certain industries and geographies.

Modeling the shutdown in the fractionator sector with the modified region for sector 154—petroleum refineries yields a total loss to GRP of $30.8 million, which is 0.89 percent of the combined county GRP and a 75 percent reduction in the total economic impact compared to Dr. Grainger's $121.3 million in output, albeit recognizing that researchers do not know at what level Dr. Grainger estimates output at the state level.[143] A direct job loss of 16 jobs leads to 48 additional jobs lost in the two-county region for 64 total jobs lost in Delta County, Michigan, and Douglas County, Wisconsin or 0.17 percent of the total civilian labor force in the two-county region.[144]

Petroleum Refineries Modeling Conclusion

PSC's model notes that the total economic loss to GRP would be $37.6 million at the combined state level and $30.8 million at the combined county level. Total job loss would be 177 at the state level and 64 at the county level. Putting these figures into perspective, the fractionator shutdowns would result in a total loss of 0.002 percent of the combined state labor force and 0.004 percent reduction in the combined GSP. At the county level, the loss represents 0.17 percent of the combined civilian labor force and 0.89 percent of the combined GRP. The total economic loss to the economy is relatively minor compared to the respective economies, and the loss will be mitigated if not eliminated by the addition of rail and trucking to the states and counties as discussed later in this report. Exhibit 48 highlights PSC's results at the county and state levels compared to Dr. Grainger's.

EXHIBIT 48. PSC County and Statewide Results Compared to Dr. Grainger's Testimony

Impact	Employment	Labor Income	Value Added	Output
PSC County	64	$5,113,149.55	$30,819,690.81	$82,125,915.59
PSC Statewide	177	$11,549,258.53	$37,642,086.76	$107,997,676.38
Grainger	275	Not reported	Not reported	$121,300,000.00

Note: The county results include both Douglas and Delta Counties with the modified region for Delta. The statewide results include both Michigan and Wisconsin.
Source: PSC analysis and Dr. Grainger's testimony

141 FIPS codes are five-digit references of U.S. states and counties. States are identified by the first two digits in the number and counties are identified by the last three digits.

142 Email from IMPLAN.

143 County GRP results were pulled from the IMPLAN regions section.

144 U.S. Census Bureau. n.d.e. "DP03 Selected Economic Characteristics (Employment and Labor Force Status, All Counties Within Wisconsin, All Counties Within Michigan), 2020: ACS 5-Year Estimates Data Profiles." *American Community Survey.* Accessed April 5, 2022. https://data.census.gov/cedsci/table?t=Employment%20and%20Labor%20Force%20Status&g=0400000US26%240500000,55%240500000&tid=ACSDP5Y2020.DP03

Dr. Grainger reports the economic loss due to the fractionator shutdown in terms of total output, which does not provide an accurate measure of the loss to GRP and GSP.[145] Output can be reported with summary statistics but should be reported along with value added to provide the full context of results. The value-added column represents the loss in GRP and GSP due to the fractionator shutdowns in Michigan and Wisconsin. The output column overstates the impact to the state and county economies from the shutdowns and should be reported with value added for a better representation of the overall impact of the fractionator shutdowns.

Commodity Purchases and Multipliers

IMPLAN provides the value that each industry spends on a given commodity.[146] Dr. Grainger highlights the demand for commodity 3020—natural gas and crude petroleum as a loss and lists the top ten industries that spend money on natural gas and crude oil petroleum along with those industries' output and employment multipliers.[147] However, as noted in PSC's analysis and conclusion in Section 2 of this report, there will be ample propane supply to replace the current Line 5 delivery.[148] Consequently, PSC does not agree with Dr. Grainger's assessment that these industries will be unable to secure propane. These multipliers are provided for informational purposes.

These multipliers represent the total output or jobs generated as a result of $1 of direct output or one direct job. Exhibit 49 demonstrates the total value of individual industry purchases of natural gas and crude oil petroleum and the associated output and employment multipliers for Michigan. When an industry or a firm spends a dollar or hires employees, those actions generate a ripple effect, or what is commonly referred to as a "multiplier." The concept measures the industry or businesses' connection to the broader economy through purchases of inputs, wage and salary payments, and other expenditures. This initial spending has a direct effect but also sets off a chain of additional spending through indirect and induced effects. For example, if a furniture store spends $100 on the wood to make a dresser, a portion of that $100 will be used to pay the wages of the employee at the lumber company that processed a tree into lumber. That employee will then spend their wages on household goods, taxes, and other items. This multiplier effect diminishes over time, but the impact of the initial $100 is felt in multiple other places.

[145] GRP represents both Douglas and Delta Counties, and GSP represents both Michigan and Wisconsin.

[146] IMPLAN. "Understanding the Social Accounts Tables." *IMPLAN*. Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/115009674728-Understanding-the-Social-Accounts7444444444444444444444444444.-Tables3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333

[147] Grainger, Expert Report, 17.

[148] PSC's understanding is that the Bad River Band has retained another expert who has examined the effects of a Line 5 shutdown on crude supply. Assuming that there will be available crude supply, there will not be shortages or the associated price increases.

EXHIBIT 49. Top Ten Industries in Michigan That Purchase Commodity 3020—Natural Gas and Crude Petroleum and Associated Multipliers

Industry Code	Industry Description	Gross Inputs (Millions of $)*	Output Multiplier	Employment Multiplier
154	Petroleum refineries	$2,099.27	1.81	25.02
40	Electric power generation - Fossil fuel	$878.05	1.80	5.65
48	Natural gas distribution	$314.10	1.90	5.22
20	Oil and gas extraction	$253.63	2.25	3.38
534	Other local government enterprises	$57.29	2.03	2.68
157	Petroleum lubricating oil and grease manufacturing	$45.68	1.66	5.99
159	Petrochemical manufacturing	$27.00	1.33	8.52
158	All other petroleum and coal products manufacturing	$22.30	1.62	5.47
163	Other basic organic chemical manufacturing	$10.83	1.63	6.32
162	Other basic inorganic chemical manufacturing	$7.39	1.73	3.96

Note: *Gross inputs represent the total purchases of commodity 3020 from the top ten industries that purchase the commodity in Michigan and does not directly relate to the fractionator shutdown.
Note: These data are pulled directly from the underlying region data in IMPLAN; however, this exhibit will not match Table 1 in Dr. Grainger's report because it appears that the tenth industry in Dr. Grainger's report is cement manufacturing rather than the tenth lowest purchaser of natural gas and crude petroleum, other basic inorganic chemical manufacturing.

In summary, the top purchaser in Michigan, sector 154—petroleum refineries, spends $2.1 billion to purchase natural gas and crude petroleum, and the tenth lowest purchaser, sector 162—other basic inorganic chemical manufacturing, spends $7.4 million to purchase natural gas and crude petroleum. For every dollar spent on direct output, petroleum refineries generate an additional $0.81 in total output and inorganic chemical manufacturing generates $0.73. For every direct job created by petroleum refineries, 24 additional jobs are created, and for every inorganic chemical manufacturing job, three additional jobs are created.

Dr. Grainger suggests that a Line 5 shutdown would significantly lower the availability of commodity 3020—natural gas and crude oil.[149] As noted in PSC's analysis and conclusion in section two of this report, there will be ample propane supply to replace the current Line 5 delivery. Furthermore, as he correctly notes, the total demand for propane and other home-heating fuels is relatively inelastic.[150] This is particularly true in the short term. Due to this inelasticity, the purchases of commodity propane are likely to be made up in other counties or states. In the event of a Line 5 shutdown, propane would be transported by other means, primarily rail and truck, which have their own multipliers. Exhibits 50 and 51 highlight the top ten industries that purchase commodity 3415—rail transportation services and commodity 3417—truck transportation services in Michigan and their associated output and employment

[149] Grainger, Expert Report, 16.
[150] Grainger, Expert Report, 6–7.

multipliers. There will be a reduction in commodity 3419—pipeline transportation services in the event of a shutdown, which is more comparable to truck and rail transportation services.

EXHIBIT 50. Top Ten Industries in Michigan That Purchase Commodity 3415—Rail Transportation Services and Associated Multipliers

Industry Code	Description	Gross Inputs (Millions of $)	Output Multiplier	Employment Multiplier
40	Electric power generation - Fossil fuel	$261.50	1.80	5.65
215	Iron and steel mills and ferroalloy manufacturing	$193.11	1.75	5.59
417	Truck transportation	$120.27	2.01	1.97
164	Plastics material and resin manufacturing	$100.57	1.46	4.25
351	Motor vehicle metal stamping	$81.63	1.66	2.46
147	Paperboard container manufacturing	$56.17	1.64	2.67
341	Light truck and utility vehicle manufacturing	$55.25	1.66	6.75
175	Paint and coating manufacturing	$48.73	1.58	3.35
65	Flour milling	$48.71	2.31	9.48
193	Other plastics product manufacturing	$40.97	1.70	2.07

Source: IMPLAN

EXHIBIT 51. Top Ten Industries in Michigan That Purchase Commodity 3417—Truck Transportation Services and Associated Multipliers

Industry Code	Description	Gross Inputs (Millions of $)	Output Multiplier	Employment Multiplier
341	Light truck and utility vehicle manufacturing	$375.92	1.66	6.75
340	Automobile manufacturing	$258.89	1.55	4.81
215	Iron and steel mills and ferroalloy manufacturing	$248.71	1.75	5.59
352	Other motor vehicle parts manufacturing	$210.22	1.73	2.85
351	Motor vehicle metal stamping	$210.15	1.66	2.46
349	Motor vehicle transmission and power train parts manufacturing	$185.42	1.70	3.47
417	Truck transportation	$163.10	2.01	1.97
164	Plastics material and resin manufacturing	$140.85	1.46	4.25
89	Animal, except poultry, slaughtering	$139.99	1.95	6.53
347	Motor vehicle gasoline engine and engine parts manufacturing	$129.07	1.70	3.54

Source: IMPLAN

While Dr. Grainger highlights the negative impact a Line 5 shutdown would have on the availability and purchases of commodity 3020—natural gas and crude petroleum (again a conclusion with which PSC disagrees), he does not speak to the positive economic impact of the purchases of rail and trucking services that would replace Line 5. Exhibits 50 and 51 demonstrate that the purchases of rail and truck will have their own multiplier effects for output, value added, and employment. Furthermore, given the inelastic demand for propane and the ample supply, the multipliers noted in Exhibit 49 will continue to hold true in the event of a Line 5 shutdown for propane.

Multi-Regional Input-output Analysis

MRIO is an IMPLAN feature that allows users to estimate the effect of an economic impact on regions outside of where the impact took place. In this instance, it would be the impact of the Superior fractionator shutdown on Michigan's economy and the impact of the Rapid River fractionator shutdown on Wisconsin's economy. To estimate the difference between the in-state and out-state impacts, PSC developed another model set up exactly the same way as the statewide model except MRIO was not used. Exhibit 52 highlights the totals from PSC's sector 154—petroleum refineries model using MRIO compared to the same model not using MRIO, as well as the difference between the two.

EXHIBIT 52. Comparison of MRIO and non-MRIO Models

Impact	Employment	Labor Income	Value Added	Output
Total MRIO	177	$11,549,258.53	$37,642,086.76	$107,997,676.38
Total non-MRIO	170	$11,117,863.22	$37,014,762.02	$106,230,019.50
Percentage Difference	4.3%	3.9%	1.7%	1.7%

Source: PSC analysis in IMPLAN

This exercise highlights that less than 5 percent of the total model results are the individual fractionator's impact on the neighboring states of Michigan or Wisconsin. Dr. Grainger notes that the impacts of the closure would likely spread to other states.[151] This exercise demonstrates that to the extent that the impacts of the shutdown spread to surrounding states in the Midwest, the magnitude of such impact is likely to be small.

Tax Estimates

PSC agrees that the impacts on tax revenues are likely difficult to quantify and that there will be a decrease in tax revenues due to the fractionator shutdowns.[152] However, PSC disagrees that the implications will be severe. Researchers did not model the tax impacts of the fractionator shutdown because the underlying data that support the tax results in IMPLAN are aggregated and generalized based on geographic level (zip code, county, state, etc.) and do not provide a significant level of detail.[153] However, PSC can provide context for the tax results identified in Dr. Grainger's model:

- A combined annual effect of $1.5 million in county and subcounty taxes

[151] Grainger, Expert Report, 12.

[152] Grainger, Expert Report, 22–23.

[153] IMPLAN. December 13, 2021. "Generation and Interpretation of IMPLAN's Tax Impact Report." *IMPLAN.* Accessed April 5, 2022. https://support.implan.com/hc/en-us/articles/115009674528-Generation-and-Interpretation-of-IMPLAN-s-Tax-Impact-Report

- $1.9 million in state taxes
- $3.7 million in federal taxes
- $36.5 million in property tax across Wisconsin and $67.4 million for Line 5 and all associated facilities

Comparing these figures to similar metrics from the county, state, and federal levels provides additional context for the magnitude of these changes.

- $1.5 million in county and subcounty taxes represents 4.54 percent of the combined county tax revenue for Delta and Douglas Counties[154,155]
- $1.9 million in state taxes represents 0.004 percent of the combined state tax revenue for Michigan and Wisconsin[156,157]
- $3.7 million in federal taxes represents 0.0002 percent of federal income tax revenue[158]
- $103.9 million in property tax across Wisconsin and Michigan represents 0.39 percent of the total property tax levied in both states, 0.33 percent in Wisconsin and 0.44 percent in Michigan[159,160]

"Large" is a relative term and depends on interpretation but based on these relatively modest percentages, PSC cannot concur with his ultimate conclusion that the tax implications of a Line 5 closure would be large. To begin, PSC does agree with Dr. Grainger that effects on county and subcounty taxes, state taxes, and federal taxes would be "modest."[161] The largest tax loss would be less than 5 percent of the comparative metric at the county level. Notably, however, the local, state, and federal governments are likely to offset lost tax revenues in whole or in part through increased tax revenues from the entities that step in to provide alternative transportation options for the product that is currently transported through Line 5.

Dr. Grainger's conclusion that the tax implications of a Line 5 shutdown would be large or severe seems to stem primarily from the possible loss of property tax revenue from Enbridge. However, Dr. Grainger implies that the full measure of property taxes that Enbridge pays to Wisconsin ($36.5 million) and Michigan ($67.4 million) would be lost to those states if Line 5 shuts down, which is incorrect. In Wisconsin, most Enbridge pipeline miles and facilities are not associated with Line 5, but rather a system of pipelines that extend from the northernmost boundary to the southernmost boundary of the state, including Line 6A, Line 13, Line 14, and Line 61.[162] Given the comparative mileage of Line 5 in Wisconsin

[154] Douglas County. 2021. *Adopted Budget.* Accessed April 8, 2022. https://www.douglascountywi.org/Archive/ViewFile/Item/3641

[155] Delta County. n.d. *Citizen's Guide to Local Unit Finances—Delta County (21-0000).* Accessed April 8, 2022. https://deltacountymi.gov/wp-content/uploads/2021/12/21-22-Citizens-Guide.pdf

[156] Michigan Department of Treasury. n.d. *2019–2020 Annual Report of the Michigan State Treasurer.* Accessed April 8, 2022. https://www.michigan.gov/documents/treasury/STAR_2019-20_730605_7.pdf

[157] Wisconsin Division of Research and Policy. May 6, 2021. "State and Local Taxes: Taxes as a Percent of Personal Income." *Tableau.* Accessed April 8, 2022. https://public.tableau.com/app/profile/research.policy/viz/WIStateandLocalTaxes/Story1

[158] Data Lab. n.d. "Federal Revenue Trends Over Time." *Data Lab.* Accessed April 8, 2022. https://datalab.usaspending.gov/americas-finance-guide/revenue/trends/

[159] State of Michigan. 2020. *2020 Ad Valorem Property Tax Report.* Accessed April 8, 2022. https://www.michigan.gov/taxes/-/media/Project/Websites/taxes/Uncategorized/2021/2021_2020_Ad_Val_Tax_Levy_Report_FINAL.pdf?rev=b07c1fac51df4c91a7ec7f8a1f2796f3&hash=36020607374BBEBFB4D59FF817F07228

[160] Wisconsin Division of Research and Policy. December 27, 2019. *Property Tax Overview.* Accessed April 8, 2022. https://www.revenue.wi.gov/DORReports/ProTax.pdf

[161] Grainger, Expert Report, 22–23.

[162] Enbridge. n.d.b. *Enbridge Pipelines in Wisconsin: Fueling Wisconsin's Economic Engine.* Accessed April 8, 2022. https://www.enbridge.com/~/media/Enb/Documents/Projects/Wisconsin/FS_EnbridgePipelinesInWisconsin.pdf

to Enbridge's overall pipeline network in the state, as well as the facilities associated with the various other pipelines, the property tax implications of a shutdown of Line 5 in Wisconsin are likely to be much smaller than Dr. Grainger implies. The same would be true in Michigan, where Line 5 is only one of multiple Enbridge pipelines through the state, including Line 17, Line 6B/78, Line 79, the Vector Pipeline, and the Nexus Gas Transmission pipeline.[163] Consequently, any property tax implications from a shutdown of Line 5 are also likely to be modest (and well below the 1.55 percent of total property tax revenue in Wisconsin and Michigan described above).

StatCan Input-output Model

PSC does not have expertise with StatCan, the Canadian IO model used as the counterpart to IMPLAN for the economic impacts of a Line 5 shutdown in Ontario. However, given Dr. Grainger's use of output as the primary reporting metric in his IMPLAN analysis, it can be assumed that the same is the case with the Ontario model. Using the percentage difference between Dr. Grainger's estimate of output using IMPLAN and PSC's estimates of GSP using IMPLAN, PSC estimated the negative impact on Ontario's economy. A 69 percent reduction of Dr. Grainger's StatCan estimate of $18.9 billion is approximately $5.9 billion. Using the total job loss of 25,478 from the Dr. Grainger model, these figures can be put into perspective as was done with the IMPLAN results. A $5.9 billion economic loss represents 0.67 percent of GSP, and the job loss of 25,478 represents 0.3 percent of the total labor force in Ontario. For reference, Ontario's GSP grew by 2.4 percent in the third quarter of 2021, and the labor force grew by 54,300 jobs from January 2022 to February 2022.[164,165,166,167] Furthermore, Dr. Grainger assumes a price of $2 per gallon for propane and butane in the StatCan model, which PSC presumes is a retail price. PSC assumes the fractionator would sell propane and butane to distributors or manufacturers at a wholesale price, which have averaged closer to $1 per gallon for the last decade.[168]

Rail and Trucking Economic Impact

So far, this report has focused on the economic loss caused by a shutdown of Line 5; however, as noted in Dr. Grainger's testimony, the demand for NGLs is inelastic, and the demand for transportation fuel will not change in the short run.[169] Those served may purchase less propane or other petroleum products in the long run, but that is likely not feasible in the short term.[170] Given this, other transportation methods will replace Line 5 in the event of a shutdown. These transportation methods will mitigate if not eliminate any economic loss associated with the Line 5 shutdown and fractionator closures. More than 16 truck and rail employees will be employed to replace the demand supplied by Line 5 as well as additional employment in ancillary services, such as transloading. The top three industries that purchase natural gas and crude petroleum according to IMPLAN are petroleum refineries, electric power generation—fossil

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[163] Enbridge. n.d.c. *Enbridge Pipelines in Michigan: Fueling Michigan's Economic Engine.* Accessed April 8, 2022. https://www.enbridge.com/~/media/Enb/Documents/Factsheets/FS_Line5_and_Pipelines_in_Michigan.pdf?la=en

[164] The most recent data available.

[165] The most recent data available.

[166] Ministry of Finance. April 4, 2022. "Ontario Economic Update." *Ontario.ca.* Accessed April 5, 2022. https://www.ontario.ca/page/ontario-economic-update

[167] Statistics Canada. March 11, 2022. "Labour Force Characteristics by Province, Monthly, Seasonally Adjusted." *Statistics Canada.* Accessed April 5, 2022. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410028703

[168] https://apps.cer-rec.gc.ca/CommodityStatistics/Statistics.aspx?language=English

[169] Grainger, Expert Report, 7 and 17.

[170] For the purposes of this summary, short term can be thought of as one year.

fuel, and natural gas distribution. This demand will still exist and will be combined with the greater economic impact of increased demand for trucking and rail services. Furthermore, construction and maintenance of the infrastructure required to support these transportation alternatives will create additional positive impact. The IMPLAN modeling discussed above indicates some measure of economic loss; however, it is likely that any such loss would be offset in whole or in part by the economic impact from increased demand for trucking and rail services.

Conclusion

PSC's economic loss figures are substantially less than Dr. Grainger's overall estimate of economic loss. This is primarily because PSC estimates the economic impact as a loss to GRP and GSP (value added) rather than overall output and uses sector 154 rather than sector 20 in the research model. PSC compares its results to the economic results in Dr. Grainger's report; however, it is difficult to truly do a comparative analysis because Dr. Grainger does not provide a full methods section in his testimony. PSC's modeled loss to GSP is $37.6 million, which represents a 69 percent reduction in the total loss to the economy compared to $121.3 million in output and is 0.004 percent of the Michigan and Wisconsin combined GSP in 2020. While the fractionator shutdowns will result in an economic loss at the county and state levels, the demand for propane and butane is inelastic, so rail and truck alternatives will be used to make up the capacity difference. The addition of the employment, labor income, GRP, and tax revenues will have a positive economic impact at the county and state levels. Furthermore, construction and maintenance of the infrastructure required to support these transportation alternatives will create additional positive impact. Finally, Dr. Grainger's report notes multiple times that a Line 5 shutdown would create a propane shortage and drastically increase prices. As noted in PSC's analysis and conclusion in Section 2 of this report, there will be ample propane supply to replace the current Line 5 delivery, and PSC describes the price impacts as modest (less than 5 percent impact on prices or price impact expected to last for duration of two years or less) or minimal (less than 2 percent impact on prices). As noted in PSC's commodity purchases discussion, modest price impacts and ample supply of propane combined with the additional economic impact of rail and truck will mitigate if not eliminate any losses due to a Line 5 shutdown.

Section Six: Environmental Impacts of Transportation Options

Mr. Earnest states in his expert report that greenhouse gas emissions will be higher if transporting propane or butane by rail or truck but does not quantify the impact.[171] PSC has estimated the emission impact of rail and truck transportation of propane and butane, and compared emissions associated with the use of propane for context.

Comparison of Greenhouse Gas Emissions Between Pipeline, Rail, and Truck

PSC compared different alternatives when it comes to greenhouse gas (GHG) emissions. PSC focused on establishing an apples-to-apples comparison for the GHG emissions associated with the transportation of one gallon of petroleum products. PSC based its comparison on the amount of fuel required to transport one gallon of petroleum products between two locations by truck, rail, and pipeline. PSC did not include estimates for the total amount of GHG emissions beyond spent fuel, such as fugitive emissions, assuming

[171] Earnest, Expert Report, 12, 56, 78.

for the sake of comparison that these emissions would be consistent across transportation modes. These estimates therefore do not present a complete picture of GHG emissions associated with transportation.

PSC used two approaches, one where distances were held constant based on the length of Line 5 and another using actual truck and rail routing between two locations—Janesville, Wisconsin, and Rapid River, Michigan—which was then replicated for Edmonton, Alberta, to Superior, Wisconsin. These locations were chosen to see how rail and truck compare at different distances.

To develop an estimate for truck, PSC used its prior assumptions for tractor trailer storage size and miles per gallon. PSC calculated the gallons used per cycle by dividing the distance travelled by the miles per gallon. PSC then estimated the total gallons of petroleum products that could be delivered for each gallon of diesel fuel used by dividing the gallons delivered per cycle by the gallons used per cycle. PSC used the U.S. Environmental Protection Agency's (EPA's) GHG calculator to estimate the GHG equivalent for each gallon of diesel used and then divided by the gallons of NGL delivered per each gallon of diesel used. The result of that calculation is the GHG emissions per gallon of NGL delivered (0.0002245 metric tons carbon dioxide equivalent [MTCO2e]).[172]

To develop an estimate for rail, prior PSC assumptions were used as the basis for calculations. For an estimate for miles per gallon, PSC used a study from the Upper Great Plains Transportation Institute at North Dakota State University that estimated the revenue train miles per gallon (RTM/G) for petroleum and coal products, defined as the miles per gallon for the cargo only, all else held constant.[173] Following a similar methodology as truck, PSC was then able to estimate the amount of fuel used per cycle by dividing the distance by the miles per gallon. PSC then estimated the total gallons of petroleum products that could be delivered for each gallon of diesel fuel used by dividing the gallons delivered per cycle by the gallons used per cycle. Similarly, the EPA GHG emissions calculator was used to estimate the GHG emissions for each gallon of diesel fuel used, which were then divided by the total gallons of propane delivered per trip per gallon of diesel fuel used to determine the GHG emissions per gallon delivered (0.0000012 MTCO2e).

[172] US EPA. March 28, 2022. "Greenhouse Gas Equivalencies Calculator." "*Energy and the Environment*." Accessed April 8, 2022. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[173] Denver Tolliver, Pan Lu, and Douglas Benson. May 2013. *Analysis of Railroad Energy Efficiency in the United States.* Accessed on April 6, 2022. https://www.ugpti.org/resources/reports/downloads/mpc13-250.pdf

EXHIBIT 53. GHG Emissions by Transportation Mode Due to Fuel Used, per Gallon Transported, Line 5 Distance Equivalent

Calculation Input	Truck	Rail
Distance	645.0	645.0
Storage capacity of a tractor trailer/tank car	9010.0	28475.0
MPG	6.5	385.0
Gallons used per cycle	198.5	3.4
Petroleum product gallons transported per gallon of diesel used	45	8498
GHG emissions per gallon diesel used (MTCO2e per gallon)	0.01019	0.01019
GHG emissions per cycle per truck/rail car (MTCO2e per gallon)	2.02232	0.03414
GHG emissions per gallon transported—fuel use only	**0.0002245**	**0.0000012**

Source: PSC calculations

Comparing the two, rail delivers 187 times more petroleum product gallons per gallon of diesel fuel used and is similarly more efficient in terms of GHG emissions. This means that to deliver one gallon of petroleum product, truck will produce 187 times the amount of GHG emissions than it would by rail.

PSC then repeated these calculations using actual distances for truck and rail determined by leading software routing systems between two locations, Janesville, Wisconsin, and Rapid River. PSC used the PC*Miler software to determine a truck route for hazardous materials and used the U.S. Department of Transportation Federal Railroad Administration's web-based geographic information system application to determine rail distances.[174,175]

EXHIBIT 54. GHG Emissions by Transportation Mode Due to Fuel Used, per Gallon Transported, Janesville to Rapid River Actual Routing

Calculation Input	Truck	Rail
Distance from Janesville to Rapid River	289	337
Storage capacity of a tractor trailer/tanker	9010	28,475
MPG	6.5	385
Gallons used per cycle	88.9	1.8
Propane gallons transported per gallon of diesel used	101	16256
GHG emissions per gallon diesel used (MTCO2e per gallon)	0.01019	0.01019
GHG emissions per cycle (MTCO2e per gallon)	0.90613	0.01785
GHG emissions per gallon transported—fuel use only	**0.00010**	**0.0000006**

Source: PSC calculations

[174] Axon Software. 2022. "PC*Miler." *Axon Development Corporation*. Accessed April 8, 2022. https://axonsoftware.com/pc-miler/?keyword=pc%20miler%20software&gclid=CjwKCAjwur-SBhB6EiwA5sKtjtVe4fWYcmkd5hEZp3Yt-u-hj-TZsTeU5YyfwAH9zwypdqy_3kQ57hoCbN8QAvD_BwE

[175] Federal Railroad Administration. January 23, 2020. "Maps – Geographic Information System." U.S. Department of Transportation. Accessed April 8, 2022. https://railroads.dot.gov/maps-and-data/maps-geographic-information-system/maps-geographic-information-system

Looking at Janesville to Rapid River, where the rail route is 48 miles longer, PSC found that rail delivers 160 times more petroleum product gallons per gallon of diesel fuel used, and from a GHG emissions per gallon delivered standpoint, rail is 160 times more efficient than truck. This means that to deliver one gallon of petroleum product, truck delivery will produce 160 times the amount of GHG emissions than it would by rail.

PSC replicated this approach for another route, Edmonton, Alberta, to Superior, Wisconsin, as shown in Exhibit 55.

EXHIBIT 55. GHG Emissions by Transportation Mode Due to Fuel Used, per Gallon Transported, Edmonton, Alberta, to Superior, Wisconsin Actual Routing

Calculation Input	Truck	Rail
Distance from Edmonton to Superior	1258	1100
Storage capacity of a tractor trailer/tanker	9010	28475
MPG	6.5	385
Gallons used per cycle	387.2	5.7
Propane gallons transported per gallon of diesel used	23	4983
GHG emissions per gallon diesel used (MTCO2e per gallon)	0.01019	0.01019
GHG emissions per cycle (MTCO2e per gallon)	3.94525	0.05823
GHG emissions per gallon transported—fuel use only	**0.00044**	**0.000002**

Source: PSC calculations

In this example, the truck route was 158 miles longer than the rail distance. On this route, rail delivers 214 gallons more petroleum product per gallon of diesel used than truck. Truck delivery produces 214 times more GHG emissions per gallon delivered than rail.

PSC attempted to establish a similar comparison for pipelines, seeking to establish the amount of fuel used by the U.S. pipeline system overall as well as by an individual pipeline and compare this to the volume of petroleum products delivered by the U.S. pipeline system and by a given pipeline. Unfortunately, PSC was not able to identify credible sources in the public domain that would allow development of similar estimates.

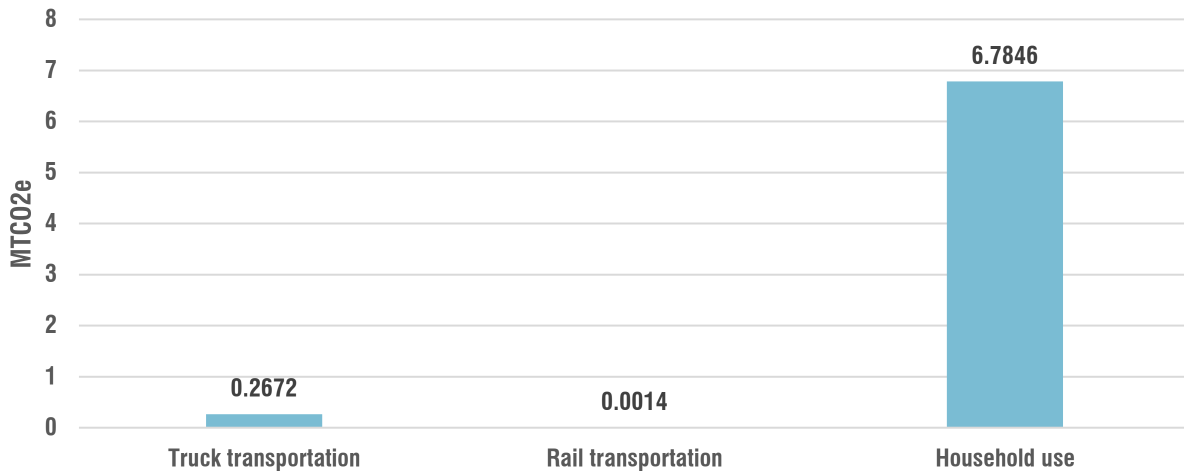
PSC also sought to find emissions information specifically for Line 5 from the EPA, but Enbridge pipelines are not included in the EPA's FLIGHT database (facility-level information on greenhouse gases tool).[176]

PSC did compare the greenhouse gas emissions from the annual household use of propane with the GHG emissions used to transport this same amount of propane by truck and by rail. What this analysis shows is

[176] U.S. EPA. August 7, 2021. "Total Report Emissions by Facility in Metric Tons of CO2e." *U.S. EPA FLIGHT.* Accessed April 8, 2022. https://ghgdata.epa.gov/ghgp/main.do#/listFacility/?q=Find%20a%20Facility%20or%20Location&st=&bs=&fid=&sf=11001000&lowE=0&highE=23000000&g1=1&g2=1&g3=1&g4=1&g5=1&g6=0&g7=1&g8=1&g9=1&g10=1&g11=1&g12=1&s1=1&s2=1&s3=1&s4=1&s5=1&s6=1&s7=1&s8=1&s9=1&s201=1&s202=1&s203=1&s204=1&s301=1&s302=1&s303=1&s304=1&s305=1&s306=1&s307=1&s401=1&s402=1&s403=1&s404=1&s405=1&s601=1&s602=1&s701=1&s702=1&s703=1&s704=1&s705=1&s706=1&s707=1&s708=1&s709=1&s710=1&s711=1&s801=1&s802=1&s803=1&s804=1&s805=1&s806=1&s807=1&s808=1&s809=1&s810=1&s901=1&s902=1&s903=1&s904=1&s905=1&s906=1&s907=1&s908=1&s909=1&s910=1&s911=1&si=&ss=&so=0&ds=E&yr=2020&tr=current&cyr=2020&rs=ALL.

that while emissions resulting from transportation by truck are significantly higher than rail, and even if we assume that emissions from rail are higher than pipeline, transportation emissions are small when compared to the emissions created when the transported fuel is utilized by customers for typical uses of propane or butane. A typical Michigan propane-heated home uses 1,180 gallons per year.[177] Exhibit 56 compares the emissions related to transporting that amount of propane by truck or rail the distance of Line 5 to the emissions resulting from the use of propane at the household level.[178]

EXHIBIT 56. Greenhouse Gas Emissions from Propane Transportation and Household Use, Line 5 Distance Equivalent



Source: PSC calculations using Line 5 distance equivalents

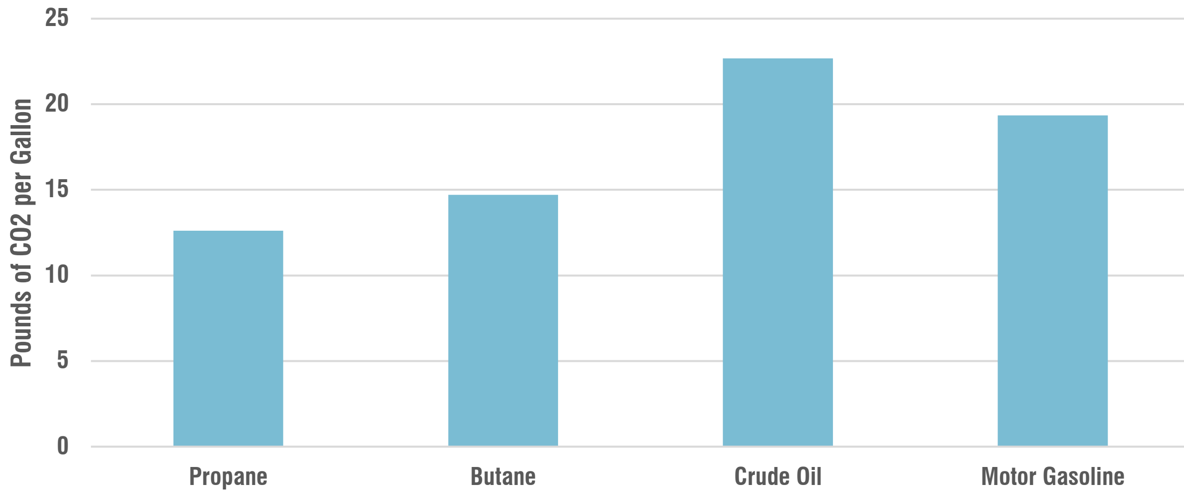
PSC also compared the CO2 emissions of propane to the emissions from other petroleum products that may be transported by rail or truck as a result of Line 5 closure.[179] As shown in Exhibit 57, other products have even higher emissions per gallon when consumed. PSC expects that the relationship between emissions related to transportation and emissions related to consumption shown for propane will persist across any Line 5 transported product or products produced from inputs from Line 5. Transporting crude oil or NGLs by rail or truck will not result in an appreciable increase in total emissions as stated by Mr. Earnest.

[177] Public Sector Consultants, Analysis of Propane Alternatives, 28.

[178] U.S. EIA. November 18, 2021. "Carbon Dioxide Emissions Coefficients." *Environment.* Accessed April 6, 2022. https://www.eia.gov/environment/emissions/co2_vol_mass.php

[179] U.S. EPA. April 4, 2012. "Emission Factors for Green House Gas Inventories." *EPA.* Accessed April 8, 2022. https://www.epa.gov/sites/default/files/2015-07/documents/emission-factors_2014.pdf

EXHIBIT 57. CO2 Emissions from Line 5 Products



Sources: EPA 2012 and PSC calculations

Section Seven: Final Conclusion

In summary, and contrary to the reports of Mr. Earnest and Mr. Rennicke, PSC estimates that closure of Line 5 will have minimal impact on the availability and cost of propane and butane. Substantial increases in natural gas production and related NGLs ensure that there will be adequate supply to meet the needs of Wisconsin, Michigan, and Ontario. The plethora of supply options will ensure affordable and reliable propane and butane supplies. Increased supplier diversity will give propane retailers more options to serve their customers, increase supply competition in the market, and potentially decrease prices for propane in the long run. Industrial users of butane may find more direct routes for their supply.

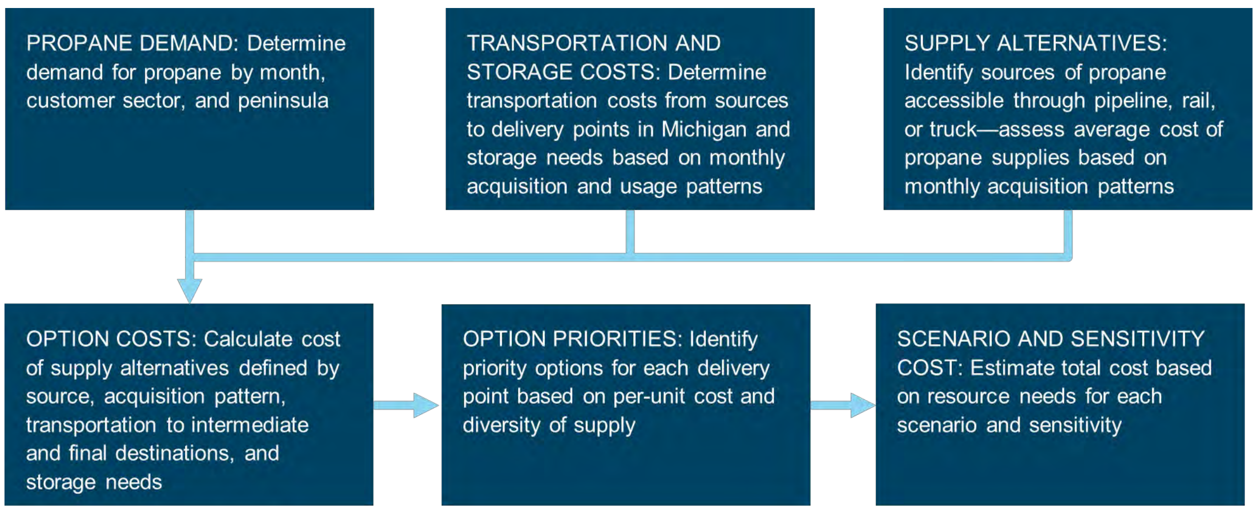
PSC projects much smaller impacts on the economies of the Wisconsin, Michigan, and Ontario than does Dr, Grainger. While no amount of job loss is preferred, PSC predicts new employment opportunities in the United States and Canada due to the increase in demand for transportation alternatives to Line Five. The minimal job loss at the Michigan and Wisconsin fractionators will be more than made up for by the increase in truck and rail employees. The growing and vibrant economy of Eastern Canada, where over 54,300 new jobs were created from January 2022 to February 2022, will likely absorb any workers affected in Sarnia. Further, PSC sees options for continued operation of the fractionator there.

Supply diversity serves to increase alternate transportation options including truck and rail. PSC concludes that rail and trucking are feasible transportation alternatives to Line 5. Further, the environmental impact of using these transportation methods is vastly overshadowed by the environmental impacts of using the products shipped on, or produced using inputs from, Line 5. These transportation methods will support demand for propane and butane use in Canada and the Midwest until demand for NGLs diminishes in response to state and federal initiatives to reduce carbon emissions.

Appendix A: Modeling Methodology

PSC developed a cost-based model to assess the cost of alternate propane supplies in the event of Line 5's closure. Exhibit A1 provides an overview of the model framework.

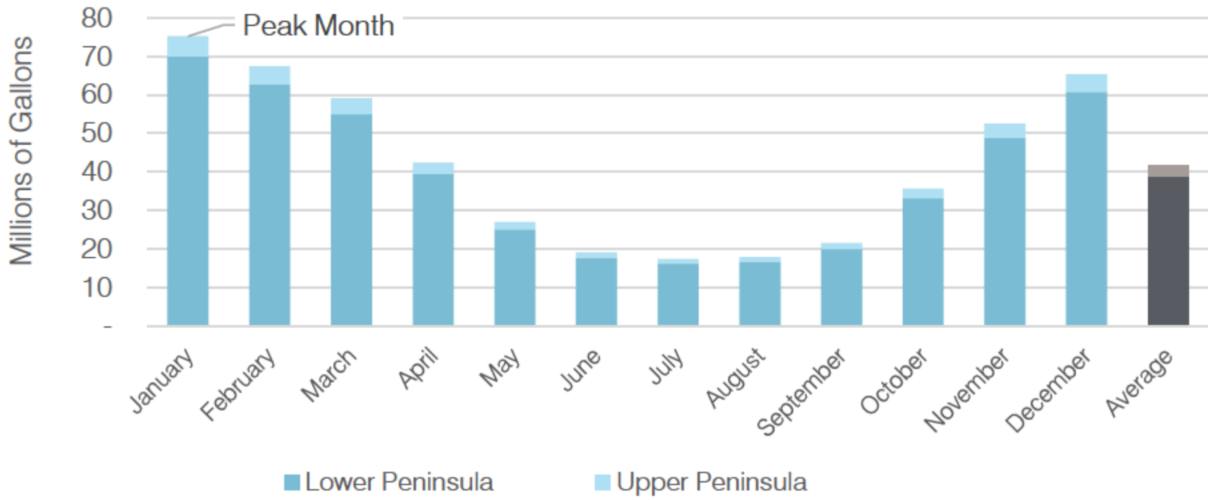
EXHIBIT A1. Model Framework



Using historical consumption and weather data, PSC estimated monthly propane consumption for Upper and Lower Peninsula households based on normal weather conditions. Propane can be procured in different patterns that may nor may not be synchronous with the seasonally driven consumption of propane. For this analysis, PSC considered two acquisition patterns: flat demand, in which the same amount of propane is purchased each month, or just in time, which is based on expected monthly consumption under normal weather conditions. The acquisition pattern dictates the size of the delivery infrastructure required, that is, the number of rail cars and/or the number of trucks/tankers, and the utilization of that infrastructure.

If propane is procured just in time, the delivery system would be sized to meet peak demand, estimated to occur in January, as shown in Exhibit A2, whereas if propane is procured in even amounts each month, the delivery system would be sized to meet average demand. However, when propane is procured in a different pattern than monthly consumption, storage is required to balance supply and demand.

EXHIBIT A2. Monthly Consumption of Propane in Michigan Under Normal Weather Conditions



PSC identified several routes by which propane could be shipped from hubs to locations within Michigan. Some of the routes considered go directly from the hub to the destination, others go through an intermediate point where typically propane would be transferred from one mode of transport to another. The routes considered are shown Exhibit A3.

EXHIBIT A3. Route Alternatives

Hub	Transport Mode	Intermediate Point(s)	Transport Mode
Conway, Kansas	Pipeline	Dubuque, Iowa	Truck
	Pipeline	East Chicago, Indiana	Truck, rail
	Pipeline	Inver Grove Heights, Minnesota	Truck
	Pipeline	Janesville, Wisconsin	Truck
	Pipeline	Rosemount, Minnesota	Truck
	Rail	N/A	N/A
Mont Belvieu, Texas	Pipeline	Coshocton, Ohio	Truck
	Pipeline	Lebanon, Indiana	Truck
	Pipeline	Greensburg, Pennsylvania	Truck
	Rail	N/A	N/A
Edmonton, Alberta	Truck	N/A	N/A
	Rail	N/A	N/A

Source: PSC analysis

For each route considered, PSC calculated the cost of the supply alternative using the following formula:

$$\begin{aligned}&\mathit{Supply\ alternative\ cost}\\&\qquad = \mathit{Commodity\ cost\ (hub\ price)} + \mathit{transportation\ to\ intermediate\ point}\\&\qquad + \mathit{Transportation\ from\ intermediate\ point\ to\ final\ destination}\\&\qquad + \mathit{Incremental\ storage\ investment}\end{aligned}$$

PSC then employed a two-stage prioritization of options, first identifying the low-cost option for each route. For example, for the route from Edmonton, Alberta, to Rapid River, Michigan, by rail, the low-cost option is to procure propane in a pattern that aligns with monthly consumption. Once the low-cost option for each route is determined, the lowest-cost routes are identified to determine priority alternatives.

Exhibit A4 shows provides a key to the alternative codes shown in Section 3.

EXHIBIT A4. Supply Alternative Codes

Code	Hub	Intermediate Point	Transport Mode	Destination	Transport Mode	Pattern
EA_SUP_R_NW	Edmonton,			Superior	Rail	Normal
CK_SUP_R_NW	Conway,			Superior	Rail	Normal
CK_IGM_P_SUP_T_NW	Conway,	Inver Grove	Pipeline	Superior	Truck	Normal
EA_RR_R_NW	Edmonton,			Rapid River	Rail	Normal
CK_RR_R_NW	Conway,			Rapid River	Rail	Normal
MBT_RR_R_NW	Mont			Rapid River	Rail	Normal
EA RR T FD	Edmonton,			Rapid River	Truck	Flat
EA_MRY_R_NW	Edmonton,			Marysville	Rail	Normal
CK_MRY_R_NW	Conway,		Rail	Marysville		Normal
CK_RM_P_RR_T_NW	Conway,	Rosemount,	Pipeline	Rapid River	Truck	Normal
MBT_CO_P_MRY_T_FD	Mont	Coshocton,	Pipeline	Marysville	Truck	Flat
IGM_SUP_T_NW	Inver Grove			Superior	Truck	Normal
DI SUP T NW	Dubuque,			Superior	Truck	Normal
JW_SUP_T_NW	Janesville,			Superior	Truck	Normal
IGM_RR_T_NW	Inver Grove			Rapid River	Truck	Normal
JW_RR_T_NW	Janesville,			Rapid River	Truck	Normal
DI_RR_T_NW	Dubuque,			Rapid River	Truck	Normal
JW_MRY_T_NW	Inver Grove			Marysville	Truck	Normal
IGM_MRY_T_NW	Janesville,			Marysville	Truck	Normal
DI_MRY_T_NW	Dubuque,			Marysville	Truck	Normal

Appendix B: Relationship Between Wholesale and Retail Prices

PSC analysis indicated wholesale prices would likely not be fully passed on to retail consumers. For each one dollar increase in wholesale propane prices over the course of a year, retail consumers would experience approximately a $0.70 increase in the price of propane.

Reasons for the lack of a full wholesale cost increase pass-through include consumer price sensitivity of demand and a competitive retail company market. In response to higher prices, consumers may, to a modest degree, reduce propane consumption, resulting in a retail price increase that is lower than the wholesale price increase. Additionally, given that the retail propane company market appears competitive (i.e., one or two companies do not appear to dominate market share in Michigan), it may be difficult for companies to fully pass on wholesale price increase to consumers. However, PSC recognizes that switching propane companies in the short term (within a year) may be unrealistic for some households, given the prevalence of annual contracts and some propane companies' requirements that households rent propane tanks as a condition of purchase. PSC did not differentiate competitive retail markets by region (e.g., in the Upper or Lower Peninsula), indicating that some consumers in more sparsely populated areas may have fewer propane options than those located near more populated areas.

Finally, PSC's analysis did not assume any energy efficiency improvements that households and businesses may make from winter to winter (e.g., insulation, more efficient appliances), which could lead to lower propane consumption and winter heating costs over time. PSC also did not assume any reductions in propane consumption due to residential electrification for heating purposes.

London Economics' previous research also concluded that prices would not be fully passed on to retail consumers. Their analysis indicated that a one-dollar increase per gallon propane supply price increase would increase retail prices by $0.45 per gallon.[180]

Data and Methodology

Wholesale and Retail Prices

PSC utilized publicly available wholesale and retail propane price data from the U.S. Energy Information Administration.[181] Retail and wholesale prices are only available for the state of Michigan during the winter heating months (October–March). There are no regional price breakdowns. Retail price data is available for the years 1990 to 2021, while wholesale data is only available for 2016 to 2021. Price data is available for weekly levels at the state level, and there are six years of corresponding winter wholesale and retail price data (equivalent to 130 weeks). PSC generally utilized weekly propane data for analysis, which is priced as of 8:00 AM every Monday. The weekly price covers Monday through Sunday each week. PSC used weekly prices to calculate average monthly prices as well.

PSC analyzed wholesale and retail price relationships between 2016 and 2021. There appears to be a positive, reasonably strong, and linear relationship between wholesale and retail prices as shown in Exhibit B1. Additionally, the average monthly retail propane price between 2011 and 2021 was

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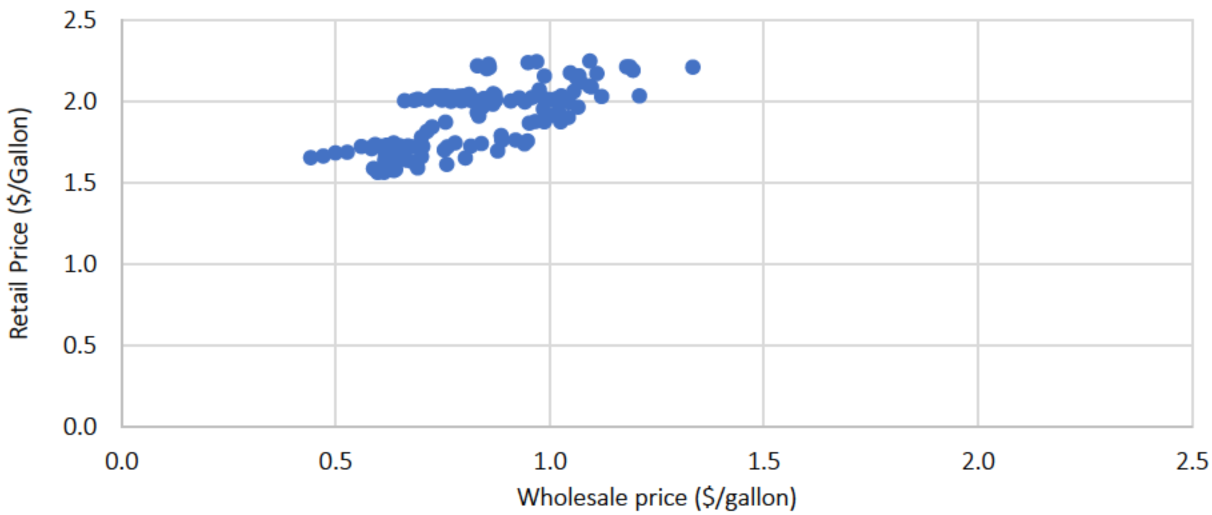
[180] London Economics International, LLC. *Assessment of Alternative Methods of Supplying Propane.* Accessed April 8, 2022. https://www.londoneconomics.com/wp-content/uploads/2018/07/LEI-Enbridge-Line-5-Michigan-Propane_7_27_2018.pdf

[181] U.S. Energy Information Administration. n.d.a. "Heating Oil and Propane Update." *U.S. Energy Information Administration Independent Statistics and Analysis.* Accessed November 2021. https://www.eia.gov/petroleum/heatingoilpropane/

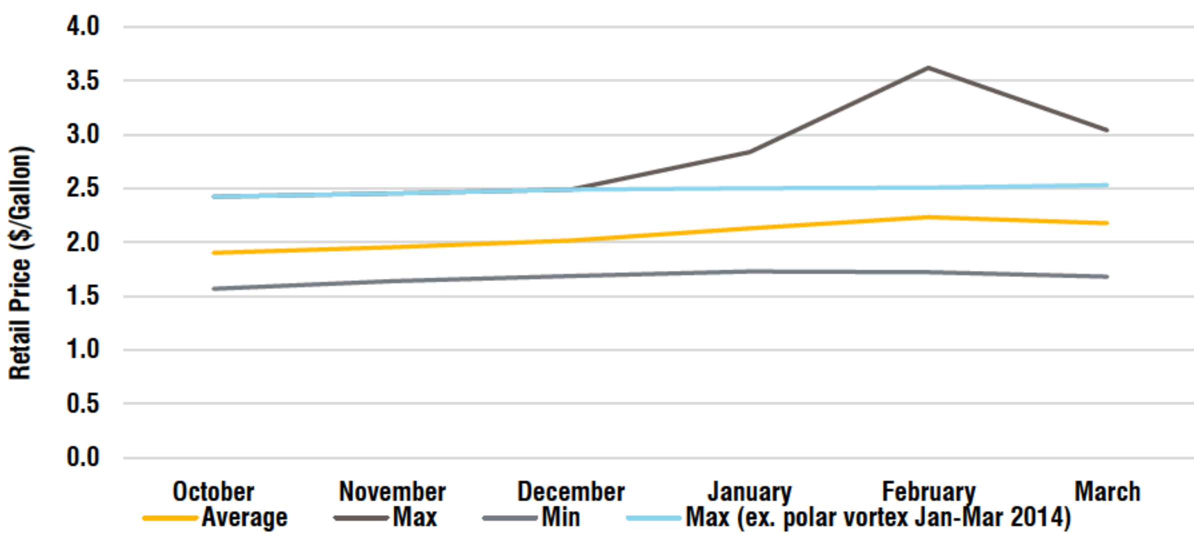
approximately $2.00 per gallon, ranging from $1.50 per gallon to $2.50 per gallon through the winter. The one exception is the polar vortex of 2014, during which average monthly prices peaked at over $3.50 per gallon (Exhibit B2).

EXHIBIT B1. Relationship Between Weekly Retail and Wholesale Propane Prices, 2016–2021



Source: U.S. EIA March 30, 2022c

EXHIBIT B2. Average Retail Propane Prices in Michigan by Month, 2011–2021



Source: U.S. Energy Information Administration.

PSC conducted a simple linear regression based on year-on-year price changes (i.e., price changes from one winter to another). Retail price changes were the dependent variable and wholesale price changes were the independent variable. Results pointed to a statistically significant relationship with a coefficient of 0.68, indicating that a one-dollar change in wholesale prices from winter to winter results in a roughly

70-cent change in retail prices (Exhibit B3). As a result, increases in wholesale prices do not lead to one-to-one increase for households and businesses, implying that retail companies would absorb the cost through lower margins. Similarly, a reduction in wholesale prices likely does not result in a commensurate reduction in retail price. While PSC did not build a propane supply and demand propane model for Michigan, the results suggest that retail consumers are somewhat price sensitive and would reduce demand under higher prices. A competitive retail market also suggests that it may be difficult for companies to fully pass wholesale price increases over time. Furthermore, demand for propane is relatively inelastic in the short term due to the administrative difficulties in changing suppliers, annual contracts, and lack of other heat sources in the home. However, demand for propane is likely more elastic in the long term because consumers can switch suppliers, perform energy efficiency upgrades, or install additional home-heating methods.

EXHIBIT B3. Retail and Wholesale Price Regression Output, 2016–2021

Regression Statistics	
Multiple R	0.81
R Square	0.66
Adjusted R Square	0.65
Standard Error	0.14
Observations	104

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95%*	*Upper 95%*
Intercept	-0.04	0.01	-2.68	0.01	-0.07	-0.01	-0.07	-0.01
HDDs	0.68	0.05	14.01	0.00	0.58	0.78	0.58	0.78

Source: PSC analysis of EIA data.

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