IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

STANDING ROCK SIOUX TRIBE, Plaintiff, and CHEYENNE RIVER SIOUX TRIBE, Plaintiff-Intervenor, v. U.S. ARMY CORPS OF ENGINEERS, Defendant-Cross Defendant, and DAKOTA ACCESS, LLC, Defendant-Intervenor-Cross Claimant.	Case No. 1:16-cv-1534-JEB (and Consolidated Case Nos. 16-cv-1796 and 17-cv-267)

DECLARATION OF IAN GOODMAN

I, Ian Goodman, declare as follows:

1. My name is Ian Goodman. I am President and founder of The Goodman Group, Ltd. (TGG). My CV is attached as Exhibit A to this declaration. For over 35 years, I have

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conducted research and consulted in energy regulation and economics (related to conventional, unconventional and renewable energy, and energy efficiency). My practice has addressed a broad range of issues, including pipeline economics and regulation, evolving North American oil, gas and electric markets, and economic development and environmental impacts of various energy supply and transportation options. Since 2011, my focus has been oil supply and transportation (notably, shale, Canadian tar sands, pipelines and rail). I also have expertise in the planning and operations of energy systems, as well as inter-jurisdictional energy trade in North America.

2. Since 1991, I have conducted over 30 national, regional, and state/provincial studies on the economic development impacts (notably jobs) and environmental impacts of various energy options in the US and Canada. Since 2011, I have co-authored nine expert reports on the economic development impacts and environmental impacts of crude oil transportation (particularly interjurisdictional pipeline projects and crude by rail projects). I have prepared expert reports and testimony on multiple crude oil pipelines and crude-by-rail ("CBR") terminals, including the Keystone XL pipeline, Enbridge Line 9 pipeline, TransMountain pipeline, Vancouver, WA CBR terminal, Valero CBR terminal, and others.

3. I have reviewed the declarations filed by DAPL in support of brief regarding remedy in this litigation, as well as the brief itself.

DAPL SHUTDOWN ANALYSIS

I. CONTEXT AND MARKET OVERVIEW

4. The DAPL Brief and Hanse Declaration[1] claim that a shutdown of DAPL would

[1] Hanse Declaration (DAPL Ex. 5). For brevity, "DAPL Brief" and "Hanse Declaration" are sometimes referred to herein as "DAPL" and "Hanse."

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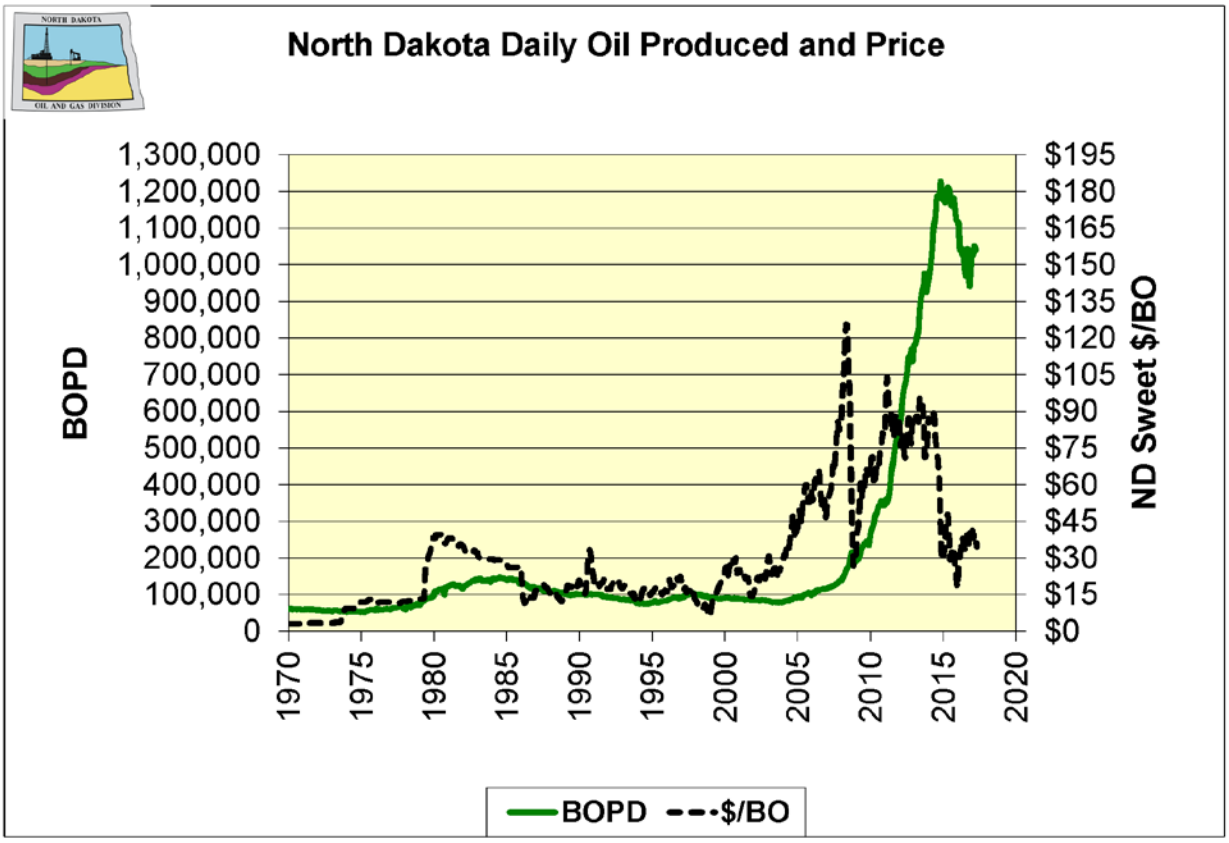
have severe disruptive consequences to markets and consumers. These claims are contradicted by market fundamentals and historical experience. To date, DAPL has been in service for just over two months. For years prior, the entirety of Bakken crude production was transported to a variety of destination markets, via a variety of transport options, throughout a variety of rapidly evolving market conditions, overcoming a wide variety of logistical and other challenges.

5. The Bakken boom was enabled by advances in shale production techniques, combined with an extended period of sustained high crude prices. See Figure 1 and Figure 2. Since 2014, market conditions have shifted dramatically. Crude prices are much lower and (with a lag) production has declined and then stabilized.

Figure 1: North Dakota Daily Oil Produced and Price[2]



[2] North Dakota Pipeline Authority, North Dakota Major Oil Pipelines, June 2017 https://ndpipelines.files.wordpress.com/2012/05/nd-major-oil-pipelines-june-2017.pdf

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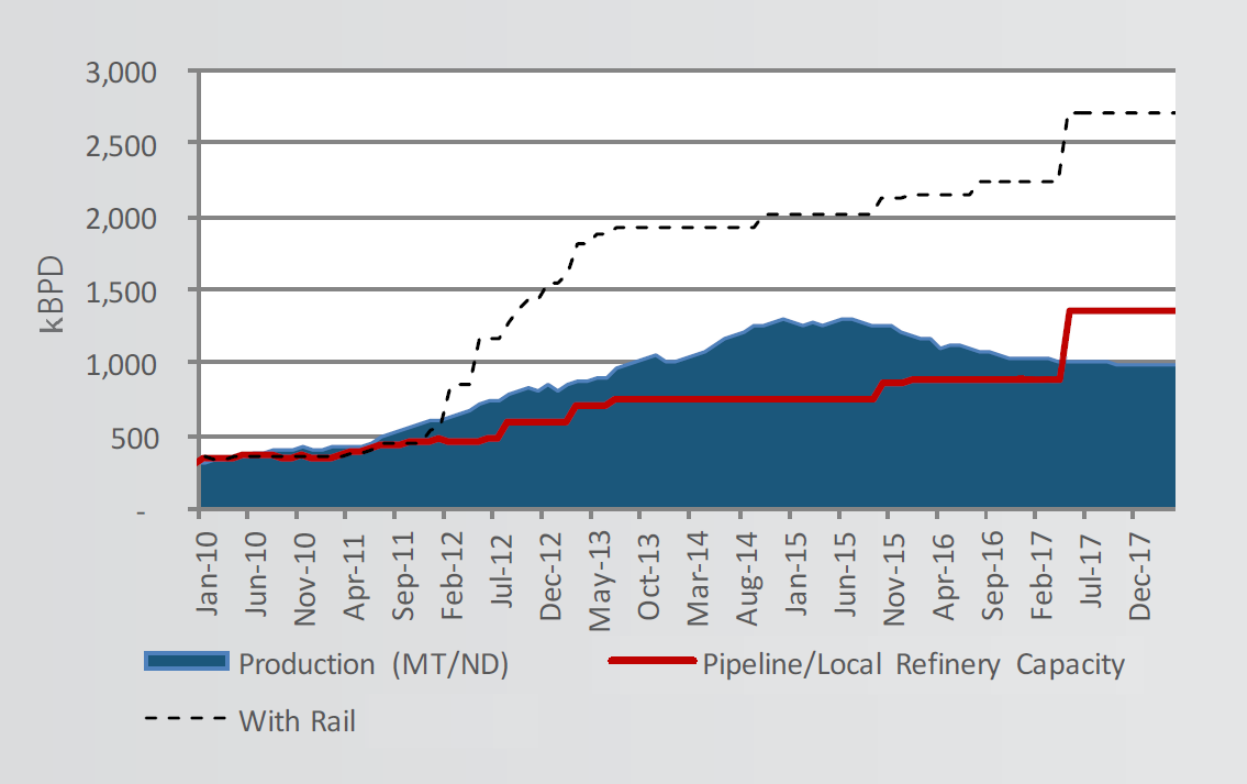
Figure 2: Bakken Production and Takeaway Capacity[3]



6. Bakken production peaked and plateaued around 1.2 million bpd in late 2014 and 2015. Production then declined, but since late 2016 has stabilized around 1.0 million bpd and is expected to stay at level for at least the short-term. The Bakken is now neither in a boom, nor a bust.

[3] Figure is based on figures in following Genscape documents, updated to be consistent with more recent information from US EIA and North Dakota Pipeline Authority.

David Arno, "North Dakota Rail Shipments to Increase on DAPL Easement Denial, OPEC Production Cuts," Genscape, December 14, 2016 http://www.genscape.com/blog/north-dakota-rail-shipments-increase-dapl-easement-denial-opec-production-cuts

David Arno, "North Dakota Crude-by-Rail Players Adjust Strategies as Dakota Access Crude Pipe Work Continue". Gescape, October 2016 http://info.genscape.com/dakota-access-crude-pipeline-white-paper-2016-web

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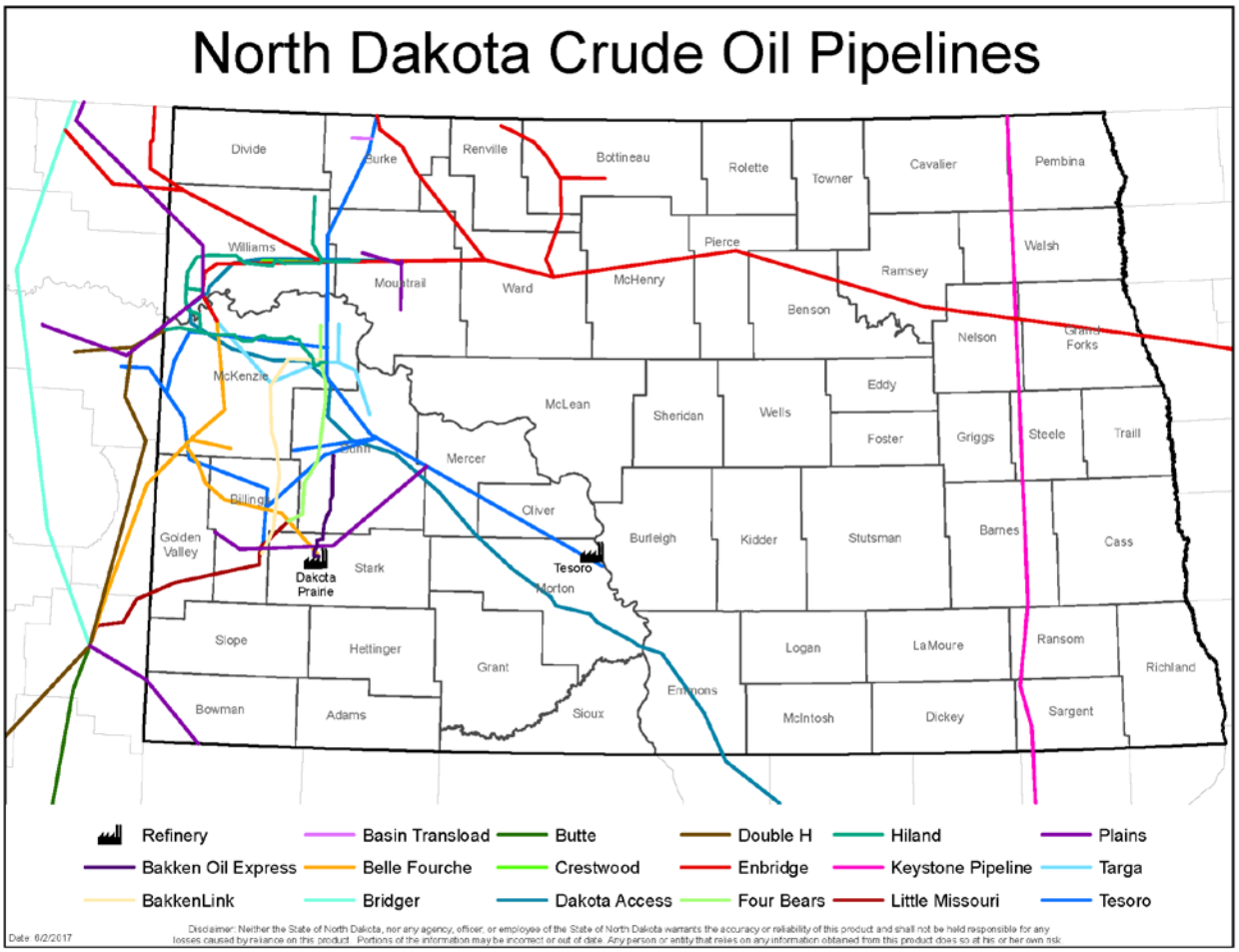
7. Aside from DAPL, there are multiple other pipelines used to transport Bakken crude (see map in Figure 3). With DAPL in-service, the total amount of pipeline capacity available now substantially exceeds the total amount of Bakken production (current and projected).

Figure 3: North Dakota Crude Oil Pipelines [4]



8. Even before DAPL and without DAPL, pipeline capacity had been expanded and almost 70% of Bakken production was being transported by pipeline to a variety of destination

[4] North Dakota Pipeline Authority, North Dakota Major Oil Pipelines, June 2017 https://ndpipelines.files.wordpress.com/2012/05/nd-major-oil-pipelines-june-2017.pdf

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markets. Only 25% was transported by rail, with the remainder refined in North Dakota. See Figure 2.[5]

9. With DAPL in-service, the total amount of pipeline capacity available now substantially exceeds the total amount of Bakken production (current and projected).

10. The capacity to transport Bakken crude that was already in place and used in the past is typically still in place and can be used in the future, notably in response to a DAPL shutdown. Prior to DAPL entering service in 2017, pipeline capacity had already been greatly expanded. Almost 70% of Bakken crude production was being transported by pipelines (other than DAPL) and only about 25% via crude by rail.[6] Even before DAPL began operations, the use of crude by rail had dropped to only about one-third of peak levels in 2014, so there is now substantial capacity available for continued (or even expanded) shipments via rail.

11. During a considerable portion of the period prior to DAPL entering service, Bakken crude production was higher than current and expected levels. See ¶6, Figure 1, and Figure 2. Notably, in 2014 and 2015, Bakken crude production was about 200 kbpd higher than current and expected levels. Nonetheless, even the entirety of this higher level of production could be transported to destination markets, via infrastructure significantly more limited than what is now available (even without DAPL).

12. Hence, a reasonable starting point for analysis is to assume that all Bakken crude production can be transported in the future, even without DAPL. It is then necessary to test this assumption and evaluate to what extent a shutdown of DAPL could have disruptive

[5] See also Technical Appendix, Section 2 for additional information regarding crude production and transport.

[6] A small portion of Bakken crude production (typically around 8%) is supplied to North Dakota refineries. See Technical Appendix, Section 2 for additional information regarding Bakken crude production.

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consequences to markets and consumers. Put another way, how rapidly and readily can the energy system (and broader economy) adapt to potentially disruptive change in energy transport options? Put in simpler, less technical terms, to what extent is there an "undo," so that Bakken crude can be transported to markets without DAPL, as it had been at all times for years prior to DAPL entering service a few weeks ago.

Shippers Decide How Crude Will Be Transported

13. In analysis of a potential DAPL shutdown, it is important to understand that decisions to transport (or not transport) crude on any available transport option are typically made by shippers,[7] based on a variety of commercial considerations. Put simply, shippers transport crude via a given option when it is in their commercial interest to do so. In general, crude is transported when it is more profitable to do so than not to do so.

14. Hence, the amount of Bakken crude that is transported on DAPL or alternative transport options, (including other pipelines and rail) is decided by shippers, rather than by transport operators (including DAPL), or by the actions of this court. That said, if (for any reason) DAPL is shut down, it is then unavailable as a transport option for shippers.

15. Shippers on DAPL (and other transport alternatives including rail) typically make commitments that are financial, as opposed to physical. These commitments often referred to as take-or-pay or minimum volume, guarantee a minimum level of revenues to the transport facility. Put more simply, the shipper is required to pay regardless of whether the facility is

[7] Shippers are the customers contracting with the transport operators. The crude being transported is typically owned by shippers; on DAPL (and more generally), the transport operator does not own (take title of) the crude. Hence, shippers include crude producers (selling crude at refineries), refiners (buying crude in the producing region) and intermediaries/logistics providers.

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actually utilized. This creates a strong financial incentive to actually use the facility, but it is not a binding commitment to physically transport crude.[8]

DAPL Utilization and Revenue Analysis: Introduction

16. If DAPL is shut down, shippers will need to shift crude that would have been transported on DAPL to other transport options. Hence, it is important to consider how much crude would have been transported on DAPL absent a shutdown.

17. In determining how much crude will be shipped on a pipeline, a useful starting point is information from the pipeline operator. For a variety of operational and commercial reasons, the pipeline operator must know how much crude has actually been flowing through the pipeline, and it must estimate future flows. Among other reasons, revenues paid by shippers (and received by the pipeline operator) are based (in part) on the volume of crude transported.

18. I have reviewed the DAPL Brief and Hanse Declaration, as well as other publicly available information, regarding how much crude has been flowing through the pipeline and is estimated to flow in the future. I have also reviewed information on DAPL revenues. As explained below, this DAPL utilization and revenue analysis proved to be more complicated, and less straightforward, than expected. The information provided by DAPL (the pipeline operator) is both limited and ambiguous. But even more problematically, the information provided by DAPL is both internally inconsistent and inconsistent with other usually reliable information sources. Hence, the claims of DAPL and Hanse regarding DAPL utilization, revenues, and

[8] Shippers also make commitments to transport alternatives by ownership and leasing of infrastructure. Once a shipper makes a commitment, a considerable portion of total transport costs may be "locked-in" (fixed, unavoidable, and not incremental). Shippers then decide on whether to actually utilize a transport alternative based on incremental costs, rather than total cost. Hence, even if a given transport alternative would not be utilized based on total costs, it may be used because it is competitive on an incremental cost basis.

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potential impacts of a DAPL shutdown should not be relied upon in evaluating a shutdown of DAPL.

DAPL Utilization Analysis

19. DAPL claims that the pipeline carries nearly half of North Dakota and Bakken crude production, which is currently about 1 million barrels per day.[9] DAPL also reports that the pipeline has capacity to carry more than half of this crude production. The DAPL Brief states:[10]

> In the few weeks that the pipeline has been in operation, it has already carried more than 18 million barrels of crude oil to market safely and efficiently. Indeed, the pipeline carries nearly half of the crude oil currently produced in North Dakota. Ex. 5 ¶ 4 (Hanse Dec.).11

> the pipeline carries approximately half of all oil produced in the nation's second largest oil-producing state—which equates to nearly 5% of national oil production. Ex. 5 ¶ 4 (Hanse Dec.).12

Hanse Declaration ¶ 4 states:[13]

> North Dakota accounts for approximately 11% of the country's domestic crude oil production, and Dakota Access carries half of that volume, or approximately 5% of domestic production, to market.

The DAPL Brief further states in regard to the impacts of DAPL continuing to operate or shutting down:

> In North Dakota alone, DAPL has the capacity to carry more than

[9] There is a small volume of North Dakota crude production outside of the Bakken, and a small volume of Bakken crude production in the US outside of North Dakota (notably in Montana proximate to North Dakota). But as a simple and reasonable approximation, the volume of crude production in North Dakota and the US Bakken are similar, and currently about 1 million barrels per day.

[10] DAPL Brief, p. 13, emphasis italics in the original, emphasis underlining added.

[11] DAPL Brief, p. 13, emphasis italics in the original, emphasis underlining added.

[12] DAPL Brief, p. 15, emphasis italics in the original, emphasis underlining added.

[13] Hanse Declaration ¶ 4, emphasis underlining added.

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> half of the current one million barrels a day produced by the Bakken shale to receipt points in Patoka, Illinois and beyond. Ex. 5 ¶ 4 (Hanse Dec.). In other words, roughly half of the oil jobs in the Bakken region, and all of the jobs that in turn rely on those jobs, are dependent in part on the continued operation of DAPL.[14]
>
> […] an indefinite halt in the means for delivering more than 400,000 barrels of oil per day will impose severe hardship on private and public stakeholders alike.[15]

20. The above statements by DAPL and Hanse do not clearly and consistently specify just how much crude is actually being transported daily by the pipeline. But read together, these statements claim that DAPL carries about 450 to 500 kbpd (thousand barrels per day).[16] Likewise, the DAPL Brief states that the pipeline has capacity to transport more than 500 kbpd, and it is reported elsewhere (including by DAPL owners) that capacity is now 520 kbpd but could be expanded to 570 kbpd.[17] So according to DAPL and Hanse, actual flows on the pipeline

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[14] DAPL Brief, p. 2, emphasis underlining added.

[15] DAPL Brief, p. 6, emphasis underlining added.

[16] As variously stated by DAPL and Hanse, North Dakota and Bakken crude production is about 1 million barrels per day and 11% of US crude production (which would be and is about 9 million barrels per day); DAPL carries nearly or about 5% of US crude production (which would be nearly or about 450 kbpd), nearly or about half of North Dakota production (nearly or about 500 kbpd), or more than 400 kbpd. Likewise, DAPL claims that the pipeline has carried more than 18 million barrels in the few weeks it has been in operation. DAPL entered commercial service on June 1, 2017. Assuming 450 to 500 kbpd, more than 18 million barrels would be carried after 36 to 40 days (July 7 to July 11), in less than 6 weeks.

[17] Energy Transfer Press Release, "Energy Transfer Announces the Bakken Pipeline is in Service Transporting Domestic Crude Oil from the Bakken/Three Forks Production Areas," June 1, 2017 http://ir.energytransfer.com/phoenix.zhtml?c=106094&p=irol-newsArticle&ID=2278014

> Dakota Access and ETCO […] have commitments, including shipper flexibility and walk-up, for approximately 520,000 barrels per day. This is up from 470,000 barrels per day due to the successful Supplemental Open Season held earlier this year that committed an additional 50,000 barrels per day.

See also https://ndpipelines.files.wordpress.com/2012/04/oil-table-6-1-171.png

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(450-500 kbpd) are around 90% of capacity (520 kbpd).

21. But according to other, widely relied upon sources, flows on DAPL have been and will be only about half of those claimed in the DAPL Brief and Hanse Declaration. Consistent with this low utilization, DAPL has not yet had major impacts on energy markets, and it remains to be seen how, when, and how much DAPL will actually have major market impacts.

22. Genscape (an energy analytics firm which monitors pipeline flows) reports that actual flows on DAPL were only about 223 kbpd from June 1 to July 6.[18] The flows reported by Genscape (averaging 223 kbpd) half or less those claimed by DAPL and Hanse (450-500 kbpd).[19]

23. Another leading energy analytics firm (Platts Analytics' Bentek Energy) forecasts that DAPL will have 50% utilization in second half of 2017, and thus muted impacts on energy transport and markets.[20]

> Platts Analytics' Bentek Energy expects Dakota Access to have muted price and flow impacts initially, given an estimated 50% utilization in the second half of 2017.

24. The Bentek Energy forecast (50% utilization) is broadly consistent with the data from Genscape on actual pipeline flows.

25. Directors of the North Dakota state agencies that regulate and monitor oil

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[18] Attached as Exhibit B: Genscape, Mid-Continent Pipeline Daily Update, July 7, 2017 (Volume 9; Issue 130), pp. 4-5, http://info.genscape.com/mid-continent-pipeline-sample-report. See Technical Appendix, Section 1 for additional information regarding Genscape and DAPL flow data.

[19] ¶17.

[20] Platts, "Dakota Access, ETCO oil pipelines to start interstate service May 14", April 17, 2017. https://www.platts.com/latest-news/oil/washington/dakota-access-etco-oil-pipelines-to-start-interstate-21463845

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production and transport report that:[21]

- shipper commitments on new pipelines are often staggered and phase in over time, so flows can be substantially below capacity;
- no information is publicly available on the specifics of DAPL shipper commitments and crude flows;[22]
- it is unknown when DAPL might be more fully utilized;
- DAPL is not having a major impact on North Dakota crude prices;
- North Dakota crude prices are now about $35/barrel (lower than before DAPL entered service);
- North Dakota crude prices continue to be discounted below benchmark WTI crude prices (similar to before DAPL entered service);
- it may take six months or longer to determine if DAPL helps raise crude oil prices.

DAPL Revenue Analysis

26. To evaluate how DAPL might be utilized and how a shutdown could affect the energy system and markets, I also analyzed information regarding pipeline revenues.

27. The DAPL Brief claims that Dakota Access would lose almost $90 million in revenue for each month the pipeline was shut down:[23]

> a shutdown would once again prevent Dakota Access from being

[21] See Technical Appendix Section 2 for additional information and sources relating to June 13, 2017 and July 14, 2017 reports/presentations, Lynn Helms and Justin Kringstad, Directors of North Dakota Department of Mineral Resources and North Dakota Pipeline Authority.

[22] As discussed in ¶22 and Technical Appendix Section 1, Genscape provides flow data for various pipelines, including DAPL. The North Dakota agency Directors did not identify Genscape as a potential data source.

[23] DAP Brief, p. 18 (emphasis italics in original).

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> able to perform the contracts it has entered into with producers. Dakota Access would lose almost $90 million in revenue for *each month* that the pipeline lies idle. Ex. 5 ¶ 3 (Hanse Dec.).

Hanse Declaration (¶3) states that DAPL has anticipated revenues of about $3 million per day, or $88 million per month:

> Based on contractual commitments, Dakota Access has anticipated revenue of approximately $3 million per day, or approximately $88 million per month.

28. DAPL revenues will likely be considerably less than claimed by DAPL and Hanse. At least in the short-term, actual revenues may be less than half of those claimed. Hence, any revenue loss as result of a DAPL shutdown will likely be far less than has been claimed by DAPL and Hanse. Moreover, these lower revenues (less than claimed by DAPL and Hanse) are related to lower pipeline utilization (less than claimed by DAPL and Hanse).

29. DAPL tariffs (issued by Hanse and submitted to US FERC on April 13, 2017 and May 31, 2017) specify that committed shippers that entered into a TSA pay between $4.335 and $4.845 per barrel.[24] Other committed shippers pay $5.35 per barrel, and the rate for uncommitted (walk-up) shippers is $6.01 per barrel. There are also discounts for shippers that jointly utilize DAPL and the Energy Transfer Crude Oil Pipeline ("ETCO"). Energy Transfer reports that DAPL capacity is now 520 kbpd.[25] In keeping with standard practice for FERC-

[24] Dakota Access, Oil Pipeline Tariffs:

April 13, 2017 https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14559293. As defined (p. 4):

> "TSA" means a Transportation Service Agreement executed pursuant to the "Dakota Access Pipeline" open season that commenced on March 12, 2014, the expansion open season that commenced on September 23, 2014, or the supplemental open season that commenced on August 12, 2016.

May 31, 2017, https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14603826.

[25] See footnote 17.

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regulated pipelines, committed shippers could have contracted for up to 90% of this capacity (468 kbpd), and the remaining 10% (52 kbpd) would be available for uncommitted (walk-up) shippers and flexibility for additional throughput by committed shippers. Hence, shippers may be committed to pay for up to 90% of capacity (468 kbpd), even if the amount of crude actually transported is below the committed volumes.

30. Based on committed volumes of 468 kbpd, and actual shipments at or below committed volumes, DAPL revenues would be around $2.2 million per day (tariffs averaging about $4.70 per barrel for 468 kbpd).[26]

31. But at least in the short-term, committed volumes may be significantly less than 468 kbpd, and DAPL revenues may be significantly less than $2.2 million per day.

32. Committed volumes are determined by the contracts negotiated between DAPL and shippers. These contracts can be (and often are) structured, so that the committed volumes phase in (ramp up) over time. In particular, committed volumes may be lower following start-up of a new pipeline, providing flexibility for shippers and the pipeline operator as they adapt to new operating and market conditions. As explained by North Dakota Pipeline Authority Director Justin Kringstad:[27]

> "The nameplate capacity is 520,000 b/d, and it is not uncommon for a pipeline company to stagger volumes committed to it, so the company or a shipper may have their volumes stagger in, depending on how the contracts are written," Kringstad said. "The operator and shipper usually keep pretty private what the actual

[26] If pipeline capacity is fully utilized, including by uncommitted (walk-up) shippers paying higher rates, revenues could be up to $2.5 million per day (tariffs averaging about $4.80 per barrel for 520 kbpd). DAPL is seeking additional commitments from shippers, and it is possible that capacity on DAPL could be further expanded, up to 570 kbpd. Under some growth scenarios, DAPL revenues could approach the levels estimated by Hanse. Energy Transfer Website http://www.energytransfer.com/ops_copp.aspx

[27] See ¶25 and Technical Appendix Section 2 for additional information and sources.

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flowing volumes are."

33. Moreover, it is likely that DAPL's contracts with shippers have been subject to renegotiations due to changing circumstances, and in particular the delays in project in-service. Mahmoud Declaration ¶70 (August 18, 2016) states:

> In connection with its long-term transportation contracts with 9 committed shippers, Dakota Access has committed to complete, test and have DAPL in service by January 1, 2017. The long-term transportation contracts give shippers a right to terminate their commitments if DAPL is not in full service per the contract deadline. Meanwhile, faced with an uncertain delay, shippers would need to determine alternative sources for secure, reliable transportation of crude oil supplies to the refineries. These costs cannot be recovered and loss of shippers to the project could effectively result in project cancellation.

Faced with the possibility of shippers terminating their commitments and project cancellation, DAPL may have agreed to reduce committed volumes, at least in the short-term. Put simply, DAPL may have decided that some revenue is better than no revenue.

34. DAPL's failure to meet its service commitment gave shippers the opportunity to renegotiate (and possibly terminate) their contracts with DAPL. And it would not be surprising if shippers took advantage of this opportunity. Since the DAPL project was initiated in 2014 (and contracts originally negotiated with shippers), market conditions have shifted dramatically in a variety of ways.

35. And to the extent that committed volumes are lower, especially in the short-term, this will result in lower revenues to DAPL and lower actual flows on the pipeline. If shippers are not committed to DAPL, they do not have to pay for DAPL capacity whether they use it or not. Hence, they can use transport alternatives without having "to pay twice" (first for the alternative actually used to transport crude and second for DAPL committed capacity not used).

36. And this helps to explain why actual shipments on DAPL are reported and

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forecasted to be far below capacity, at least in the short-term. Shippers have likely been able to negotiate lower committed volumes and are now using that flexibility to take advantage of transport alternatives that are more commercially attractive and profitable to utilize. Hence, in contrast to the severe disruptive consequences claimed by DAPL if the pipeline were to shut down, shippers may already be freely choosing to not utilize DAPL, even when it is operating and available.

37. At least in the short-term, actual revenues may be less than half the revenues claimed by DAPL and Hanse. As discussed in ¶21-22, actual utilization of DAPL appears to have been, and may continue to be, only about 50% of pipeline capacity (260 kbpd). Based on committed volumes of 260 kbpd, and actual shipments at or below committed volumes, DAPL revenues would be around $1.2 million per day and $37 million per month.[28] This would only about 40% of the revenues claimed by DAPL and Hanse (about $3 million per day and $88 million per month).

38. It is possible (and even likely) that the level of shipper commitments could increase (ramp-up) over time. Hence, if DAPL continues to operate, revenues could be higher after 2017.

39. A higher level of shipper commitments and revenues would clearly be beneficial for DAPL. As will be further discussed in ¶75-76, it is less clear what the benefits and costs will be for other affected parties, including shippers and transportation alternatives.

40. DAPL has not publicly disclosed the specifics of its agreements with committed shippers, and how these may have changed as a result of renegotiations.[29] So it remains

[28] Tariffs averaging about $4.70 per barrel for 260 kbpd.

[29] In disclosures to investors, DAPL reports that shippers have made long term commitments

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uncertain what volumes are actually committed, for which periods, under what arrangements, and how this may affect revenues for DAPL, as well as benefits and costs for other affected parties.

41. Absent reliable information regarding shipper commitments, it is difficult to estimate revenues (and utilization) for the pipeline. DAPL has access to this information,[30] but it has not provided a reliable estimate of revenues (and utilization) for the pipeline. Based on my revenue analysis of available information (including the tariffs DAPL has filed with FERC), DAPL revenues (and utilization) will likely be substantially less than indicated by DAPL and Hanse. The claims of DAPL and Hanse regarding loss of revenues and other potential impacts of a DAPL shutdown should not be relied upon to determine the likely impacts of a shutdown.

Energy System and Market Impacts

42. Rather than being the game changer claimed by DAPL and Hanse, operation of the pipeline has so far been (at most) a small event for the energy system and markets. The US energy system and markets are very large, dynamic, and ever evolving. Put more simply and less technically, there are a lot of moving parts, and it takes a really big event (or combination of events) to really move the dials. Smaller events may be "lost in the noise" and not have much readily observable impact on the broader system and markets.

43. A DAPL shutdown would be a relatively small event for the energy system and markets. Hence, a DAPL shutdown, and especially a planned temporary suspension of

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averaging 9 years.

http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9Njc0NDIyfENoaWxkSUQ9MzgyNjAwfFR5cGU9MQ==&t=1 p. 15

[30] Shipper commitments are contracts between shippers and DAPL.

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operations, will not result in the severe disruptions claimed by DAPL and Hanse. Instead, the likely impacts range from small to very small.

44. In particular, the US energy system relating to crude oil is typically not severely disrupted by even large and unexpected events. The energy system is designed and managed to operate effectively and efficiently under a very wide range of conditions. The energy system has many components, which are subject to a variety of planned and unplanned outages, as well as evolving market conditions and many other shifts that affect operations.

45. The energy system and markets have not been dramatically affected by DAPL coming into service, and they will not be severely disrupted by a planned shutdown of DAPL requiring relatively small shifts in crude transportation.

46. DAPL has been operating for only a few weeks, and its in-service date was delayed and remained highly uncertain until shortly before it was actually brought into service. Based on the limited, publicly available information, it appears that shippers have so far chosen to transport only relatively small amounts of crude on DAPL. Hence, shippers have continued to rely upon other transport options, such as those relied upon before DAPL entered service.

47. Related to these low flows, DAPL has not had much impact on crude prices.

48. DAPL is thus having much less impact and providing much less benefit than claimed by DAPL.[31]

49. As discussed in ¶31, to the extent that committed volumes are lower, at least in the short-term, this could (and likely would) result in lower actual flows on the pipeline. Shippers may have been able negotiate lower committed volumes and are now using that

[31] See Technical Appendix Section 2 for additional information regarding crude market pricing dynamics.

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flexibility to take advantage of transport alternatives that are more commercially attractive and profitable to utilize. In practice, this may mean that shippers are continuing to use the transport alternatives they had relied upon prior to DAPL entering service a few weeks ago. And if DAPL were to shut down (or otherwise be unavailable or unattractive to shippers), the most likely response may be that shippers would continue utilizing the transport alternatives that they have been using.

50. In this context, it is important to note that a scenario where DAPL is not available to transport crude is not merely some heretofore unlikely event that will be highly novel and disruptive. In fact, a scenario without DAPL operating was the real world experience at all times until a few weeks ago.

51. This real world experience demonstrates that shippers have alternatives to DAPL, which they can, do, and will utilize. To the extent that utilization of DAPL is below capacity and apparently far below capacity, shippers are choosing not to use DAPL, even when DAPL is operating and available to transport additional crude. And if DAPL was not available, following an action of this court or for any other reason, shippers will utilize alternatives to DAPL to mitigate any adverse impacts affecting their commercial activities.

52. The DAPL Brief and Hanse Declaration claim that a shutdown of DAPL would have severe disruptive consequences for the oil industry (crude producers, transporters, and refiners) and more generally for energy markets. [32]

53. In fact, especially in relation to the Bakken, the oil industry has a demonstrated capability to overcome logistical challenges. Put simply, absent the speed and agility of industry in surmounting these challenges, there would now be much less Bakken crude production, and

[32] See ¶77 for the claims specified by DAPL and Hanse.

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DAPL would likely never have been proposed and constructed. The Bakken region is remote and has traditionally had very limited population and infrastructure. This region also has severe climate conditions (especially in winter) that further intensify logistical challenges. Nonetheless, industry had the capability for an exceptionally rapid growth in crude production and transportation. During the Bakken boom (notably the four years from 2011 to 2014), crude production increased by about 900 kbpd, which was all transported to destination markets, mostly via new crude by rail infrastructure.

54. Given this demonstrated capability, it would be very surprising (and a big departure from historical experience) if a DAPL shutdown resulted in the severe disruptions claimed by DAPL and Hanse. It is far more likely that the oil industry will continue to do what it has been doing to enable ongoing crude production, processing, and consumption of refined products under a wide variety of evolving circumstances.

55. Severe disruptive consequences from a DAPL shutdown are even less likely given current and expected levels of Bakken crude production.[33] The Bakken boom coincided with a period of ongoing high crude prices. Since 2014, crude prices have been much lower, and Bakken production has shifted from a period of rapid growth to a plateau period. Production is now somewhat lower than the peak and is expected to remain around this level for the short-term. Put simply, current conditions in the Bakken are neither a boom nor a bust.

56. Hence, a future without DAPL operating is likely to be overall similar to the recent past, without DAPL operating. There has been and will be more than adequate capacity available to transport the entirety of Bakken crude production, both in the past and in the future,

[33] See Technical Appendix Section 2 for additional information regarding Bakken crude production.

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even without DAPL operating.

57. The amount of Bakken crude transported by rail has substantially declined, in both absolute (barrel per day) terms, and as a proportion of overall Bakken production.

58. Whether DAPL is operating or not will likely have some impact, but any such impact is within the range that has occurred and will continue to occur owing to a variety of market conditions.

59. Moreover, any shutdown of DAPL ordered by the court will be an event known in advance and can be managed to limit any disruption and adverse impacts. Thus, a planned shutdown of DAPL will typically be less disruptive than an unexpected event. Especially given the history of DAPL and the Court's Opinion, contingency planning for a possible shutdown has presumably already been initiated.

60. A planned shutdown of DAPL will also be a relatively small event in terms of resulting shifts in crude transport. The likely result is that some crude will instead be transported via other pipelines and some via rail.

61. Aside from DAPL, there are multiple other pipelines used to transport Bakken crude (see map in Figure 3). Even before DAPL and without DAPL, pipeline capacity had been expanded and almost 70% of Bakken production was being transported by pipeline to a variety of destination markets. Only 25% was transported by rail, with the remainder refined in North Dakota. (See Figure 2.)[34]

62. With DAPL in-service, the total amount of pipeline capacity available now substantially exceeds the total amount of Bakken production (current and projected). To the

[34] See also Technical Appendix, Section 2 for additional information regarding crude production and transport.

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extent that crude is transported on DAPL, much of it would be shifted off these other pipelines. And if DAPL was shut down, much of this crude would in turn shift back to these other pipelines, rather than to rail. Other pipelines remain in service and available to transport crude. A likely outcome is that the crude that had been transported on these other pipelines (prior to DAPL entering service) would shift back to the same pipelines that had been used previously. These shippers and pipeline operators would have established relationships and operating experience that would facilitate any shifts in crude transport following a DAPL shutdown. Put in simple, non-technical terms, this might be an especially easy undo.

63. With DAPL in-service, there may be less transport of crude by rail, but it is unclear how soon and how much crude might be shifted on to DAPL from rail. Even before DAPL and without DAPL, only 25% of Bakken crude was still being transported by rail.[35] Even in the unlikely scenario where all of this crude eventually shifts from rail to DAPL, this would require only half of DAPL capacity.

64. But for variety of reasons, there is likely to be some continued use of crude by rail, with or without DAPL.[36] Hence, DAPL operating (or not operating) would have, at most, a relatively small impact on use of crude by rail. About 100-150 kbpd of crude could eventually shift from rail on to DAPL (and other pipelines), but these shifts would likely phase in over an extended period of time (notably as shipper commitments to rail eventually terminate). Hence, in a scenario where DAPL is fully utilized (520 kbpd) and 100-150 kbpd of this capacity is used

[35] See Technical Appendix, Section 2 for additional information regarding transport of crude by crude by rail.

[36] Much of the remaining crude by rail from the Bakken is supplying West Coast markets (notably Washington) which are not pipeline-accessible; rail is especially competitive for this routing owing to various factors, including relatively short distance and extensive crude by rail infrastructure in destination markets. See Technical Appendix Section 4 for additional information regarding crude by rail.

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for crude shifted from rail, 70-80% of capacity would be used for crude off of other pipelines.

65. This analysis confirms that DAPL would be mainly used for crude shifted off of other pipelines, not rail. **Hence, the main potential impact of a DAPL shutdown is to shift crude back onto other pipelines.**

66. Hanse Declaration (¶5) claims that a DAPL shutdown could be disruptive, since it would entail a shift of crude transport onto rail, where capacity might not be readily available. As discussed above, suspension of DAPL operations will primarily result in a shift in crude transportation to other pipelines. Even if there is some shift to using rail, this will not result in logistical difficulties. There is adequate or even far more than adequate capacity in place to support current or even substantially expanded use of crude by rail to accommodate oil shipments if DAPL operations are suspended.

67. There was a very rapid expansion in crude by rail by shipments from 2010 through 2014, together with a large build-out of infrastructure, especially for Bakken crude, but also in destination markets and some other production areas. Since then, crude by rail shipments have plateaued and then declined, especially for Bakken crude, but elsewhere as well.

68. Hence, there is now very substantial surplus capacity for crude by rail, including:

- loading and unloading terminals with very low utilization rates (or mothballed);
- tank cars available for lease at low rates and/or being stored (but could be returned to service if there was market demand);
- rail system capacity (in part due to the decline in coal shipments, which had been a very large portion of overall traffic, railroads typically have more than adequate capacity).

69. Transport of Bakken crude by rail has declined very substantially from peak

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levels. Even prior to DAPL entering service in 2017, Bakken crude by rail had declined to about one-third of peak levels in 2014. At peak levels, there were about 12 loaded crude unit trains leaving the Bakken every day; in early 2017 (pre-DAPL), there were only about 4 trains per day.

70. With DAPL operating, crude by rail might be lower by 100-150 kpbd, compared with a scenario where DAPL is shut down. This potential impact is 1.5-2.5 trains per day (10-16 trains per week).

71. With or without DAPL, future use of rail to transport Bakken crude will remain a small proportion of crude by rail activity in prior years. And with or without DAPL, there is adequate or even far more than adequate capacity in place to support current or even substantially expanded use of crude by rail.

72. So there is not going to be severe disruption if DAPL is shut down. Crude will just shift back to pipe and rail, which together provide more than enough capacity to transport all of Bakken crude production, even without DAPL.

73. There may be some increased costs, but these cost are probably relatively small, especially short-term. First, as explained above, much of the crude that might be transported on DAPL would be shifted from other pipelines. DAPL may be cheaper or otherwise more attractive to shippers than other pipelines, but the advantages of DAPL over other pipelines may not be highly significant. Also, DAPL has failed to provide any substantive information about potential impacts of a DAPL shutdown in regard to crude being shifted onto other pipelines.

74. Second, as explained above, the amount of crude might be shifted back onto rail is likely at most only 100-150 kbpd, and these shifts would likely only phase in over time.[37]

[37] Due to a variety of factors, the incremental cost of using rail instead of DAPL may be smaller than claimed by DAPL ($5-$7/barrel); see footnote 36 and Technical Appendix Section 4 for additional information regarding crude by rail.

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75. Shifts between DAPL and transportation alternatives may have little if any impact on the overall economy, even if it does have some impacts on specific commercial interests. DAPL's owners would be adversely affected by a shutdown of DAPL and other commercial interests would benefit (including other pipelines and rail providers (notably railroads and owner/leasers of tank cars and terminals)).

76. Given the complex ownership arrangements, there is significant overlap in the ownership of DAPL, other pipelines, and crude by rail. Hence, there is overlap in the winners and losers from a DAPL shutdown. A meaningful analysis of overall impacts has to consider both winners and losers. The claims of DAPL and Hanse regarding potential impacts of a DAPL shutdown should not be relied upon to determine the likely impacts of a shutdown.

Impacts on Crude Producers, Refiners and Consumers: DAPL and Hanse Claims

77. The DAPL Brief and Hanse Declaration repeatedly, emphatically and unambiguously claim that a DAPL shutdown will have severe disruptive consequences for crude producers, refiners and consumers of gasoline and other refined products. The DAPL Brief states:

> there is no question that stopping the flow of oil would be highly disruptive […] to producers of oil in North Dakota whose oil DAPL carries, the customers who buy the oil and refine it, the employees of those producers and customers, the consumers of the end products which are priced based on significant cost savings from transporting the oil by pipe[38]
>
> transport by pipeline costs about $5.00 to $7.00 per barrel less than shipment by rail, Ex. 5 ¶¶ 4, 8 (Hanse Dec.) […] Those savings ultimately benefit consumers. They also encourage oil production—and hence employment—by North Dakota producers. Ex. 5 ¶ 6 (Hanse Dec.). These benefits would disappear with a switch to rail transport. Moreover, refineries would face increased

[38] DAPL Brief, p. 1, emphasis underlining added.

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> costs, which would ultimately be passed on to the consumers who buy gasoline, diesel, plastics, or other petroleum products from refined Bakken crude.[39]

Hanse Declaration states:

> DAPL increases the price producers receive at the well-head, making production more cost effective. Shutting the pipeline down will wreak havoc on Bakken crude oil producers' current production flows and revenues, drilling plans, and long-range development plans for Bakken acreage. […] A sudden or even short-term loss of transport of roughly half of the Bakken production would have devastating impacts not only on domestic industrial and commercial consumers but also on ordinary Americans who rely on crude derivatives to fuel their cars, heat their homes, and so much more.[40]
>
> the impacts to the economics would be catastrophic to the producers, shippers, refiners and ultimate consumers.[41]
>
> The additional costs of crude transportation and crude-based products […] would increase prices for numerous consumer goods and services, negatively impacting the national economy for all Americans.[42]
>
> large negative impacts to consumer prices will occur […] immediately upon any shutdown of DAPL.[43]

78. DAPL and Hanse claim that the following chain of events will occur:

- crude transport via DAPL will result in large benefits to producers and refiners,
- these large benefits to producers and refiners will in turn result in large benefits to consumers of gasoline and other refined products.
- these large benefits to producers, refiners and consumers would be lost if DAPL is

[39] DAPL Brief, p. 15.

[40] Hanse Declaration ¶ 4

[41] Hanse Declaration ¶ 5, emphasis underlining added.

[42] Hanse Declaration ¶ 7, emphasis underlining added.

[43] Hanse Declaration ¶ 8, emphasis underlining added.

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shut down, with impacts that would be highly disruptive, devastating, and catastrophic.

79. As discussed in ¶21-25 and ¶47-49, the impacts of DAPL operations on energy markets are to date small. But it is possible that a DAPL shutdown could result in some increased costs for crude transport. These costs are likely small, but it is relevant to consider how they could affect crude producers, refiners and consumers of refined products.

80. The claims of DAPL and Hanse regarding potential impacts on producers, refiners and consumers are not credible and should not be relied upon in evaluating a shutdown of DAPL. Properly evaluating potential impacts of a change in transport costs requires consideration of the relevant economic linkages and potential scale of impacts. As such, meaningful analysis can be highly technical. The results of my economic analysis are briefly summarized below and further discussed in the Technical Appendix, Section 4.

81. A DAPL shutdown would not be highly disruptive for Bakken crude producers. It is possible that DAPL could provide some benefit to Bakken crude producers via reduced transport costs and higher crude prices. And in turn, a DAPL shutdown could conceivably have some adverse impacts on crude producers. But any such impacts are likely to only at the margins and over time. Bakken crude production is now relatively stable and in neither a boom or a bust, and conditions with or without DAPL will be largely similar.

82. A DAPL shutdown would not be highly disruptive for consumers of gasoline and other refined products. To the extent that DAPL provides some benefit to refiners in terms of lower cost crude supply, the result will be higher profits for refineries, but little or no impact on the prices at the pump for consumers. Likewise, to the extent that a DAPL shutdown results in some added costs to refiners, the result will be lower profits for refineries, but little or no impact

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on the prices at the pump for consumers.

II. TRANSPORT OF CRUDE OIL BY PIPELINE IS NOT NECESSARILY SAFER THAN BY RAIL

83. The DAPL Brief (based on the McCown Declaration) claims that "shipment by pipeline is undeniably safer than shipment by rail" and that "pipelines are a more reliable, safer, and more economical alternative" to rail. (DAPL Brief, p. 15)

84. I have co-authored multiple expert reports evaluating the worst-case spill scenarios for both pipeline and crude-by-rail. The DAPL Brief/McCown claim is a simplistic analysis of the risk of pipeline versus rail, which fails to take into account the various factors that affect the respective risks, both absolutely and relatively.

A. Worst Case Scenarios for Pipeline Spills and Crude by Rail

85. My research has examined how crude transport by both rail and pipeline can result in catastrophic spills. Recent accidents involving crude transport by both pipelines and rail have resulted in damages in excess of US $1 billion. Examples include Enbridge's Line 6B spill in Marshall, MI (2010) and the CBR catastrophe at Lac-Mégantic, Québec (2013).

86. However, potential worst-case scenarios can be even more catastrophic and escalate into the multi-billion-dollar range. Under some scenarios, the cost of a major pipeline rupture could escalate into the multi-billion-dollar range. Similarly, the U.S. Department of Transportation's Final Rule on Enhanced Tank Car Standards and Operational Controls concluded that major crude by rail accidents could result in multi-billion dollar damages from high consequence events in areas with high proximity to people, water, and economic activity.[44]

[44] DOT/PHMSA Final Rule on Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains, May 1, 2015, pp. 289-291. https://www.fra.dot.gov/Elib/Document/14508;

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87. A major rupture of a 30" pipeline under pressure (such as DAPL) could result in a substantially larger spill than the Lac-Mégantic disaster (in either a metropolitan or a non-metropolitan area). A rupture from a 30" pipeline is capable of putting a far larger volume of oil into the environment than any CBR train.

88. In short, transporting crude either by pipeline or rail involves risks. It is simplistic and incorrect to state that pipelines are "undeniably safer" than rail. Moreover, large diameter high pressure pipelines (such as DAPL) are capable of releasing substantially more oil than trains.

B. Factors Affecting Risks of Pipeline Spills Versus Crude by Rail Spills

89. There are various factors that affect risks (absolutely and relatively) for crude transport by pipelines and rail. These relevant factors do not consistently favor pipelines over rail as lower risk, nor do they consistently favor rail over pipelines. Instead, comparison of the risks associated with pipelines and those associated with rail is nuanced. A meaningful comparison must take into account various specific factors, which vary by transport mode, region, project, and site, as well as over time. These factors can affect both the probability of large accident/rupture/spill, as well as the impact. DAPL's simplistic blanket claim that that "shipment by pipeline is undeniably safer than shipment by rail" fails to take into account these specific factors. This analysis can be misleading, particularly in the case of worst-case spill risk affecting Tribal lands and resources in North Dakota. Key factors with particular relevance to DAPL that affect risks for crude transport by pipelines and rail include: (1) delay in detection of

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DOT/PHMSA Final Regulatory Impact Analysis on Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains, Final Rule, May 2015, pp. 95-111, 191-192, Appendix G.

http://www.regulations.gov/contentStreamer?documentId=PHMSA-2012-0082-3442&attachmentNumber=1&disposition=attachment&contentType=pdf

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accident/spill and response time; (2) landslide risk; and (3) proximity to people, water and economic activity.

1. Delay in detection of accident/spill and response time

90. A rail accident/spill (especially for worst-case events) is typically detected instantly/very promptly. Put simply, the train crew usually knows immediately if the train is involved in an accident. More generally, rail typically operates above ground, and crosses above water bodies. Rail routings are sometimes in close proximity to people, water, and economic activity. As will be discussed below, this proximity can increase risk and impacts, but it does mean that rail accidents are typically detected quickly, and this also facilitates quick response. By comparison, pipelines are typically buried below ground and water bodies. Pipeline routings are often in remote areas. Pipelines are mostly automated/unattended. This implies that leaks/ruptures can go undetected for relatively long periods and that response time can be very slow. According to pipeline safety expert Richard Kuprewicz:[45]

> Pipeline investigation history and PHMSA/NTSB investigation files are filled with pipeline ruptures that released for many hours before they were acknowledged by the control center and appropriate operation/response action taken.

91. Particularly in North Dakota, where DAPL is routed through quite remote areas, delay in detection of accident/spill and response time is more likely to be a risk factor for DAPL than for a crude by rail accident.

2. Landslide risk

92. Landslides are a major risk factor for crude oil pipelines. Pipeline safety expert

[45] Kuprewicz, Richard, Accufacts Review of the U.S. Army Corps of Engineers (USACE) Environmental Assessment (EA) for the Dakota Access Pipeline ("DAPL"), October 28, 2016, p. 5.

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Richard Kuprewicz has warned that DAPL crosses high-landslide risk areas in North Dakota and that "some of these high risk areas are in close proximity to or could affect Lake Oahe." He further cautions that:[46]

> Placing pipeline in areas with high risk of landslide is unwise, as even modern steel pipe cannot survive such high abnormal loading threat activity which usually results in pipeline rupture with high rate high volume oil spill releases. Steel tubes (pipelines) cannot bear the extreme loading forces that are associated with massive landslide movements.

93. This risk is substantially lessened for crude by rail. A worst case/large spill would typically require a train loaded with oil to be present during (or immediately after) the landslide. Unlike pipelines, which are always present along the full routing and generally full of oil, rail lines only have significant oil present when occupied by a loaded oil train. In practice, even on a rail line with heavy oil train traffic, there are typically only oil trains present at a given location at a few times per day, for a limited time. Also, the oil in trains is carried in numerous separate tank cars, notably in unit trains that are more than a mile long. A landslide might result in damage to only a limited number of cars on a train. And depending on the specifics of the event, only a portion (and possibly none) of the oil might be released from damaged cars.

94. Given the nature of rail, a worst-case scenario from a landslide would require a combination of circumstances that appear to be extremely unlikely. Conversely, for pipelines, especially in the Dakotas (e.g., DAPL and KXL), realistic worst case scenarios could include landslides. Hence, landslide risk in general (and particularly in North Dakota), is more of a risk for pipelines (including DAPL) than for rail.

[46] *Ibid.*, p. 3.

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3. Proximity to People, Water and Economic Activity

95. The third and perhaps the most important key risk factor for crude transport affecting the magnitude of the impact for a large spill is proximity to people, water, and economic activity. A large spill from pipeline or rail transport will typically be much more damaging in an urban area with high proximity to people, water and economic activity.

96. It is more complex to analyze how proximity to people, water and economic activity affects the risk of pipelines relative to rail. In the case of DAPL versus crude by rail, the risk is increased by the proximity of the respective rail routes or pipeline routes to (1) the Plaintiffs' reservations; and (2) people, water and economic activity outside the reservations. It is possible to analyze whether proximity to (1) the Plaintiffs' reservations; and to (2) people, water and economic activity outside the reservations is greater for DAPL versus crude by rail. As such, I have undertaken a proximity analysis as set out below.

C. Proximity Analysis to Plaintiffs' Reservations for DAPL versus CBR

97. The DAPL Brief not only claims that crude transport by DAPL is safer than rail. It also claims that, compared with rail lines, DAPL is less proximate to the Plaintiffs' reservations and the reservations of other tribes.[47] In fact, a careful and detailed analysis of relevant proximity demonstrates the opposite. Compared with crude by rail, DAPL (and related crude transport) is overall substantially more proximate to the Plaintiffs' reservations. For DAPL, the proximity analysis is facilitated by the fixed nature of pipelines. For the existing pipeline, routing is at locations that are specific, known, and invariant. Likewise, key attributes of pipeline design and operations are fixed (at least currently) and known. DAPL is a 30" diameter, high-pressure crude oil pipeline. Capacity is currently 520 kpbd, but could possibly be

[47] DAPL Brief, p. 16.

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increased to 570 kbpd in the future.

98. DAPL crosses disputed Sioux land in the Dakotas, and under the Missouri River/Lake Oahe just half a mile north (upstream) of the Standing Rock Reservation. The DAPL routing west of, and leading to, this water crossing is proximate to the northern boundary of the Standing Rock Reservation. A spill, and particularly a major spill, at that site would clearly affect the Reservation very directly.

99. Rail differs from pipelines in fundamental ways that must be considered in a meaningful analysis. For rail, proximity analysis is complicated by a variety of factors. By definition, a meaningful proximity analysis for rail requires careful consideration of relevant factors. These factors can (and especially for Bakken crude by rail do) vary significantly by transport mode, region, project, and site, as well as over time. Hence, a meaningful proximity analysis for rail is typically highly detailed and lengthy. In the context of this Declaration, I have undertaken a proximity analysis for rail, which is provided in the attached Technical Appendix. The results of this proximity analysis are summarized below.

100. In contrast to the fixed nature of pipelines, crude by rail is non-fixed and variable. Bakken crude production occurs over a large area and is loaded onto trains at multiple terminals in various locations. There are 17 crude by rail loading terminals, spread over a large area but clustered, with a capacity totaling about 1.5 million barrels per day.[48] Use of crude by rail, and

[48] All of these terminals are located in western North Dakota, except for one in Montana (Northstar Transloading in Fairview), which is just across the border. See following sources for description of Bakken crude by rail terminals and maps showing these terminals and rail lines:

https://ndpipelines.files.wordpress.com/2012/04/oil-table-6-1-171.png
https://ndpipelines.files.wordpress.com/2012/05/nd-rail-facilities-feb-2015.pdf
http://www.bnsf.com/ship-with-bnsf/industrial-products/crude-and-lpg/interactive-map/pdfs/BNSF-OG-Overview-Map.pdf
http://www.bnsf.com/ship-with-bnsf/industrial-products/crude-and-lpg/interactive-map/pdfs/BNSF-OG-Wiliston-Map.pdf

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associated rail traffic, can be highly variable over time, both short-term and longer term.

101. Destinations and routings are variable for crude by rail. However, Bakken crude by rail currently has two main destination markets: West Coast, notably unloading and transloading terminals at and near refineries in Washington State; and East Coast, notably unloading and transloading terminals at and near refineries in New Jersey, Pennsylvania, and Delaware. Crude by rail to the West Coast is most likely to be sourced from Bakken loading terminals further north and west, and thus more proximate to the West Coast. This crude by rail traffic is a considerable distance from and otherwise not proximate to the Plaintiffs' reservations. Crude by rail terminals north of the Missouri (and especially those further east and closer to Minot) may send crude east along the rail lines towards Twin Cities and Chicago. This rail traffic is also not highly proximate to the Plaintiffs' reservations.

102. There is somewhat greater proximity if crude from the loading terminals south of the Missouri is moving east, toward Plaintiffs' reservations and crossing the Missouri at Bismarck. Nonetheless, compared with DAPL and the Missouri River crossing at Lake Oahe, this crude by rail has relatively low proximity. Moreover, the volumes of crude that might be moving on this routing to the east are likely to be quite small relative to volumes of crude associated with DAPL

103. Finally, there is the one loading terminal (Enserco, in Gascoyne, North Dakota), along the BNSF rail routing (Mobridge and Hettinger Subdivisions, between Mobridge, South Dakota and Montana), which is considerably more southerly than all of the other loading terminals and rail lines discussed above. This rail routing crosses the Standing Rock Reservation. So perhaps this routing constitutes the "rail lines" referred to in the DAPL Brief.[49]

[49] DAPL Brief, p. 16.

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Not only is DAPL safer than rail, rail lines (but not DAPL) run through Plaintiffs' reservations and the reservations of other tribes.

104. Focusing on the loading terminal in Gascoyne, this terminal is unlikely to generate substantial crude by rail traffic. The Gascoyne terminal is not proximate to sizable crude production, and the limited production in the area is unlikely to use rail transport. The crude by rail loading terminal in Gascoyne has a nominal capacity of 65 kbpd, but it is likely used at a much lower level, if at all. And to the extent that there is any rail traffic generated by this loading facility, it could be supplying markets to the west and thus trains would go through Montana, away from the Plaintiffs' reservations. It cannot be ruled out that there are crude trains that travel east from this loading facility through Standing Rock Reservation and across the Missouri River, but this may be only occasionally. Hence, the Gascoyne loading terminal does not appear to result in much if any actual crude by rail proximity for the Plaintiffs' reservation. This lack of proximity is notable, given that the Gascoyne terminal is located along a rail line, which considerably further to the east, passes through the Standing Rock Reservation and across the Missouri River.

105. As this analysis helps to demonstrate, meaningful risk and proximity analysis require careful consideration of relevant factors. For both pipeline and rail transport of crude, these factors can be highly specific and vary by transport mode, region, project, and site, as well as over time. This is particularly the case for Bakken crude by rail.

106. In light of my careful risk and proximity analysis, I conclude that DAPL (and related crude transport) is overall substantially more proximate to the Plaintiffs' reservations than crude by rail (contrary to what is claimed in the DAPL Brief).

D. Proximity Analysis for CBR to People, Water and Economic Activity (Outside Plaintiffs' Reservations)

107. For the purposes of this Declaration, I have focused on proximity in regard to the

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Plaintiffs' reservations. But DAPL and crude by rail certainly have significant other proximity, such that an accident/spill involving either DAPL or crude by rail could result in large damages.

108. The claims in DAPL's Brief are not just in relation to potential impacts in relation to the Plaintiffs' reservations. DAPL's Brief more generally claims that "shipment by pipeline is undeniably safer than shipment by rail" and that "pipelines are a more reliable, safer, and more economical alternative" to rail. (DAPL Brief, p. 15) In this context, I can provide some guidance regarding the proximity of Bakken crude by rail to people, water and economic activity, other than in relation to the Plaintiffs' reservations.[50]

109. Transport of Bakken crude by rail has declined very substantially from peak levels. Even prior to DAPL entering service in 2017, Bakken crude by rail had declined to about one-third of its peak level in 2014. At peak levels, there were about 12 loaded crude unit trains leaving the Bakken every day; in early 2017 (pre-DAPL), there were only about 4 trains per day.

110. Moreover, there has been a shift in destinations for Bakken crude by rail. Overall, the combination of less trains and different routings has very substantially reduced the proximity of Bakken crude by rail to people, water and economic activity. During the period when Bakken crude by rail was rapidly expanding, much of the crude was going to destination markets on the East Coast (US and Canada), and secondarily US Gulf Coast. These rail routings went through many urban centers, as well as smaller communities highly proximate to rail routings. Since 2014, there have been dramatic shifts affecting crude markets and transport, notably a big drop in prices affecting both crudes produced in the US (notably Bakken) and crude produced globally.

[50] I have been able to undertake only a limited analysis for the full routings of Bakken crude by rail. A meaningful proximity analysis for rail is typically highly detailed and lengthy. The proximity analysis I have provided for crude by rail in relation to the Plaintiffs' reservations (summarized above and provided in the attached Technical Appendix) is by itself a major effort. A more comprehensive proximity analysis for crude by rail for the entire routings from Bakken to destination markets would be a much larger effort, which was not feasible to undertake in the context of this Declaration.

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As a result, Bakken crude by rail has sharply declined to eastern and southern markets. And in turn, much less Bakken crude by rail is being transported through urban centers and other areas with high proximity to people, water and economic activity.

111. Regarding the proximity analysis for CBR to people, water and economic activity (outside Plaintiffs' reservations), I have the following conclusions:

112. One, the large reduction in crude by rail shipments since 2014 has substantially reduced the overall level of proximity and risk of CBR.

113. Two, nonetheless, the remaining Bakken crude by rail continues to have significant proximity to people, water and economic activity and results in significant risks for accidents and spills. A very extensive analysis would be required to estimate how the risk relating to this remaining Bakken crude by rail compares with the risk relating to DAPL. Unfortunately, reliable analysis of this type has not been conducted and provided to assist in various decisions in regard to DAPL.

114. Three, for the purposes of this Declaration, the more limited and relevant issue is a whether a DAPL shutdown would have significant adverse impacts in regard to risk of accidents/spills. For the Plaintiffs' reservations, the answer is clear: DAPL has much higher proximity and much greater risk than does crude by rail. For other locations, it is less clear how the risk of DAPL compares with the risk of crude by rail. But especially in terms of the risk of worst-case accidents and spills, there is no clear reason to assume that DAPL is less risky than crude by rail.

115. Four, the other perspective that is highly relevant for decision-making is scale of potential shifts in crude transport and associated risk. As explained above, even without (and before) DAPL becoming operational, shipments of Bakken crude by rail had dropped to only

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one-third of peak levels in 2014. At most, DAPL could now eliminate all of the remaining crude by rail. But as explained in ¶61-71, the impact of DAPL operating is likely to be much smaller in terms of reducing crude by rail.

116. With DAPL operating, crude by rail might be lower by 100-150 kpbd, compared with a scenario where DAPL is shutdown. **This potential impact is about 1.5-2.5 trains per day (10-16 trains per week).** Especially given the relatively small likely impact of DAPL operations on crude by rail, there is no clear significant demonstrated increase in overall accident and spill risk if DAPL is not operating.

117. Furthermore, the US energy system is very large and very dynamic. Based a variety of market conditions, crude by rail shipments can and do vary by large amounts month to month and over longer time periods. Whether DAPL is operating or not will likely have some impact, but any such impact is within the range that has occurred and will continue to occur owing to a variety of market conditions.

118. Five, in light of the above, I conclude that there is no clear reason foreclosing a shutdown of DAPL owing to increased risk associated with CBR to either Plaintiffs' reservations or more generally. As concluded above, a shutdown of DAPL can reduce risks to Plaintiffs' reservations. It is unclear what effect a shutdown of DAPL will have on risk outside the Plaintiffs' reservations. But any effect is likely to be quite small, both absolutely and in relation to the overall fluctuations that happen continually in the US energy system.

E. DAPL Creates Greater Risk to the Standing Rock Reservation Than Rail

119. The worst-case scenario of particular impact and interest to the Plaintiffs is a large spill proximate to the Missouri River and Standing Rock. Compared to crude by rail, DAPL (and related crude transport) is overall substantially more proximate to the Plaintiffs' reservations. Therefore, a large crude spill proximate to the Missouri River and Standing Rock is

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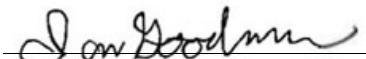
more likely to occur from DAPL than from a rail shipment

120. DAPL crosses the Missouri River just upstream of the Standing Rock reservation. Large-diameter high-pressure crude oil pipelines can result in large, expensive, high-impact spills. DAPL is 30" diameter with current capacity of 520 kbpd, and it might be further expanded (probably by adding more pumping) to a capacity of 570 kbpd.[51] A full-bore rupture on DAPL could result in a very large crude spill near the Missouri River and Standing Rock. And even at actual crude flows through DAPL at less than full capacity, there can be operational issues (and large spills) with both high and low flow rates

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed this 7th day of August, 2017, at Berkeley, California.



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[51] As discussed in above, actual crude flows through DAPL may be less than full capacity. To the extent that DAPL is transporting less crude, this could somewhat reduce the risk and volume of large spills. At lower flow rates, crude flows more slowly and is at lower pressure. Nonetheless, the pipeline is full of crude, and the volume that can be released from DAPL's 30" diameter pipe can be large. Spill volumes can be especially large if the release occurs at a lower elevation section of the pipeline (notably a water crossing), such that crude can drain down from adjacent (higher elevation) sections of the pipeline.

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EXHIBIT A

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Professional Profile

Ian Goodman is President and founder of The Goodman Group, Ltd. For over 35 years, he has conducted research and consulted in energy regulation and economics (related to conventional, unconventional and renewable energy, and energy efficiency). His practice has addressed a broad range of issues, including pipeline economics and regulation, evolving North American oil, gas and electric markets, and economic development and environmental impacts of various energy supply and transportation options. Since 2011, his practice has focused on oil supply and transportation (notably Canadian tar sands, shale, pipelines and rail). Mr. Goodman has co-authored reports and expert testimony on the most controversial pipeline projects in North America. He also has expertise in the planning and operations of energy systems, as well as interjurisdictional energy trade in North America.

He has provided expert evidence in over 50 regulatory, environmental assessment, and legal proceedings in various North American jurisdictions including California, Washington, Colorado, North Dakota, South Dakota, New York, New Jersey, three New England states, Florida, British Columbia, Manitoba, Ontario, Quebec, as well as the Federal Energy Regulatory Commission (FERC) in the US and the National Energy Board (NEB) in Canada. He has also assisted counsel in those and other proceedings. His clients have included energy sector companies (electric and gas utilities, marketers, project developers, and equipment providers), regulators, government, customer and environmental groups, and North American Native/First Nations organizations. Mr. Goodman is the author or co-author of over 60 publications and major reports relating to the energy industry. Ian Goodman co-authored an influential and widely publicized study on the employment impacts of the Keystone XL pipeline ("Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL").

Professional Experience

1989 – present **President, The Goodman Group, Ltd.,**
Berkeley, California (formerly Boston, Massachusetts)

Collaborating with a team of associates to provide an array of expert consulting services such as expert testimony, reports, research, policy assessment and litigation support related to energy regulation and economics (conventional, unconventional and renewable energy, and energy efficiency).

Specializing in pipeline economics and regulation, evolving North American oil, gas and electric markets, economic development and environmental impacts of various energy supply and transportation options, and energy system planning and operations.

Major Projects:

Economic Development and Environmental Impacts of Energy Options

- Since 1991, has conducted or co-authored over 30 national, regional, and state/provincial studies on the economic development impacts (notably jobs) and environmental impacts of various energy supply and transportation options in the US and Canada.

- Since 2011, has co-authored nine expert reports on the economic development impacts and environmental impacts of crude oil transportation (particularly interjurisdictional tar sands crude pipeline projects and crude by rail projects) and one report on a natural gas pipeline.

- Co-authored written Expert Testimony on the Need for the Vancouver Energy Distribution Terminal (VEDT) with Brigid Rowan. The expert report was filed in May 2016 before the State of Washington Energy Facility Site Evaluation Council on behalf of Earthjustice. The testimony concludes that the VEDT will do little if anything to supply Washington with energy. Consequently, there is no economic need for this Project to supply the state.

  The testimony also shows that the VEDT is likely not in Washington's public interest. TGG's cross-jurisdictional study of the costs and benefits of energy logistics facilities for host jurisdictions consistently concludes the following: the benefits are relatively small; the cost/risks are relatively

large; and the economic benefits and costs/risks tend to be unevenly distributed (across stakeholders and regions), with the project proponents getting the majority of the benefits and the hosting jurisdiction bearing the majority of the costs/risks.

- Co-authored the "Expert Report on the PennEast Pipeline Project Economic Impact Analysis for New Jersey and Pennsylvania" with Brigid Rowan, commissioned by the New Jersey Conservation Foundation. This November 2015 report evaluates the economic impact study (PennEast Pipeline Project Economic Impact Analysis) prepared for the PennEast Pipeline Company. The PennEast Analysis claims that the pipeline project to transport Marcellus shale natural gas from Pennsylvania to New Jersey would have considerable economic benefits in both states. Goodman and Rowan demonstrate that the PennEast Analysis significantly overstates the total jobs from designing and building the pipeline by approximately two thirds or more.

- Co-authored written expert testimony, entitled "Changes to the Economic Costs and Benefits of the Keystone XL Pipeline for South Dakota" with Brigid Rowan. The testimony filed in April and June 2015 at the South Dakota Public Utilities Commission on behalf of the Rosebud Sioux Tribe and withdrawn in July 2015. Based on the conclusions of pipeline safety expert, Richard Kuprewicz, Rowan and Goodman estimate a range of Worst-Case Scenario Costs starting at US$1 billion and escalating to $2 billion or more for a very high consequence event. Given the Keystone XL's very small employment and property tax benefits, TGG concludes that, under a range of worst-case scenarios, the costs of the Project will greatly exceed the benefits for South Dakota.

- Co-authored the "Economic Costs and Benefits of the Trans Mountain Expansion Project (TMX) for BC and Metro Vancouver" with Brigid Rowan in collaboration with Simon Fraser University's Centre for Public Policy Research. The report, released in November 2014 and re-released in February 2015, refutes Kinder Morgan's claims regarding the positive economic development benefits of its controversial pipeline project. Goodman and Rowan show that the benefits of the pipeline are very small and have been significantly overstated by Kinder Morgan, whereas the worst-case costs of a catastrophic spill are very large and have been vastly understated.

- Co-authored the "Economics of Transporting and Processing Tar Sands Crudes in Quebec" with Brigid Rowan in collaboration with Équiterre and Greenpeace Canada. The January 2014 report demonstrates that the economic development benefits for Quebec of moving and refining tar sands crudes would be insignificant while the costs and risks are very high.

- Co-authored an "Analysis of the Potential Costs of Accidents/Spills Related to Crude by Rail" with Brigid Rowan on behalf of Oil Change International (OCI). The November 2013 report demonstrates that the economic costs of crude by rail accidents can be very large and concludes that a major crude by rail (CBR) unit train accident/spill could cost $1 billion or more for a single event. The report was incorporated into Comments filed by NRDC, Sierra Club and OCI before PHMSA as part of the Advance Notice of Proposed Rulemaking Hazardous Materials: Rail Petitions and Recommendations To Improve the Safety of Railroad Tank Car Transportation, December 5, 2013.

- Co-authored expert testimony, entitled "The Relative Economic Costs and Benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project" with Brigid Rowan. The expert report was filed in August 2013 at Canada's National Energy Board on behalf of the Équiterre Coalition, a coalition of Quebec- and Ontario-based environmental groups. In light of pipeline safety expert, Richard Kuprewicz's high-risk assessment for rupture on the Project, Goodman and Rowan demonstrate that due to Line 9B's extraordinary proximity to people, water and economic activity, the rupture costs of the Project (under a wide variety of pipeline accident/spill possibilities) range from significant to catastrophic. They conclude that the potential economic costs could exceed (and, under a wide range of accident/spill conditions, greatly exceed) the potential economic benefits.

- Co-authored "Comments on Initial Study/Mitigated Negative Declaration (IS/MND) Valero Crude by Rail Project Benicia, California" with Brigid Rowan on behalf of NRDC. The July 2013 report provides a Market Analysis of a proposed crude by rail project for the Valero Benicia Refinery. Goodman and Rowan conclude that the proposed project could significantly affect crude supply (and thus quality) for the refinery, and recommend that a full Environmental Impact Report be undertaken. The report was included as an attachment to NRDC's Comments on Notice of Intent to Adopt a Mitigated Negative Declaration for the Valero Crude by

Rail Project, filed with the City of Benicia on July 1, 2013.

- Co-authored a "Report evaluating the adequacy of the Keystone XL (KXL) Draft Supplemental Environmental Impact Statement (DSEIS) Market Analysis" with Brigid Rowan, and filed as an attachment to the Comments on KXL DSEIS jointly submitted by the Sierra Club, NRDC, and 14 other environmental and public interest organizations in April 2013. Based on their evaluation of the early 2013 market conditions (including emerging crude markets, factors driving tar sands expansion, availability and cost of crude oil transportation, and tar sands breakeven costs), Rowan and Goodman concluded that (i) the US State Department's DSEIS Market Analysis was deeply flawed and not a sound basis for decision-making; and (ii) KXL, and specifically its impact on tar sands logistics costs and crude prices, would have a significant impact on tar sands expansion under a very broad range of conditions and assumptions.

- Co-authored an influential and widely publicized study of the Keystone XL pipeline employment impacts ("Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL") with Brigid Rowan and the Cornell Global Labor Institute. The report was released in September 2011 and updated in January 2012. Goodman and Rowan provided the economic analysis to demonstrate that TransCanada Pipelines Ltd had greatly exaggerated the employment impacts of the Keystone XL (KXL) Project. TGG estimated the Project would create no more than 2,500-4,650 temporary direct construction jobs for two years and at the most a handful of permanent jobs (ranging from a low of 20 to a high of 127). TGG's conclusions in Pipe Dreams were used to demonstrate to the US media and to the Obama Administration that KXL would not be a major job creator for the US, nor would it have any substantial impact on US unemployment.

- Co-authored "Employment Impacts of Air-Pollution Controls at North Dakota Coal Plants" with Brigid Rowan. This November 2011 study for Sierra Club National estimated the employment impacts of Air-Pollution Controls at North Dakota Coal Plants.

- Provided expert testimony on behalf of The Greenlining Institute on economic development impacts (focusing on job creation and stimulus) of capital expenditures and rate increases proposed by the Pacific Gas & Electric Company in its 2011 General Rate Case.

- Co-authored the Avoided Energy Supply Costs in New England: 2009 Report, prepared for Avoided-Energy-Supply-Component (AESC) Study Group, which represents all major electric and gas utilities in New England, as well as efficiency program administrators, state energy offices and regulators. TGG's contribution to this report was an analysis of the economic development impact of Massachusetts electricity and gas energy efficiency programs.

- Co-developed E^3AS (Energy, Economic, and Environmental Analysis System) software on behalf of the US EPA in 1996 and made it available to assist government agencies in evaluating the economic and environmental impacts of energy supply and efficiency programs, and in considering both the benefits and costs of energy alternatives.

- Has incorporated E^3AS model analysis in all studies of economic and environmental impacts since 1996.

Manitoba Hydroelectric System Planning, Operations, Project Assessment, and US Exports

Wuskatim Generating Station and Transmission Project (1999-2005)

On behalf of the Pimicikamak Cree Nation (PCN):

- Evaluated Manitoba Hydro system planning, environmental review, and disclosure relating to the Churchill-Nelson hydro project
- Assessed the environmental and other impacts from existing hydro and the proposed 200 MW Wuskwatim hydro project
- Analyzed the need for comprehensive assessment of the entire Churchill-Nelson project (existing, proposed, and future)
- Reviewed precedents regarding comprehensive assessment of existing major hydro projects
- Submitted comments to the Minnesota Public Utilities Commission on Northern States Power's supply requirements in relation to Manitoba energy exports from Wuskatim.

Conawapa Generating Station (1990, 1992)

On behalf of a coalition of citizens', conservation and environmental groups:

- Filed expert evidence in the 1992 Conawapa Project Environmental Assessment concerning:
    - the need for environmental reviews to evaluate the justification of design alternatives to the 1290 MW Conawapa hydro project
    - a description of the changes in the utility industry and new supply source options affecting the design alternatives included in an environmental review

  - a review of the treatment of the project justification in North American environmental assessments.

- Filed expert evidence before the Manitoba Public Utilities Board in the context of the 1990 Manitoba Hydro Submission for the Conawapa generating station, which included:
  - a review of the Manitoba Hydro submission; a review of Manitoba Hydro load forecasting; an estimation of economic and attainable conservation potential; development of principles of conservation program design and delivery; a critique of the utility's proposed demand-side management program, an evaluation of supply-side alternatives and analysis of avoided costs; an assessment of employment and economic development effects of hydroelectric development and conservation; and an analysis of profitability and risks of the proposed power sales contracts.

Hydro-Québec System Planning, Operations, Project Assessment, and US Exports

Great Whale Project (1989-1994)

Submitted evidence and testified before various regulatory and legal bodies in the US and Canada on behalf of the Grand Council of the Crees (of Québec) and/or a coalition of environmental groups to assess the economic and environmental impacts of the proposed 3160 MW Great Whale Project, as well as the long-term US export contracts based on the project.

Mr. Goodman's wide-ranging efforts were instrumental in Hydro-Québec's eventual cancellation of the Great Whale Project. Key interventions included:

- Submitting evidence between 1989 and 1991, before the Vermont Public Service Board, including a review of a proposed thirty year, 450 MW purchase by twenty-four Vermont utilities of Hydro-Québec power derived from the development of the Great Whale Project; and an analysis of planning and operation of Hydro-Québec power supply and modeling of hydro reservoir levels.

- Testifying in 1991 before the State of Vermont Supreme Court regarding the same 450 MW purchase and providing a summary of changes concerning load forecasts and supply-side alternatives and an analysis of the cost effectiveness of the contract.

- Submitting an analysis of the nexus between New York Power Authority purchases and the construction of specific Hydro-Québec facilities (notably Great Whale), as well as the operation of fossil fuel electric

generation before the State of New York Supreme Court in 1990.

- Presenting a review of Hydro-Québec's proposed export contracts to Vermont (450 MW) and New York State (1000 MW) before Canada's National Energy Board in 1990.

- Analyzing confidential risk-sharing electric supply contracts between Hydro-Québec and large industrial customers, including an assessment of the resulting implications for Hydro-Québec and its ratepayers in 1991.

- Submitting evidence in 1992 for the Canadian and Québec governments' Environmental Review of the Great Whale Project including a discussion of changes in the utility industry and new supply resource options affecting design alternatives included in an environmental review.

- Assessing an 800 MW seasonal diversity contract in the context of the 1994 energy market before the State of New York Assembly Standing Committees on Energy and Conservation.

1986 – 1989 Consulting Associate, PLC, Inc., Boston, Massachusetts

Research and consulting in various aspects of utility regulation and economics. Advised utilities and regulatory commissions on electric and gas least-cost planning. Assessed potential for conservation, non-utility generation, and other supply alternatives. Reviewed prudence of power supply investment decisions. Analyzed rate design and allocation issues. Developed end-use demand estimates. Evaluated district heating system management. Analyzed markets and rates of regulated transportation services.

1981 – 1986 Consulting Associate, Analysis and Inference, Inc., Boston, Massachusetts

Research and consulting in various aspects of utility regulation and statistical applications. Reviewed prudence of utility power plant construction programs with emphasis on cost and schedule of nuclear plants. Researched utility rate design and allocation issues. Reviewed demand forecasts. Analyzed taconite industry economics and electricity supply. Analyzed causal factors for statistical theft estimation of fuel oil overbilling and diversion of parking meter and transit revenue.

1978 – 1987 Consultant, Salgo & Lee, Boston, Massachusetts

Research and consulting in electric utility regulation and civil damage litigation. Reviewed nuclear construction programs and alternatives, demand forecasts, transmission line proposals, and state rate-making policies. Analyzed effects of regional power pool rules on independent power producers. Evaluated damage claims arising from power plant equipment outages.

Education

1977	S.B., Civil Engineering, Massachusetts Institute of Technology

Advisory Assignments to Regulatory and Investigatory Commissions and Staff

1996	Commission of Inquiry on Hydro-Québec's Purchase Policy for Electricity from Independent Power Producers (*Commission d'enquête sur la politique d'achat par Hydro-Québec d'électricité auprès de producteurs privés*), Commission Staff.
1993 – 2000	Maine Public Utilities Commission Staff, Docket Nos. 92-331, 95-598, 98-791, 2000-441, and 2000-47; Special Industrial Rate Contracts
1993	Maine Public Utilities Commission Staff, Docket No. 93-147; Certificate of Public Convenience to Erect a Transmission Line
1987 – 1988	District of Columbia Public Service Commission, Docket No. 834 Phase II; Least-cost Planning Procedures and Goals.

Appointments

1991 – 1995	Committee to Review the Glen Canyon Environmental Studies, National Research Council Water Science and Technology Board
1978	New England Energy Congress, Regulatory and Institutional Process Committee.

Publications and Major Reports

Expert Report on the PennEast Pipeline Project Economic Impact Analysis for New Jersey and Pennsylvania, commissioned by the New Jersey Conservation Foundation, *November 4, 2015* (co-author with Brigid Rowan).

Comments on Scoping Supplemental Environmental Impact Statement (SEIS) Rulemaking for Colorado Roadless Coal Exception #46470 to the U.S. Department of Agriculture Forest Service on behalf of the Sierra Club, *May 22, 2015* (co-author with Brigid Rowan).

Comments on Draft Environmental Impact Report (DEIR) Analysis of Oil and Gas Well Stimulation Treatments in California on behalf of NRDC, *March 16, 2015* (co-author with B. Rowan), incorporated as an attachment to Comments filed by Natural Resources Defense Council (NRDC), Center for Biological Diversity (CBD), Sierra Club, Los Angeles Waterkeeper on the Department of Conservation's, through its Division of Oil, Gas and Geothermal Resources (DOGGR), Draft Environmental Impact Report (DEIR) for Well Stimulation in California (the Project) prepared pursuant to the California Environmental Quality Act (CEQA).

Economic Costs and Benefits of the Trans Mountain Expansion Project (TMX) for BC and Metro Vancouver in collaboration with The Centre for Public Policy Research, Simon Fraser University, *November 10, 2014* (co-author with B. Rowan, re-released *February 4, 2015*).

Report on the Economics of Transporting and Processing Tar Sands Crudes in Quebec in collaboration with Équiterre and Greenpeace Canada, *January 2014* (co-author with B. Rowan).

Analysis of the Potential Costs of Accidents/Spills Related to Crude by Rail, *November 8, 2013* (co-author with B. Rowan) on behalf of Oil Change International (OCI), incorporated as Attachment 3 to Comments filed by NRDC, Sierra Club and OCI before The Pipeline and Hazardous Materials Safety Administration, U.S. Department Of Transportation as part of the Advance Notice of Proposed Rulemaking Hazardous Materials: Rail Petitions and Recommendations To Improve the Safety of Railroad Tank Car Transportation, *December 5, 2013*.

Comments on Initial Study/Mitigated Negative Declaration (IS/MND) Valero Crude by Rail Project, Use Permit Application 12PLN-00063, Benicia, California, *July 1, 2013* (co-author with B. Rowan) on behalf of NRDC, included as an attachment to NRDC's Comments on Notice of Intent to Adopt a Mitigated Negative Declaration for the Valero Crude by Rail Project, filed with the City of Benicia Community Development Department on *July 1, 2013*.

Report evaluating the adequacy of the Keystone XL (KXL) Draft Supplemental Environmental Impact Statement (DSEIS) Market Analysis, *April 22, 2013* (co-author with B. Rowan), filed as an attachment to the Comments on KXL DSEIS jointly submitted by the Sierra Club, NRDC, and 14 other environmental and public interest organizations.

Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL, *September 28, 2011* (co-author with B. Rowan, TGG, and L. Skinner and S. Sweeney, Cornell Global Labor Institute; *revised January 18, 2012*).

Employment Impacts of Air-Pollution Controls at North Dakota Coal Plants, prepared for Sierra Club, *November 21, 2011* (co-author with B. Rowan).

The Economics of Supplier Diversity Examining Areas of Potential Interest for GLI with respect to GRC 2011 and Potential Amendments to GO 156, prepared for The Greenlining Institute, *August 6, 2010* (co-author with B. Rowan).

Avoided Energy Supply Costs in New England: 2009 Report, prepared for Avoided-Energy-Supply-Component (AESC) Study Group, *August 21, 2009* (co-author with R. Hornby, P. Chernick, et al.; *revised October 23, 2009*).

Reallocation of Funds from National Grid's Current Energy Efficiency Programs to Other Uses, prepared for National Grid USA, *October 24, 2006*

National Grid's Energy Efficiency Programs: Benefits for Rhode Island's Economic Development and Environment, prepared for National Grid USA, *July 28, 2006*.

Comment of Pimicikamak Cree Nation (PCN) on Minnesota Draft State Energy Planning Report, sponsored by Minnesotans for an Energy-Efficient Economy (ME3), *November 21, 2001.*

Proposal for PV and Energy Efficiency at State Facilities: Benefits for California's Economic Development and Environment, prepared for PowerLight Corporation, *November 15, 2001.*

Narragansett Electric's Energy Efficiency Programs: Benefits for Rhode Island's Economic Development and Environment, prepared for Narragansett Electric Company, *August 14, 2001.*

Comment Submitted By Pimicikamak Cree Nation on An Investigation Into Environmental And Socio-Economic Costs Under Minnesota Statute §216B.2422, Subd. 3, submitted in Minnesota Public Utilities Commission Docket No. E999/CI-00-1636, *January 16, 2001* (co-author with P. Chernick and A. Orkin).

Comment Submitted By Pimicikamak Cree Nation on Northern States Power's 1999 Request for Proposals for Supply Resources Needed Starting 2001-2005, submitted in Minnesota Public Utilities Commission Docket No. E002/M-99-888, *March 1, 2000,* Supplemental Comment *August 18, 2000* (co-author with R. McCullough, A. Orkin, A. Stewart, et al.).

Analysis of Special Industrial Rate Contracts: Maine Public Service Company with McCain Foods (Docket 2000-441) and J.M. Huber (Docket 2000-47), prepared for Maine Public Utilities Commission Staff, *July 2000.*

Energy, Economic, and Environmental Analysis System (E3AS) User's Guide: Version 2, prepared for the US Environmental Protection Agency, *July 1998* (co-author with R. Carlson and B. Krier).

Employment, Earnings, and Environmental Impacts of Regional Improvements in Energy Efficiency, the Southern States Energy Board, *December 23, 1996* (co-author with B. Krier and P. Kelly-Detwiler).

North Carolina State Energy Supply Plan for Use with E3AS, prepared for North Carolina Department of Commerce Energy Division, *November 27, 1996* (co-author with R. Carlson).

Energy, Economic, and Environmental Analysis System (E3AS) User's Guide, prepared for the Southern States Energy Board, *May 1996* (co-author with R. Carlson and B. Krier).

Preliminary Results of Mohave Competitiveness Analysis, prepared for the Hopi Tribe, *March 11, 1996.*

River Resource Management in the Grand Canyon, Committee to Review the Glen Canyon Environmental Studies, National Research Council Water Science and Technology Board (Washington: National Academy Press, *1996*) (co-author with W. Lewis, et al.).

Submission of the Grand Council of the Crees (of Québec) and the Cree Regional Authority, Addressed to the Consultation of the Public Debate on Energy: Complement, prepared for Grand Council of the Crees (of Québec), *August 1995* (co-author with P. Raphals, et al.).

"Energy Efficiency and Employment: Recent Findings and Directions for Future Research," Third International Energy Efficiency & DSM Conference: Charting the Future, (Bala Cynwyd: SRC International, *1994*) (co-author with B. Krier).

"A Win/Win Approach to Commercial/Industrial DSM: Making DSM Work for All Utility Customers," The Electricity Journal, Vol. 7, No. 9, *November 1994* (co-author with H. Lachman, P. Cillo, and P. Kelly-Detwiler).

Conformity Analysis of Hydro-Quebec's Great Whale Project Feasibility Study, prepared by the Great Whale Environmental Assessment Office of the Grand Council of the Crees (of Québec)/Cree Regional Authority in consultation with Environmental Economics Intl., et al., *July 1994* (co-author with R. Torrie, et al.).

"DSM as Economic Development Strategy," The Electricity Journal, Vol. 7, No. 4, *May 1994* (co-author with S. Laitner and B. Krier).

Review of the Draft Environmental Impact Statement on Operation of Glen Canyon Dam, Committee to Review the Glen Canyon Environmental Studies, National Research Council Water Science and Technology Board (Washington: National Academy Press, *April 1994*) (co-author with W. Lewis, et al.).

Review of the Draft Federal Long-Term Monitoring Plan for the Colorado River Below Grand Canyon Dam, Committee to Review the Glen Canyon Environmental Studies, National Research Council Water Science and Technology Board (Washington: National Academy Press, *1994*) (co-author with W. Lewis, et al.).

A Comparison of New York State Employment Impacts from Expanded Demand-Side Management and Hydro-Québec Imports, prepared for Greenpeace USA, *February 16, 1994* (co-author with B. Krier and P. Kelly-Detwiler; *revised March 1, 1994*).

Employment Impacts of Electricity Efficiency in Florida, prepared for the Florida Energy Office, *November 18, 1993* (co-author with B. Krier and P. Kelly-Detwiler).

Economic Analysis of Mohave Generating Station Gas Conversion, prepared for the Alternative Coal Transport Study, Economic Analysis for the Hopi Tribe, *September 13, 1993.*

The Impact of Increased Coal Transportation Costs Upon Mohave Generating Station Customers, prepared for the Alternative Coal Transport Study, Economic Analysis for the Hopi Tribe, *July 27, 1993.*

Track II Position Paper on Behalf of the Grand Council of the Crees (of Québec) and PROTECT, submitted in New York Public Service Commission Case 92-E-1187 (Concerning Incorporation of Environmental Costs into Long-run Avoided Costs), *June 25, 1993* (co-author with J. Dumont and P. Kelly-Detwiler).

Review of the 1993 Hydro-Québec Development Plan, submitted to Québec Parliamentary Commission on the Economy and Employment, prepared for Grand Council of the Crees (of Québec), *March 11, 1993* (co-author with P. Kelly-Detwiler and E. Titus; also available in French as Analyse Critique du Plan de Développement 1993 d'Hydro-Québec).

Assessment of the Requirement and Rationale for Transmission Facilities Associated with the 1000 MW Electricity Purchase from Manitoba Hydro, submitted in Ontario Environmental Assessment Board Ontario Hydro Demand/Supply Plan Hearing, on behalf of Nishnawbe-Aski Nation/Grand Council Treaty #3/Teme-Augama Anishnabai, *December 1992.*

Economic Evaluation of Ontario Hydro's Proposed Moose River Basin Hydroelectric Projects, submitted in Ontario Environmental Assessment Board Ontario Hydro Demand/Supply Plan Hearing, on behalf of the Moose River/James Bay Coalition, *December 1992* (co-author with R. Carlson, R. McCullough, and W. Huddleston).

Energy Efficiency: Opportunities for Employment, prepared for Greenpeace U.K./International, *November 11, 1992* (co-author with B. Krier).

"Electricity Generation and Greenhouse Gases," Planning Our Electric Future Now, Conference Proceedings of Canadian Electric Association, *November 1992.*

Comments of Pace Energy Project; Natural Resources Defense Council, National Audubon Society; Vladeck, Waldman, Elias and Englehard; Environmental Defense Fund; Environmental Planning Lobby on the 1993-1994 Annual and Long Range Demand-Side Management and Integrated Resource Plans of the New York Utilities, submitted in New York Public Service Commission Case No. 28223, *September 14, 1992* (co-author with A. Gupta, J. Tripp, J. Vladeck, D. Wooley, et al.).

Employment Effects of Electricity Provision in Québec: The Great Whale Hydroelectric Project and Electricity Efficiency Alternative, prepared for Grand Council of the Crees (of Québec), *June 16, 1992* (co-author with B. Krier and M. Clark; *revised November 5, 1992;* abbreviated James Bay Publication Series version November 1994; full version and abbreviated versions also available in French as Effets de la fourniture d'électricité sur l'emploi au Québec: le projet d'aménagement hydroélectrique Grande Baleine et la solution de rechange axée sur l'efficacité énergétique).

A Comparison of the Employment Creation Effects of the AES-Harriman Cove Coal-Fired Generating Station and Maine Demand-Side Management, prepared for Conservation Law Foundation and National Resources Council of Maine, *May 15, 1992* (co-author with M. Clark, P. Kelly-Detwiler, and M. Anthony).

A Review of the Report on Gas Integrated Resource Planning for Submission to the Ontario Energy Board, on behalf of Ontario Metis and Aboriginal Association, *February 28, 1992* (co-author with B. Morse, M. Watkins, J. Stevenson, P. Kelly-Detwiler, and M. Clark).

"Electricity Imports from Quebec: The Current and Historical Context," Northeast Indian Quarterly, *Winter 1991.*

The Role of Non-utility Generation in Vermont, *December 12, 1991* (co-author with P. Messerschmidt).

Economic and Employment Impacts of Vermont State Energy Options, prepared for Northeast Alliance to Protect James Bay, *November 7, 1991* (co-author with P. Kelly-Detwiler and M. Anthony).

Comments on the Draft New York State Energy Plan 1991 Biennial Update, on behalf of PROTECT, Hudson Sloop Clearwater, and Grand Council of the Crees (of Québec), *October 7, 1991.*

"Energy Conservation vs. the James Bay Hydroelectric Project," Canadian Water Watch, Vol. 4, No. 5, *June 1991.*

Employment Impacts of New York State Energy Options, prepared for Grand Council of the Crees (of Québec), *June 2, 1991* (co-author with M. Tennis and M. Clark).

Comments on the Determination of the Supply Resources and Environmental Effects Affiliated with Ontario Hydro Proposed Export Sales, submitted in Canadian National Energy Board Order No. EW-3-90, on behalf of Moose River James Bay Coalition / Nishnawbe-Aski Nation / Grand Council Treaty No. 3, *January 28, 1991* (co-author with P. Kelly-Detwiler).

Comments of Sierra Club, Inc.; Atlantic States Legal Foundation, Inc.; PROTECT; and Grand Council of the Crees (of Québec) on Issues to be Addressed in the New York State Energy Planning Report 1991, *January 2, 1991* (co-author with P. Messerschmidt).

"Analysis of Residential Fuel-Switching as an Electric Conservation Option," Gas Energy Review, Vol. 18, No. 12, *December 1990* (co-author with P. Chernick and E. Espenhorst).

Comments of Center for Environmental Legal Studies; Natural Resources Defense Council, National Audubon Society; Vladeck, Waldman, Elias and Englehard; Environmental Defense Fund on the 1991-1992 Annual and Long Range Demand-Side Management Plans of the Major Electric Utilities, submitted in New York Public Service Commission Case No. 28223, *September 28, 1990* (co-author with J. Plunkett, et al.).

"Hydro-Québec's Long-Term Export Policy," Canadian Water Watch, Vol. 3, No. 7-8, *July-August 1990.*

Conservation and Capacity Optimization Alternatives to the PGT/PG&E Gas Pipeline Project, Tellus Institute Study No. 90-03, prepared for California Public Utilities Commission, *May 1990* (co-author with R. Hornby, S. Bernow, D. Marron, D. Nichols, D. Singh, and M. Tennis).

Complément Technique au Mémoire du Grand Conseil des Cris (du Québec) à la Commission de l'Économie et du Travail de l'Assemblée Nationale du Québec, prepared for Grand Council of the Crees (of Québec), *April 1990* (co-author with R. Mainville, et al.).

Analysis of Fuel Substitution as an Electric Conservation Option, PLC, Incorporated, prepared for Boston Gas Company, *December 22, 1989* (co-author with P. Chernick and E. Espenhorst).

Conservation Potential in the State of Minnesota, Volumes I and II, PLC, Incorporated, prepared for Minnesota Department of Public Service, *June 27, 1988* (co-author with P. Chernick).

The Excess Capacity Situation of Minnesota Power: Magnitude, Duration, and Origin, PLC, Incorporated, prepared for Minnesota Department of Public Service, *July 20, 1987* (co-author with P. Chernick; *revised August 12, 1987*).

Final Report, Phase I, Module IV, Rate Design/Analysis, Pacific Northwest Electric Power and Conservation Planning Council, *December 1981* (co-author with P. Chernick, S. Finger, and M. Meyer).

Regional and Commodity Price-Indices for the Trucking Industry, M.I.T. Center for Transportation Studies, CTS Report 77-13, *July 1977* (co-author with A. Friedlander)

Expert Testimony and Formal Submissions

Information is presented in the following order: jurisdiction and docket number; title of case; client; date testimony filed; and subject matter covered.

1. **State of Washington Energy Facility Site Evaluation Council (Case No. 15-001); Application No. 2013-01 of Tesoro Savage LLC Vancouver Energy Distribution Terminal; Earthjustice; May 13, 2016 (with in-depth participation of B. Rowan); Technical Appendix: Market Analysis; May 13, 2016; (co-author with B. Rowan).**
   Evaluation of the economic need for Washington State of the Vancouver Energy Distribution Terminal (VEDT). Demonstrated that the VEDT will do little if anything to supply Washington with energy. Consequently, concluded that there is no economic need for this Project to supply Washington. Analysis of whether the Project is in the public interest of Washington State. TGG's cross-jurisdictional study of the costs and benefits of energy logistics facilities for host jurisdictions consistently concludes the following: the benefits are relatively small; the cost/risks are relatively large; and the economic benefits and costs/risks tend to be unevenly distributed (across stakeholders and regions), with the project proponents getting the majority of the benefits and the hosting jurisdiction bearing the majority of the costs/risks. Recommendation that the Project be rejected based on the conclusion that it is highly likely that the VEDT is not in the public interest of Washington**.**

2. **South Dakota Public Utilities Commission (Docket HP14-001); Petition of TransCanada Keystone Pipeline, LP (Keystone) for Order Accepting Certification of Permit Issued in Docket HP09-001 to Construct the Keystone XL Pipeline; The Rosebud Sioux Tribe; April 24, 2015; Rebuttal Testimony June 26, 2015 (joint testimony with B. Rowan). Testimony withdrawn July 17, 2015.**
   Analysis of the changes to the economic costs and benefits of the Keystone XL Pipeline for South Dakota. Based on the conclusions of pipeline safety expert, Richard Kuprewicz, evaluation of a range of Worst-Case Scenario Costs starting at US$1 billion and escalating to $2 billion or more for a very high consequence event. Given the Keystone XL's very small employment and property tax benefits, concluded that, under a range of worst-case scenarios, the costs of the Project will greatly exceed the benefits for South Dakota.

3. **Canadian National Energy Board Hearing Order OH-002-2013; Enbridge Pipelines Inc. Line 9B Reversal and Line 9 Capacity Expansion Project Application; Équiterre (Coalition); August 8, 2013 (joint testimony with B. Rowan).**
   Analysis of relative economic costs and benefits of Enbridge's Line 9B Reversal and Line 9 Capacity Expansion Project. Evaluation of the

Project, which would transport a mix of tar sands dilbit, Bakken, and conventional WCSB crudes through Ontario and Quebec, crossing major waterways and Canada's most populous urban areas, (including Toronto and Montreal). Recommendation that the Enbridge Project be rejected, based on (i) the results of this relative economic cost-benefit analysis, demonstrating that the potential economic costs could exceed (and, under a range of malfunction/accident conditions, greatly exceed) the potential economic benefits; (ii) the highly uneven allocation of costs and benefits among the stakeholders, and across regions; and (iii) the conclusion of international pipeline safety expert, Richard Kuprewicz, that there is a high risk of pipeline rupture in the early years following Project implementation due to a combination of cracking and corrosion.

4. **California Public Utilities Commission Application No. 09-12-020; Pacific Gas & Electric Company General Rate Case 2011; The Greenlining Institute; May 19, 2010; Rebuttal Testimony June 4, 2010.**
   Analysis of economic development impacts (focusing on job creation and stimulus) of PG&E's proposed capital expenditures and associated rate increases. Consideration of the impacts of these expenditures and rate increases on customers and communities. Recommendation that PG&E increase its supplier diversity activities in order to offset adverse impacts on customers and communities while addressing equity concerns. Analysis of PG&E's Customer Retention and Economic Development (Load Attraction and Retention) activities. Analysis of the direct testimony of other intervenors with respect to economic development impacts of the proposed capital expenditures and quantification of these impacts in the Rebuttal Testimony.

5. **Manitoba Clean Environment Commission Public Registry Files 4724/4725; Wuskwatim Generating Station and Transmission Project; Pimicikamak Cree Nation (PCN); August 8, 2003 (joint affidavit with R. McCullough).**
   Evaluation of Manitoba Hydro system planning, environmental review, and disclosure relating to the Churchill-Nelson hydro project. Consideration of environmental harm and other impacts from existing hydro and proposed 200 MW Wuskwatim project. Analysis of need for comprehensive assessment of the entire Churchill-Nelson project (existing, proposed, and other future). Discussion of precedents regarding comprehensive assessment of existing major hydro projects.

6. **United States District Court, Northern District of New York Case 01-CV-0951; Pogliani, et al. v. Army Corps of Engineers; Stand Together Oppose Power Plant (STOPP); June 29, 2001.**
   Analysis of need for proposed 1080 MW gas combined cycle power plant in Athens, New York. Consideration of locational requirements for supply. Evaluation of potential for other in-state sources and imports.

7. **Vermont Public Service Board Docket 6300; Proposed Sale of Vermont Yankee Nuclear Power Station; New England Coalition on Nuclear Pollution and Vermont Public Interest Research Group; April 14, 2000.**
   Consideration of power supply planning in the context of risk and uncertainly. Evaluation of whether the proposed plant sale is consistent with sound utility planning, regulatory oversight, and electricity restructuring.

8. **Maine Public Utilities Commission Docket 98-791; Bangor Hydro-Electric Company; Maine Public Utilities Commission Staff; May 4 1999 (Bench Analysis joint with A. Monroe and M. Force).**
   Assessment of request for extension and amendment of special industrial rate. Analysis of the economic and physical viability of paper mill self-generation options. Evaluation of whether the contract extension would be beneficial for other utility ratepayers. Development of recommendations for amended contract termination provisions.

9. **California Public Utilities Commission A. 96-03-031; Southern California Gas Company; The Utility Reform Network (TURN); December 30, 1998; Rebuttal Testimony February 26, 1999.**
   Review of claims by gas utility and other parties that economic development would be promoted by allocating transition costs away from large industrial and other noncore gas customers. Evaluation of how economic development will be impacted by the period selected for amortization of these transition costs. Provision of recommendations regarding consideration of economic development issues by the Commission.

10. **California Public Utilities Commission A. 97-12-048; Southern California Gas Company; The Utility Reform Network (TURN); April 17, 1998; Rebuttal Testimony May 4, 1998.**
    Review of claims by gas utility and other parties that economic development would be promoted by allocating transition costs away from large industrial and other noncore gas customers. Provision of recommendations regarding consideration of economic development issues by the Commission.

11. **Ontario Energy Board E.B.O. 177-17; Union Gas Ltd./Centra Gas Ontario, Inc. Application to Transfer Appliance Businesses to Union Energy; Pollution Probe; January 19, 1998.**
    Review of gas utilities' proposal to transfer their appliance sales, financing, renting and servicing businesses to an unregulated subsidiary. Evaluation of costs and benefits for gas consumers. Assessment of impacts upon competition, DSM, and the environment. Discussion of precedents

regarding large-scale divestiture of utility assets, tender processes, and market-based valuation. Provision of recommendations regarding the future of the appliance businesses and development of competitive markets.

12. **United States Federal Energy Regulatory Commission Dockets ER97-1079-000 and OA97-237-000; New England Power Pool; Grand Council of the Crees (of Québec) and New England Coalition for Energy Efficiency and the Environment; July 1, 1997 (joint affidavit with R. Carlson).**
    Review of the market power analysis and market power mitigation principles submitted by New England Power Pool. Development of applicable standard for market power analysis. Evaluation of the potential for exercise of horizontal and vertical market power by Hydro-Québec. Assessment of possible market power mitigation measures.

13. **State of Vermont House Commerce Committee and House Judiciary Committee; April 30, 1997.**
    Review of a contract for purchases of Hydro-Québec power by Vermont utilities. Analysis of how changes in load forecasts, supply-side alternatives, and the wholesale power markets affect contract cost-effectiveness. Evaluation of decisions by Vermont utilities and state agencies to approve the contract. Discussion of implications for utility restructuring.

14. **United States Federal Energy Regulatory Commission Docket ER97-851-000; Petition of H.Q. Energy Services (U.S.) Inc. for Order Accepting Initial Rate Schedule, Authorizing Market-Based Rates, and Granting Certain Waivers and Blanket Approvals; Grand Council of the Crees (of Québec) and New England Coalition for Energy Efficiency and the Environment; March 27, 1997; Affidavit August 19, 1997 (joint affidavit with R. Carlson); Supplemental Affidavit September 25, 1997 (joint affidavit with R. Carlson).**
    Review of Hydro-Québec subsidiary's request for power marketer status. Assessment of Hydro-Québec transmission tariff and conformity with FERC Transmission Pricing Principles and Order 888. Development of applicable standard for market power analysis and critique of applicant's analysis under traditional Hub-and-Spoke and Merger Policy Statement frameworks. Identification of potential affiliate abuse, anti-competitive behavior, and environmental impacts. Assessment of possible market power mitigation measures. Discussion of reciprocal access to Québec markets.

15. **Massachusetts Department of Public Utilities 96-25; Massachusetts Electric Restructuring Proposal; Wheeled Electric Power Company; November 21, 1996.**
    Review of Massachusetts Electric's proposed Restructuring Settlement. Analysis of effects upon the utility's financial position and retail competition. Evaluation of the financial and rate reduction implications of an alternative proposal for Standard Offer retail prices to be market-based, rather than pre-specified.

16. **Commission d'enquête sur la politique d'achat par Hydro-Québec d'électricité auprès de producteurs privés; Commission Staff; September 16, 1996.**
    Analysis of Hydro-Québec's cycle of electricity surpluses and sales promotion in domestic and export markets. Evaluation of the relationship between sales promotion and the utility's independent power program. Review of mechanisms used elsewhere to acquire independent power. Discussion of transfer of utility small hydro projects to independent producers.

17. **Ontario Energy Board E.B.R.O. 493/494; Union Gas Ltd./Centra Gas Ontario, Inc. 1997 Rates Hearing; Pollution Probe; September 6, 1996 (joint testimony with R. Carlson).**
    Evaluation of the utilities' gas avoided cost methodology, and avoided cost estimates used in their 1997 DSM Plan. Review and verification of the utilities avoided cost analysis. Development of recommendations for future avoided cost submissions.

18. **Ontario Energy Board HR 24; Ontario Hydro 1997 Rate Proceeding; Green Energy Coalition; June 11, 1996 (joint testimony with R. Carlson).**
    Examination of social and economic consequences affiliated with Ontario Hydro's existing and proposed industrial, residential, and commercial optional rates. Specific analysis of load retention/expansion, surplus power, real time, and aggregation rates, with reference to the Board's stated concerns regarding transparency, consideration of environmental impacts, and due diligence to prevent free ridership.

19. **Vermont Public Service Board Docket 5870; Tariff filing of Green Mountain Power requesting authority to implement its Customer Pilot Pricing Program; Grand Council of the Crees (of Québec), New England Coalition for Energy Efficiency and the Environment, and Vermont Public Interest Research Group; March 19, 1996.**
    Review of a proposed rate discount for incremental sales to residential and small commercial customers. Analysis of impacts upon sales, energy efficiency, and net revenues. Evaluation of program design, evaluation

plan, equity considerations, environmental impacts, and potential for free ridership.

20. **Maine Public Utilities Commission Docket 95-598; Central Maine Power Company's Annual Demand-Side Management Targets; Maine Public Utilities Commission Staff; June 26, 1995 (joint testimony with J. Raab).**
    Discussion of the rationale for Central Maine Power Company's continued acquisition of demand-side management resources and the need for utility efficiency programs. Review of Central Maine Power Company's 1996 DSM targets and presentation of alternative efficiency targets and associated budgets. Evaluation of CMP's DSM proposal in the context of basic program design principles.

21. **Ontario Energy Board HR 23; Ontario Hydro 1996 Rate Proceeding; Green Energy Coalition; June 16, 1995 (joint testimony with R. Carlson).**
    Examination of social and economic consequences affiliated with Ontario Hydro's existing and proposed industrial discount rates. Specific analysis of load retention and risk-sharing rates, with reference to the Board's stated concerns regarding transparency, consideration of environmental impacts, and due diligence to prevent free ridership.

22. **Ontario Energy Board E.B.L.O. 251; 1995/96 Trafalgar Facilities Expansion Program of Union Gas Limited; Pollution Probe; May 5, 1995; Supplemental Testimony February 8, 1996 (joint testimony with R. Carlson).**
    Evaluation of Union Gas Ltd.'s application for a natural gas pipeline expansion. Verification of its discounted cash flow analysis. Critique of Union's expected energy cost savings to participants from displacement of alternative fuels, and development of alternative energy cost savings estimates. Verification and validation of its long-term transmission facilities expansion model and its total resource cost savings analysis.

23. **Ontario Energy Board E.B.R.O. 486; Union Gas Ltd. 1995 Rate Hearing; Pollution Probe; December 5, 1994 (joint testimony with R. Carlson).**
    Evaluation of Union Gas Ltd.'s gas avoided cost methodology and avoided cost estimates used in its 1995 DSM Plan. Review of Union's avoided cost analysis. Verification of Union's results. Discussion of the limitations inherent in the utility's avoided cost modeling approach, and provision of an alternative perspective to that approach. Development of recommendations for future avoided cost submissions.

24. **New York Public Service Commission Case 94-E-0334; Consolidated Edison Company of New York Rate Proceeding; Enersave, Inc., Natural Resources Defense Council, Pace Energy Project, and New York Energy Efficiency Council; September 23, 1994; Revised Testimony October 11, 1994 (joint testimony with J. Peters).**
    Assessment of proposed changes to Consolidated Edison's demand-side management programs, focusing on the Commercial & Industrial Lighting Program. Analysis of the impacts on rates, revenue requirements, and societal costs associated with demand- and supply-side resources. Discussion of the interaction between electricity rates and economic competitiveness. Provision of recommendations concerning changes to the utility's proposed DSM program.

25. **Maine Public Utilities Commission Docket 92-345, Phase II; Central Maine Power Company's Proposed Increase in Rates; Office of the Maine Public Advocate; June 15, 1994 (joint testimony with R. Carlson).**
    Discussion of Central Maine Power Company's load-building programs, including fuel-switching, within the context of Maine's economic and regulatory environment. Assessment of short-run and long-run risks associated with Central Maine Power Company's flexible pricing proposal. Review of pricing flexibility impacts from surplus energy auctions. Provision of recommendations concerning appropriate cost-effectiveness tests for load-building activities, limitations to auction of surplus electricity, and the insulation of residential rates from the impact of commercial/industrial sector promotional activities.

26. **Ontario Energy Board HR 22; Ontario Hydro 1995 Rate Proceeding; Grand Council Treaty #3; June 2, 1994.**
    Summary of First Nation concerns relating to the proposed corporate restructuring of Ontario Hydro and potential impacts on price of electricity and quality of service. Discussion of the potential impact of restructuring on the settlement of outstanding grievances.

27. **Ontario Energy Board HR 22; Ontario Hydro 1995 Rate Proceeding; Nishnawbe Aski Nation and Grand Council Treaty #3; June 2, 1994 (joint testimony with R. Carlson).**
    Review of First Nation concerns related to Ontario Hydro's ratesetting policies and orientations, including proposed discount rates and market-based pricing. Assessment of the potential impacts of rate restructuring on rural rates and equity. Critique of Ontario Hydro's cost allocation process and its potential impacts on rural customers.

28. **Ontario Energy Board HR 22; Ontario Hydro 1995 Rate Proceeding; Green Energy Coalition; June 2, 1994 (joint testimony with R. Carlson).**

Summary of general considerations relating to discounted industrial rates. Outline of the problems inherent in Ontario Hydro's proposed strategy of offering discount rates to industrial customers. Description of the applicable standard for granting special discount rates. Recapitulation of Hydro-Québec's experiences and financial difficulties associated with a strategy promoting discount rates.

29. **Florida Public Service Commission Case Nos. 930548-EG to 930551-EG; Adoption of Numeric Conservation Goals and Consideration of National Energy Policy Act Standards by Florida's Investor-Owned Utilities; Florida Department of Community Affairs; April 29, 1994 (joint testimony with B. Krier).**
Discussion of precedents for utility commission consideration of employment and economic development issues. Summary of the role of energy efficiency programs in Florida's economic development. Interpretation of the qualitative findings contained in a companion Goodman Group report entitled The Employment Impacts of Electricity Efficiency in Florida. Comparison of this analysis with standards and practices utilized in similar studies in other jurisdictions.

30. **Ontario Energy Board E.B.L.O. 246 Amended; 1994/95 Trafalgar Facilities Expansion Program of Union Gas Limited; Pollution Probe; April 4, 1994; Supplemental Oral Direct Testimony April 22, 1994 (joint testimony with R. Carlson).**
Assessment of utility's demand-supply framework. Review of gas use projections and potential impacts of DSM and greenhouse gas restrictions. Critique of utility's application of cost-benefit test. Evaluation of fuel-switching analysis. Critique of fuel price forecasts utilized. Analysis of economic risk associated with proposed facility expansion.

31. **State of New York Assembly Standing Committee on Energy and Assembly Standing Committee on Environmental Conservation; March 2, 1994.**
Assessment of 800 MW Hydro-Quebec/New York Power Authority seasonal diversity contract in the context of reduced load forecasts, increased projections for independent power production and demand-side management, and the changing wholesale power markets. Analysis of the contract's cost-effectiveness. Analysis of risk, reliability, and economic development considerations.

32. **Maine Public Utilities Commission Docket No. 93-147; Central Maine Power Company Petition for a Certificate of Public Convenience and Necessity to Erect a Transmission Line Carrying 100 Kilovolts or More in York County; Maine Public Utilities Commission Staff; September 21, 1993 (joint testimony with R. Carlson and W. Scott).**
Assessment of peak load forecasts through 2008 for York County.

Economic analysis of the need for a transmission line. Cost-effectiveness analysis of alternative line routes.

33. **Maine Public Utilities Commission Docket No. 92-331; Airco Industrial Gases Request for Interruptible Load Retention Service Rate with Central Maine Power Company; Maine Public Utilities Commission Staff; July 9, 1993; Supplemental Testimony August 10, 1993 (joint testimony with R. Carlson and R. McCullough).**
Assessment of request for a special industrial rate. Review of supply and demand trends in the industrial gases industry. Analysis of production scheduling and transportation cost models. Calculation of internal rates of return based on alternative assumptions. Development of recommendations for the framework, evidentiary standards, and evaluation criteria to be used in consideration of special industrial tariffs.

34. **Ontario Energy Board 169-III; Integrated Resource Planning for Ontario's Local Gas Distribution Companies; Ontario Metis and Aboriginal Association; November 20, 1992.**
Identification of importance of considering environmental and social externalities in energy planning generally and in Ontario natural gas industry specifically. Formulation of recommendations for incorporating externalities into the planning process. Consideration of externalities from the standpoint of the Aboriginal population.

35. **Government of Canada and Government of Manitoba; Conawapa Project Environmental Assessment; Concerned Citizens of Manitoba, Sierra Club of Western Canada (Manitoba Branch), Manitoba Naturalists Society, Inc., Manitoba Branch of the Canadian Parks and Wilderness Society, and Time to Respect Earths' Ecosystems (TREE) Inc.; June 4, 1992 (joint testimony with C. Goodwin and W. Marcus).**
Discussion of the need for environmental reviews to evaluate justification of design alternatives to the proposed 1290 MW Conawapa Project. Description of changes in the utility industry and new supply resource options that will affect the design alternatives included in an environmental review. Review of the treatment of project justification in North American environmental assessments.

36. **Government of Canada and Government of Québec; Great Whale River Project Environmental Review; Grand Council of the Crees (of Québec); March 18, 1992 (joint testimony with R. McCullough).**
Discussion of the need for environmental reviews to evaluate justification of design alternatives to the 3160 MW Great Whale River Project. Description of changes in the utility industry and new supply resource options that will affect the design alternatives included in an environmental review. Review of the treatment of project justification in North American environmental assessments.

37. **New York Public Service Commission Case 90-E-0775; Petition to Reopen Proceeding and Determine the Prudence of the Contracts for Delivery of Hydro-Quebec Power; Environmental Defense Fund, Center for Environmental Legal Studies of the Pace University School of Law, Natural Resources Defense Council, National Audubon Society, Sierra Club, (Atlantic Chapter), Greenpeace U.S.A., Environmental Planning Lobby, and Hudson River Sloop Clearwater; November 25, 1991.**
    Review of the need for a contract for purchases of Hydro-Québec power by New York utilities. Summary of declining load forecasts and changes in the supply outlook. Analysis of the cost-effectiveness of the proposed purchase. Discussion of risk, reliability, and other considerations.

38. **State of Vermont Supreme Court and Public Service Board; In re: Application of Twenty-Four Electric Utilities for a Certificate of Public Good Authorizing Execution and Performance of a Firm Power and Energy Contract with Hydro-Québec and a Hydro-Québec Participation Agreement, and Specifically Concerning Motions for a Remand to the Board for a New Trial; October 15, 1991; Reply Affidavit October 28, 1991.**
    Review of a contract for purchases of Hydro-Québec power by Vermont utilities. Summary of changes concerning load forecasts and supply-side alternatives. Analysis of how these changes affect the cost-effectiveness of the contract.

39. **State of New York Assembly Energy Committee Senate Environmental Conservation Committee; September 30, 1991 (updated October 7, 1991).**
    Assessment of Hydro-Quebec contract in the context of reduced load forecasts, increased projections for independent power production, and the changing wholesale power markets. Analysis of the contract's cost-effectiveness. Estimation of risk, reliability, and economic development considerations.

40. **New York Public Service Commission Case 91-E-0462; Consolidated Edison Company of New York Rate Proceeding; City of New York; September 6, 1991.**
    Review of Consolidated Edison's demand-side management programs. Analysis of program delivery mechanisms and incentive levels. Identification of additional cost-effective efficiency measures. Discussion of opportunities for increased cooperation between Consolidated Edison and the City of New York to achieve greater efficiency.

41. **New York Public Service Commission Case 91-E-0462; Consolidated Edison Company of New York Rate Proceeding; Environmental**

Defense Fund, National Audubon Society, Greenpeace, and Center for Environmental Legal Studies; September 6, 1991.
Analysis of Consolidated Edison's resource planning process with respect to demand-side management programs and the 482 MW Hydro-Québec purchase. Evaluation of demand-side management and the Hydro-Québec purchase in context of long run avoided cost estimates. Determination of cost-effectiveness of Hydro-Québec contract. Discussion of risk, reliability, environmental and economic development considerations relating to the Hydro-Québec purchase.

42. **New York Public Service Commission Case 90-E-1185; Long Island Lighting Company Rate Proceeding; Vladeck, Waldman, Elias and Englehard, Natural Resources Defense Council, and Center for Environmental Legal Studies; June 3, 1991 (joint testimony with C. Komanoff).**
Evaluation of Long Island Lighting Company's proposed 20 year, 218 MW purchase of electricity from Hydro-Québec. Comparison of Long-Run Avoided Cost and the Hydro-Québec purchase. Review of supply and demand options as alternatives to the purchase. evaluation of risk, reliability, environmental, and economic development considerations.

43. **Québec Access to Information Commission No. 90-04-07; Risk-Sharing Contracts; Grand Council of the Crees (of Québec); May 3, 1991.**
Analysis of confidential risk-sharing electricity supply contracts between Hydro-Québec and thirteen large industrial customers. Description of participants by company ownership, location, principal activities, and business relationships. Estimation of energy and capacity required to service contracts. Assessment of resulting implications for Hydro-Québec and its ratepayers. Review of treatment of electricity contracts for aluminum smelters and other large industrial customers in North American jurisdictions.

44. **Massachusetts Department of Public Utilities 90-261-A; Massachusetts Electric Fuel Switching; Massachusetts Division of Energy Resources; April 17, 1991.**
Evaluation of fuel switching as a demand-side management option. Review of current status of fuel-switching technologies. Formulation of cost and benefit allocation algorithms to optimize program participation and maximize societal benefits by incorporating fuel choice options, including renewables and active and passive solar, as part of utility least-cost planning.

45. **State of Vermont, Chittenden County Superior Court, Docket S518-91 CnC; March 5, 1991 Burlington Municipal Election Question 8; Grand Council of the Crees (of Québec); March 28, 1991.**

Analysis of Burlington Electric Department Assessment provided as "voter information" in referendum concerning power purchase contract with Hydro-Québec. Evaluation of accuracy and impartiality of information concerning cost estimates, alternative sources of supply, environmental effects, and economic benefits.

46. **Manitoba Public Utilities Board; Manitoba Hydro Submission in Respect to Major Capital Projects; Concerned Citizens of Manitoba, Sierra Club of Western Canada (Manitoba Branch), and Conservation Strategy Association of Manitoba; July 23, 1990; Surrebuttal Testimony August 30, 1990 (joint testimony with W. Marcus).**
Review of Manitoba Hydro's submission and the proposed: construction of 1290 MW Conawapa generating station and other northern hydro projects; 100 MW demand-side management program; twenty-two year, 1000 MW power sale to Ontario Hydro; and two 150 MW seasonal diversity exchanges. Review of Manitoba Hydro load forecasting. Estimation of economic and attainable conservation potential. Development of principles of conservation program design and delivery. Critique of utility's proposed demand-side management program. Evaluation of alternative supply-side resources. Analysis of avoided costs. Assessment of employment and economic development effects of hydroelectric development and conservation. Analysis of profitability and risks of proposed power sales contracts.

47. **State of New York Supreme Court; Application of Sierra Club, Inc. et al. For Judgment Under Article 78 Against the Power Authority of the State of New York, et al.; April 18, 1990; Reply Affidavit August 6, 1990; Supplemental Reply Affidavit September 13, 1990.**
Analysis of nexus between New York Power Authority purchases and construction of specific Québec hydro facilities and operation of fossil fuel electric generation. Evaluation of power imports in New York State Energy Plan. Assessment of energy conservation as a potential substitute for hydro and fossil generation. Comparison of employment and economic development impacts of power purchase and conservation options.

48. **Canadian National Energy Board Hearing Orders No. EH-3-89 and AO-1-EH-3-89; Application of Hydro-Québec for Export License for Firm Power and Energy Contracts with Vermont Joint Owners and New York Power Authority; Grand Council of the Crees (of Québec); February 14, 1990 (joint testimony with W. Marcus).**
Review of a proposed thirty year, 450 MW sale of Hydro-Québec power to twenty-four Vermont utilities and review of a proposed twenty year, 1000 MW sale of Hydro-Québec power to the New York Power Authority. Analysis of planning and operation of Hydro-Québec power supply. Modeling of hydro reservoir levels. Determination of marginal supply resources associated with sales to Vermont and New York. Estimation of

acid rain and greenhouse gases emissions from fossil and hydro generation. Analysis of reliability including adequacy of energy, capacity, and transmission supply. Estimation of achievable conservation potential in Québec. Analysis of the profitability of the proposed power sales on both a private cost and social cost basis.

49. **Vermont Public Service Board Docket 5330; Application of Vermont Utilities for Approval of a Firm Power and Energy Contract with Hydro-Québec; Grand Council of the Crees (of Québec) and New England Coalition for Energy Efficiency and the Environment; December 19, 1989; Supplemental Testimony January 18, 1990 (joint testimony with W. Marcus). Docket 5330-A; Testimony April 30, 1991.**
Review of a proposed thirty year, 450 MW purchase of Hydro-Québec power by twenty-four Vermont utilities. Analysis of planning and operation of Hydro-Québec power supply. Modeling of hydro reservoir levels. Determination of marginal supply resources associated with sales to Vermont. Estimation of acid rain and greenhouse gases emissions from fossil and hydro generation. Analysis of risk and reliability including supply diversity, and adequacy and security of energy and transmission supply. Estimation of achievable conservation potential in Québec. Development of proposal for exports to Vermont based on conservation and alternative supply resources in Québec. Evaluation of costs and benefits of Vermont Joint Owners' proposed Waiver and Release to extend the date for cancellation of export contracts without penalty.

50. **Massachusetts Department of Public Utilities 89-72; Statewide Towing Association, Police-Ordered Towing Rates; Massachusetts Automobile Rating and Accident Prevention Bureau; September 13, 1989 (joint testimony with P. Chernick).**
Review of study supporting proposed increase in towing rates. Critique of study sample and methodology. Comparison with competitive rates. Supply of towing services. Effects of joint products and joint sales on profitability of police-ordered towing.

EXHIBIT B

GENSCAPE®

Date: July 7, 2017; **Volume:** 9; **Issue:** 130

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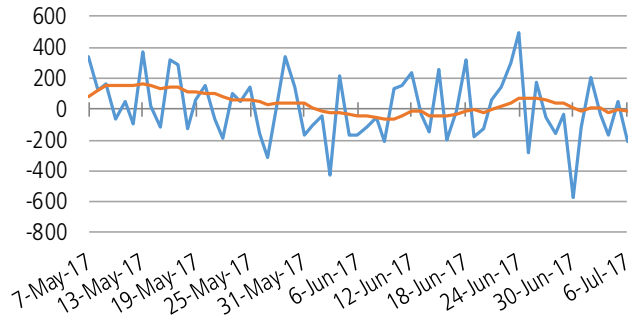
Mid-Continent Pipeline Daily Update

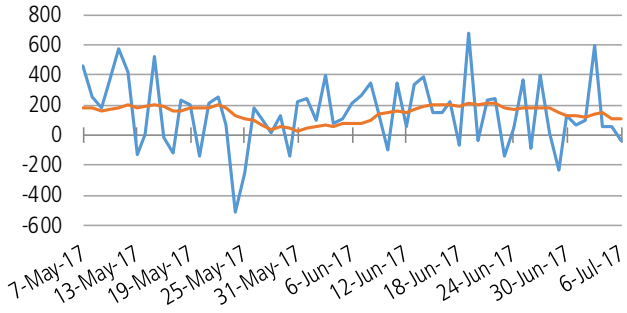
Net Flows

Legend: Daily Flow — 15-day rolling average

Cushing (1000 bpd)



Patoka (1000 bpd)

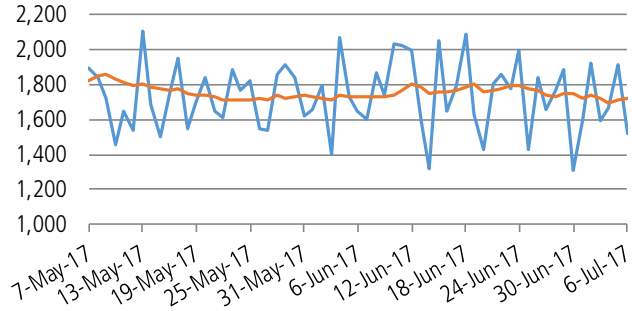


Cushing

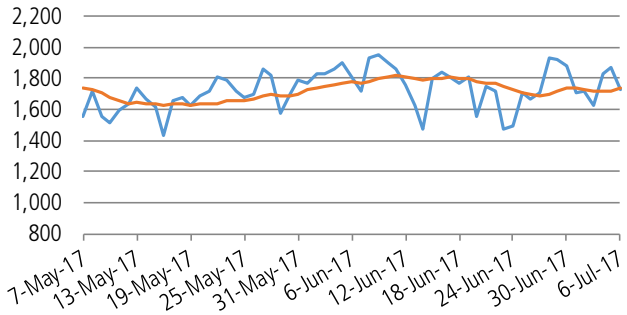
Pipeline Flows

Legend: Daily Flow — 15-day rolling average

Incoming (1000 bpd)



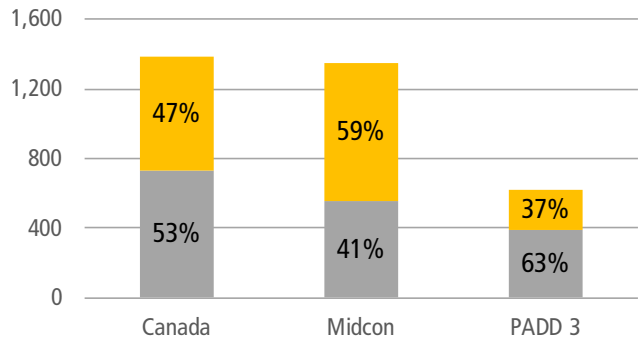
Outgoing (1000 bpd)



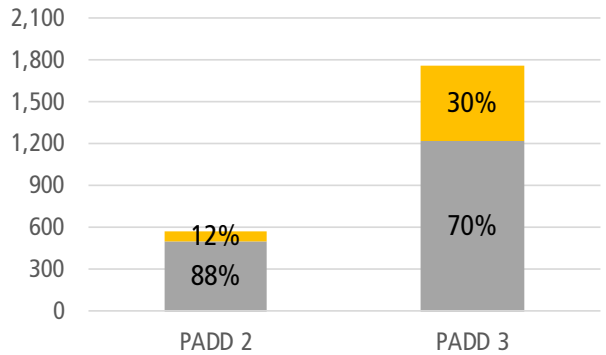
Daily Capacity Utilization (monitored)

Legend: Utilized — Not utilized

Incoming (1000 bpd)



Outgoing (1000 bpd)



OIL

Cushing

Cushing Incoming (bpd)							
Pipeline	CL	6 Jul 17	Daily Chg	% Chg	Avg This Month	Avg Prev Month	Monthly Chg
Basin	4	321,466	-64,124	-16.6%	328,300	309,238	19,062
Basin - Duncan Offtake	4	160,674	160,674	0.0%	26,779	39,929	-13,150
Cashion	2	36,157	-1,657	-4.4%	35,775	35,168	607
Centurion North	2	69,744	-724	-1.0%	69,516	65,781	3,735
Eagle North	2	6,611	-2,130	-24.4%	6,899	5,913	986
Flanagan South	3	237,045	-19,832	-7.7%	304,043	241,683	62,360
Glass Mountain - Cleo Springs to Cushing	2	59,907	12,660	26.8%	40,735	45,639	-4,903
Great Salt Plains	2	34,906	69	0.2%	34,467	34,301	166
Hawthorn	4	0	0	0.0%	0	0	0
Keystone - Steele City to Cushing	4	347,350	-76,583	-18.1%	306,060	432,602	-126,542
Mississippian Lime	2	57,183	-58,349	-50.5%	87,198	98,543	-11,345
Pony Express	4	202,052	-53,427	-20.9%	239,388	248,474	-9,087
Saddlehorn-Grand Mesa	2	43,714	38	0.1%	42,894	42,793	101
Spearhead	4	149,080	5,042	3.5%	133,831	142,800	-8,969
White Cliffs - Into Cushing	2	119,797	25,650	27.2%	101,595	85,451	16,144
Total Cushing Incoming		**1,685,012**	**-233,368**	**-12.2%**	**1,730,700**	**1,788,385**	**-57,685**
Adjusted Cushing Incoming		**1,524,338**	**-394,042**	**-20.5%**	**1,703,921**	**1,748,456**	**-44,535**

Cushing Outgoing (bpd)							
Pipeline	CL	6 Jul 17	Daily Chg	% Chg	Avg This Month	Avg Prev Month	Monthly Chg
BP1	3	112,375	3,744	3.4%	103,650	113,570	-9,920
Osage	4	175,498	16,517	10.4%	168,927	162,183	6,744
Ozark	4	218,083	2,775	1.3%	217,384	216,880	504
Phillips	4	19,514	-3,178	-14.0%	19,422	9,600	9,823
Red River	2	0	-272	-100.0%	8,864	8,196	669
Red River - Cushing to Longview	2	0	-59,621	-100.0%	37,889	39,230	-1,342
Seaway	4	371,613	-4,964	-1.3%	296,264	312,925	-16,661
Seaway Twin	4	450,000	0	0.0%	431,513	401,249	30,265
TransCanada Gulf Coast	3	383,937	-89,135	-18.8%	462,644	503,911	-41,267
Total Cushing Outgoing		**1,731,020**	**-134,135**	**-7.2%**	**1,746,558**	**1,767,744**	**-21,186**
Total Cushing Net Flow		**-46,008**	**-99,233**	**-186.4%**	**-15,859**	**20,641**	**-36,499**
Adjusted Cushing Net Flow		**-206,682**	**-259,907**	**-488.3%**	**-42,638**	**-19,288**	**-23,349**

The **Mid-Continent Pipeline Update** is based on readings of power flow on lines serving selected pumping stations on the pipelines in question. The readings are taken using a proprietary, patented monitoring technique that remotely senses the electrical and magnetic fields generated by power flowing on the line. For more details on the pumping stations being monitored, please contact genscapeoil@genscape.com.

CL = Confidence Level. Levels 1–4 are assigned as follows. CL 1: maintenance; pipeline model undergoing maintenance; treat pipeline data with discretion. CL 2: low confidence; uncalibrated pipeline. CL 3: medium confidence; technical issues with one or more pumping stations in model, or some divergence from calibration data. CL 4: high confidence; calibrated pipeline; no significant issues at any monitored pumping stations used in model.

Cushing Capacity Coverage

Incoming	Capacity (bpd)	
Pipelines	Monitored	Unmonitored
Basin	450,000	
Cashion	100,000	
Centurion North	170,000	
Eagle North	20,000	
Flanagan South	600,000	
Glass Mountain - Cleo Springs to Cushing	147,000	
Great Salt Plains	35,000	
Hawthorn	90,000	
Keystone - Steele City to Cushing	590,000	
Mississippian Lime	150,000	
Pony Express	320,000	
Saddlehorn-Grand Mesa	340,000	
Spearhead	193,000	
White Cliffs - Into Cushing	215,000	
Blueknight OK Mainline		25,000
Magellan – Drumright to Cushing		70,000
Medford/Plains LPG		25,000
Northern Cimarron		32,000
Total Incoming Capacity	**3,420,000**	**152,000**

Outgoing	Capacity (bpd)	
Pipelines	Monitored	Unmonitored
BP1	180,000	
Osage	150,000	
Ozark	230,000	
Phillips	59,000	
Red River	22,000	
Red River - Cushing to Longview	125,000	
Seaway	400,000	
Seaway Twin	450,000	
TransCanada Gulf Coast	700,000	
Coffeyville		110,000
Magellan Tulsa		30,000
PAA Cherokee		18,000
Phillips Ponca		122,000
Sunoco OK1		35,000
Sunoco OK2		35,000
Total Outgoing Capacity	**2,316,000**	**350,000**

Recent Alerts

Cushing Pipelines		
Pipeline	**Notes**	**Date & Time (EST)**
Mississippian Lime	The Mississippian Lime pipeline shut from approximately 88,000 bpd. Initial decreased power consumption was observed at approximately 10:00 a.m. (EST) Jul. 6. Pipeline flow is currently averaging an estimated 94,000 bpd this week thus far.	6-Jul-17 2:09 PM
Mississippian Lime	The Mississippian Lime pipeline shut from approximately 115,000 bpd. Initial decreased power consumption was observed at approximately 11:00 a.m. (EST) Jul. 6. Pipeline flow is currently averaging an estimated 95,000 bpd this week thus far.	6-Jul-17 1:07 PM
Seaway	The Seaway pipeline decreased to near 154,000 bpd from approximately 390,000 bpd. Initial decreased power consumption was observed at approximately 3:30 p.m. (EST) Jul. 2. Pipeline flow is currently averaging an estimated 238,000 bpd this week thus far.	3-Jul-17 7:30 AM

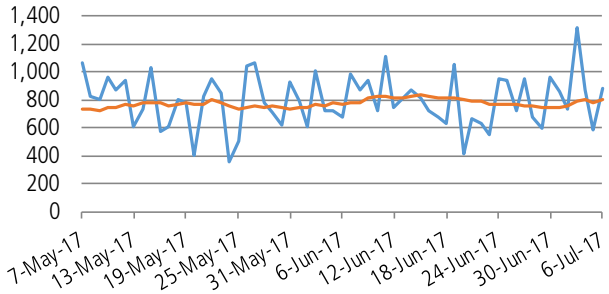
Alerts sent out less than one hour prior to the publication time of this report can be found on the Genscape's Oil Intelligence Dashboard.

Patoka

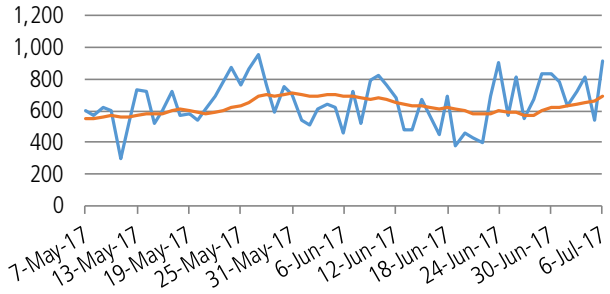
Pipeline Flows

Legend: — Daily Flow — 15-day rolling average

Incoming (1000 bpd)



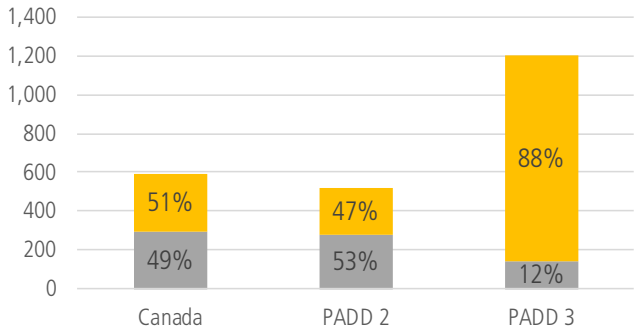
Outgoing (1000 bpd)



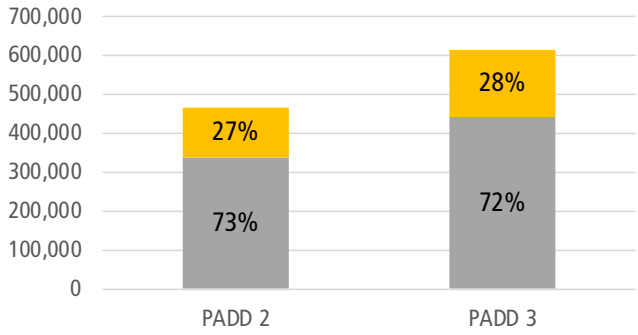
Daily Capacity Utilization (monitored)

Legend: Utilized Not utilized

Incoming (1000 bpd)



Outgoing (1000 bpd)



Patoka Incoming (bpd)							
Pipeline	CL	6 Jul 17	Daily Chg	% Chg	Avg This Month	Avg Prev Month	Monthly Chg
Capline - Collierville to Patoka	2	142,032	132,803	1439.0%	143,591	185,459	-41,868
Dakota Access	2	274,609	50,951	22.8%	254,412	217,093	37,319
Keystone - Steele City to Patoka	4	291,731	107,959	58.7%	315,199	191,601	123,598
Southern Access Extension	2	174,238	775	0.4%	162,056	191,019	-28,963
Total Patoka Incoming Flow		**882,609**	**292,488**	**49.6%**	**875,258**	**785,172**	**90,086**

Patoka Outgoing (bpd)							
Pipeline	CL	6 Jul 17	Daily Chg	% Chg	Avg This Month	Avg Prev Month	Monthly Chg
Chicap	3	137,767	2,804	2.1%	135,524	104,476	31,048
ETCOP	2	441,783	408,162	1214.0%	269,449	157,886	111,563
Marathon to Catlettsburg	2	200,034	-11,862	-5.6%	213,528	216,193	-2,665
Marathon to Lima	2	139,320	-16,494	-10.6%	115,918	139,579	-23,662
Pegasus	1	0	0	0.0%	0	0	0
Total Patoka Outgoing Flow		**918,905**	**382,610**	**71.3%**	**734,419**	**618,135**	**116,285**
Total Patoka Net Flow		**-36,296**	**-90,122**	**-167.4%**	**140,839**	**167,037**	**-26,199**

Patoka Capacity Coverage

Incoming	Capacity (bpd)	
Pipelines	Monitored	Unmonitored
Capline - Collierville to Patoka	1,200,000	
Dakota Access	520,000	
Keystone - Steele City to Patoka	590,000	
Southern Access Extension	300,000	
Mustang		100,000
Woodpat		315,000
Total Incoming Capacity	**2,610,000**	**415,000**

Outgoing	Capacity (bpd)	
Pipelines	Monitored	Unmonitored
Chicap	360,000	
ETCOP	520,000	
Marathon to Catlettsburg	230,000	
Marathon to Lima	238,000	
Pegasus	99,000	
Capwood		277,000
Marathon to Robinson		210,000
Total Outgoing Capacity	**1,447,000**	**487,000**

Other Pipeline Flows

Other Pipeline Flows (bpd)							
Pipeline	CL	6 Jul 17	Daily Chg	% Chg	Avg This Month	Avg Prev Month	Monthly Chg
Basin - Duncan Offtake	4	160,674	160,674	0.0%	26,779	39,929	-13,150
Capline - Collierville to Memphis	2	198,313	136,941	223.1%	162,511	70,526	91,986
Capline - St. James to Collierville	3	340,345	269,744	382.1%	306,103	255,985	50,118
Glass Mountain - Alva to Cleo Springs	2	49,875	16,904	51.3%	31,237	36,587	-5,350
Glass Mountain - Arnett to Cleo Springs	2	10,031	-4,244	-29.7%	9,499	9,052	447
Keystone - Hardisty to Steele City	4	639,080	31,376	5.2%	621,259	624,203	-2,944
Koch Minnesota	2	160,899	-28,404	-15.0%	150,616	135,662	14,954
Mid Valley	4	222,553	-6,421	-2.8%	222,366	238,098	-15,732
Platte	4	30,663	-64,060	-67.6%	103,098	146,587	-43,489

Recent Alerts

Recent Alerts – Patoka and Other Pipelines		
Pipeline	Notes	Date & Time (EST)
Marathon to Catlettsburg	The Marathon To Catlettsburg pipeline resumed to near 220,000 bpd. The pipeline was shut for approximately 1.5 hours. Initial increased power consumption was observed at approximately 8:30 a.m. (EST) Jul. 6. Pipeline flow is currently averaging an estimated 213,000 bpd this week thus far.	6-Jul-17 1:05 PM
Platte	The Platte pipeline shut from approximately 55,000 bpd. Initial decreased power consumption was observed at approximately 8:00 p.m. (EST) Jul. 5. Pipeline flow is currently averaging an estimated 110,000 bpd this week thus far.	6-Jul-17 12:45 PM
Marathon to Catlettsburg	The Marathon To Catlettsburg pipeline shut from approximately 214,000 bpd. Initial decreased power consumption was observed at approximately 5:30 a.m. (EST) Jul. 6. Pipeline flow is currently averaging an estimated 214,000 bpd this week thus far.	6-Jul-17 10:08 AM

EXHIBIT C

Technical Appendix to Ian Goodman's Declaration in Support of the Plaintiffs Standing Rock Sioux Tribe; Yankton Sioux Tribe; Robert Flying Hawk; Oglala Sioux Tribe and Cheyenne River Sioux Tribe

on the Question of Remedy

by Ian Goodman

Case No. 1:16-cv-01534-JEB
BEFORE THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

the goodman group, ltd.
www.thegoodman.com

August 7, 2017

Table of Contents

1 Genscape Pipeline Flow Estimates

Genscape monitors a variety of pipelines (including DAPL) and other energy facilities to provide market intelligence.[1]

For oil pipelines, Genscape monitors electric power flows into pumping stations, which are proportional to crude flow.[2]

> The Mid-Continent Pipeline Update is based on readings of power flow on lines serving selected pumping stations on the pipelines in question.
>
> The readings are taken using a proprietary, patented monitoring technique that remotely senses the electrical and magnetic fields generated by power flowing on the line.

As further explained in the Methodology section on the Genscape website:[3]

> **How pipeline data is collected**
>
> Genscape uses proprietary technology to monitor the power flows on power lines feeding electricity to pumping stations on oil pipelines. This is the same proven strategy and patented technology that Genscape has used to monitor power plants and transmission since 2002. The Genscape power monitors are placed near the power lines but not in the right of way of the utility. The monitors are self-powered, non-contact devices which measure electromagnetic fields generated by the power lines. Using proprietary algorithms, these EMF measurements are transformed into power flow data.
>
> **How does the power consumption data relate to flow?**
>
> The flow rate model takes into account the elevation gain or loss between a monitored pumping station and the next station downstream. That

[1] http://www.genscape.com/blog/north-dakota-crude-rail-loadings-plummet-dapl-startup-imminent
http://www.genscape.com/aboutus
http://info.genscape.com/capabilities-brochure-web
[2] Attached as Exhibit B: Genscape, Mid-Continent Pipeline Daily Update, July 7, 2017 (Volume 9; Issue 130), p 2. http://info.genscape.com/mid-continent-pipeline-sample-report
[3] http://www.genscape.com/solutions/oil/mid-continent-pipeline-service#tabs-Methodology_panel (emphasis bold in original)

elevation change and the power usage are used to estimate the pressure differential between the output side of the first pumping station and the input side of the next station downstream. The pressure change calculations take hard limit parameters (minimum and maximum pressure) into account.

Genscape reports the following data for DAPL:[4]

	Patoka Incoming Flow (bpd)
June 1-30, 2017 (average)	217,093
July 1-6, 2017 (average)	254,412
Capacity	520,000

Based on the above Genscape data, the following summary statistics are computed.

	DAPL Patoka Incoming Flow			
	Days	Average Flow (bpd)	Utilization (Flow as % of Capacity)	Total Flow (barrels)
June 1-30, 2017	30	217,093	41.7%	6,512,790
July 1-6, 2017	6	254,412	48.9%	1,526,472
June 1-July 6, 2017	36	223,313	42.9%	8,039,262

[4] Attached as Exhibit B: Genscape, Mid-Continent Pipeline Daily Update, July 7, 2017 (Volume 9; Issue 130), pp. 4-5. http://info.genscape.com/mid-continent-pipeline-sample-report

2 Analysis of Bakken Crude Markets and Transport

2.1 North Dakota State Agencies Reporting on Crude Markets and Transport

Directors of the North Dakota state agencies that regulate and monitor oil production and transport report that:

- pipeline flows are often substantially below capacity as shipper commitments phase in;
- no information is publically available on the specifics of DAPL crude flows and shipper commitments;
- it is unknown when DAPL might be more fully utilized;
- DAPL is not having a major impact on North Dakota crude prices;
- it may take six months or longer to determine if DAPL helps raise crude oil prices.

Sources:

Lynn Helms, North Dakota Department of Mineral Resources: Director's Cut, June 13, 2017 and July 14, 2017
https://www.dmr.nd.gov/oilgas/directorscut/directorscut-2017-06-13.pdf
https://www.dmr.nd.gov/oilgas/directorscut/directorscut-2017-07-14.pdf
Justin Kringstad, North Dakota Department Pipeline Authority: Monthly Update, June 13, 2017 and July 14, 2017
https://ndpipelines.files.wordpress.com/2012/04/ndpa-monthly-update-june-13-2017.pdf
https://ndpipelines.files.wordpress.com/2012/04/ndpa-monthly-update-july-14-2017.pdf

Webcast, June 13, 2017 (summarized in Nemec June 16 article below)
https://www.dmr.nd.gov/oilgas/presentations/webinarsmedia.asp
https://www.youtube.com/watch?v=EtVA3ZivoH0

Director's Cut North Dakota crude prices are North Dakota Sweet Crude, pricing source Flint Hills https://www.fhr.com/products-services/fuels-and-aromatics

The June and July 2017 Director's Cut and webcast are summarized and quoted in the following articles:

Richard Nemec, "Shadow of DAPL Hanging Over Bakken Oil Prices, Flows", NGI/Natural Gas Intelligence, June 16, 2017.
http://www.naturalgasintel.com/articles/110804-shadow-of-dapl-hanging-over-bakken-oil-prices-flows

> Anemic crude oil prices are sticking around even as operations ramp up on the Dakota Access Pipeline (DAPL) to carry Bakken Shale supplies out of North Dakota […]
>
> During a monthly webcast Tuesday to discuss the latest production statistics in North Dakota, Lynn Helms, director of the Department of Mineral Resources, said the added competition that DAPL represents "doesn't appear to have kicked in yet." […].
>
> […] North Dakota Pipeline Authority Director Justin Kringstad said there is no public information available as to when DAPL may reach full maximum capacity of up to 570,000 b/d.
>
> "The nameplate capacity is 520,000 b/d, and it is not uncommon for a pipeline company to stagger volumes committed to it, so the company or a shipper may have their volumes stagger in, depending on how the contracts are written," Kringstad said. "The operator and shipper usually keep pretty private what the actual flowing volumes are."
>
> It may take six months or longer to determine if DAPL helps raise crude oil prices from the Williston, he said.
>
> "I think it will take at least six to 12 months before we see what the 'new-normal' is within the Williston Basin," Kringstad said. […] it is going to take awhile for the market to adjust because this is a new environment for the refining, shipping and producing communities."

Richard Nemec, "Bakken 'Steady As She Goes' in North Dakota; DAPL Fails to Reduce WTI Differential", NGI/Natural Gas Intelligence, July 17, 2017. http://www.naturalgasintel.com/articles/111112-bakken-steady-as-she-goes-in-north-dakota-dapl-fails-to-reduce-wti-differential

> […]
> According to Helms, the only real surprise in the latest statistics was related to the Dakota Access Pipeline (DAPL), which is moving crude to a hub in Illinois and on to the Gulf Coast. The initial startup did not narrow the price differential between Bakken supplies and West Texas Intermediate (WTI) prices. […]
>
> "We're going to have to do some more research on this because that differential should shrink," Helms said. He expected DAPL's competitive transportation costs to drive up the prices Bakken crude can fetch.

2.2 Crude Market Locational Pricing Dynamics

Crude flows and pricing are highly interactive; crude flows vary with price, and price varies with crude flows.

Crude flows are closely interrelated with crude prices and affected by the cost of transport. Crude prices vary by location. Shippers will transport and crude will flow when profitable to do so. For example, it will be profitable to move crude from Point A to Point B when prices at Point B exceed the cost of crude at Point A, plus the cost of transport (from Point A to Point B).

Hence for crude to flow from production areas to destination markets, crude prices must be discounted in production areas (i.e. prices must be lower in production areas and higher in destination markets). Prices for Bakken crude are discounted relative to prices of benchmark crudes more proximate to destination markets, notably WTI.

If current crude prices made it highly profitable to move crude on DAPL, more crude would be transported on DAPL. And if more crude was being transported on DAPL, it would be having more on impact on prices. But neither is happening, at least to date. Shippers are choosing not to use DAPL, because there is only a relatively small amount of crude that can be transported profitably on DAPL.

3 Analysis of Impacts on Crude Producers, Refiners, and Consumers of Refined Products

3.1 Introduction

Section 3.2 describes DAPL and Hanse claims about impacts of consumers of gasoline and other refined products.

Section 3.4 provides economic framework for this analysis of refined products pricing.

Section 3.5 uses example cases to illustrate potential pricing dynamics.

Section 3.6 describes historical experience and pricing dynamics in US regional markets.

Section 3.7 considers the impacts of DAPL on refined product pricing and concludes that DAPL is unlikely to significant impacts.

Section 3.8 provides sources relied upon in this analysis; individual sources are often relevant to multiple points in the analysis below.

3.2 DAPL and Hanse Claims About Impacts on Refiners and Consumers of Gasoline and other Refined Products

As discussed in Declaration ¶77-78, the DAPL Brief and Hanse Declaration repeatedly, emphatically and unambiguously claim that a DAPL shutdown will also have severe disruptive consequences for refiners and consumers of gasoline and other refined products. In particular, DAPL and Hanse claim that:

- DAPL will result in large benefits to refiners,
- these large benefits to refiners will in turn result in large benefits to consumers of gasoline and other refined products.
- these large benefits to refiners and consumers would be lost if DAPL shutdown, with impacts to consumers that would be highly disruptive, devastating, and catastrophic.

The alarmist claims of DAPL and Hanse regarding refined product markets and pricing are unsupported assertions inconsistent with market fundamentals and historical

experience. These claims are contradicted by the extensive market analysis provided by a wide variety of sources, including refiners and other energy suppliers, as well as governments (US, Canada, and various states and provinces). Likewise, these claims are contradicted by historical experience, notably in regard to US Midwest refined product pricing.

A DAPL shutdown would not be highly disruptive for consumers of gasoline and other refined products. And a shutdown would certainly not have devastating and catastrophic impacts for consumers.

As discussed in ¶Declaration ¶19-41, to date and at least for the short-term, DAPL may operate far below full capacity and have only a muted impact on energy markets. Hence, it is unclear to what DAPL is actually providing benefits to refiners. But it is possible and perhaps even likely that benefits to refiners will increase over time if the pipeline continues to operate.

Hence, it is relevant to consider to what extent benefits to refiners will result in benefits to consumer of refined products. Put more simply, if refiners get cheaper crude as a result of DAPL, will consumers get cheaper gasoline?

The short answer is no. Refiners will use access to lower cost crudes in order to be more profitable, rather than to pass these savings on to consumers. To the extent that DAPL does provide some benefit to refiners in terms of lower cost crude supply, the result will be higher profits for refineries, but little or no impact on the prices at the pump for consumers.

My analysis and conclusions regarding DAPL and refined product pricing are based on, and consistent with, extensive market analysis and historical experience. This market analysis and historical experience is briefly summarized below and further discussed in the Sections 3.4 to 3.7.

Pricing of refined products for specific refineries typically reflects regional/global market factors (and particularly global crude prices), rather than the crude prices paid by the specific refineries making the products. Especially in coastal locations (notably the US Gulf Coast), refiners have access to profitable global export markets and can sell their products at prices reflecting global crude prices as opposed to North American crude prices.

But even in inland locations, including the US Midwest, refined product prices are typically connected to global markets. The US Midwest is mostly supplied by regional refineries, but also relies upon supply from refineries on the US Gulf Coast. Hence,

refined product prices in the US Midwest are typically based on US Gulf Coast prices, plus a mark-up for the cost of shipping from US Gulf Coast, even for the refined products produced and consumed within the US Midwest.

In recent years, refineries in the Midwest have had access to crude supply from the Bakken and Canadian tar sands, which has sometimes been substantially discounted relative to global crudes. The result has been very high profits for refineries, but little or no impact on the prices at the pump for consumers. Likewise, to the extent that DAPL provides some benefit to refiners in terms of lower cost crude supply, the result will be higher profits for refineries, but little or no impact on the prices at the pump for consumers.

3.3 Impacts on Crude Producers and Refiners

DAPL could have benefits in terms of enabling crude transport that was lower cost (and/or otherwise more commercially beneficial) for crude producers and refiners. As a result, the price (in North Dakota) for Bakken crude might be higher; this would benefit producers, but not refiners. Alternatively, the delivered cost (at the refinery) for Bakken crude might be lower; this would benefit refiners, but not producers. Or the result could be somewhere in between, with crude producers and refiners each getting a part of overall benfits. The distribution of potential benefits between crude producers and refiners will be determined by various market dynamics and competitive factors, including whether shipping is undertaken (contracted for) by crude producers, refiners, or intermediaries.

Put more simply and in less technical terms, it is uncertain in advance how the pie of any potential benefits will get sliced up between crude producers and refiners, and those shares could shift over time.[5] But also put more simply and in less technical terms, crude producers and refiners do not both get the same slice.[6]

[5] Distribution of potential benefits can be affected by the complex ownership structures in the energy industry. Some companies are both crude producers and refiners, notably large integrated oil companies such as ExxonMobil and Suncor (a committed shipper on DAPL). Many energy projects (including DAPL) have multiple owners.

[6] So to the extent that DAPL results in higher netbacks for crude producers, this will in turn reduce the benefits to refiners. The netback price of a barrel of crude oil is calculated by taking the revenue that producers receive for that oil and subtracting all the costs associated with getting that crude oil to a market. All else being equal, if producers receive higher netbacks, refiners will be paying more for their crude supply.

The DAPL Brief and Hanse Declaration also claim that a DAPL shutdown will also have severe disruptive consequences for Bakken crude producers.

The impacts of a DAPL shutdown would be far more limited and muted than claimed by DAPL and Hanse. Nonetheless, compared with a scenario where DAPL is operating (available as a crude transport alternative), a scenario where DAPL is shutdown (unavailable) could have some adverse impacts on Bakken crude production and on Bakken crude producers. The linkages and dynamics could play out in various ways; however, a simple (and realistic) modeling is that:

- a DAPL shutdown will result in lower Bakken crude prices (compared with DAPL available), and in turn;
- lower Bakken crude prices will result in lower profitability for Bakken crude production (compared with DAPL available and higher crude prices); and in turn
- lower profitability will result in lower crude production (compared with DAPL available, higher crude prices, and higher profitability).

Hence, potential impacts of a DAPL shutdown on Bakken crude production/producers are a function of impacts on crude prices: how much lower crude prices will be with DAPL shutdown. In turn, impacts of Bakken crude production will be a function of how crude prices affect production.

Severe disruptive consequences from a DAPL shutdown are even less likely given current and expected levels of Bakken crude production.

Production is now somewhat lower than the peak and is expected to remain around this level for the short-term. Put simply, current conditions in the Bakken are neither a boom nor a bust.

Over the last several years, there has been what economists refer to as a natural experiment regarding the viability of crude production from new and existing wells under a wide range of circumstances. To some extent, Bakken crude production is price-sensitive and responsive to the level of crude prices. But it is important to understand that this price sensitivity is limited and mainly relates to new, rather than existing production.

As is generally true for shale production, wells in the Bakken typically have much higher production initially, which then declines rapidly over the following several years. Hence,

to maintain and especially to increase overall production levels, new wells must be drilled to add new production to offset the decline in production from existing wells.

The Bakken boom coincided with period of ongoing high crude prices.[7] Crude prices in North Dakota were typically over $80/barrel and somewhat higher in destination markets. A large number of new wells were drilled and completed, enabling a very large and rapid increase in crude production.

Since 2014, crude prices have been much lower, and Bakken production has shifted from a period of rapid growth to a plateau period. Crude prices in North Dakota have been below $40/barrel and sometimes (notably in early 2016) below $20/barrel, with prices somewhat higher in destination markets.

In response to lower crude prices, and with a lag, drilling of new wells declined, and overall production levels eventually began to fall. Since early 2016, prices have rebounded somewhat, and drilling of new wells has increased. And Bakken crude producers have continue to innovate and lower their cost of production from new and existing wells. As a result, after a period of decline, Bakken production has leveled off and begun to increase.

There has been no evidence of large-scale curtailment (shutting in) of existing production, due to either a physical inability to transport crude or to continued crude production ceasing to be economically viable.

3.4 Economic Framework for Refined Products Pricing Analysis

This analysis of pricing for refined products focuses on wholesale prices. The retail prices paid by consumers include wholesale prices, plus retail margins and taxes. DAPL could conceivably affect wholesale prices for refined products, but it is unlikely to have any significant impact on retail margins or taxes.

In general, wholesale prices for gasoline and diesel (and other refined products) are not a function of crude prices for the specific refineries supplying a specific market. Rather, pricing for refined products tends to follow crude prices in broad international markets. This linkage to pricing in international markets reflects that there is typically substantial

[7] Crude prices in North Dakota were typically over $80/barrel and somewhat higher in destination markets.

physical ability to trade products over broad areas (via pipeline and sometimes water in continental markets and by water in overseas markets). Moreover, the cost of moving products between markets is typically not that high. Owing to these linkages between markets (both between crude and refined markets, and between markets in various states/regions/countries), wholesale prices for refined products of similar quality do not vary that much between most markets within the US and throughout the world.

An important corollary of the relationships described in the previous paragraph is that it is refiners, rather than end-use consumers, that typically benefit from projects like DAPL that might provide access to lower cost crude.

3.5 Potential Pricing Dynamics

To illustrate potential pricing dynamics, consider the following example cases:

Case 1: Assume refineries A and B typically each supply half of demand in Market 1, and Refineries C and D typically each supply half of demand in Market 2. There is normally no trade between Market 1 and 2, but trade is possible with a transport cost of 10¢/gallon. Also assume that initially all refineries have identical costs for crude and other cost components. Hence, the price of refined products will be the same in Markets 1 and 2, and all refineries will be equally profitable (and this profit is just a normal economic profit required to compensate investors for providing financing and taking on risk).

Case 2: Same as Case 1, except Refinery A is able to obtain crude at 5¢/gallon less than the other refineries. In Case 2, refined product prices will not change from Case 1, since product prices have to remain high enough to enable Refinery B to provide supply for half of demand in market 1. Hence the benefit of Refinery A having access to cheaper crude goes to the refinery in the form of increased profits. Consumers do not benefit.

Case 3: Same as Case 1, but assume Refinery B can now only supply 40% of demand in Market 1, and Refinery A cannot increase production. But Refinery C and/or D can increase output to send product to Market 1, and their cost of production/gallon will be the same as for the baseline production needed to supply Market 2.

The result will be that demand in Market 1 is supplied as follows: 50% from Refinery A, 40% from Refinery B, and 10% imports from Market 2. The price of refined products in Market 1 will be 10¢/gallon higher than in Market 2, to enable imports from Market 2. Refineries C and D will be indifferent to supplying Market 1 or Market 2, since the

revenue per gallon net of transport costs will be the same. Refinery A will have higher profits than in Case 1, since it will have revenue 10¢/gallon higher, but the same costs of production. Refinery B will also have higher margins than in Case 1, but it will also have lower volume.

Case 4: Combines Case 2 and Case 3. So it is the same as Case 3, except Refinery A is able to obtain crude at 5¢/gallon less than the other refineries. Refinery A is now doubly advantaged. It is getting crude 5¢/gallon cheaper than the other refineries, but it is able to sell its refined products at 10¢/gallon more than the refineries selling into Market 2. So Refinery A has margins 5¢/gallon higher than Refinery B, and 15¢/gallon higher than Refineries C and D.

Case 5: Same as Case 4, except Refinery B is now also able to obtain crude at the same price as Refinery A, which is 5¢/gallon less than Refineries C and D. As was true when Refinery A got access to lower cost crude in Case 2, refined product prices will not change. Product prices in Market 1 do not drop, since they have to remain high enough to enable imports from Market 2 to supply 10% of demand in Market 1. Hence the benefits of Refinery A and B having access to cheaper crude goes to the refinery in the form of increased profits. Consumers do not benefit.

Case 6: Same as Case 5, except Refinery C is now also able to obtain crude at same price as Refinery A and B, which is 5¢/gallon less than Refinery D. Once again, product prices don't change and the benefit of lower crude prices goes to the refinery. Refinery C now has higher margins than Refinery D, so it is a lower cost producer and more likely to be the source of the shipments to Market 1.

Case 7, Same as Case 6, except Refinery D is now able to obtain crude at the same price as Refineries A, B, and C, which is 5¢/gallon less than Refinery D previously paid (in Cases 1-6). Now, product prices drop by 5¢/gallon, in both Markets 1 and 2. The benefits of lower crude prices now flow to consumers, since these lower crude prices are now available across the board to all refiners. But product prices in Market 1 remain 10¢/gallon higher than in Market 2, because Market 1 is still getting 10% of its supply from Market 2.

Case 8: Same as Case 7, but a new export Market 3 can now be accessed by refineries in Market 2. The refineries in Market 3 have access to the same low cost crude as all the other refineries, but they have much higher operating costs owing to much stricter environmental regulations than in Markets 1 and 2. So it can now be profitable for Refineries in Market 2 to export to Market 3, even given shipping costs. As a result, product prices in Markets 1 and 2 will have to rise so that Refineries in Market 2 are indifferent to supplying Markets 1, 2, and 3.

Case 8 helps to illustrate that prices for refined products typically follow crude prices in broad international markets, because there is typically substantial ability to trade products over broad areas and thus linkages between markets. If domestic refineries can access profitable export markets, pricing for refined products in domestic markets will be linked to pricing in export markets based on international crude prices. Likewise, if a domestic market is reliant on imports, refined product pricing must be high enough to enable imports (so equal to pricing in source markets, plus transport costs to destination markets).

3.6 Pricing Dynamics in US Regional Markets

There are real world examples over the last few years for all of the above example cases. Crude prices have bounced around, both for specific refineries and in broad national and international markets. Hence, there have been situations where some refineries were very profitable, because they had access to cheaper crude than other refineries and/or were selling into markets where product prices were high because these markets were also reliant on imports from markets with higher crude costs.

But it is only since mid-2014, when crude prices began to fall basically everywhere (nationally and internationally), that refined product prices have also come way down. So lower crude prices since mid-2014 have definitely benefitted consumers. But the shifts toward lower crude and refined product pricing have also had some benefits for refineries, by increasing demand for refined products and also by lowering inventory costs.

Refineries on the US Gulf Coast have good access to ports and are huge exporters to markets in Latin America, Europe, and elsewhere. The US East Coast also has good access to ports and is supplied with refined products from a mix of local refineries, shipments from the US Gulf Coast, and imports from foreign refineries (in both Atlantic Canada and Europe). Markets for refined products throughout the Atlantic Basin have strong linkages.

The US Midwest is inland, so its refined product markets have less direct linkages with overseas markets. But the US Midwest is supplied with refined products from a mix of local refineries and shipments from the US Gulf Coast via pipeline. Thus, markets for refined products in the US Midwest have strong linkages with US Gulf Coast markets, which have strong linkages with global markets. Hence, the real world situation in US Midwest tends to resemble Case 5 or Case 7, such that refined product prices are based on prices on the US Gulf Coast, plus a premium for shipping costs into the US Midwest.

But for various reasons, markets on the US West Coast (and especially California) are not as strongly linked to continental and global markets, as is the case for refined product markets elsewhere in the US.

Markets for refined products on the US West Coast (and especially California) differ from markets elsewhere in the US in part due to geography. In the US east of the Rockies, there is a sizable pipeline network facilitating distribution of refined products over wide areas, as well as some ability to move products on both inland and coastal waterways. But there is very little pipeline connectivity between the US West Coast and markets in the rest of the US, reflecting both the long distances and rugged terrain in the West (such that pipelines would be difficult and expensive to build and operate). And on the West Coast, there is only limited and very localized ability to move product on inland waterways (notably on the Columbia within Washington).

The US West Coast does have good access to coastal ports, and this is important for moving refined products within the West Coast (such as from Washington to California). But in terms of marine transport, the US West Coast is remote from the US Gulf Coast (and East Coast), requiring either transit via Panama (through the Canal or parallel pipeline) or around Cape Horn (southern tip of South America). So refined product markets on the US West Coast have limited linkage to markets in the rest of the US.

Moreover, shipping distances (and thus shipping times and costs) for overseas Pacific markets are higher than in the Atlantic Basin. Asian markets are further away from the US West Coast, than are Latin American and European markets from the US Gulf and East Coast. And the US West Coast is even further away from most other overseas markets. Hence, refined product markets on the US West Coast have limited linkage to overseas markets.

Another important issue relates to differing requirements for fuel formulations. Some jurisdictions (and especially California) require gasoline and other fuels to meet more stringent requirements, typically to reduce air emissions.

Higher standard fuels are typically more expensive to produce than lower standard fuels, and requirements for fuel formulations can and do affect both production costs and wholesale prices. Put simply, pricing is higher for fuels that are harder and more expensive to produce, such as the gasoline required in California.

Differing requirements for fuel formulations can also affect markets and pricing due to market fragmentation. With the fuels market subdivided into a variety of boutique formulations, variability in supply and demand (such as due to refinery outages and demand spikes) becomes more difficult and expensive to manage. That said, higher

standard fuels can have very important environmental benefits. And the supply systems and markets for refined products are highly developed and responsive in the US, such that industry is typically able to supply whatever is required in terms of fuel formulations.

3.7 DAPL Impacts on Refined Product Pricing

DAPL is a sizable project (with a capacity of 520k barrels per day), but it is currently utilized at a much lower level. DAPL delivers crude to the Patoka, Illinois storage hub, where it interconnects with various pipelines, including Energy Transfer Crude Oil Pipeline ("ETCO") to US Gulf Coast (Nederland, Texas).[8] Crude from DAPL can supply refineries in PADD 2 (US Midwest, and specifically the more easterly portions), PADD 3 (US Gulf Coast, and specifically Texas and Louisiana), as well as Eastern Canada (Ontario and Quebec).[9] These destination refinery markets are very large, both in comparison with other US and Canadian regional markets, and in comparison with regional and national markets outside North America.

In the context of these very large regional refinery destination markets, DAPL (even if operating at full capacity) can provide only a very small portion of overall crude supply. DAPL is simply not large enough to broadly affect pricing for refined products in the relevant US (and Canadian) regional destination markets. And DAPL is not such a big project that it would likely have any measurable impact on global markets.

DAPL may provide some benefits to specific refineries in terms of lower cost crude supply. But to the extent that DAPL does provide some benefit to refiners in terms of lower cost crude supply, the result will be higher profits for refineries, but little or no impact on refined product pricing.

3.8 Sources

3.8.1 Suncor and Valero

The tariffs for DAPL specifically refer to delivery of crude to Suncor and Valero refineries in Ontario and Quebec.

[8] DAPL and ETCO are related project with shared ownership and operations. There are discounts for shippers that jointly utilize DAPL and the ETCO.
https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14559293
https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14603826
http://ir.energytransfer.com/phoenix.zhtml?c=106094&p=irol-newsArticle&ID=2278014
[9] Ibid. The tariffs for DAPL specifically refer to delivery of crude to refineries in Illinois, Indiana, Ohio, Kentucky, Ontario, and Quebec.

As explained by Suncor and Valero in disclosures to investors, refining is a global business; global market conditions impact refiners in every market because products are generally very storable, transportable, and fungible commodities; prices for refined products are tied to global markets based on Brent (the benchmark for global crude pricing); Quebec is part of the Atlantic Basin where refined products (including gasoline and diesel) are widely traded throughout the intercontinental market; Valero and Suncor are using lower cost crude supply to increase profits and shareholder value, and to return cash to shareholders. The sources below were identified via research conducted in 2014, but they continue to be relevant and representative in regard to refined product pricing.

Suncor 2012 Annual Report (especially pp. 7-8, 11, 20-21, 27-29, 39-42, 53, 65) and Q1 2013 Investor Presentation. Accessed May 16, 2013.
http://www.suncor.com/pdf/Suncor_Annual_Report_2012_en.pdf
http://www.suncor.com/pdf/Suncor_IR_Presentation_April_2013_v3.pdf

"Valero Citi Global Energy Conference Presentation," May 14, 2013. Accessed May 16, 2013.
http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MTg1NzM5fENoaWxkSUQ9LTF8VHlwZT0z&t=1

3.8.2 Other Sources

The market analysis described Section 3.8.1 (and presented to investors by Suncor and Valero) is broadly consistent with other market analysis regarding refinery economics and pricing for gasoline and other refined products (including that presented by energy suppliers and government agencies (US and Canadian federal, state, and provincial)).

US EIA, Midwest and Rocky Mountain Transportation Fuels Markets
https://www.eia.gov/analysis/transportationfuels/padd2n4/pdf/transportation_fuels.pdf

US EIA, East Coast and Gulf Coast Transportation Fuels Markets
https://www.eia.gov/analysis/transportationfuels/padd1n3/pdf/transportation_fuels_padd1n3.pdf

US EIA, West Coast Transportation Fuels Markets
http://www.eia.gov/analysis/transportationfuels/padd5/pdf/transportation_fuels.pdf
especially pp. 8-9, 35-41

US Department of State, “Draft Supplemental Environmental Impact Statement for the Keystone XL Project,” pp. 1.4-64 – 1.4-66 and Appendix C, pp. 6-13. Accessed July 17, 2013. http://keystonepipeline-xl.state.gov/documents/organization/205654.pdf

Natural Resources Canada, “Crude Oil and Petroleum Products Market,” October 8, 2013. http://www.nrcan.gc.ca/energy/crudepetroleum/4541

Natural Resources Canada, “Petroleum Products and Crude Oil Prices,” January 22, 2014. http://www.nrcan.gc.ca/energy/fuel-prices/4593

Resources Canada, “Petroleum Products and Crude Oil Prices,” January 22, 2014. http://www.nrcan.gc.ca/energy/fuel-prices/4593

Régie de l’énergie, “Rapport sur les différents mécanismes de contrôle des prix des produits pétroliers et sur la pertinence d’adopter de telles mesures au Québec,” July 2011.
http://www.regie-energie.qc.ca/documents/autres/RapportMinistre_ControlePrixProduitsPetroliers_juillet2011.pdf

http://canadianfuels.ca/userfiles/file/CPPI%20Presentation%20to%20Standing%20Committee%20June%202011%20ENG.pdf

Ervin, Michael J. “A Brief to the Standing Committee on Industry, Science and Technology,” June 22, 2011.
http://www.kentmarketingservices.com/dnn/LinkClick.aspx?fileticket=RNZladVtT54%3d&tabid=121

MJ Ervin Associates, “Canadian Retail Markets Study, A Review of Competitiveness in the Canadian Refined Petroleum Marketing Industry,” September 15, 1997.
http://www.kentmarketingservices.com/dnn/LinkClick.aspx?fileticket=1vZJ6i_fNXo%3d&tabid=107

http://www.commerce.wa.gov/Documents/EO2012WAEnergyStrategy.pdf especially p. 7

http://www.commerce.wa.gov/Documents/Petroleum-Whitepaper-7-15-2013.pdf especially p. 29;

https://fortress.wa.gov/ecy/publications/documents/1508010.pdf especially pp. 45, 276,282-4

http://www.api.org/news-policy-and-issues/fuels-and-renewable-policy/us-gasoline-requirements

http://www.api.org/~/media/Files/Policy/Fuels-and-Renewables/US-Gasoline-Requirements-Map.pdf

http://blogs.berkeley.edu/2012/10/08/what-if-anything-to-do-about-california-gasoline-price-spikes/

http://www.theenergycollective.com/severinborenstein/2211561/praise-cleaner-burning-gasoline

http://www.energy.ca.gov/almanac/petroleum_data/petroleum_watch/2016_Petroleum_Watch/2016-01_Petroleum_Watch.pdf p. 7

http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-10/TN205140_20150623T152843_California_Transportation_Fuel_Trends_in_Historical_Demand.pptx especially p. 15

http://www.cueainc.com/documents/CaliforniaFuelSetAsideProgramGordonSchrempFinal20150618.pdf especially p. 7

http://www.calepa.ca.gov/Refinery/Documents/2015/Petroleum.pdf

http://www.energy.ca.gov/reports/2002-03-11_600-02-004CR.PDF

http://www.energy.ca.gov/2006publications/CEC-600-2006-012/CEC-600-2006-012.PDF

http://www.energy.ca.gov/2006publications/CEC-600-2006-012/CEC-600-2006-012-AP.PDF

4 DAPL Risk Analysis

The DAPL Brief (based on the McCown Declaration) claims that "shipment by pipeline is undeniably safer than shipment by rail" and that "pipelines are a more reliable, safer, and more economical alternative" to rail. (DAPL Brief, p. 15)

I have co-authored multiple expert reports evaluating the worst-case spill scenarios for both pipeline and crude-by-rail.[10] The DAPL Brief/McCown claim is a simplistic analysis of the risk of pipeline versus rail, which fails to take into account the various factors that affect the respective risks, both absolutely and relatively. As will be further elaborated below, recent accidents involving crude transport by both pipelines and rail have resulted in damages in excess of US$1billion. However, potential worst-case scenarios can be even more catastrophic and escalate into the multi-billion dollar range.

4.1 Worst-Case Scenarios for Pipeline and Crude by Rail Spills

My research has examined how crude transport by both rail and pipeline can result in catastrophic spills. Recent accidents involving both large-diameter pipeline spills and crude-by-rail (CBR) spills have resulted in large-volume crude releases to water and damages exceeding US$1 billion (i.e. Enbridge's Line 6B spill in Marshall, MI (2010) and the CBR catastrophe at Lac-Mégantic, Québec (2013)).

Moreover, TGG has estimated that under bad to worst-case scenarios, the cost of a major pipeline rupture can escalate into the multi-billion dollar range (up to $2 billion for a worst-case scenario for Keystone XL in ND, up to $5 billion for a worst-case spill for Kinder Morgan's Trans Mountain Expansion Project, up to $5-$10 billion for a worst-case scenario on Enbridge's Line 9B).

Based on various sources, the US Government's Final Rule on Enhanced Tank Car Standards and Operational Controls concluded that major crude by rail accidents could result in multi-billion dollar damages from high consequence events (i.e. CBR accidents) in areas with high proximity to people, water, and economic activity.[11]

[10] See CV of Ian Goodman, Major Projects - Economic Development and Environmental Impacts of Energy Options, pp. 2-5; Publications and Major Reports, pp. 11-12; Expert Testimony and Formal Submissions, pp. 18-19. http://www.thegoodman.com/pdf/TGG20160716IanGoodmanCV.pdf

[11] DOT/PHMSA Final Rule on Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains, May 1, 2015, pp. 289-291. https://www.fra.dot.gov/Elib/Document/14508;

While the Enbridge Line 6B spill had devastating effects on wetlands and the Kalamazoo River, and the Lac-Mégantic tragedy killed 47 people and incinerated a small town, neither is near the worst-case scenario for a major pipeline rupture or a major CBR accident. A major pipeline rupture or CBR accident in a metropolitan area could do far more damage (in terms of property, infrastructure and loss of life) than either of these catastrophes.

And a major rupture of a 30" gihg pressure pipeline (such as DAPL) could result in a substantially larger spill than the Lac-Mégantic disaster (in either a metropolitan or a non-metropolitan area).

> A large pipeline under pressure such as Line 9 can spill far more than 70 tank cars. [...] In the aftermath of the [Mégantic] tragedy, pipeline safety expert Richard Kuprewicz said:
>
> "Not to scare anyone, but a rupture on a 30-inch pipeline is going to put more tonnage into an area than railcars ever can, despite that terrible tragedy this past weekend that shows what can happen when respect for hydrocarbons is not grasped." [Footnote 106 in original Kuprewicz, Richard, email, July 8, 2013.][12]

4.2 Worst-Case Scenario for Plaintiffs' Tribal Lands

The worst-case scenario of particular impact and interest to the Plaintiffs is a large spill proximate to the Missouri River and Standing Rock.

DOT/PHMSA Final Regulatory Impact Analysis on Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains, Final Rule, May 2015, pp. 95-111, 191-192, Appendix G.
http://www.regulations.gov/contentStreamer?documentId=PHMSA-2012-0082-3442&attachmentNumber=1&disposition=attachment&contentType=pdf
The Regulatory Impact Analysis (RIA) estimates for higher consequence events (i.e. major catastrophic accidents resulting in large releases of crude/ethanol and a sizable number of injuries and fatalities) are based on the Lac-Mégantic accident, together with various assumptions about potential major catastrophic accidents that could occur in the US. Like TGG, the RIA concludes that Lac-Mégantic is not a worst case for a catastrophic rail accident, since the Lac-Mégantic accident occurred in a small town in a mainly rural area (albeit in a downtown area very proximate to the rail line and accident). Compared with Lac-Mégantic, a major rail accident in an area that was more populous, congested, and/or sensitive could result in much larger damages (including fatalities). The RIA estimates that potential damages will be reduced by implementation of the Final Rule; nonetheless, it estimates that higher consequence events could still result in multi-billion dollar damages.

[12] Goodman, Ian and Brigid Rowan, "The Relative Economic Costs and Benefits of the Line 9B Reversal and Line 9 Capacity Expansion," pp. 41-42, August 8, 2013.
http://www.thegoodman.com/pdf/TGG20130808_EquiterreetaI_EnbridgeLine9B_NEBEvidence.pdf

As will be demonstrated in the proximity analysis below, compared with crude by rail, DAPL (and related crude transport) is overall substantially more proximate to the Plaintiffs' reservations. Therefore a large crude spill proximate to the Missouri River and Standing Rock is more likely to occur from DAPL than from a rail shipment.

DAPL crosses the Missouri River twice, including the very controversial crossing of Lake Oahe proximate to Standing Rock. A large-diameter high-pressure crude oil pipelines can result in large, expensive, high-impact spills. DAPL is 30" diameter with current capacity of 520 kbpd, and it might be further expanded (probably by adding more pumping) to a capacity of 570 kbpd.[13] A full-bore rupture on DAPL could result in a very large crude spill near the Missouri River and Standing Rock. And even at actual crude flows through DAPL at less than full capacity, there can be operational issues (and large spills) with both high and low flow rates.

4.3 Risks of Pipeline Spills Versus Crude by Rail Spills

As indicated above, there are various factors that affect risks (absolutely and relatively) for crude transport by pipelines and rail. These relevant factors do not consistently favor pipelines over rail as lower risk, nor do they consistently favor rail over pipelines. Instead, comparison of the risks associated with pipelines and those associated with rail is highly nuanced. A meaningful comparison must take into account various specific factors, which vary by transport mode, region, project, and site, as well as over time. These factors can affect both the probability of large accident/rupture/spill, as well as the impact.

DAPL/McCown's simplistic blanket analysis that concludes that "shipment by pipeline is undeniably safer than shipment by rail" fails to take into account these specific factors. This analysis can be misleading, particularly in the case of worst-case spill risk affecting Tribal lands in North Dakota.

Key factors with particular relevance to DAPL that affect risks for crude transport by pipelines and rail include: (1) delay in detection of accident/spill and response time; (2) landslide risk; and (3) proximity to people, water and economic activity.

[13] As discussed in Declaration ¶19-25, actual crude flows through DAPL may be less than full capacity; and in the near-term, DAPL crude flows may be only about half of capacity. To the extent that DAPL is transporting less crude, this could somewhat reduce the risk and volume of large spills. At lower flow rates, crude flows more slowly and is at lower pressure. Nonetheless, the pipeline is full of crude, and the volume that can be released from DAPL's 30" diameter pipe can be large. Spill volumes can be especially large if the release occurs at a lower elevation section of the pipeline (notably a water crossing), such that crude can drain down from adjacent (higher elevation) sections of the pipeline.

In the context of North Dakota, it is relatively straightforward to explain how the first two factors can increase the risk of pipelines relative to rail. As will be discussed in more detail below, it is more complex to analyze how the third factor, proximity to people, water and economic activity affects the risk of pipelines relative to rail.

4.3.1 Delay in detection of accident/spill and response time

A rail accident/spill (especially for worst-case events) is typically detected instantly/very promptly. Put simply, the train crew usually knows immediately if the train is involved in an accident. More generally, rail typically operates above ground, and crosses above water bodies. Rail routings are sometimes in close proximity to people, water, and economic activity. As will be discussed below, this proximity can increase risk and impacts, but it does mean that rail accidents are typically detected quickly, and this may also facilitate response.

By comparison, pipelines are typically buried below ground and water bodies. Pipeline routings are often in remote areas. Pipelines are mostly automated/unattended. This implies that leaks/ruptures can go undetected for relatively long periods and that response time can be very slow. According to pipeline safety expert Richard Kuprewicz:[14]

> Pipeline investigation history and PHMSA/NTSB investigation files are filled with pipeline ruptures that released for many hours before they were acknowledged by the control center and appropriate operation/response action taken.

Particularly in North Dakota, where DAPL is routed through quite remote areas, delay in detection of accident/spill and response time is more likely to be a risk factor for DAPL than for a crude by rail accident.

4.3.2 Landslide risk

Pipeline safety expert Richard Kuprewicz has warned that DAPL crosses high-landslide risk areas in North Dakota and that "some of these high risk areas are in close proximity to or could affect Lake Oahe." He further cautions that:[15]

> Placing pipeline in areas with high risk of landslide is unwise, as even modern steel pipe cannot survive such high abnormal loading threat

[14] Kuprewicz, Richard, Accufacts Review of the U.S. Army Corps of Engineers (USACE) Environmental Assessment (EA) for the Dakota Access Pipeline ("DAPL"), October 28, 2016, p. 5; this document is an attachment included in DAPL Ex. 1.
[15] Ibid, p. 3.

activity which usually results in pipeline rupture with high rate high volume oil spill releases. Steel tubes (pipelines) cannot bear the extreme loading forces that are associated with massive landslide movements.

It is possible that crude by rail could also be affected by a landslide. Rail lines tend to lac-meower elevation routings, which are often proximate to water bodies. So rail lines are often in valleys where they could be impacted by a landslide coming down onto the tracks and/or undermining the tracks.

But the risk for rail is substantially lessened, since the worst case/large spill would typically require a train loaded with oil to be present during the landslide (or at least soon afterwards).[16] Unlike pipelines, which are always present along the full routing and always (under normal operations and even when shut down) full of oil, rail lines only have significant oil present when occupied by a loaded oil train. In practice, even on a rail line with heavy oil train traffic, there are typically only oil trains present at a given location at a few times per day, for a limited time.

Also, the oil in trains is carried in numerous separate tank cars, notably in unit trains that are more than a mile long. A landslide might result in damage to only a limited number of cars on a train. And depending on the specifics of the event, only a portion (and possibly none) of the oil might be released from damaged cars.

By comparison, pipelines are continuous connected tubes, full of oil. There are typically valves at various locations that are designed to automatically or manually shut off flow, notably in an accident/spill scenario. Nonetheless, the nature of pipelines (and especially large diameter pipelines like DAPL) is that there is a large volume of oil present that can spill.

For rail, the oil is typically only more occasionally present, and it is contained in multiple separate tank cars. Those cars can and do breach and release in variety of circumstances, but the configuration of rail does tend to limit the potential for very large spill volumes.

Given the nature of rail, a worst-case scenario from a landslide would require a combination of circumstances that appear to be extremely unlikely. Conversely, for pipelines, especially in the Dakotas (e.g. DAPL and KXL), realistic worst case scenarios

[16] After a landslide, an accident could occur where track was damaged and remained open to traffic. As time passes after a landslide, damaged track will be recognized and withdrawn from service until repaired.

could include landslides. Hence, landslide risk in general (and particularly in North Dakota), is more of a risk for pipelines (including DAPL) than for rail.

4.3.3 Proximity to People, Water and Economic Activity

The third and perhaps the most important key risk factor for crude transport affecting the magnitude of the impact for a large spill is proximity to people, water and economic activity. A large spill from pipeline or rail transport will typically be much more damaging in an urban area with high proximity to people, water and economic activity.

In part, the high damages in an urban area reflect the limitations of both valuation and compensation for damages. Urban areas have high concentrations of economic activity (including real property), which has sizable market-based monetary values. Urban areas also have high populations, which can be an impetus for damages to be more fully recognized, valued, mitigated and compensated. Therefore, while major spills in urban areas are likely to be more damaging, the damages may be better compensated.

By comparison, damages in less urbanized areas may affect activities and resources, which are less well connected to market-based economic activities and monetary values. In TGG's evaluations of worst-case spill scenarios, we have emphasized that the narrow economic definition of costs used to evaluate damages (based primarily on market-based monetary values and insurance damages) typically excludes many environmental impacts. Such impacts can include GHGs, compromised ecosystem services, damage to plant and animal habitat, harm to plant and animal species, and broader human health impacts beyond injuries and death related to an accident. If a more comprehensive definition of costs were taken into account, the costs of worst-case spill scenarios would be even higher. Moreover, the application of a more comprehensive definition of costs would likely increase damages in rural areas (such as Tribal lands affected by a spill from DAPL). However, even using this narrow economic definition of the costs, we have shown that under bad to worst-case scenarios, the cost of a major pipeline rupture can escalate into the multi-billion dollar range, even in rural areas.

As indicated above, it is more complex to analyze how proximity to people, water and economic activity affects the risk of pipelines relative to rail. In the case of DAPL versus crude by rail, the risk is increased by the proximity of the respective rail routes or pipeline routes to (1) the Plaintiffs' reservations; and (2) people, water and economic activity outside the reservations. It is possible to analyze whether proximity to (1) the Plaintiffs' reservations; and to (2) people, water and economic activity outside the reservations is greater for DAPL versus crude by rail. As such, I have undertaken a proximity analysis as set out below.

4.4 Proximity Analysis: Is DAPL or CBR More Proximate to Plaintiffs' Reservations?

4.4.1 Proximity Analysis of DAPL to Plaintiffs' Reservations

The DAPL Brief not only claims that crude transport by DAPL is safer than rail. It also claims that, compared with rail lines, DAPL is less proximate to the Plaintiffs' reservations and the reservations of other tribes:[17]

> Not only is DAPL safer than rail, rail lines (but not DAPL) run through Plaintiffs' reservations and the reservations of other tribes.

In fact, as explained below, a careful and detailed analysis of relevant proximity demonstrates the opposite. Compared with crude by rail, DAPL (and related crude transport) is overall substantially more proximate to the Plaintiffs' reservations.[18]

For DAPL, the proximity analysis is facilitated by the fixed nature of pipelines. For the existing pipeline, routing is at locations that are specific, known, and invariant. Likewise, key attributes of pipeline design and operations are fixed (at least currently) and known. DAPL is a 30" diameter, high-pressure crude oil pipeline. Capacity is currently 520 kpbd, but could possibly be increased to 570 kbpd in the future.

DAPL crosses disputed Sioux land in the Dakotas, and under the Missouri River/Lake Oahe just half a miles north (upstream) of the Standing Rock Reservation; the DAPL routing west of (and leading to) this water crossing is proximate to the northern boundary of the Standing Rock Reservation. In turn, the DAPL Missouri River/Lake Oahe water crossing is also north (upstream) of other Plaintiffs' reservations.

In addition to the Missouri River crossing at Lake Oahe, DAPL crosses the Missouri River in northwestern North Dakota, near the Montana border (proximate to Bakken crude production and associated crude by rail loading terminals). This Missouri River crossing is just downstream of the confluence with the Yellowstone River and just upstream of Lake Sakakawea.

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[17] DAPL Brief, p. 16.

[18] I have focused my proximity analysis on Plaintiffs' reservations, since these are a known and relatively unambiguous set of locations. By comparison, there are reservations of other tribes at various locations in North Dakota, South Dakota, and throughout the United States. It would be a sizable undertaking, of uncertain relevance, to evaluate the relative proximity of DAPL and crude by rail for an ill-defined set of reservations in multiple states.

Lake Sakakawea is the third largest artificial lake in the United States. It is 178 miles long, controlled by the Garrison Dam, and upstream of Lake Oahe.

The DAPL Missouri River crossing upstream of Lake Sakakawea is a considerable distance north, west, and upstream of the Plaintiffs' reservations. Hence, in my analysis of relative proximity for DAPL and crude by rail, the DAPL Missouri River crossing upstream of Lake Sakakawea is not considered to be a significant factor affecting proximity to the Plaintiffs' reservations.

4.4.2 Proximity Analysis of Rail to Plaintiffs' Reservations

Rail differs from pipelines in fundamental ways that must be considered in a meaningful analysis. For rail, proximity analysis is complicated by a variety of factors.

By definition, a meaningful proximity analysis for rail requires careful consideration of relevant factors. These factors can (and especially for Bakken crude by rail do) vary significantly by transport mode, region, project, and site, as well as over time. Hence, a meaningful proximity analysis for rail is typically highly detailed and lengthy.

In contrast to the fixed nature of pipelines, crude by rail is non-fixed and variable. Bakken crude production occurs over a large area and is loaded onto trains at multiple terminals in various locations. There are 17 crude by rail loading terminals, with a capacity totaling about 1.5 million barrels per day.[19] Hence, crude by rail has the potential to transport three times as much crude as DAPL.

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[19] All of these terminals are located in western North Dakota, except for one in Montana (Northstar Transloading in Fairview), which is just across the border. See also footnote 22.
To avoid redundancy, this footnote provides sources used throughout the rail analysis:
https://northdakotapipelines.com/oil-transportation-table/
https://ndpipelines.files.wordpress.com/2012/04/oil-table-6-1-171.png
https://ndpipelines.files.wordpress.com/2012/05/nd-rail-facilities-feb-2015.pdf
http://www.nd.gov/ndic/pipe/publica/annual-report16.pdf
https://ndpipelines.files.wordpress.com/2012/05/nd-major-oil-pipelines-june-2017.pdf
https://www.dmr.nd.gov/oilgas/stats/countymot.pdf
http://www.bnsf.com/ship-with-bnsf/industrial-products/crude-and-lpg/interactive-map/pdfs/BNSF-OG-Overview-Map.pdf
http://www.bnsf.com/ship-with-bnsf/industrial-products/crude-and-lpg/interactive-map/pdfs/BNSF-OG-Wiliston-Map.pdf
https://www.bnsf.com/ship-with-bnsf/maps-and-shipping-locations/pdf/subdivisions-map.pdf
http://www.transportation.northwestern.edu/docs/2014/2014.06.11_BNSF%20P%20Moynihan.pdf
http://www.capjournal.com/news/bnsf-railway-running-record-number-of-large-grain-trains-as/article_c0ed02a0-5deb-11e6-85db-677a544c2c3c.html
http://www.cpr.ca/en/our-markets-site/Documents/bakken.pdf
https://www.eia.gov/dnav/pet/PET_MOVE_RAILNA_A_EPC0_RAIL_MBBL_M.htm

Put another way, crude by rail could potentially be used to transport the entirety of Bakken crude production (at current or even the highest levels historically). But in practice, crude by rail terminals typically operate below maximum capacity and often far below. Use of crude by rail, and associated rail traffic, can be highly variable over time, both short-term and longer term.

Crude by rail does require some infrastructure in terms of loading and unloading terminals, tank cars, and rail system (locomotives, crews, tracks, and other network capacity). Large scale crude by rail, especially for Bakken crude, typically involves unit trains, which transport only one type of car and cargo. Crude oil unit trains typically include several locomotives with up to and exceeding 100 tank cars; a single loaded train can transport around 65,000 barrels of Bakken crude.[20] Unit trains are loaded, proceed directly to the destination, are unloaded, and then return empty. So crude by rail traffic typically involves a similar number of loaded and unloaded unit trains, moving in opposite directions.

Near term and quite possibly longer term, there is generally adequate or even far more than adequate capacity in place to support current or even substantially expanded use of crude by rail. There was a very rapid expansion growth in crude by rail by shipments from 2010 through 2014, together with a large build-out of infrastructure, especially for Bakken crude, but also in destination markets and some other production areas. Since then, crude by rail shipments have plateaued and then declined, especially for Bakken crude, but elsewhere as well.

Hence, there is now very substantial surplus capacity for crude by rail, including loading and unloading terminals with very low utilization rates (or mothballed) and tank cars available for lease at low rates and/or being stored (but could be returned to service if there was market demand). Likewise, in part due to the decline in coal shipments (which had been a very large portion of overall rail traffic), railroads typically have more than adequate capacity.

Use of crude by rail, and associated rail traffic, can also be highly variable in terms of routings, both short-term and longer term. Unlike pipelines, which have fixed routings, crude by rail uses the existing rail network, which provides connectivity to destination markets throughout North America. Crude by rail can be used to supply markets that are not pipeline-accessible, notably refineries in coastal locations that had traditionally received waterborne crude supply.

[20] Trains that are longer and otherwise higher capacity can have loadings of up to 75,000 barrels (and possibly somewhat higher).

More generally, rail can provide flexibility to connect multiple crude sources to multiple destinations and adjust shipments based on evolving pricing and other factors. Rail can enable sending crude to whatever markets are most profitable. Crude by rail is also a relatively high-speed transport mode; crude gets delivered faster than on pipelines, which also facilitates responsiveness to evolving conditions.

Compared with pipelines, crude by rail often has a higher total cost per barrel. But rail costs have declined due to slack market conditions. And rail also has various advantages that crude shippers (and producers) value. As a result, rail can be widely used even when there is pipeline capacity available. Moreover, especially in the short-term, shippers typically base their transport decisions, on incremental costs, rather than total cost.

Shippers often make prior commitments to various transport modes, including contracts with carriers (including both pipelines and rail), but also by buying/leasing infrastructure (once again including both pipelines and rail). As a result, a considerable portion of total costs may be fixed, unavoidable, and not incremental. Hence, even if a given transport alternative would no longer be favored based on total costs (notably for a de novo decision), it may continue to be used because it is competitive on an incremental cost basis.

The factors described above complicate proximity analysis for rail, but it is nonetheless feasible to assess relative proximity for DAPL and crude by rail.

4.4.3 Location of Loading Terminals

As noted above, there are 17 rail terminals that can load Bakken crude, spread over a large area. But these terminals are clustered.[21]

The largest cluster (with almost 900 kbpd (thousand barrels per day) of loading capacity) is north of the Missouri River along the BNSF mainline (Glasgow Subdivision,

[21] See following sources for description of Bakken crude by rail terminals and maps showing these terminals and rail lines:
https://ndpipelines.files.wordpress.com/2012/04/oil-table-6-1-171.png
https://ndpipelines.files.wordpress.com/2012/05/nd-rail-facilities-feb-2015.pdf
http://www.bnsf.com/ship-with-bnsf/industrial-products/crude-and-lpg/interactive-map/pdfs/BNSF-OG-Overview-Map.pdf
http://www.bnsf.com/ship-with-bnsf/industrial-products/crude-and-lpg/interactive-map/pdfs/BNSF-OG-Wiliston-Map.pdf
http://www.cpr.ca/en/our-markets-site/Documents/bakken.pdf

between Minot and Montana, paralleling US 2).[22] In addition to these terminals, there are loading terminals served by CP (with over 200 kbpd of capacity), via branchlines connecting with the CP mainline (between Twin Cites and Regina, via Hankinson, Minot, and Portal, North Dakota). Two of these terminals are north of the Missouri River but south of the terminals along the BNSF mainline, and another is further north in Stampede, very close to the Canadian (Saskatchewan) border.

There is another sizable cluster of loading terminals (with over 300 kbpd of capacity) south of the Missouri River, along the BNSF mainline (Dickinson Subdivision, between Bismarck and Montana, paralleling I-94). And there is a single terminal in southwestern North Dakota (Gascoyne), along the BNSF mainline (Mobridge and Hettinger Subdivisions, between Mobridge, South Dakota and Montana).

4.5 Destination Markets and Rail Routings

As noted above, destinations and routings are variable for crude by rail. But given the location of the loading terminals and the configuration of the rail network in and near North Dakota, it is feasible to assess the proximity of crude by rail trains and the Plaintiffs' reservations.

4.5.1 Destination Markets

Currently and in the foreseeable future, Bakken crude by rail has two main destination markets:

- West Coast, notably unloading and transloading[23] terminals at and near refineries in Washington State; and
- East Coast, notably unloading and transloading terminals at and near refineries in New Jersey, Pennsylvania, and Delaware.

During the early years of the Bakken and crude by rail booms, significant volumes of Bakken crude also went to markets further south, notably along the US Gulf Coast. Some crude still goes south by rail, but these volumes are now relatively small. Crude by rail to these southern markets has become less competitive, owing to a variety of market shifts, including increased shale production in and near Texas, as well as increased pipeline capacity (even without DAPL).

[22] Two of the loading terminals are located just south of the Missouri River (in Dore, North Dakota and Fairview, Montana), on a rail line that crosses the river (near the DAPL crossing upstream of Lake Sakakawea) and connects with the BNSF mainline (paralleling US 2).
[23] Transloading terminals transfer cargo from one transport mode to another; specifically in this instance, crude is transferred from rail to marine transport.

So put simply, crude by rail from Bakken terminal is mainly going to destinations west of Bakken (Washington state) or east of Bakken (Mid-Atlantic, typically via Twin Cities and Chicago). Some crude by rail does go further south. But given the configuration the rail network, this crude likely first moves east along routings similar to East Coast destinations.

4.5.2 Rail Routings

Crude by rail to the West Coast is most likely to be sourced from Bakken loading terminals further north and west, and thus more proximate to the West Coast. This crude by rail traffic is a considerable distance from and otherwise not proximate to the Plaintiffs' reservations. Some of it is routed via CP north into Canada and is thus even less proximate to the Plaintiffs' reservations.

Crude by rail terminals north of the Missouri (and especially those further east and closer to Minot) may send crude east along the rail lines towards Twin Cities and Chicago. This rail traffic is also not highly proximate to the Plaintiffs' reservations.

The crude by rail loading terminals and the rail traffic on the BNSF mainline (south of the Missouri, paralleling I-94) are potentially somewhat more proximate to Plaintiffs' reservations. But crude from these terminals moving to the West Coast would have little proximity, since the crude is moving from loading terminals (which are not very proximate) to the west and thus even further away from Plaintiffs' reservations. This routing is also not proximate to the Missouri River.[24]

There is somewhat greater proximity if crude from the loading terminals south of the Missouri is moving east, toward Plaintiffs' reservations and crossing the Missouri at Bismarck. Nonetheless, compared with DAPL and the Missouri River crossing at Lake Oahe, this crude by rail has relatively low proximity. Moreover, the volumes of crude

[24] Unlike the other loading terminals south of the Missouri, which are around Dickinson and Fryburg (directly along BNSF mainline paralleling I-94), the loading terminal in Beulah/Zap, North Dakota is further to the east and north. It is connected to the BNSF mainline via the Zap Subdivision, which is parallel and proximate to the Missouri River between Stanton and Mandan. Hence, compared with other Bakken crude by rail facilities, crude by rail traffic related to this facility could have more significant proximity to the Missouri River. On the other hand, reports indicate that trains from this facility supply West Coast markets; thus, this traffic would move west from Mandan, instead of east crossing the Missouri River to Bismarck. In any event, the proximity of this rail traffic to the Missouri River is considerably north of the Plaintiffs' reservations. So it has overall proximity to Plaintiffs' reservations that is relatively lower than DAPL. Moreover, this loading facility has a capacity of 80 kbpd, with actual utilization that may be far below that.
http://www.railwayage.com/index.php/news/basin-transload-bnsf-to-connect-with-tesoro-oil-facility-via-new-pipeline.html

that might be moving on this routing to the east are likely to be quite small relative to volumes of crude associated with DAPL.

Finally, there is the one loading terminal (Enserco, in Gascoyne, North Dakota), along the BNSF rail routing (Mobridge and Hettinger Subdivisions, between Mobridge, South Dakota and Montana), which is considerably more southerly than all of the other loading terminals and rail lines discussed above. This rail routing crosses the Standing Rock Reservation.[25] So perhaps this routing constitutes the "rail lines" referred to in the DAPL Brief.[26]

> Not only is DAPL safer than rail, rail lines (but not DAPL) run through Plaintiffs' reservations and the reservations of other tribes.

Focusing first on the loading terminal in Gascoyne, this terminal is unlikely to generate substantial crude by rail traffic. The Gascoyne terminal is not proximate to sizable crude production, and the limited production in the area is unlikely to use rail transport.

The Bakken/Three Forks/Williston Basin crude resource is spread over a very large area of western North Dakota and extends into neighboring states (notably Montana but also South Dakota) and provinces (notably Saskatchewan but also Manitoba). There is at least some crude production in 16 North Dakota counties, including Bowman, where the Gascoyne loading facility is located.[27]

But Bowman County crude production is small (now less than 18 kbpd) and has been declining for many years, even as other parts of the Bakken boomed. As is common in mature production areas, crude production in this area typically has longstanding pipeline access.[28] The areas near Bowman County have little if any crude production. The Gascoyne loading facility is at considerable distance from more active crude production areas, which have more proximate access to other crude by rail loading terminals, as well as considerable pipeline access, even without DAPL.

The crude by rail loading terminal in Gascoyne has a nominal capacity of 65 kbpd, but it is likely used at a much lower level, if at all. And to the extent that there is any rail traffic generated by this loading facility, it could be supplying markets to the west and thus

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[25] The BNSF Mobridge Subdivision crosses the Standing Rock Reservation for essentially its entire distance in South Dakota west of the Missouri River, from the river crossing west of Mobridge to near Thunder Hawk, South Dakota (which is both at the western border of the Standing Rock Reservation and where the rail line crosses into North Dakota).

[26] DAPL Brief, p. 16.

[27] https://www.dmr.nd.gov/oilgas/stats/countymot.pdf

[28] https://ndpipelines.files.wordpress.com/2012/05/nd-crude-gathering-map-sep-2013-data.pdf http://www.nd.gov/ndic/pipe/publica/annual-report16.pdf p. 30

trains would go through Montana, away from the Plaintiffs' reservations. It cannot be ruled out that there are crude trains that travel east from this loading facility through Standing Rock Reservation and across the Missouri River, but this may be only occasionally.

Hence, the Gascoyne loading terminal does not appear to result in much if any actual crude by rail proximity for the Plaintiffs' reservation. This lack of proximity is notable, given that the Gascoyne terminal is located along a rail line, which considerably further to the east, passes through the Standing Rock Reservation and across the Missouri River.

Aside from the Gascoyne crude loading facility, this proximity analysis considered the possibility of crude by rail traffic from other Bakken crude loading facilities using the southerly BNSF rail routing through Mobridge. But given the location of the other loading facilities and the configuration of the rail network, it is unlikely that a significant volume of crude trains would utilize this southerly routing.

This southerly routing is far removed from any efficient rail paths between Bakken terminals and West Coast markets. And even for trains from the Bakken destined for eastern or southern destinations, a routing through Mobridge would require backtracking, heading west into Montana, then south, and finally east through Mobridge. It is conceivable that such a routing might be used, notably if other routes were blocked or severely congested. But use of this southerly rail line by Bakken crude trains does not appear to be a likely or frequent event, especially in the near term. Put another way, despite the physical proximity of this rail line to the Plaintiffs' reservations, it does not appear to have significant Bakken crude train traffic and thus does not have relevant proximity for this analysis.

4.6 Meaningful Analysis of Relevant Factors

As this analysis helps to demonstrate, meaningful risk and proximity analysis require careful consideration of relevant factors. For both pipeline and rail transport of crude, these factors can be highly specific and vary by transport mode, region, project, and site, as well as over time. This is particularly the case for Bakken crude by rail. It is notable, and frankly disappointing, that the analysis presented by DAPL does not provide the required careful consideration of relevant factors.

This is further notable because DAPL is a pipeline company operating in a context that otherwise requires very careful consideration of various relevant factors that have substantial overlap with those I have considered in my risk and proximity analysis.

For example, the DAPL Brief apparently focuses on the single rail line through Mobridge, despite its lack of relevant proximity to crude production, crude by rail loading facilities, and crude train traffic. Meanwhile, DAPL is otherwise quite aware of the relevant geographic factors relating to Bakken crude production. Bakken crude production is concentrated in just four North Dakota counties (Dunn, McKenzie, Mountrail, and Williams), which together now produce over 900 kbpd (around 90% of total Bakken production). And DAPL is routed to loop through these 4 counties, going west from Mountrail County to Williams, then south across the Missouri River to McKenzie, then east through Dunn, with 6 access points to feed in local production. In effect, DAPL is routed along the same locations where the crude by rail loading terminals are clustered, north and south of the Missouri River.[29]

But while DAPL is routed through the major clusters of crude production and crude by rail loading terminals, it does not go further south to tap crude production in Bowman County (where the Gascoyne loading terminal is located). This is not surprising, since there is little crude production in that area, and it already has good access to other pipelines. Given that DAPL is seemingly well aware of the geography relating to Bakken crude production, it is surprising that its Brief appears to focus on crude by rail relating to the Gascoyne loading terminal and the rail line through Mobridge, which are not major factors relating to Bakken crude production.

4.6.1 Conclusions

In light of my careful risk and proximity analysis, I conclude that DAPL (and related crude transport) is overall substantially more proximate to the Plaintiffs' reservations than crude by rail (contrary to what is claimed in the DAPL Brief).

4.7 Proximity Analysis: Is DAPL or CBR More Proximate to Concentrations of People, Water and Economic Activity (Outside the Plaintiffs' Reservations)?

For the purposes of this Declaration, I have focused on proximity in regard to the Plaintiffs' reservations. But DAPL and crude by rail certainly have significant other

[29] As indicated above, unlike the crude by rail terminals, DAPL is a not constrained to be along existing rail lines. Hence, DAPL follows a routing south of the Missouri River that is closer to the river and areas of high crude production; the crude by rail loading terminals south of the Missouri are further south along the existing BNSF rail lines in this area.

proximity, such that an accident/spill involving either DAPL or crude by rail could result in large damages.

Perhaps the most important factor affecting the magnitude of the impact for a large spill is proximity to people, water and economic activity. In other words, a large spill from pipeline or rail transport will typically be much more damaging in an urban area with high proximity to people, water and economic activity.

In the context of this Declaration, I have not undertaken analysis of the proximity of DAPL to people, water and economic activity, other than in relation to the Plaintiffs' reservations. Put another way, I have not considered the risk and impacts relating to pipeline accidents/ruptures/spills at locations along the entire routing in North Dakota, much less along the entire 1172 mile routing from North Dakota to Illinois.

Likewise, in the context of this Declaration, I have focused on the proximity of Bakken crude by rail to the Plaintiffs' reservations. This provides a consistent ("apples to apples") basis of comparison in regard to the relative risks of alternative means of crude transport (DAPL and crude by rail, in relation to Plaintiffs' reservations).

However, the claims in DAPL's Brief are not just in relation to potential impacts in relation to the Plaintiffs' reservations. DAPL's Brief more generally claims that "shipment by pipeline is undeniably safer than shipment by rail" and that "pipelines are a more reliable, safer, and more economical alternative" to rail. (DAPL Brief, p. 15)

In this context, I can provide some guidance regarding the proximity of Bakken crude by rail to people, water and economic activity, other than in relation to the Plaintiffs' reservations.[30]

Transport of Bakken crude by rail has declined very substantially from peak levels. Even prior to DAPL entering service in 2017, Bakken crude by rail had declined to about one-third of peak levels in 2014. At peak levels, there were about 12 loaded crude unit trains leaving the Bakken every day; in early 2017 (pre-DAPL), there were only about 4 trains per day.

[30] I have been able to undertake a only a limited analysis for the full routings of Bakken crude by rail. As noted above, a meaningful proximity analysis for rail is typically highly detailed and lengthy. The proximity analysis I have provided for crude by rail in relation to the Plaintiffs' reservations (summarized above and provided in the attached Technical Appendix) is by itself a major effort. A more comprehensive proximity analysis for crude by rail for the entire routings from Bakken to destination markets would be a much larger effort, which was not feasible to undertake in the context of this Declaration.

Moreover, there has been a shift in destinations for Bakken crude by rail. Overall, the combination of less trains and different routings has very substantially reduced the proximity of Bakken crude by rail to people, water and economic activity.

During the period when Bakken crude by rail was rapidly expanding, much of the crude was going to destination markets on the East Coast (US and Canada), and secondarily US Gulf Coast. These rail routings went through many urban centers, as well as smaller communities highly proximate to rail routings (such as Lac-Mégantic). Put simply, this was a bad accident waiting to happen, and bad accidents did happen, most notably at Lac-Mégantic. And as noted above, a major crude by rail accident in a metropolitan area could be even more damaging (in terms of property, infrastructure and loss of life).

Since 2014, there have been dramatic shifts affecting crude markets and transport, notably a big drop in prices affecting both crudes produced in the US (notably Bakken) and crude produced globally (some of which are imported by refineries in coastal locations). As a result, Bakken crude by rail has particularly declined to eastern and southern markets. And in turn, much less Bakken crude by rail is being transported through urban centers and other areas with high proximity to people, water and economic activity.

Around half of the Bakken crude by rail remaining (pre-DAPL) was transported to the West Coast and specifically to the Pacific Northwest (notably Washington). These crude by rail routings are both shorter and substantially less urbanized than the rail routings to eastern and southern markets.

Notably, the routings between North Dakota and the Pacific Northwest are mostly very rural, especially in Montana and Idaho. These routings do include some smaller towns, as well as water crossings and other areas that are environmentally sensitive. Within the Pacific Northwest (Washington and Oregon), the crude by rail routings include some more urbanized locations, as well as other proximity to people, water and economic activity (including the Columbia River and Puget Sound).

To conclude, I return to the question: Is DAPL or CBR More Proximate to Concentrations of People, Water and Economic Activity (Outside the Plaintiffs' Reservations)? Based on the limited analysis I have been able undertake within the context of this Declaration, I have the following conclusions.

(1) The large reduction in crude by rail shipments since 2014 has substantially reduced the overall level of proximity and risk. All else being equal, there is less risk with fewer trains. But all else is not equal. Destinations for Bakken crude have shifted, such that around half of the remaining crude by rail shipments are

to the West Coast. This shift has further reduced overall proximity, since routings to the Pacific Northwest are both shorter and less urbanized than routings to eastern and southern destinations.

(2) Nonetheless, the remaining Bakken crude by rail continues to have significant proximity to people, water and economic activity and results in significant risks for accidents and spills. A very extensive analysis would be required to estimate how the risk relating to this remaining Bakken crude by rail compares with the risk relating to DAPL. Unfortunately, reliable analysis of this type has not been conducted and provided to assist in various decisions in regard to DAPL.

(3) For the purposes of this Declaration, the more limited and relevant issue is a whether a DAPL shutdown would have significant adverse impacts in regard to risk of accidents/spills. For the Plaintiffs' reservations, the answer is clear: DAPL has much higher proximity and much greater risk than does crude by rail. For other locations, it is less clear how the risk of DAPL compares with the risk of crude by rail. But especially in terms of the risk of worst-case accidents and spills, there is no clear reason to assume that DAPL is less risky than crude by rail.

(4) The other perspective that is highly relevant for decision-making is scale of potential shifts in crude transport and associated risk. As explained above, even without (and before) DAPL becoming operational, shipments of Bakken crude by rail had dropped to only one-third of peak levels in 2014. At most, DAPL could now eliminate all of the remaining crude by rail. But as explained in Declaration ¶61-71, the impact of DAPL operating is likely to be much smaller in terms of reducing crude by rail.

With DAPL operating, crude by rail might be lower by 100-150 kpbd, compared with a scenario where DAPL is shutdown. **This potential impact is about 1.5-2.5 trains per day (10-16 trains per week).** Especially given the relatively small likely impact of DAPL operations on crude by rail, there is no clear significant demonstrated increase in overall accident and spill risk if DAPL is not operating.

Furthermore, the US energy system is very large and very dynamic. Based a variety of market conditions, crude by rail shipments can and do vary by large amounts month to month and over longer time periods. Whether DAPL is operating or not will likely have some impact, but any such impact is within the range that has occurred and will continue to occur owing to a variety of market conditions.

(5) Therefore, I conclude that there is no clear reason foreclosing a shutdown of DAPL owing to increased risk to either Plaintiffs' reservations or more generally. As concluded above, a shutdown of DAPL can reduce risks to Plaintiffs' reservations. It is unclear what effect a shutdown of DAPL will have on risk outside the Plaintiffs' reservations. But any effect is likely to be quite small, both absolutely and in relation to the overall fluctuations that happen continually in the US energy system.