Canadian Oil and Gas Export Infrastructure

CANADA'S OIL & NATURAL GAS PRODUCERS

Content Summary

Canada is both a significant consumer and supplier of energy. Substantial energy infrastructure has been developed over decades to gather, process, and ship energy to domestic and export markets.

Oil and Natural Gas Liquids Infrastructure Highlights

- There are more than 840,000 km of transmission, gathering, and distribution pipelines in Canada. The pipeline network delivers natural gas, natural gas liquids, and crude oil for domestic use and export.
- Canada has more than doubled its pipeline and rail flows out of the Western Canadian Sedimentary Basin (WCSB) to ~4.5 MMB/d (from ~2 MMB/d) since 2007 to accommodate oil sands growth, however, growth has ultimately been constrained due to limited egress capacity, including the cancellation of three major pipeline projects.
- The Trans Mountain Expansion (TMX) is nearing completion and will add ~590 MB/d of egress capacity, marking a major milestone for Canadian oil producers and providing tidewater access to new markets.

Natural Gas Infrastructure Highlights

- A large network of pipelines moves natural gas from producing regions in Western Canada to Eastern Canada and the United States, where Canada represents the largest foreign supplier.
- Starting in 2016/2017, constraints in regional gathering systems and export lines have limited growth and depressed prices, but recent capacity expansions have helped mitigate these issues. Canadian gas started to be exported from US LNG terminals in 2023. The first Canadian LNG export projects are under construction and will provide greater access to higher-priced international markets.

Western Canada Oil and Gas Export Capacity (2022)

10.9 Bcf/d

Natural Gas

4.6 MMB/d

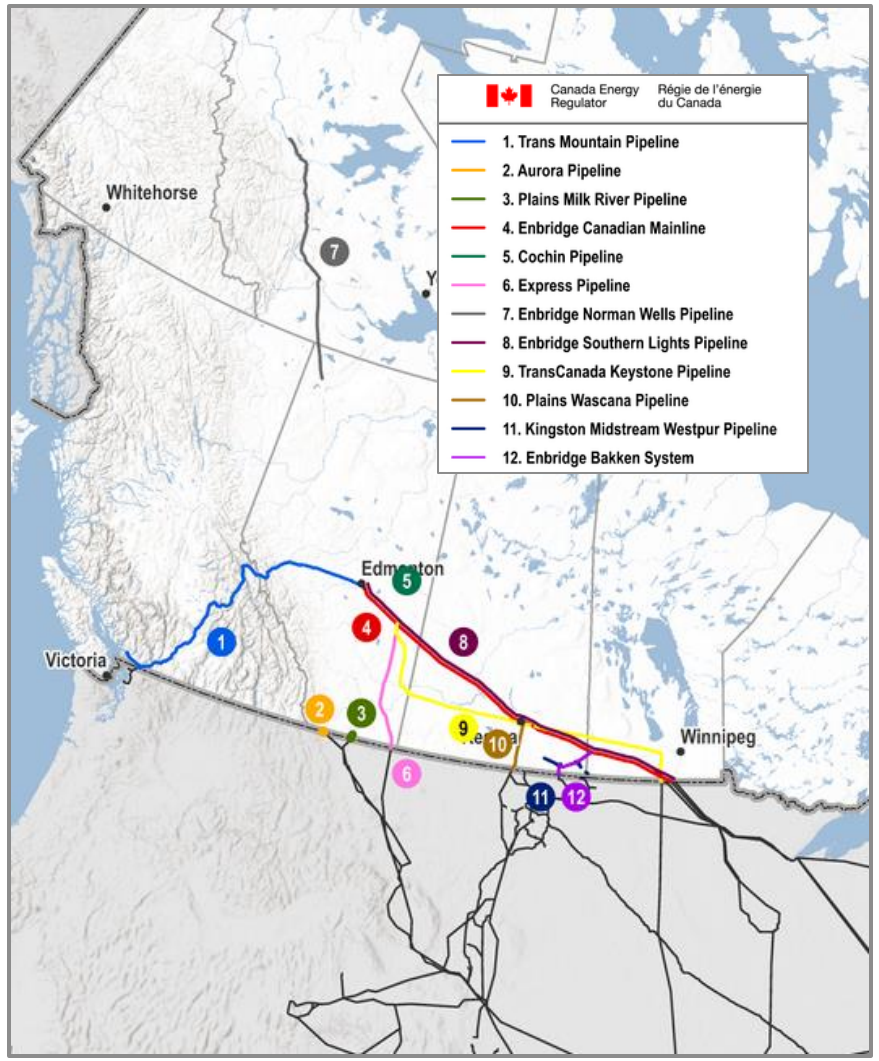
Crude Oil and NGLs

Source: Natural Resources Canada, Canada Energy Regulator
Note: Gas capacity is effective capacity considering NGTL constraints

Liquids Transportation

CANADA'S OIL & NATURAL GAS PRODUCERS

WCSB Crude Oil Export Infrastructure



- In 2022, ~4.3 MMB/d of crude oil and NGL was exported out of the WCSB via six major export pipelines, including ~3.8 MMB/d of crude oil exports to the US, the majority of the rest was consumed in Canada.
- With ~3.0 MMB/d of throughput in 2022, the Enbridge Mainline is the largest export pipeline in Western Canada, transporting crude oil and NGLs to Eastern Canada and the US.
- There are five other major export pipelines out of Western Canada that account for the remaining crude oil and NGL flows.

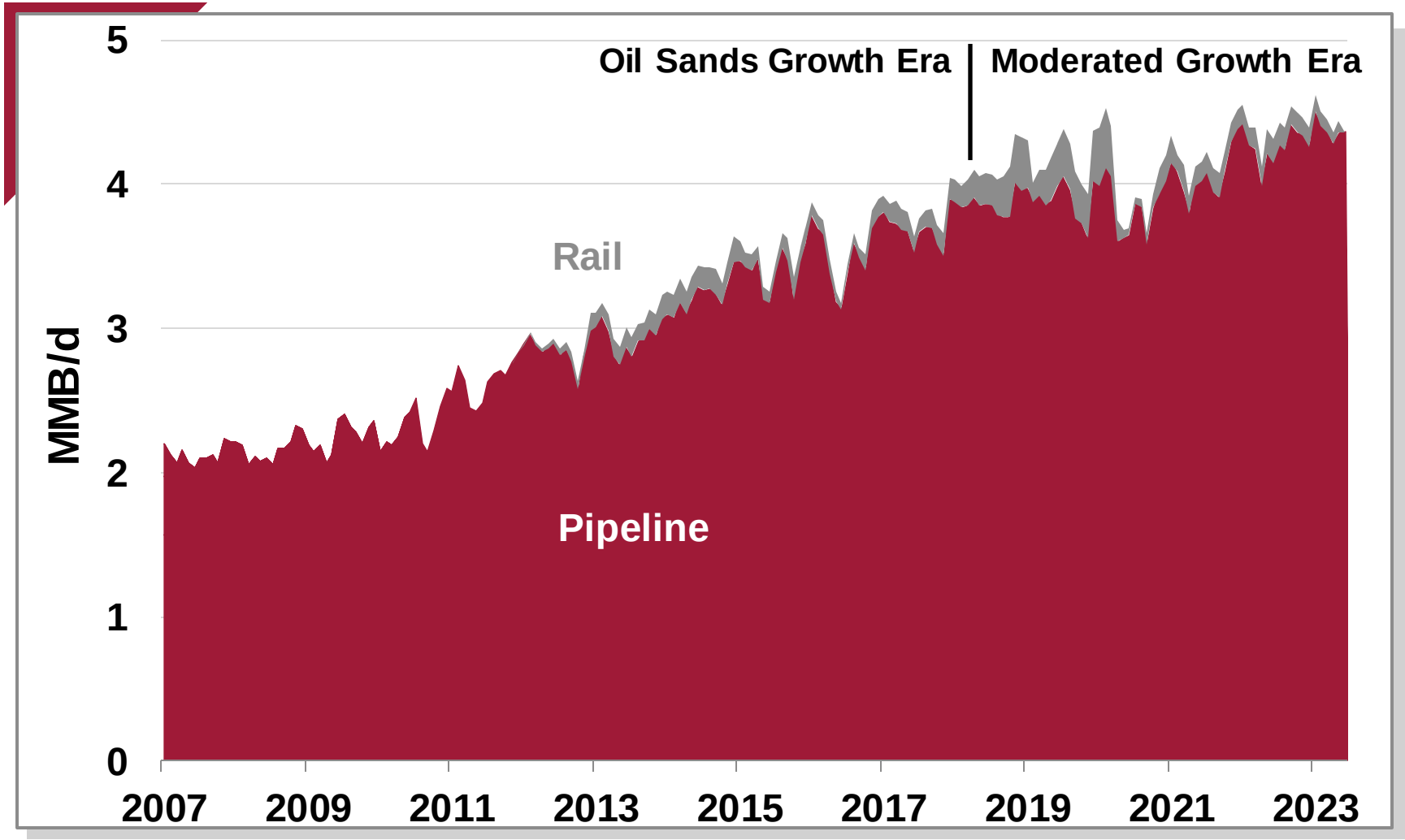
Export Pipelines			
	Pipeline	Average Annual Throughput - 2022 ('000s B/d)	Destination
4	Enbridge Mainline	2,956	US Exports, Eastern Canada
1	Trans Mountain	323	Marine Exports, BC
6	Enbridge Express*	276	US Exports
9	TC Energy Keystone	582	US Exports
2 3	Rangeland / Milk River*	127	US Exports
	Total	4,263	

*Express/Rangeland/Milk River throughput assumed equal to capacity

Note: The above list is comprised of crude oil export pipelines only

Source: Canada Energy Regulator, US Energy Information Administration

WCSB Canadian Oil Exports by Pipeline Throughput and Rail | Monthly | 2007 to Q2/2023*

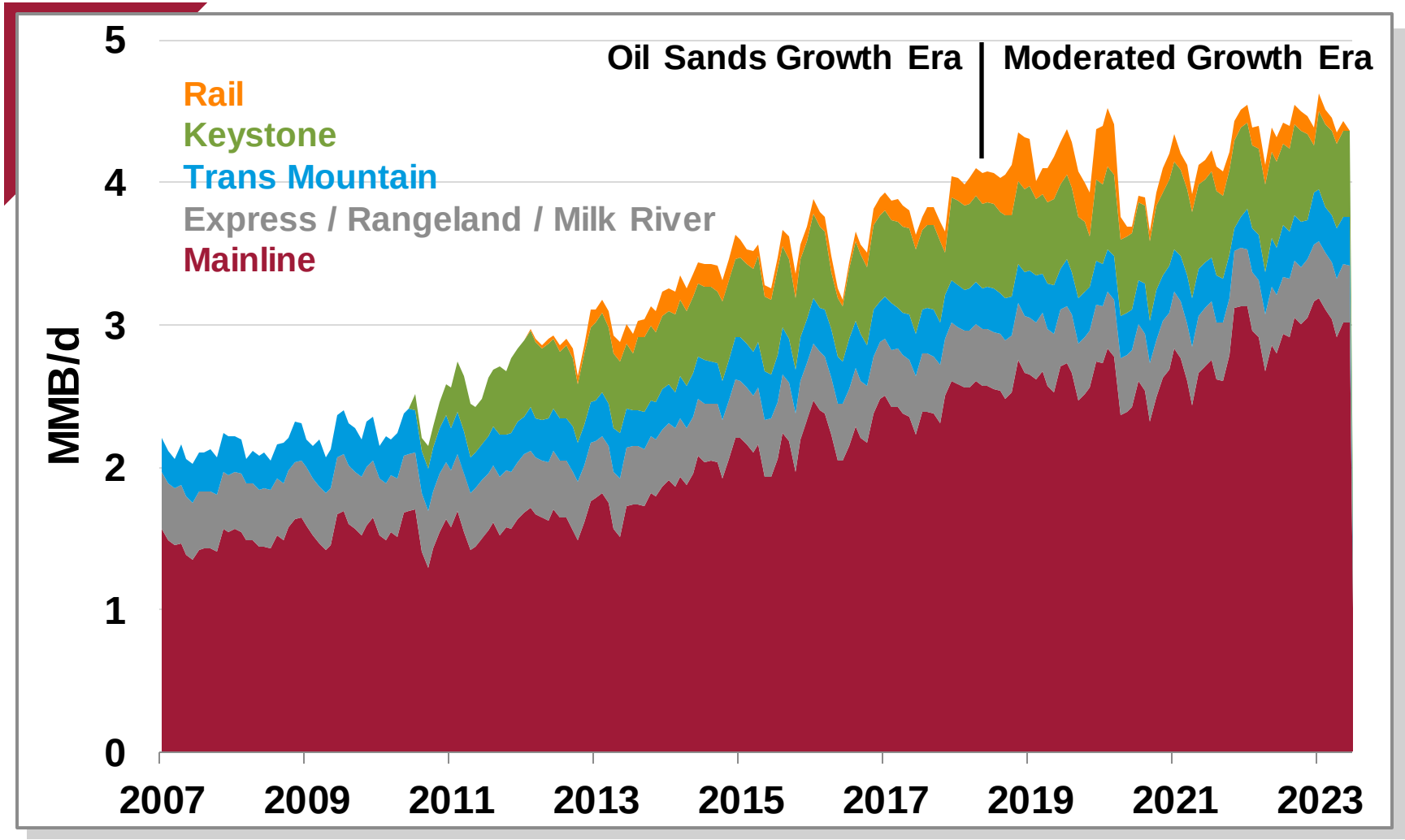


- Since 2007, Canada has more than doubled its export flows (pipeline and rail) out of the WCSB to ~4.5 MMB/d (from ~2 MMB/d) to accommodate oil sands growth.
- However, growth has ultimately been constrained due to limited egress capacity, including the cancellation of three major pipeline projects (Keystone XL, Northern Gateway, and Energy East).
- When insufficient pipeline capacity exists, oil can also be exported by rail. Even with ample takeaway, some volumes still flow on rail due to a lack of pipeline capacity, or advantaged rail economics in certain regions.

Source: Canada Energy Regulator

*2023 data is YTD average up to June 2023

WCSB Canadian Oil Exports by Pipeline Throughput and Rail | Monthly | 2007 to Q2/2023*

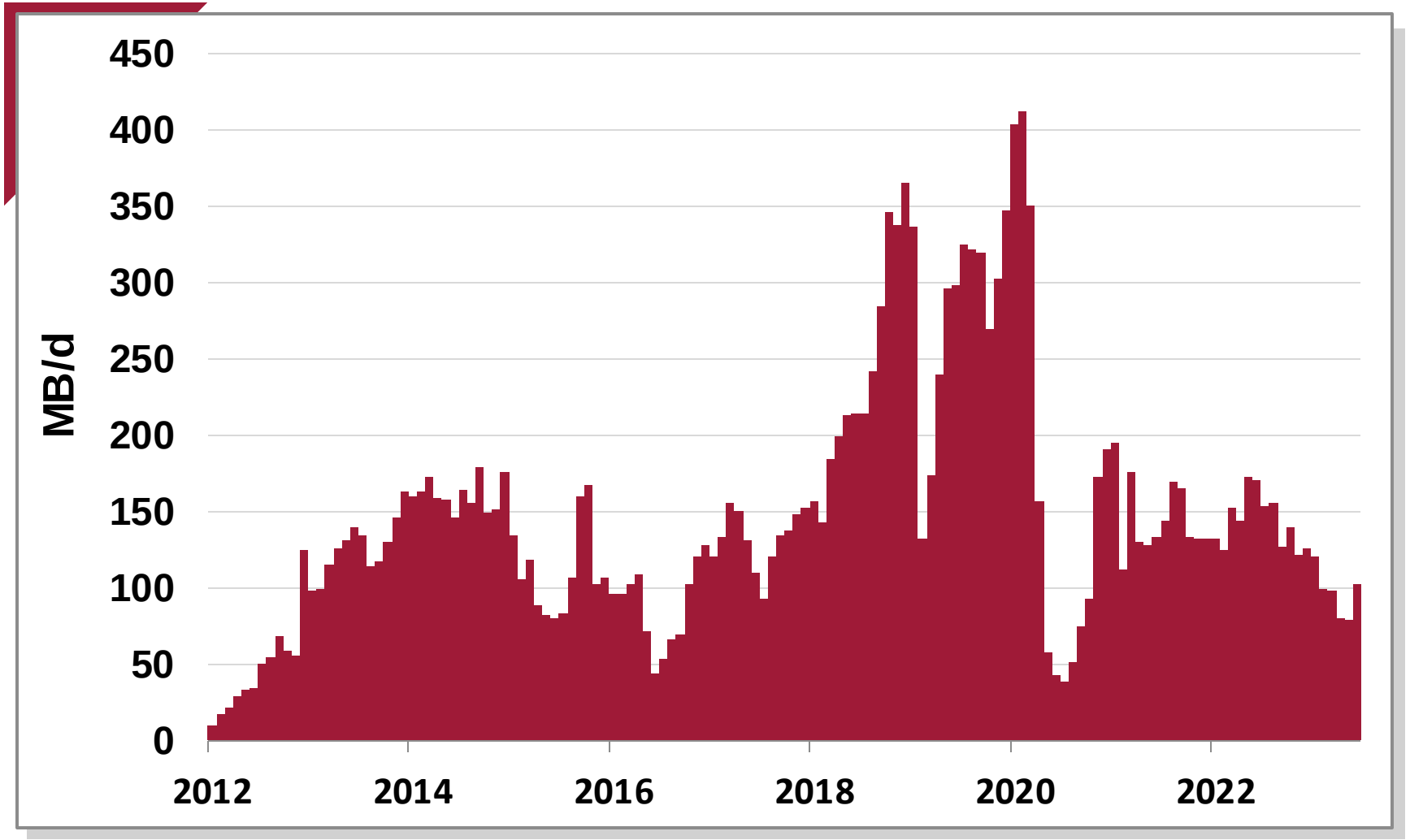


- Of note, Enbridge has doubled pipeline throughput on the Mainline from ~1.5 MMB/d in 2007 to ~3.0 MMB/d currently, owing to debottlenecking initiatives and the recently completed Line 3 Replacement.

Source: Canada Energy Regulator

*2023 data is YTD average up to June 2023

Canadian Oil Exports to the United States by Rail | Monthly | 2012 to Q3/2023*

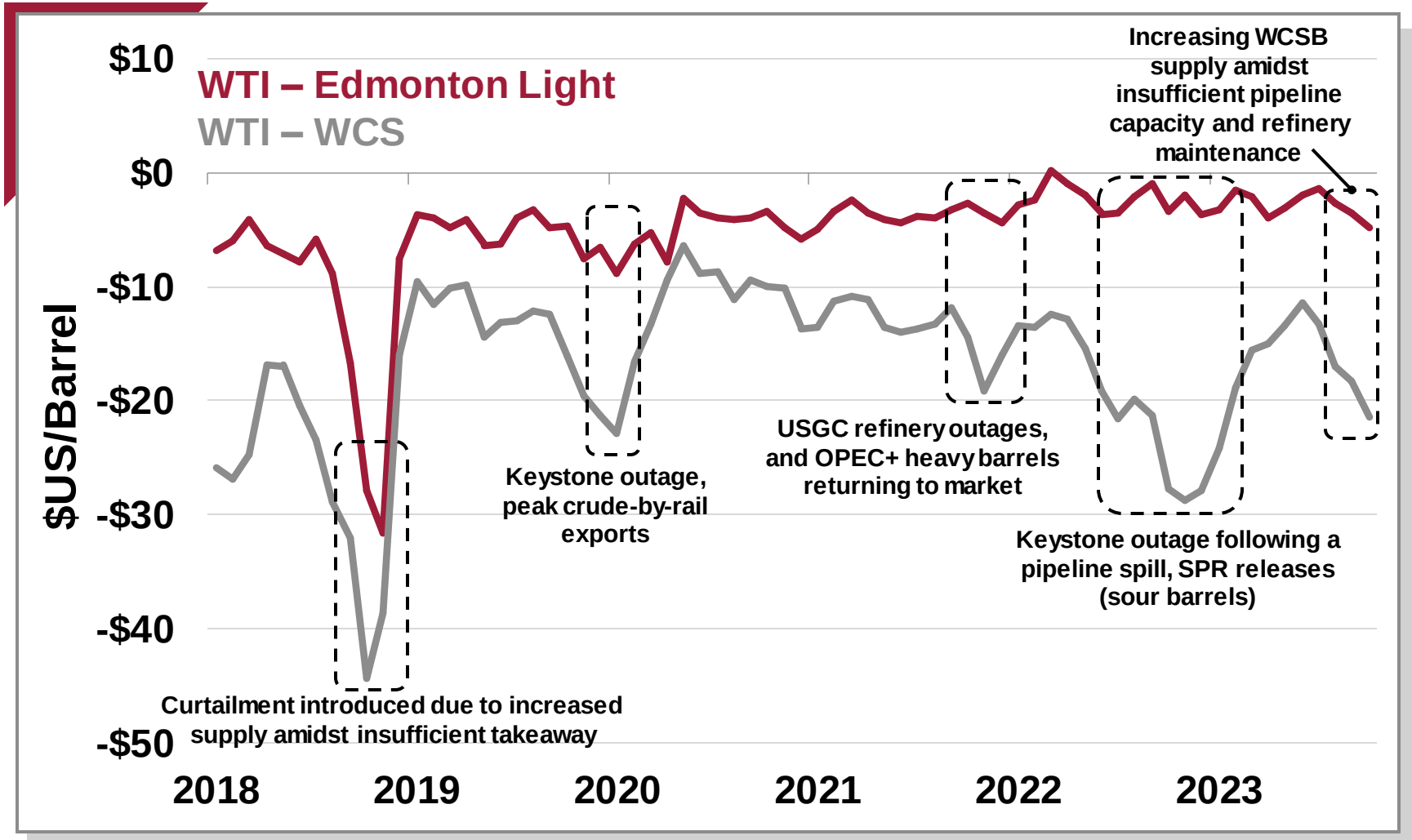


- Rail exports act as an important relief valve at times of insufficient pipeline capacity. The interconnected North American rail network allows access to the many important export markets.
- Rail exports peaked at 412 MB/d in early 2020 due to a lack of egress but fell shortly after when supply fell due to the COVID-related price drop.
- Crude-by-rail remains in place as the marginal transport option should pipeline disruptions occur. However, it is generally a more expensive alternative to pipelines.

Source: Canada Energy Regulator

*2023 data is YTD average up to June 2023

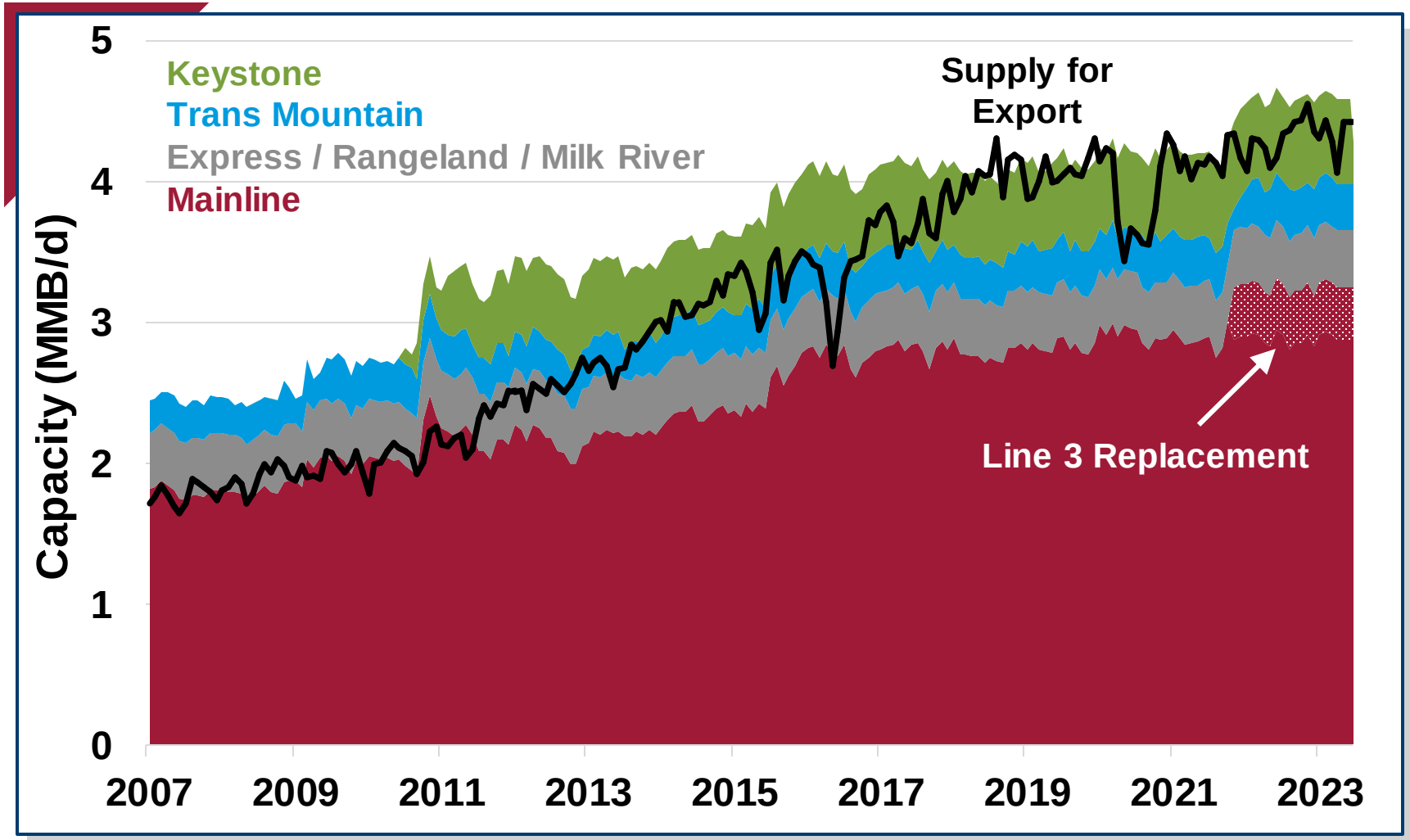
Western Canada Crude Oil Differentials to WTI | Monthly | 2018 to October 2023



- Canadian price discounts blew out during the fall of 2018 as new oil sands supply came to market amidst insufficient pipeline takeaway capacity.
- During times of insufficient pipeline capacity, price differentials for Canadian crude oil widen against US benchmark pricing.
- The Alberta government introduced a production curtailment program, which helped alleviate the oversupply.
- Since mid-2020, incremental capacity has helped keep discounts relatively narrow, although outages and other anomalies can still lead to a temporary widening.

Source: Bloomberg

WCSB Oil Pipeline Capacity *vs.* Supply for Export | Monthly | 2007 to Q2/2023*

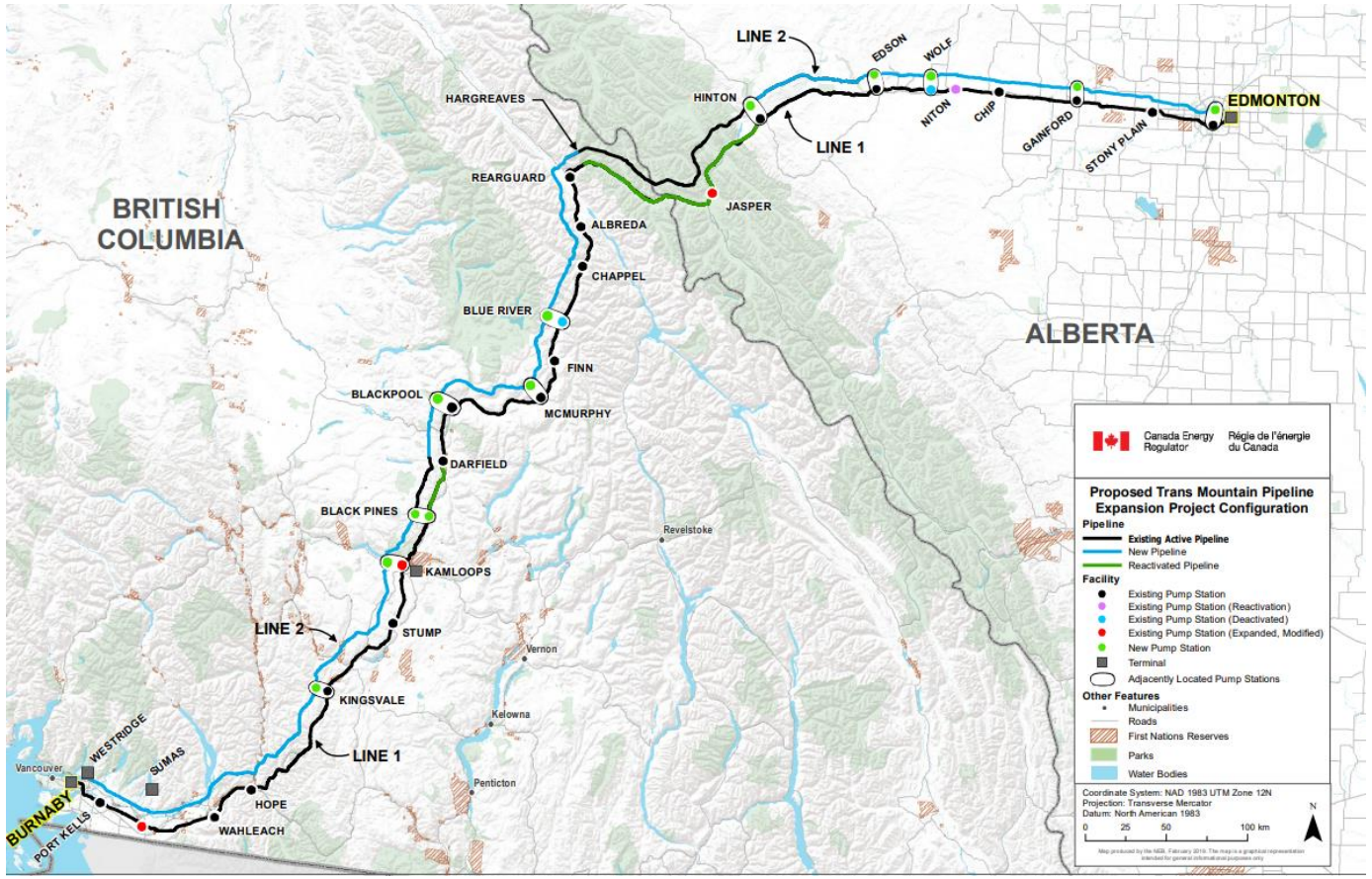


- The WCSB reached a point of insufficient egress capacity in 2018 following a period of significant oil sands growth.
- The recently completed Enbridge Line 3 Replacement in 2021 (+370 MB/d) has helped normalize supply/demand dynamics in the short term.
- Looking ahead, TMX will be needed to accommodate future growth out of the WCSB and mitigate further differential blowouts.
- TMX is poised to reach mechanical completion by Q1/2024, adding 590 MB/d of takeaway capacity.

Source: Canada Energy Regulator
Note: Supply for Export is net of Western Canada refinery demand

*2023 data is YTD average up to June 2023

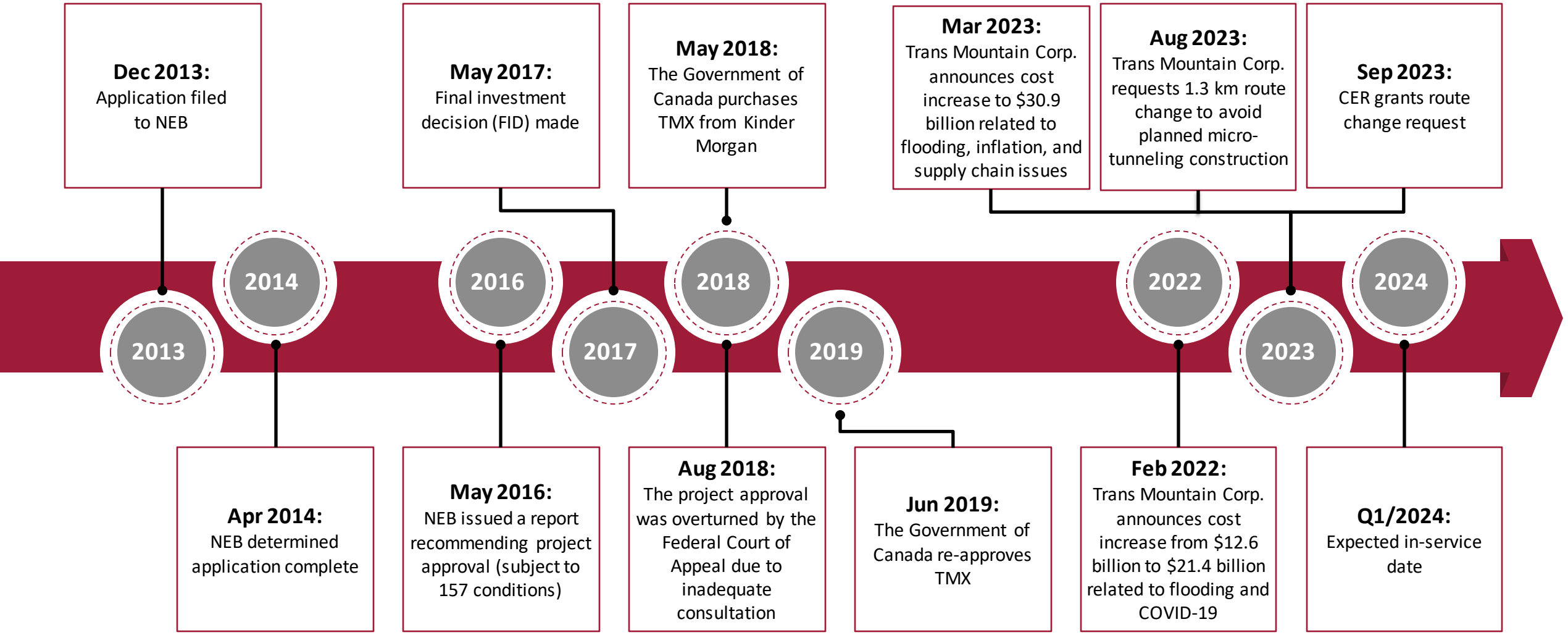
Trans Mountain Expansion (TMX) Overview



- **Location**: Edmonton, AB to Burnaby, BC
- **Capacity**: 590 MB/d
- **Committed shippers**: 10 (incl. Canadian Natural Resources, Cenovus, Suncor., etc.) representing ~80% of the total pipeline capacity
- **Commercial operation date**: Est. Q1/2024
- **Project Description**: The TMX pipeline is a twinning of the existing ~1,150 km Trans Mountain pipeline and will add 590 MB/d of export capacity. Importantly, once complete, the pipeline will provide shippers with increased tidewater access to key export markets in California and Asia.

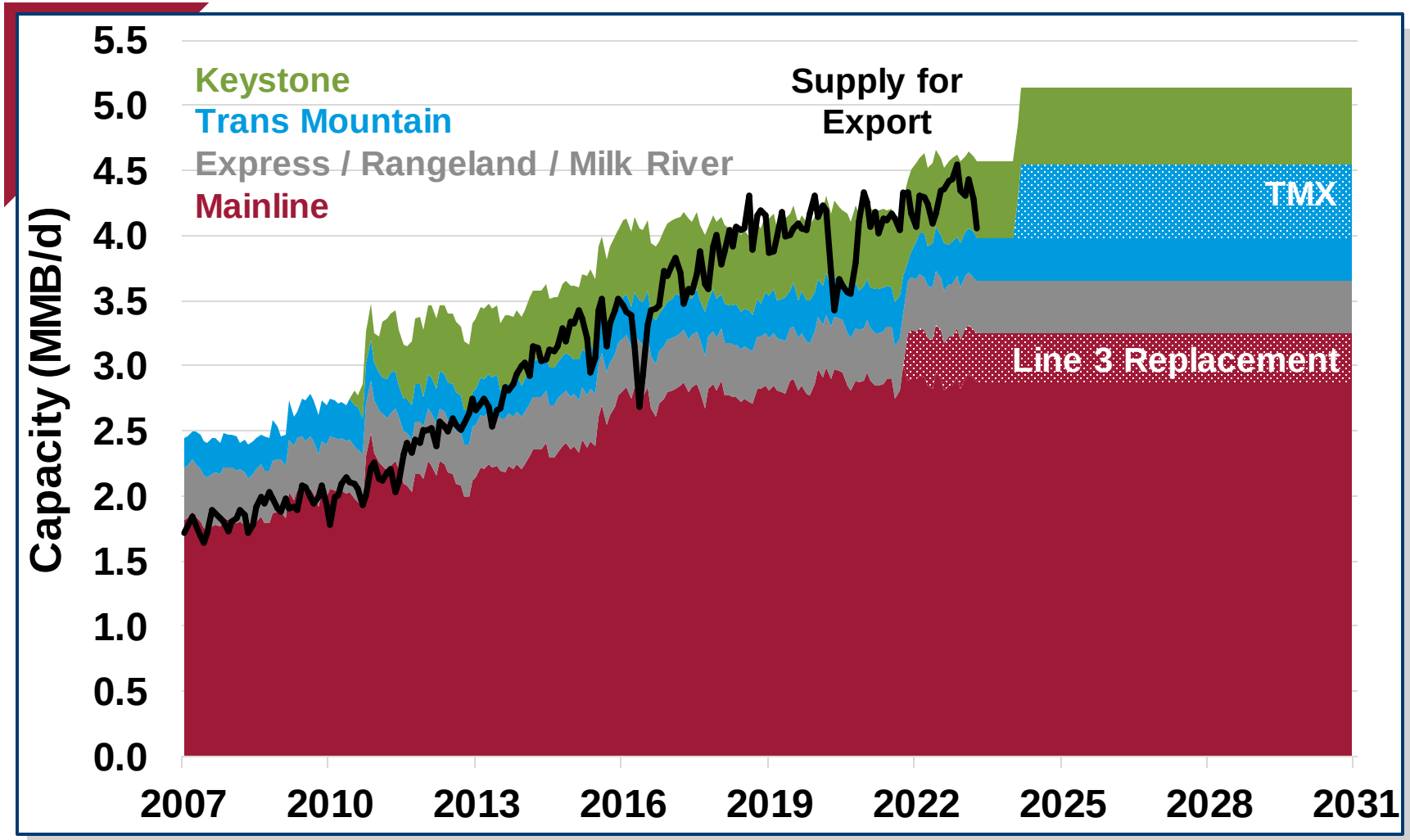
Source: Canada Energy Regulator, Trans Mountain Corp.

TMX Historical Timeline – Key Dates



Source: Canada Energy Regulator, Trans Mountain Corporation

WCSB Egress Outlook *vs.* Supply | Monthly | 2007 to Q2/2023*



- TMX should have a positive impact on crude differentials as firm service occupies 80% of the overall system (equating to ~700 MB/d), which will reallocate barrels otherwise destined for Ontario and the US Midwest (PADD II), creating scarcity in those markets.
- Presently, no further major crude oil export pipelines are planned. Based on assumed pipeline capacities and refinery demand, with TMX, if production grows by ~900 MB/d from 2022 levels, pipeline capacity would once again become a constraint to growth.
- Enbridge can increase the Mainline capacity by another ~200 MB/d (not pictured).

Source: Canada Energy Regulator
Note: Supply for Export is net of Western Canada refinery demand

*2023 data is YTD average up to June 2023

WCSB Oil Export Pipeline Tolls

Pipeline Tolls for Light Oil (US $ per Barrel)		Low		High
Edmonton to:	Burnaby (2024 Trans Mountain Expansion)	7.15[v]	–	9.30[v]
	Anacortes (TMX/Puget)	7.30[v]	–	9.40[v]
	Sarnia (Enbridge)			4.70[iv]
	Montréal (Enbridge)			8.00[iv]
	Chicago (Enbridge)			4.15[iv]
	Cushing (Enbridge)	5.75[iii]	–	7.35[iv]
	Wood River (Enbridge/Mustang/Capwood)			6.10[iv]
	USGC (Enbridge/Seaway)			10.15[iv]
	Westridge (2024 Trans Mountain Expansion)	7.70[v]	–	9.95[v]
Hardisty to:	Guernsey (Express/Platte)			3.80[i]
	Wood River (Express Platte)			5.85[i]
	Wood River (Keystone)	4.70[ii]	–	10.55
	USGC (Keystone)	8.00[iv]	–	13.70[ii]
	USGC (Enbridge)			9.95[iv]
Pipeline Tolls for Heavy Oil (US $ per Barrel)				
Edmonton to:	Westridge (2024 Trans Mountain Expansion)	7.75[v]	–	10.00[v]
Hardisty to:	Chicago (Enbridge)			4.60[iv]
	Cushing (Enbridge)	6.20[iii]	–	7.80[iv]
	Cushing (Keystone)	6.15[ii]	–	10.45
	Wood River (Enbridge/Mustang/Capwood)			6.65[iv]
	Wood River (Keystone)	5.45[ii]	–	11.55
	Wood River (Express/Plattte)			6.55[i]
	USGC (Enbridge/Seaway)			10.60[iv]
	USGC (Keystone)	8.70[iv]	–	14.60[ii]

Paths to Tidewater

- Tolls determine the difference between prices in export markets and what Canadian producers receive.
- Tolls vary based on several factors, including crude quality, pipeline route, length of commitment, and volume.
- Canadian crude oil is exported predominantly to the US Midwest, the US Gulf Coast, and Eastern Canada. Coastal markets generally offer the strongest pricing, but access has historically been limited.
- TMX tolls have been applied for but not finalized. They are comparable to other tidewater paths, although marine costs are uncertain.

Notes: 1) Assumed exchange rate = 0.74 US$ / 1C$ (May 2023 average); 2) Tolls rounded to nearest 5 cents; 3) Tolls In effect July 1, 2023.

[i] 10-14 year committed toll; [ii] 20-year committed toll; [iii] Committed >= 10,000 b/d; [iv] International Joint Tariff, others are uncommitted tolls; [v] Based on Interim Commencement Date Filing

Major Cancelled Crude Oil Pipeline Projects

Proposed Pipeline	Capacity ('000s B/d)	From	To	Date of Cancellation	Reason
Enbridge Northern Gateway	525	Bruderheim, AB	Kitimat, BC	Nov 2016	Cancelled by the Government of Canada due to environment effects and banned oil tanker traffic on the north coast of BC.
TC Energy Energy East	1,100	Hardisty, AB	Saint John, NB	Oct 2017	Project application withdrawn by TC Energy due to potential cost implications associated with the regulatory process
TC Energy Keystone XL	830	Hardisty, AB	Steel City, Nebraska	June 2021	Project cancelled by TC Energy due to its cross-border permit being revoked by the Biden administration
Total	**2,455**				

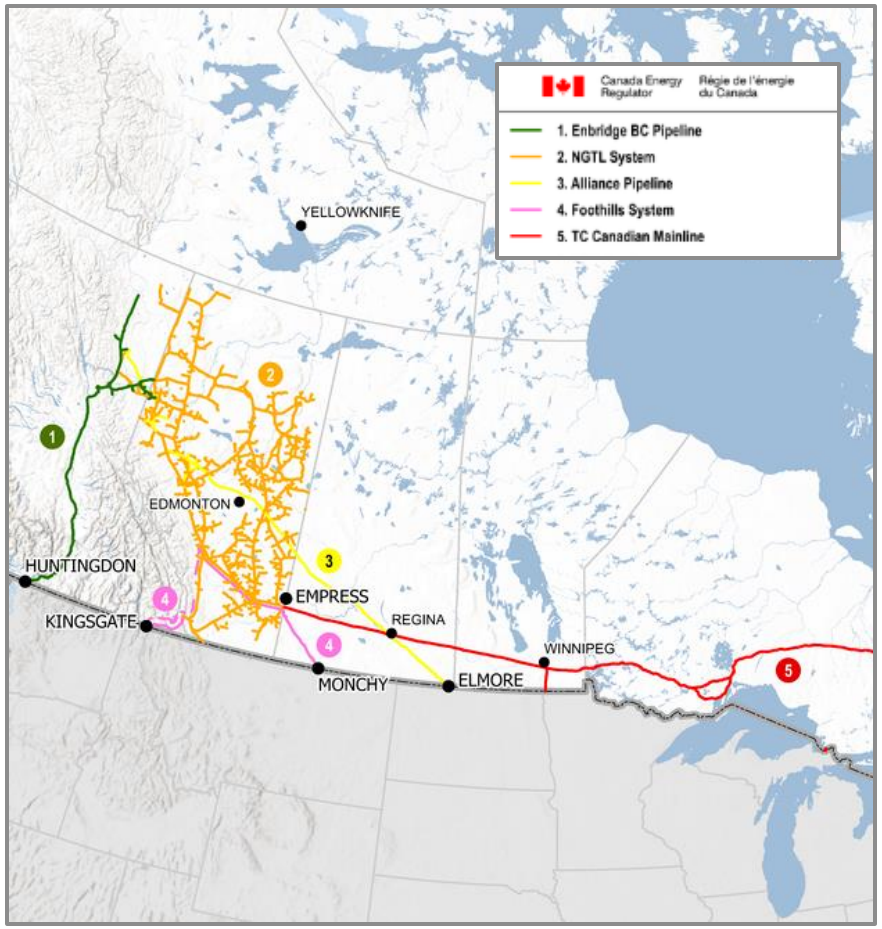
- Despite the cancellation of three major pipeline projects (Keystone XL, Northern Gateway, and Energy East), Canada has more than doubled its export flows out of the WCSB to ~4.5 MMB/d (from ~2 MMB/d) since 2017.
- These projects were canceled due to regulatory impediments and environmental concerns.
- Due to this track record, future major greenfield export pipelines are not expected. Project cancellations have proven to be costly, with Alberta on the hook for ~$1.3 billion in sunk costs related to KXL, and a ~$1.1 billion impairment charge for TC Energy.

Source: Canada Energy Regulator, Government of Alberta, TC Energy

Natural Gas Transportation

CANADA'S OIL & NATURAL GAS PRODUCERS

WCSB Natural Gas Export Infrastructure



- The Western Canadian Sedimentary Basin (WCSB) has a large network of natural gas gathering and export infrastructure. In 2022 over 9.8 Bcf/d of natural gas left the basin via four main export systems, travelling to markets in Canada and the United States.
- The NOVA Gas Transmissions Ltd (NGTL) System is the main gas gathering system for Alberta. While it does not export gas directly, it connects with other export lines.
- Although capacity on export lines technically exceeds annual throughput, constraints on the NGTL system currently limit the amount of gas that can reach these other systems and ultimately move to export markets.

CER Regulated Natural Gas Export Pipelines and Gathering Infrastructure

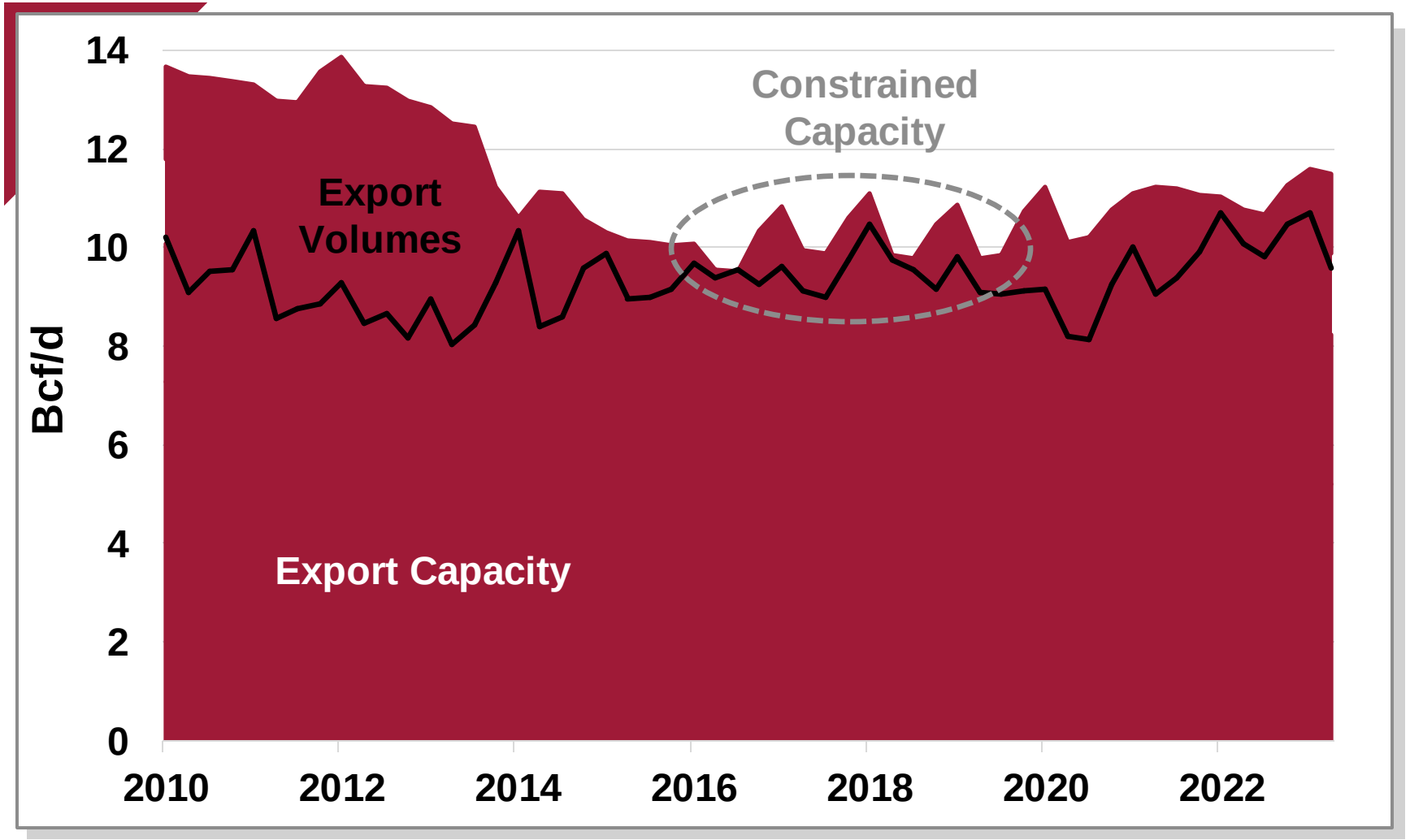
Pipeline	Avg Annual Capacity - 2022* (Bcf/d)	Avg Annual Throughput - 2022* (Bcf/d)	Destination
1 Enbridge BC Pipeline	1.73	1.17	US Exports, Western-Canada
2 NGTL System**	-	-	Local Use and Other Pipelines
3 Alliance Pipeline	1.62	1.78	US Exports
4 Foothills System	5.12	3.17	US Exports
5 TC Energy Mainline	6.31	3.72	US Exports, Eastern-Canada
Total	14.78	9.84	

*WCSB export volumes only. Capacity based on average daily available capacity not nameplate

**NOVA Gas Transmission Ltd. (NGTL) System does not export directly from the WCSB, but interconnects with other export pipelines: Foothills System & TC Energy Mainline via West Gate and East Gate

Source: Canada Energy Regulator

WCSB Effective Gas Export Capacity *vs.* Export Volume | Quarterly | 2010 to Q2/2023*

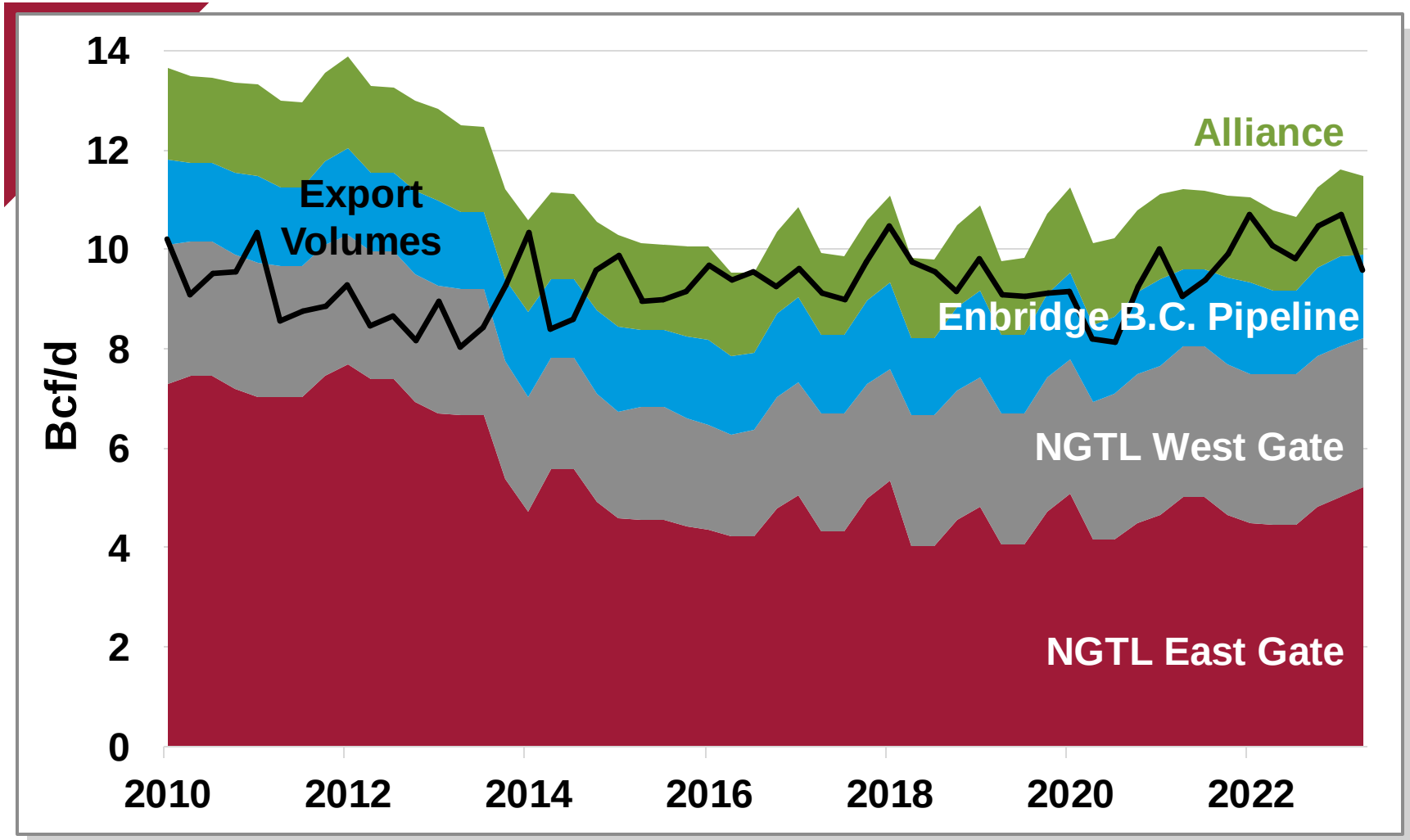


- Total effective export capacity in the WCSB was higher in the early 2010s but fell due to a number of operational constraints. Capacity has been gradually increasing after hitting a bottom in 2016.
- Export volumes have varied over this period, sometimes reaching over 10 Bcf/d. When pipeline capacity utilization exceeds 90% the system is less able to accommodate for disruptions, creating constrained capacity.
- Capacity was tight from 2016 to 2019, and again in the summer of 2022. However, new capacity in late 2022 has helped to alleviate constraints. Future expansions are also expected.

Source: Canada Energy Regulator

*2023 data is YTD average up to June 2023

WCSB Effective Gas Export Capacity *vs.* Export Volume | Quarterly | 2010 to Q2/2023*

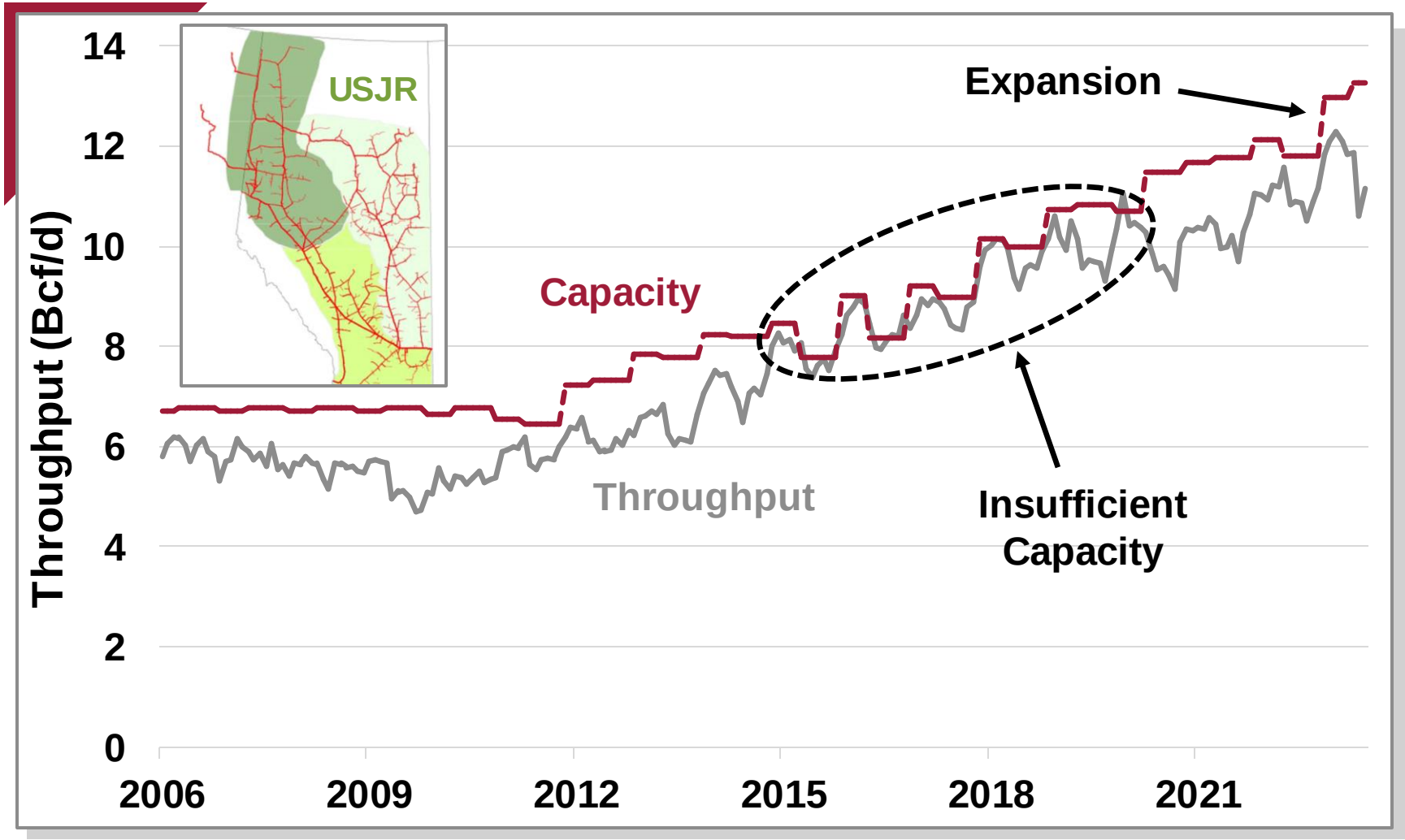


- The total effective capacity to export gas from the WCSB depends on the available capacity to leave the NGTL system (West and East Gate), plus the Alliance and Enbridge BC systems.
- The drop in effective capacity from 2010 to 2016 was largely driven by constraints in the NGTL system delivering to other pipelines.
- A large expansion at the end of 2022 has helped to mitigate these constraints.

Source: Canada Energy Regulator

*2023 data is YTD average up to June 2023

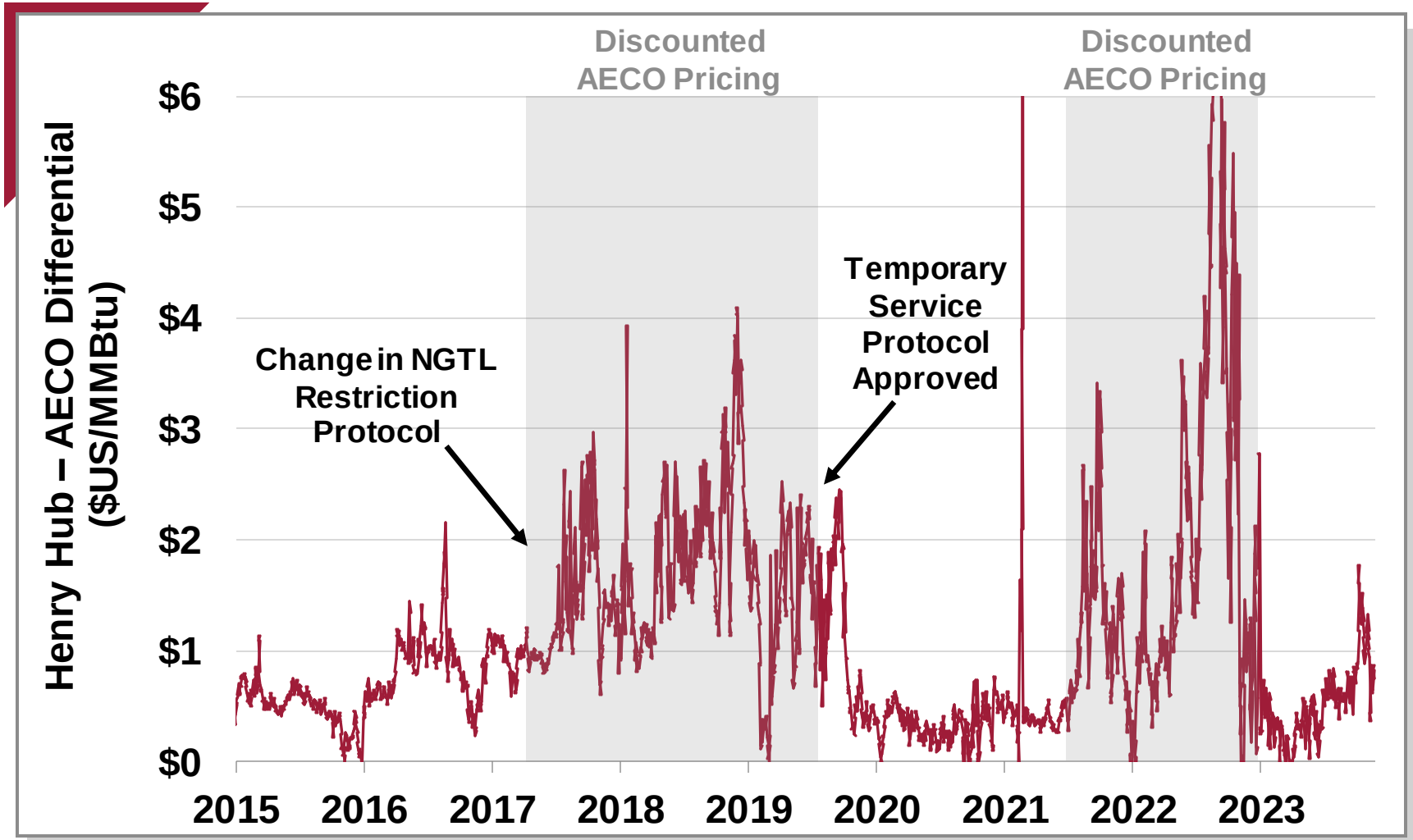
NGTL Natural Gas Transportation Capacity | Upstream of James River



- NGTL export constraints were partially driven by a shift in where natural gas is produced.
- The NGTL System is split into five regions. The N.W. region is called the Upstream of James River area (USJR). This area is home to the most prolific shale plays. Over the past 15+ years, gas production in the area has nearly doubled.
- Capacity has also grown substantially, but at times, has lagged the significant supply growth, leading to constraints that impacted prices.
- A large capacity addition at the end of 2022 has helped to relieve these constraints.

Source: Canada Energy Regulator

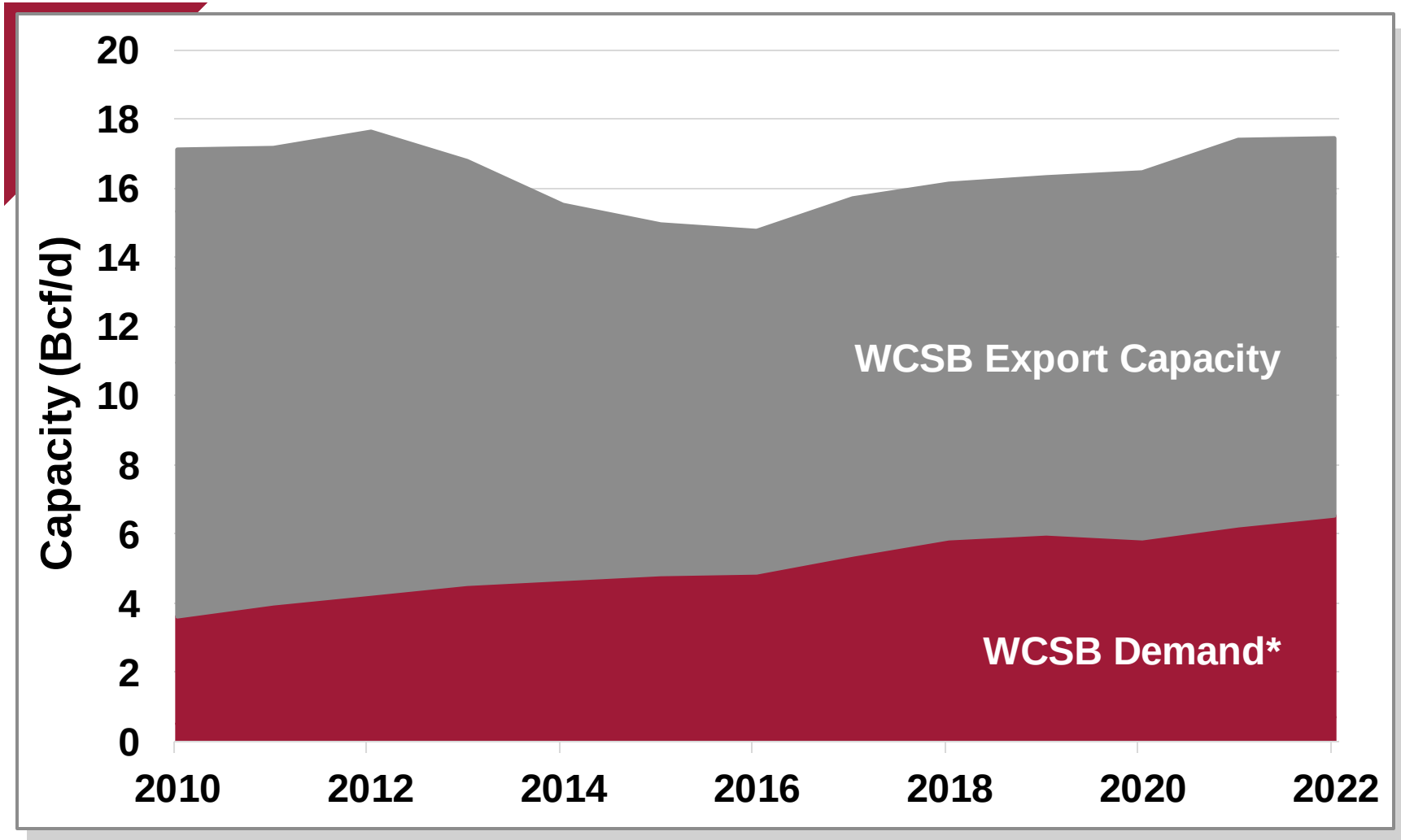
AECO Differential to Henry Hub | Daily Spot Price | 2015 to October 2023



- During periods of capacity constraint, price discounts at the AECO Hub (Alberta's main pricing point) grow dramatically.
- These price disconnections were made more severe by a change to the NGTL restriction protocols, which restricted interruptible (spot) deliveries commonly used to access storage.
- In 2019, regulators approved a Temporary Service Protocol which improved access to storage and pricing. However, physical constraints remained.
- Since the NGTL expansion at the end of 2022, differentials have narrowed considerably.

Source: Bloomberg

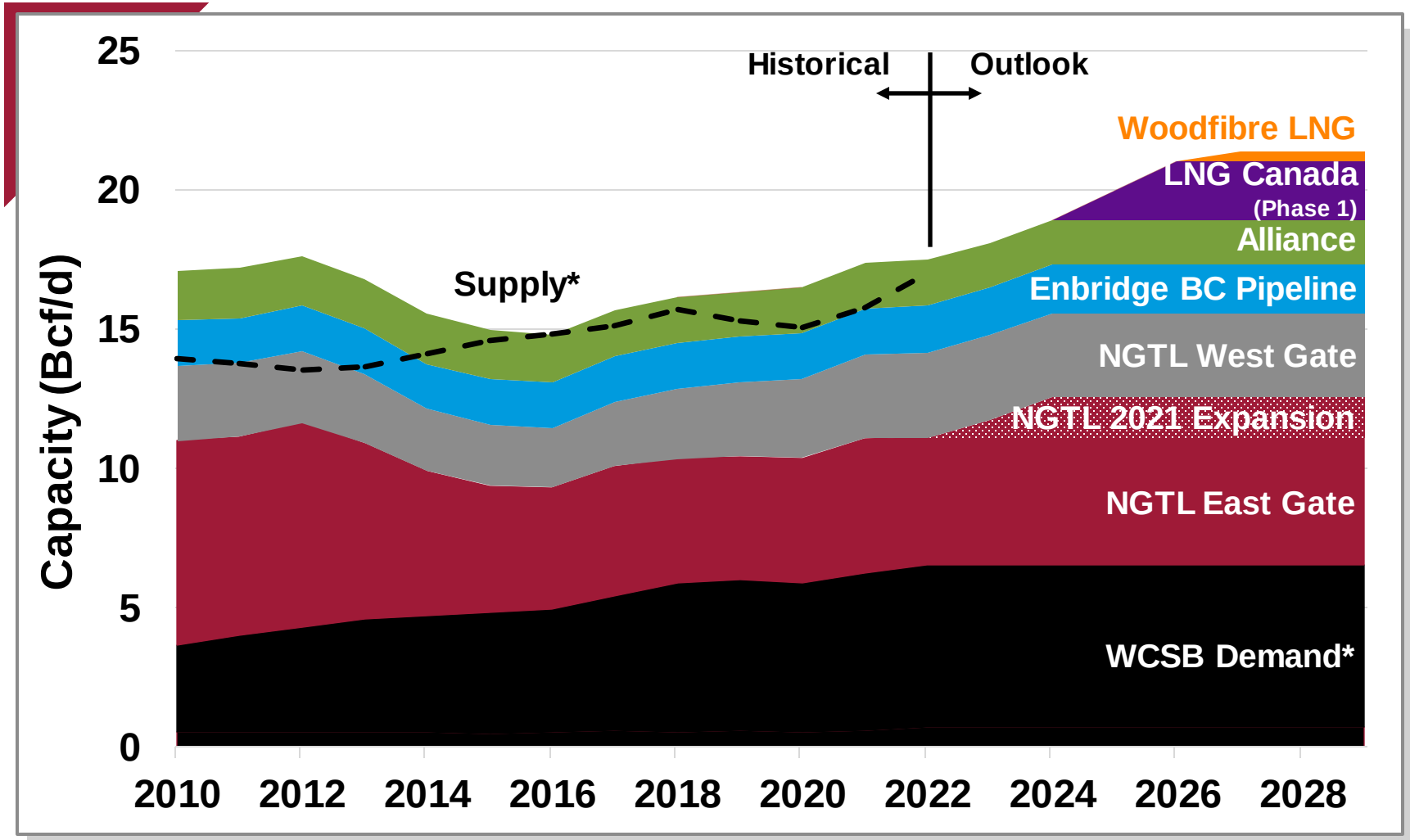
WCSB Natural Gas Demand and Egress Capacity | Annual | 2010 to 2022



- Demand for natural gas in the provinces that make up the Western Canadian Sedimentary Basin has grown over the past decade.
- This growth has been driven primarily by increased use in the oil sands and the switch from coal power generation towards cleaner-burning natural gas.
- Higher domestic demand has supported production increases even in times of export constraints.

Source: Canada Energy Regulator, Alberta Energy Regulator, BC Ministry of Farming, Natural Resources and Industry
*WCSB supply and demand are shown for only Alberta and British Columbia, as major export capacity constraints occur west of Saskatchewan

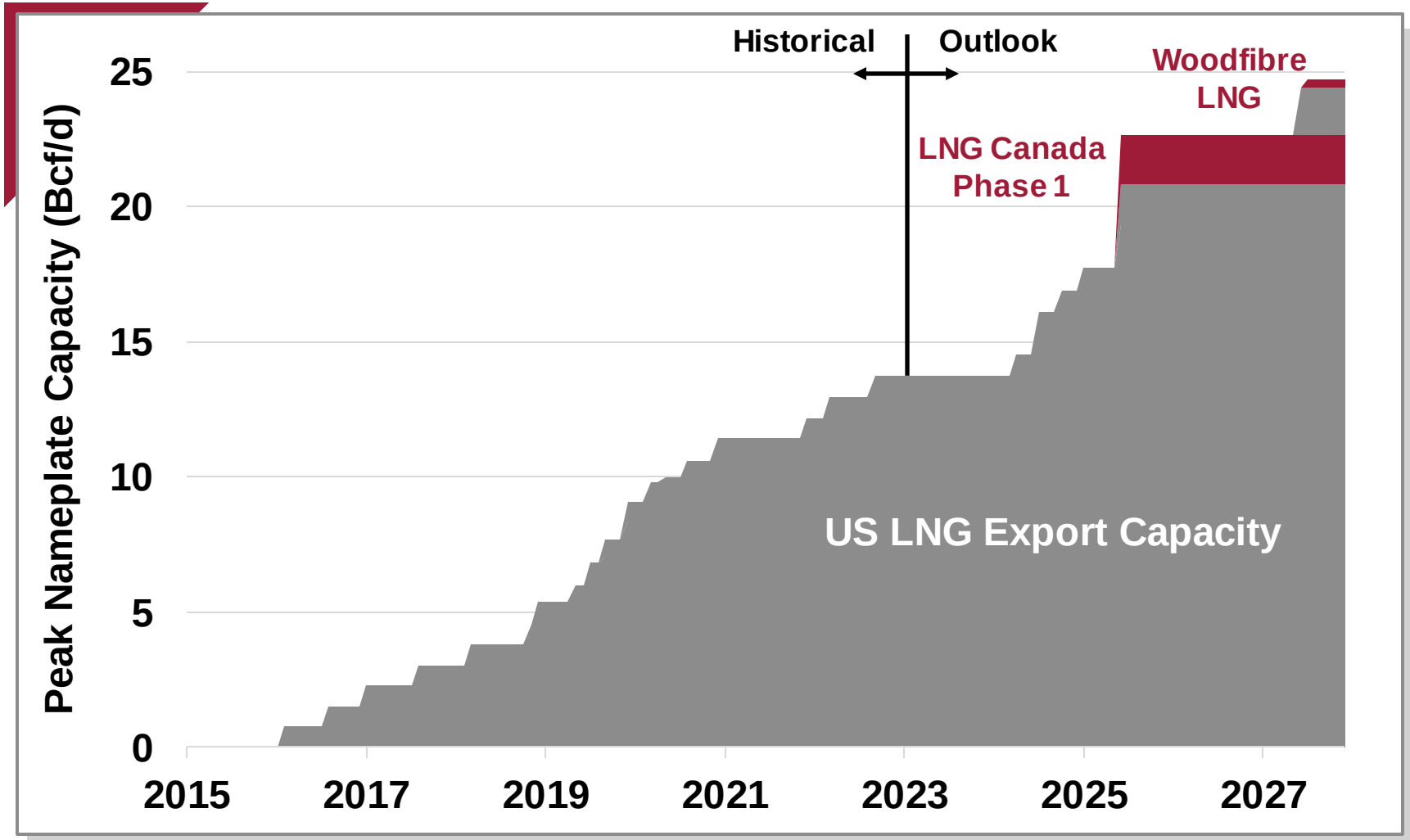
WCSB Natural Gas Demand and Egress Capacity *vs.* Supply | Incl. Expected Export Capacity | Annual



- Since the mid-2010s, supply has often approached export capacity, but the situation should improve going forward.
- The NGTL Expansion Project, which came online in late 2022, increased capacity throughout the NGTL system and relieved export constraints.
- The next major increase in capacity will come when LNG Canada comes online, followed by Woodfibre LNG. Future LNG projects have yet to reach a final investment decision.
- These projects will allow Canadian gas to reach global markets amidst growing LNG demand.

Source: Canada Energy Regulator, AER, BC Ministry of Farming, Natural Resources and Industry, LNG Canada, Woodfibre LNG
*WCSB supply and demand are shown for only Alberta and British Columbia, as major export capacity constraints occur west of Saskatchewan
Outlook only shows NGTL 2021 Expansion (1.45 Bcf/d) and Post-FID LNG projects. Demand and other pipes assumed to equal 2022

North American LNG Export Capacity | Operational and Under Construction



- Since 2016, the US has added ~14 bcf/d of operational LNG nameplate capacity via 20 export facilities, and an additional ~9 Bcf/d of capacity is under construction.
- Comparatively, only two projects in Canada are currently under construction equating to ~2 Bcf/d of nameplate export capacity. Additional Canadian projects are awaiting FID.
- Due to the interconnected North American gas market, Canadian gas was exported from US LNG terminals for the first time in 2023. Select Canadian natural gas producers have signed ~0.4 Bcf/d of long-term supply agreements with LNG facilities in the US Gulf Coast.

Source: Energy Information Administration, Canada Energy Regulator, Company Reports

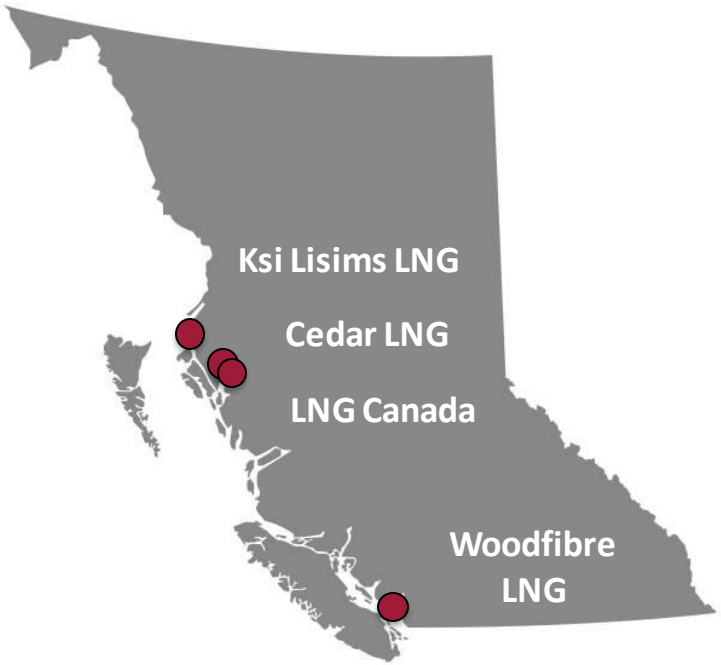
Selected West Coast Canada LNG Projects Under Development

LNG Canada

- **Location**: Kitimat, BC
- **Export Capacity**: Phase I - 1.8 Bcf/d, Phase II - 1.8 Bcf/d
- **Pipeline**: Coastal Gas Link (under construction)
- **Project Proponents**: Shell, PETRONAS, PetroChina, Mitsubishi Corporation and KOGAS
- **FID**: Phase 1 (Oct 1, 2018), Phase 2 TBD
- **Commercial operation date**: Est. 2025

Cedar LNG

- **Location**: Kitimat, BC
- **Export Capacity**: 0.4 Bcf/d
- **Pipeline**: Coastal Gas Link (under construction)
- **Project Proponents**: Pembina, Haisla Nation
- **FID**: Expected Q4/2023 or early 2024
- **Commercial operation date**: Est. 2027



Woodfibre LNG

- **Location**: Squamish, BC
- **Export Capacity**: 0.29 Bcf/d
- **Pipeline**: Eagle Mountain (under construction)
- **Project Proponents**: Pacific Energy Corporation, Enbridge Inc.
- **Notice to Proceed**: April 2022
- **Commercial operation date**: Est. 2027

Ksi Lisims LNG

- **Location**: Wil Milit, BC
- **Export Capacity**: 1.6 Bcf/d
- **Pipeline**: TC Prince Rupert Gas Transmission
- **Project Proponents**: Nisga'a Nation, Western LNG, Rockies LNG (Canadian producer consortium)
- **FID / Commercial Operation Date**: TBD; Environmental Assessment Certificate application filed

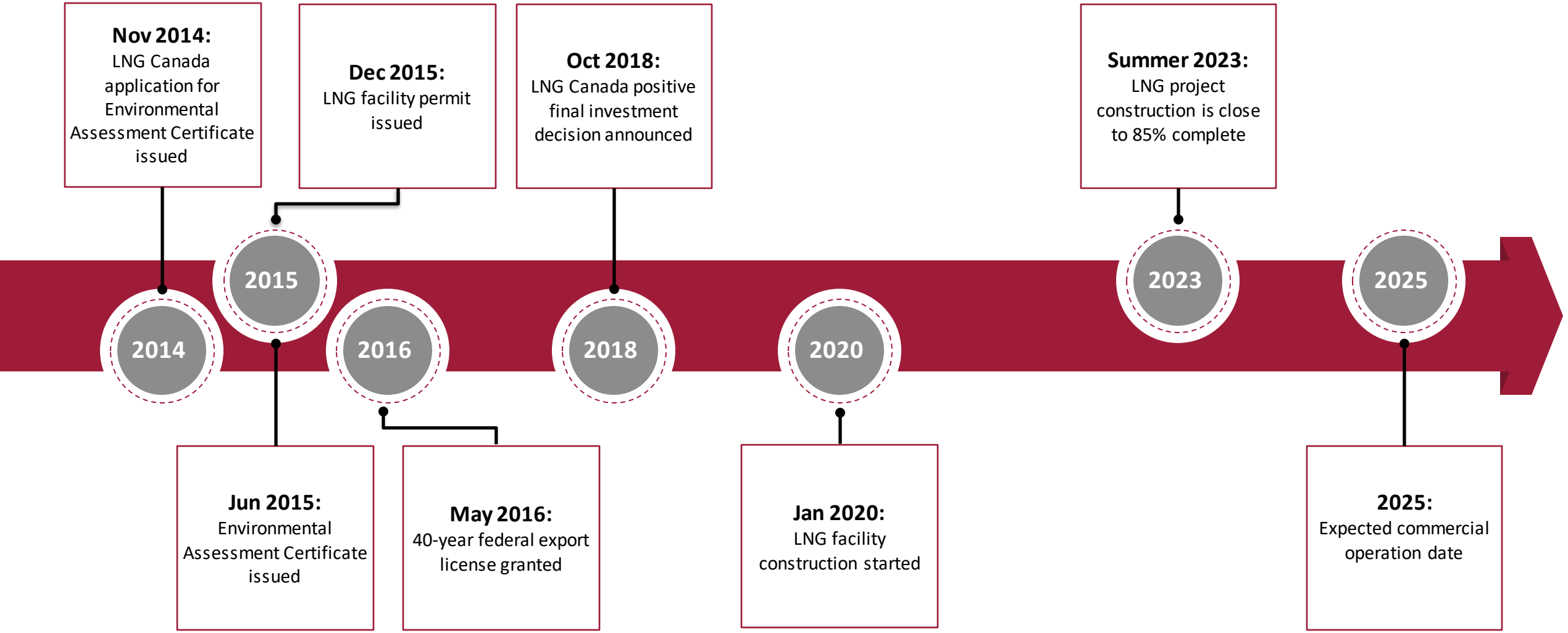
Source: Canada Energy Regulator, LNG Canada, Cedar LNG, Woodfibre LNG, Ksi Lisims LNG

LNG Canada Project Overview

- **Location:** Kitimat, BC
- **Capacity:** Phase I – 1.8 Bcf/d, Phase II – 1.8 Bcf/d
- **Feedgas Requirement**: Phase I - 2.1 Bcf/d, Phase II - TBD
- **Pipeline:** Coastal Gas Link (under construction)
- **Project Proponents:** Shell, PETRONAS, PetroChina, Mitsubishi Corporation and KOGAS
- **FID:** Phase 1 (Oct 1, 2018), Phase 2 TBD
- **Commercial operation date:** Est. 2025
- **Project Description:** LNG Canada will bring BC and Alberta natural gas to the West Coast for sale in higher-priced Asian markets. LNG Canada is the largest private sector investment in Canadian history.

Source: LNG Canada

LNG Canada Historical Timeline – Key Dates



Source: Canada Energy Regulator, LNG Canada