S&P Global
Commodity Insights

Canadian Petrochemical Feedstock Update

Prepared for:

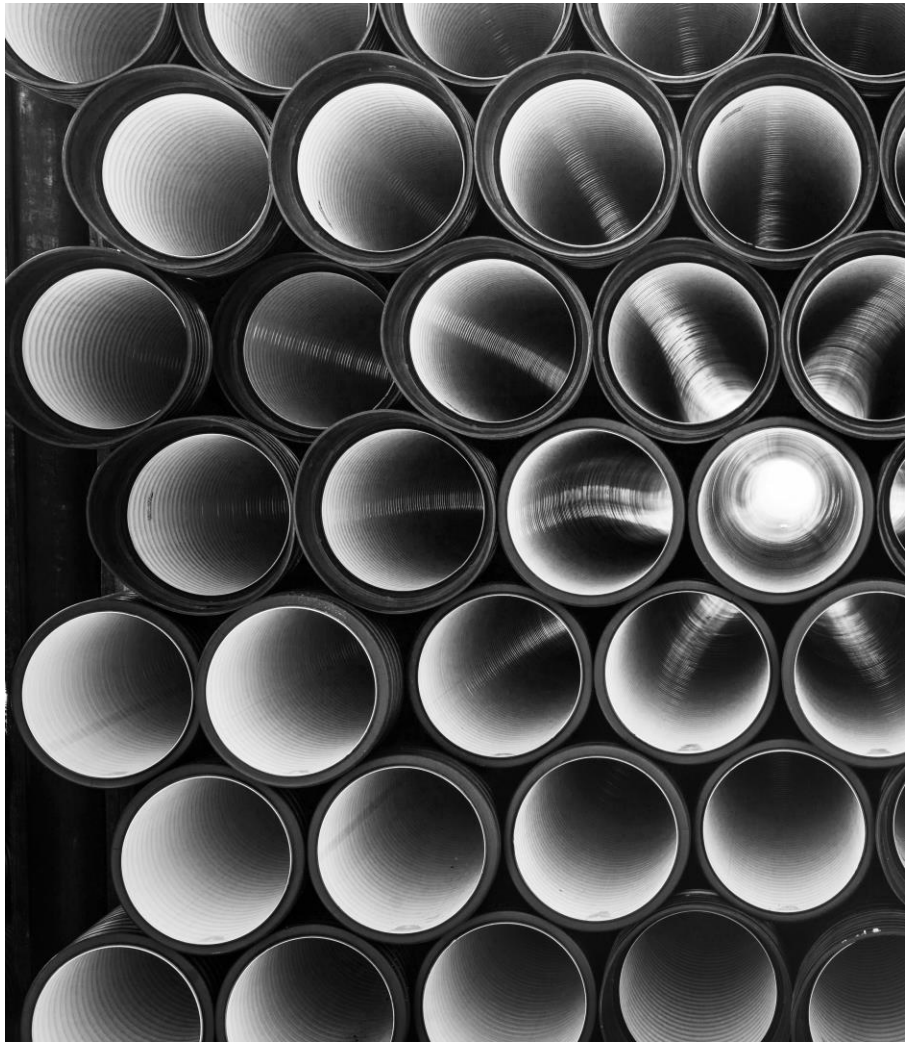
CANADIAN PETROCHEMICAL SUMMIT

Jordan Woloschuk / Commodity Insights / Associate Director

June 2024

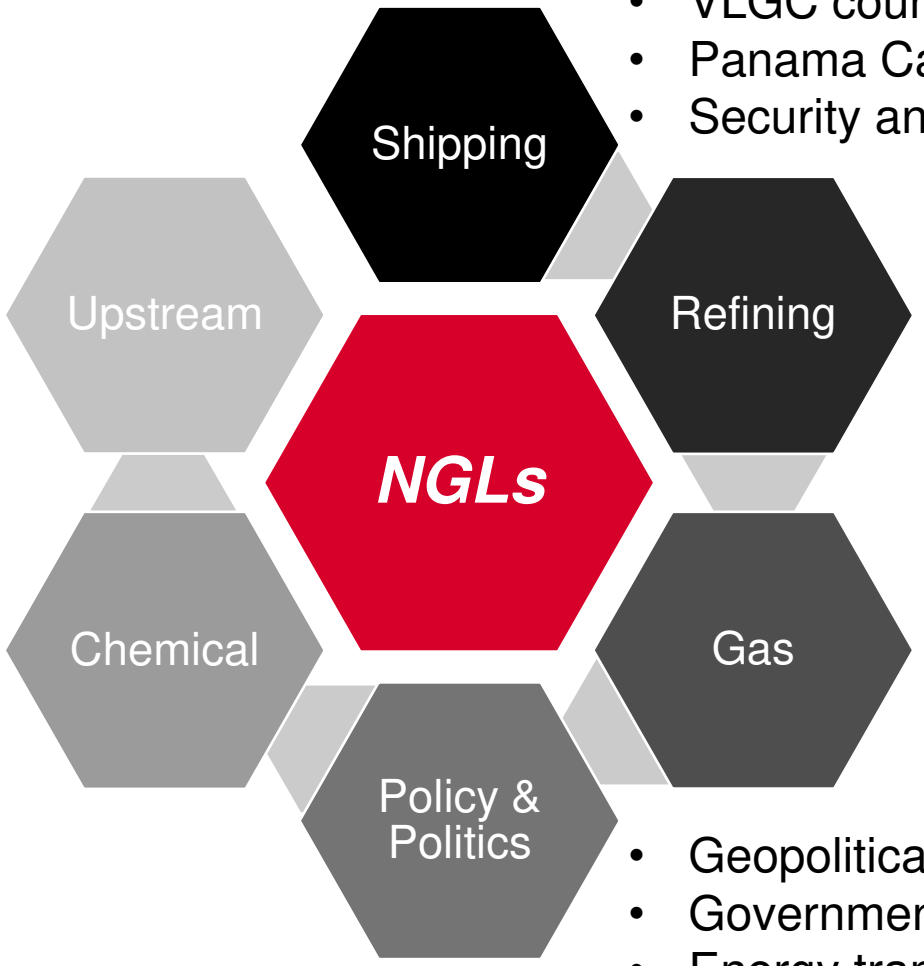
Agenda

- Canadian Petrochemical Feedstock Update
  - Global NGL Market Update
  - Canada NGL Market Update
    - Ethane
    - Propane



Global NGL Market Update

NGL markets are shaped by and constantly react to the changes in adjacent markets as well as broader global developments



- VLGC count
- Panama Canal transits / water levels
- Security and routing concerns

- Oil prices
- US capital discipline
- OPEC+ oil supply management

- Refinery yields
- Refinery runs and leads/lags in products demand
- Net impact on butane

- 'Build cycle' and demand recovery
- Feedstock requirements and competition

- Global gas/LNG market
- Fuel switching

- Geopolitical issues
- Government policies and market intervention
- Energy transition & security

Source: S&P Global Commodity Insights.

Global economic expansion continues to edge higher, but at a mixed rate; meanwhile core inflation rates expected to remain stubborn

Real GDP (% change)

Region	2023	2024	2025	2026
World	2.7	2.7	2.7	2.7
United States	2.5	2.5	1.6	1.6
Canada	**1.1**	**1.5**	**2.0**	**2.0**
Brazil	2.9	2.1	2.4	2.4
Eurozone	0.6	0.7	1.5	1.5
United Kingdom	0.1	0.5	1.1	1.2
Russia	3.6	3.1	2.5	2.0
Mainland China	5.2	4.8	4.5	4.5
Japan	1.9	0.8	1.1	0.9
India*	7.4	6.7	6.3	6.2

Data compiled May 15, 2024.
* Fiscal year starting April 1, 2023.
Source: S&P Global Market Intelligence.

Consumer prices (% change)

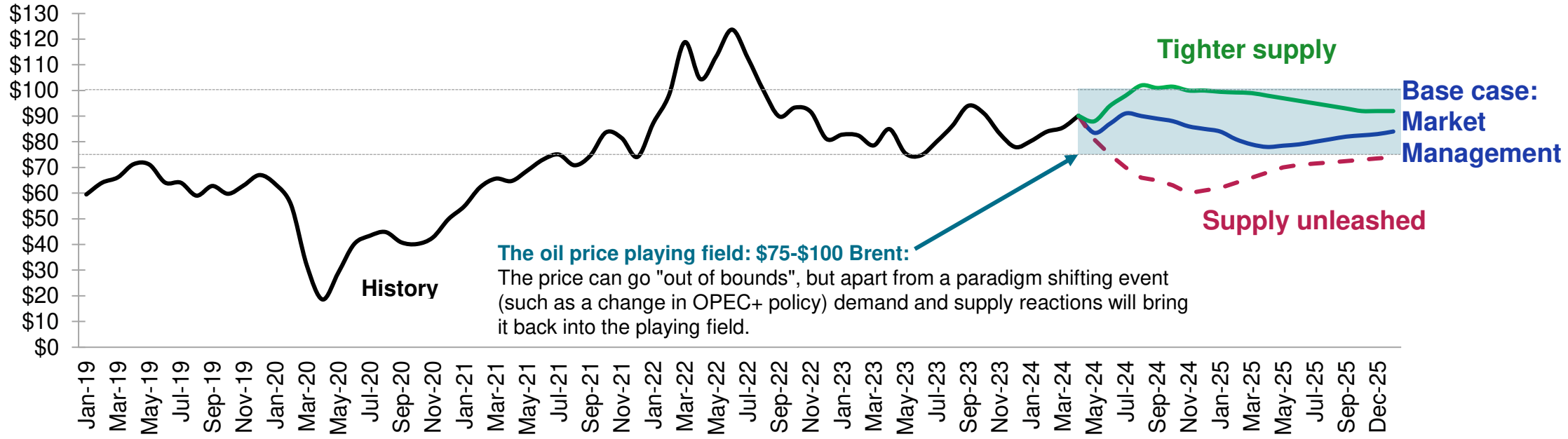
Region	2023	2024	2025	2026
World	5.7	4.8	3.3	2.9
United States	4.1	3.3	2.2	2.4
Canada	**3.9**	**2.7**	**2.0**	**2.0**
Brazil	4.6	3.8	3.3	3.2
Eurozone	5.4	2.5	2.0	1.9
United Kingdom	7.3	2.5	1.9	1.8
Russia	5.9	5.9	4.7	4.5
Mainland China	0.2	0.8	1.7	2.0
Japan	3.3	2.4	2.2	1.7
India	5.7	5.2	4.9	5.1

Data compiled May 15, 2024.
Source: S&P Global Market Intelligence.

Stronger economic growth will support greater energy demand; however, lingering inflationary pressures leads to uncertainties

OPEC+ supply restraint is key to keeping oil prices within the $75-100/b range through 2024 and 2025…

S&P Global Commodity Insights Dated Brent price outlook ($/b)



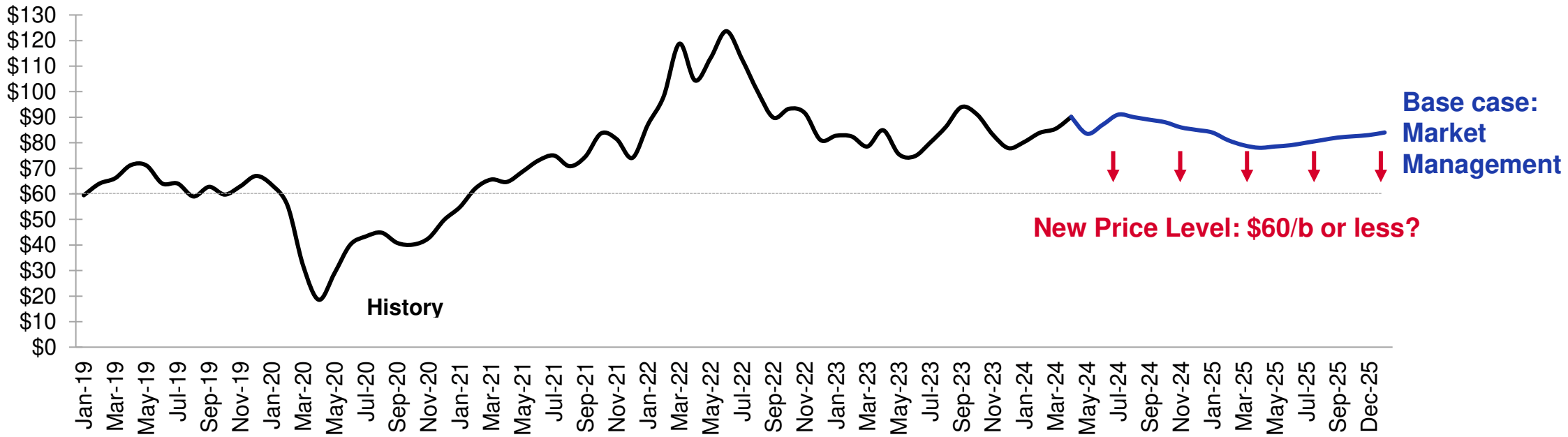
Market management (base case):

- Saudi Arabia and Russia decide to extend their unilateral cuts until 2024. OPEC+ also agrees to implement an additional shared cut of 1 million b/d in 2025 to limit surpluses and maintain prices above $70/b. Without these measures, production is expected to increase, leading to the risk of significantly lower oil prices.
- The growth of US production, while slowing down, continues to be the main driver of non-OPEC+ supply increases.

Data compiled May 16, 2024.
Source: S&P Global Commodity Insights.

However, on June 2, 2024, OPEC+ announced plans to roll back voluntary production cuts beginning in October 2024, increasing the risk of weaker oil prices

S&P Global Commodity Insights Dated Brent price outlook ($/b)

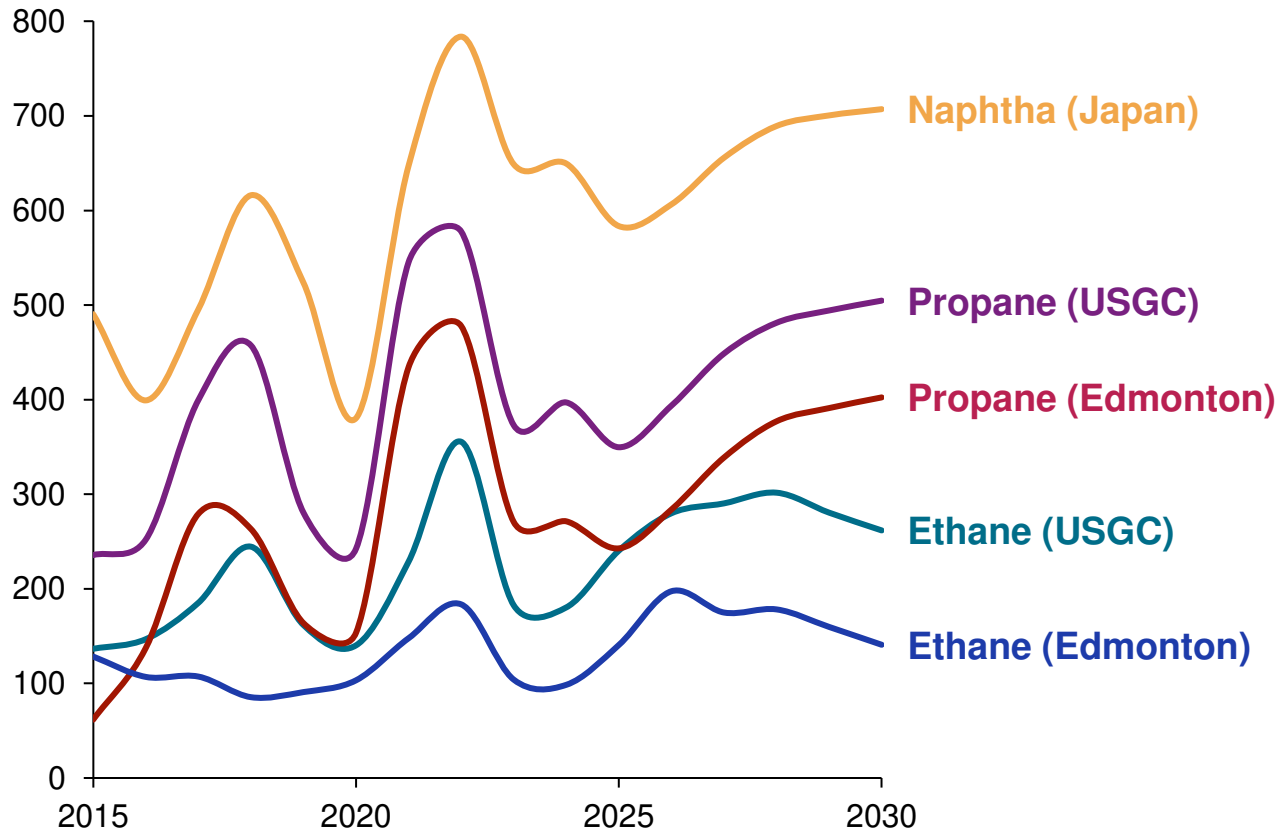


Current cuts would be extended through September 2024, with a gradual increase in OPEC+ crude oil production by nearly 2.5 million b/d from October 2024 to September 2025; increases the likelihood of even weaker oil prices…

Data compiled June 4, 2024.
Source: S&P Global Commodity Insights.

The relationship between ethane and competing feedstocks will change over the long-term due to declining oil demand; ethane still expected to remain competitive

Feedstock price comparison ($/metric tons – Constant 2023 $US)



Data compiled Feb. 29, 2024.
Note: Estimated Edmonton ethane price is calculated based on the AECO natural gas price and an assumed extraction premium.
Source: S&P Global Commodity Insights

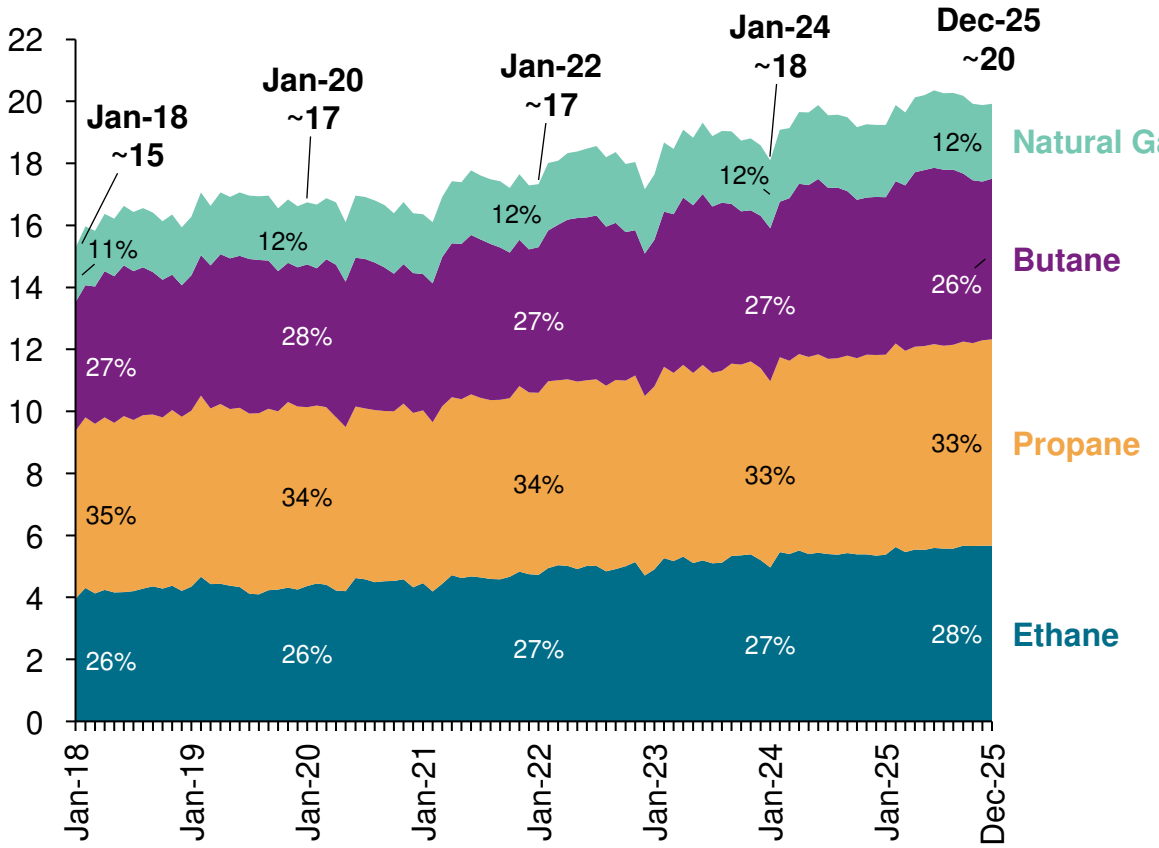
- By comparing the prices of naphtha, propane, and ethane on a long-term annual average basis historically and forecasting future trends, one can gain insight into the advantages of North American NGLs as petrochemical feedstocks.
  - Price difference illustrates the value of importing U.S. ethane for the production of ethylene in Asia.
- Ethane will continue to remain significantly lower than both propane and naphtha.
  - A longer-term increase in ethane post-2030 is expected to be linked to higher natural gas prices, driven by increased costs of supply from areas outside the Permian Basin.
- Demand for naphtha over the longer-term will increase in price, while LPG supply tightens.

Strong price advantage exists for Canadian feedstocks compared to other feedstock supplies

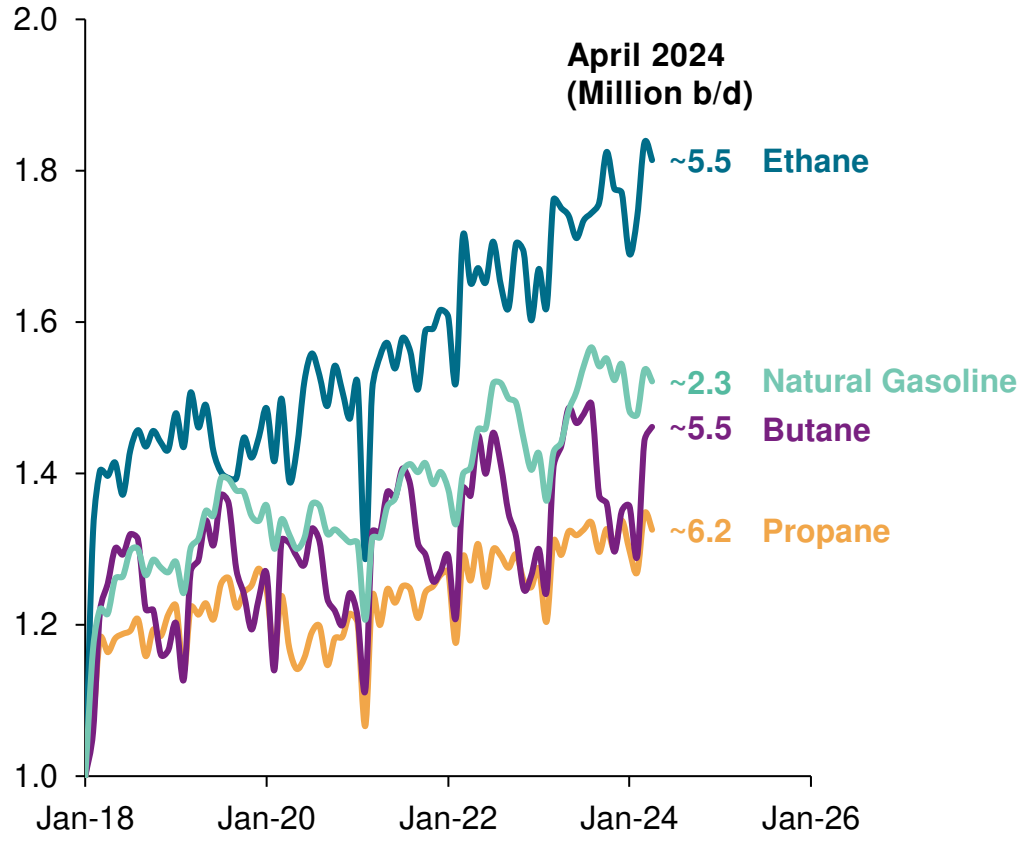
NGL

Global NGL production will steadily increase over the short-term; ethane production growth rate higher due to strong petrochemical demand

Global NGL production (Million b/d)



Global NGL production growth index



Data compiled May. 31, 2024.

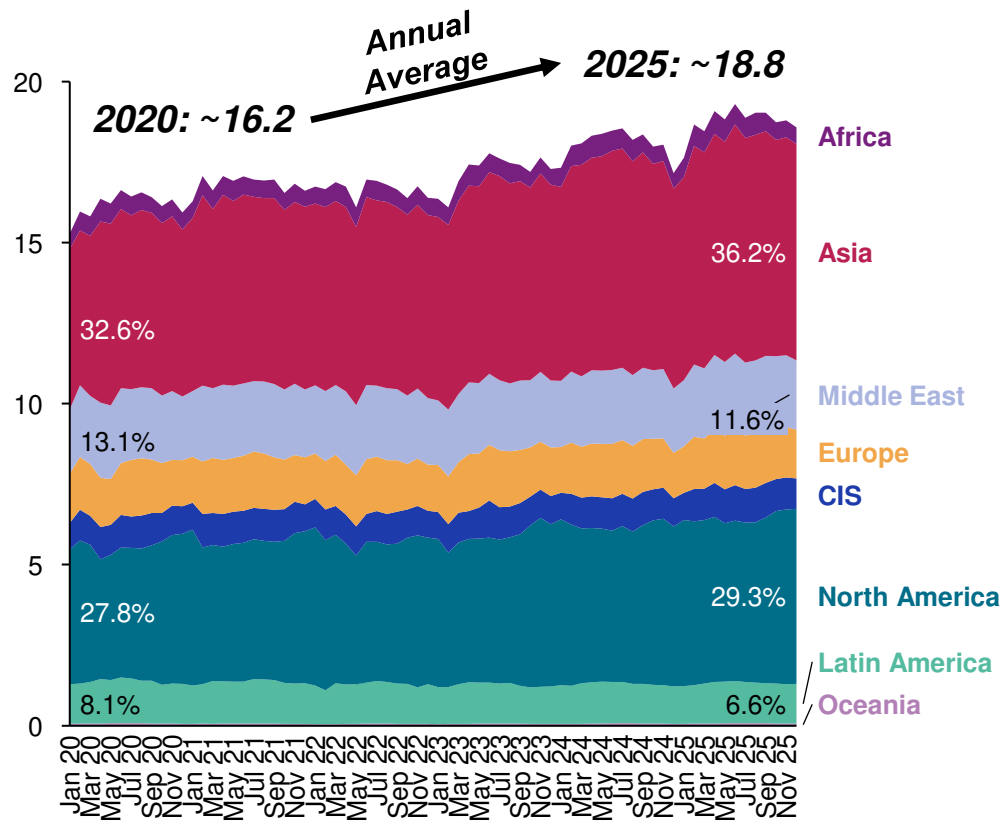
Notes: Global demand estimates based of monthly STO and ASW reports (May 2023). Global demand balance based off prior month regional outlooks. Monthly data is only available for select countries. For all other regions, a monthly average has been assumed based on the annual figure. Includes demand for C2, C3, C4, and C5+. NGL production from both gas processing/fractionation facilities and refineries. Does not include other production or net storage withdrawals.

Source: S&P Global Commodity Insights

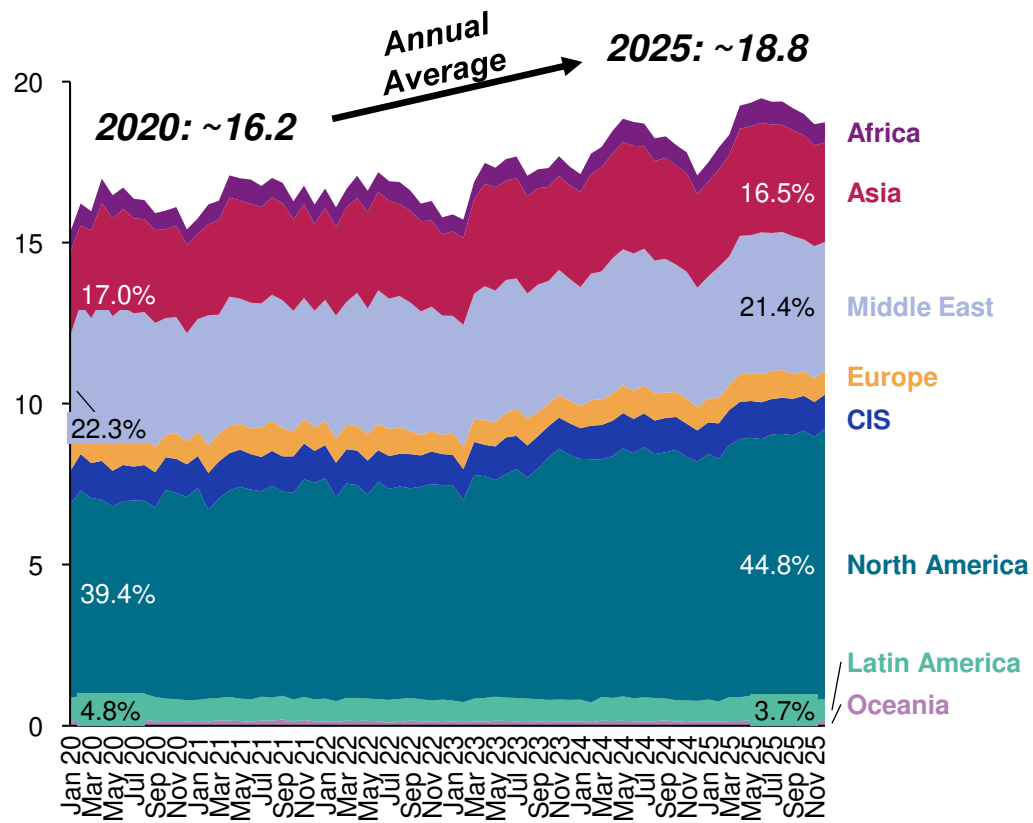
NGL

North America will play a greater role in supplying NGLs, while Asia will account for the largest and fastest-growing share of global demand

Global NGL Demand by Region (Million b/d)



Global NGL Supply by Region (Million b/d)



Data compiled May. 31, 2024.

Notes: Global demand estimates based of monthly STO and ASW reports (May 2023). Global demand balance based off prior month regional outlooks. Monthly data is only available for select countries. For all other regions, a monthly average has been assumed based on the annual figure. Includes demand for C2, C3, C4, and C5+.

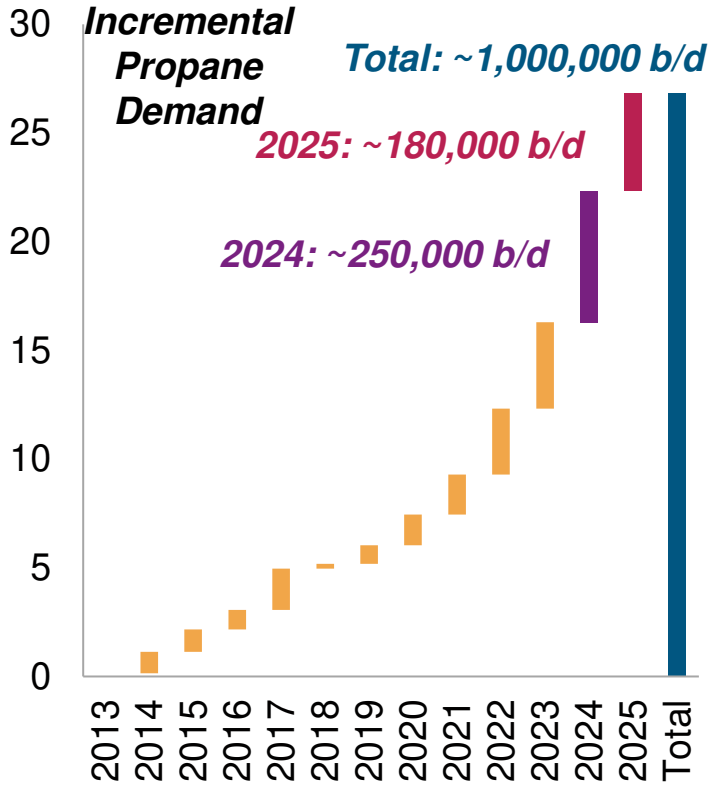
Source: S&P Global Commodity Insights

NGL

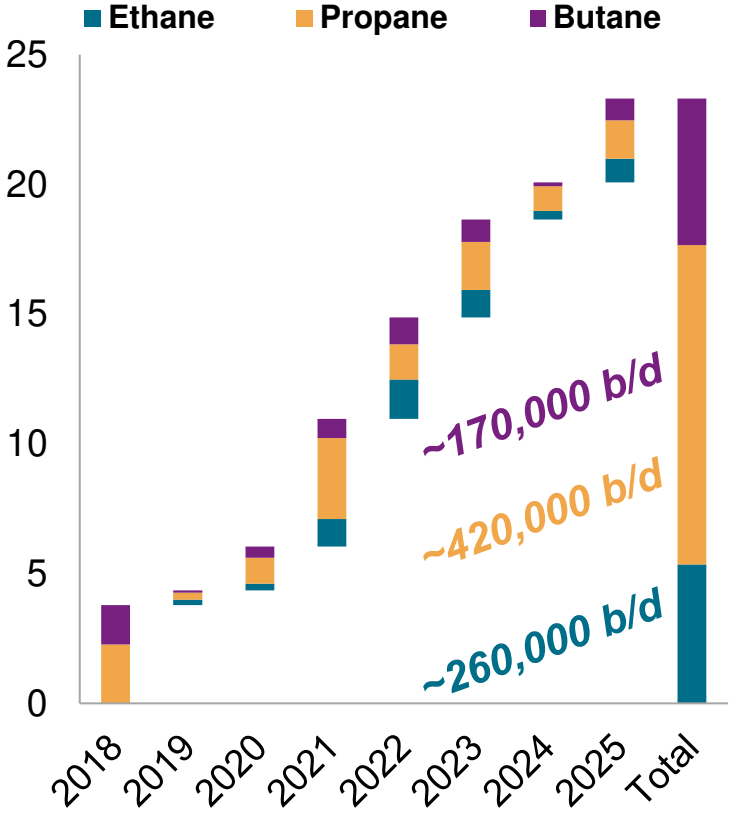
Asia will continue to drive the growth of LPG demand for olefins in the world, however…..

Incremental LPG demand from mainland China for PDH and stream cracking dominates the demand growth

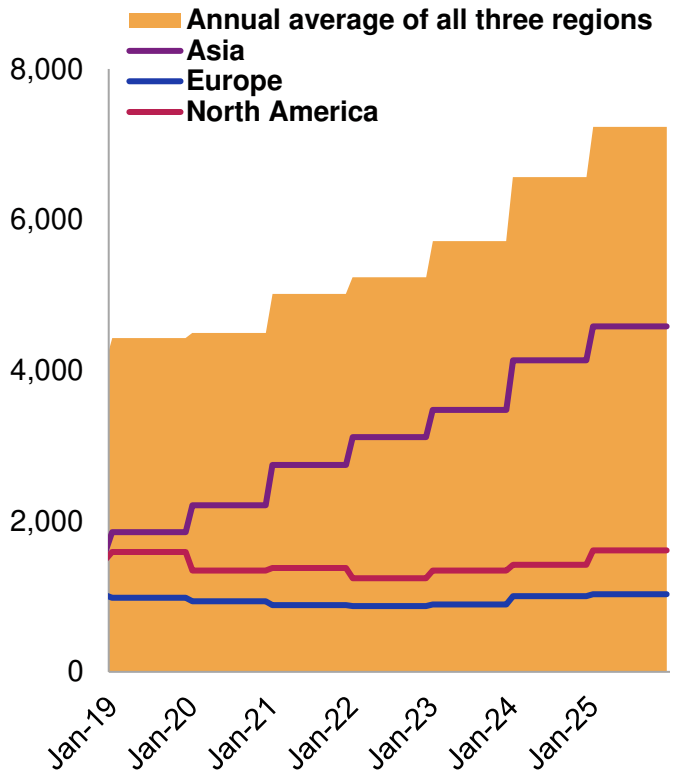
PDH capacity of mainland China: year-over-year growth (million metric tons per year)



Year-over-year growth of NGL demands for steam cracking of mainland China (million metric tons)



LPG demand for olefins: Asia, Europe and North America (million metric tons)



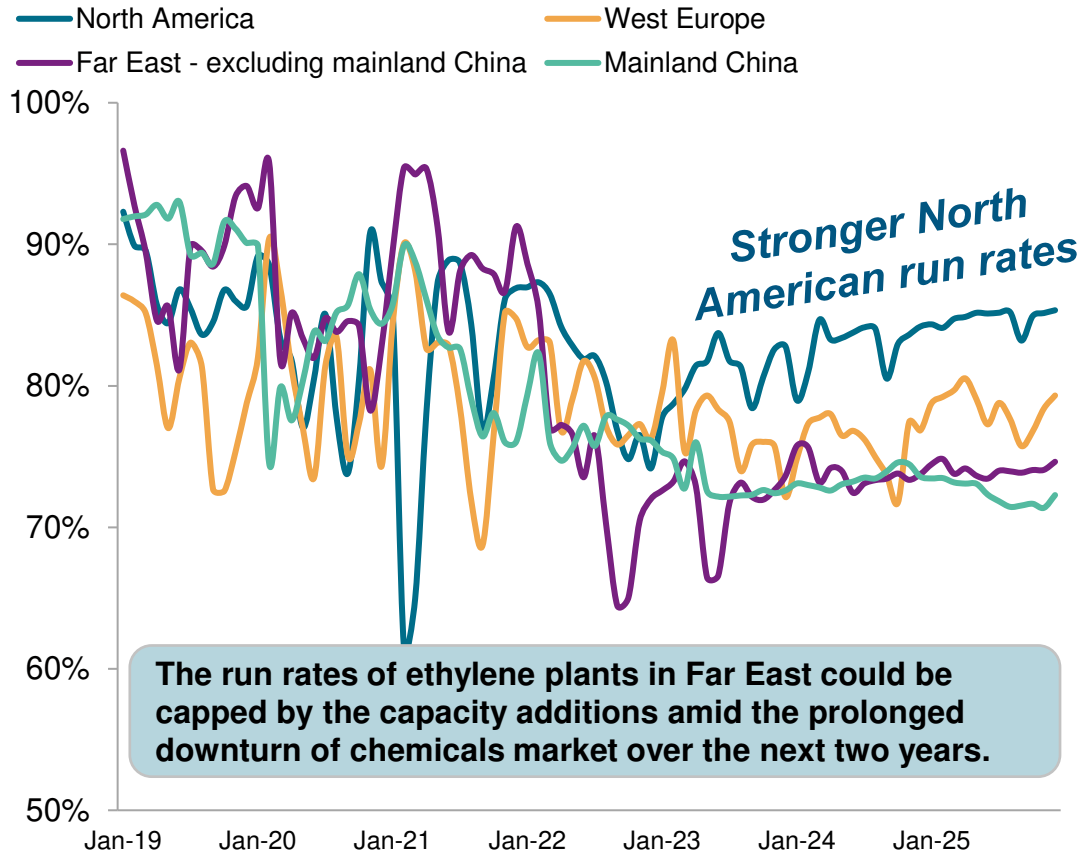
Data compiled May 2024.
Source: S&P Global Commodity Insights

S&P Global
Commodity Insights

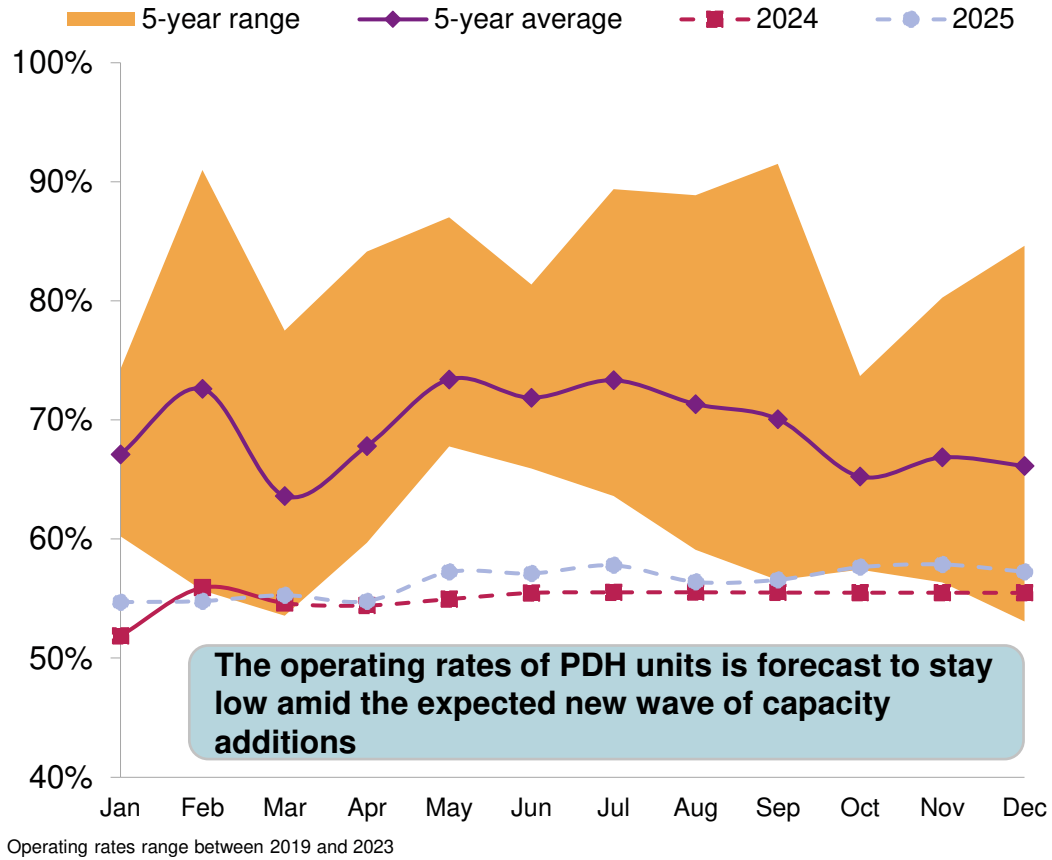
NGL

Given the projected weak chemicals market, the run rates of olefins plants in Asia could stay low over the foreseeable future

Run rates of global ethylene plants



Run rates of PDH units in mainland China



Operating rates range between 2019 and 2023

Despite the subdued run rates of olefins plants, ***the massive new olefins capacity additions can still push to achieve considerable growth of LPG demand***

Data compiled May 2024.
Source: S&P Global Commodity Insights

S&P Global
Commodity Insights

There are various NGL applications across different demand segments, and the importance of each demand segment varies among markets

Residential

- Cooking
- Water heating
- Space heating
- Clothes drying
- Air conditioning
- Grills
- Lights
- Bug killers
- Heat pumps
- Generators

Commercial

- Cooking
- Space heating
- Water heating
- Clothes drying
- Heat pumps
- Cooling
- Cogeneration

Industrial

- Space heating
- Water heating
- Process heating
- Furnaces
- Kiln
- Oven
- Dryers

Engine Fuel

- Fleet vehicles
- Taxi
- Buses
- Deliver vehicles
- Forklifts
- Private vehicles

Agricultural

- Tractor fuel
- Crop drying
- Frost protection
- Poultry brooding
- Flame weeding
- Generators
- Irrigation
- Water heating

Manufactured Gas

- LNG enrichment
- Propane-air (natural gas substitute)

Refining

- Gasoline blending
- Alkylation feedstock

Chemical

- Olefins feedstock
- Propane dehydrogenation
- MTBE / Isooctane
- Maleic Anhydride
- Isomerization

Data compiled May 2024.
Note: Manufactured Gas also known as Town Gas
Source: S&P Global Commodity Insights

In North America, the key demand segments are residential, commercial, and chemical, accounting for over half of domestic demand

Residential

- Cooking
- Water heating
- Space heating
- Clothes drying
- Air conditioning
- Grills
- Lights
- Bug killers
- Heat pumps
- Generators

Commercial

- Cooking
- Space heating
- Water heating
- Clothes drying
- Heat pumps
- Cooling
- Cogeneration

Chemical

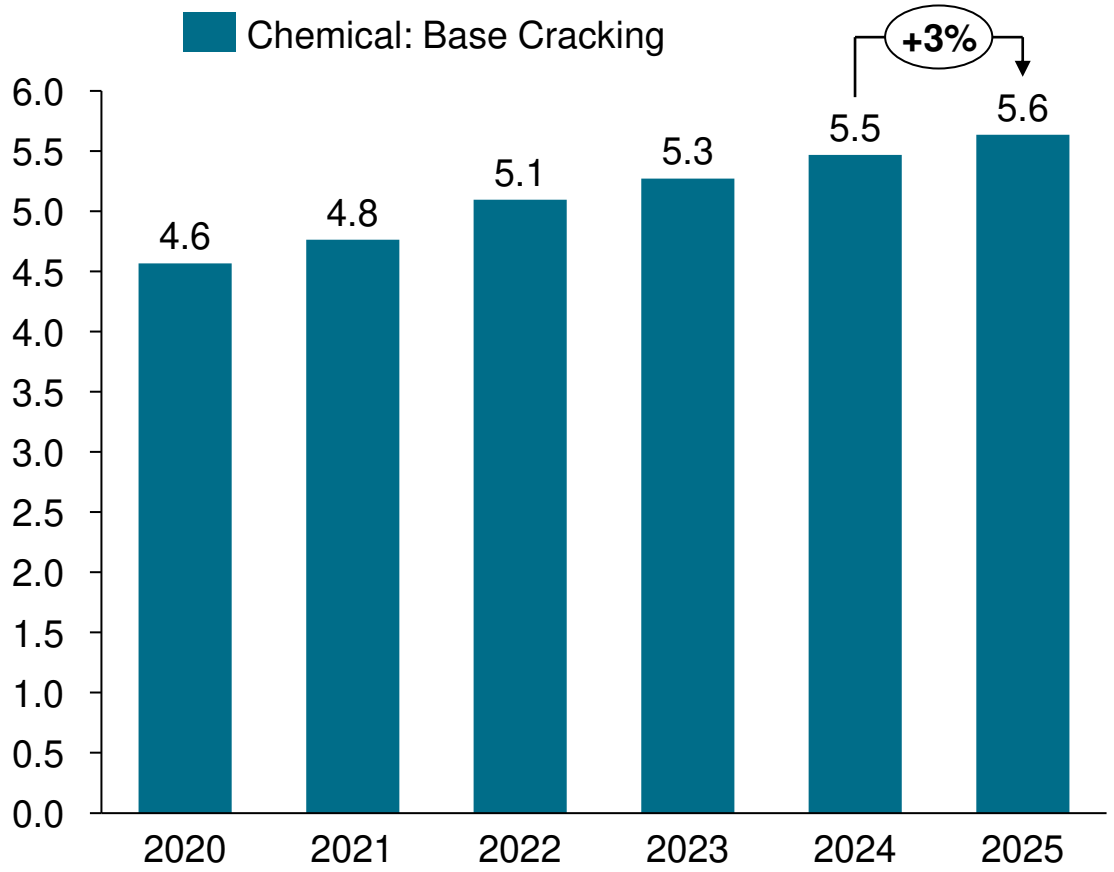
- Olefins feedstock
- Propane dehydrogenation
- MTBE / Isooctane
- Maleic Anhydride
- Isomerization

Data compiled May 2024.
Source: S&P Global Commodity Insights

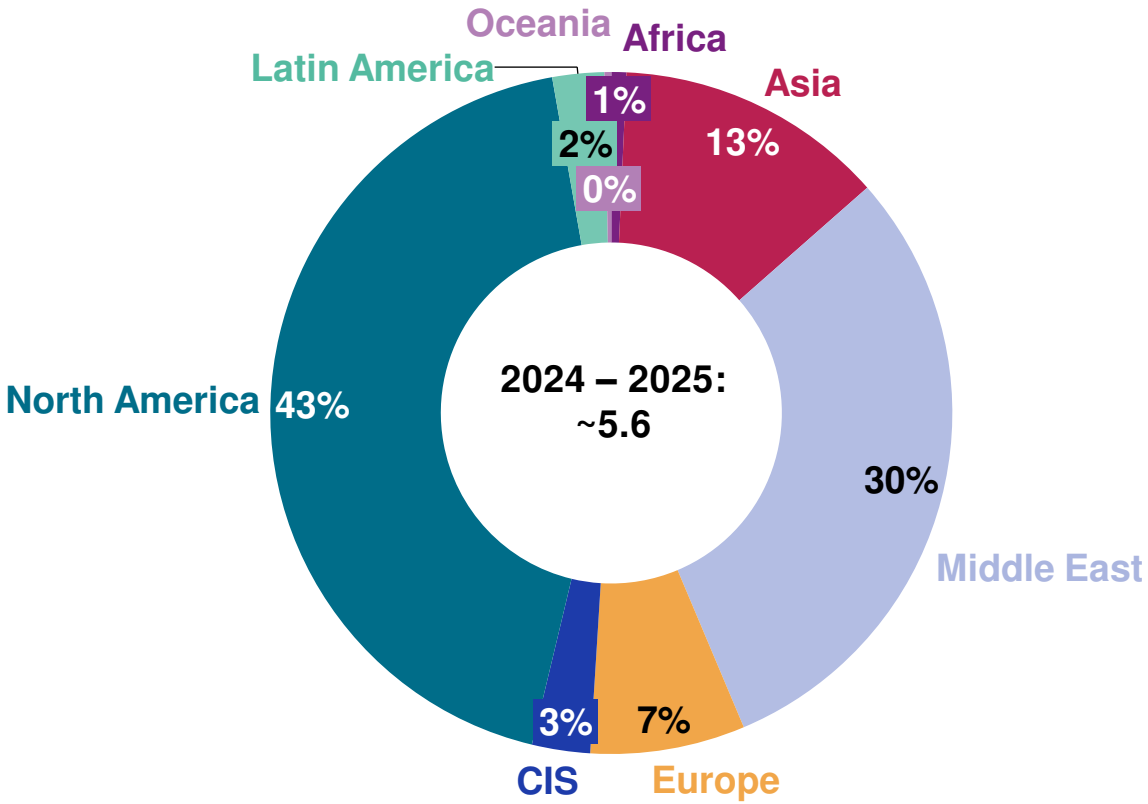
Ethane

Ethane market primary driven by North America and the Middle East; demand is effectively driven entirely by base chemical cracking

Global Ethane Demand by Source (Million b/d)



Global Ethane Demand by Region (Million b/d)



Data compiled May 2024.

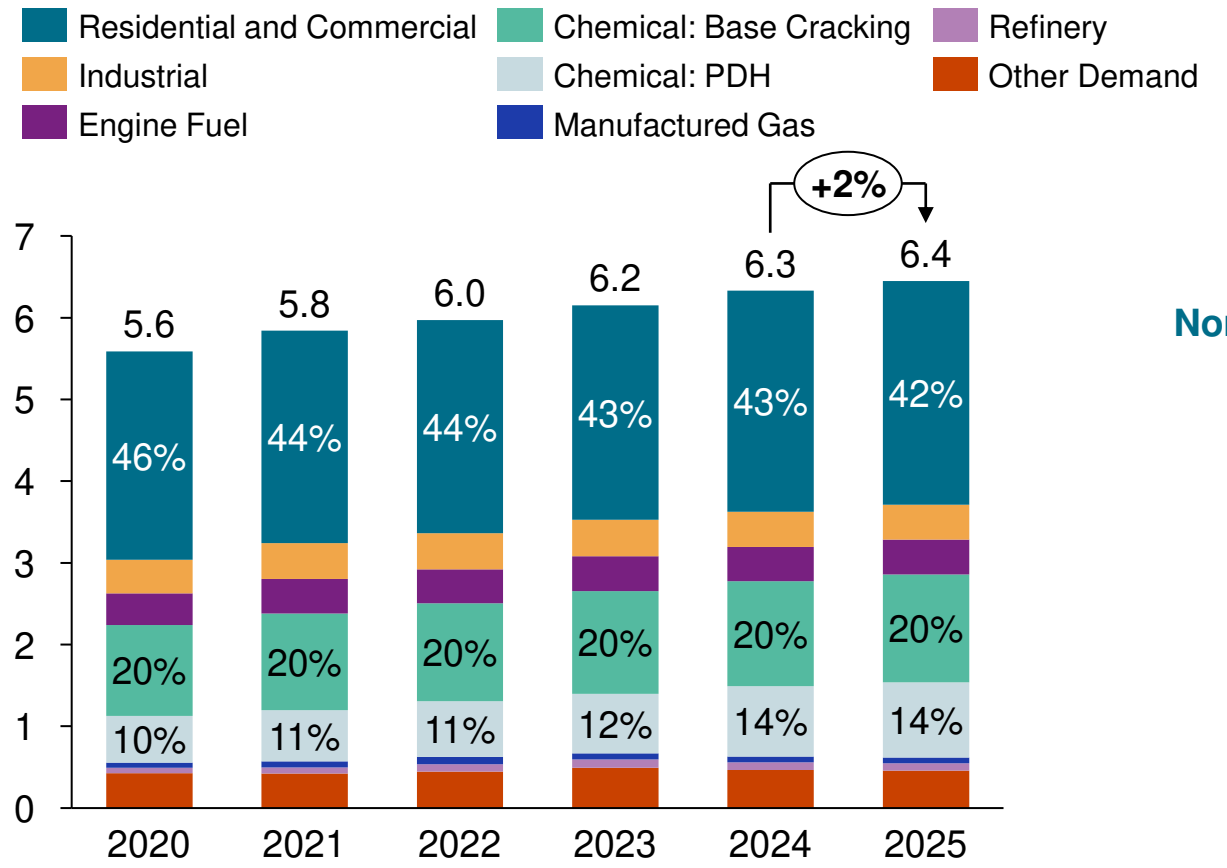
Notes: Global demand/supply estimates based of monthly STO and ASW reports (May 2023). Global demand/supply balance based off prior month regional outlooks. Monthly ethane data is only available for select countries in North America, Latin America, Europe and Africa. For all other regions, a monthly average has been assumed based on the annual figure.

Source: S&P Global Commodity Insights

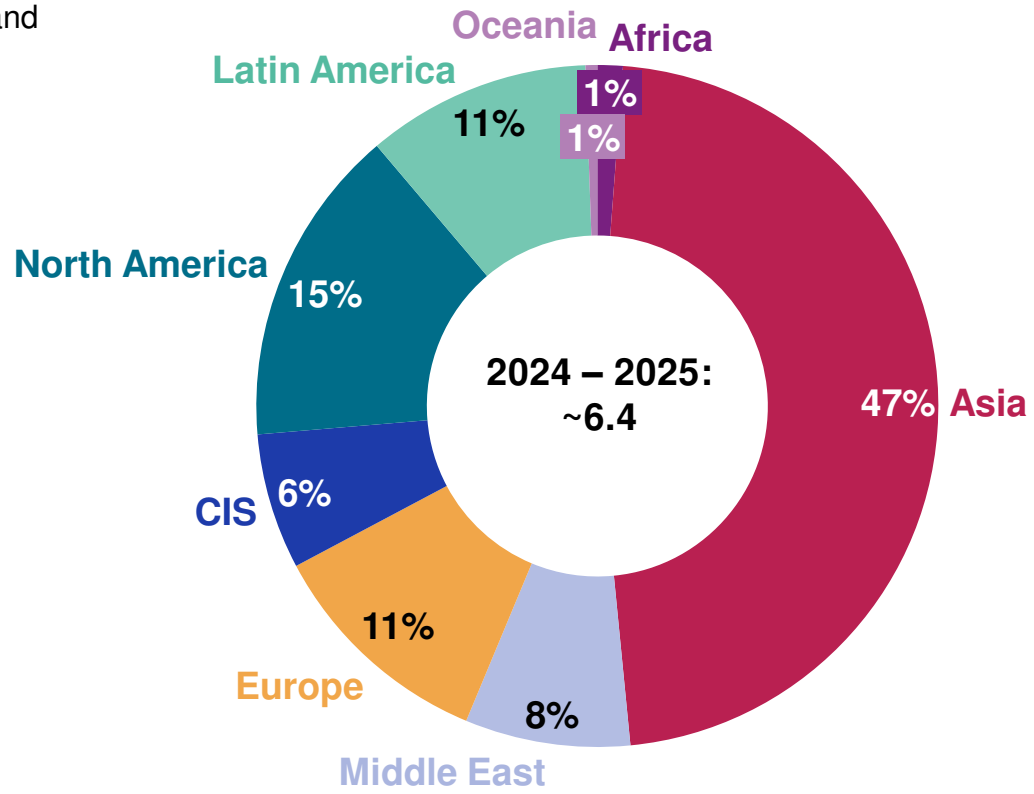
Propane

Total petrochemical demand expected to increase in outlook; Asia expected to account for nearly 50% of propane demand

Global Propane Demand by Source (Million b/d)



Global Propane Demand by Region (Million b/d)

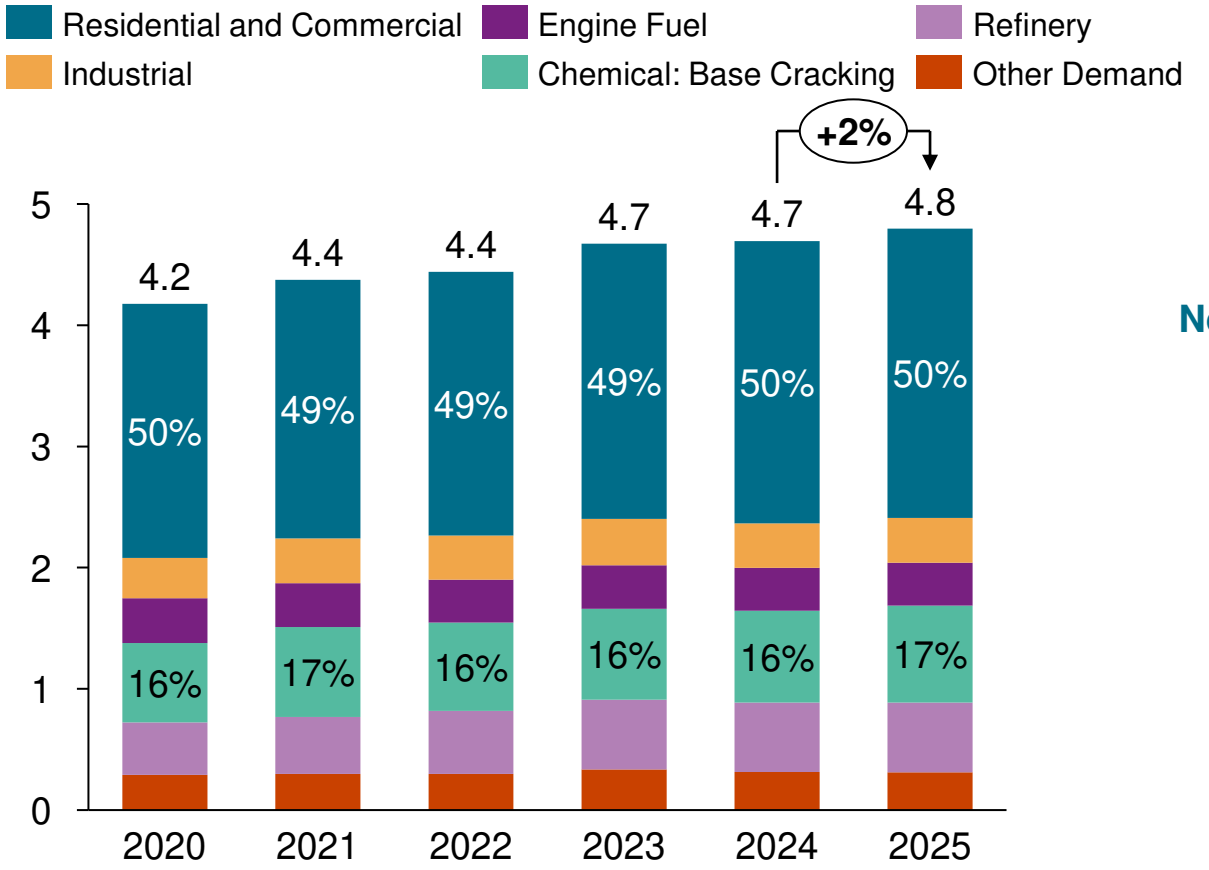


Data compiled May 2024.
Notes: Global demand/supply estimates based of monthly STO and ASW reports (May 2023). Global demand/supply balance based off prior month regional outlooks. Supply includes net storage withdrawals.
Source: S&P Global Commodity Insights

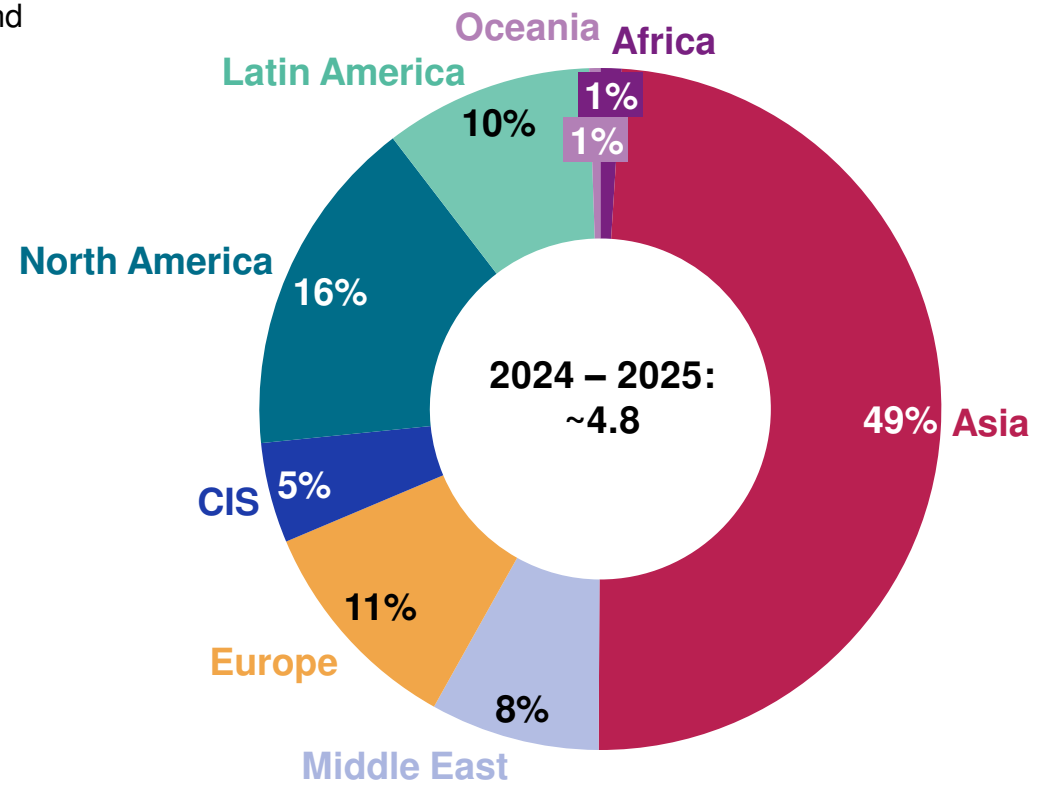
Butane

Similar to propane, in that residential and commercial accounts for a significant portions, but petrochemical demand is more limited

Global Butane Demand by Source (Million b/d)



Global Butane Demand by Region (Million b/d)



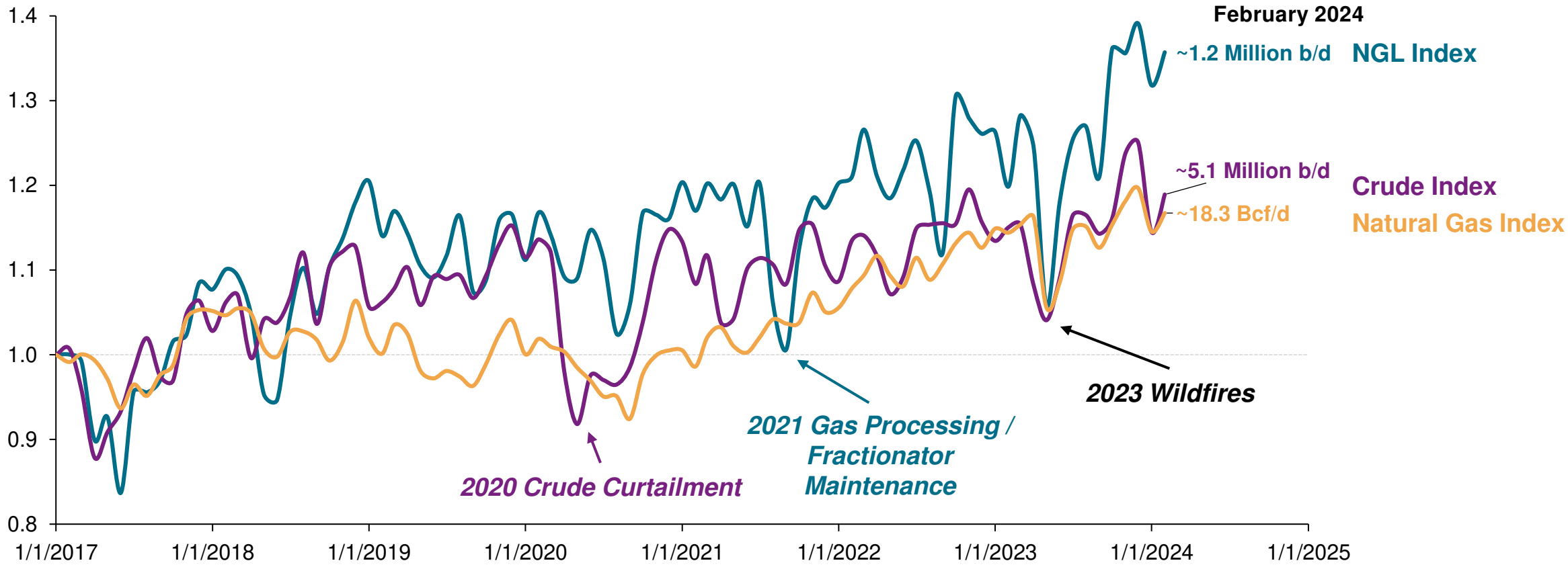
Data compiled May 2024.
Notes: Global demand/supply estimates based of monthly STO and ASW reports (May 2023). Global demand/supply balance based off prior month regional outlooks. Supply includes net storage withdrawals.
Source: S&P Global Commodity Insights

Canada NGL Market Update

S&P Global
Commodity Insights

The growth rates of Canadian NGL, crude oil, and natural gas began to diverge in 2018, with NGLs showing a clear advantage compared to the other two resources

Canadian crude oil, natural gas and NGL production growth index



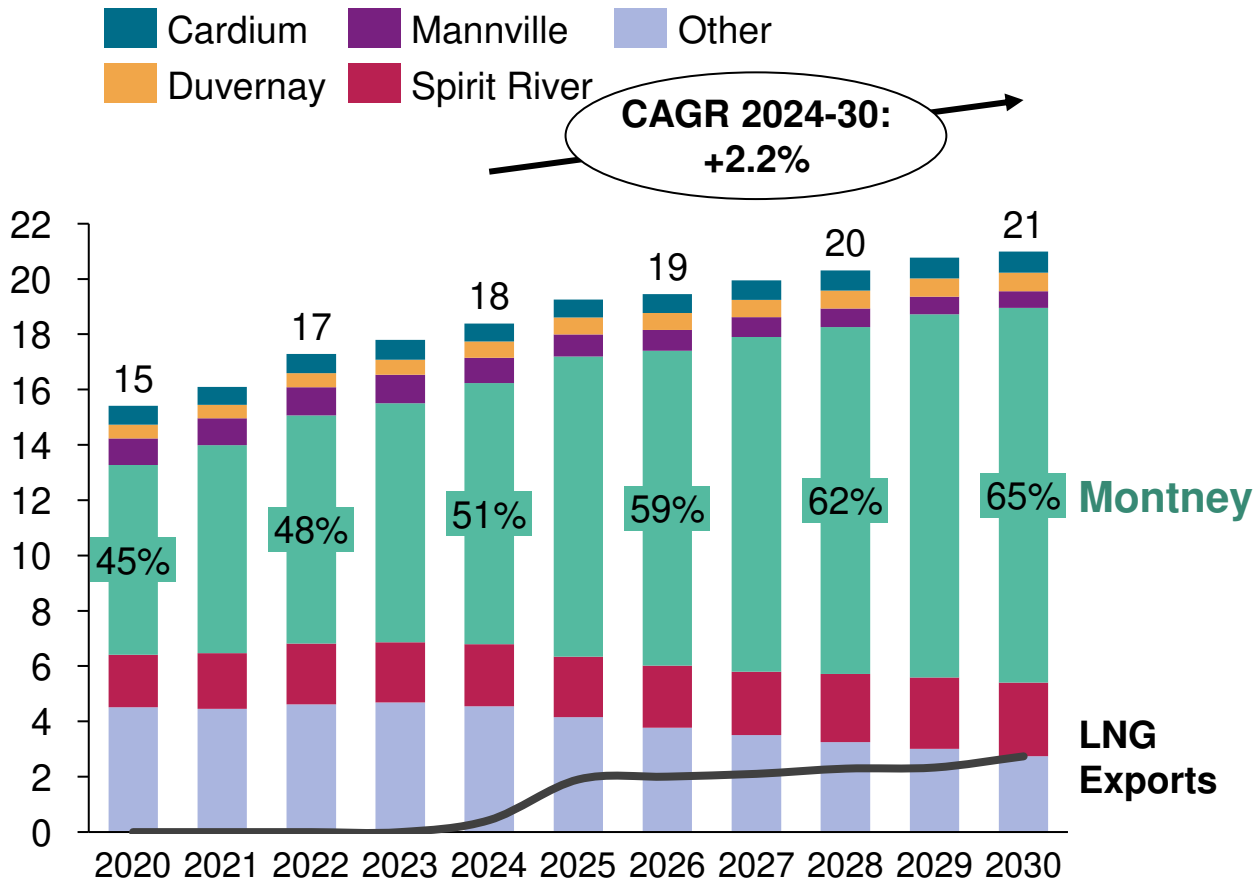
Data compiled May 2024.

Note: Marketable natural gas is shown for gas production. Crude production includes heavy and bitumen crude, light crude and equivalent production. NGL data only represents gas processing / fractionation-based production and does not include refinery NGL volumes. NGL production does not include condensate volumes. Actual production data for the latest Statistics Canada month is shown in the chart for Canadian crude, natural gas and NGLs.

Sources: S&P Global Commodity Insights, Statistics Canada, Canada Energy Regulator

LNG exports remain the main driver of Western Canadian demand growth; nearly all Canadian production growth is expected to come from the Montney formation

Western Canada natural gas production and LNG exports (Bcf/d)



Data compiled February 2024.
Note: CAGR = Compound Annual Growth Rate
Source: S&P Global Commodity Insights

Western Canada LNG Projects

LNG Canada Phase 1
Commercial Start: July 2025
Capacity: ~1.84 Bcf/d

Woodfibre LNG
Commercial Start: November 2027
Capacity: ~0.28 Bcf/d

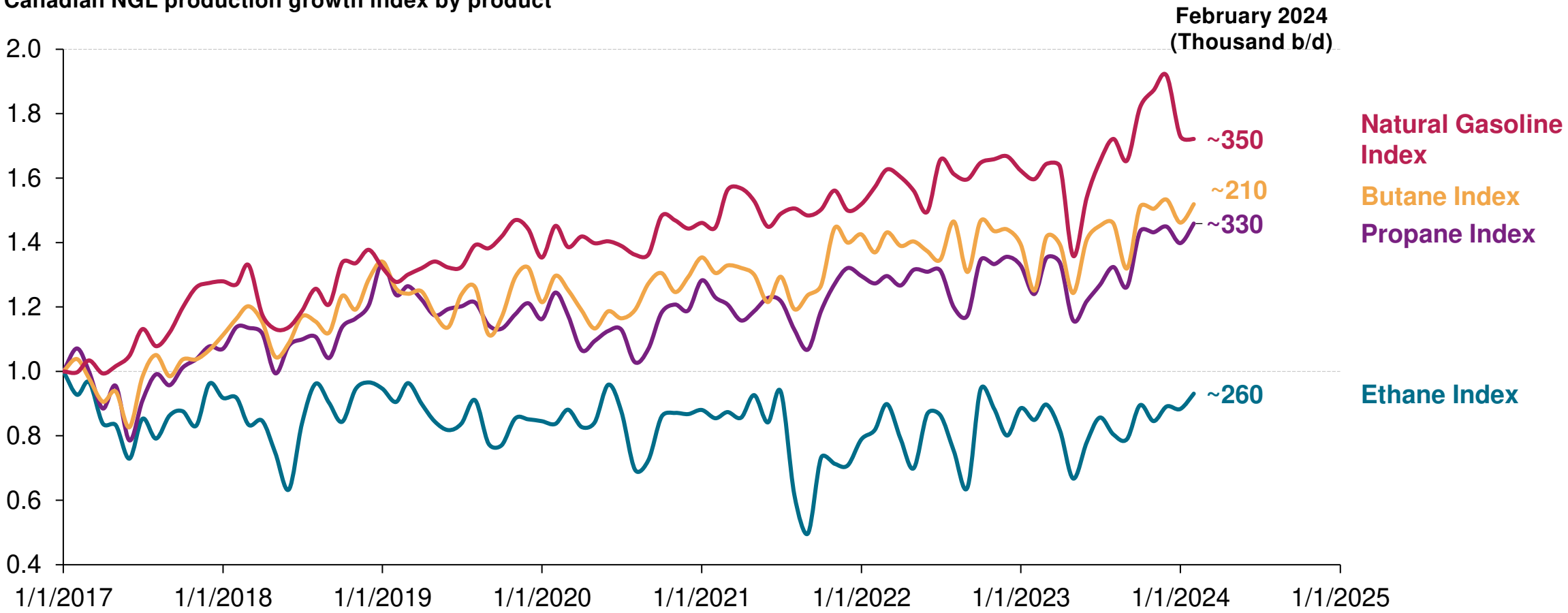
Cedar FLNG
Commercial Start: January 2029
Capacity: ~0.39 Bcf/d

Total 2030 LNG Export Capacity: ~2.5 Bcf/d

S&P Global
Commodity Insights

Heavier NGL products are experiencing stronger growth compared to lighter NGLs in Canada; ethane production has remained relatively low and stable

Canadian NGL production growth index by product



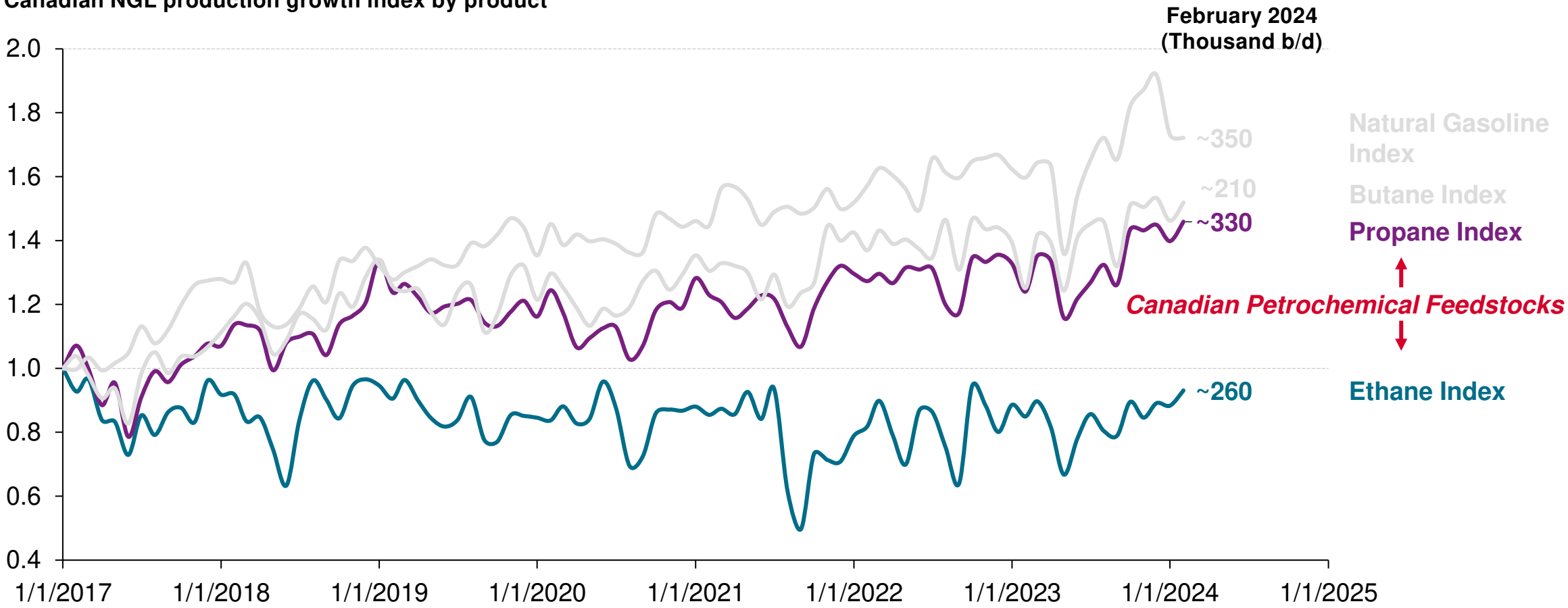
Data compiled May 2024.

Note: NGL data only represents gas processing / fractionation-based production and does not include refinery NGL volumes. Natural gasoline production does not include condensate volumes. Actual production data for the latest Statistics Canada month is shown in the chart for Canadian NGLs.

Sources: S&P Global Commodity Insights, Statistics Canada, Canada Energy Regulator

Ethane production linked directly with petrochemical demand since varying quantities are currently rejected; propane production linked with upstream activity

Canadian NGL production growth index by product



Data compiled May 2024.

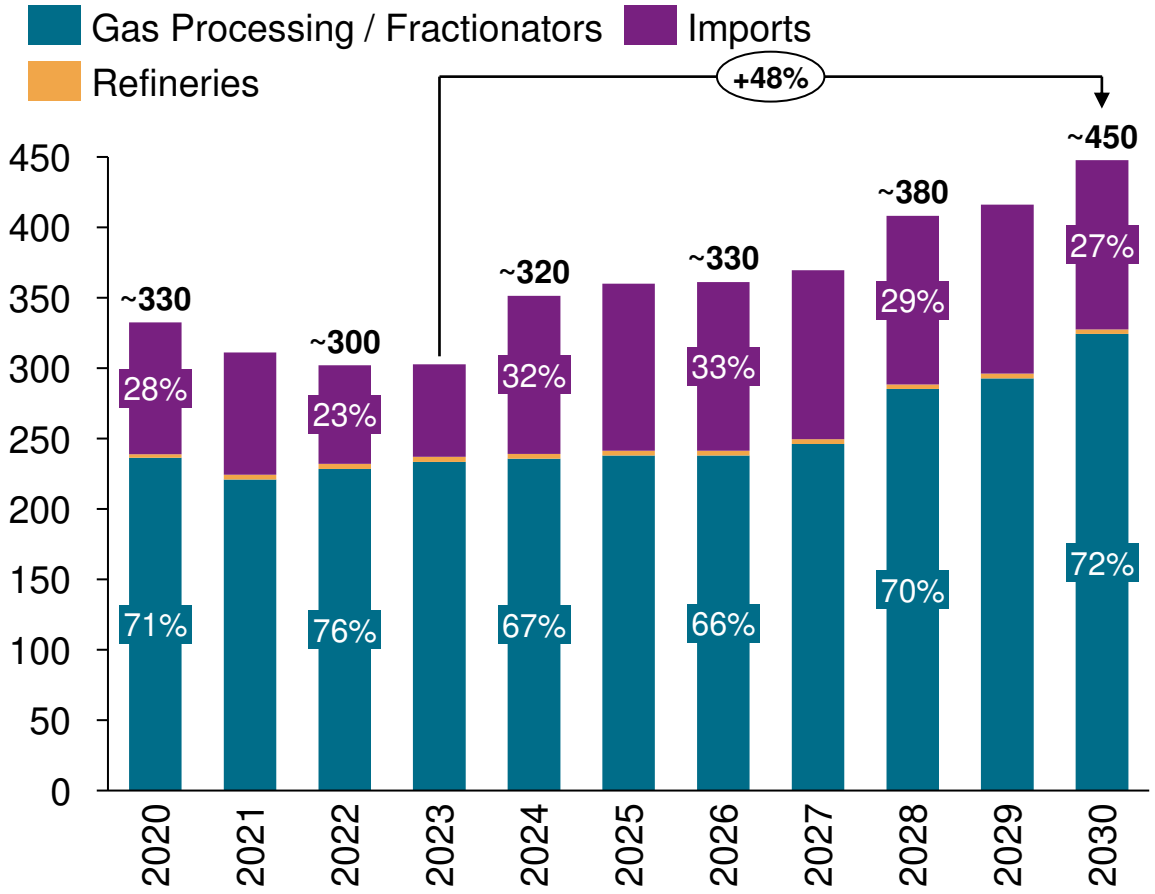
Note: NGL data only represents gas processing / fractionation-based production and does not include refinery NGL volumes. Natural gasoline production does not include condensate volumes. Actual production data for the latest Statistics Canada month is shown in the chart for Canadian NGLs.

Sources: S&P Global Commodity Insights, Statistics Canada, Canada Energy Regulator

Ethane

Canadian ethane supply should increase from lows seen in 2022, but domestic production will remain soft until ethane demand recovers

Canada ethane supply (Thousand b/d)



Data compiled May 2024.
Notes: Supply excludes net inventory changes and other adjustments.
Sources: S&P Global Commodity Insights, AER, Government of British Columbia, Government of Saskatchewan, Statistics Canada, CER, EIA

- Production is expected to remain weak for the next few years due to weaker petrochemical demand and ethylene margins. However, demand is expected to increase with Nova Chemical's Corunna cracker expansion and Dow's net-zero ethylene cracker.
- It is anticipated that operating rates at petrochemical plants will be lower over the next few years across North America. If Canadian rates are higher than forecasted, additional production and/or imports will be necessary.

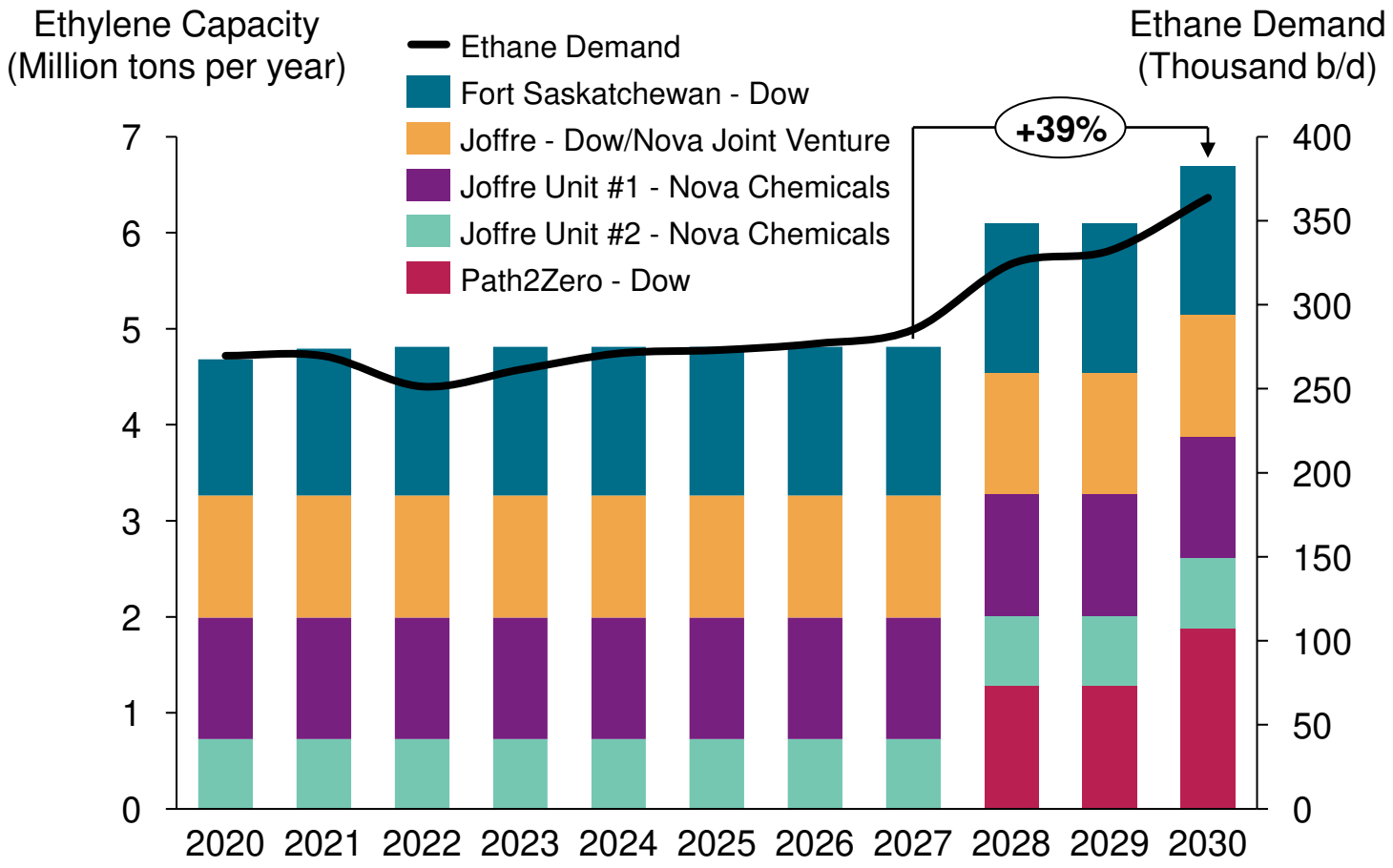
Domestic production will ultimately depend on domestic petrochemical demand and US import volumes since varying quantities of Canadian ethane are currently rejected.

S&P Global
Commodity Insights

Ethane

Western Canadian ethane demand will increase significantly with the completion of Dow's Path2Zero cracker

Western Canada ethylene capacity and ethane demand



Data compiled May 2024.
Source: S&P Global Commodity Insights

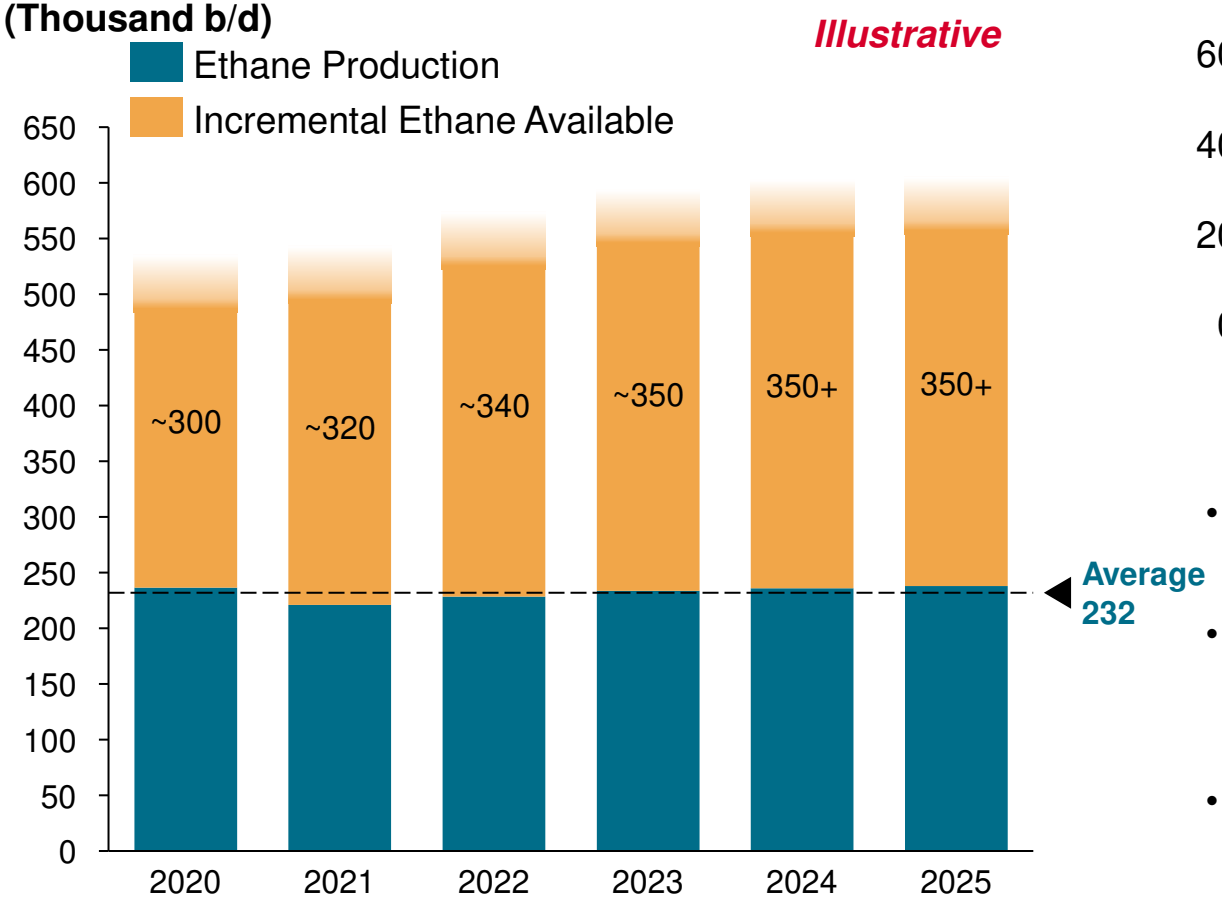
- S&P Global has assumed that Phase 1 of Dow's Path2Zero cracker will begin operations in 2028 with ~1.29 million metric tons per year of ethylene capacity.
  - Phase 2 is assumed to come online in 2030 with an additional ~600,000 tons per year of ethylene capacity.
  - In total, this facility is anticipated to boost Western Canadian ethane demand by around 110,000 b/d.
- Total ethane demand will be around 364,000 b/d by 2030, assuming all ethylene facilities operate at a utilization rate of ~90%.

S&P Global
Commodity Insights

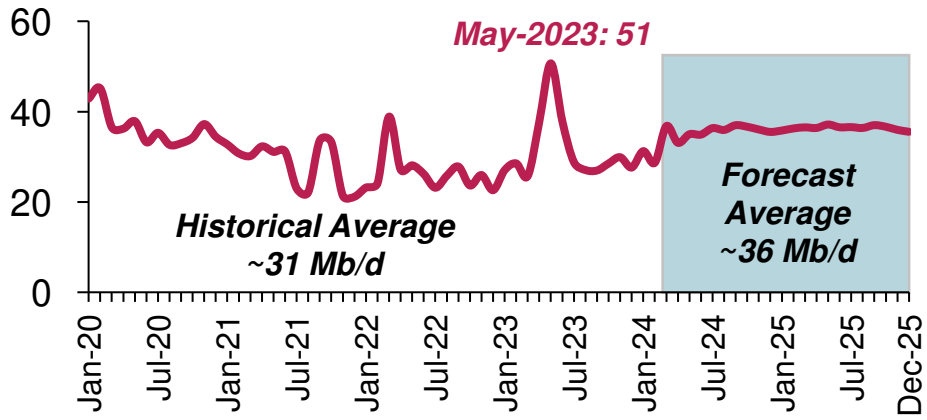
Ethane

Varying quantities of Canadian ethane are currently rejected but adequate supply is available; new extraction facilities would be required

Western Canada estimated ethane rejection and production (Thousand b/d)



Alberta ethane imports (Thousand b/d)



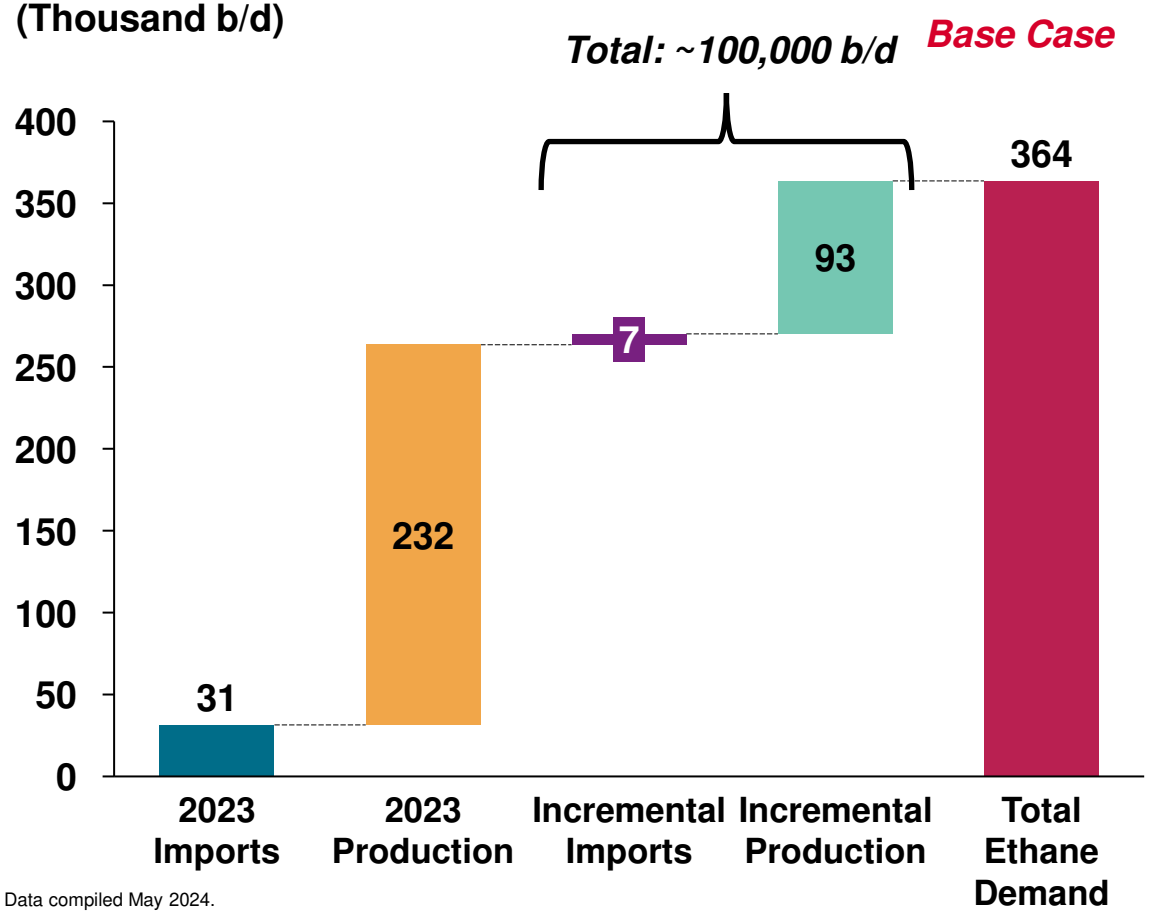
- Ample ethane supply should be available as feedstock for the new Dow ethylene cracker.
- Total ethane available in Western Canada will grow as natural gas production increases – however, additional ethane extraction capacity would likely be required.
- Ethane demand that is not met with local production and recovery will be met by imports.

Data compiled May 2024.
Notes: Recoverable ethane estimated based on upstream reported gallons of NGLs produced per m3 of gas processed, an assumed recovery factor and forecasted natural gas production. Assumed rejection rate of between 30-50%.
Sources: S&P Global Commodity Insights, AER, Government of British Columbia, Government of Saskatchewan, Statistics Canada, CER, EIA

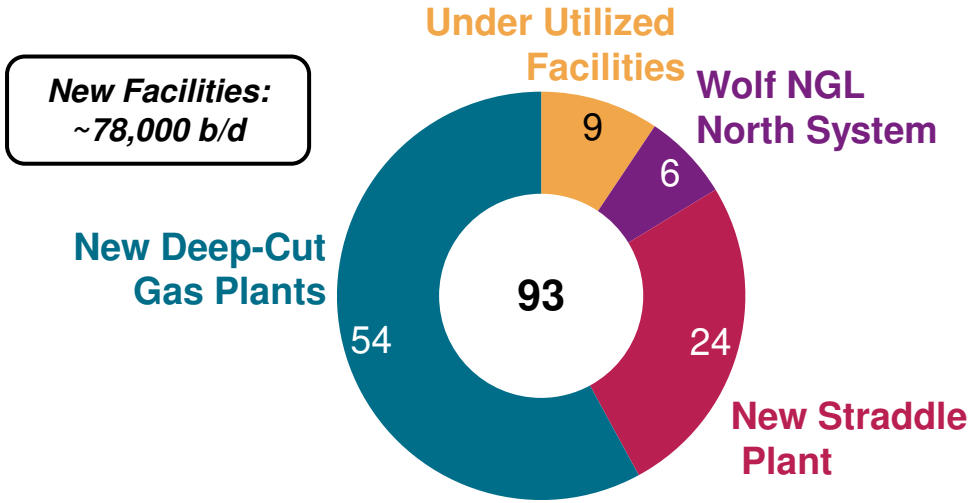
Ethane

Incremental ethane demand will be met by a combination of stronger domestic production, along with stronger imports

Incremental ethane supply for Western Canada in 2030 (Thousand b/d)



Sources of incremental ethane production (Thousand b/d)



- S&P Global assumes that the incremental ethane demand will be met by a combination of increased imports and domestic production. The additional domestic production could come from both existing and new facilities.
  - 1 Bcf/d Straddle Plant
  - ~6 New 200 Mcf/d Deep-Cut Gas Processing Plants

Data compiled May 2024.

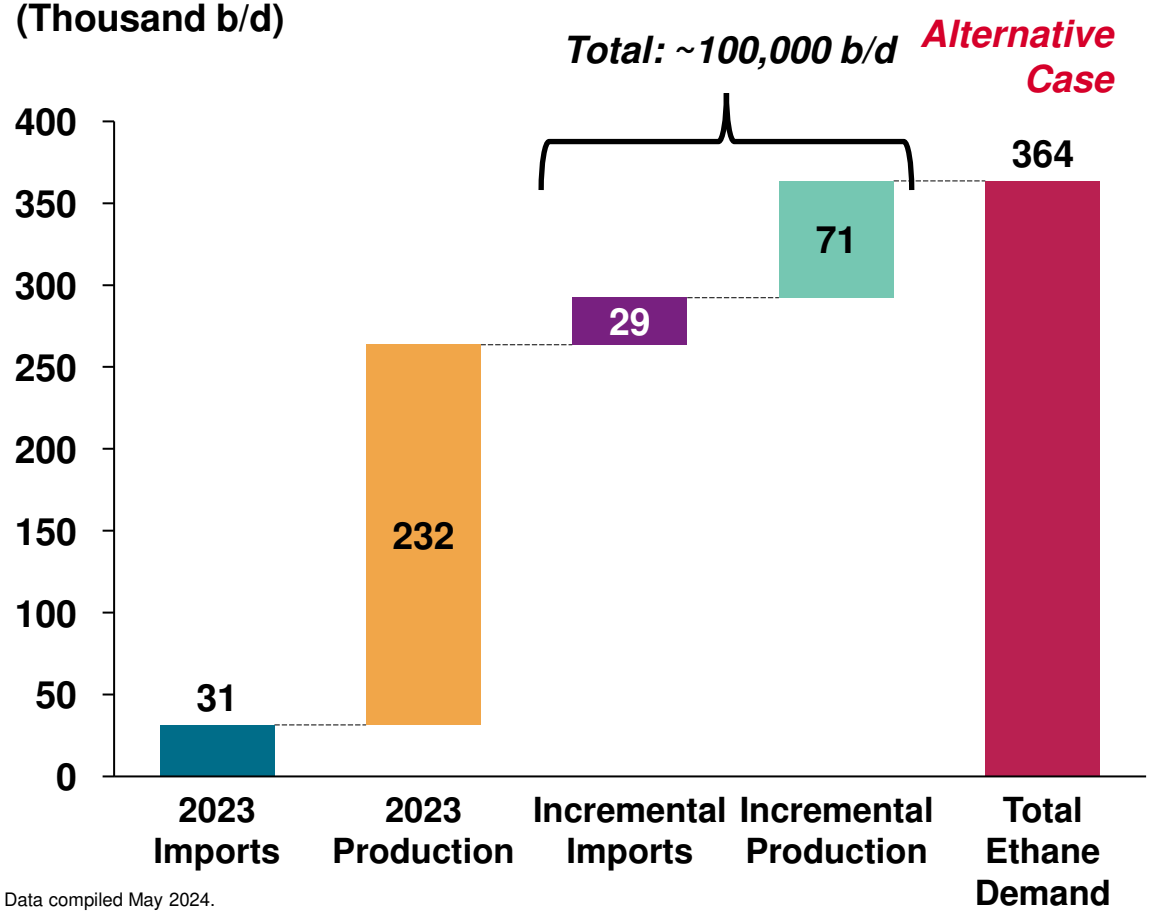
Notes: Ethane demand based on the assumption that all ethylene facilities operate at a utilization rate of ~90%. Based on an assumed ~1 Bcf/d straddle plant design, processing marketable specification natural gas with a utilization of 95%. Number of gas plants based on an assumed 200 MMcf/d deep-cut gas processing plant design with a utilization of 95%. Deep-cut plant assumed to be fed by a stream of liquid-rich Montney natural gas and an ethane recovery rate of 90%.

Source: S&P Global Commodity Insights

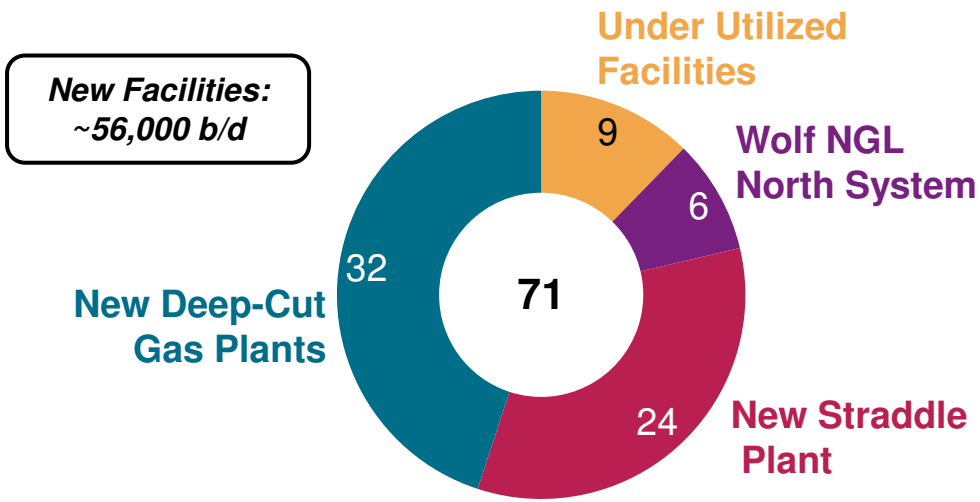
Ethane

Also possible to see substantially stronger ethane imports, as the Vantage pipeline has an import capacity of ~68,000 b/d

Incremental ethane supply for Western Canada in 2030 (Thousand b/d)



Sources of incremental ethane production (Thousand b/d)



- If ethane imports were to increase to around 60,000 barrels per day, then a lower amount of incremental ethane production would be necessary.
- If this were to occur, then incremental domestic production could again be met through existing and new facilities.
  - 1 Bcf/d Straddle Plant
  - ~4 New 200 Mcf/d Deep-Cut Gas Processing Plants

Data compiled May 2024.

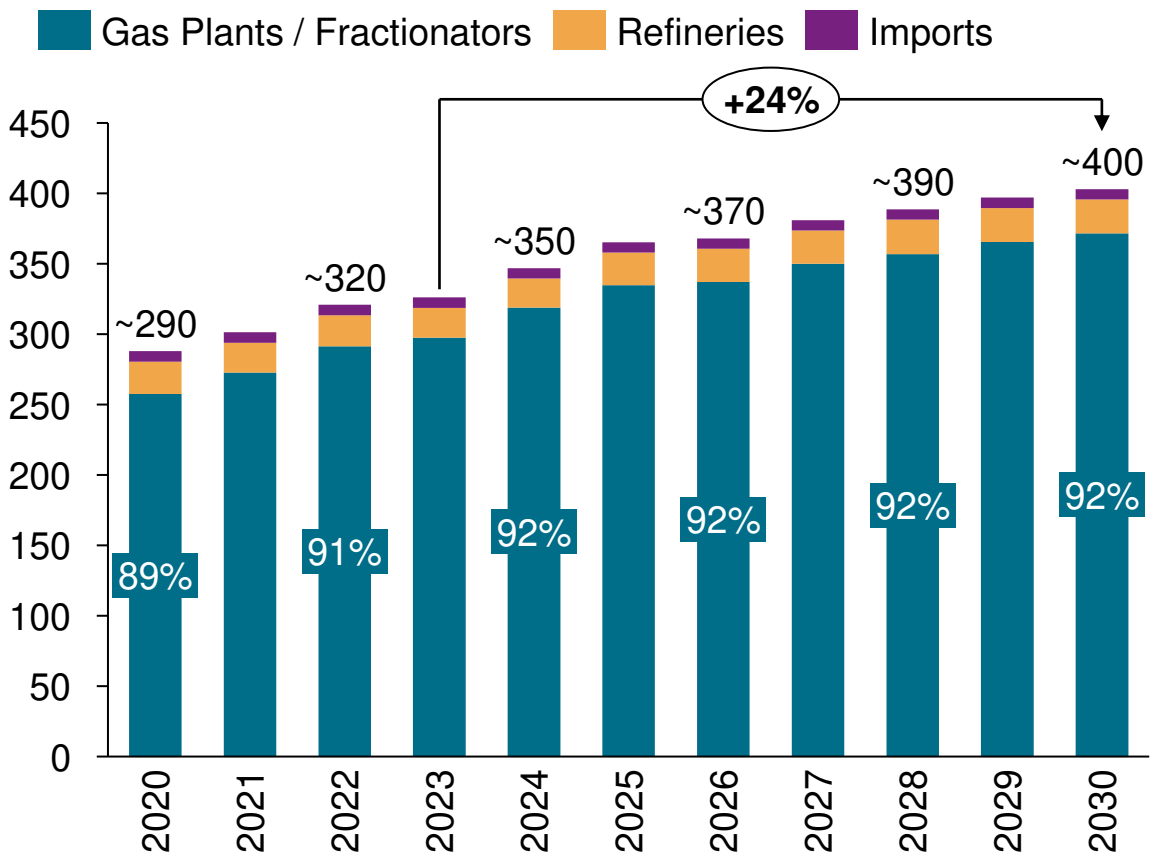
Notes: Ethane demand based on the assumption that all ethylene facilities operate at a utilization rate of ~90%. Based on an assumed ~1 Bcf/d straddle plant design, processing marketable specification natural gas with a utilization of 95%. Number of gas plants based on an assumed 200 MMcf/d deep-cut gas processing plant design with a utilization of 95%. Deep-cut plant assumed to be fed by a stream of liquid-rich Montney natural gas and an ethane recovery rate of 90%.

Source: S&P Global Commodity Insights

Propane

Canadian propane supply is expected to continue recovering following a dip in 2020; longer-term outlook growth will be driven by LNG exports

Canada propane supply (Thousand b/d)



Data compiled May 2024.
Notes: Supply excludes net inventory changes and other adjustments. Refinery production includes bio-propane production.
Sources: S&P Global Commodity Insights, AER, Government of British Columbia, Government of Saskatchewan, Statistics Canada, CER, EIA

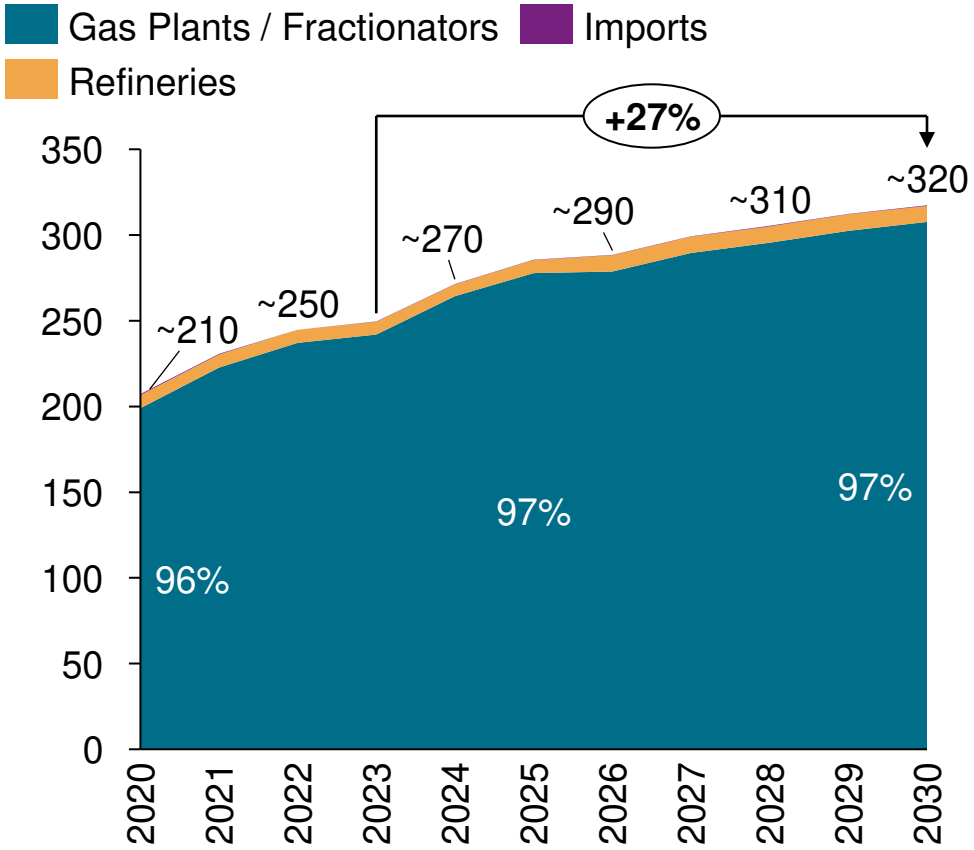
- Canadian propane production for 2023 averaged around 326,000 b/d, while 2024 average production will be stronger still at around 350,000 b/d.
- Production is expected to continue to grow and will increase by roughly 75,000 b/d over the period of 2023 to 2030.
- Natural gas production continues to be the driver of incremental propane growth.
  - Domestic production will far exceed domestic demand; especially in Western Canada, and as a result excess barrels are directed towards the US market or West Coast marine export terminals.

S&P Global
Commodity Insights

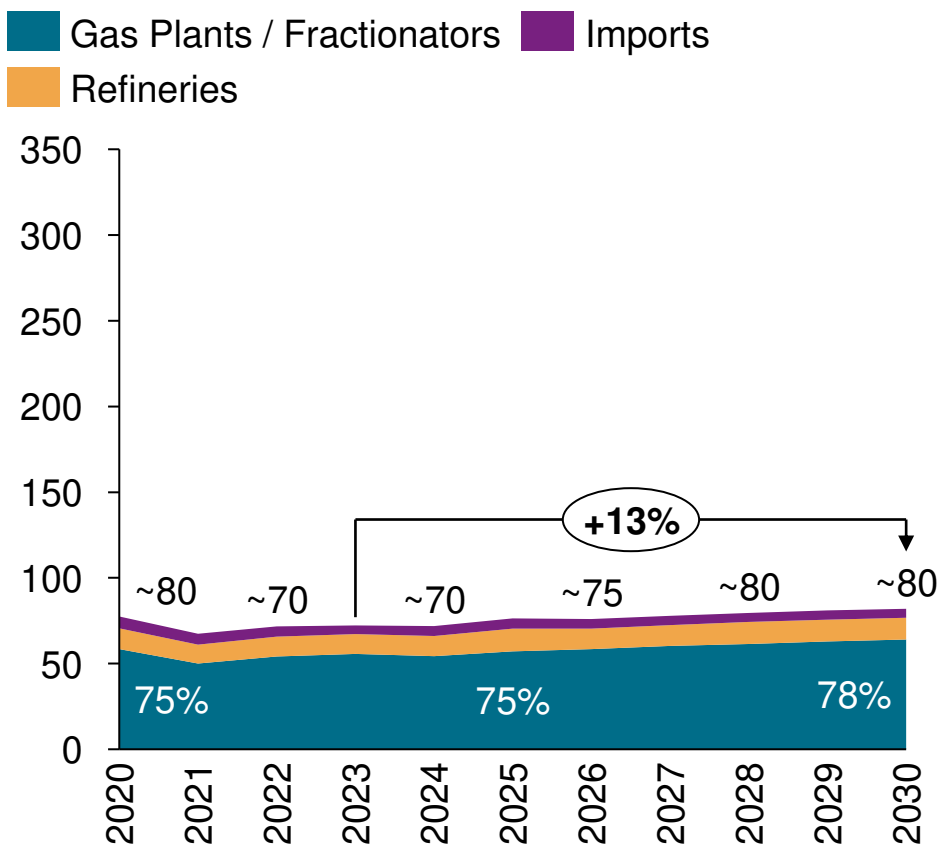
Propane

Western Canada is expected to see steady growth over the forecast period while Eastern Canada will see relatively more muted growth

Western Canada propane supply (Thousand b/d)



Eastern Canada propane supply (Thousand b/d)



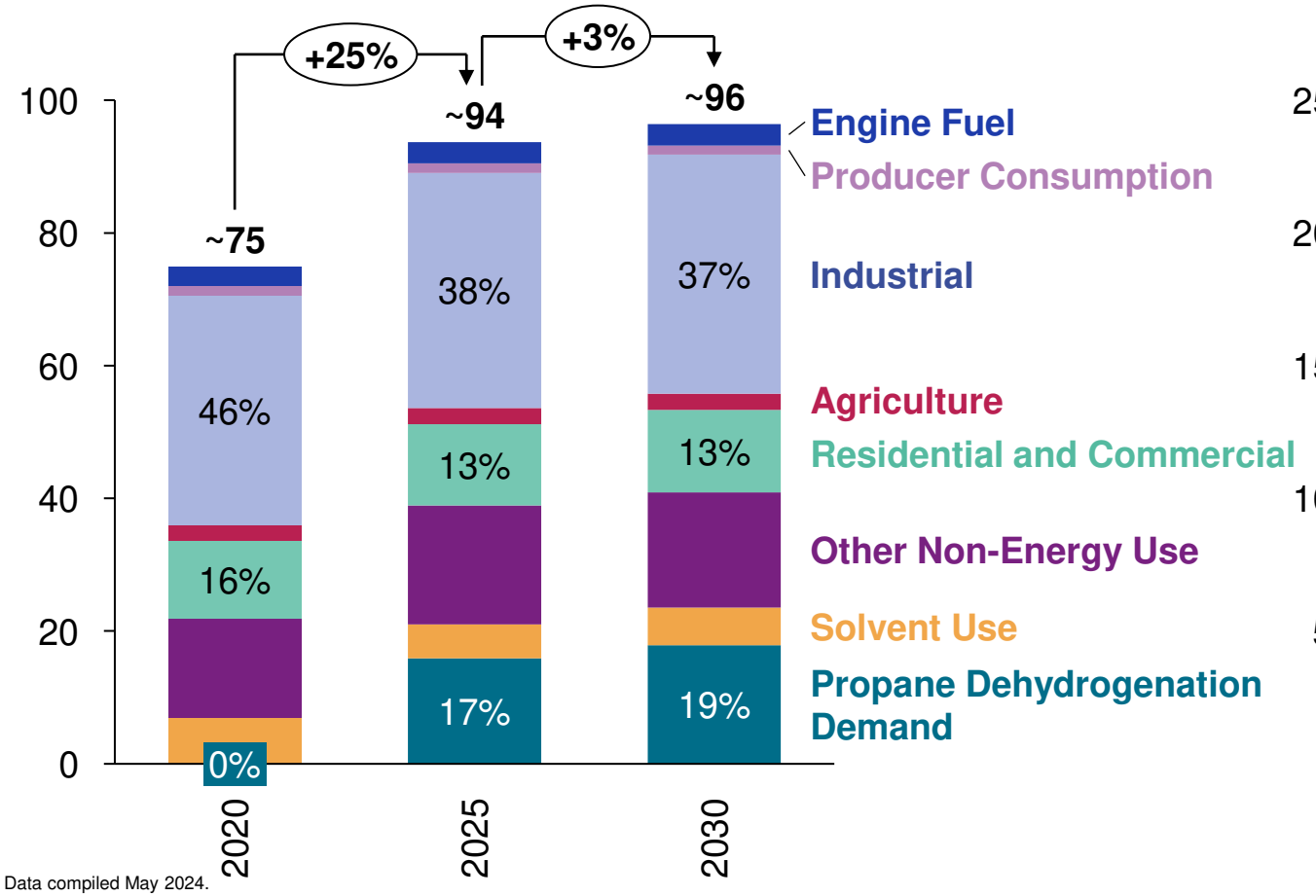
Data compiled May 2024.
Notes: Excludes supply changes as a result of Reclassification/Other/Inventory Change and Inter-regional movements. Refinery production includes bio-propane production.
Sources: S&P Global Commodity Insights, Statistics Canada

S&P Global
Commodity Insights

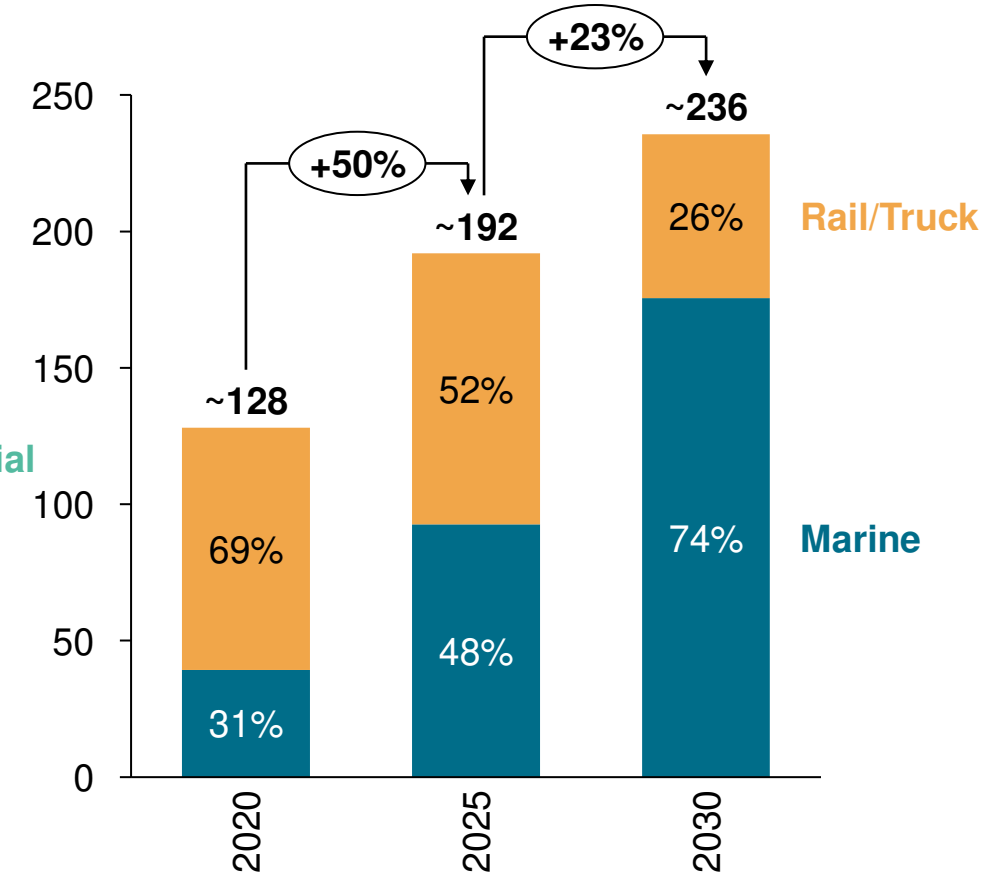
Propane

Although Western Canadian propane demand will grow, primarily due to PDH demand, it will be overshadowed by significantly stronger exports

Western Canada domestic propane demand (Thousand b/d)



Western Canada propane exports (Thousand b/d)

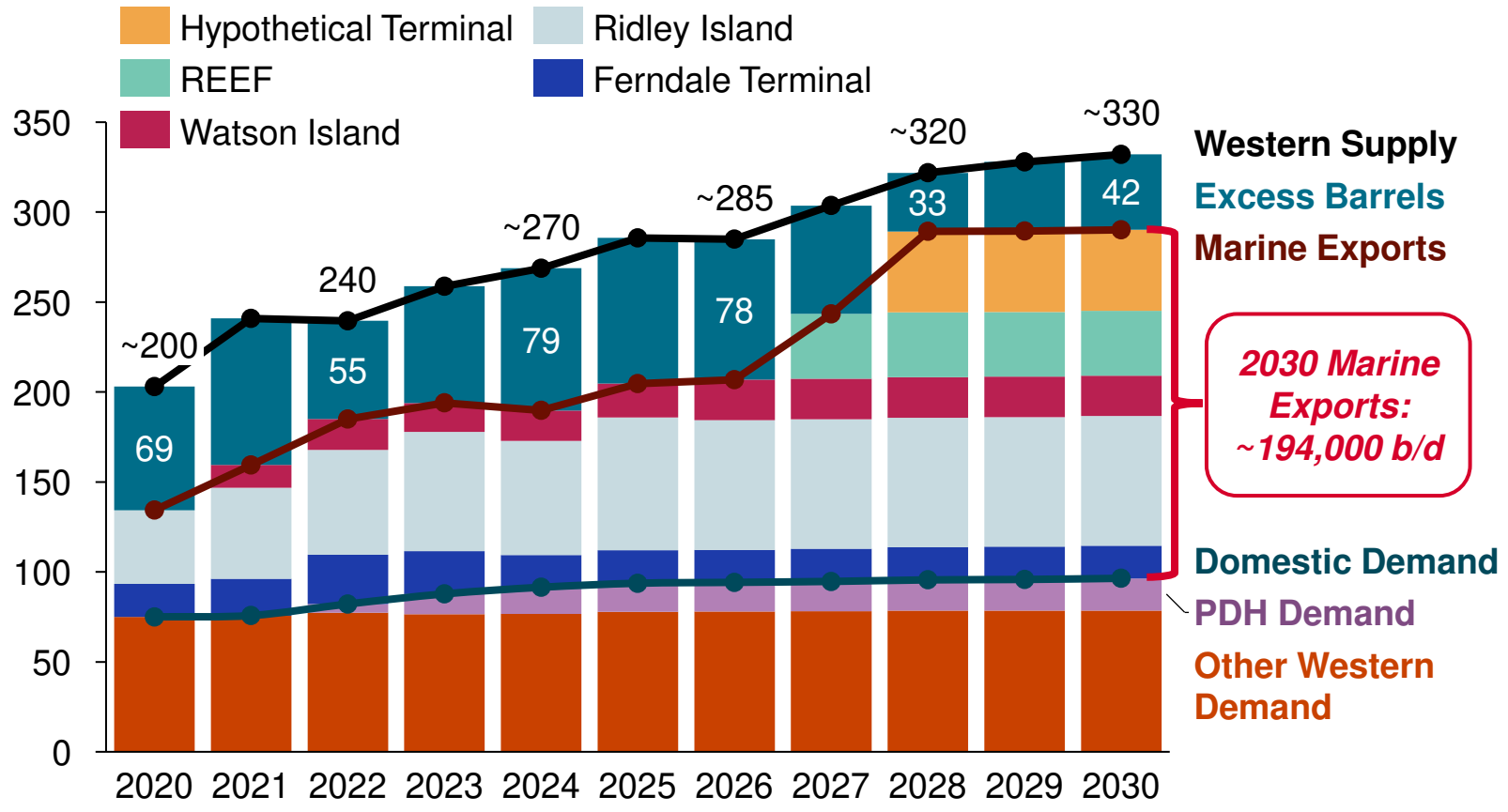


Data compiled May 2024.
Notes: Marine exports do not include rail volumes directed to Ferndale, Washington.
Sources: S&P Global Commodity Insights, AER, Government of British Columbia, Government of Saskatchewan, Statistics Canada, CER, EIA

Propane

Increased export of propane via marine terminals will be bolstered by the addition of new facilities, albeit at the cost of surplus barrels

Western Canada propane supple and dispositions (Thousand b/d)



Data compiled May 2024.
Notes: Assumed marine export terminals operate at a utilization rate of 90%.
Sources: S&P Global Commodity Insights, AER, Government of British Columbia, Government of Saskatchewan, Statistics Canada, CER, EIA

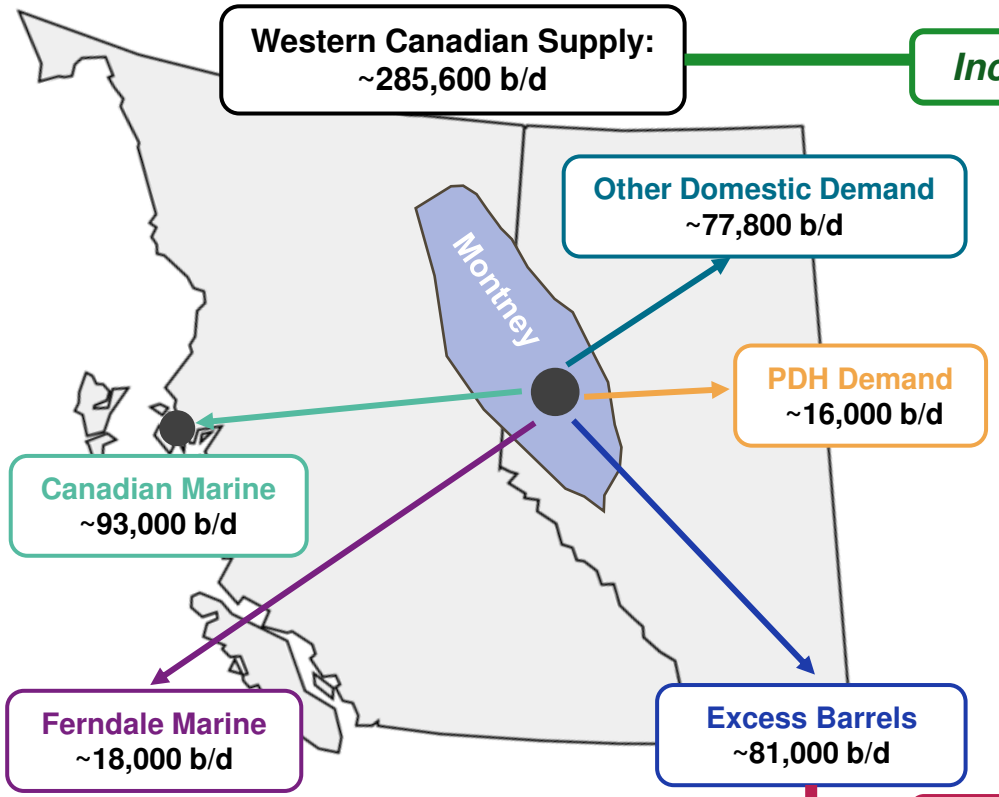
- S&P Global has assumed that the REEF export terminal with an LPG export capacity of ~55,000 b/d will come online in 2027 and that the terminal will have a propane export capacity of ~40,000 b/d.
- A hypothetical export terminal has also been assumed to come online in 2028 with an LPG export capacity of ~67,000 b/d. This terminal is assumed to have a propane export capacity of ~50,000 b/d.

If the hypothetical export terminal were not included, there would be an excess supply available that could support the construction of additional PDH facilities in Western Canada.

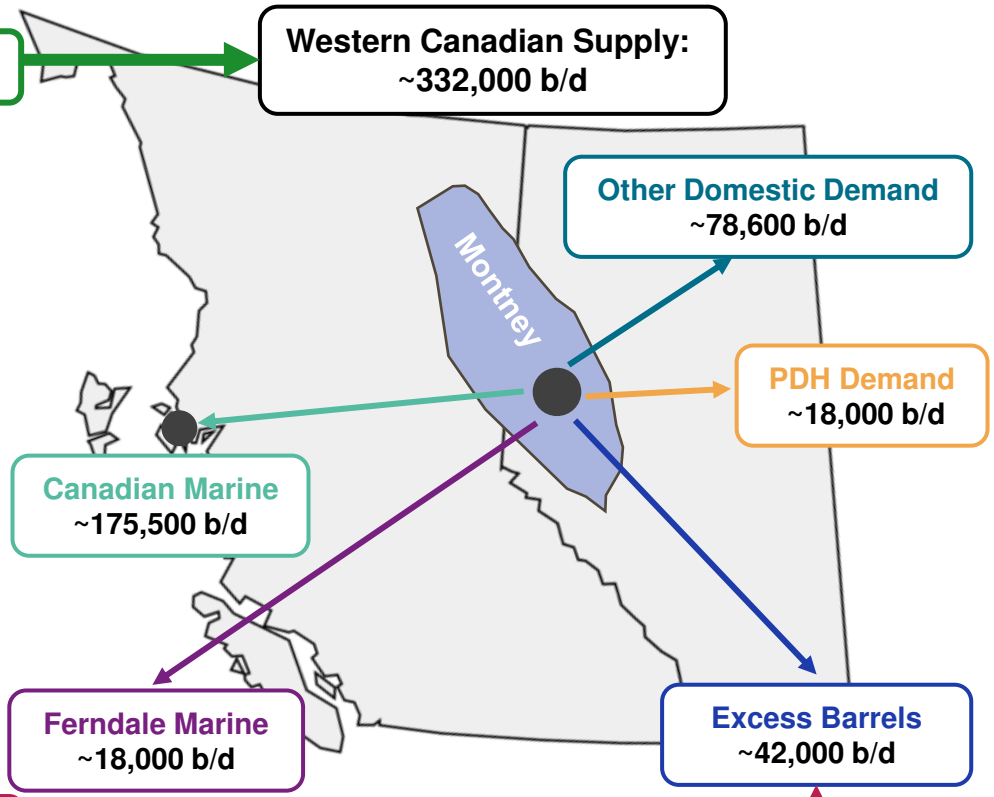
Propane

While propane supply is projected to increase from 2025 to 2030, the growth in marine exports will constrain excess barrels that are available

Western Canadian propane disposition overview: 2025



Western Canadian propane disposition overview: 2030



Increase of ~16%

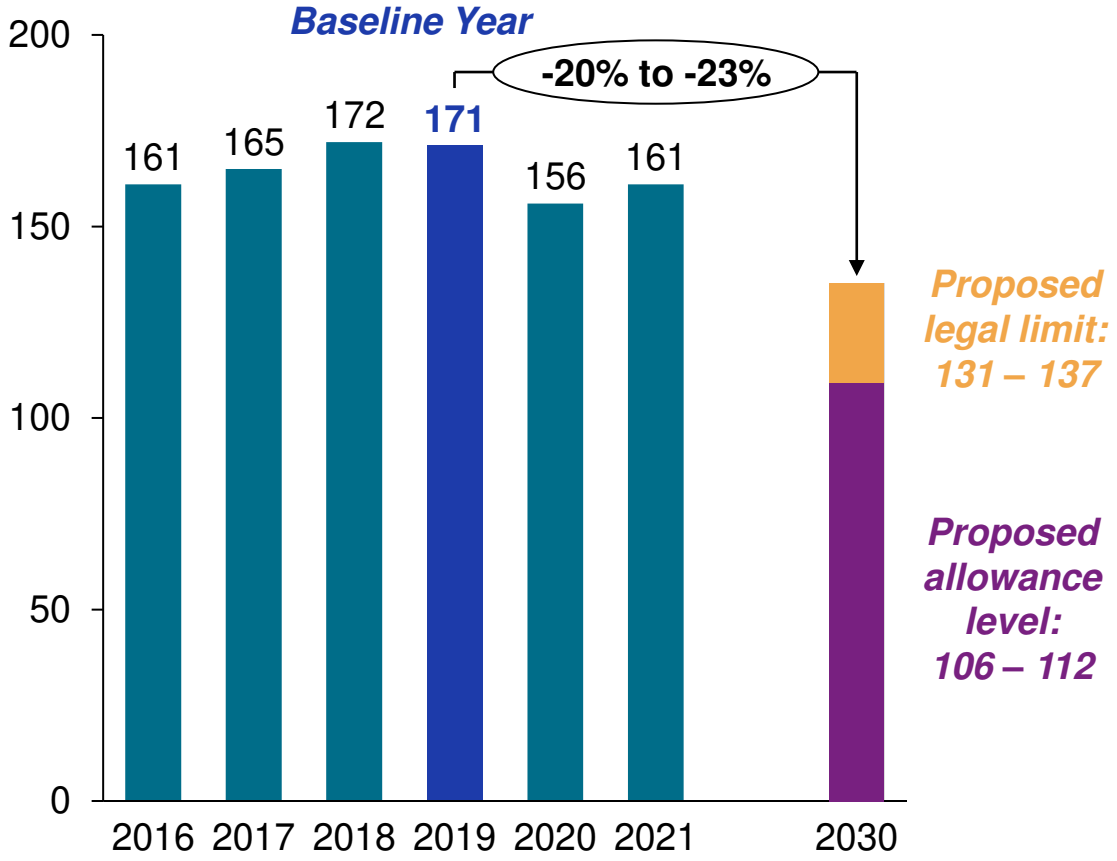
Decrease of ~48%

Data compiled May 2024.
Notes: Approximate Montney basin extent – other plays and basins also contribute to total NGL supply
Sources: S&P Global Commodity Insights, Statistics Canada

S&P Global
Commodity Insights

Government proposed a new cap-and-trade system to reduce emissions from oil and gas extraction

Oil and gas emissions subject to cap compared with 2030 cap levels ($MMtCO_2e$)



Canada's proposed oil and gas cap-and-trade system

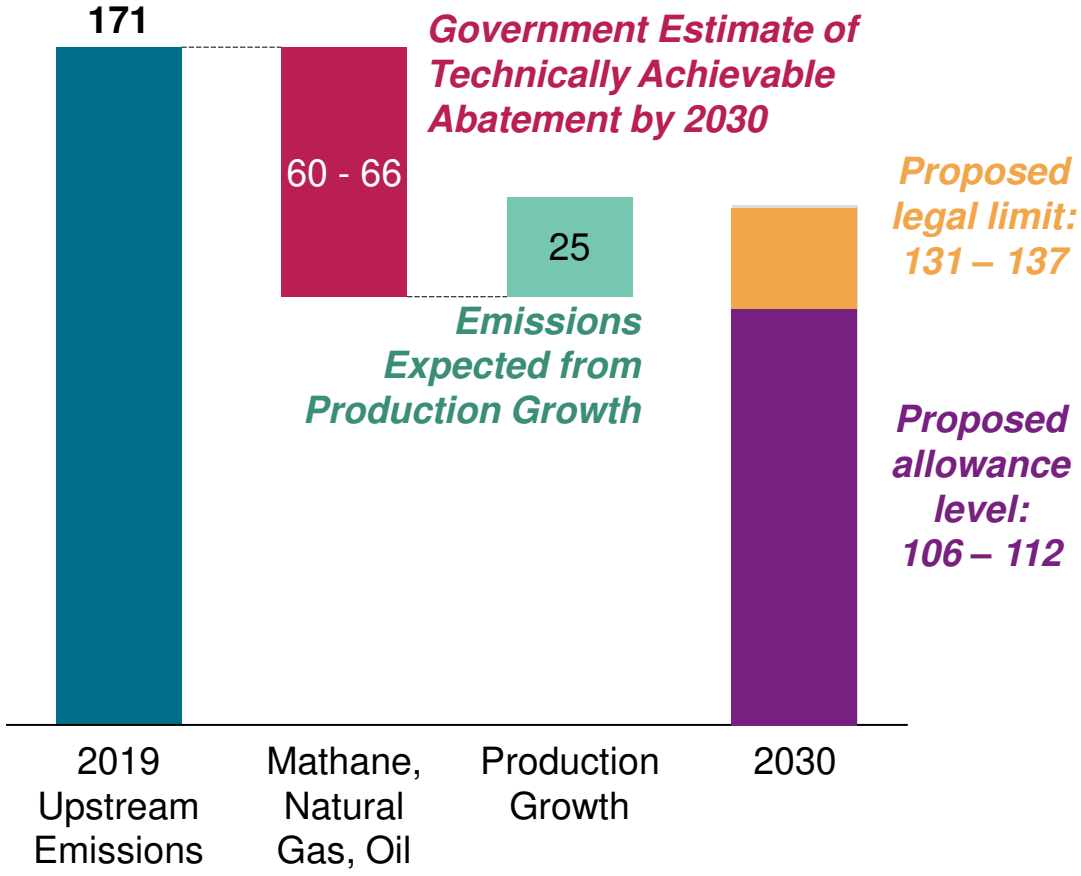
- On Dec. 7, 2023, the government of Canada released its proposed framework to cap and then reduce greenhouse gas emissions from Canada's oil and gas sector.
- Emissions subject to the proposed cap are focused on upstream oil and gas activity, specifically oil and gas extraction.
  - Approximately 85% of oil and gas emissions will be subject to the proposed cap-and-trade regulation.
- This cap-and-trade system would establish a sectoral emissions cap for 2030 that would decline over time at a pace to meet net-zero targets by 2050.
- Allowance level and legal upper limit a 20 – 23% reduction compared to the 2019 baseline year to provide compliance flexibility.

- **S&P Global developed an economic impact assessment report in May 2024 for CAPP.**
- **Report shows a stringent emissions cap could cost Canada 51,000 jobs and $247 billion in GDP contributions by 2035**
- **The report can be found on CAPP's website here**

Data compiled Dec. 12, 2023.
Sources: S&P Global Commodity Insights, Environment and Climate Change Canada, National Inventory Report 1990-2021: Greenhouse gas sources and sinks in Canada 2023. Government of Canada: A Regulatory Framework publication

Proposed emissions reduction to be met principally from abatement of methane and the oil sands

Oil and gas emissions subject to cap compared with 2030 cap levels ($MMtCO_2e$)



Canada's proposed oil and gas cap-and-trade system

- Proposed regulations are expected in 2024, with final a publication targeted for 2025.

Implications

- **Production growth may complicate emission reductions if growth exceeds government estimates.**
- **Time is not on the sector's side as challenges remain for the deployment of large-scale carbon capture and storage processes.**
- **The proposed cap-and-trade system could improve decarbonization project economics, but at the expense of upstream competitiveness.**
- **The proposed cap-and-trade regulation does not reduce uncertainty to financing large-scale decarbonization projects.**

Data compiled Dec. 12, 2023.
Sources: S&P Global Commodity Insights, Environment and Climate Change Canada, National Inventory Report 1990-2021: Greenhouse gas sources and sinks in Canada 2023. Government of Canada: A Regulatory Framework publication

NGL

Key takeaways

Ethane expected to remain a competitive feedstock for ethylene production.

Domestic ethane production/recovery depends on domestic petrochemical demand and US import volumes.

Ample domestic ethane should be available to meet new Western demand, but additional extraction facilities will likely be needed.

Domestic propane demand will be relatively stable; new PDH/PP facility has boosted Western demand, but further petrochemical projects are uncertain.

LNG activity will spur additional supply, resulting in additional excess LPG barrels; Marine exports increasingly important.

Government regulations regarding cap-and-trade could result in significant changes to upstream investment and activity.

Feedstock supply exists for further petrochemical projects, but future investment is not guaranteed

Contact us

PRIMARY CONTACT(S)

Jordan Woloschuk

jordan.woloschuk@spglobal.com

CONTACT US

Americas	+1 800 597 1344
Asia Pacific	+60 4 296 1125
Europe, Middle East, Africa	+44 (0) 203 367 0681

www.spglobal.com/en/enterprise/about/contact-us.html

www.spglobal.com/commodityinsights

S&P Global
Commodity Insights