



Goobie Tulk Inc.

Western Canadian Petrochemical Feedstock Availability and Competitiveness 加拿大西部石化原料的可用性和竞争力

Prepared for
**2019 China Petroleum & Chemical
International Conference
2019年中国国际石油化工大会**

Disclaimer 免责声明

This presentation has been prepared for the sole benefit of the Client. This report or any part of it shall not be provided to third parties without the express written consent of Goobie Tulk Inc.

本报告是为客户的唯一利益而制作。未经Goobie Tulk Inc.明确书面同意，本报告或其任何部分不得提供给第三方。

Goobie Tulk Inc. conducted the analysis herein utilizing reasonable professional skill, expertise, diligence and care consistent with normal industry practice. All results are based on information available at the time the analysis was conducted. Changes in factors upon which the analysis is based could affect the results. Forecasts are inherently uncertain and Goobie Tulk Inc. accepts no liability with respect to the Client's or any other third party's conclusions or decisions which are based on the analysis or forecasts herein.

Goobie Tulk Inc.运用合理的专业技能和专业知识，对相关内容进行了仔细的符合行业惯例地分析。所有结论都是基于进行分析时的信息。分析所依据的因素的变化可能会影响结果。预测本身是不确定的，Goobie Tulk Inc.不对客户或任何其他第三方基于本文的分析或预测得出的结论或决定承担任何责任。

Some of the information on which this analysis is based has been provided by others. Goobie Tulk Inc. has utilized such information without verification unless specifically noted otherwise. Goobie Tulk Inc. accepts no liability for errors or inaccuracies in information provided by others.

该分析所依据的某些资料已从其他方面获得。除另有特别说明，Goobie Tulk Inc.直接使用了此类信息。Goobie Tulk Inc.不对他人提供的信息中的错误或不准确负责。

Key Messages 关键信息

- Western Canada has a world scale endowment of cost competitive hydrocarbon supply
加拿大西部地区具有世界规模的且具有成本竞争力的碳氢化合物供应条件
 - Several hundred years of natural gas, NGL and crude oil supply at current production rates
以目前的生产速度，可继续供应数百年天然气、天然气凝析液和原油
- Western Canadian Light Tight Oil (LTO) and LNG developments are driving a large and growing surplus of low cost natural gas, petrochemical feedstocks and associated infrastructure
加拿大西部地区轻质致密油(LTO)和液化天然气(LNG)的开发，正推动低成本天然气、石化原料和相关基础设施的大量过剩，而且这种过剩还在不断增加
- Federal and provincial governments as well as industry are supporting investments to capture value added opportunities
联邦和省级政府以及工业界都在支持投资，以抓住增值机遇
- Canada has supply, China has demand
加拿大有供应，中国有需求
 - There is a compelling opportunity to supply China with cost competitive feedstocks and finished products
这是一个非常好的向中国提供具有成本竞争力的原料和成品的良机

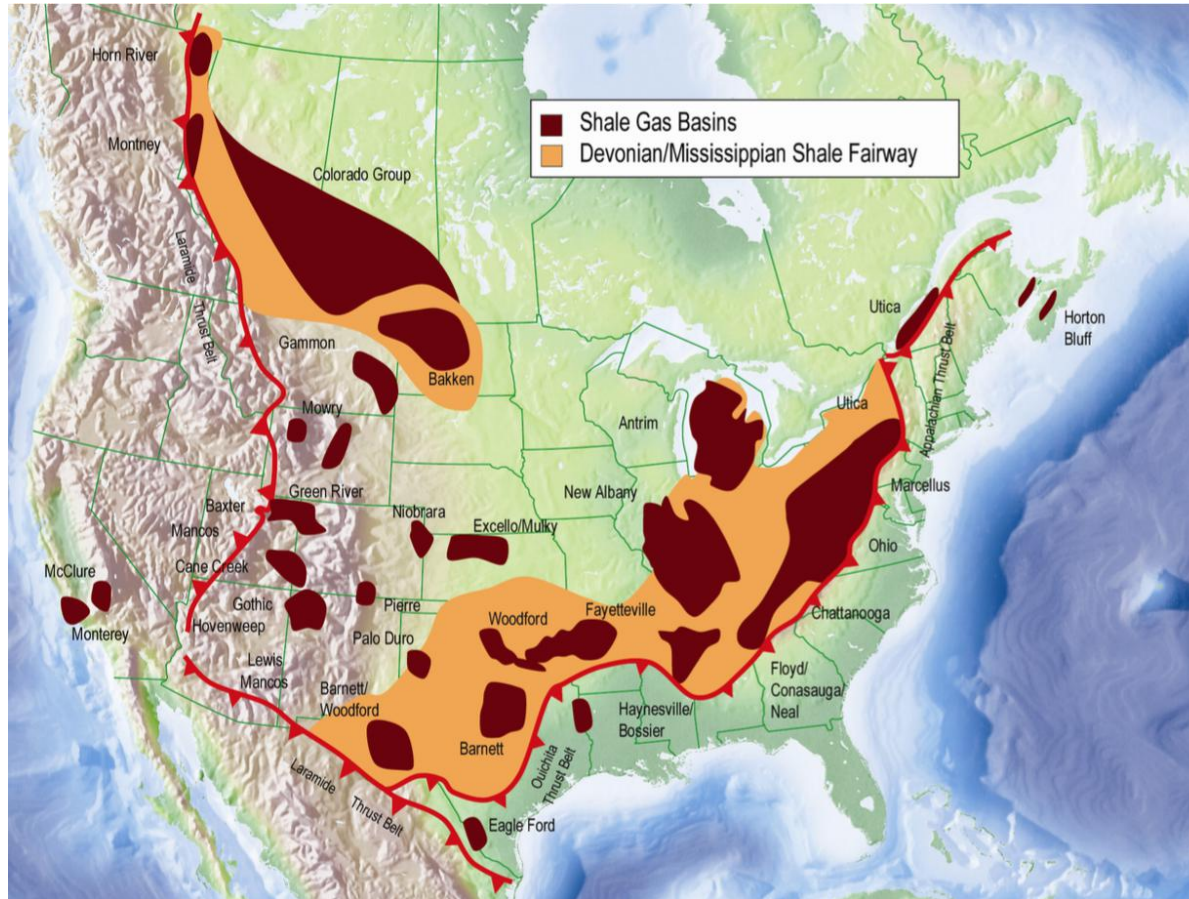
Presentation Outline 报告大纲

- Western Canada Resources
加拿大西部资源
- Western Canada Natural Gas and NGL Supply and Demand
加拿大西部天然气和天然气凝析液的供需情况
- Western Canada Petrochemical Feedstocks
加拿大西部石化原料
- Western Canada Natural Gas and Feedstock Pricing
加拿大西部天然气和原料价格
- Conclusions
结论

Western Canada Resources

加拿大西部资源

North American Resources 北美地区资源

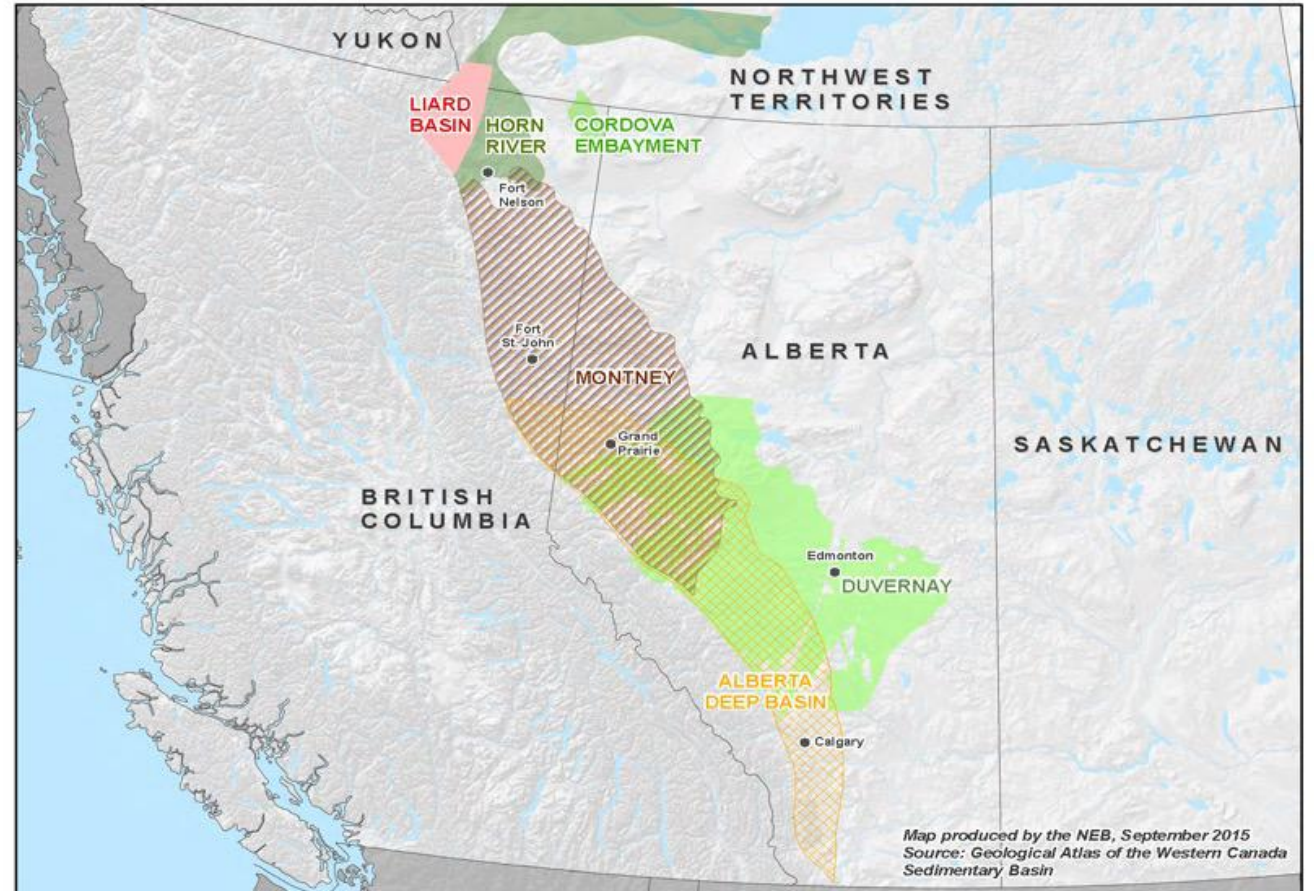


Source: National Energy Board

- North America has some of the world's largest energy resources
北美地区拥有世界上最大的能源资源
- Western Canada has the largest concentration of energy resources in North America
加拿大西部是北美能源资源最集中的地区
- Ultimate Recoverable Resources* in North America are estimated to be:
北美的最终可采资源*估计为
 - Up to 5,000 Tcf of natural gas
天然气储量高达5000万亿立方英尺
 - > 80 billion barrels of NGL
天然气凝析液储量超过800亿桶
 - > 600 billion barrels of oil
石油储量超过6000亿桶

Western Canada Unconventional Plays 加拿大西部非常规油藏

- Western Canadian unconventional resources are prolific
加拿大西部非常规资源丰富
- Total marketable resources* in the WCSB are estimated at:
加拿大西部沉积盆地的总可售资源*估计为
 - 1,128 Tcf of natural gas
1,128万亿立方英尺天然气
 - 35.6 billion barrels of NGL
356亿桶天然气凝析液
 - 329 billion barrels of oil
3,290亿桶石油
- The Montney, Duvernay and Deep Basin are primarily light oil/condensate plays with rich associated gas
蒙特尼、杜威内和深水盆地主要是含丰富伴生气的轻油/凝析油藏。
- The Liard and Horn River are primarily dry gas plays
利亚德河和霍恩河主要是干气油藏。



Source: National Energy Board

*Conventional + unconventional

Montney Play 蒙特尼油藏

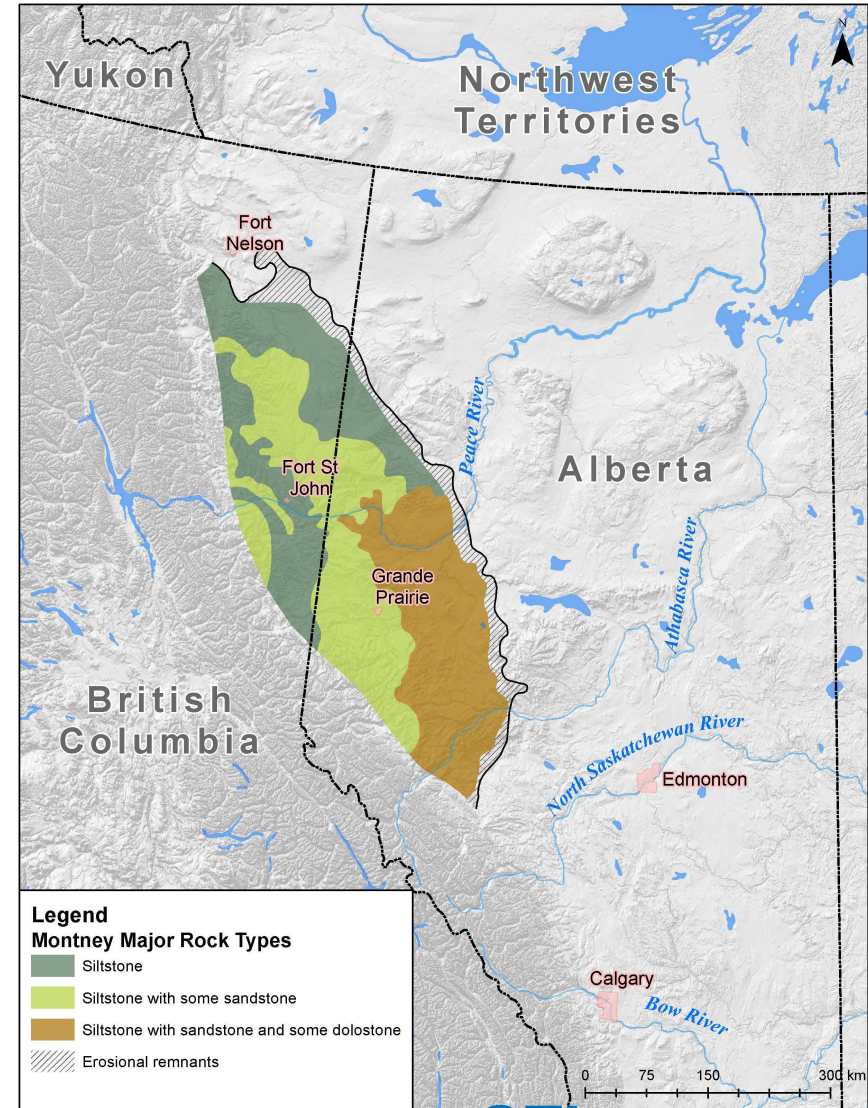
- Total marketable resource 总可售资源
 - 450 Tcf of natural gas 450万亿立方英尺天然气
 - 14.5 billion barrels of NGL 145亿桶天然气凝析液
 - 1.1 billion barrels of oil 11亿桶石油
- Similar in size to the Marcellus 在规模上与马塞勒斯相当
 - Similar cost to drill and produce 开采成本和生产成本相当
 - Much higher NGL content 天然气凝析液含量更高
 - Lower breakeven cost due to NGL revenue 由于天然气凝析液的收入，使得盈亏平衡成本更低

- In recent years, drilling has shifted overwhelmingly to the Montney creating natural gas and NGL disposition bottlenecks

近年来，开采工作大量地转移到蒙特尼，迎来了天然气和天然气凝析液的处理瓶颈

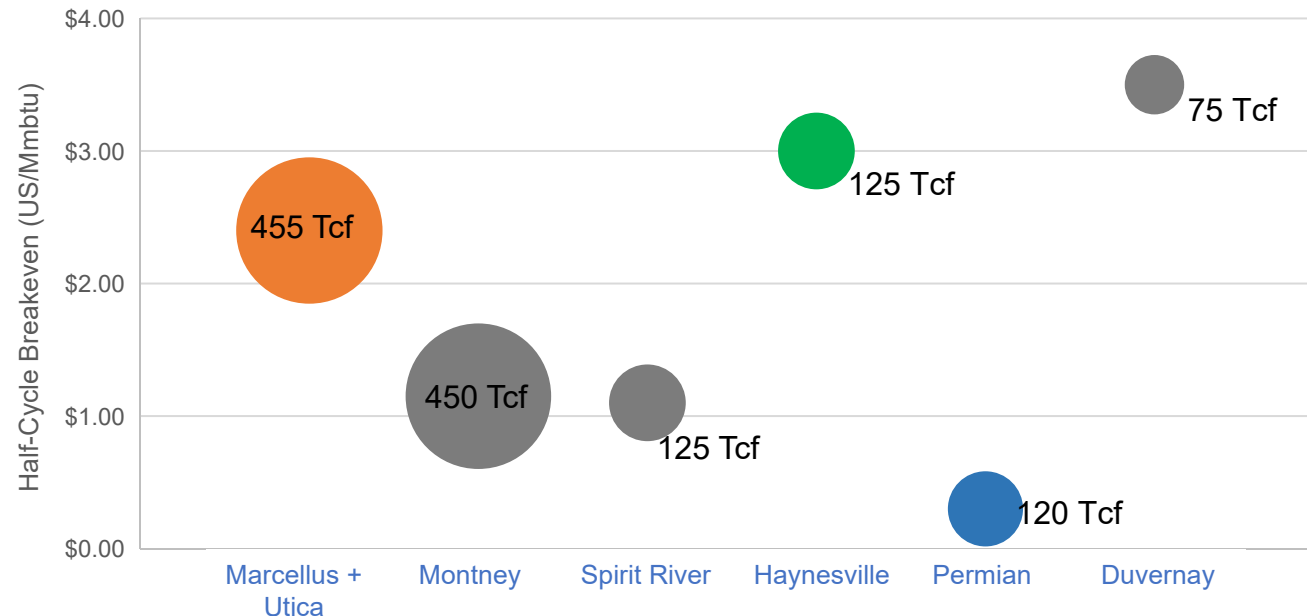
- Methane, ethane and propane have become low value byproducts 甲烷、乙烷和丙烷已成为低价值副产品
- The Montney alone could cost competitively supply an incremental 20 bcf/day of gas demand for over 60 years

如果以日产量200亿立方英尺计算，蒙特尼可以持续为市场提供超过60年天然气。

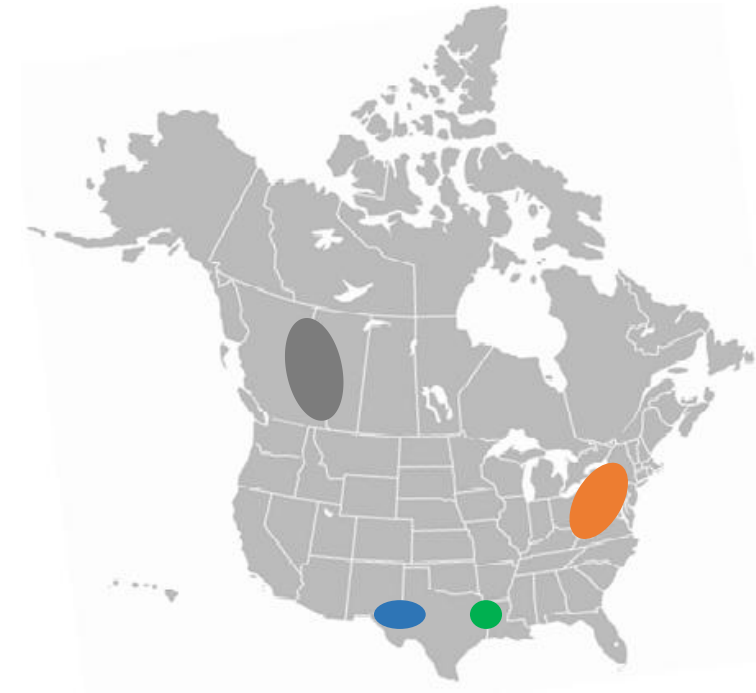


Canada vs US major plays 加拿大 vs 美国的主要油藏

- Natural Gas Liquids drive down supply costs in the Montney
天然气凝析液降低了蒙特尼的供应成本



Note: Technically recoverable resource volume



Source: Bloomberg NEF, Sproule Play Metrics, GTI, EIA, NEB

Western Canada Natural Gas and NGL Supply and Demand 加拿大西部天然气和天然气凝析液 供需情况

NGL Recovery 天然气凝析液采收

- The continued growth of unconventional gas production is primarily driven by producers pursuing Light Tight Oil (LTO) and condensate plays which produce growing volumes of rich associated gas

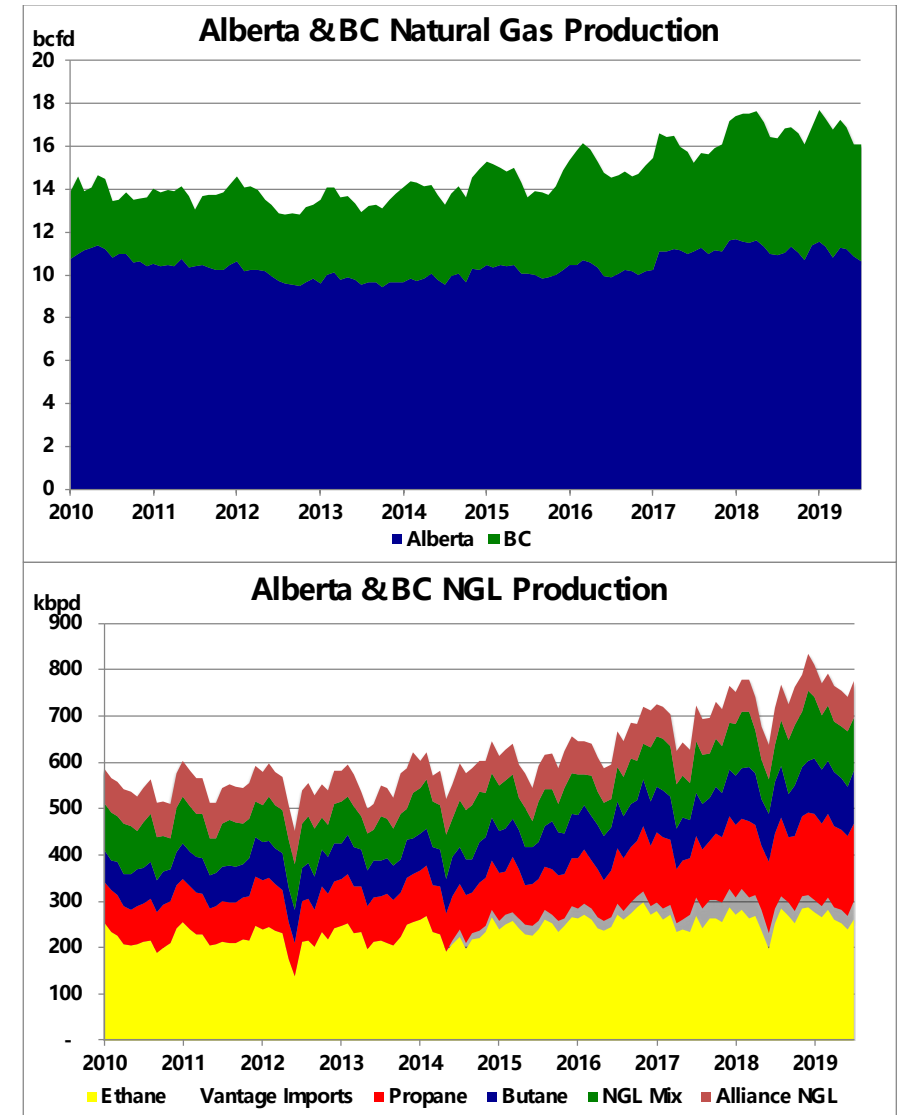
非常规天然气产量的持续增长主要是由寻求轻质致密油(LTO)和凝析液的生产商推动, 这些生产商生产的伴生气量不断增加

- Consequently, NGL recovery has grown faster than gas production growth

因此, 天然气凝析液采收的增长快于天然气产量的增长

- Ethane production is constrained by limited demand and a large amount of ethane is being rejected

乙烷生产受到需求限制, 大量乙烷被拒绝使用

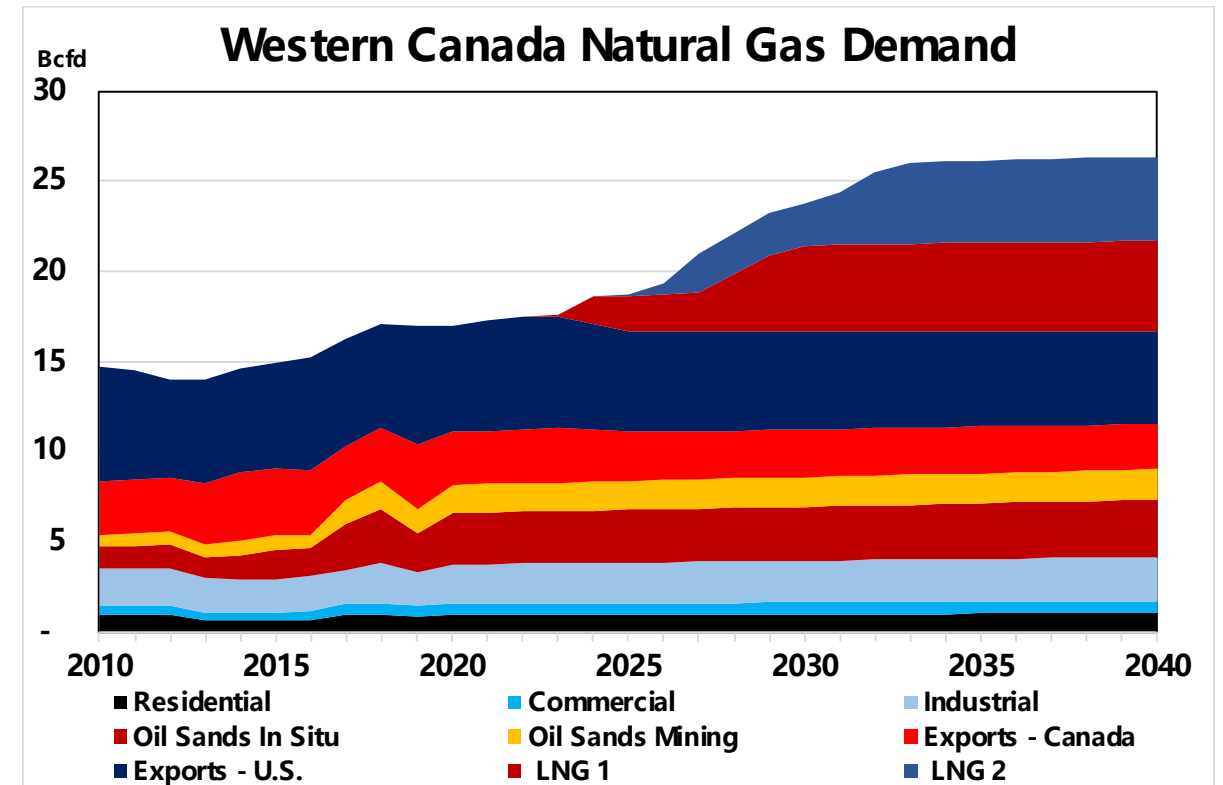


Natural Gas Demand Outlook 天然气需求展望

- Western Canadian natural gas demand is comprised of

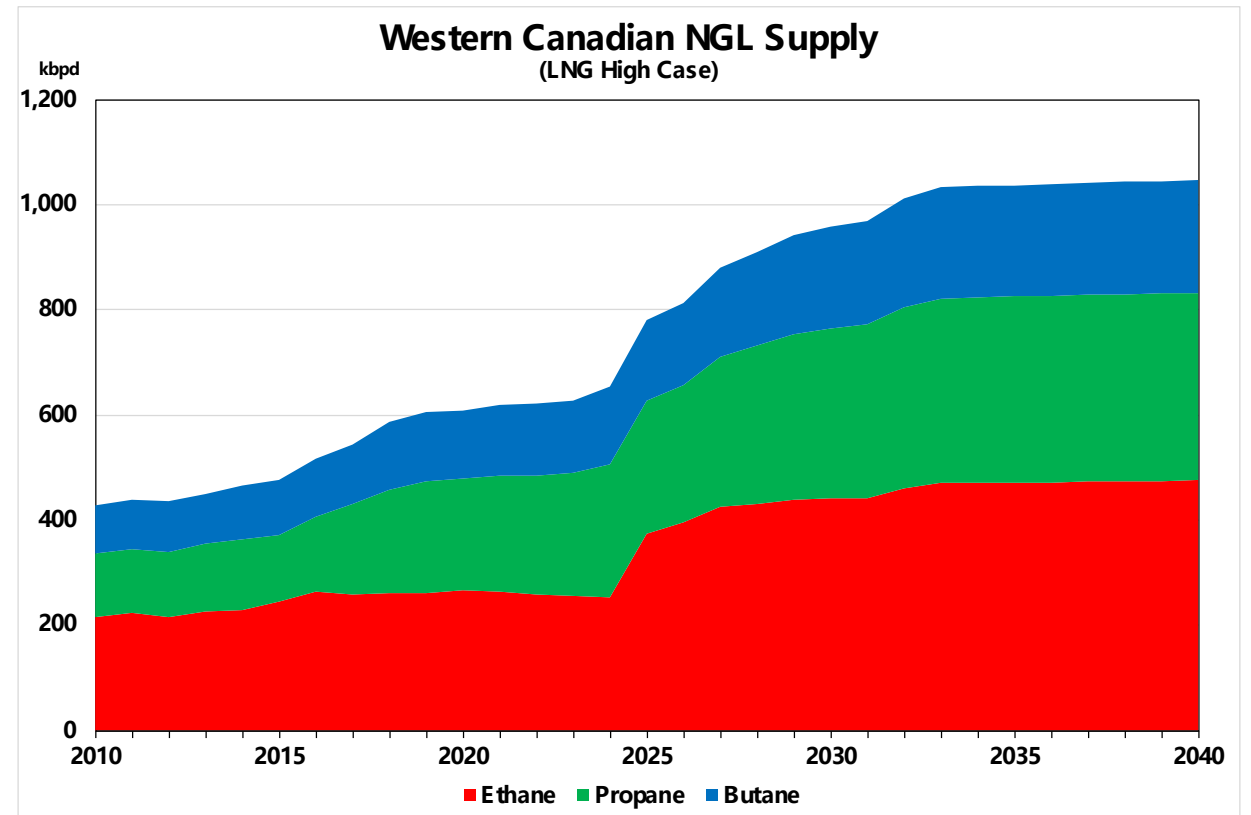
加拿大西部天然气需求包括

- Domestic demand
国内需求
 - Eastern Canada/U.S. export demand
加拿大东部/美国出口需求
 - Future west coast LNG exports
未来西海岸液化天然气出口
- Most of Canadian natural gas production will continue to be exported
加拿大大部分天然气生产将继续出口
 - LNG export projects are required to take away surplus methane from LTO production
液化天然气出口项目需要将剩余的甲烷从轻质致密油生产中抽走



NGL Supply Forecast 天然气凝析液供应预测

- Growing NGL production growth driven by Light Tight Oil and rich associated gas production
轻质致密油和丰富伴生气生产推动天然气凝析液产量的增长
- Ethane is rejected until a new cracker startup in 2025/26
乙烷被拒绝使用，直至在2025/26年新裂解装置开车



Methane Feedstock 甲烷原料

- In any gas production scenario, Western Canada has a large surplus of competitively priced methane
不论何种天然气生产方案，加拿大西部都有大量的具有价格竞争力的过剩甲烷
- Volumes are sufficient to build several world scale methane based projects such as methanol or fertilizer facilities in Alberta

其产量足以在艾伯塔省建立几个全球规模的以甲烷为原料的项目，如甲醇或化肥厂



Ethane Feedstock 乙烷原料



- In a low gas production scenario there is enough surplus ethane to support a new world scale cracker and derivative facilities as well as the debottleneck of existing crackers

在低天然气产量的情况下，有足够的过剩乙烷来支撑一个新的世界规模的裂解装置及衍生设备，并为现有裂解装置解除瓶颈。

- In a high gas production scenario there is enough surplus ethane to support another two world scale ethylene crackers and several derivatives facilities

在高天然气产量的情况下，有足够的过剩乙烷来支撑另外两个世界规模的乙烯裂解装置及相关衍生设备。

Western Canada Petrochemical Feedstocks 加拿大西部石化原料

Propane Feedstock 丙烷原料

- In all gas production scenarios there is sufficient competitively priced propane to build at least two world scale propane dehydrogenation (PDH) and associated polypropylene derivative facilities as well as several LPG export projects

不论何种天然气生产方案，这里有足够的具有价格竞争力的丙烷来建设至少两个世界规模的丙烷脱氢(PDH)和相关的聚丙烯衍生装置，以及几个液化石油气出口项目



Butane Feedstock 丁烷原料



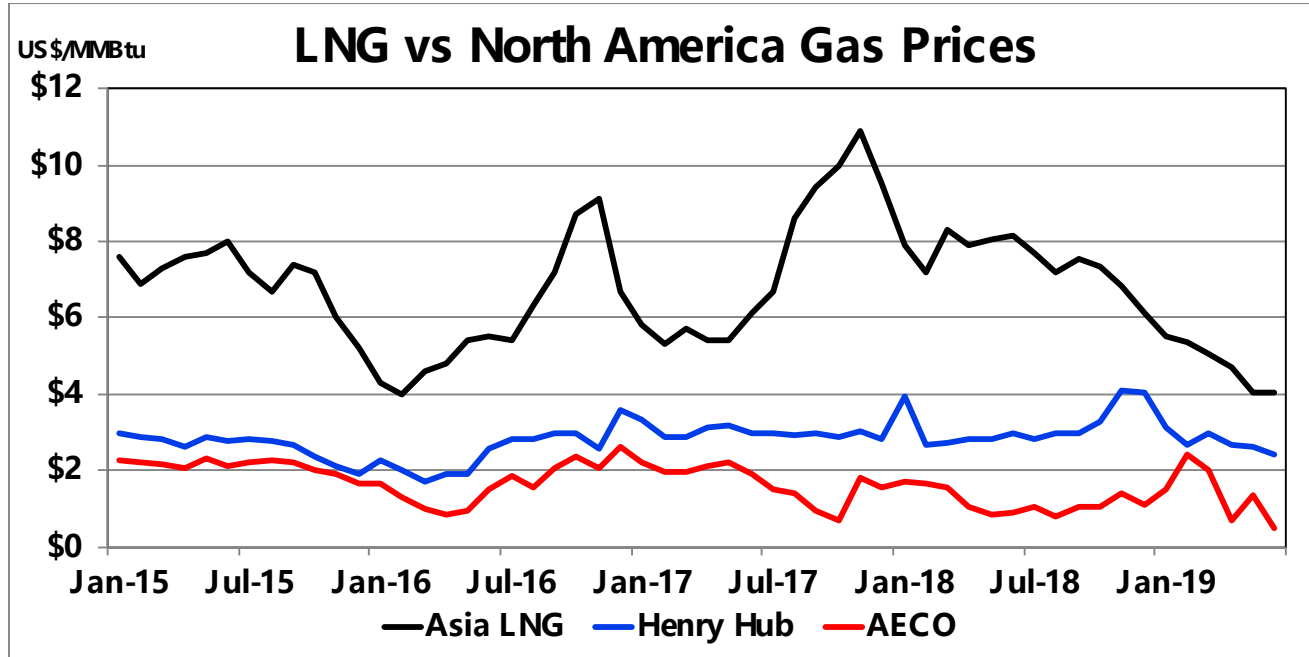
- In any gas production scenario there is enough surplus butane to support a new world scale alkylate facility as well as solvent and export demand

不论何种天然气生产方案，都有足够的过剩丁烷来支持一个新的世界规模的烷基化装置，以及溶剂和出口需求

Western Canada Natural Gas and Feedstock Pricing

加拿大西部天然气和原料价格

Natural Gas Prices 天然气价格



- Alberta natural gas prices (AECO) are lower than US prices (Henry Hub) and lower than Asian LNG prices

艾伯塔省天然气价格(AECO) 低于美国(Henry Hub)和亚洲液化天然气价格

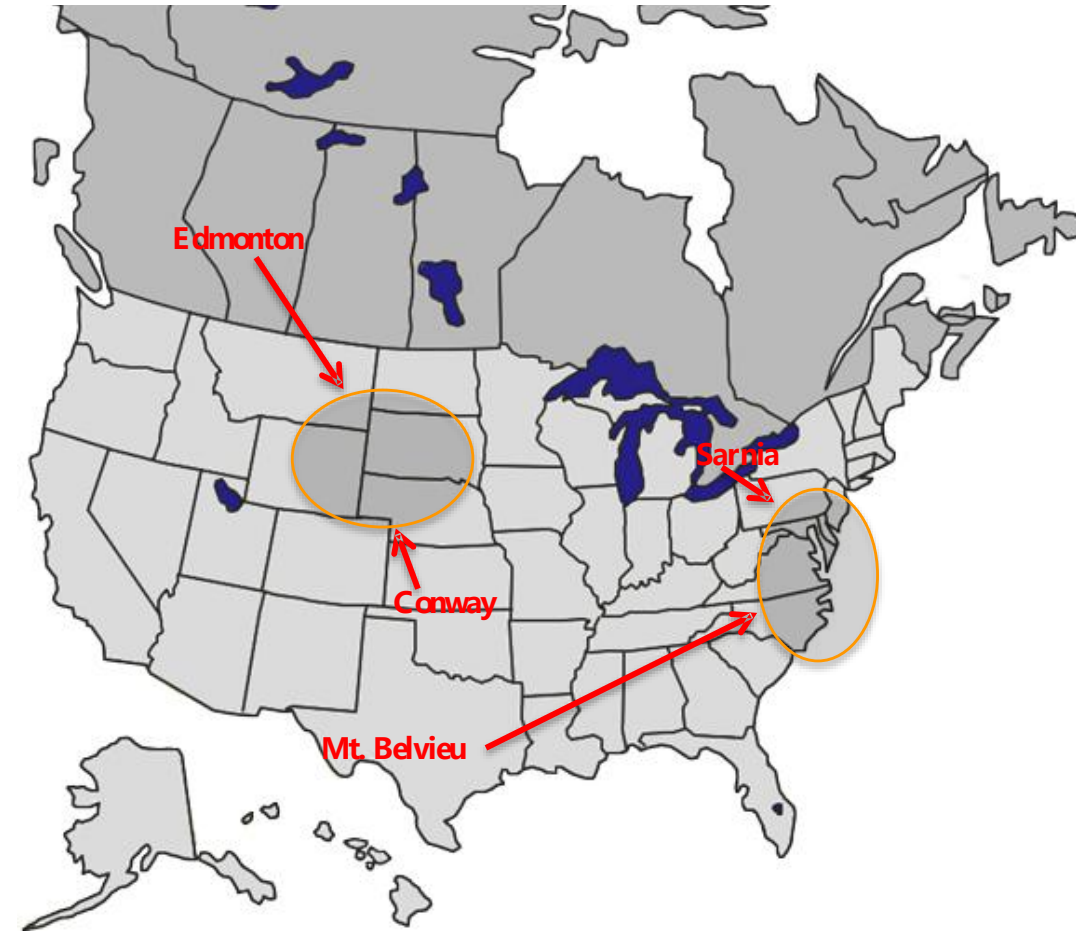
- Low priced natural gas is a strong advantage for petrochemical operations in Western Canada

对于加拿大西部的石化企业来说，低价天然气是一个巨大的优势

NGL Pricing Influences

影响天然气凝析液定价的因素

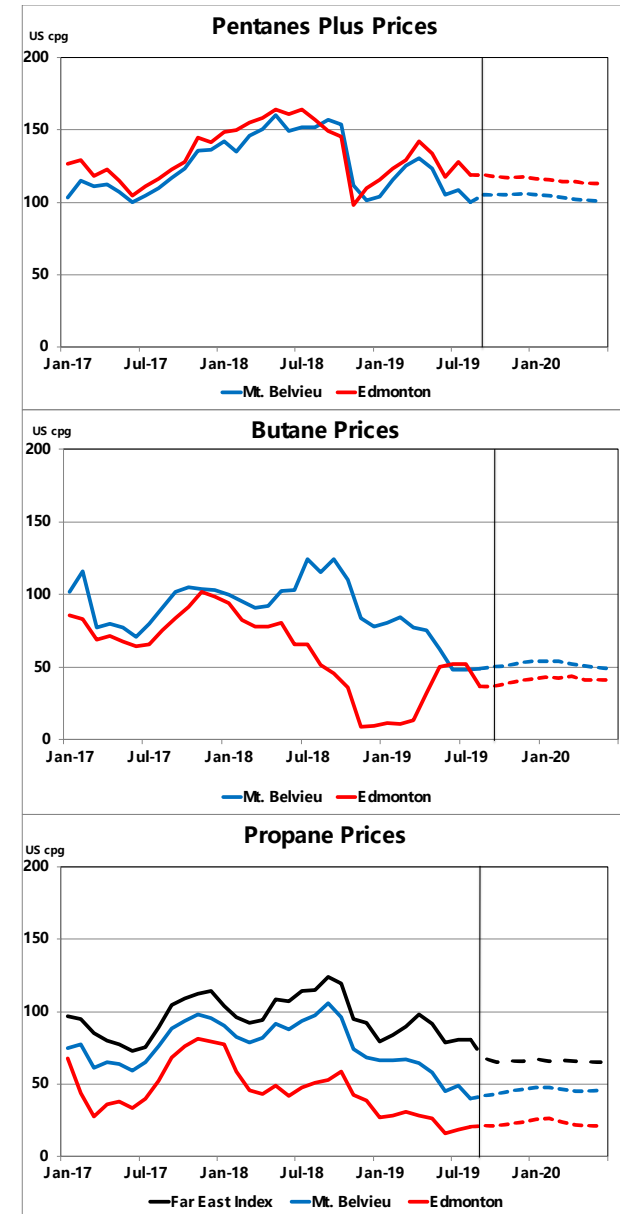
- Sarnia serves similar markets as Mt. Belvieu, i.e., US northeast
萨尼亚与蒙特贝尔维市场类似，例如美国东北部。
- Edmonton serves similar markets as Conway, i.e., midcontinent
埃德蒙顿与康威市场类似，例如中陆
- Therefore Sarnia prices are a differential (+/-) to Mt. Belvieu and
Edmonton prices are a differential (+/-) to Mt. Belvieu and Conway
因此，萨尼亚的价格与蒙特贝尔维存在一个差异(+/-)，埃德蒙顿的价格与蒙特贝尔维和康威存在一个差异(+/-)。



Natural Gas Liquids Prices

天然气凝析液价格

- Canadian NGL prices track U.S. prices
加拿大天然气凝析液价格追随美国价格
- Canadian pentanes plus and condensate prices are a premium to U.S. prices
加拿大正戊烷和凝析液价格高于美国
- Canadian butane prices are at a discount to U.S. prices
加拿大丁烷的价格低于美国的价格
- Canadian propane prices are at a large discount to U.S. prices and a very large discount to Asian prices
加拿大丙烷的价格大大低于美国和亚洲价格
- Canadian ethane is priced at natural gas value plus extraction cost and is at a significant discount to U.S. prices
加拿大乙烷的价格是天然气价格加上开采成本，而且大大低于美国价格
- Canada has a significant feedstock cost advantage over the U.S.
与美国相比，加拿大在原料成本上有明显的优势



Canadian LNG and LPG Opportunity

加拿大液化天然气和液化石油气 机遇

Understanding the Race 理解游戏规则

- When running away from a grizzly bear, you don't have to be the fastest, just don't be the slowest

当你从灰熊面前逃跑时，你不必是最快的，只要不是最慢的就行了

- This is true for producing commodity products like LNG and LPG

在生产液化天然气和液化石油气等大宗商品时也是如此

- In a well supplied market, high cost producers will be forced to curtail production

在供应充足的市场，高成本生产商将被迫减产

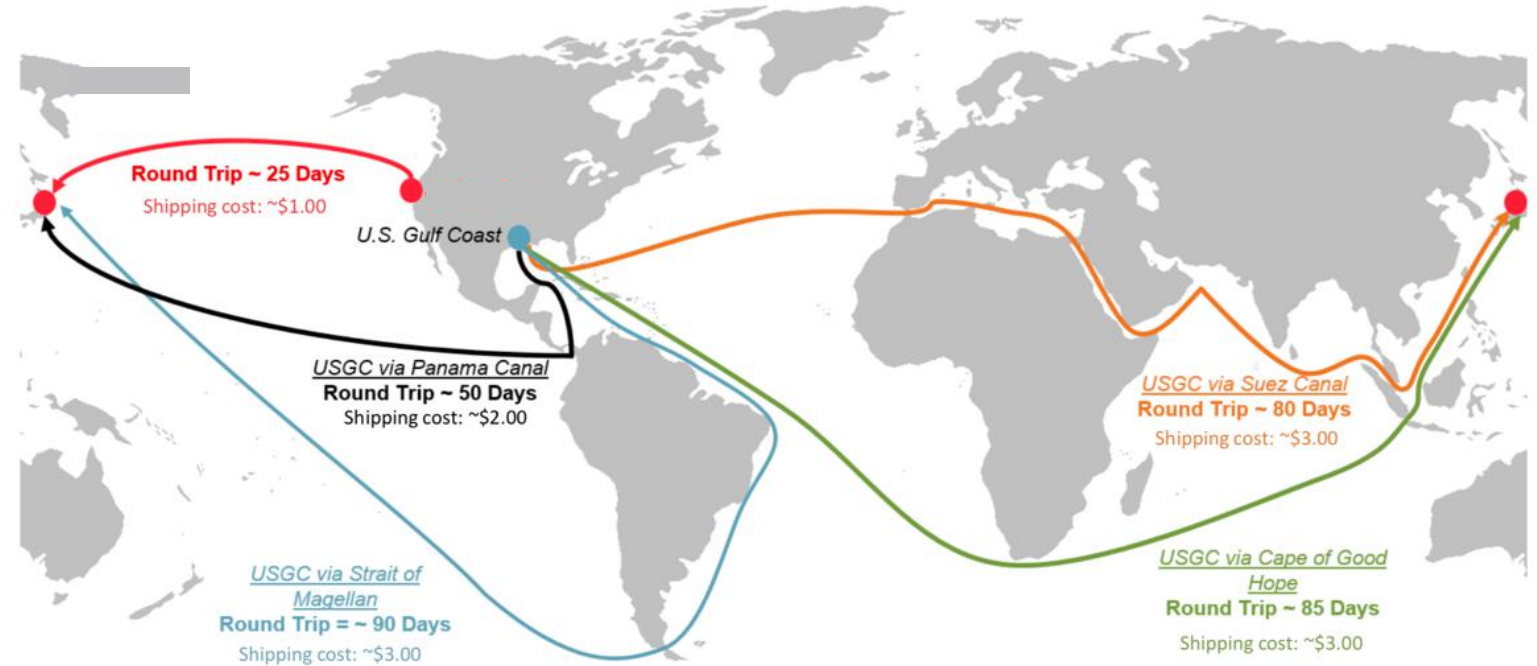
- Canada is a low cost producer and will continue to sell LNG and LPG to world markets

加拿大是一个低成本生产国，并将继续向世界市场销售液化天然气和液化石油气



West Coast Advantage 北美西海岸的优势

- Shipping any product from the West Coast of North America to Asia is much lower cost than from the USGC and avoids Panama Canal congestion and delays
- 从北美西海岸向亚洲运输产品比从美国海运公司(USGC)向亚洲运输的成本低得多，而且可以避免巴拿马运河的拥堵和延误



Source: pembina.com

Western Canada LNG and LPG Opportunity

加拿大西部液化天然气和液化石油气机遇

- The U.S. Gulf Coast (USGC) has become the world's marginal source of crude oil, LPG and LNG
美国墨西哥湾地区已渐渐成为世界上原油、液化石油气和液化天然气的不太重要的供应地
- Western Canada's combination of low feedstock cost and proximity to China means that LNG and LPG have a long term "cash cost advantage" over USGC competitors supplying China
加拿大西部的低原料成本和与中国毗邻意味着液化天然气和液化石油气相对于供应中国的USGC竞争对手具有长期的现金成本优势
- Western Canadian LNG and LPG have lower GHG emissions over most other LNG and LPG producers
与大多数其他液化天然气和液化石油气生产商相比，加拿大西部的液化天然气和液化石油气的温室气体排放量较低
- Canada will be a formidable supplier of LNG and LPG to China
加拿大将成为中国液化天然气和液化石油气的重要供应国

Summary and Conclusions

结论

Summary & Conclusions 结论

- Producers will continue to target Light Tight Oil and condensate due to high crude
由于原油价格高，生产商将继续瞄准轻质致密油和凝析液
 - Consequently, large amounts of rich associated gas will be produced
因此，将生产大量丰富的伴生气
- Large amounts of rich associated gas means large amounts of NGL
大量丰富的伴生气意味着大量的天然气凝析液
 - Condensate and butanes stay in Western Canada as diluent and alkylate feedstock
加拿大西部有作为稀释剂和烷基化原料的凝析液和丁烷
 - Propane – increased domestic petrochemical demand and increased waterborne exports to China
丙烷——增加了国内石化需求，增加了对中国的水运出口
 - Ethane – new cracker(s) or export to China or both
乙烷——新裂解装置或出口到中国或两者兼而有之
- Understanding NGL markets and pricing is critical to understanding the competitiveness and future development of Western Canadian markets
了解NGL市场和定价对于了解加拿大西部市场的竞争力和未来发展至关重要
- Canada has supply, China has demand 加拿大有供应，中国有需求
 - Future markets for Western Canadian ethane and propane will be in China either as feedstocks or finished products



Goobie Tulk Inc.

Gerry Goobie, P.Eng.

gerry@goobietulk.com

403-680-9110

Dave Tulk, P.Eng.

dave@goobietulk.com

403-813-0254

www.goobietulk.com



Goobie Tulk Inc.



Delivering sound and objective advice to clients based upon experience, analysis and deep understanding of the energy

industry

| NGLs | Petrochemical | Gas & LNG | Other |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Supply • Demand • Markets • Pricing outlooks • Netbacks • Infrastructure Development • Regulatory | <ul style="list-style-type: none"> • Feedstock • Ethylene business development & infrastructure • New plant economics • “Alberta Advantage” | <ul style="list-style-type: none"> • Processing Fees & negotiation • Unconventional gas infrastructure development • JV agreement development, negotiation & related services | <ul style="list-style-type: none"> • Strategic planning for natural gas, LNG and NGL infrastructure • Acquisitions & divestitures • Mediation, arbitration & expert witness testimony • Knowledge transfer & mentoring • Facility evaluation & economic analysis • Infrastructure development & project/commercial management • Contract negotiation |