EXHIBIT NO. ___(HSY-3~~H~~C)
DOCKET NO. UG-151663
WITNESS: HAROLD "SKIP" YORK

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

In the Matter of the Application of **PUGET SOUND ENERGY, INC.** **for (i) Approval of a Special Contract for Liquefied Natural Gas Fuel Service with Totem Ocean Trailer Express, Inc. and (ii) a Declaratory Order Approving the Methodology for Allocating Costs Between Regulated and Non-regulated Liquefied Natural Gas Services**	**DOCKET NO. UG-151663**

SECOND EXHIBIT (~~HIGHLY~~ CONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF HAROLD "SKIP" YORK ON BEHALF OF PUGET SOUND ENERGY, INC.

CONFIDENTIAL PER PROTECTIVE ORDER IN WUTC DOCKET NO. UG-151663

~~**AUGUST 11, 2015**~~
REVISED SEPTEMBER 23, 2015

Wood Mackenzie

March 2014

Natural Gas, ULSD and Fuel Oil Dynamics Study

Background

Puget Sound Energy (PSE) is requesting a discussion on the price spreads of ULSD and IFO-380 to Sumas natural gas. The intent is to support the appropriate oil pricing outlook for considering future price spreads in the Puget Sound region to be used for contracting purposes. In particular, PSE has asked for an analysis detailing the probable ceiling price on Sumas natural gas and probable floor price on ULSD and IFO-380, drivers behind the current spread, and what factors could lead to a degradation of the spread in the study period (2013-2030) and the likelihood of such circumstances occurring.

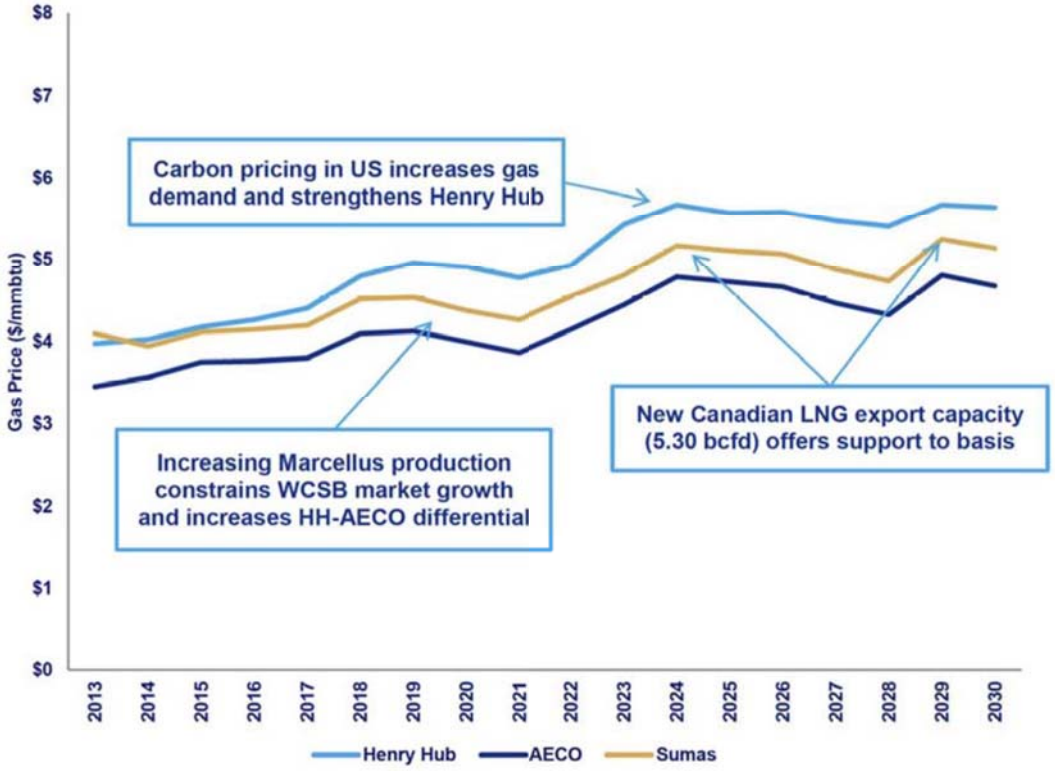
The ULSD and IFO-380 price spread to Sumas natural gas will be driven by regional supply/demand dynamics in US PADD V and Western Canada (Figure 1). PADD V covers the US West Coast and consists of Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington. Western Canada is defined as the provinces of British Columbia and Alberta for the purposes of this study.

Figure 1: Map of US PADD V and Western Canada

Sumas Gas Price Dynamics

Natural Gas Hub Prices

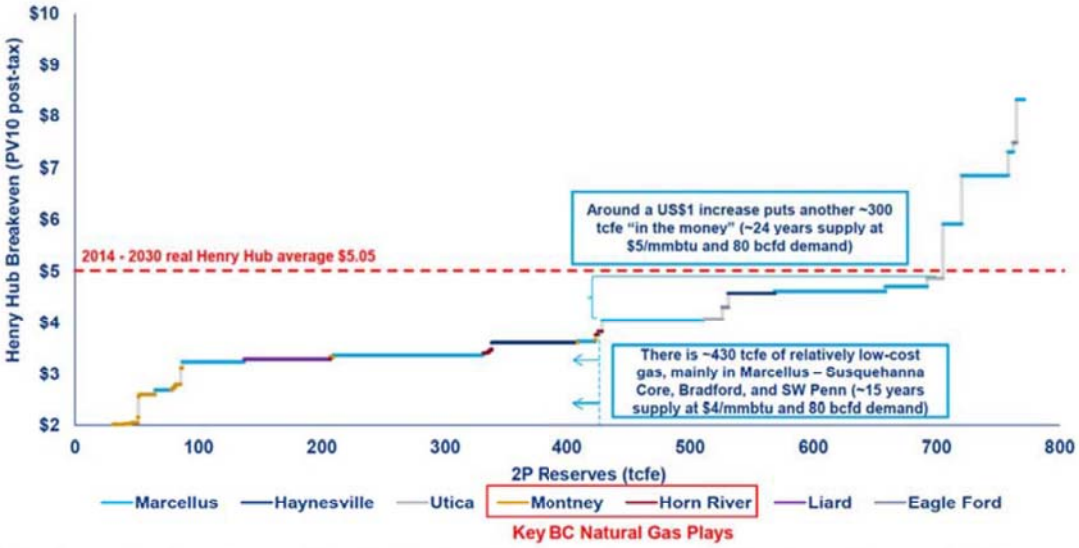
Figure 2: North American Natural Gas Prices



Wood Mackenzie does not forecast a significant recovery of gas prices and expects Sumas gas price to remain in the $4.00-$5.25/mmbtu range throughout the study period (Figure 2). Despite price support to Henry Hub due to LNG exports coming online in the Gulf Coast as well as robust industrial demand growth, Sumas sources the majority of its natural gas from British Columbia, which prices its volumes off of AECO. At the AECO hub, price increases are constrained due to limited demand access as well as increasing competition from sources of supply in North America flowing into current end markets (i.e. Marcellus). Consequently, upside to Sumas gas price is limited, and Sumas gas price is not expected to cause the price spread to ULSD/fuel oil to collapse.

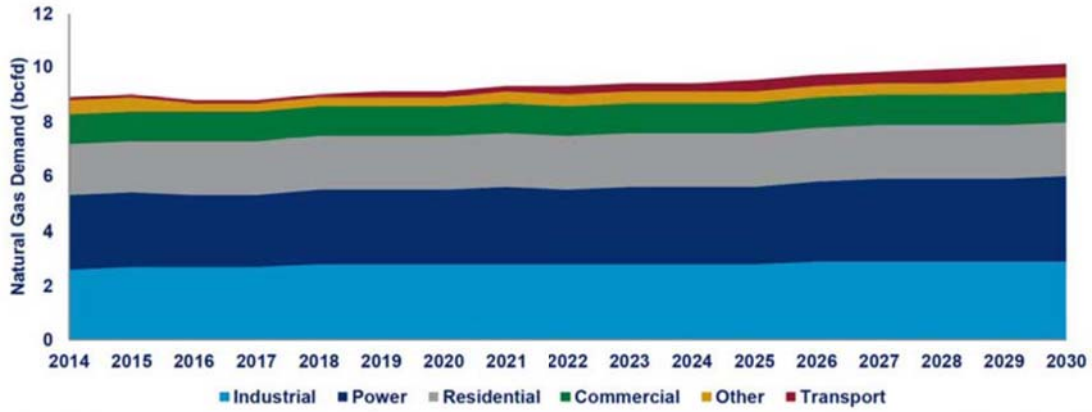
Natural Gas Supply/Demand Dynamics

Figure 3: PV10 Breakeven Gas Price by Sub-Play



Natural gas price dynamics are driven by the rise of North American unconventionals and the associated increase in volumes of relatively low-cost gas. At prices of $4/mmbtu, there is ~430 tcf of economic reserves in unconventional plays alone with another ~300 tcf of gas available with just a $1/mmbtu increase, enough to supply North America for another 24 years at current demand levels (Figure 3).

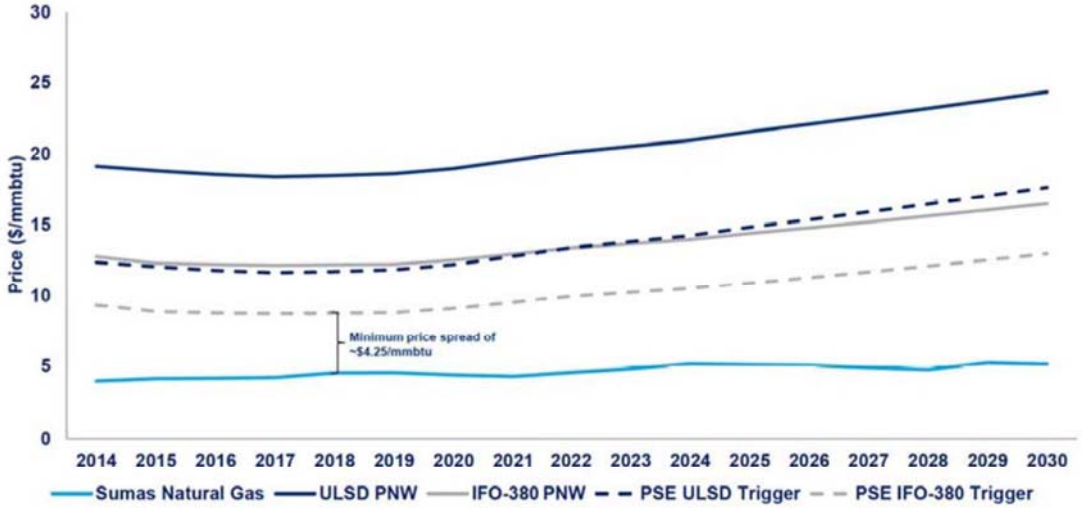
Figure 4: North American Pacific Coast Natural Gas Demand



North American gas demand is expected to grow through the study period, driven by increases in the power generation sector and LNG export facilities coming online. However, the North American Pacific Coast is expected to contribute very little of this growth, with only an increase of ~1 bcfd of demand by 2030 (Figure 4). Industrial growth demand is forecast to be negligible due to a dearth of established industrial projects in the pipeline. NGV penetration is also expected to have little effect as the lack of re-fuelling infrastructure has constrained NGV uptake and competition with hybrid / electric vehicles has further eroded their market share. Opportunity for long-term upside in British Columbia LNG (BCLNG) exists, but high deliverability risk makes the timing and cost of these projects very uncertain. A number of issues must be resolved on technical, political, and fiscal aspects for these projects to move forward. Most tellingly, a large number of these concerns are dependent on regulation and thus are high-risk projects.

ULSD and IFO-380 Price Dynamics

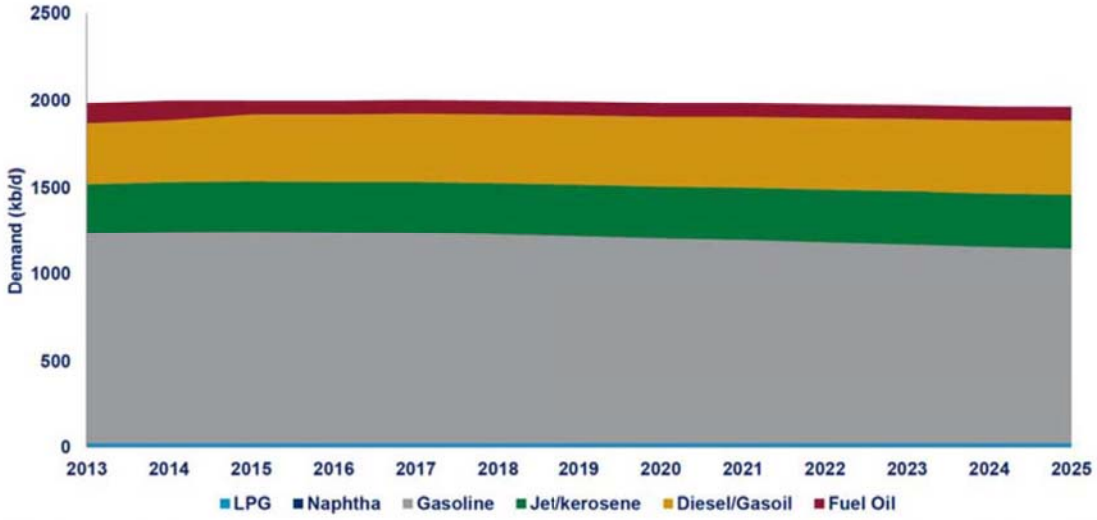
Figure 5: PNW Price Forecast for Sumas Natural Gas, ULSD and IFO-380



Wood Mackenzie expects the basis spreads between natural gas to ULSD and IFO-380 to be sustained throughout the study period due to crude price support and decreased ULSD and IFO-380 price in PNW. Even taking into account the PSE Price Triggers as defined by the PSE contracts, Wood Mackenzie expects a minimum price spread of $4.25/mmbtu occurring in 2018 before the differential reverses trend and widens through the end of the study period (Figure 5).

ULSD and IFO-380 Supply/Demand Dynamics

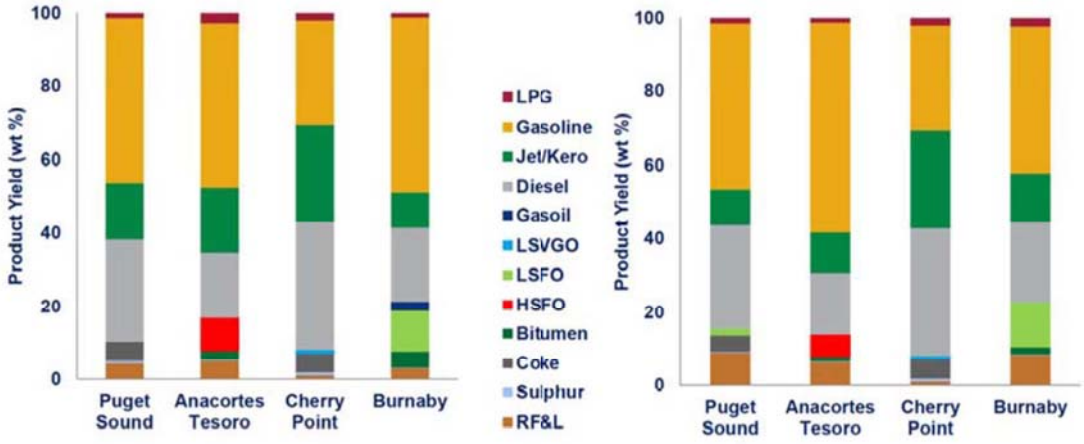
Figure 6: PNW Petroleum Product Demand Forecast



Petroleum product dynamics are not expected to change significantly through 2030 (Figure 6). Demand is forecast to

decrease slightly from ~2000 kb/d in 2014 to ~1960 kb/d in 2030, with diesel demand increasing and fuel oil demand decreasing to small extents over the same timeframe.

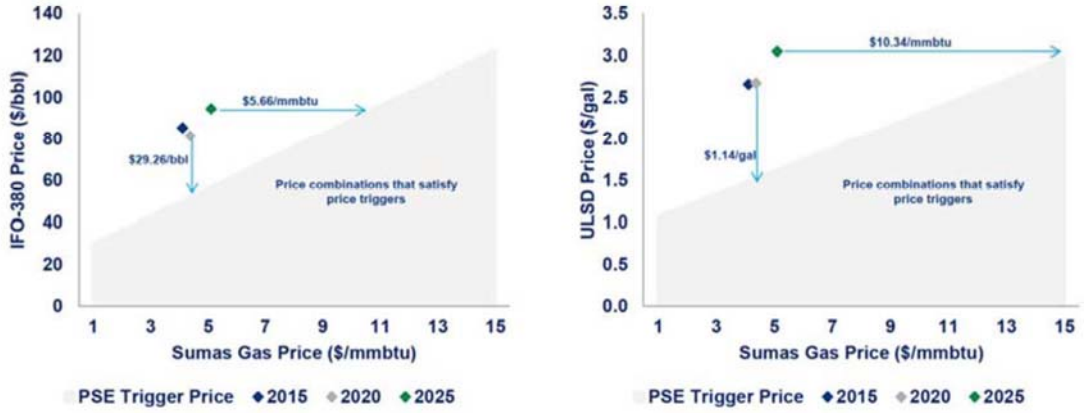
Figure 7: 2012 and 2020 Snapshots of PNW Refinery Yields



Refinery yields in the region are expected to remain relatively consistent with minor changes resulting from increased light, tight oil (LTO) production from the Bakken. However, these changes provide favourable price increases as refining of LTO shifts yields towards the lighter end of the product barrel and decreases supply of ULSD and IFO-380. Further price upside exists as current rail offloading capacity in California and PNW is currently underutilized; should rail buildout occur there is available capability to handle increased volumes of Bakken crude.

Conclusions and Risk Factors

Figure 8: IFO-380 and ULSD Trigger Prices



Wood Mackenzie expects ULSD and IFO-380 price spreads to Sumas gas to be sustained throughout the study period. Production of ULSD and IFO-380 will decrease due to lightening of the crude slate, while product demand in PNW will remain relatively constant through 2030. Natural gas price growth is expected to remain muted due to the ability to access significant volumes of economic reserves; Sumas will grow even less due to AECO-priced volumes struggling to find end markets.

Wood Mackenzie has identified a number of risk factors to the study, but even in the event of a "perfect storm" scenario, a substantial price spread will still be sustained. Wood Mackenzie's forecast currently includes four BCLNG facilities coming online; even if all projects proposed in the queue were to be constructed, price upside to Sumas natural gas is limited. Therefore, NGV demand would need to increase by an extreme amount (greater than current North American diesel demand) before prices begin to approach trigger prices due to substitution for long-haul trucks and potentially rail. However, the narrowing of the ULSD-Sumas gas spread would impair substitution economics, since increased gas price increased cost of NGV use, making it unlikely a large enough volume swap will occur to drive prices towards each other. On the product side, price support from oil project breakevens keep product prices at a premium to gas. In addition, market forces are able to adjust to worst case scenarios in a span of months to push them back towards the base case.

Background and Objectives

Background

Puget Sound Energy is requesting a discussion on the price spread between Sumas natural gas and ULSD as well as Sumas natural gas and IFO-380. The intent is to support the appropriate oil pricing outlook for considering future price spreads in the Puget Sound region to be used for contracting purposes.

Key objectives of this study

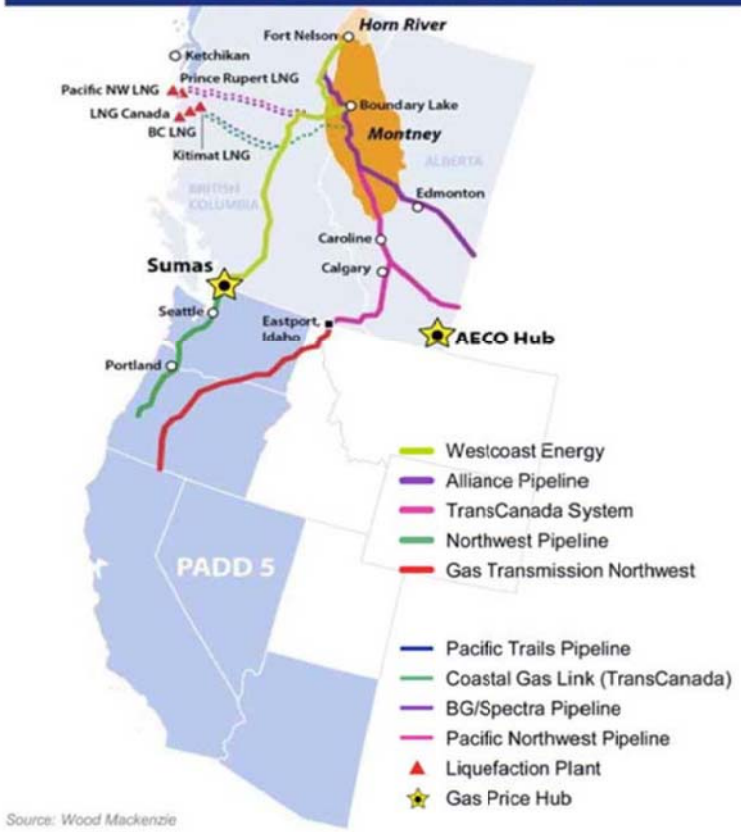
- Understand the minimum spread by examining a probable ceiling price on Sumas natural gas and a probable floor price on ULSD and IFO-380
- Understand what factors and drivers have led to the current spread as well as the sustainability of such factors
- Understand any factors that could lead to a degradation of the spread in the study period (2013-2030) and the likelihood of such circumstances occurring

Agenda

1. **Executive Summary**
2. Sumas Gas Price Dynamics and Risks
3. ULSD and IFO-380 Price Dynamics and Risks
4. Conclusions
5. Appendix

The ULSD and IFO-380 price spread to Sumas natural gas will be driven by regional dynamics in US PADD V and Western Canada

US PADD V and Western Canada



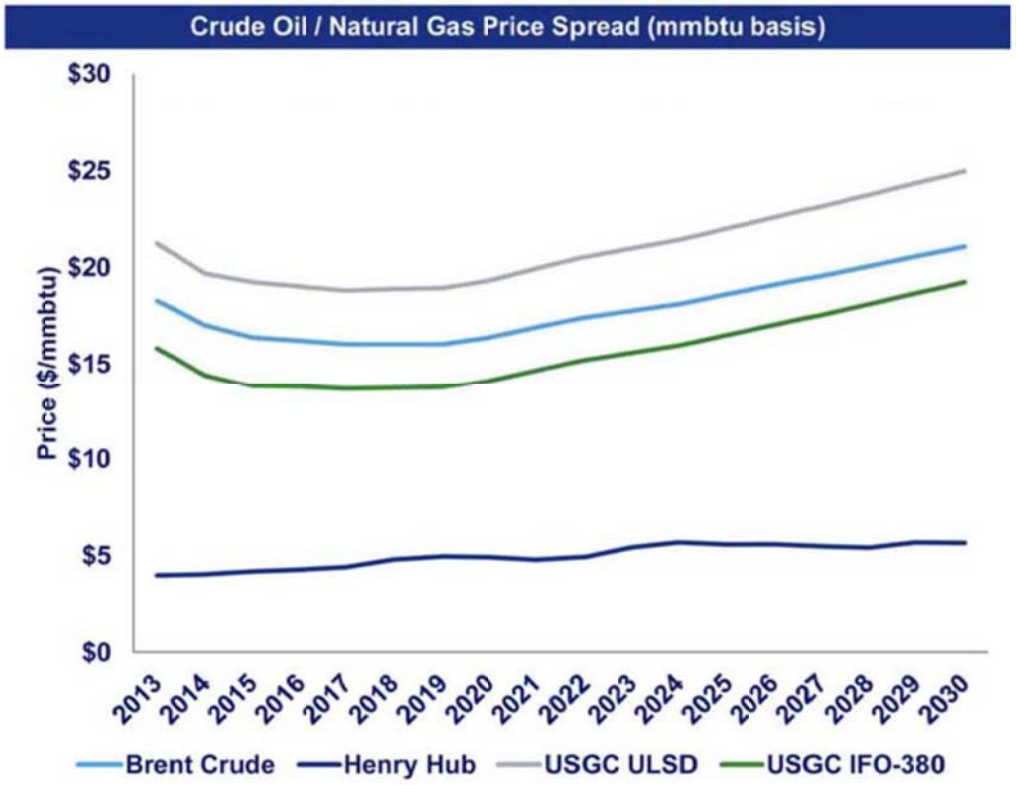
Source: Wood Mackenzie

- PADD V covers the US West coast and consists of Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington
- Western Canada is commonly defined as the four provinces west of Ontario, but for the purposes of this study refer to British Columbia and Alberta
- Supply/demand dynamics in these two regions are key to the ULSD and IFO-380 forecast price spread to Sumas natural gas

Executive Summary

- **Wood Mackenzie forecasts Sumas to remain in the $4.00-$5.25/mmbtu range and does not expect significant sustained price increases**
  - » There is already ample recoverable gas supply with ~430 tcfe economic under current prices
    - » Additional ~300 tcfe of reserves with just a $1/mmbtu increase in price
  - » Demand is forecast to grow at a slower pace from ~80 bcfd (~29 tcf/yr) to ~125 bcfd (~46 tcf/yr), with growth driven by increases in the power sector and LNG exports
- **ULSD and IFO-380 prices are expected to be sustained at a considerable premium to Sumas gas prices**
  - » Overall product demand on the North American Pacific Coast is forecast to remain relatively constant, with ULSD demand increasing ~76 kb/d and IFO-380 demand decreasing ~37 kb/d
  - » Supply is skewed towards the lighter end of the barrel due to PNW refineries running higher volumes of Bakken crude (LTO)
- **Wood Mackenzie has identified potential risk factors to our forecast but expects the price spread to persist even in a "perfect storm" worst case scenario**
  - » Sumas gas price has potential upside from LNG exports, NGV demand, and US carbon policy regulations, but these factors are all dependent upon regulatory policy
  - » ULSD and IFO-380 demand will be affected by regulations such as LCFS and MARPOL as well as refinery crude slates but prices are supported by breakevens for new oil projects needed to meet projected demand
  - » ***Circumstances approaching PSE's "price triggers" would be extreme market imbalances and would resolve as the market reacts – this would occur in months, not years***

Supply increases driven by shale production in North America will drive further expansions of the crude products/gas price spread



- Henry Hub price remains significantly lower than crude prices as accessibility to reserves is more than sufficient to meet forecast demand growth
- Crude pricing is forecast to soften in the short to medium term due to demand risks in OECD markets
  - In the long-term, crude pricing is strengthened by increasing demand and breakeven economics for marginal projects
- Increased LTO production skews refinery output towards the lighter end of the barrel, limiting supply of ULSD and IFO-380

Source: Wood Mackenzie

Agenda

1. Executive Summary
2. **Sumas Gas Price Dynamics and Risks**
3. ULSD and IFO-380 Price Dynamics and Risks
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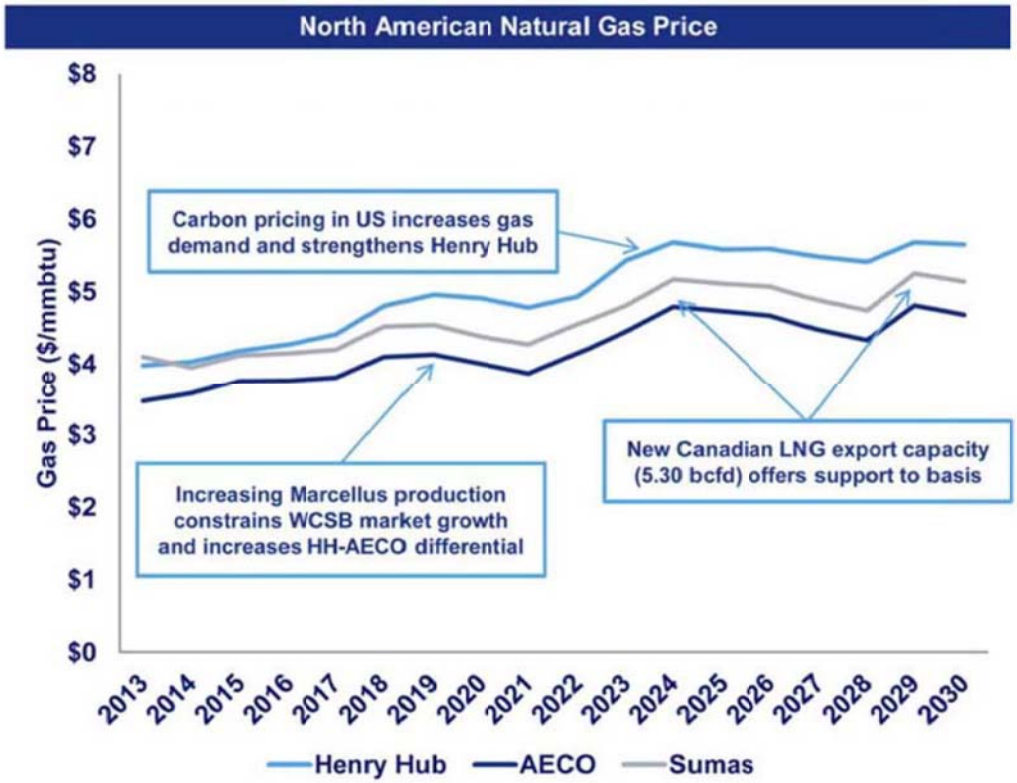
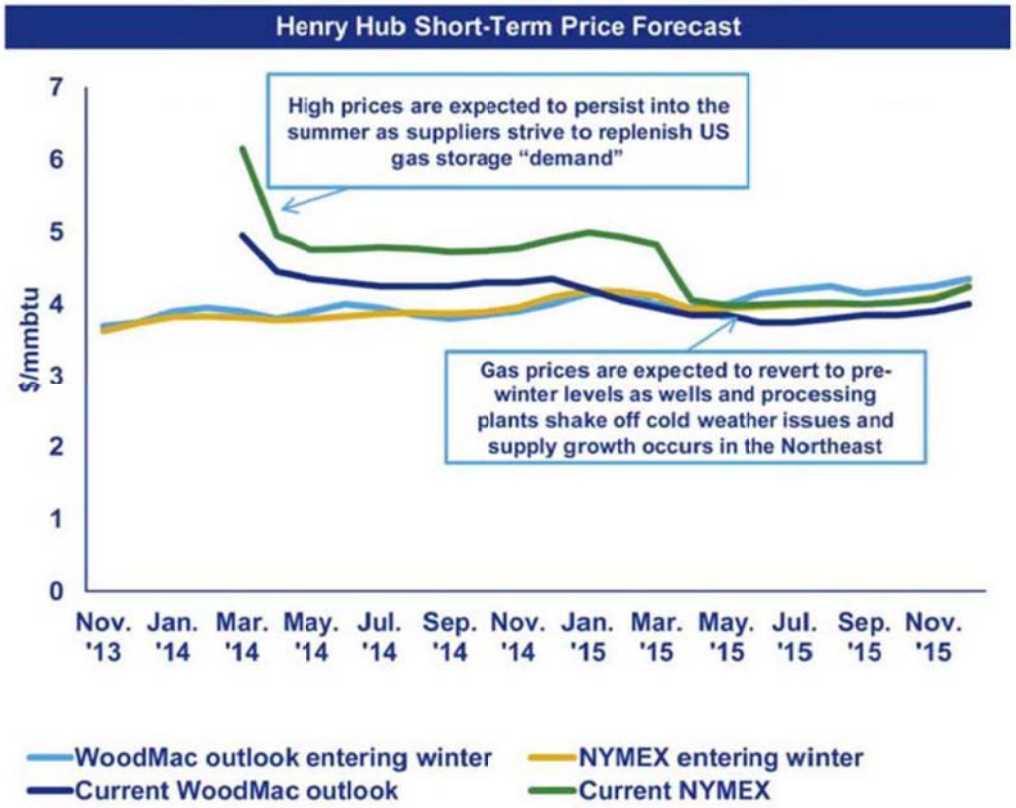
Wood Mackenzie does not forecast a significant recovery of gas prices, despite increased demand driven by regulatory policies and LNG exports



- Henry Hub is largely strengthened by LNG exports and industrial demand growth along the Gulf Coast region
- Price increases at AECO are constrained by limited demand access as well as increasing production from competing sources of supply in North America
- Sumas sources the majority of its natural gas from British Columbia which is priced off AECO, causing it to remain at a premium due to transport cost

Source: Wood Mackenzie

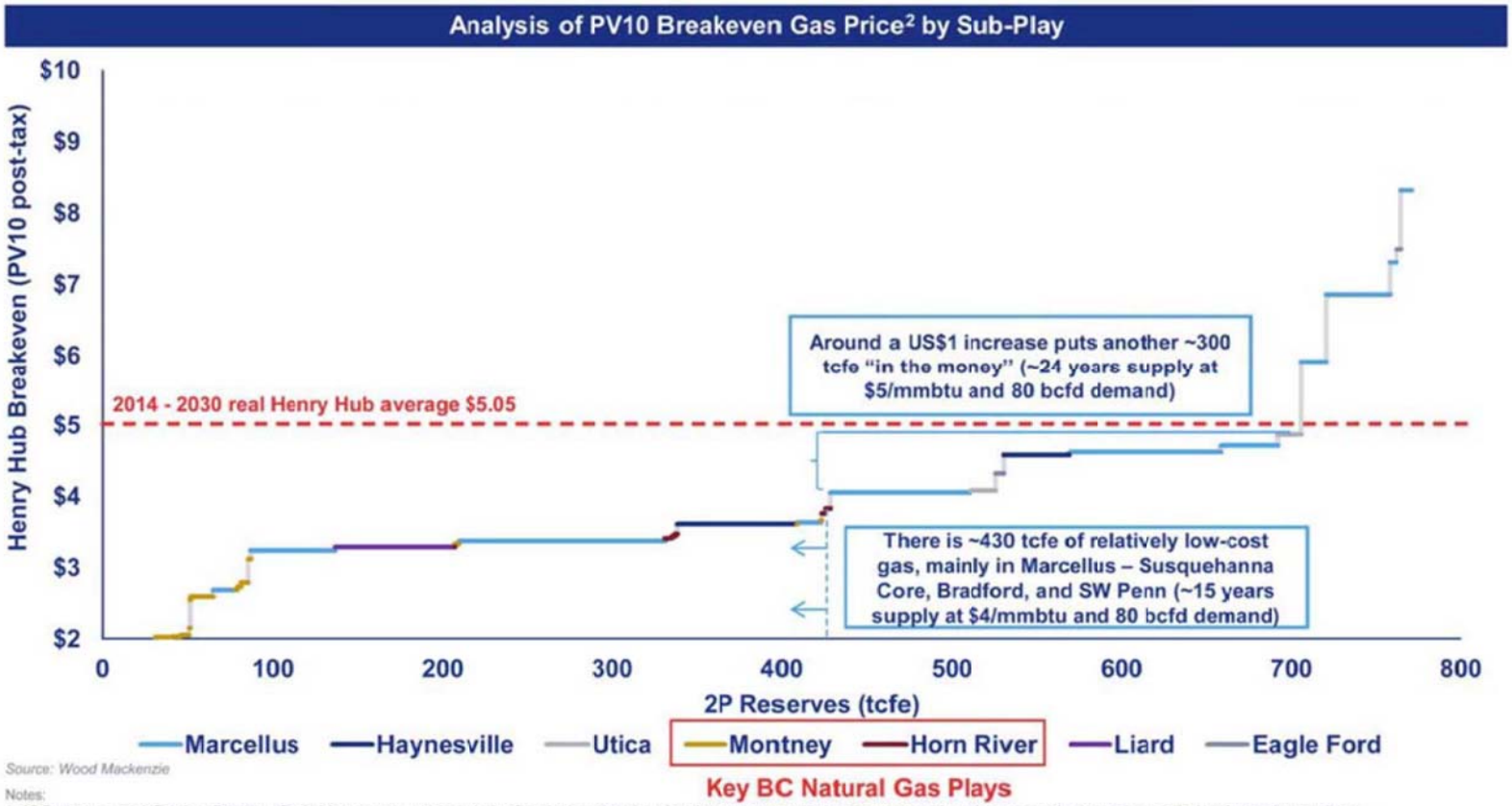
Recent gas prices have been driven by colder than normal weather in several regions, but fundamentals return to the norm in the long-term



- **This winter has been the coldest since 2000-2001, causing increased gas-fired generation, and withdrawals from US storage have been well above average levels drawn historically**
  - Prices will be sustained in the short-term as suppliers strive to refill US storage "demand"
- **However, Wood Mackenzie expects this to be a short-lived phenomenon as temperatures revert to the norm**
  - As demand falls back to normal levels, supply will increase driven by relief of cold-weather issues (plant shutdowns, well freeze-offs) and increased production from the Northeast

Source: Wood Mackenzie

North American unconventionals have provided access to significant volumes[1] of relatively low cost gas

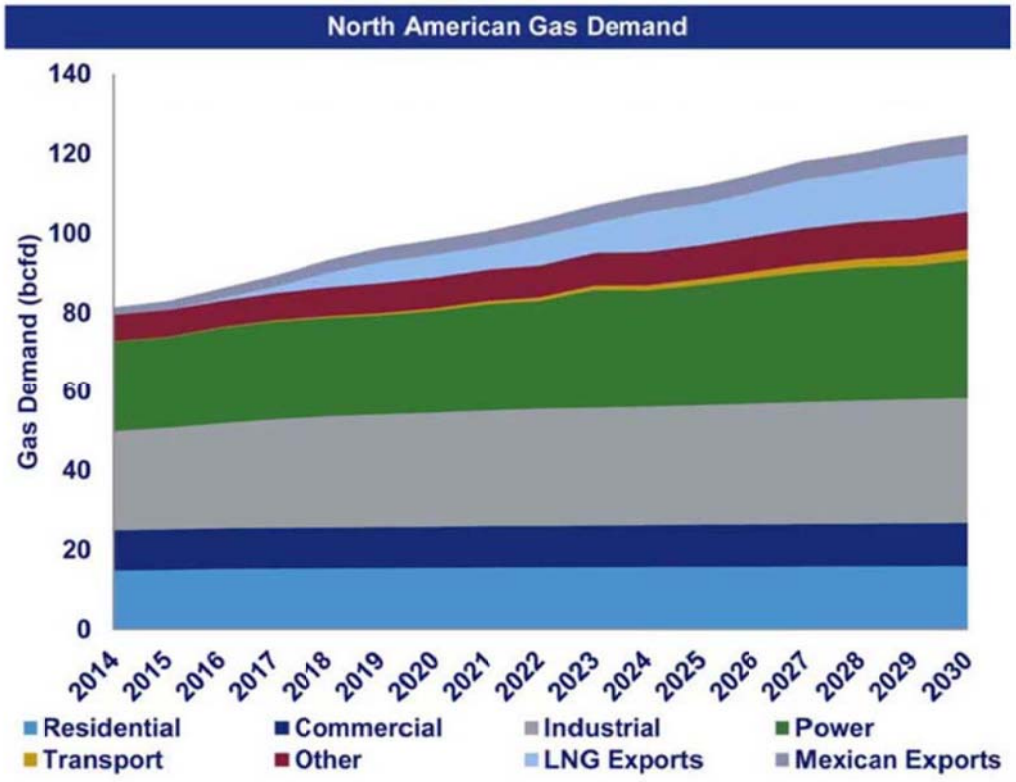


Source: *Wood Mackenzie*

Notes:
1. **2P Reserves are defined as Proven + Probable** reserves, which analysis of geologic and engineering data suggest are likely to be recoverable under reasonable economic, technical and operating conditions
2. Breakeven analysis includes current views of typical drilling & completion costs, per-well infrastructure Capex, operating expenses and fiscal take; excludes lease acquisition and E&A

PUGET SOUND ENERGY Wood Mackenzie

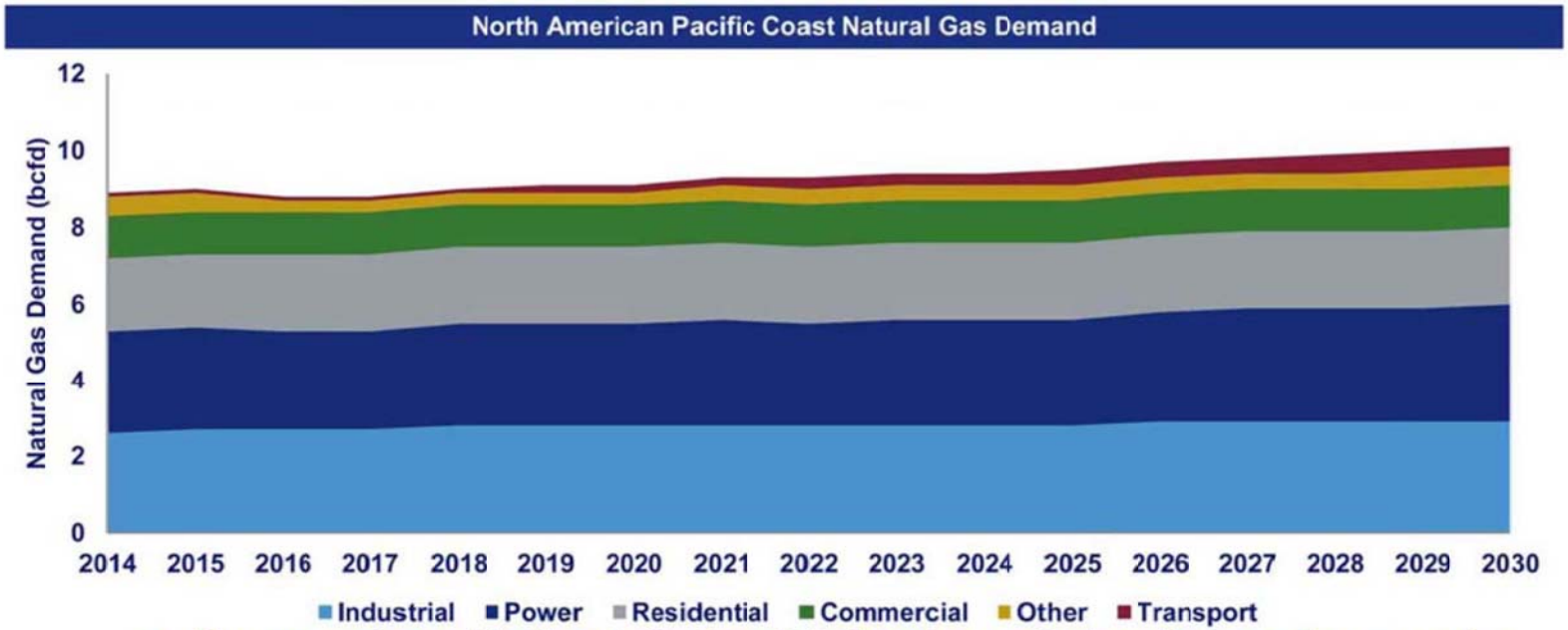
North American gas demand is expected to grow through the study period, driven mainly by the power sector and LNG exports



- The power sector is forecast to grow from 23 bcfd in 2014 to 35 bcfd in 2030 due to additional gas-fired generation addressing mandated retirements of coal-fired power plants in the US
- LNG exports are expected to add another 15 bcfd (5 bcfd from BCLNG) to demand by 2030 and compete strongly with other global sources into the Asian markets
- Economic growth supports an additional 7 bcfd of industrial demand by 2030 as low gas prices lead to increasing competiveness and investment in additional industrial capacity

Source: Wood Mackenzie

Gas demand on the North American Pacific Coast contributes very little of this growth, with only an increase of ~1 bcfd of demand by 2030

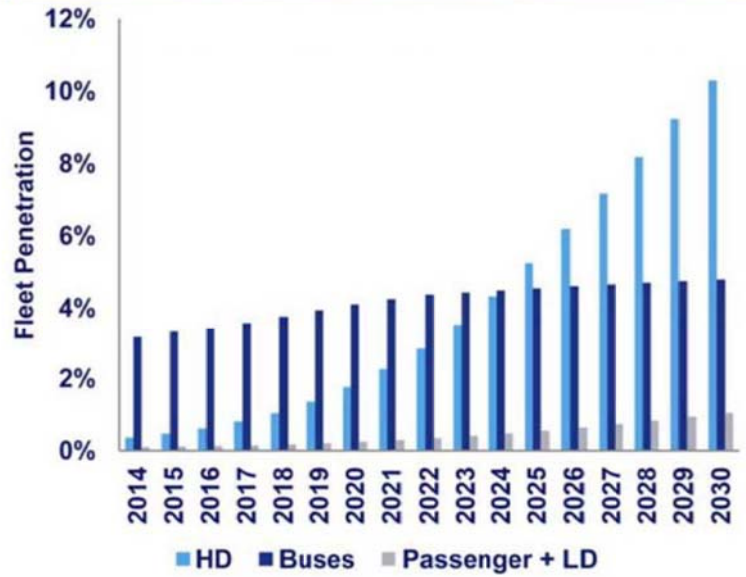


- The power sector provides the majority of growth in the region as natural gas displaces other sources due to environmental regulations coming into effect
- Industrial demand is not forecast to increase significantly due to a lack of industrial projects; Canada Methanol Corporation's plant in British Columbia is still early in the planning stage and must resolve offloading issues

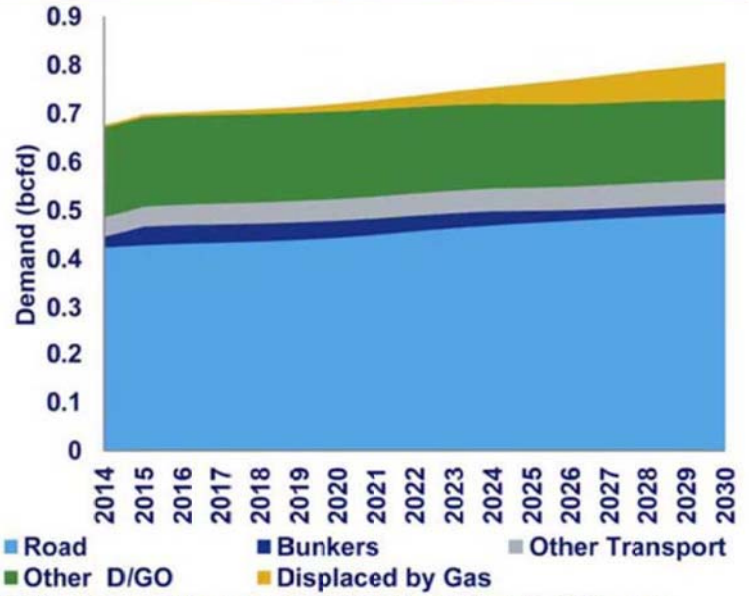
Source: Wood Mackenzie

Despite clean air initiatives and incentives, Wood Mackenzie does not forecast significant demand growth for NGVs in the US

NGV Vehicle Fleet Penetration



US Diesel / Gasoil Demand



- The lack of re-fuelling infrastructure has constrained NGV uptake, with only ~1,300 CNG stations (~50% open to public) and 70 LNG stations (c.f. 5,000 diesel stops)
- In addition, NGVs face stiff competition in the market from alternative vehicle technologies, notably hybrid / electric vehicles

Source: Wood Mackenzie

Notes:
1. HD = heavy duty truck, LD = light duty truck. Based on gross vehicle weight rating (GVWR)

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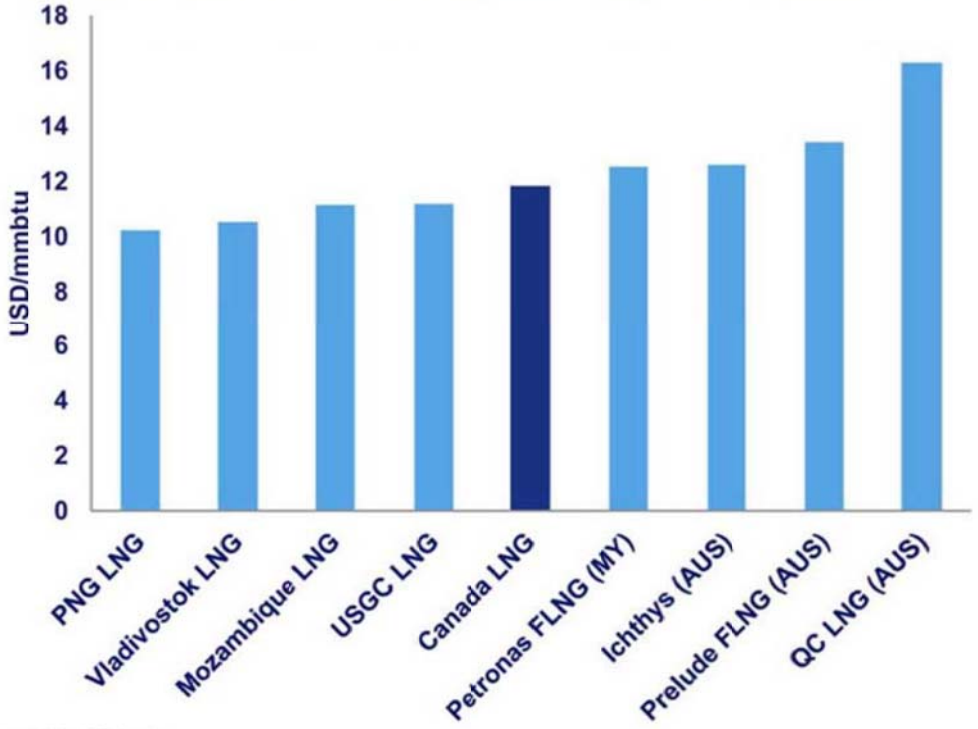
North American LNG export projects are expected to be competitive into Asian markets, but a race is on to build capacity and secure commitments

2020 Est. Delivered Cost[1] Comparison with Competing Projects into Asia



- **The potential LNG projects in North America, East Africa and Australia are competing to supply a "limited re-gas market"**
  - Proposed liquefaction capacity greatly exceeds forecast LNG appetite
- **LNG exports from Western Canada are intriguing due to proximity to Asian markets, but face a number of challenges:**
  - Remote location of source gas plays (Montney and Horn River)
  - Regulatory hurdles to secure right-of-ways and approvals (including First Nations)
  - High costs due largely to labor force competition with oil sands

Source: Wood Mackenzie

Notes:
1. Includes gas feedstock, liquefaction costs, and shipping costs to Japan
2. PNG = Papua New Guinea

There is opportunity for long-term upside in Canadian LNG but high deliverability risk makes timing and costs very uncertain

Project (Partners)	NEB export license status	Proposed Capacity (1st phase, mmtpa/bcfd)	Location
Kitimat LNG (Apache, Chevron)	Received	10.0 / 1.3	Kitimat
BC LNG Export Co-op (LNG Partners, Haisla First Nation, Golar)	Received	0.9 / 0.1	Kitimat
LNG Canada (Shell, PetroChina, KOGAS, Mitsubishi)	Received	12.0 / 1.6	Kitimat
Pacific Northwest LNG (PETRONAS, JAPEX)	Approved	12.0 / 1.6	Prince Rupert
WCC LNG (Exxon Mobil, Imperial)	Approved	30.0 / 3.9 (NEB Application Total)	Not finalized
Prince Rupert LNG (BG Group)	Approved	14.0 / 1.8	Prince Rupert
Woodfibre LNG (Pacific Oil & Gas)	Approved	2.1 / 0.3	Squamish
Jordan Cove[1] (Veresen)	Approved	6.0 / 0.8	Coos Bay, Oregon
Triton LNG (AltaGas, Idemitsu)	Applied	2.3 / 0.3	Not finalized (Kitimat or Prince Rupert proposed)
Aurora LNG (Nexen, INPEX, JGC)	Applied	24.0 / 3.1	Prince Rupert
Kitsault LNG (Kitsault Energy)	Applied	20.0 / 2.6	Kitsault
Oregon LNG[2] (Leucadia)	Applied	9.6 / 1.3	Warrenton, Oregon

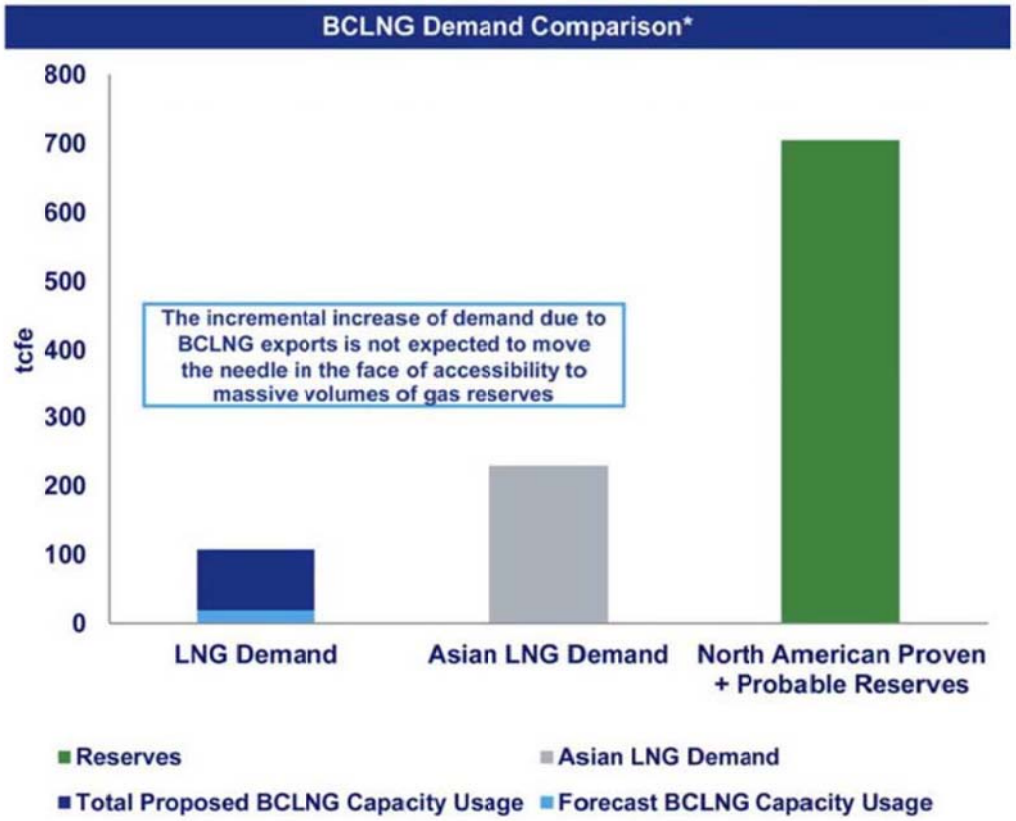
Included in WM Forecast

- **Technical challenges:**
  - Greenfield construction with limited labor and resources
  - Aggressive drilling campaigns necessary to achieve sufficient feed gas
  - Infrastructure buildout is necessary to support proposed LNG volumes
- **Political/fiscal challenges:**
  - Local stakeholder support must be secured: First Nations have protested use of their land in the past
  - Concerns that LNG fiscal policy might burden competitiveness (i.e. proposed LNG tax)
  - Possibility of NEB scrutinizing future approvals
- **Corporate appetite:**
  - Major developers seeking to lower exposure (PETRONAS, KOGAS farm-downs) may indicate a "wait-and-watch" approach

Source: Wood Mackenzie

Notes:
1. Jordan Cove is proposed in the US but plans to source feedgas from Canada
2. Oregon LNG is proposed in the US but plans to source feedgas from Canada

Even if additional LNG projects come online, British Columbia LNG is expected to have a negligible effect on Sumas gas price

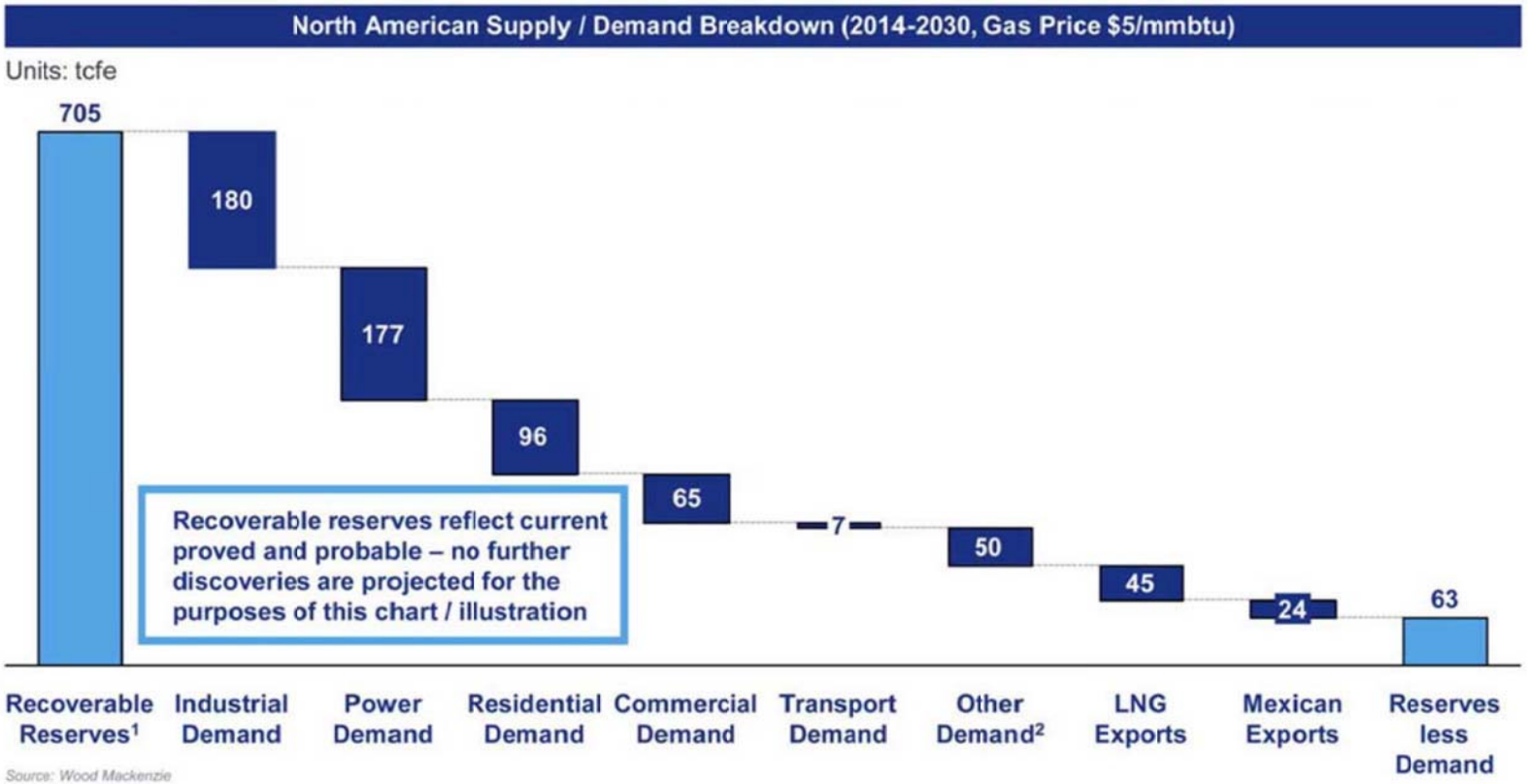


- Wood Mackenzie's current forecast assumes four Canadian projects come online within the study period: BC LNG, LNG Canada, Pacific NW LNG, and Prince Rupert LNG
- As LNG capacity comes online and flows increase, Sumas gas price receives support and strengthens ~2021
- However, this effect is limited as the increased price along with LNG stakeholder interests encourage access to stranded Horn River gas

Source: Wood Mackenzie

*Forecast and Total Proposed BCLNG Capacity Usage assumes 100% capacity utilization. 2P reserves based on $5/mmbtu Henry Hub price. Demand and LNG usage estimated out to 2030.

Current recoverable reserves are more than sufficient to supply projected demand and exports for the next 15 years, keeping gas prices low



Source: Wood Mackenzie

Notes:
1. Recoverable Reserves does not include conventional or offshore fields
2. Other Demand includes pipeline and fuel usage

SUMAS GAS PRICE DYNAMICS AND RISKS

There is more downside than upside price risk to the Sumas price forecast as many strengthening factors are dependent on regulatory policy

Risk Factor	Consequences	Effect on Sumas Gas Price	Impact
LNG Exports	• Several LNG projects are in various stages of the approval process for LNG exports into Asian markets • Canadian and US West Coast LNG exports will use source gas from British Columbia	Price Increase: Increase in demand and linking to Asian gas prices	Low
NGV Usage Growth	• The US DoE Clean Cities Coalition is incentivizing the use of alternative and renewable fuels to reduce petroleum consumption • Ongoing initiatives to increase NGV re-fuelling infrastructure improves accessibility to CNG and increases natural gas demand	Price Increase: Increased gas demand from higher NGV penetration into the vehicle fleet	Low
US Carbon Policy Regulations	• Previous proposals for carbon regulations (Bingman-Specter, Kerry-Lieberman) have garnered political backing in the past, and rising emissions levels are expected to produce increased political pressure • A tightening of carbon emissions causes the power sector to switch from coal to natural gas for its energy source, increasing gas demand	Price Increase: Increased gas demand for the power sector	Medium
Shale Gas Supply / Production Growth	• Continued delineation and improvements in operational efficiencies increases natural gas reserves and production, providing additional supply	Price Decrease: Increased gas supply from available economic reserves	High

Price Decrease Price Increase No Price Effect

Source: Wood Mackenzie

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Sumas Gas Price Dynamics Overview

- **Wood Mackenzie forecasts Sumas gas price to remain in the $4.00-$5.25/mmbtu range throughout the study period and does not expect price to increase significantly**
  - » Recent temperature patterns have resulted in price spikes for natural gas, but Wood Mackenzie does not expect these trends to sustain gas prices in the long-term
- **North American unconventionals have provided access to considerable volumes of low-cost shale gas, far outpacing forecasted demand growth**
- **Demand growth resulting from NGVs is not expected to be significant due to re-fuelling infrastructure constraints and competition from alternative vehicle technology**
- **Despite long-term opportunity for exports from BCLNG, these projects face a number of technical, political, and fiscal challenges that must be overcome**

Agenda

1. Executive Summary
2. Sumas Gas Price Dynamics and Risks
3. **ULSD and IFO-380 Price Dynamics and Risks**
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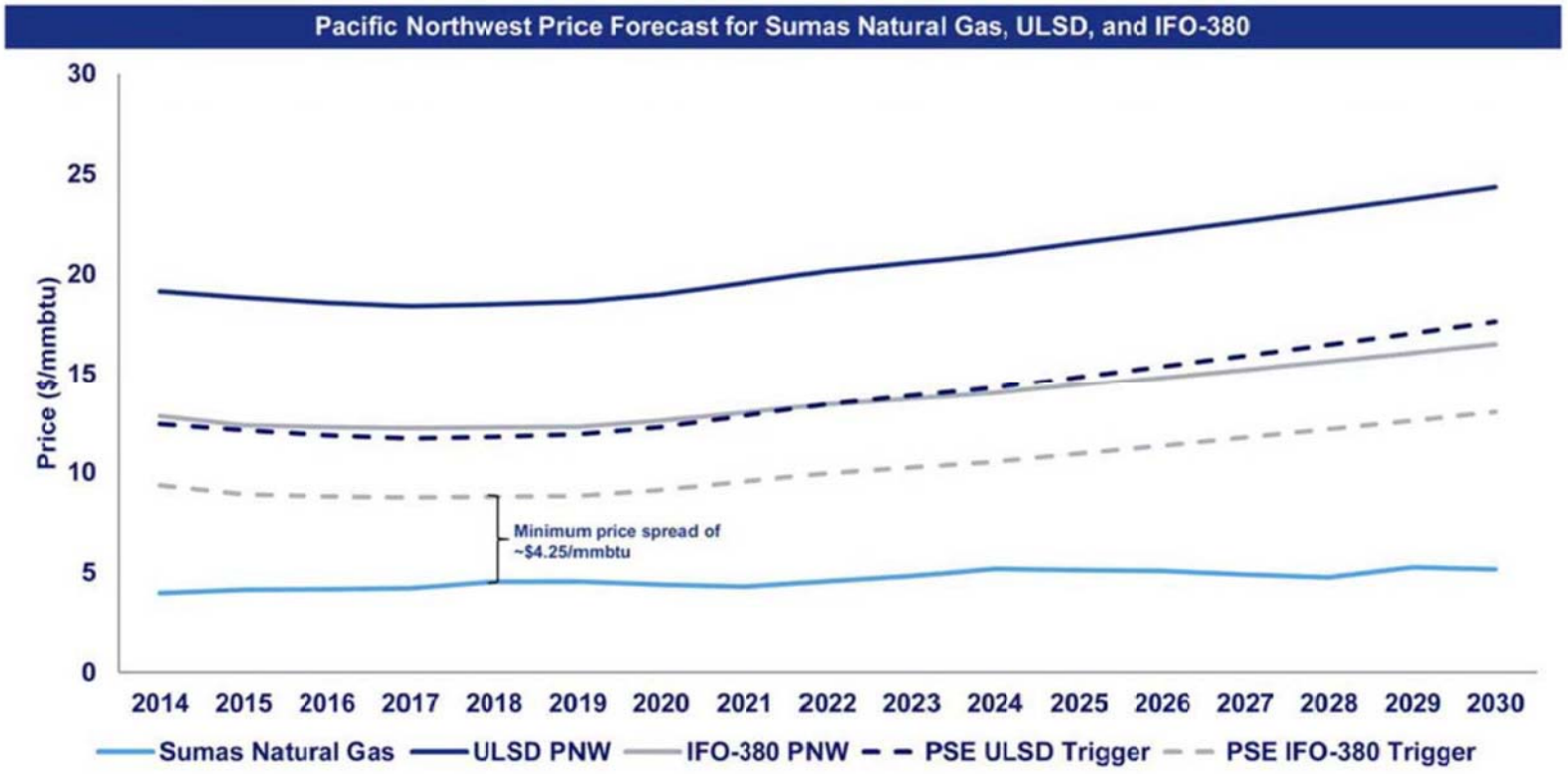
ULSD AND IFO-380 PRICE DYNAMICS AND RISKS

Wood Mackenzie expects the basis spread between natural gas to ULSD and IFO-380 to be sustained throughout the study period



Source: Wood Mackenzie

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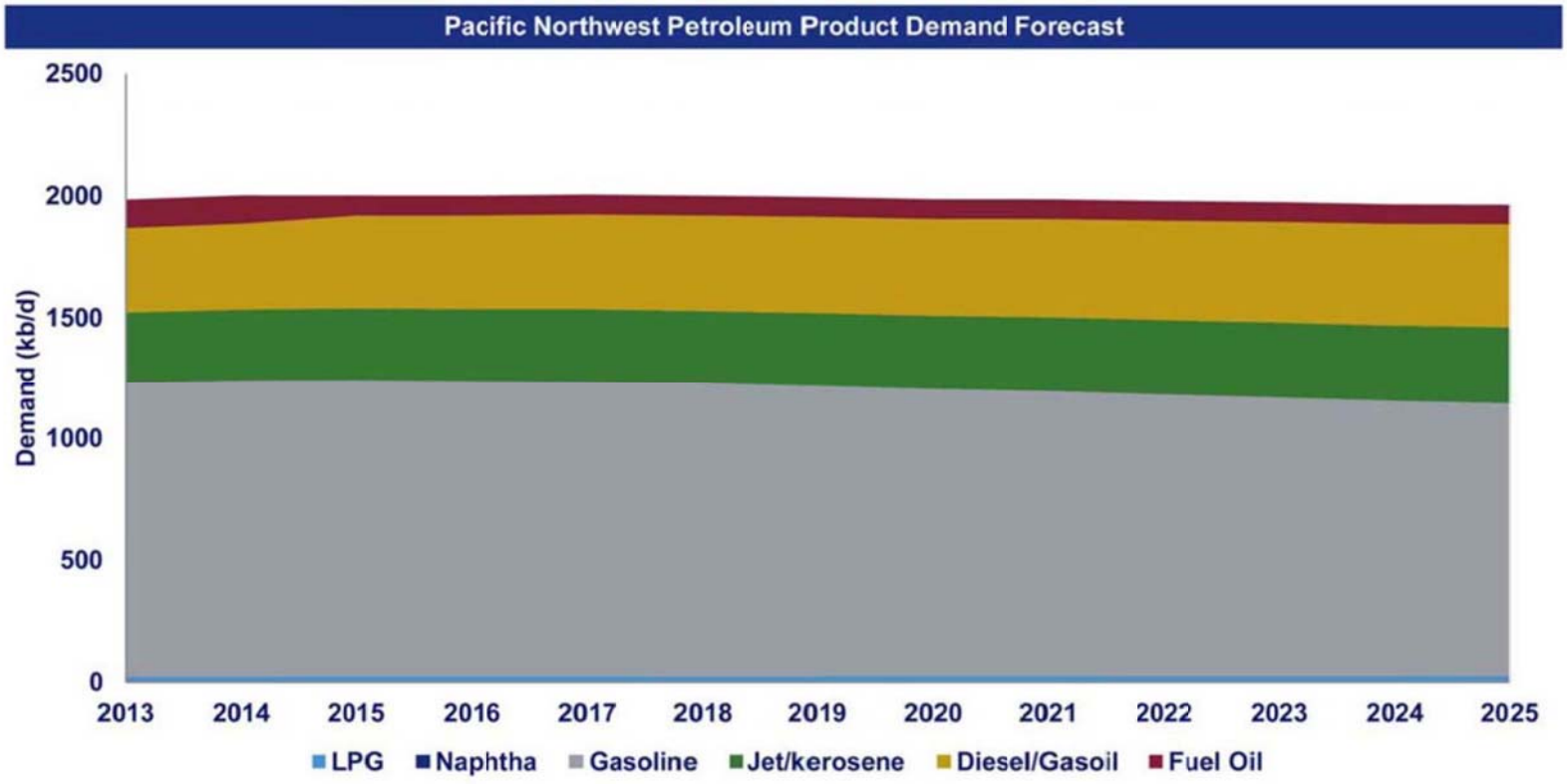
ULSD AND IFO-380 PRICE DYNAMICS AND RISKS

Petroleum product dynamics in the Pacific Northwest are not expected to change significantly through the study period



Source: Wood Mackenzie

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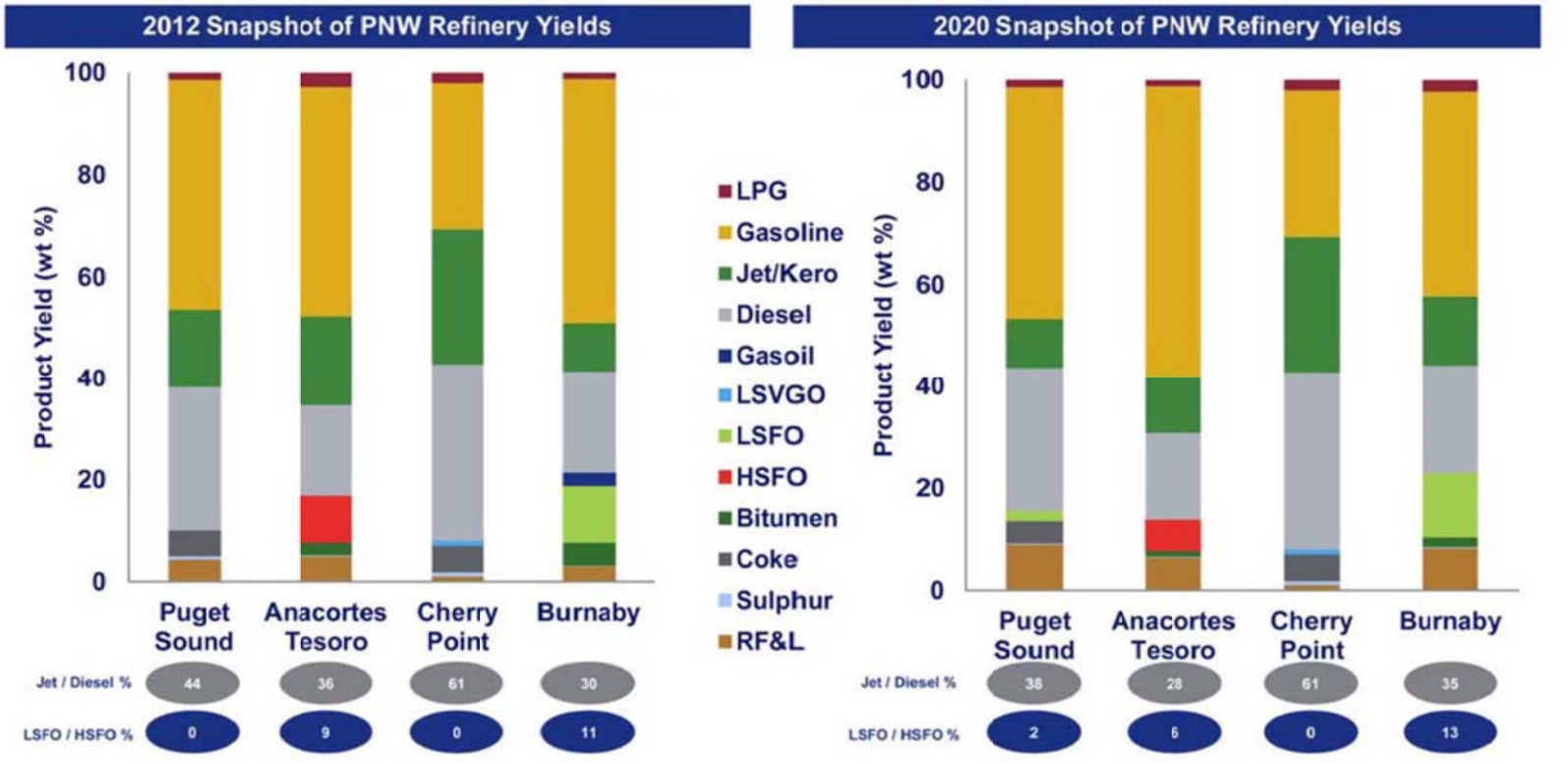
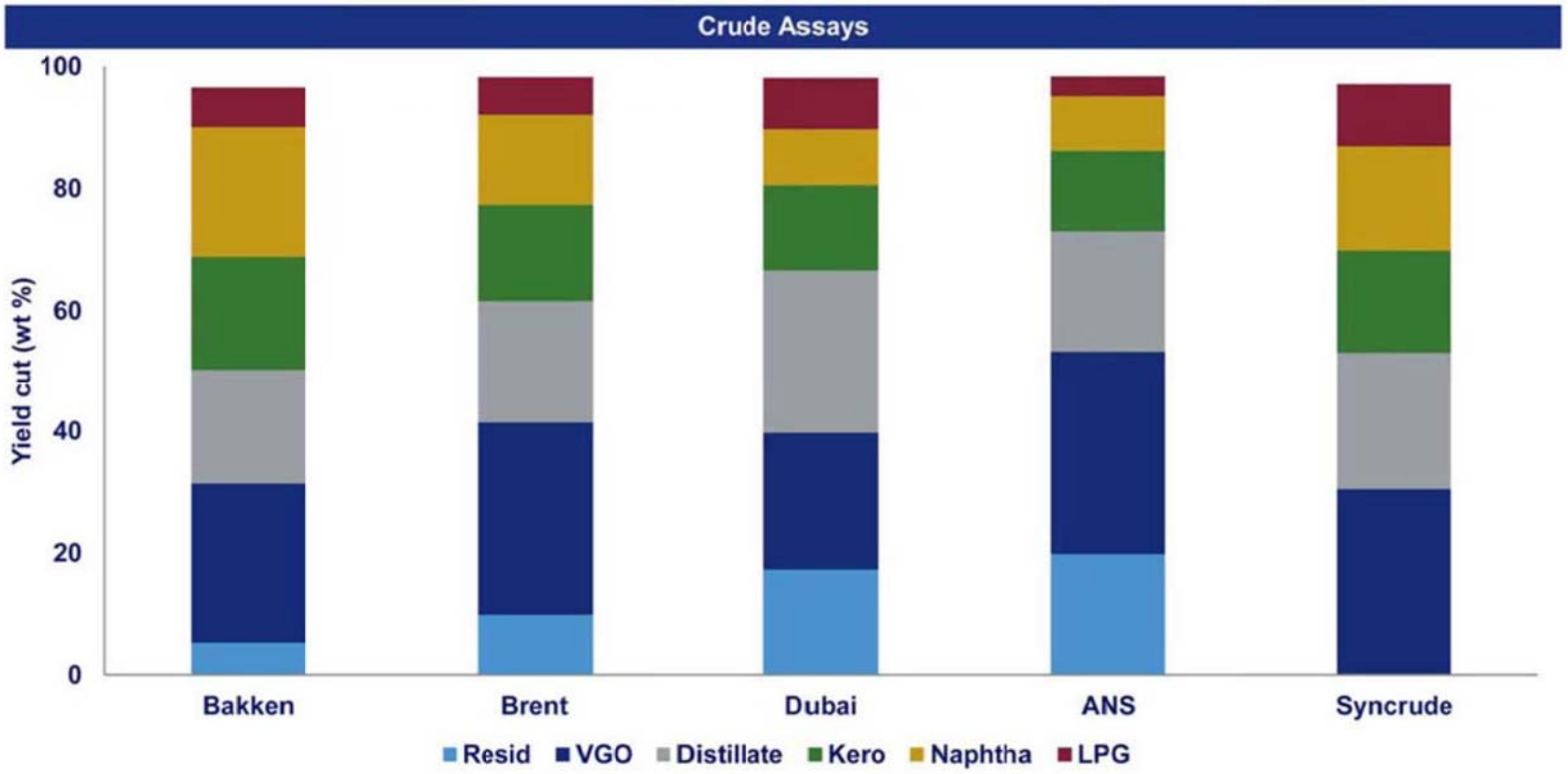
Consequently, refinery yields remain relatively consistent, with minor changes resulting from increased LTO production



Source: Wood Mackenzie

ULSD AND IFO-380 PRICE DYNAMICS AND RISKS

Relative to conventional grades, LTO produces less residue and more LPG and naphtha, shifting yields toward the lighter end of the product barrel



Source: Wood Mackenzie

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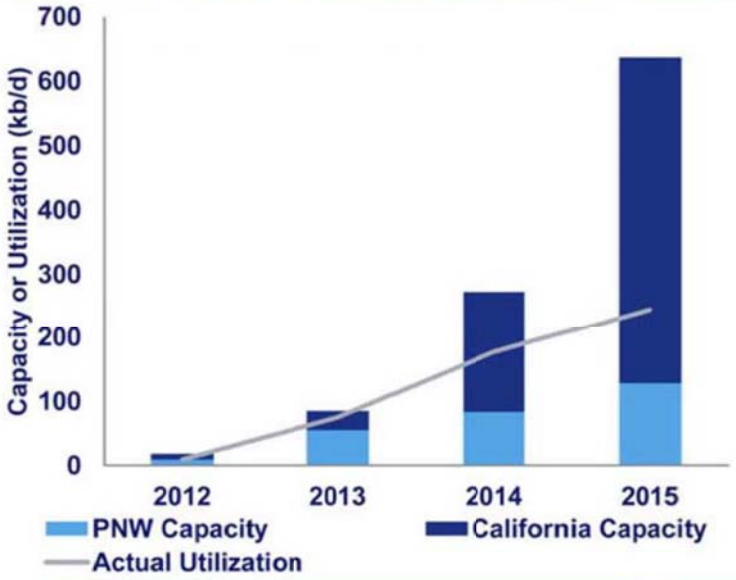
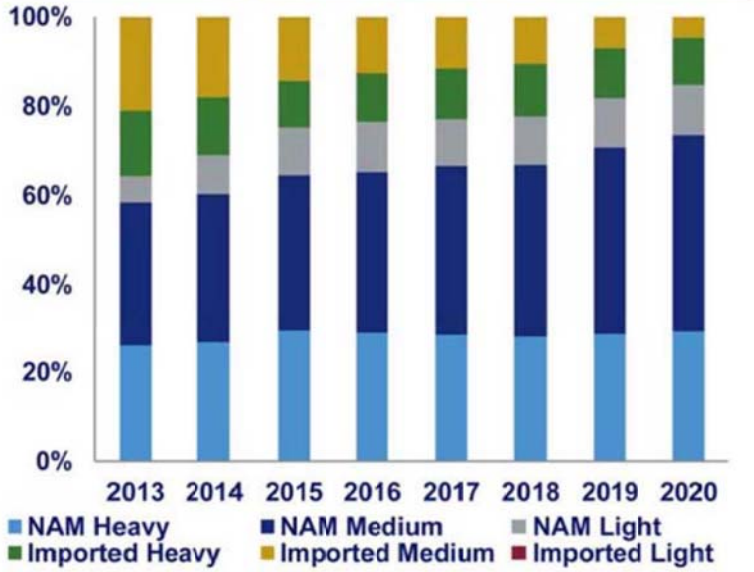
Upward product (ULSD, IFO) price pressure as North American supply (including LTO) enters PADD V, with negative yield impact on heavier cuts

Light/Medium Rail Offloading Capacity[1]



PADD V Crude Slate



- LTO penetration will largely be confined to PNW as there is limited crude by rail into California; the PNW is expected to continue running as many Bakken volumes as possible

Source: *Wood Mackenzie*

Notes:
1. Assumes rail offloading capacity is 75% of maximum daily rate

ULSD AND IFO-380 PRICE DYNAMICS AND RISKS

Wood Mackenzie has identified a number of possible risk factors to our ULSD and IFO-380 price forecast

Risk Factor	Consequences	Effect on ULSD Price	Effect on IFO-380 Price
California LCFS Regulations	• Due to inability of PNW refineries to make LCFS diesel, PNW diesel surplus is exported to Japan • California exports of non-LCFS diesel find a new market in Asia (Singapore) • Due to the more stringent diesel specifications, hydrotreating finishing becomes more valuable	Price Decrease: decreased demand and exports to Asian markets	No Price Effect: the price spread increases due to hydrotreating becoming more valuable in the face of more stringent diesel specifications
MARPOL Regulations	• MARPOL regulations cause gasoil to be substituted for fuel oil, increasing diesel demand • Fuel oil is pushed out of the bunker market, increasing gasoil price and decreasing resid price	Price Increase: increased diesel demand	Price Decrease: decreased IFO-380 demand, though tempered by the corresponding increase in gasoil price
Heavy Crude Supply/Demand Balance	• A short balance of heavy crude increases the value of heavy crude, which in turn increases the value of resid	No Price Effect	Price Increase: increased value of resid causes processing cost of IFO-380 to increase
Tight Oil (LTO) Production	• Reduced distillate yield reduces the supply of ULSD • Reduced resid yield increases the price of residuals which are used to blend fuel oil	Price Increase: reduction in ULSD supply	Price Increase: decreased supply of resid increases their price, causing cost of IFO-380 processing to increase as well

Notes:
1. LCFS = Low Carbon Fuel Standard. Compliant fuels are a separate commodity from standard ULSD.

Price Increase Price Decrease No Price Effect

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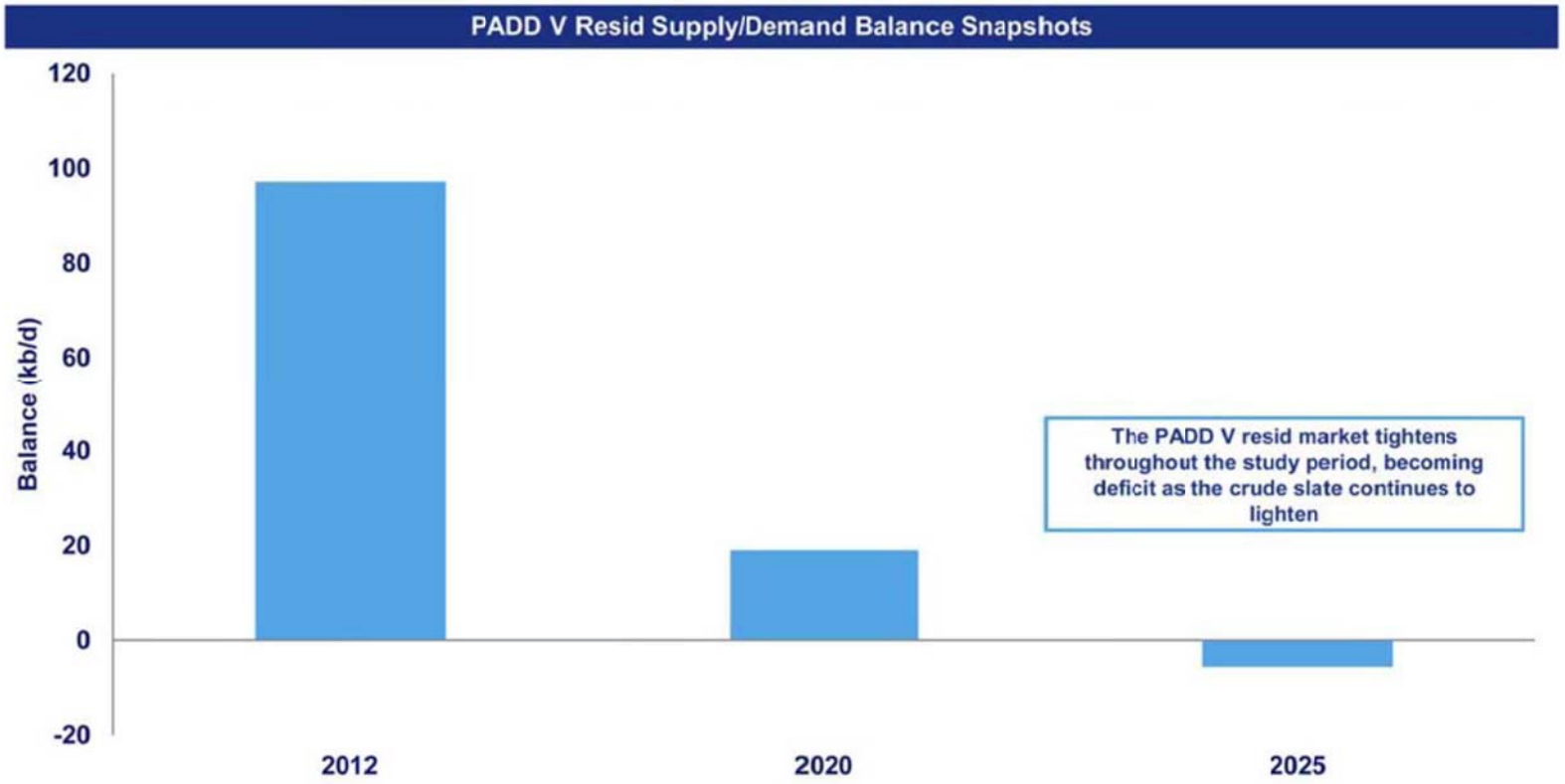
Price downside is limited as IFO-380 becomes deficit, implying import price parity as the price-setting mechanism and providing upward price pressure



Source: Wood Mackenzie

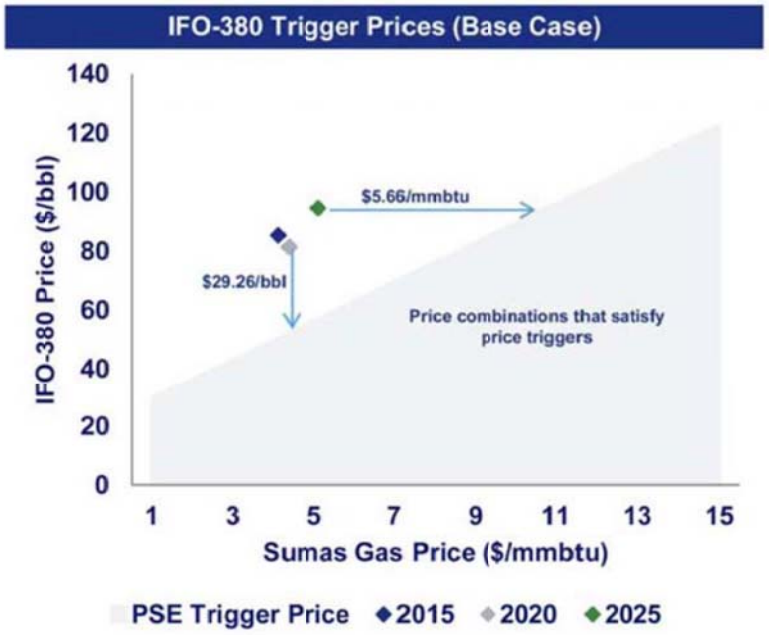
Agenda

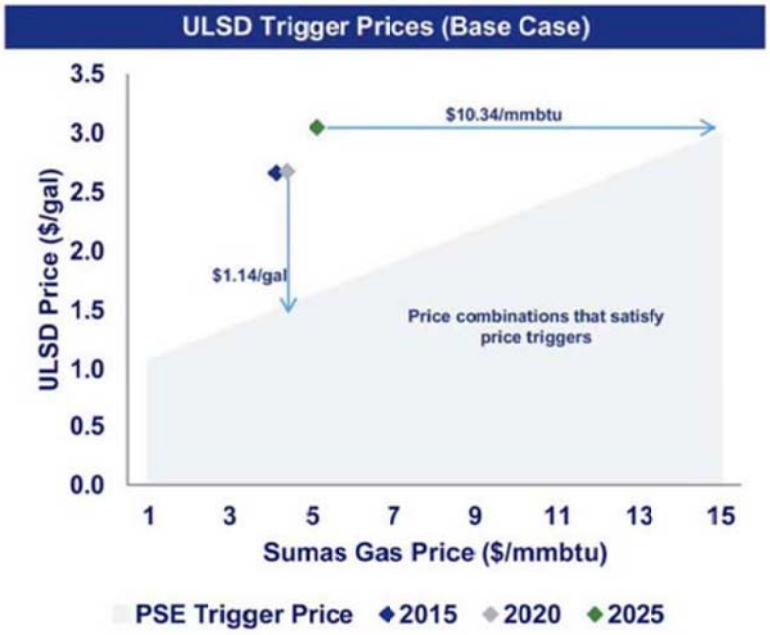
1. Executive Summary
2. Sumas Gas Price Dynamics and Risks
3. ULSD and IFO-380 Price Dynamics and Risks
4. **Conclusions**
5. Appendix

Key Conclusions

- **Even in the event of a "perfect storm", a substantial price spread will emerge and be sustained**
  - » Gas demand (e.g. LNG, NGV) needs to increase by an extreme amount before prices begin to approach trigger prices
  - » Decreasing supply from increased LTO and price support from oil project breakevens keep product prices at a premium versus gas
  - » Market forces are able to adjust to worst case scenarios in a span of months to push them back towards the base case
- **ULSD and IFO-380 price spreads to Sumas gas are sustained throughout the study period as crude supply shifts towards lighter products**
  - » Production of ULSD and IFO-380 will decrease due to lightening of the crude slate, while overall product demand in PNW is forecast to remain relatively constant through 2030
  - » PNW is a net importer of ULSD and net exporter of IFO-380 so price-setting mechanisms do not change
  - » IFO-380 price has the potential to strengthen due to local resid market deficit with lighter USWC crude slate
- **Wood Mackenzie does not expect Sumas gas price to increase significantly, remaining in the $4.00-$5.25/mmbtu range**
  - » Currently existing 2P reserves are sufficient to supply forecast demand through at least 2030
  - » Even a doubling of LNG demand and NGV penetration does not materially change production cost

Price risk factors would need to manifest in the extreme in order to collapse the price spread



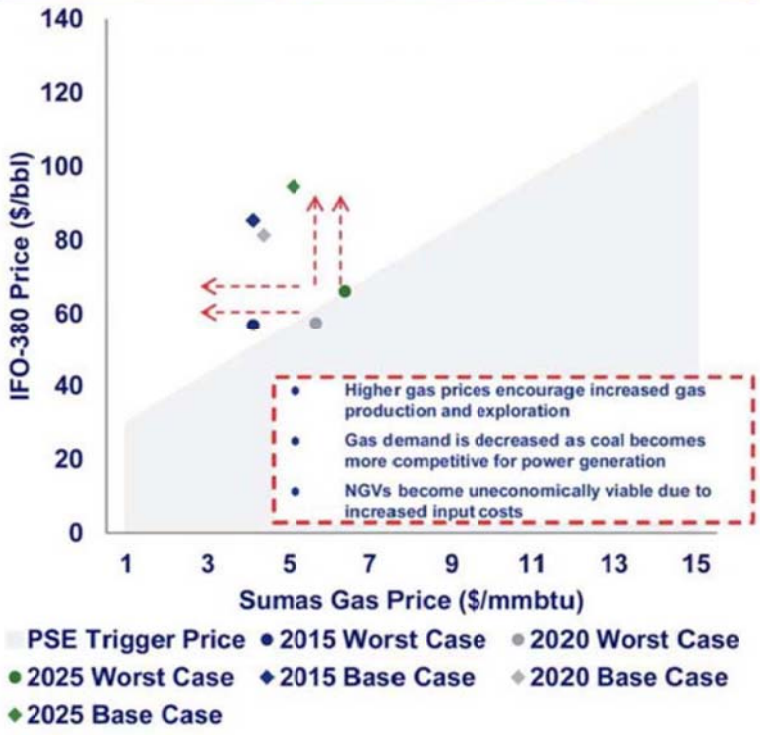


- Not only would all proposed BCLNG capacity need to be fully utilized, but NGV demand would also have to grow by an enormous amount (*more than all forecast North American diesel demand*)
- For IFO-380 and ULSD prices to drop below the trigger line, LTO production would need to drop by a significant amount and be replaced by heavy crudes from Canadian oil sands in the North American crude slate

Source: Wood Mackenzie

Even if the spread does collapse for a short time, market forces will push prices back towards the base case and away from the trigger line

IFO-380 Trigger Prices (Worst Case)



ULSD Trigger Prices (Worst Case)

Source: Wood Mackenzie

Agenda

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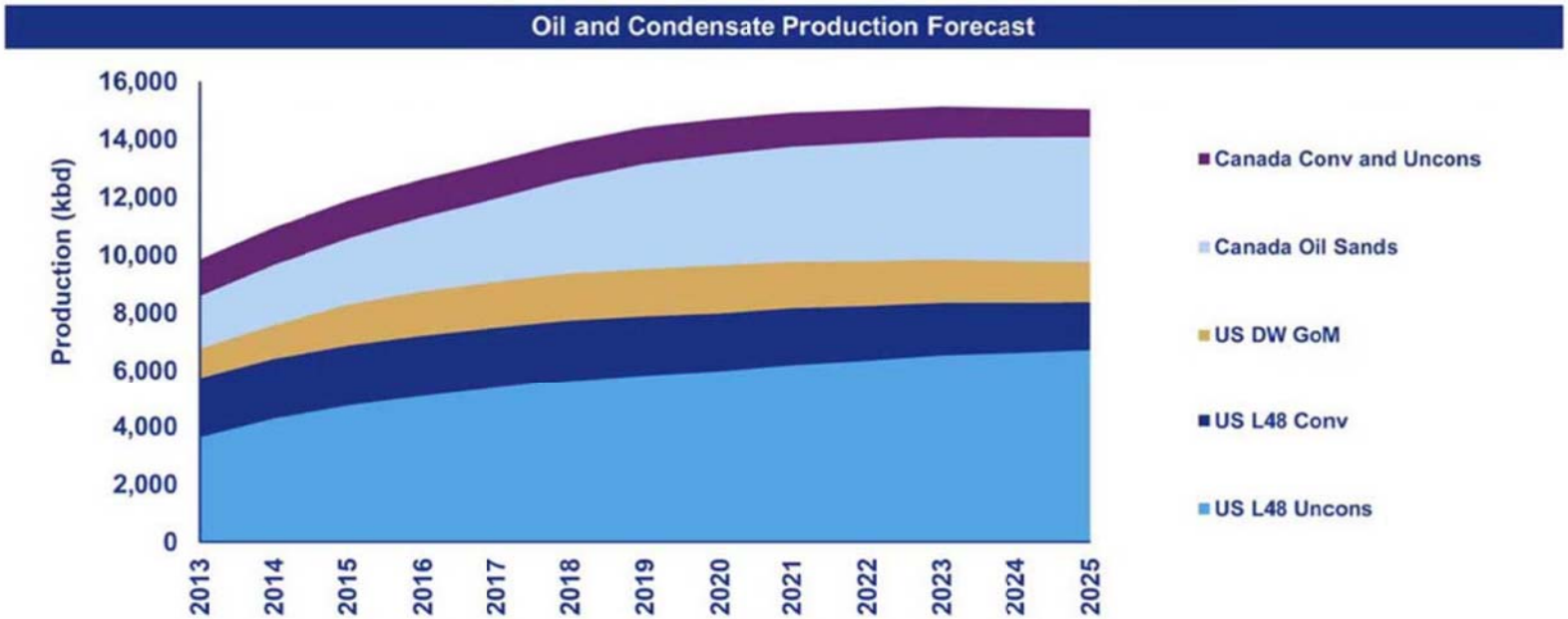
APPENDIX

Total North American production is forecast to increase to ~16 million barrels by 2025, driven by growth in US uncons and Canada oil sands

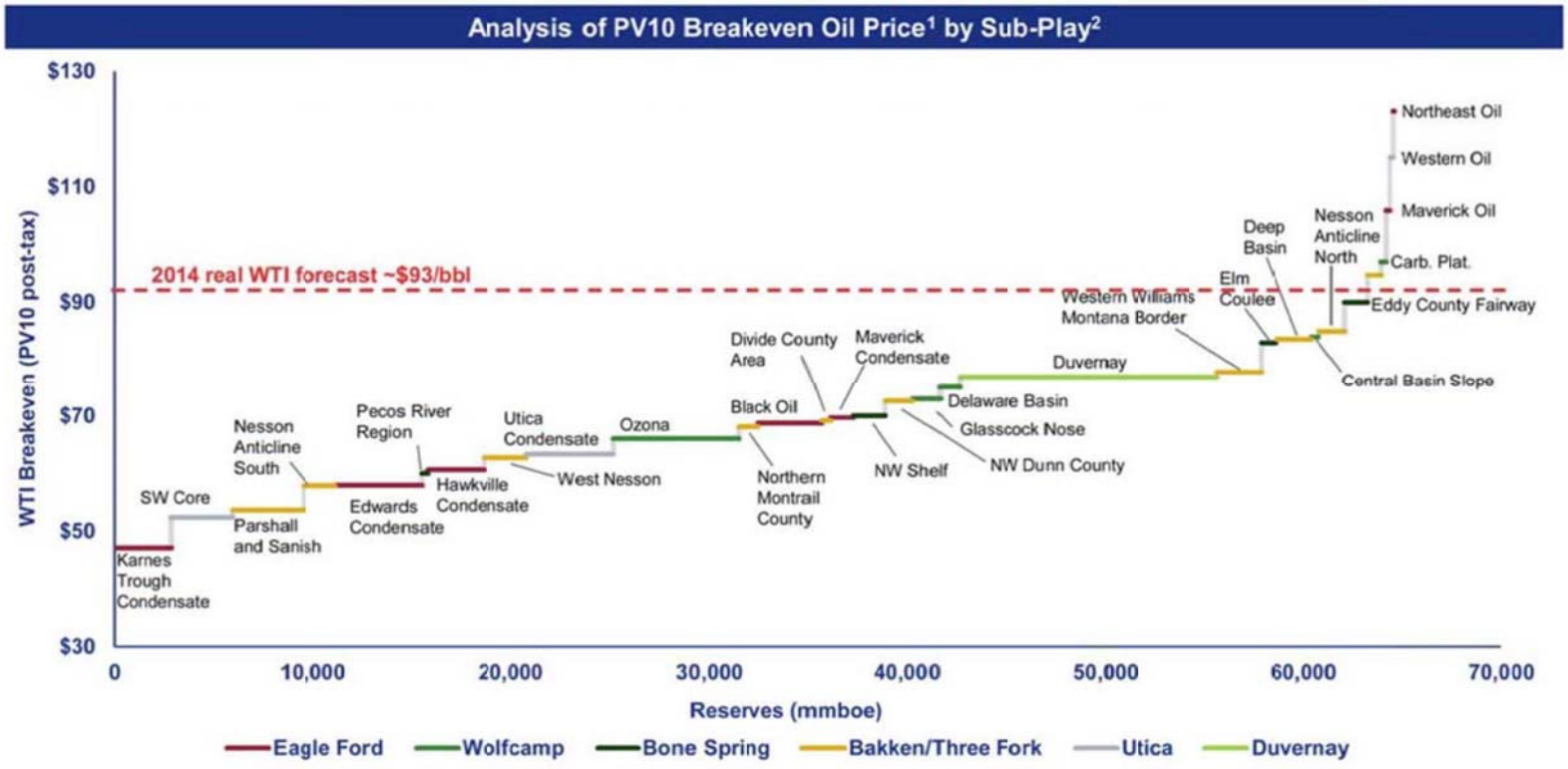


- Production growth is most aggressively forecast from US tight oil and Canadian bitumen projects, which will create a "barbell" of API quality grades skewed towards the light and heavy ends of the spectrum

Source: Wood Mackenzie

APPENDIX

Significant tight oil reserves have been identified, with much of the available supply base comfortably economic at current US oil prices



Source: Wood Mackenzie

Notes:
1. Breakeven analysis includes current views of typical drilling & completion costs, per-well infrastructure Capex, operating expenses and fiscal take; excludes lease acquisition and E&A
2. These are sub-plays recognized by Wood Mackenzie and reflect different well performances and economics

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APPENDIX

Breakevens for new projects provide some support for prices, as a third of new oil developments requires more than $80 per barrel to breakeven

Source: Wood Mackenzie

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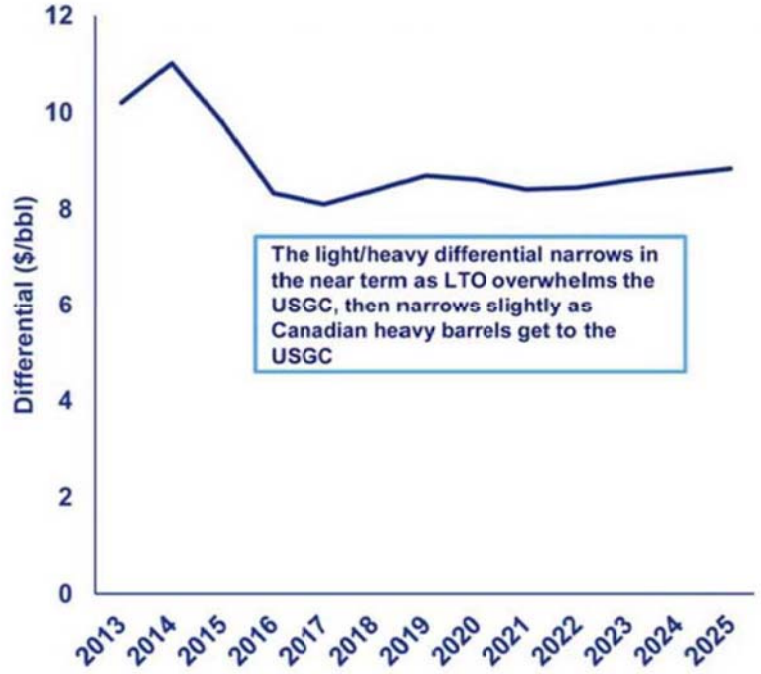
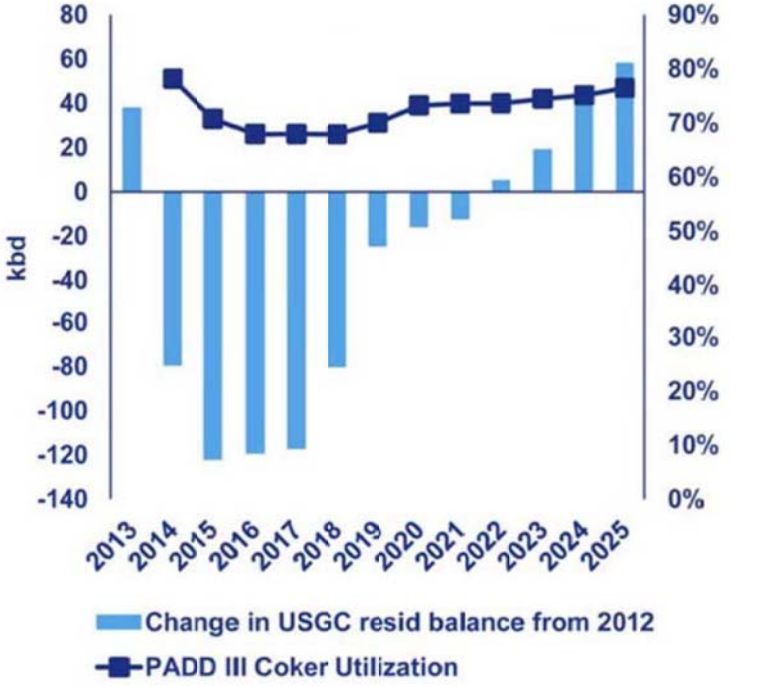
APPENDIX

Heavy crude is expected to remain in short supply with tight oil dominating much of North American supply

LLS – Maya Differential



PADD III Coker Feed Supply Change



Source: Wood Mackenzie

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