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There's No Business Like The Gas Business, Even at Low Gas Prices

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GPAC Operations & Maintenance Conference, Calgary, Alberta, May 9, 2013

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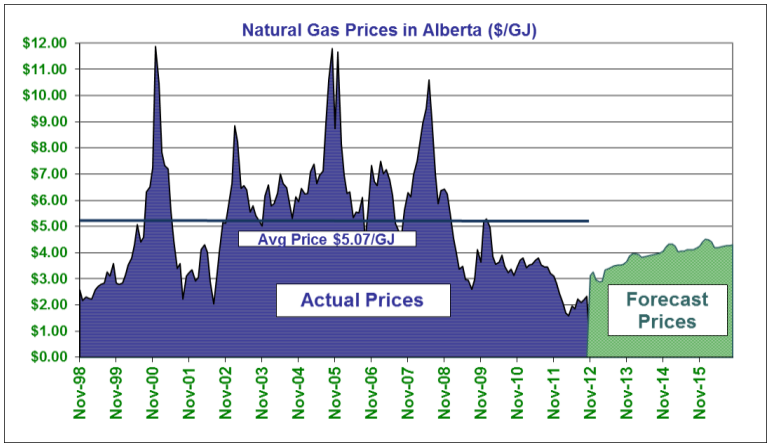
Presentation Outline

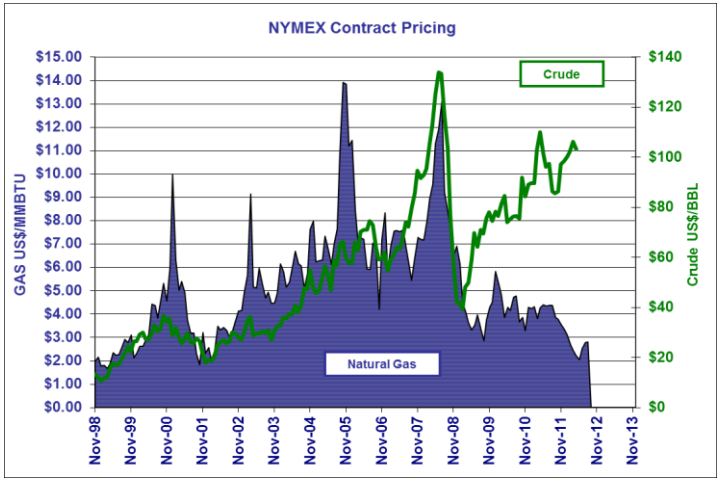
- Natural Gas Situation 2013
- Gas Utilization and Conversion Options
- Alberta/British Columbia Regional Options
  - Export gas to high value market
  - Add value (e.g. GTL or Methanol)
  - Focus on liquids rich gas – demand for C2 and C5+
  - Opportunities for high CO2 content shale gas
- Basic Process Schemes for LNG, GTL and deep cut gas plant
- Case Studies
  - High CO2 content shale gas utilization
  - Montney gas commercialization LNG vs. GTL
- GTL and LNG relative economics
- Crystal Ball Outlook and Final Observations

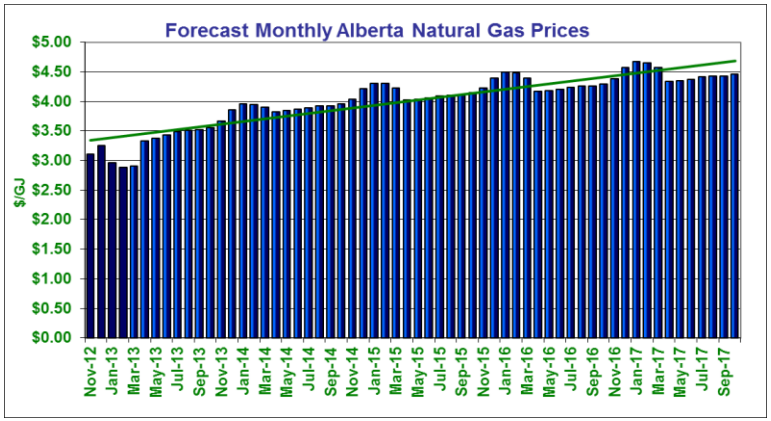
Natural Gas Situation 2013 – North America

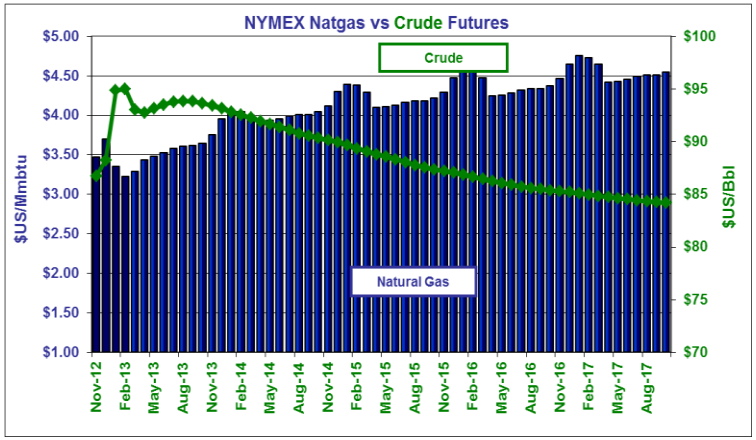
- The way it was (Energy Economic Research 2004)
  - US is experiencing both depletion and steep decline curves
  - Similar works are at work in Canada, producers in the vast Western Sedimentary Basin face declines
  - Increased demand to be covered by LNG imports
  - “Low scenario” indicates about 4.8 Tcf of LNG imports by 2015
- The way it is in 2013
  - Deployment of unconventional gas (primarily shale gas) makes North America net export region
  - Gas prices long term forecast is around $4.50-$4.75, some optimists forcast $7.00/mmbtu by 2017
  - Gas definitely remains disconnected from crude on btu basis
  - Canada plans to export up to 20 mtpa LNG from West Coast by 2020-2025 (about 3 bscfd gas)

Natural Gas & Crude Oil Forecasts Q1/2013









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Gas Utilization and Transportation Alternatives

- Gas gathering and transmission by pipeline
- Volume reduction to enhance transportation efficiency (LNG, CNG, hydrates)
- Conversion to other products by changing the “methane” molecule
  (FT synfuels, Methanol, Ammonia, DME, etc.)
- Conversion to other energy (power)
- NGL to chemicals (ethane, propane, butanes)

Natural Gas Value Chain

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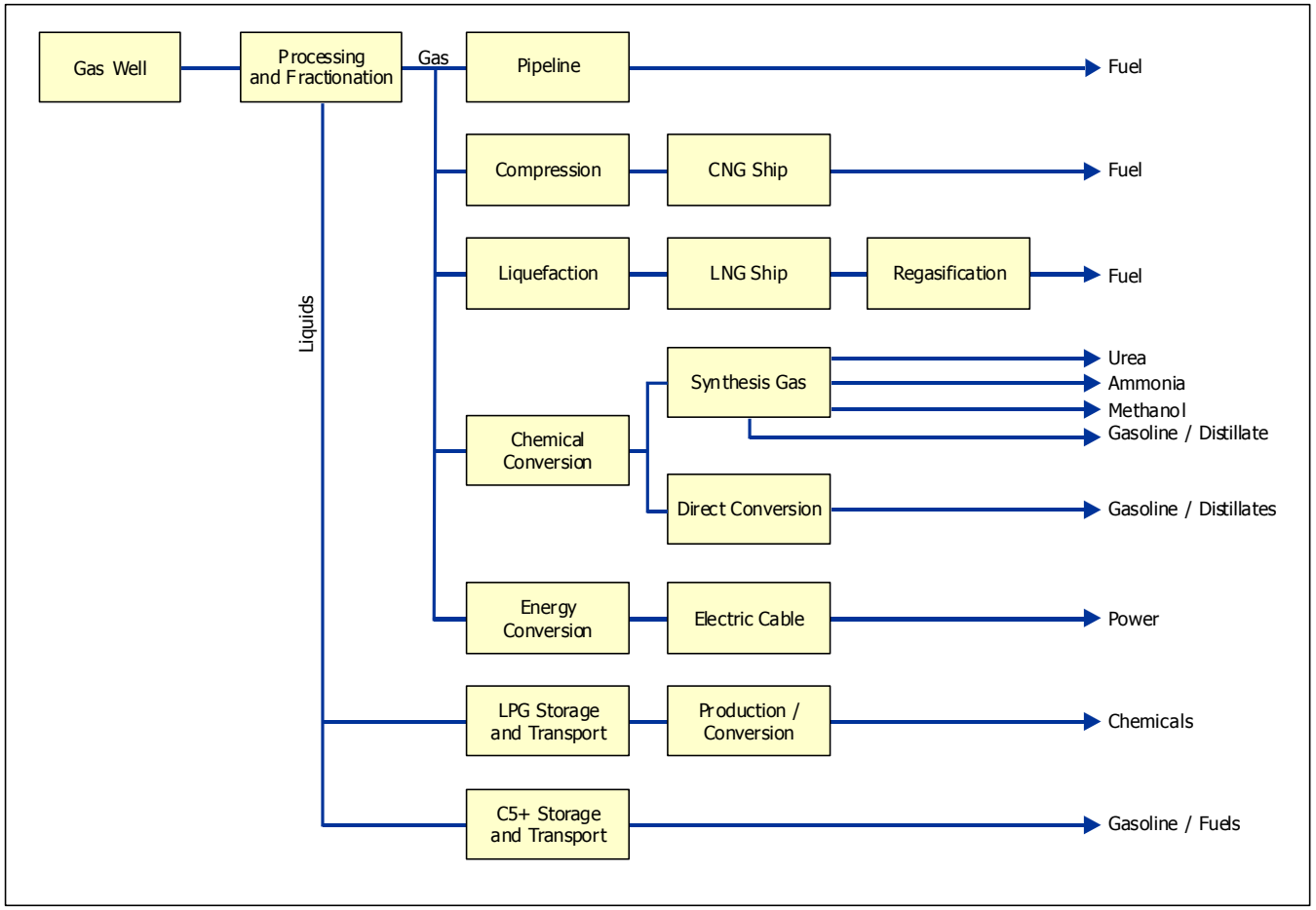

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Gas Export to High Value markets

- The primary markets for Canadian gas exports are South East Asia and China
- The distance eliminates any subsea pipeline options
- Distance and volumes eliminate marine transportation as CNG or hydrates
- The only remaining option is LNG

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LNG/CNG/Hydrates – Gas Transportation Options

- LNG (liquefied natural gas)
  - Transportation at atmospheric pressure, temperature -160 C (-260 F)
  - Volume reduction about 600 times
- CNG (compressed natural gas), transportation at elevated pressures (2,000 to 4,000 psig)
  - Temperature varies by concept and application
  - Volume reduction about 200-280 times
- Hydrates are produced at moderate pressures and temperatures (~870 psig, 50-60 F)
  - Transport at atmospheric pressure, safe storage and transport for natural gas
  - 1 ft3 of hydrate contains 180 ft3 of natural gas

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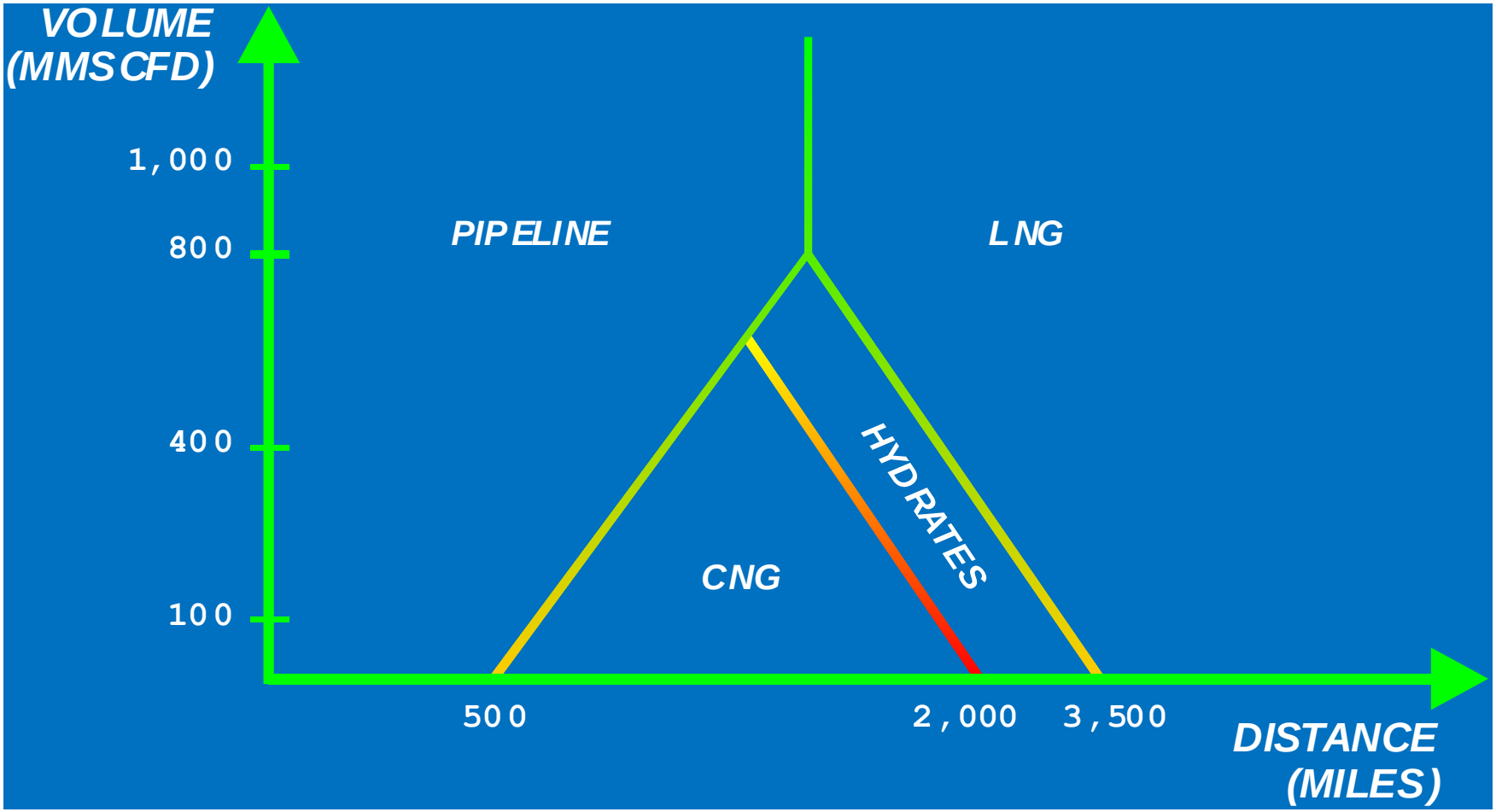
Gas Transportation Options



Liquefied Natural Gas - LNG

- The entire LNG chain consists of:
  - Gas reservoir and production
  - Gas processing and pipelining (27%)
  - Gas treatment and liquefaction (50%)
  - LNG shipping (15%)
  - LNG regasification (8%)
  - Gas distribution to markets
- Liquefaction facility is the main part and represents about 50% of the total value chain costs
- Several processes are available, C3MR leading the way
- Actual liquefaction cost vary by region and project timing
- Liquefaction cost range is about $300 to $750/mta

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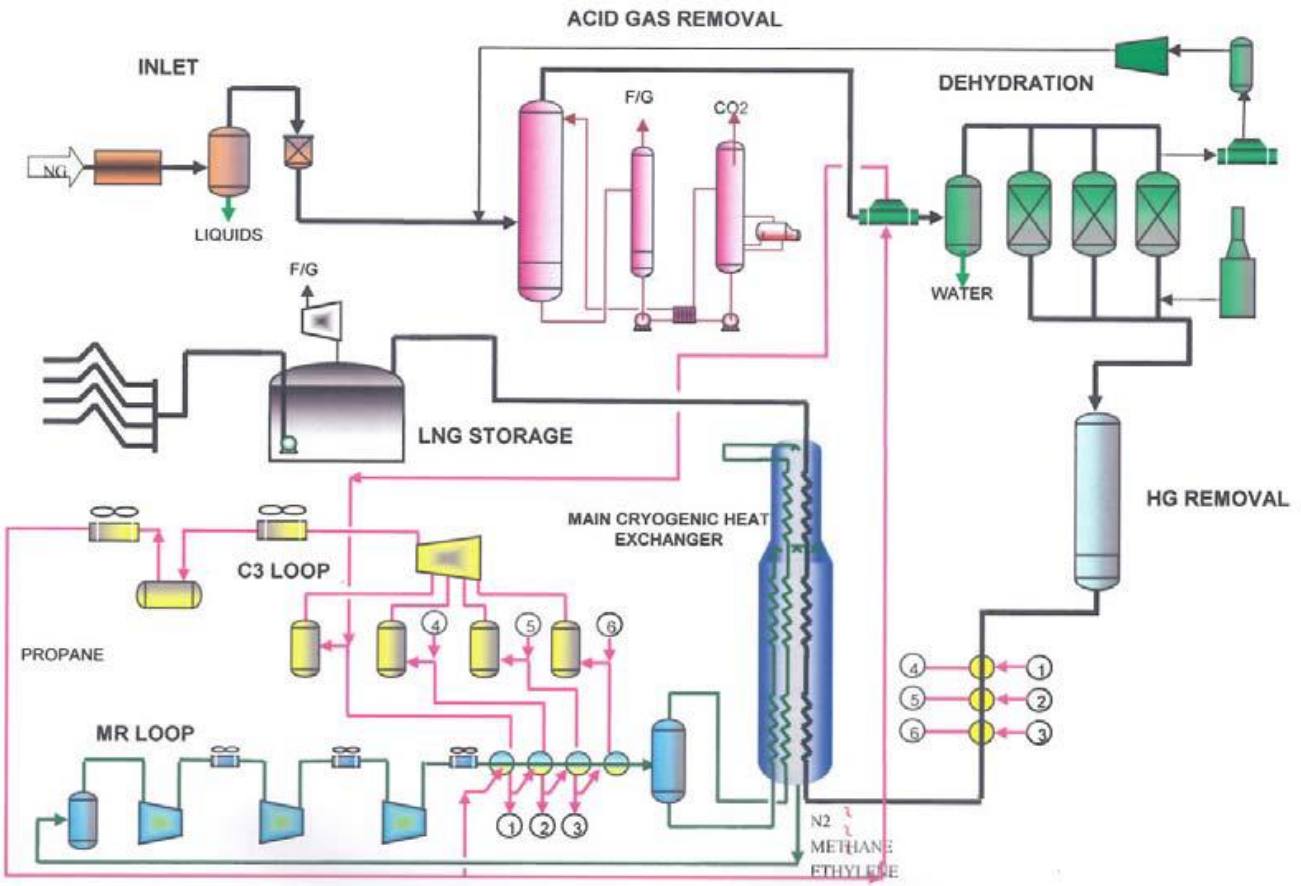
Typical NGL – Liquefaction Plant



Value Added Options – Syngas Route

- Syngas is a mixture of CO and H2 and can be produced from wide range of hydrocarbon materials (e.g. natural gas, biomass, vacuum residue, ashpaltenes, coal/coke)
- In principle syngas is produced through partial oxidation of hydrocarbon materials (example $CH4 + ½ O2 = CO + 2 H2$)
- Syngas after clean up is catalytically converted into various product such as Ammonia/Urea, Methanol/DME or Fischer-Tropsch (F-T) Liquids
- GTL F-T option attracts significant attention in Alberta and BC driven by gas and crude price differential
- Originally Sasol and Talisman planned 96,000 bpd facility in Alberta

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What is Fischer-Tropsch?

- Process converting synthesis (mixture CO and H_2) gas to liquid hydrocarbons
- Synthesis gas is derived from natural gas through “reforming” (combination of SMR and POX)
- First developed in 1920s by German chemist Hans and Franz Tropsch (Fischer-Tropsch)
- Iron catalyst and syngas from coal was originally used
- Later cobalt-based catalyst and natural gas as feedstock are increasingly used with emphasis on diesel/jet fuel production
- F-T products are long chain paraffinic hydrocarbons which have to be upgraded (hydrotreating and hydro-isomerization) to desired transportation products
- Basic reaction is CO + 2 H2 = -CH2- + H2

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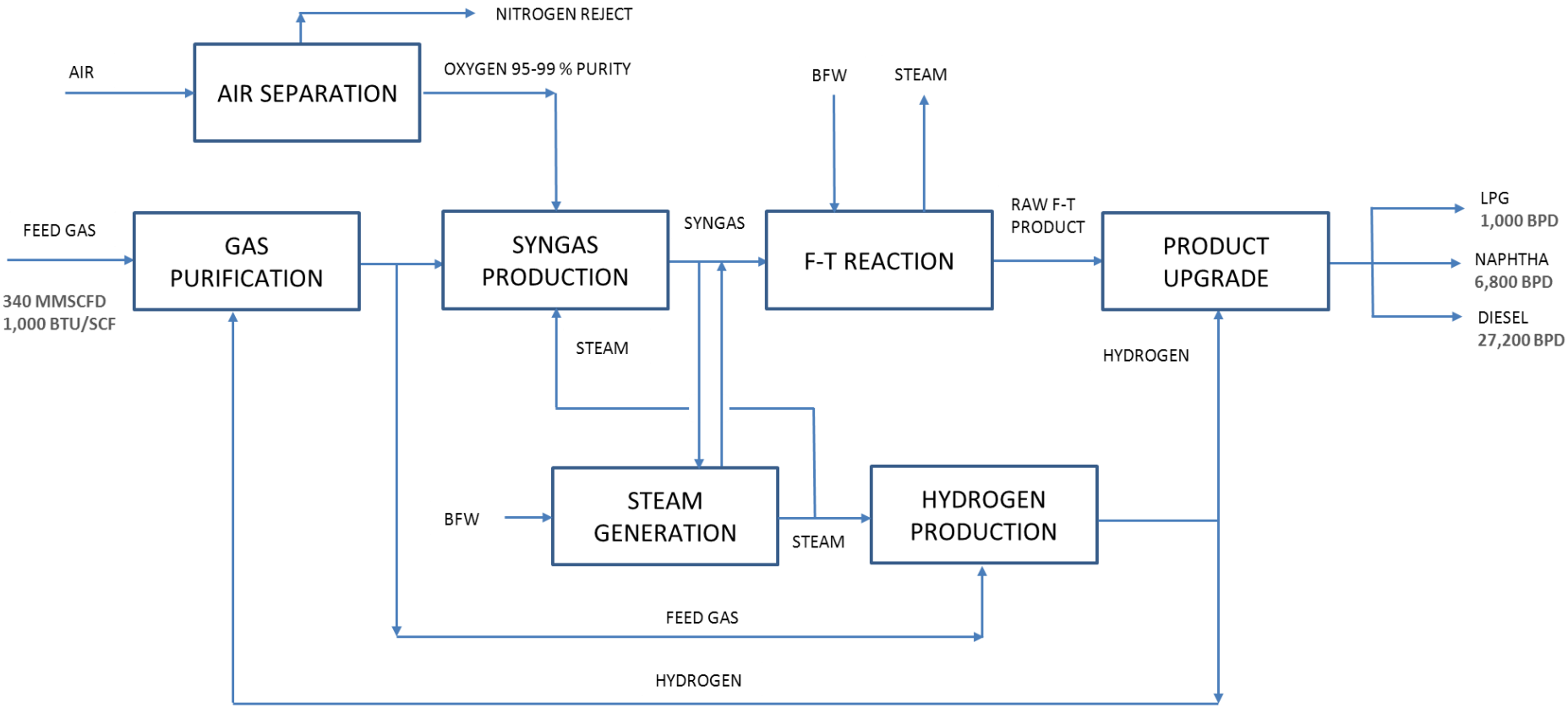
Fischer-Tropsch GTL Concept - 34,000 BPD GTL Plant



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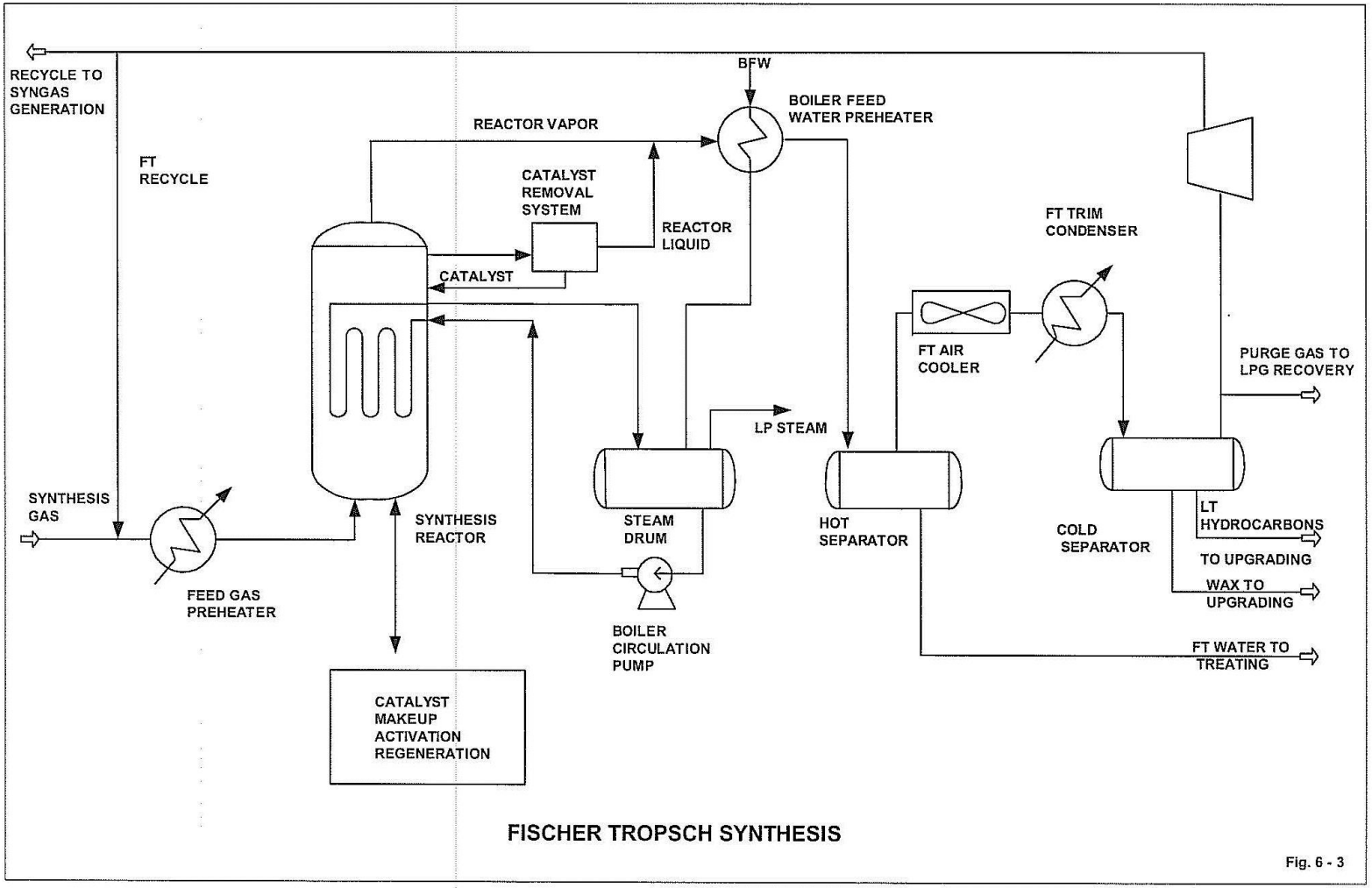
F-T Synthesis Simplified Diagram



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Typical F-T Products Specifications

Product Specifications	
Property	Specification
Naphtha	
Cut Range, °F	C_5 – 300
Density, °API	74.5
Reid Vapor Pressure, psi	10 Max.
% Paraffin	Near 100%
Diesel	
Cut Range, °F	300 – 650
Density, °API	54
Flash Point (Closed PM) at 1 Atm., °F	130 Min.
Cold Filter Plugging Point, °F	14
Sulphur Content	Less than 1 ppm
Cetane Number	75 – 80

Deep Cut Gas Plants

- Because of depressed natural gas prices producers concentrate on liquids rich assets
- Ethane and condensate offer significant project revenue
- The dream combination would be a deep cut gas plant associated with GTL facilities
- In such configuration only high demand products will be produced: ethane, C5+ condensate and F-T naphtha and diesel/jet fuel
- Cryogenic turbo-expander plant recovers 60 to 90% ethane, over 90% propane and virtually 100% of the rest
- Most processes and their variations are based on the original Gas Sub-cooled Process (GSP)

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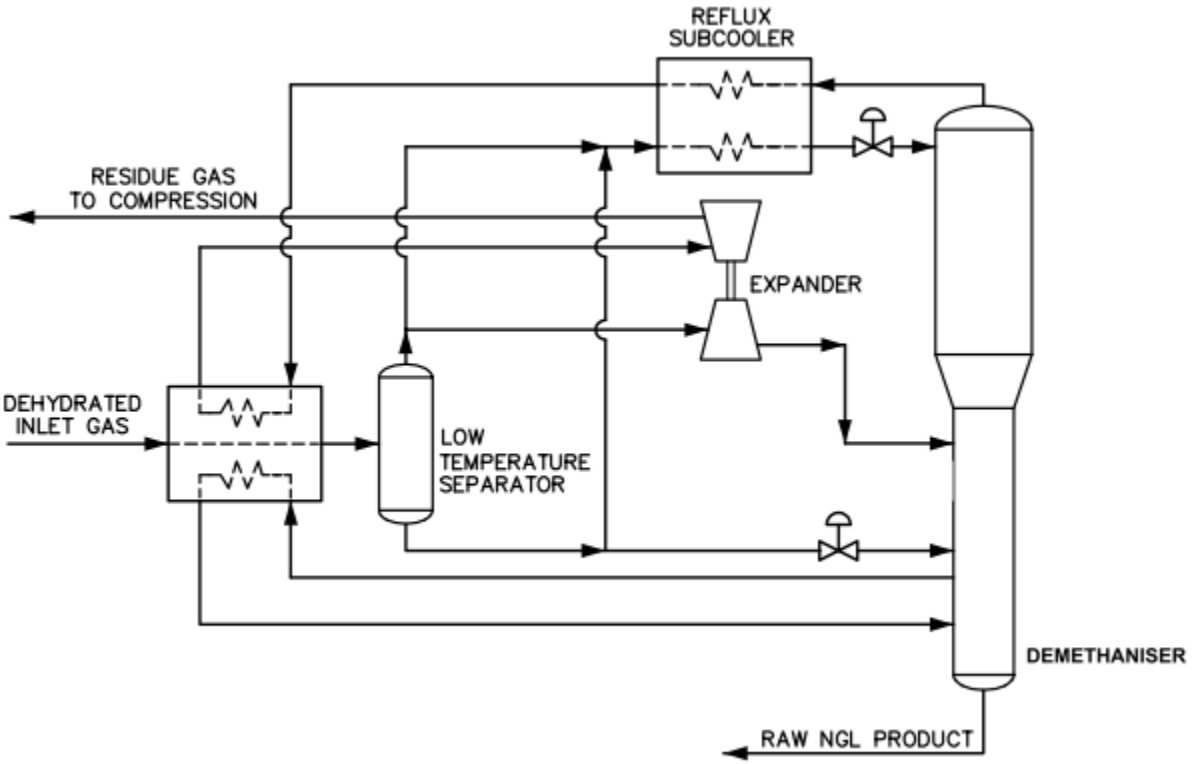
Deep Cut Gas Plant – Generic GSP



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High CO2 Content Shale Gas Utilization

- Typical Horn River Basin shale gas composition:
  - CO_2 12.0%
  - H_2S 0.05%
  - C1 86.4%
  - C2 0.67%
  - C3 0.01%
  - C4+ nil
- Sales gas specification (TCPL)
  - CO_2 2.0% max.
  - H_2S 16 ppm max.
- As result for a 400 mmscfd plant 40 mmscfd (2,100 tpd) of CO_2 have to be removed and are typically vented

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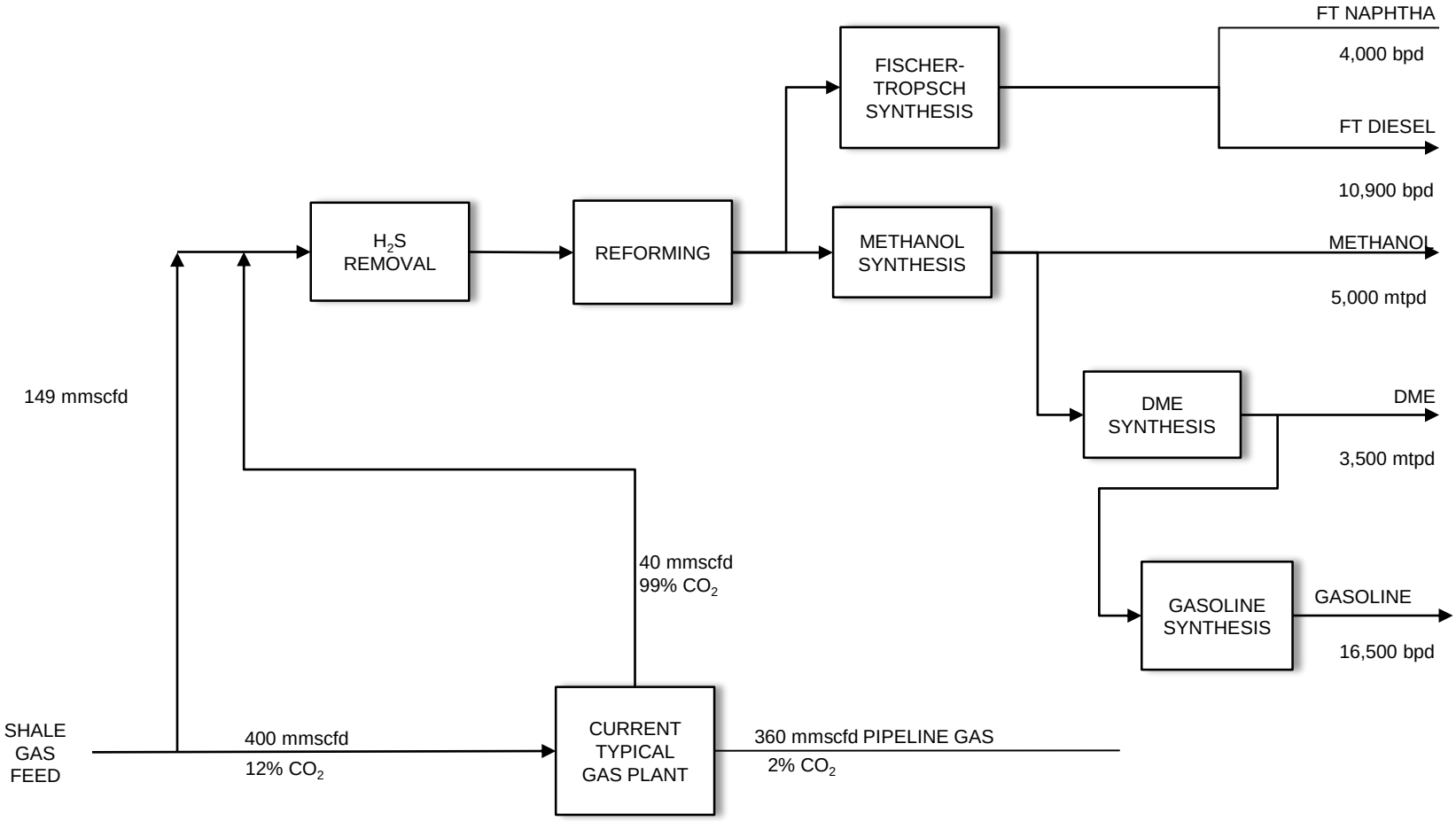
Methanol Derivatives and Fischer-Tropsch Products



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Montney Gas Utilization – Case Study

- Montney gas is rich in liquids
- Case study covered GTL and LNG options for 400 mmscfd nominal gas volumes
- Central Gas Treatment Facility located in Montney area, GTL facility located in Fort Saskatchewan, LNG Facility located in Kitimat
- Capital costs summary (ROM)
  - Central Gas Treatment Facility $250 MM
  - GTL Facility $1,500 MM
  - LNG Facility $1,680 MM
- Not included gas production and gathering, pipelines, LNG ships, etc.

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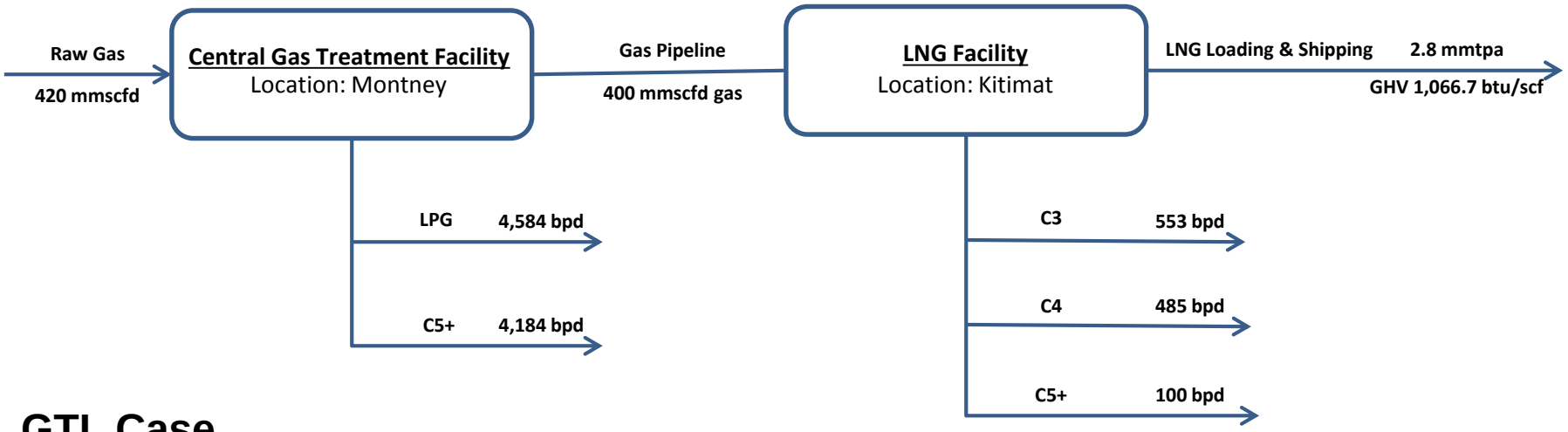
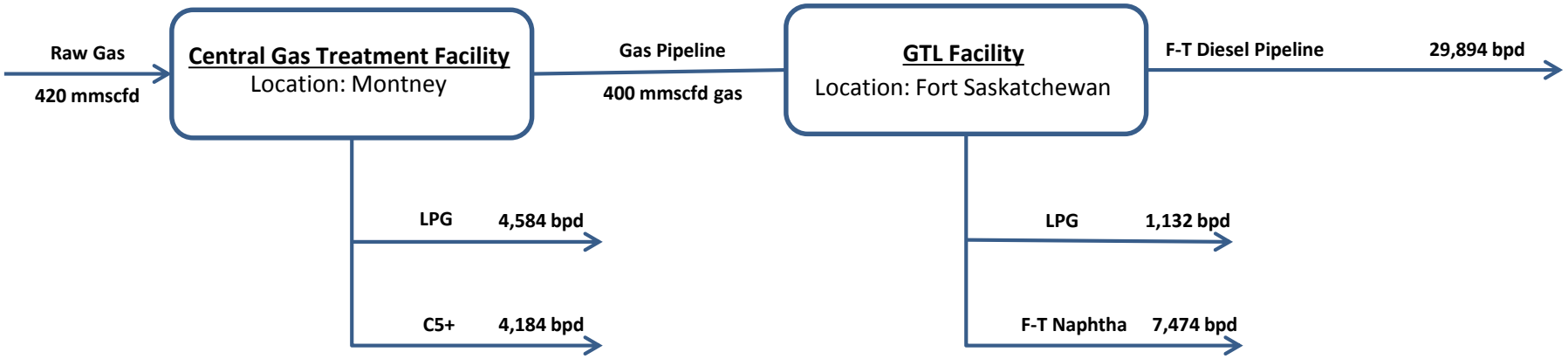
Montney GTL vs LNG Case Study

LNG Case



GTL Case



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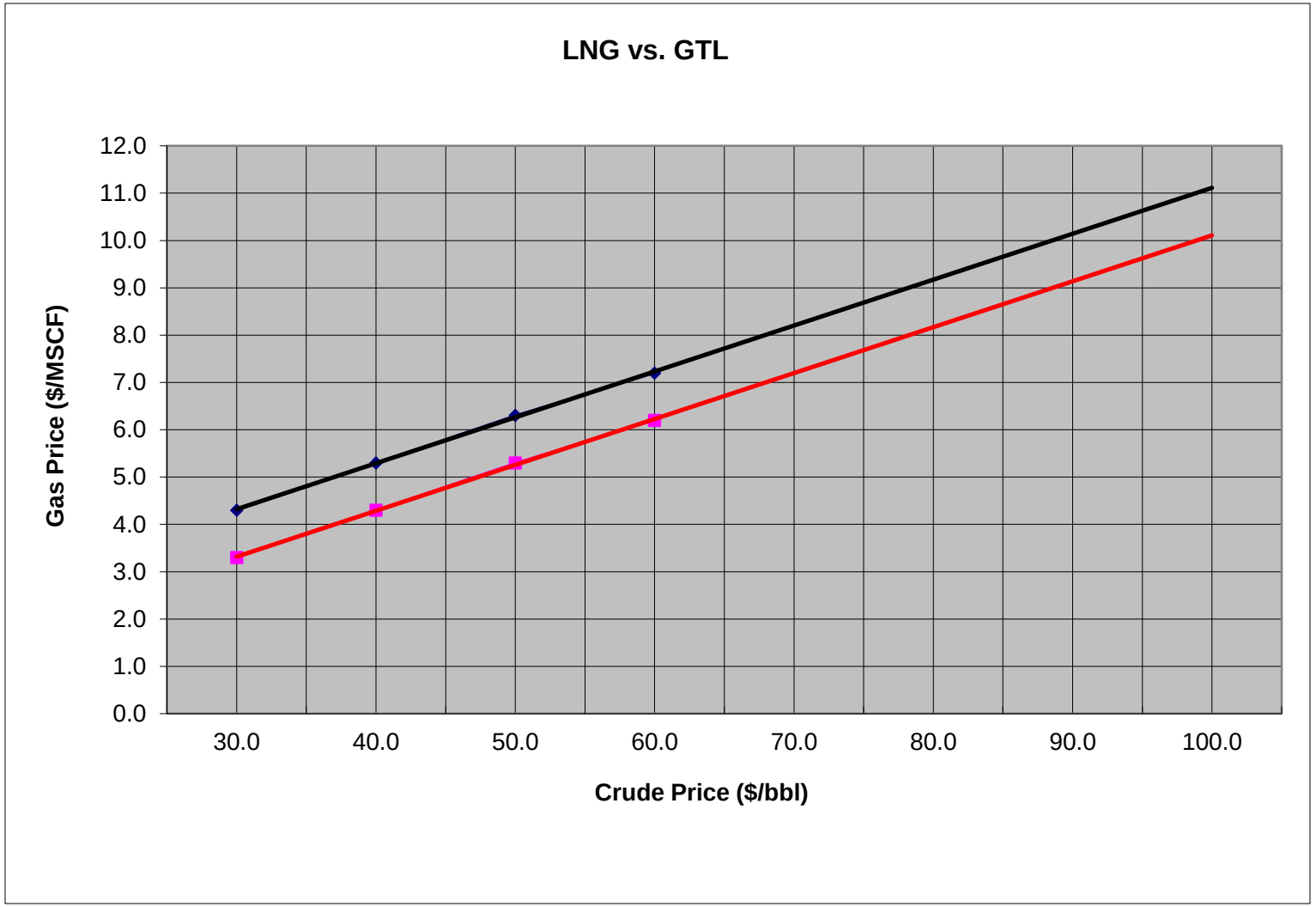
LNG vs GTL – What to do?



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Crystal Ball Outlook

- Natural gas prices North America will remain modest because of the glut and crude/gas price relationship
- The days when major profit can be made on gas a fuel are probably over
- Two principal ways how monetize gas are:
  - Export gas to high value markets as LNG
  - Add value to gas through conversion to Fischer-Tropsch liquids, Methanol, Gasoline or Fertilizers
- Some niche opportunity exists when gas is not the dominant product (e.g. rich gas liquids)
- Gas use in bitumen upgrading in addition to hydrogen or heat source will be seriously considered

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Final Observation

- Gas monetization requires out of box thinking and several rewarding options are available
- Most of the options are unfortunately capital intensive and require economy of scale
- Resource developer needs well funded partner or a banker as best friends
- In commodities market any price will make somebody happy, same as is it with any shot in golf
- Gas business will remain exciting segment of our lives, there is no business like the gas business

THANK YOU!