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# **NGL 101- The Basics**

**June 6, 2012**

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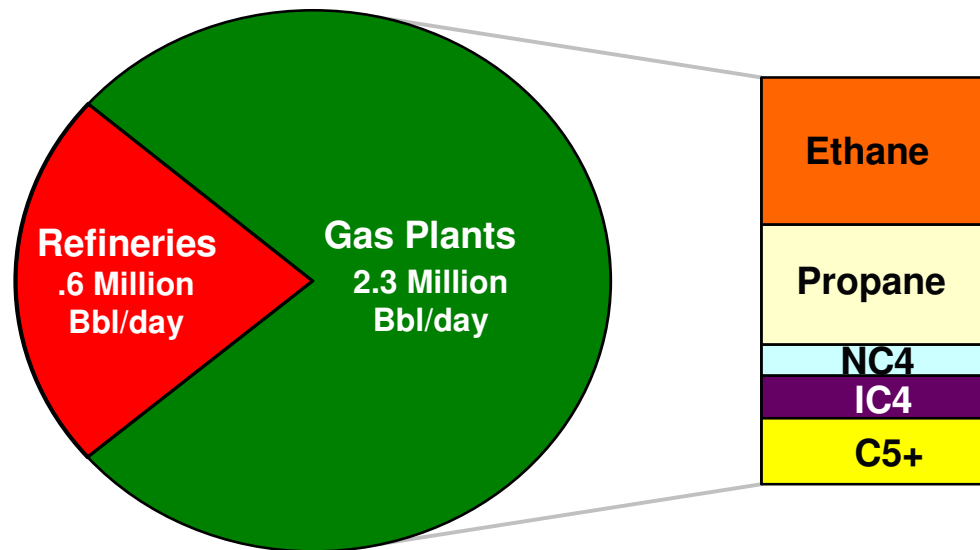
# Goals

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- 🔥 To understand
  - ❑ What “NGL’s” are
  - ❑ Size and characteristics of the NGL markets
  - ❑ Market Fundamentals (USA):
    - Supply
    - Demand
    - Logistics costs
    - Physical basis calculations/impact on gas value

# NGL Supply – U.S. Overview

- Almost 100% of the ethane production in the U.S. and Canada is sourced from natural gas processing plants
- 60% of global NGL is produced from natural gas (U.S. is app. 75%)



Now account for 20+% of total U.S. gas production and potential 15+ years of reserves



# Definitions – NGL's

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What is NGL?

- ⦿ NGL – Natural Gas Liquid
- ⦿ Typically refers to ethane, propane, butanes, and natural “gasoline” (pentanes)
- ⦿ NGL's are hydrocarbons removed (condensed) as a liquid from a hydrocarbon stream that is typically in a vapor phase (i.e. natural gas)
- ⦿ They are kept in a liquid state for storage, shipping and consumption

# Difference between “NGL & LPG”

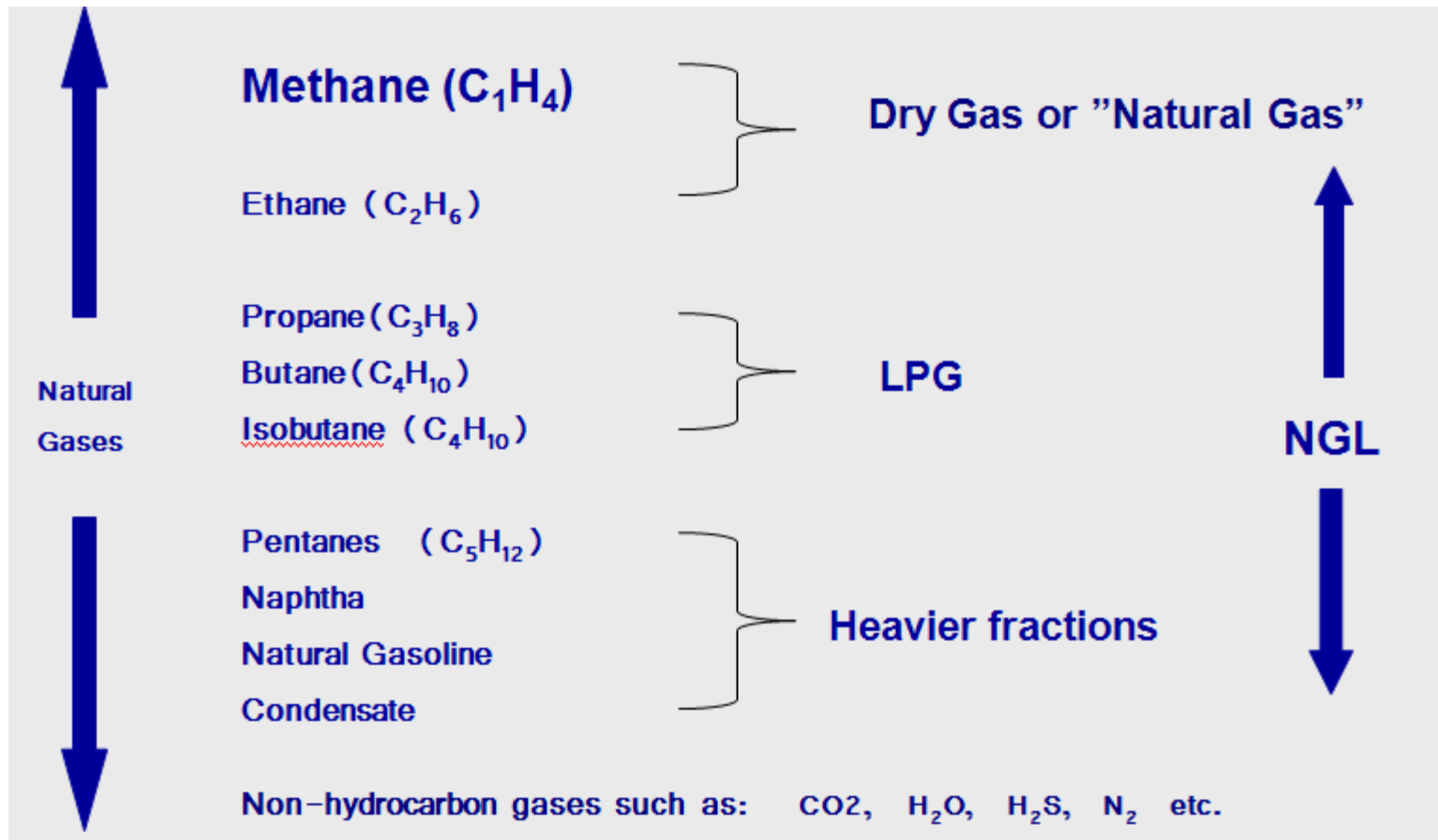


Illustration: "Natural Gas Liquids - Supply Outlook 2008-2015", International Energy Administration

# Definitions - NGL Types

## “Purity Products”

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“Purity” means that most (at least 90%) of the liquid stream contains one type of molecule

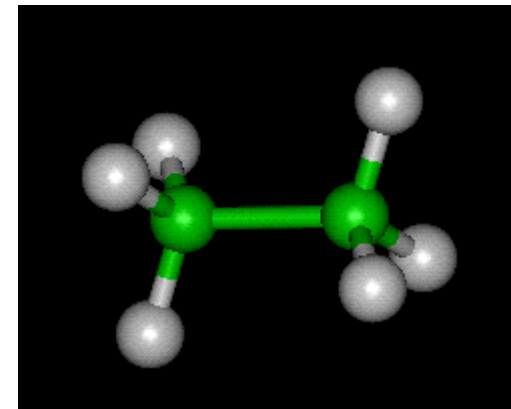
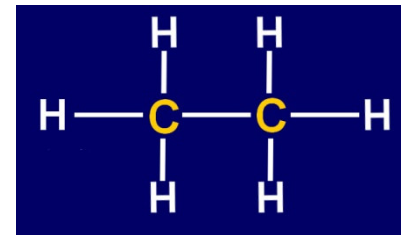
- 🔥 Ethane
- 🔥 Propane
- 🔥 Iso-butane
- 🔥 Normal butane

# Definition of Terms

## Ethane

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- Simplest molecule containing more than 1 carbon atom ( $C_2H_6$ )
- Foundation of many compounds in the petrochemical industry
- Abbreviated as “ $C_2$ ”
- Vaporizes at  $-126^{\circ}F$  ( $-88^{\circ}C$ )



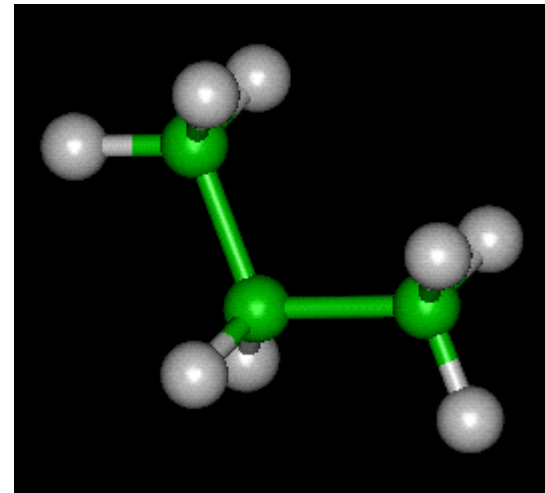
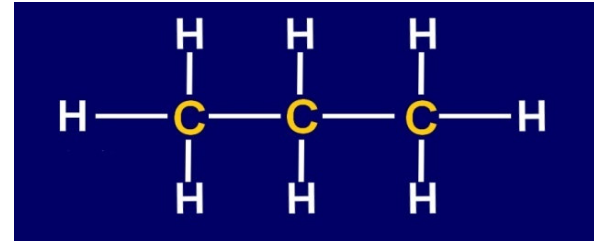


# Definition of Terms

## Propane

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- 🔥 Abbreviation – C<sub>3</sub>
- 🔥 Chemical composition
  - C<sub>3</sub>H<sub>8</sub>
    - Boiling point -44°F (-42°C)

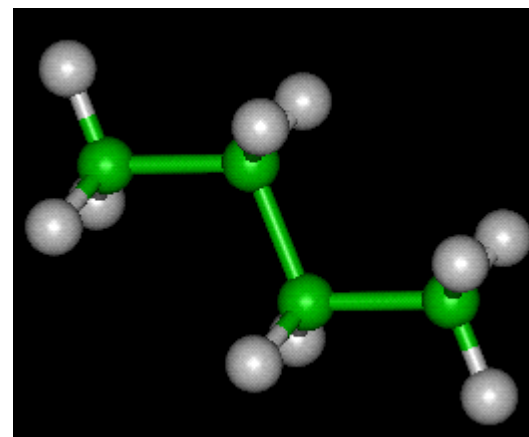
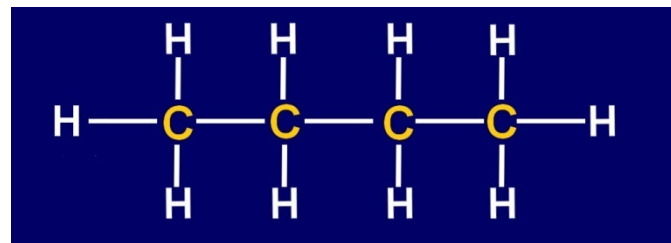


# Definition of Terms

## Normal Butane

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- 🔥 Abbreviation –  $\text{NC}_4$
- 🔥 Chemical composition
  - $\text{C}_4\text{H}_{10}$ 
    - Boiling point  $32^\circ\text{F}$  ( $0^\circ\text{C}$ )



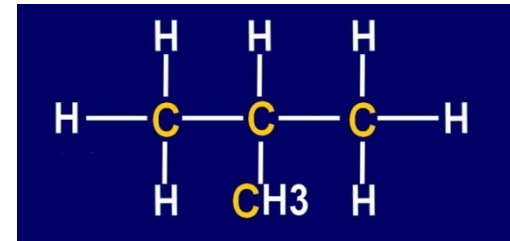
# Definition of Terms

## Iso-Butane

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### 🔥 Abbreviation – IC<sub>4</sub>

- ❑ Boiling point 11°F (-12°C)
- ❑ Also known as methylpropane



### 🔥 Chemical composition

- ❑ Is an 'isomer' of normal butane – different arrangement of the hydrogen molecules makes it behave differently; weighs less than NC<sub>4</sub>
- ❑ “Isom” (Isomerization) units convert normal butane to iso-butane when demand for IC<sub>4</sub> is high

# Definition of Terms

## “Mixed” Products

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“Mixed” means that the product stream contains at least 2 different types of molecules

- 🔥 Products sold as mixes:
  - ❑ Ethane – propane mix (E/P)
  - ❑ Natural gasoline (C<sub>5</sub>+)

# Definition of Terms

## E/P Mix

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- ④ A blend of ethane and propane meeting the individual specifications for each
  - ④ Used only for ethylene production
  - ④ “Typical” blend quoted in market reports is 80% ethane/20% propane
    - ❑ Some chemical companies require custom blends
    - ❑ Price quoted as “ethane in E/P” for the 80% portion and the purity propane price for the 20% propane portion
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# Definition of Terms

## Natural Gasoline

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- 🔥 Abbreviation – C<sub>5</sub>+  
(the “+” means it’s a mix of pentanes plus heavier molecules such as C<sub>6</sub>-C<sub>9</sub> in smaller amounts)
- 🔥 Usually few molecules heavier than C10

### 🔥 Markets

- ❑ Gasoline blending
- ❑ Ethylene production
- ❑ Solvent production (specialty application)
- ❑ Ethanol (denaturant)
- ❑ Diluent for use in syncrude operations

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# NGL Market Characteristics

# NGL Supply/Demand Overview

## How Big Is This Market?

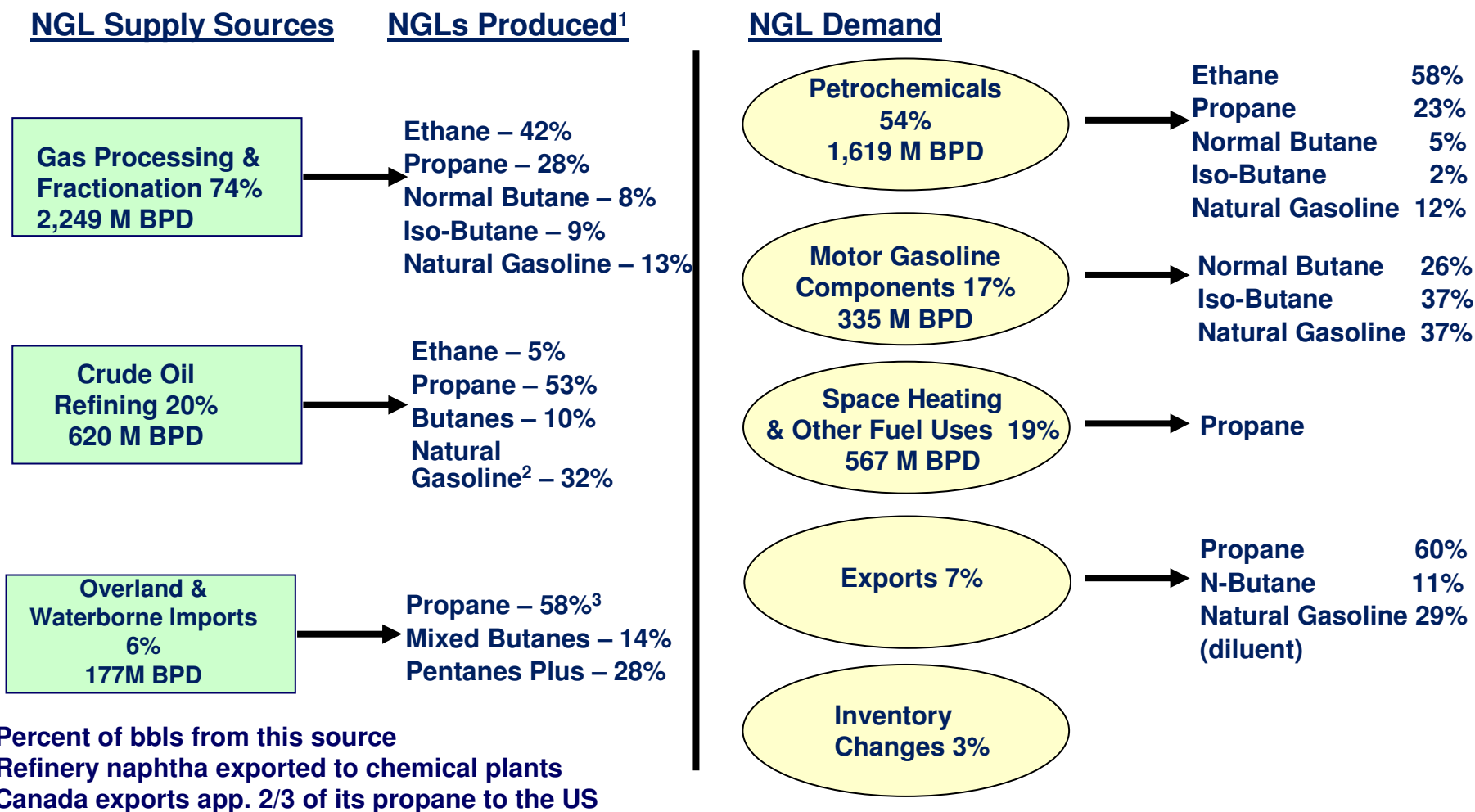
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- 🔥 Global supply – NGL:
  - ❑ 11.8 million BPD:
    - 1.79 million BPD ethane
    - 7.77 million BPD propane and butanes (aka “LPG”)
    - 2.23 million BPD gas plant condensate/C<sub>5</sub>+
- 🔥 Sources
  - ❑ Natural gas processing – 60%
  - ❑ Crude oil refining – 40%
- 🔥 Relative to crude oil and refined products, market size is small
  - ❑ Global crude oil and gas liquids supply is 89-91 million BPD
  - ❑ NGL/LPG is 13% of this
- 🔥 NGL’s are getting more attention now:
  - ❑ NGL’s are a growing source of revenue for gas producers
  - ❑ NGL production in the U.S. is 1/3 of our total crude and NGL supply



# NGL Markets Overview

## USA



12 Month Averages – March 2011 to Feb 2012

Source: EIA, Waterborne LPG Report, Hodson Report, MEG Analysis



# NGL's from Natural Gas

## Importance of Gas Supply Estimates to NGL Forecasters

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- ④ In a low gas price environment, NGL value is a key component of cash flow for gas producers
- ④ NGL volume available for extraction depends on:
  - ❑ Amount of gas available to processing plants
  - ❑ How much NGL is contained in the gas that is produced
- ④ NGL volume actually extracted depends on:
  - ❑ Process technology employed for NGL extraction
  - ❑ NGL prices at the plant, net of transportation to market
  - ❑ Economics of recovering ethane
  - ❑ Processing contract terms

# NGL's from Natural Gas

## Forecasting Gas Supply When Gas Prices Are Low

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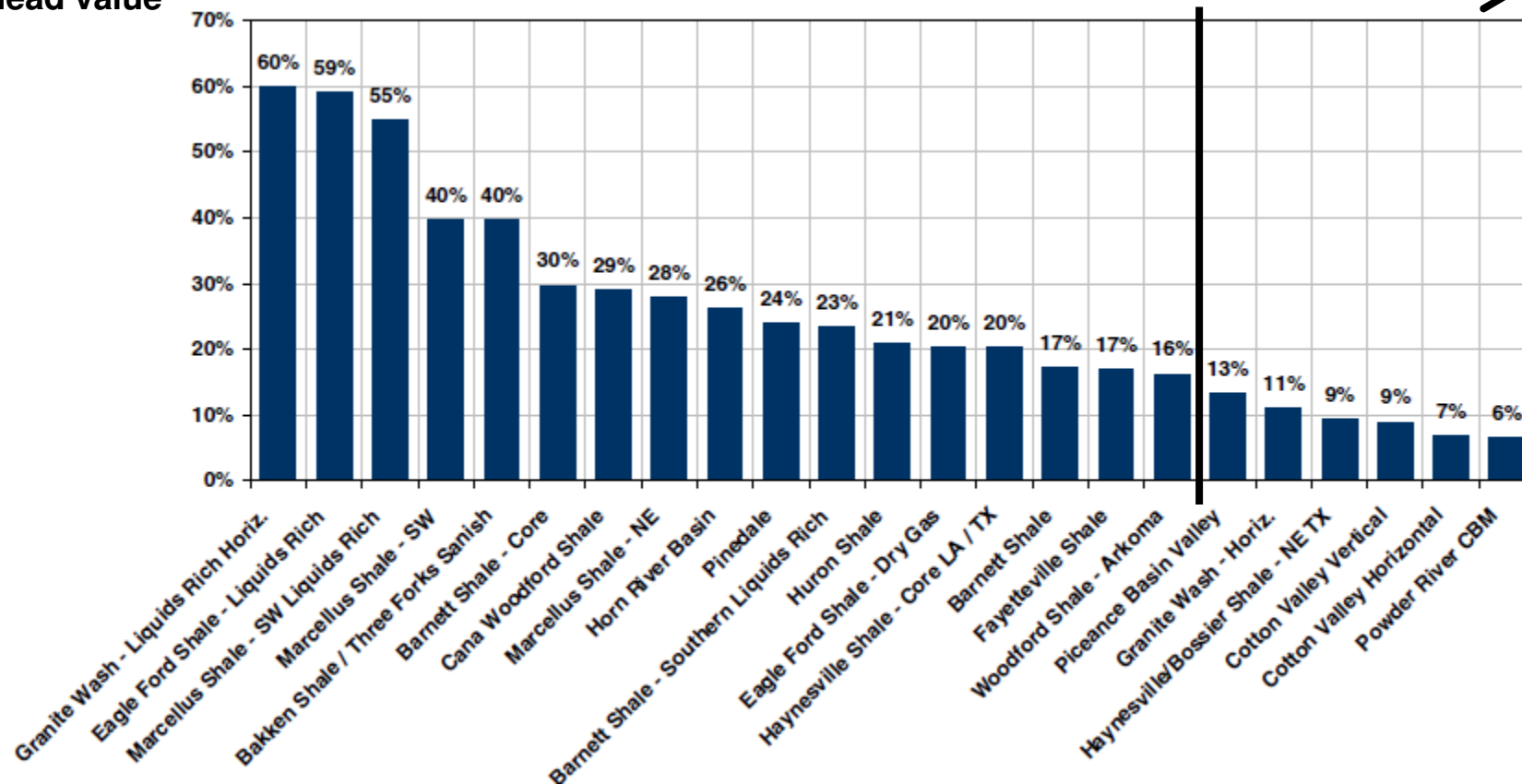
- 🔥 Factors affecting gas volume forecasts:
  - ❑ The producer's price hedge positions
  - ❑ Impact of slowing production rates on the total amount of gas that can be recovered
  - ❑ "Take or pay" commitments to service providers, such as pipelines, gas plants, NGL service companies
  - ❑ Expiration of lease agreements – keep drilling or lose the lease
  - ❑ Drilling contracts – keep drilling or lose the rigs
  - ❑ **NGL value impact on overall gas revenue – higher values may support continued drilling**

# NGL's from Natural Gas

## “Dry Gas” = Lower NGL Revenue, Lower Returns

Fees to move NGL's to market can make a big difference in wellhead value

<15% Rate of Return

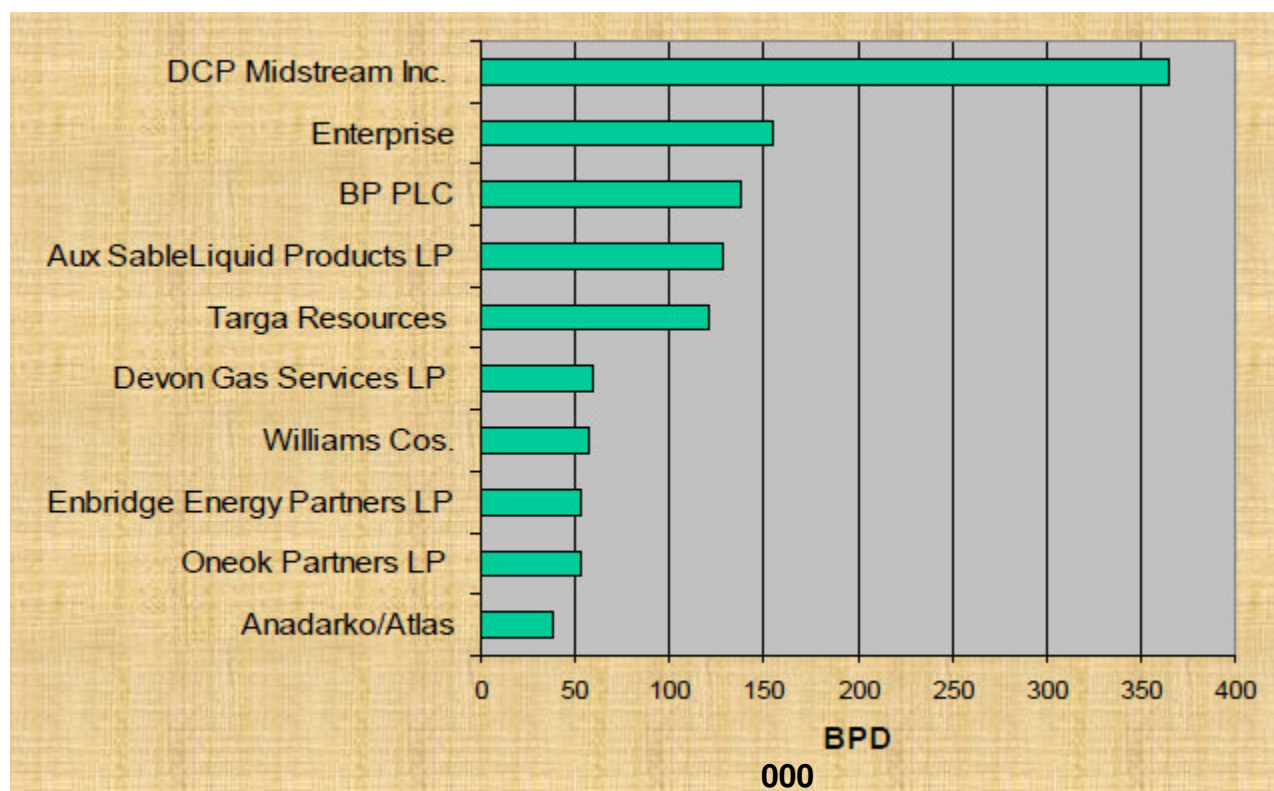


Source: Credit Suisse

# Top NGL Producers in the U.S.

## Midstream Companies Are Primary Suppliers

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Only 4 of these companies are also top gas producers; the others are midstream companies

Source: DCP Midstream

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## **NGL's from Gas - Processing Economics**

### **Gas Plant Profitability Metric – “Frac Spreads”**

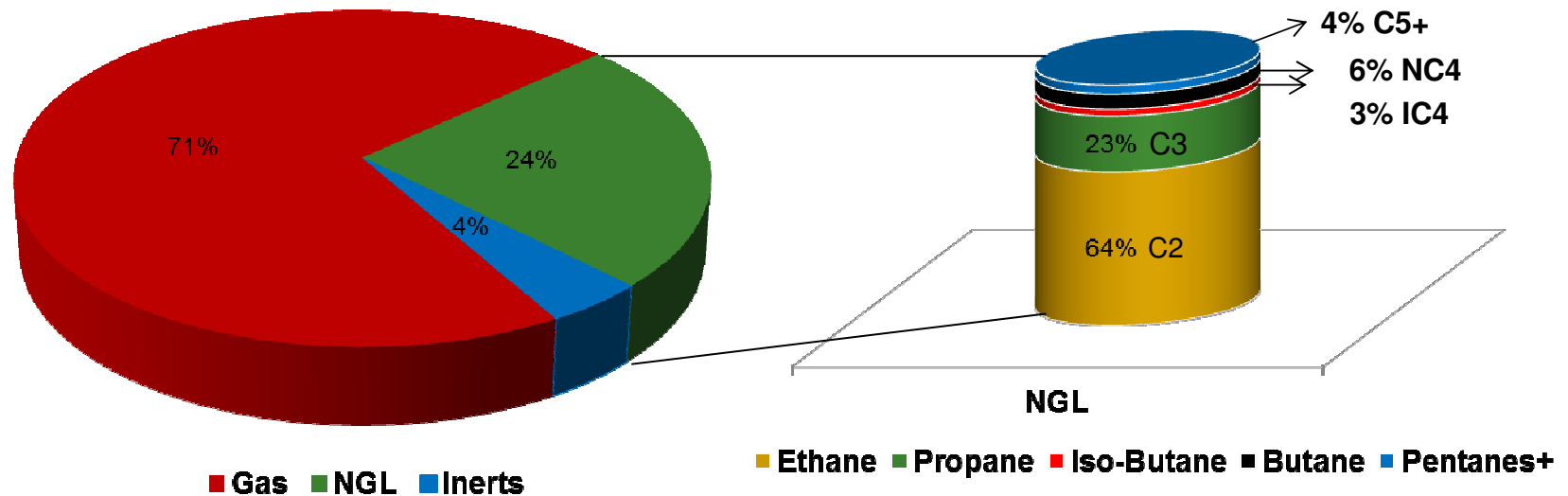
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- ④ The gas plant equivalent of a refinery “crack spread”
- ④ Measure of gross profitability for gas plants
- ④ Calculated as the difference between the revenue from sales of NGL's contained in a gas stream as liquid and their value if left in the gas pipeline and sold at gas prices

# NGL's from Gas - Processing Economics

## NGL Yields – “Gallons Per Mcf”

Wellhead Stream



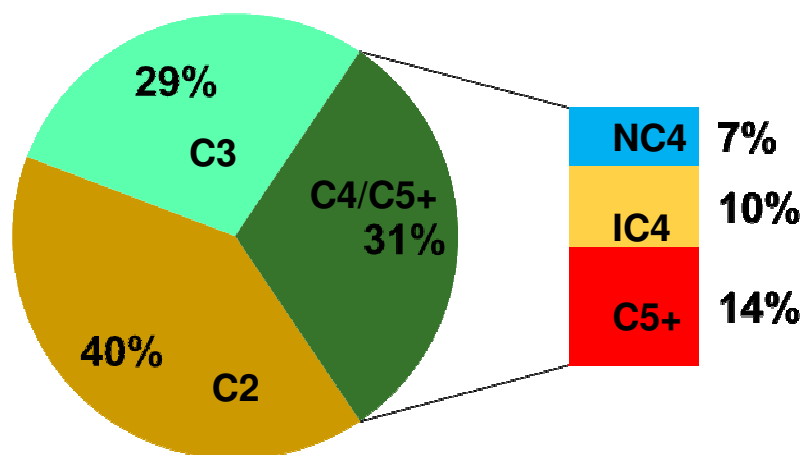
Need to know how much of the gas stream is NGL and what type NGL it is  
“Theoretical” NGL yield is 100% of what the sample shows is there  
The acronym for the “Gallons Per Mcf” of NGL’s in a gas stream is “GPM”

# NGL Composition Trend

## Higher Ethane Content per Barrel

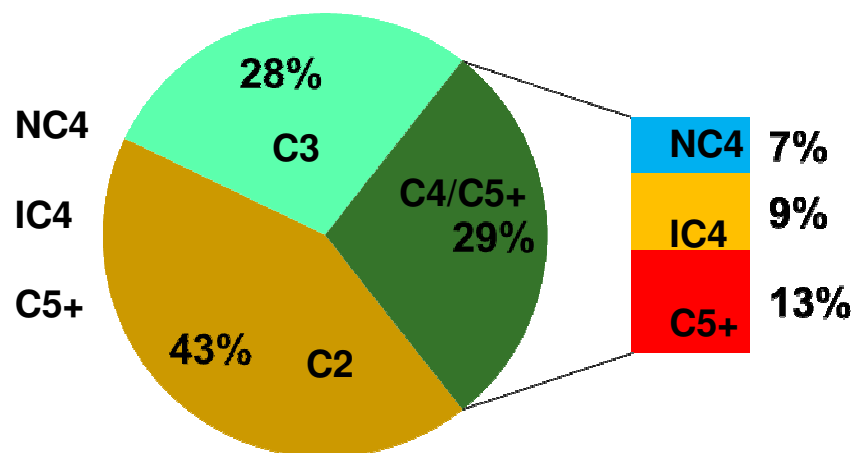
### US Composite NGL Barrel Composition by Component

2009 Average



Ethane	=	768 M BPD
Propane	=	547 M BPD
Butane/C5+	=	595 M BPD
<b>Total</b>	=	<b><u>1.910 M BPD</u></b>

Dec 2011 Average



Ethane	=	1,005 M BPD
Propane	=	669 M BPD
Butane/C5+	=	677 M BPD
<b>Total Dec 2011</b>	=	<b><u>2,351 M BPD</u></b>
<b>Total 2011 Avg.</b>	=	<b><u>2,181M BPD</u></b>

Volumes are rising – but C4+ volume share of the NGL Barrel has fallen by 2%

Source: EIA, MEG Analysis



# NGL's from Gas - Processing Economics

## Gas Quality – Example “GPM” for Various Basins



Rich Plays	NGL (GPM) Content*
Avalon/Bone Springs**	4.0 to 5.0
Bakken**	4.0 to 9.0
Barnett	2.5 to 3.5
Canawoodford	4.0 to 6.0
Eagle Ford***	4.0 to 9.0
Granite Wash	4.0 to 6.0
Green River**	3.0 to 5.0
Niobrara**	4.0 to 9.0
Piceance-Uinta	2.5 to 3.5
Green River	2.5 to 3.5
Marcellus (Rich)	4.0 to 9.0

\* gpm – gallons of NGLs per 1000 cu. ft.  
 \*\* Oil Shale Plays  
 \*\*\* Both an Oil and Gas Shale Play

# NGL's from Gas – Yield Estimates

## Impact of Gas Plant Technology

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Plant technology determines the limit of the NGL's that can actually be recovered from the gas:

- ④ “Lean oil” plant NGL recoveries
  - ❑ Least efficient for ethane, propane
  - ❑ 99% butanes and C5+, 65-75% propane, only 15-30% ethane
- ④ Refrigeration plants (use propane to “chill” the gas to remove more NGL)
  - ❑ More efficient
  - ❑ 100% propane, butanes, and C5+, up to 80-85% ethane
- ④ Cryogenic (turbo expander) technology
  - ❑ Most efficient and most expensive to build
  - ❑ 100% propane, butanes and C5+, up to 85-90% ethane

# NGL/LPG Revenues

## Logistics Costs Matter

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- ④ Gas liquids are expensive to handle, store, and transport compared to refined products
  - ❑ Require high pressure and/or low temperature to maintain liquid state for shipment and handling
  - ❑ Highly flammable – vapor “crawls” instead of rising; is heavier than air
  - ❑ Needs special trucks, ships and storage (thick steel, insulated tanks, or underground caverns for large volumes)

# NGL Logistics – Realized Pricing Estimates

## “Netback” Market Concept & the “T &F” Fee

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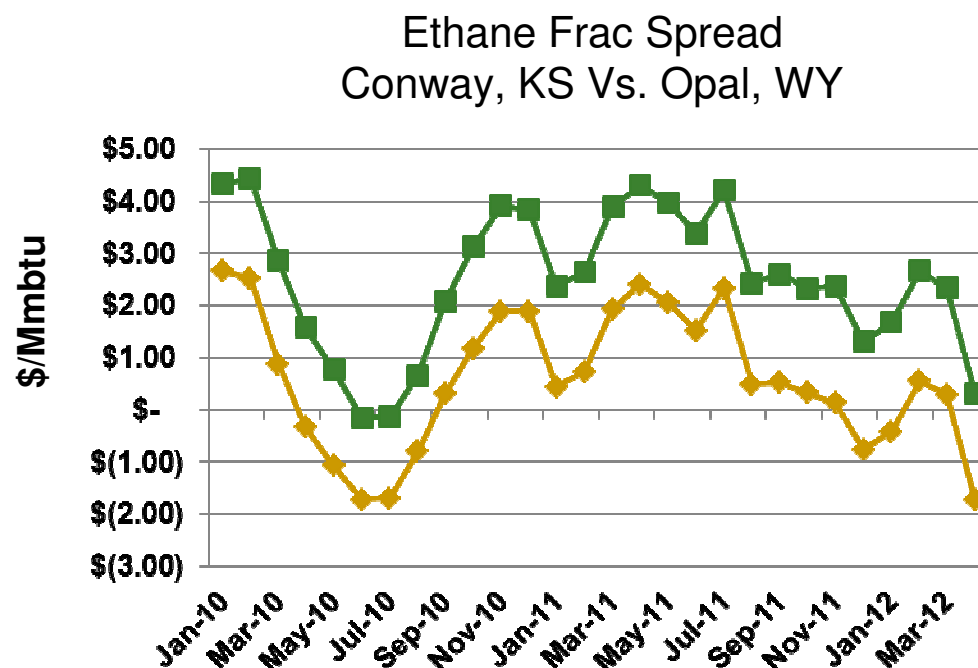
- ④ NGL values basis different locations consist of the commodity component and a location component
- ④ The commodity component is the value for the product itself, but:
  - NGL prices are only published at a few locations where large volumes are traded (hubs)
  - These traded prices must be adjusted by a location differential to get the value at the plant tailgate
- ④ Realized pricing at the plant = Hub value - the Fractionation cost – Transportation Cost
- ④ This is known as a “T&F” adjustment

# NGL Logistics

## Impact of Location on Realized Prices

### 🔹 Ethane Recovery:

- ❑ Must consider the cost of getting to market when making ethane recovery decisions:



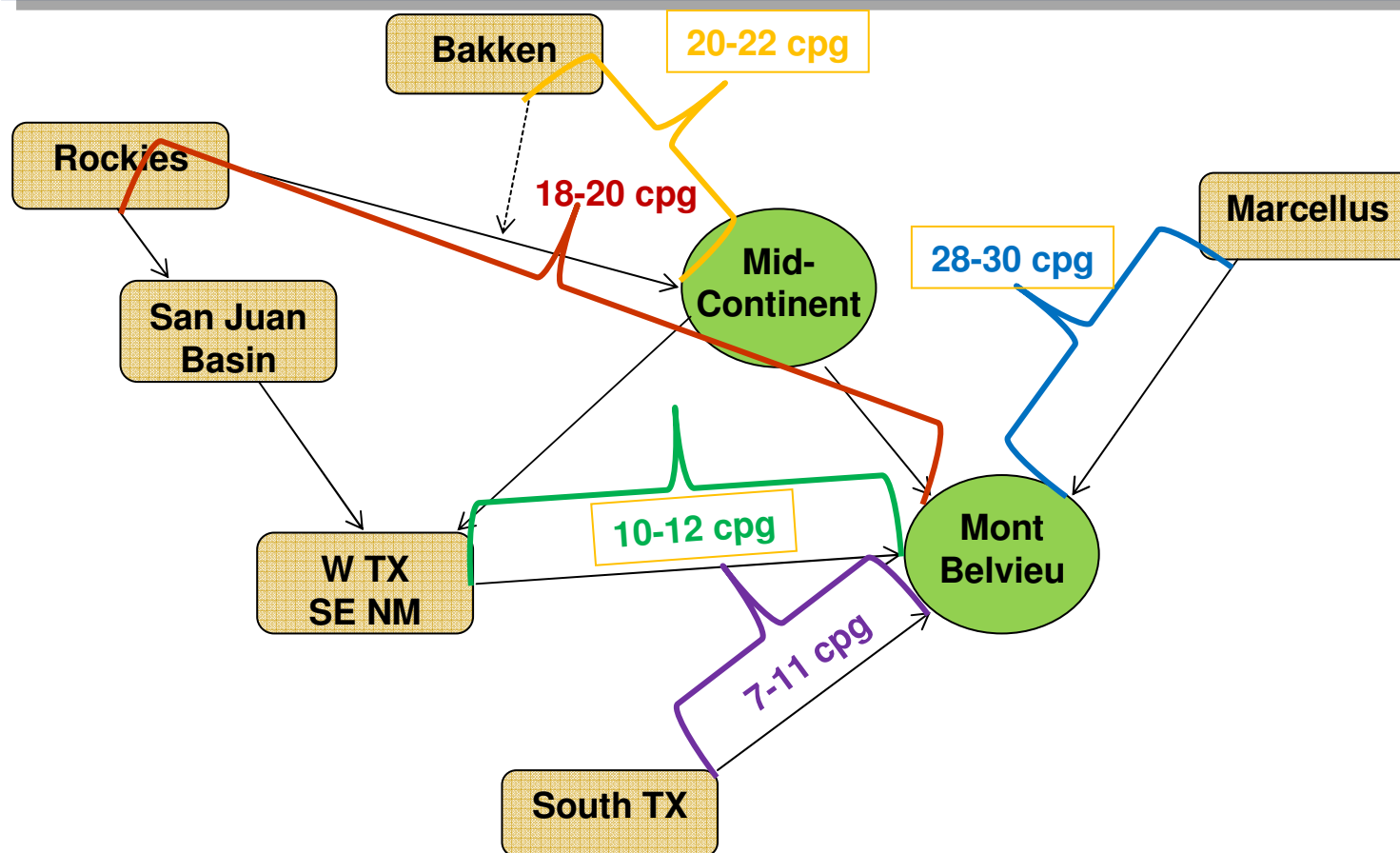
Jan 2010 – April 2012 Average Ethane Frac Spread:

At Opal with estimated “T&F” included = \$ .59/Mmbtu

At Conway w/o fee deductions = \$2.50/Mmbtu

# NGL Logistics Costs

## “T&F” Cost Snapshot – Field to Hubs



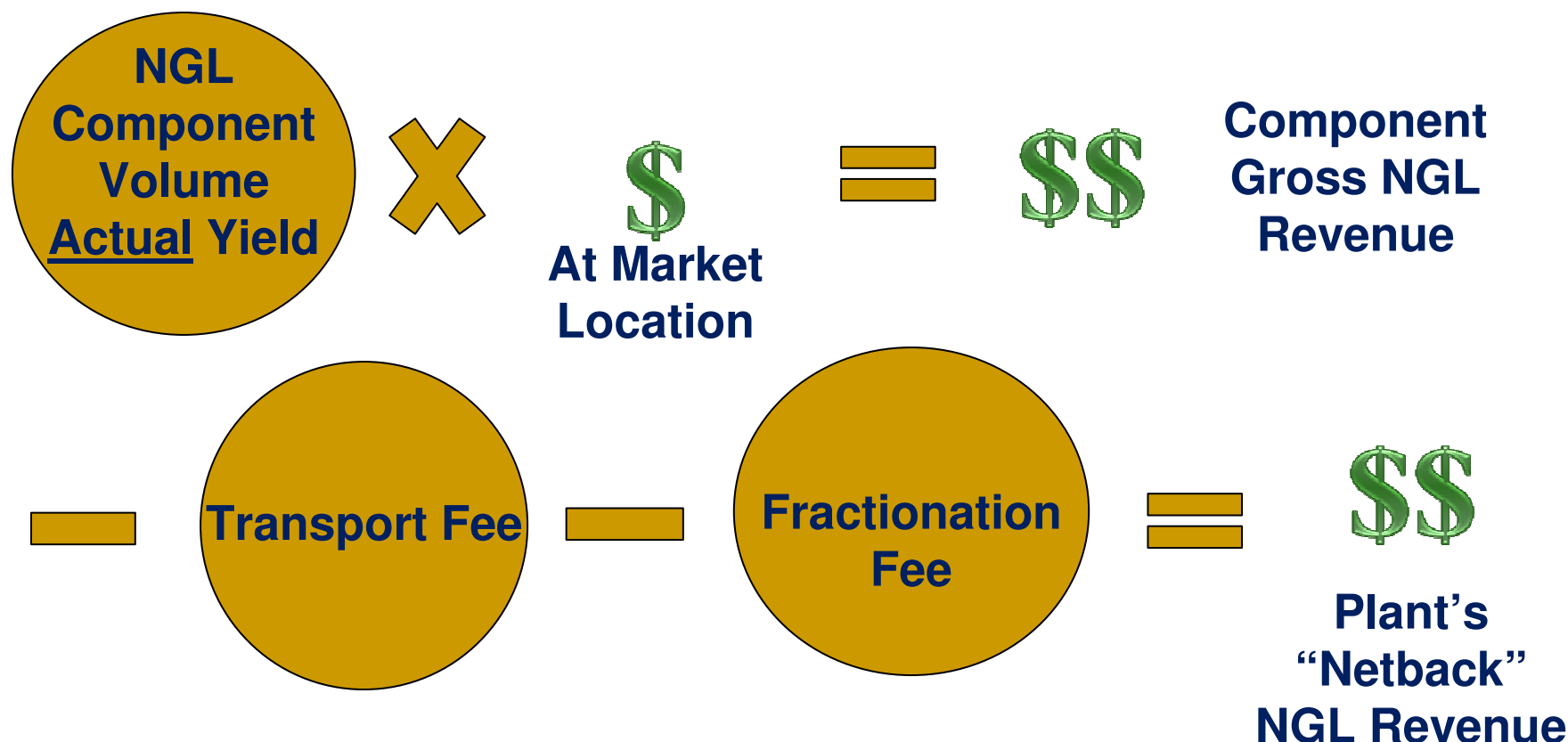
Estimated ranges for transportation & fractionation of mixed NGL's – new build economics



# NGL's from Gas - Processing Economics

## NGL Revenue Calculation – Plant Income

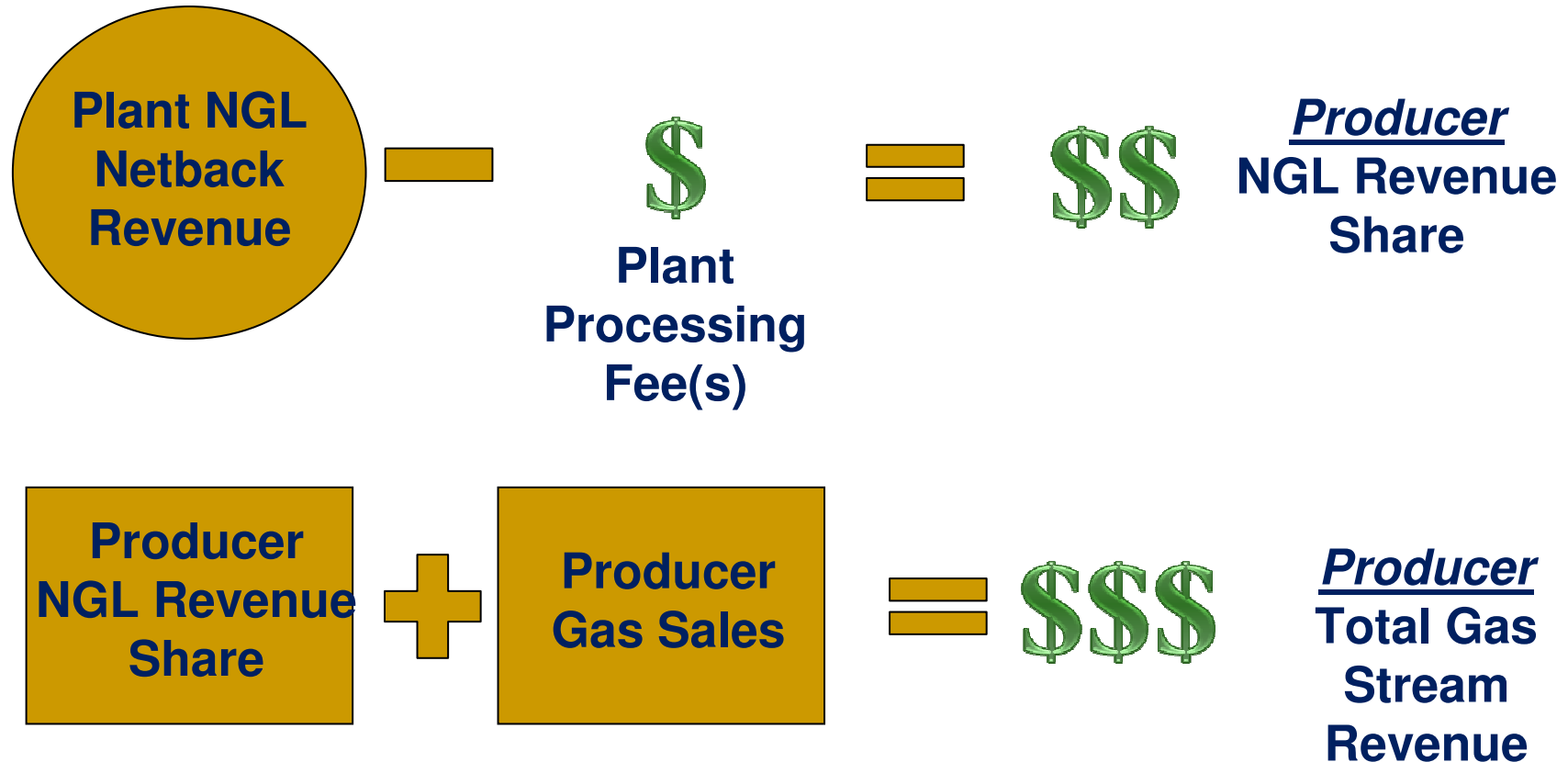
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# NGL's from Gas - Processing Economics

## NGL Revenue Calculation & Producer Income

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# Pipeline Expansions Underway All Heading to Mont Belvieu

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<http://www.ogj.com/articles/print/vol-110/issue-5/special-report-worldwide-gas/wet-shale-plays-basins.html>

----> Newly announced

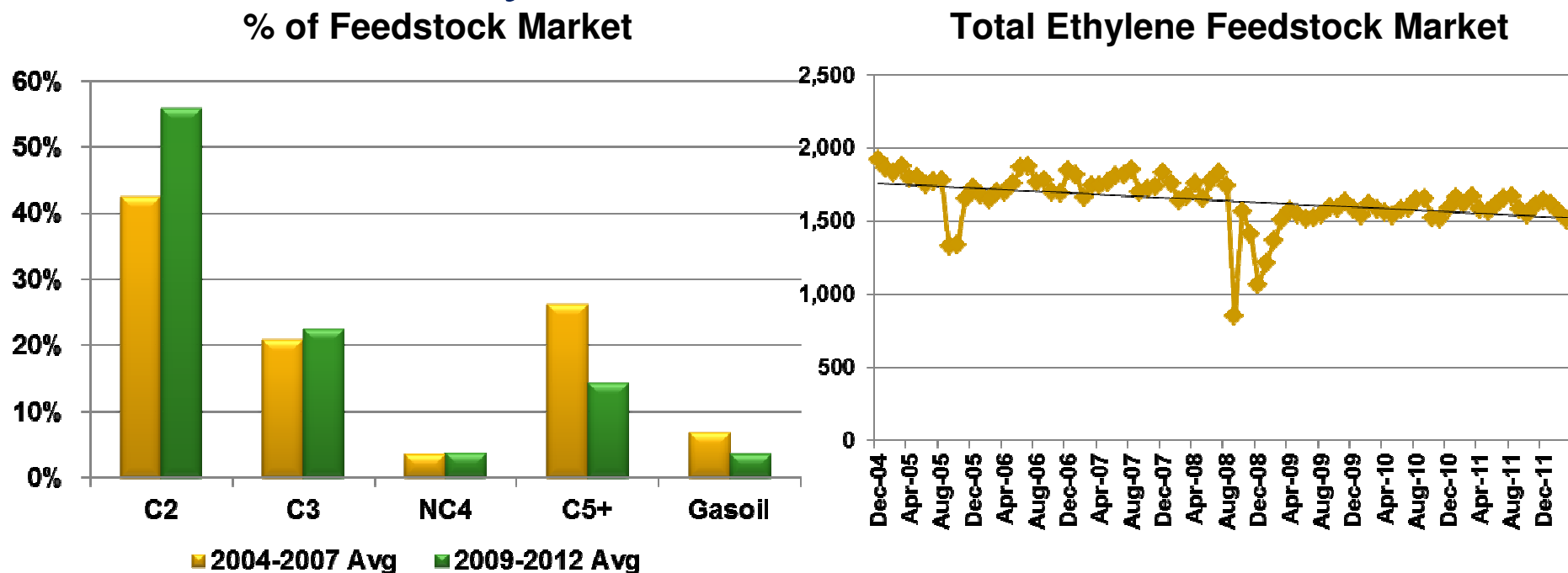
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Source: Oil & Gas Journal, May 7, 2012    \*In development/construction



# Ethane Markets

## ⦿ Ethane for Ethylene Production:



- ⦿ Total feedstock demand still 191M BPD less than 2004
- ⦿ Ethane produces more ethylene with fewer pounds of feedstock

# Ethane for Ethylene - Outlook

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- ⦿ Expansions under way will add 60-80M BPD demand to the Gulf Coast area by 2013
- ⦿ New units planned for 2016-7 could add 200M BPD more
- ⦿ But meantime, supply growth is outpacing demand

Ethane demand increasing:

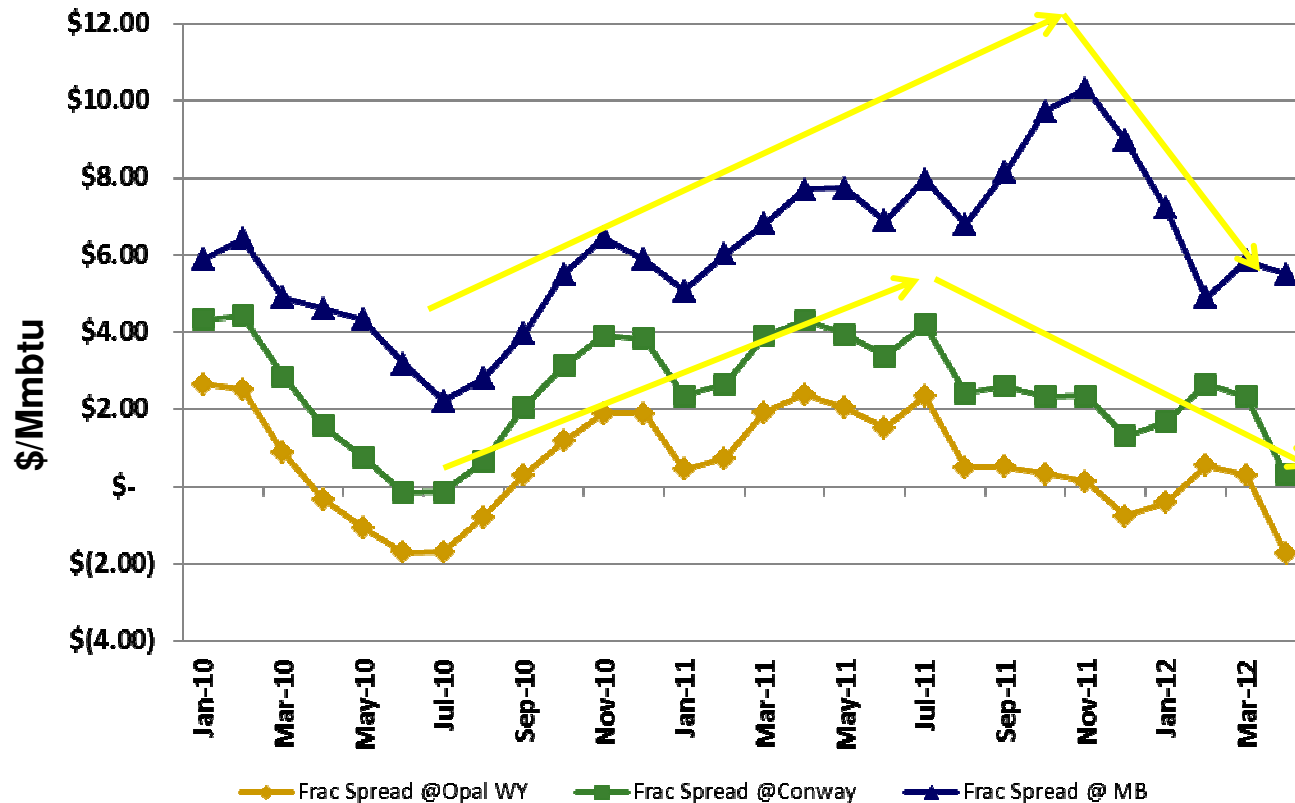
Peak 950M BPD 2010

Peak 1.015 million BPD Nov 2011

Forecast 1.2 million BPD by 2015

# Ethane Frac Spreads \$/Mmbtu

## Current Trends 2010-2012



Prices & spreads peaked in Nov 2011; record demand Dec 2011

Ethylene plant turnarounds began Jan 2012 – will prices move up when they're over?

Conway showing price pressure due to oversupply; can't get the excess barrels south

# Ethane Prices

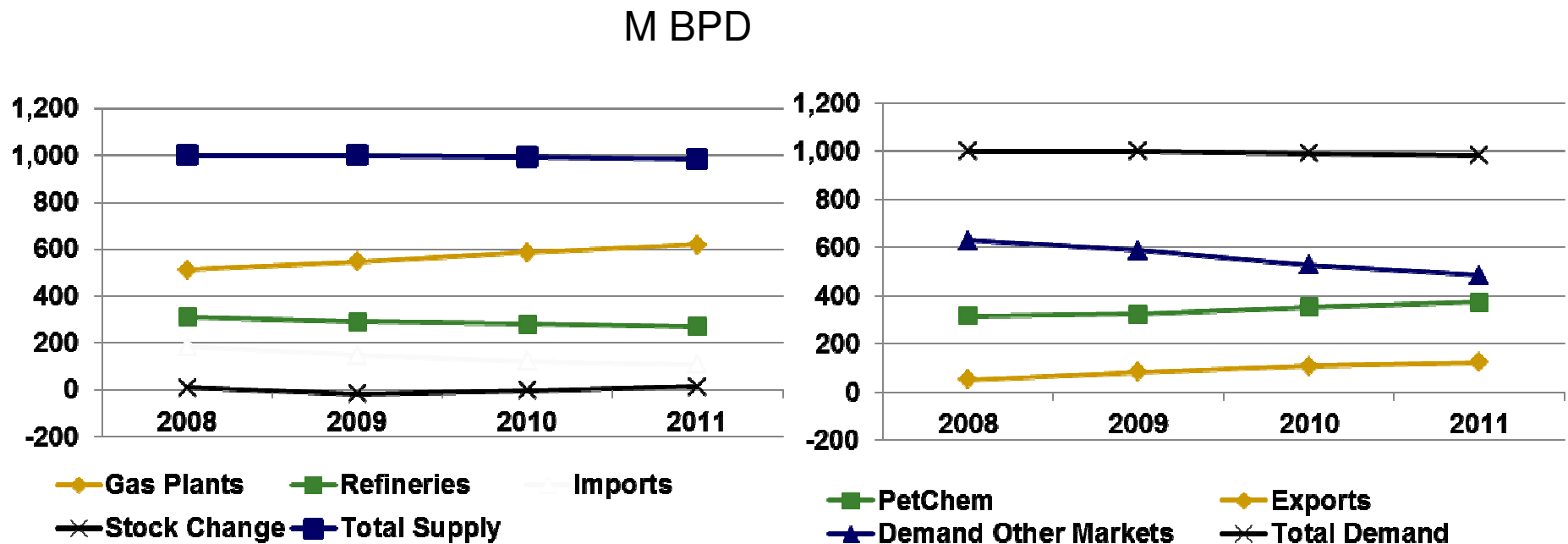
## How Low Can They Go?

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- 🔥 Ethane – the alternate market is natural gas
  - ❑ Price Forecast – start with the base price of gas at the plant tailgate, plus cost to recover it as NGL, plus transportation and fractionation cost (T&F), plus a margin
- 🔥 Example – assume gas price of \$2.00/MMBTU
  - ❑ Gas value is 13.18 CPG (BTU equivalent in CPG)
  - ❑ Transportation and fractionation of 13.8 CPG
  - ❑ Plant NGL extraction cost of 2.00 CPG (incremental expense)
- 🔥 Would need a minimum of 34 CPG at the hub to justify recovery for this plant ( $13.18 + 13.8 + 2.00 + 5.00$ ) to earn a 5 CPG margin as a return

# Propane Demand Trends

## Demand Declining in Traditional Markets

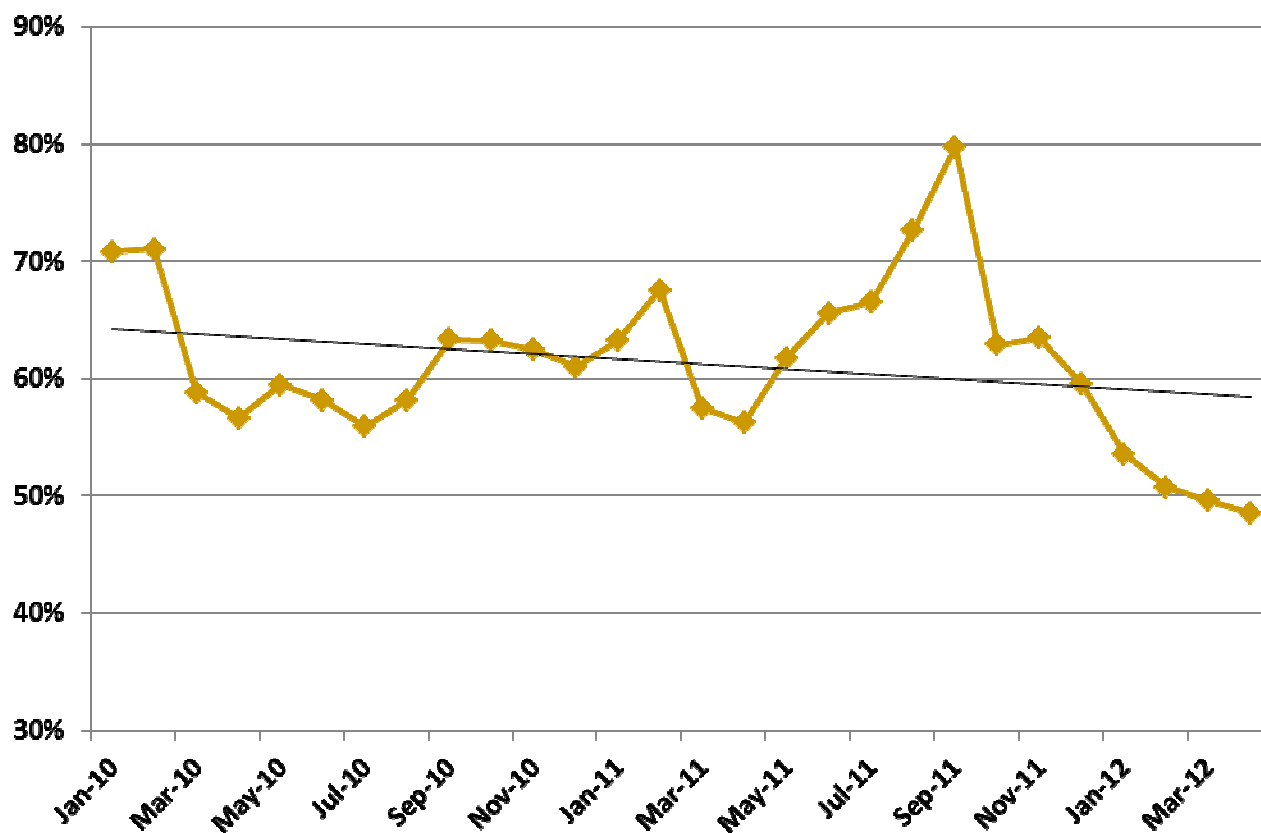


- 💧 Little change in total US balance 2008-2011
- 💧 Refinery supply & imports are falling
- 💧 Apparent demand in traditional markets is declining
- 💧 Increase in gas plant supply is going to export & chemicals

# Propane Prices Reflect Supply Imbalance

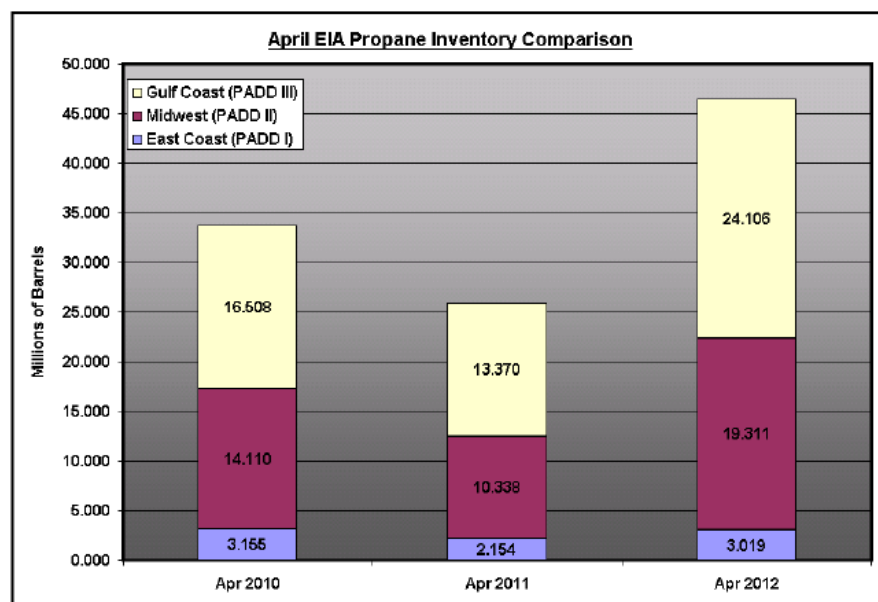
🔥 Seeing price pressure:

Propane Price as % of WTI

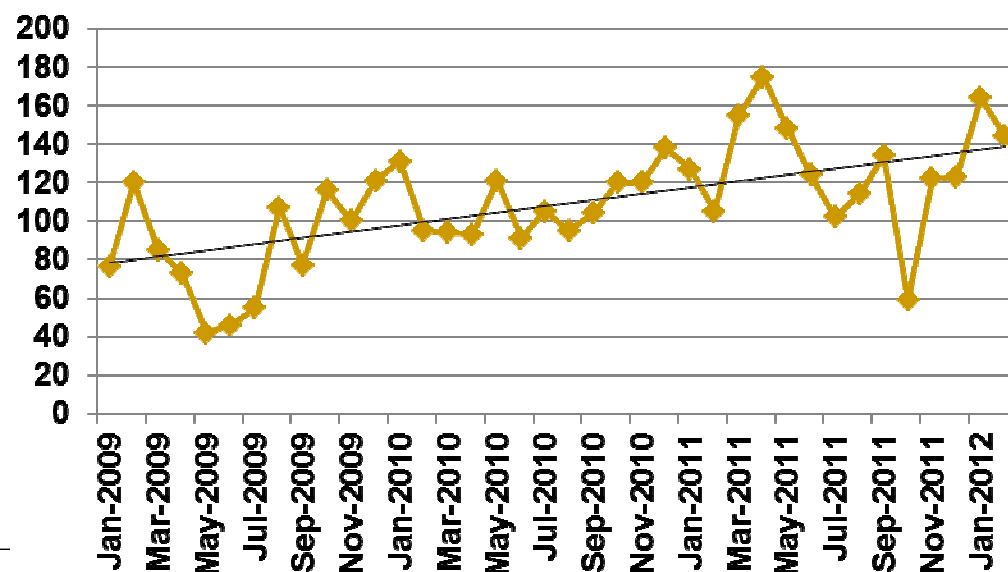


# Propane – Heading Offshore Already

## 🔥 Rising Inventories and Exports:



**Propane Exports Mont Belvieu  
000 BPD**



**Terminal Capacity Booked through 2013**

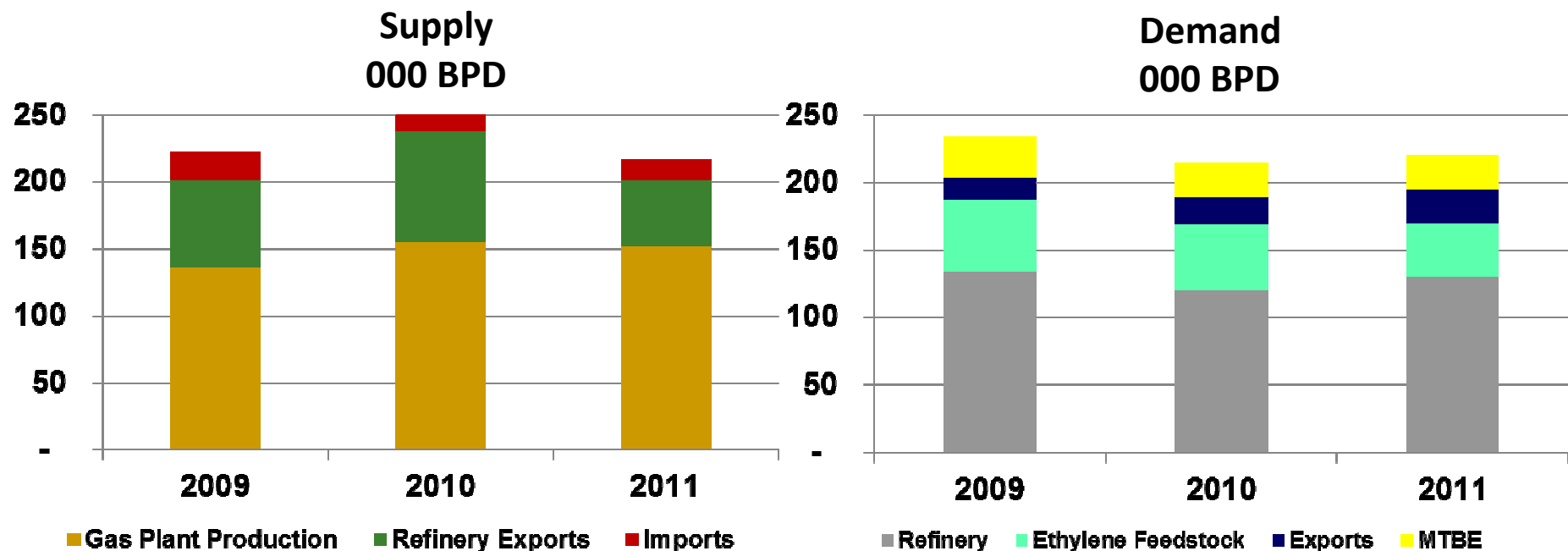
**Prices will settle at levels that encourage buying for winter**

Source: EIA



# Supply/Demand – Normal Butane

## Total Gas Plant & Refinery 2009-2011

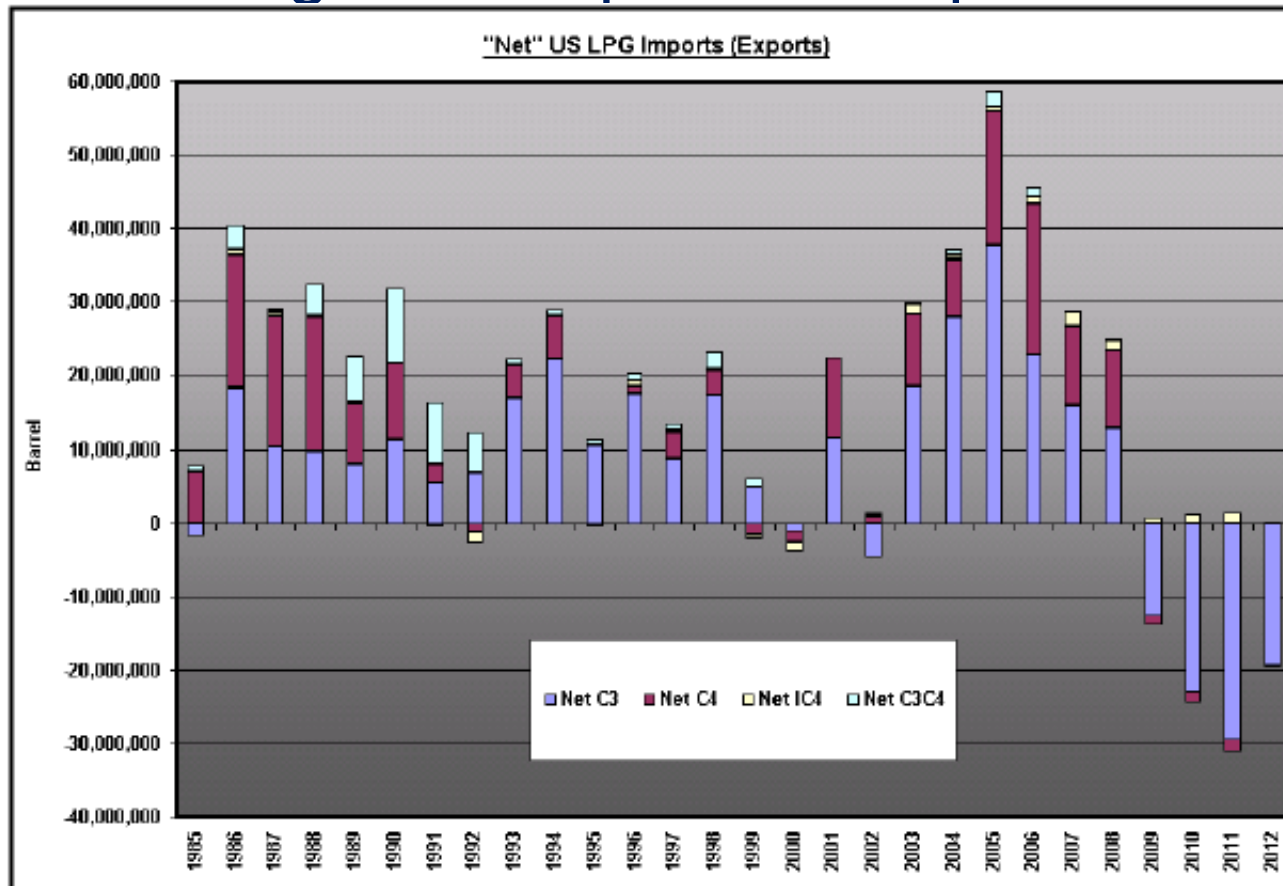


- Gas plant supply of NC4 is flat in spite of increase in overall NGL volumes; possibly converting some to IC4, leaving some in C5+
- 2011 net refinery balance is surplus of between 60 M BPD mixed butane
- Refinery demand includes direct blending and refinery isomerization feedstock
- Swing market is ethylene feedstock

Source: EIA, MEG Analysis

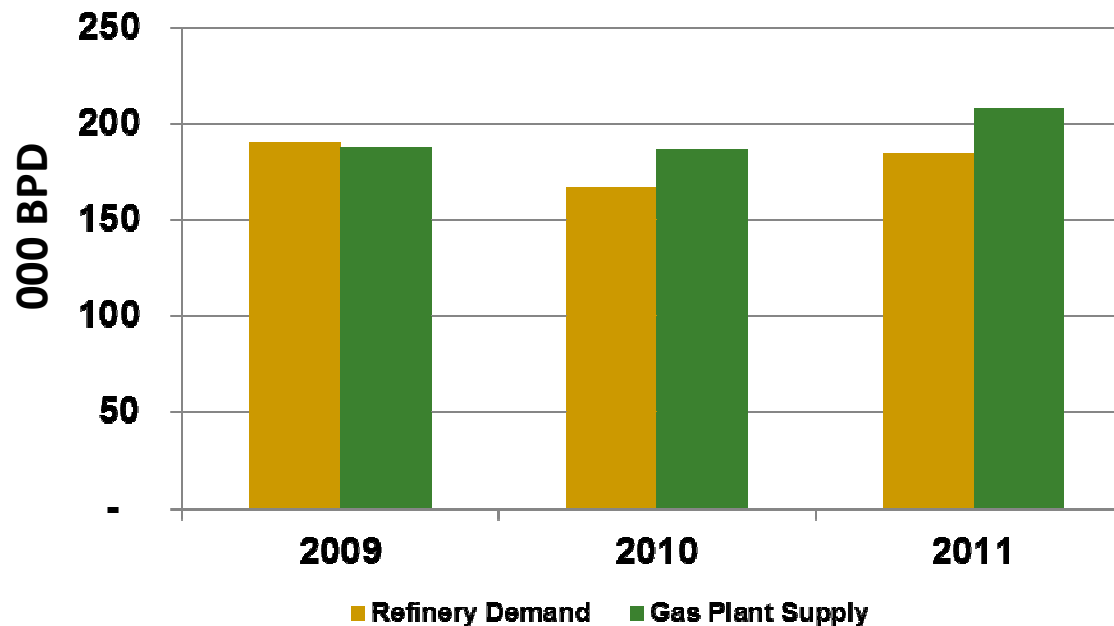
# Butane Supply Exceeding Domestic Demand

Also switching from imports to exports:



Source: Waterborne LPG Report, April 26, 2012

# Supply/Demand – Iso Butane 2009-2011

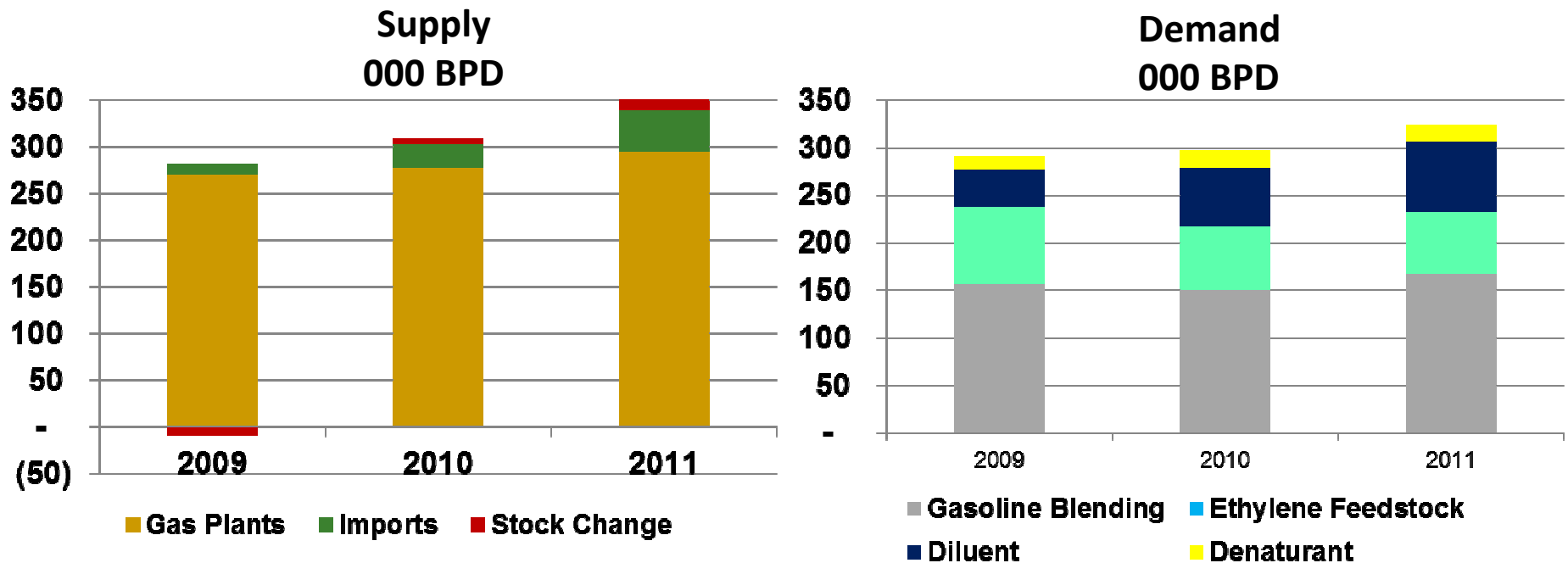


- ⦿ Big increase in supply – up 17% Dec 2011 vs. Dec 2010
- ⦿ Refinery demand meeting the challenge so far
- ⦿ Propylene oxide production uses IC4 as well

Source: EIA, MEG Analysis

# Supply/Demand – C5+

## 2009-2011



- Gas plant supply up 10+% Dec 2011 vs. Dec 2010
- Imports rising – trans-shipments going to Canadian market
- Refinery blending market is stable
- High crude prices and strong diluent market limit chemical demand

Source: EIA, MEG Analysis

# **NGL Markets – Butane/Pentane**

## **“Death Watch” for C4 and C5+ Summer Blending?**

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- ④ Key concerns for NGL markets will be proposed reductions in RVP and sulfur content
- ④ Ultimate impact depends on:
  - ❑ How much RVP is reduced and where
  - ❑ Sulfur limits
  - ❑ Changes in product flows resulting from closure of East Coast refineries
  - ❑ Whether WTI moves back toward parity with coastal crudes and pressures Mid-Continent refineries

# NGL Market View

## Summary

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- ⦿ Current bottlenecks in the logistics systems will be resolved when new pipeline, fractionation, and terminal capacity is in operation – 18-24 months
  - ⦿ Basis spreads between regions will settle at levels closer to the cost of new capacity but will stabilize at higher levels than in the past
  - ⦿ Propane supply will seek export markets near term; on purpose propylene production should help balance markets in 2-3 years
  - ⦿ Limited growth in motor gasoline demand, uncertainty around future fuels regulations is driving assumptions that increased butane supply will have to be moved offshore, or consumed in “on purpose” butadiene plants
    - The surplus is likely to be mixed refinery butane – treating, storage, and expanded logistics needed to handle this in the open market
  - ⦿ Demand for C5+ in ethylene cracking & gasoline blending not forecast to increase
    - Diluent market capability to handle increased volumes may depend on a crude export outlet other than the U.S.; prices already falling as supply grows in Upper Plains region
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# Contact Information

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Strategy consulting, project development, producer services,  
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