Light Naphtha Supply and Demand – When Push Comes to Shove

October 30, 2015
• Light Naphtha – Definitions

• Sources of Light Naphtha

• Driving Forces of Light Naphtha Demand

• Scenarios and Conclusions
Overlap of Boiling Point Ranges Contributes to Terminology Confusion

- **Condensate**: 80-600+°F
- **Full-range Naphtha**: 80-380°F
- **Light Naphtha**: 80-180°F
- **Heavy Naphtha**: 180-380°F
- **Pentanes**: 80-100°F
- **Natural Gasoline**: 80-150°F
Definitions for this Presentation

• **Naphtha** - generic term for a light volatile petroleum liquid or low octane gasoline
  – **Light Naphtha** (aka Light Straight Run or LSR)
    - Composed primarily of C5 (pentanes) and C6 (hexanes)
    - Best suited for isomerization or gasoline blending
    - RVP between 12 and 20 psi
  – **Heavy Naphtha** - Best suited for reformers, C6-C7-C8.
  – “Full-range” Naphtha: Light Naphtha + Heavy Naphtha

• **Pentanes – Mix of iso and normal C5 paraffins**
  – Can be fractionated to optimize value (uncommon)
  – Can be cracked in an olefins unit (better for nC5)
  – Can be blended into gasoline (better for iC5)
    - 65-75 Octane / 15-20 PSI RVP

• **Natural Gasoline**
  – Heaviest liquid stream from a gas fractionation plant, maybe referred to as condensate
  – Composed of C5 and heavier

• **Condensate** - Generic term for light raw petroleum that “condensed” from gas; ranges in quality from natural gasoline to light crude oil
  – Condensate may meet minimum export regulations (distilled) or not (field grade)
  – Usually meets pipeline vapor pressure specs of 11-12 psi
Light Naphtha Balance: U.S.

Sources
- Produced Natural Gasoline
- Produced Condensate
- Produced Crude Oil
- Imported Crude Oils

Disposition
- U.S. Domestic Gasoline Production
- Ethylene Cracking
- Exports - Western Canada Diluent
- Exports - other
- Ethanol Denaturant
Light Naphtha Consumers

Driving forces for Light Naphtha: Gasoline and Olefins

Relative Sizes of Light Naphtha Markets - 2015

Source: PRISM™ and Baker & O’Brien estimates.
U.S. Light Naphtha Balance: Sources of Supply and Disposition Channels

Balance Envelope

Natural Gasoline

Condensate

Crude Oil

Waterborne Imported Crude Oil

Western Canadian Dilbit

U.S. Refining System

Gasoline Pool Direct/Isom.

Diluent

U.S. Domestic Gasoline Production

Gasoline Exports

Olefins

Exports

Exports
• Conventional crude oils (non-condensate) typically yield 5-10% light naphtha
• The light naphtha content of condensates are typically 20% or more with a wide range

Source: PRISM assay database; light naphtha distillation range of 85-185 °F.
Sample Yields from Crude Oils

- Eagle Ford Condensate 54.7
- Eagle Ford 44.6
- Bakken
- WTI
- LLS
- Brent

Source: PRISM™
About 600,000 B/D of distillation capacity will come on line by 2017. Of this, about 80,000 B/D is Light Naphtha.

Source: Company Announcements, Baker & O’Brien Analysis.
Relative Economic Value of Condensate Splitter Intermediate Products
(Jan – Apr 2015 Average)

Light Tight Oil Production

Source: EIA.

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Eagle Ford Condensate Production

Source: RRC, data as of October 14, 2015

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Light Tight Oil and Light Naphtha Production

Source: EIA.

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Influences on Light Naphtha Consumption

**First Driver: U.S. Demand**

- **Billions of Vehicle Miles Travelled**
  - Source: U.S. Federal Highway Administration.

- **Record VMT**
• Second Driver: Finished Gasoline Net Exports

Source: EIA.
Influences on Light Naphtha Consumption

- Pentanes Plus Exports to Canada

Source: EIA.
• U.S. finished gasoline production jumped by 350,000 B/D in past year to record levels

- Where did all the components come from?

Source: EIA and Baker & O’Brien Analysis.
Influences on Light Naphtha Consumption

- **About 60,000 B/D of Light Naphtha blended into 350,000 B/D increase.**
  - Remaining 290,000 B/D made up by higher refinery utilization, imports, and higher operating costs.
- **High refinery utilization, imports, and higher operating costs made up for other components.**
  - Record refinery input in July 2015
  - Gulf coast blenders have begun importing high octane MTBE again, over 1 million barrels of MTBE in the first half of 2015 alone. These correspond to high finished gasoline exports to Latin America.
  - Post ethanol blending, naphtha reformers in refineries had been at low operating rates and severities. Now, increased throughputs and severities providing octane barrels

Source: EIA and Baker & O’Brien Analysis.
Heavy Naphtha Demand

Source: PRISM™.
Value of Light Naphtha in Gasoline

Value of Light Naphtha in Gasoline

NATURAL GASOLINE AS A PERCENTAGE OF GASOLINE
(Mont Belvieu Natural Gasoline / Gulf Coast Gasoline)

Simplified Steam Cracking Yields from Typical Feeds

- Ethane (C$_2$H$_6$) $\rightarrow$ Ethylene (C$_2$H$_4$ or C$_2$=) + H$_2$ + CH$_4$
- Propane (C$_3$H$_6$) $\rightarrow$ Above + Propylene (C$_3$H$_6$ or C$_3$=)
- Butane (C$_4$H$_8$) $\rightarrow$ Above + Butylenes (C$_4$H$_8$ or C$_4$=)
- Pentane and Naphtha $\rightarrow$ Above + Pygas (Aromatics)


~1.6 MM B/D
CASH COST OF ETHYLENE FOR DIFFERENT FEEDS

Source: Dan Lippe, Petral Consulting Company.
• Both butane and naphtha are at relatively low prices
  – Normal butane has historically been the seasonal blend storage component.
  – Refiners can blend as much as 10% additional low cost butane in the winter than in the summer
  – Light naphtha (aka natural gasoline) is now exhibiting similar seasonal pricing swings

• WILL THIS CORRECT?
  – More storage options?
  – More high octane, low RVP components?
  – More olefins crackers?
  – What about exports?
Naphtha Pricing: USGC, Europe, and Asia

Global Naphtha Markets

- **Worldwide naphtha markets are connected via substitution and freight differentials**

Higher value heavy naphtha is typically reformer feed; lower value paraffinic naphtha is typically cracker feed

Export markets for Light Naphtha have same alternatives as U.S. markets – gasoline blending and cracking

Europe and the Far East are not under-supplied with light naphtha

- Light naphtha exports can only discount or “push” their way into foreign markets – limited demand
Conclusions

- Production of light domestic crude with light naphtha has created large discounts of light components

- Refiners have responded by
  - Raising octane/severities at higher operating costs
  - Running at high utilization to consume low priced crude and naphtha
  - Increasing blending with imported MTBE

- Could this lead to capacity increases?
  - Olefins units still prefer lighter feeds – No.
  - Reformers and alkylation units – Possibly.

- Further declines in LTO production will tend to keep condensate in the U.S.