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Monetary vs. RSV Reality

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It’s all about the Nameplate …

Would a plant by any other size or type cost just as much?

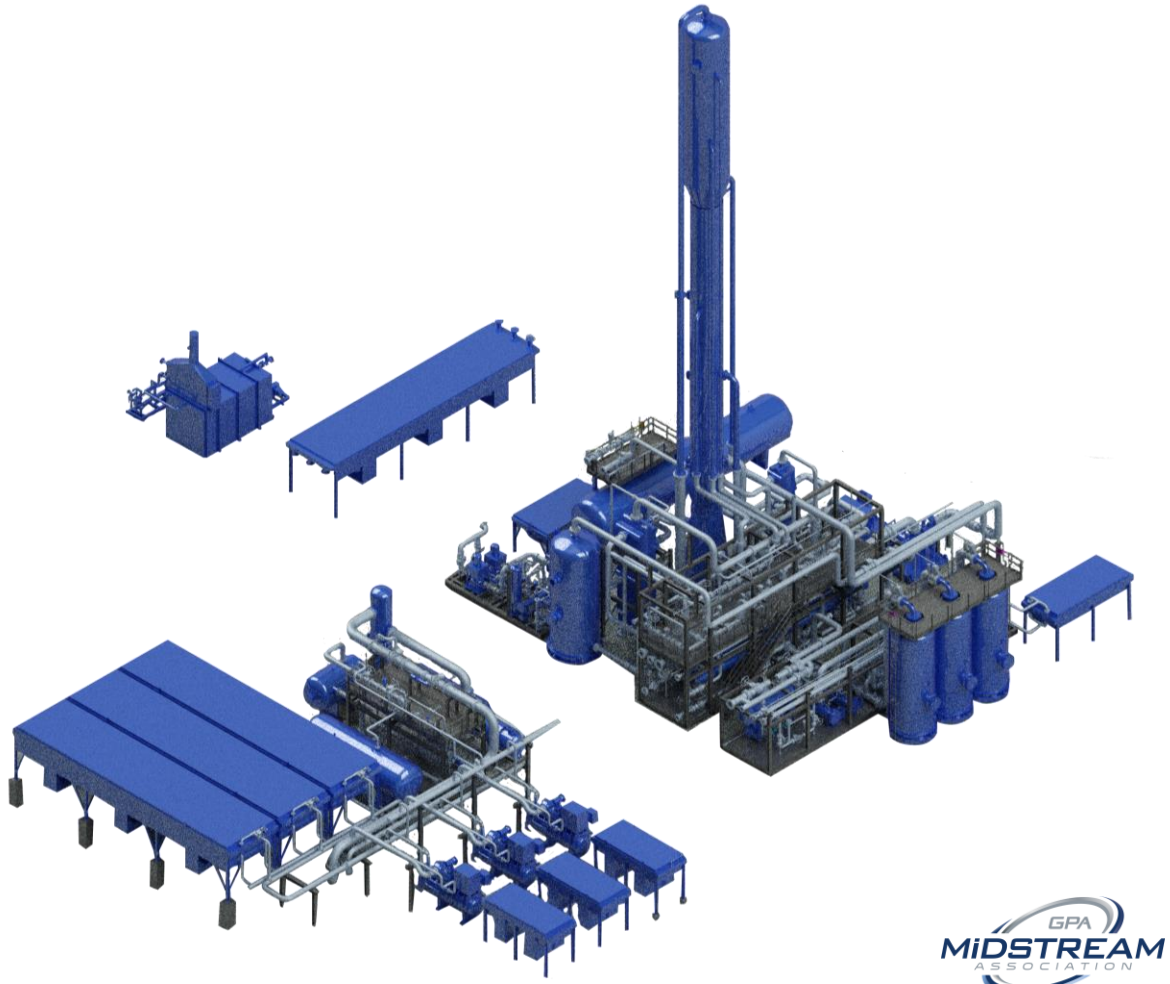
200MM

230MM

250MM

300MM

…..



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What Matters Most? …the Size

- Nameplate: 200 MMscfd has been extremely popular.
- However, the market trends upward with capacity – and the current mega facilities are pinched on plot and process >1 BCFD.
  - Site permitting and pre-planning for electrical expansion can hinder the facility's total processing capacity.
- Limited added **plant** capex is required to shift to 25% or even 50% greater nameplate. (CAPEX↑ 10% to 30%).
  - Requires very limited added plot space.
- Fixed Fee Contract (stable for processors), @ $0.65/Mscf
  - @ 200MMscfd, $47.1 million
  - @ 230MMscfd, $54.2 million
  - @ 250MMscfd, $58.9 million
  - @ 300MMscfd, $70.7 million
    - Scale-up 6/10^{ths} rule applies: Turnkey CAPEX ROI of <2.5 years vs. 200 MM.
- Facility planning should address current market sizes and potential expansion to maximize profitability.
  - Balance of the plant should be updated or flexible.

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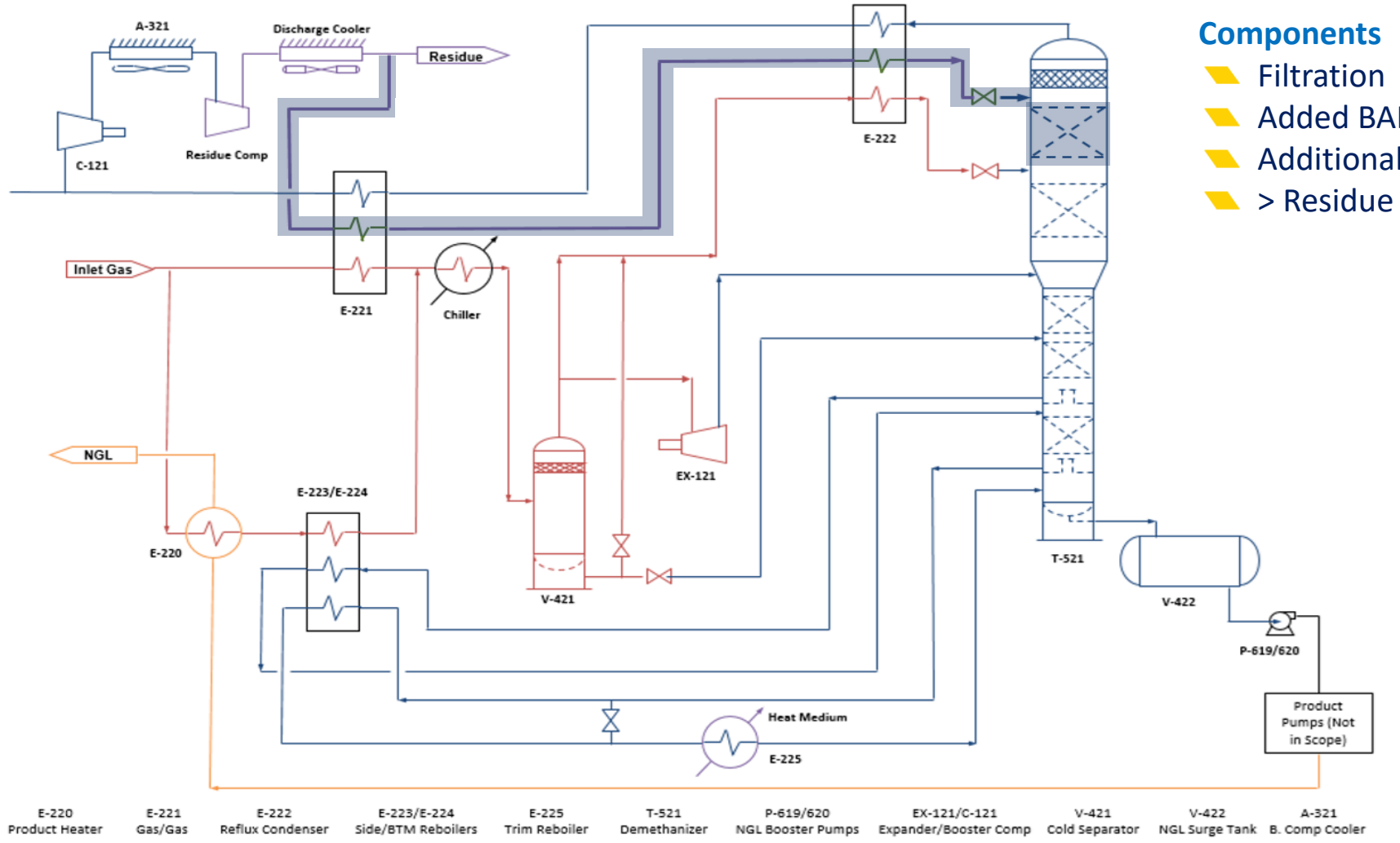
What is Recycle Split Vapor?



Components

- Filtration
- Added BAHX Pass
- Additional Tower Bed / Height
- > Residue HP, added machine

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RSV Features

Added Recycle Reflux

- Cold separator temperatures ↑ and tower pressures ↑
  - ≥ recoveries versus GSP even at richer gases

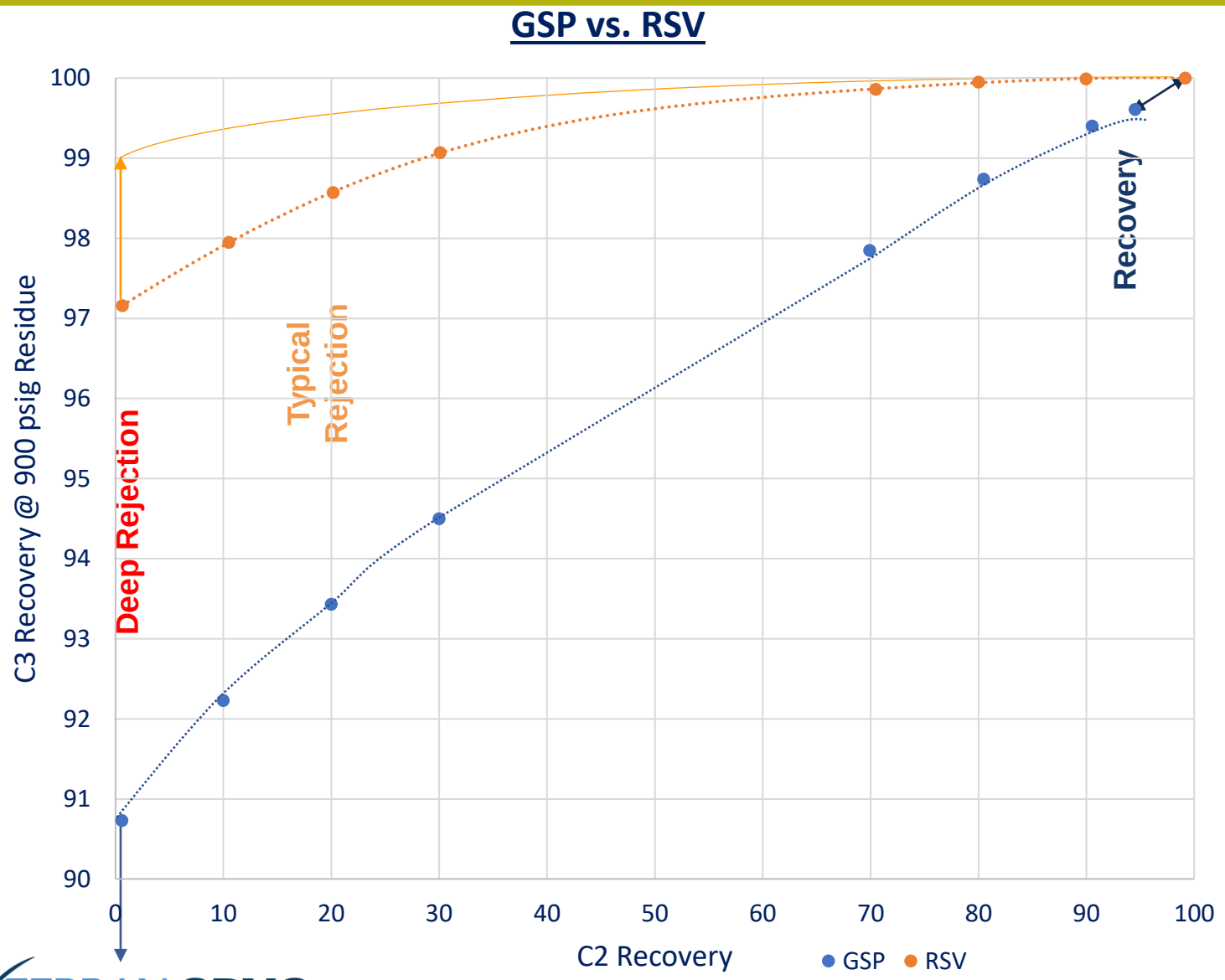
CO_2 Tolerance

- Added reflux / tower pressure positively influences CO_2 freeze tolerance
- Although rejecting C_2 means rejecting CO_2, and therefore avoiding freeze, RSV plants have the following advantage:
  - ≥ 99% C_2 recovery at 1% CO_2 in comparison to GSP near 91%

Larger Backend

- Recompressor load ↑ = ↑ turbo frames or ↑ tower pressure / operating pressure / MAWP
- However, RSV in GSP mode has potential ↑ nameplate
  - For a fixed fee contract this could be $6 million / year or more

GSP vs. RSV – The Reality in Recovery



Typical Narrative: RSV >> C_2%, however…

Rejection: GSP plants suffer losses in C_3 recovery.

- As rejection of C_2 deepens, ~10% C_3 is lost.

Additionally: as GPM ↑, Curve shifts ↓ ∴ C_3 ↓

- Energy of condensation for heavier HC streams.
- ↓ flows of residue; the cooling for inlet gas.

Residue Pressure Sensitivity:

- RSV plants perform differently from 900 to > 1,200 psig residue.
- C_3 recovery in deep rejection pivots from 97% to 99%.
- ↑ Residue pressure = ↑ C_3 Recovery.

Actual Performance:

- Based on integration of heat, the central recoveries around 30% to 60% C_2 may suffer a dip when switching from one mode to the other.

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RSV: Equipment and Precautions

BAHX ALPEMA Temperature Swings, Cyclical Fatigue

- Typical: 28°C or 50°F max delta T
  - Frequent: 1°C or 1.8°F fluctuation.
  - Infrequent (startup / shutdown): 2°C/min or 3.8°F/min
- Suggest temperature probes on all sides of exchangers and to understand flow to each leg.
- Not necessarily worse than a GSP plant, ~ 20-year life, if maintained.

Filtration

- Aerosol residue oil is detrimental to BAHX performance. Failure = GSP style operation.
  - Cleaning is arduous.
    - Peco Facet “Natural Gas Pipeline Contaminant Removal Methods”
    - Transcend “The Impact of Aerosol Contamination on RSV Efficiency”
- Recommended: (1) Full residue stream filtration and (2) dedicated RSV slip stream filtration for aerosol.
- Delay RSV start-up until after compression break-in. Avoid pockets, be wary of slugs and ambient. Potential heat trace.
- Larger plants (~300MM^{+}) with centrifugal recompression avoid this altogether.

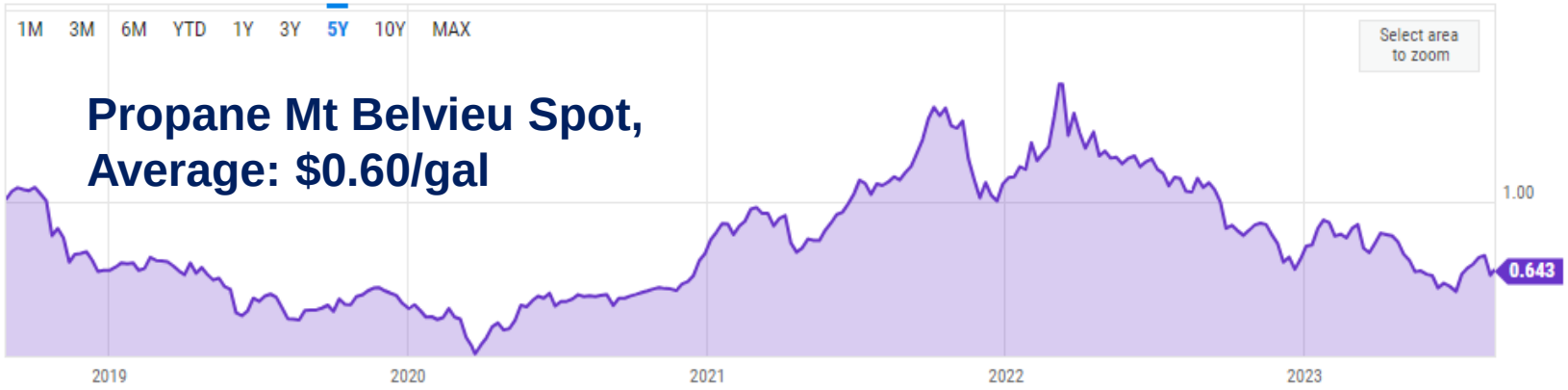
Tower

- Potential higher tower pressure = relative volatility and separation are worse ∴ ↑ HETPs / bed heights required.
- RSV bed physical properties already lead to higher HETPs. (Strigle, Packed Tower Design and Applications, EQ 9-1, 1987).
- Larger towers, when truck transport is difficult, may require shipment in pieces with field welds.

Commodities - Spot Price Averages

Henry Hub Natural Gas Spot, Average: $2.40/ MMBtu

Ethane Mt Belvieu, Average: $0.24/gal



Propane Mt Belvieu Spot, Average: $0.60/gal

Butane Mt Belvieu Spot, Average: $0.93/gal

C_5^+ Mt Belvieu Spot, Average: $1.31/gal

Utilities $0.06/kWH, 1HP = 0.756kW
-$0.10 on all liquids for transport and fractionation

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Plant Stats

- **7.2** GPM gas with **1.2** C_2/C_3 ratio
  - Higher Heating Value (HHV) match at 1,047
  - C_2 is not a valued liquid
    - From $0.24 to $0.31
  - Processor ↑ $5.9 million/year

230 MM	GSP		RSV		
C_2%	94.1%	25.5%	99.3%	94.0%	14.9%
C_3%	99.6%	93.9%	100.0%	100.0%	98.9%
C_4%	99.9%	98.8%	100.0%	100.0%	99.9%
Revenue-Utility-Processing/year	291.6M	289.7M	290.7M	291.45M	295.6M

C_2 @ $0.31 in the $$$

Contracts (Superior Pipeline, "Gas Processing 101" Aug 2016 Midcon GPA)

How do I monetize incremental propane?

- **FF:** Fixed Fee (stable for processors), $0.65 / mscf
- **Percent of Index:** ↑↑ risk / reward for processors
- **Percent of Proceeds (Gas + Liquids):** Mild R/R ~ >12% to meet FF
- **Percent of Liquids:** Medium R/R ~ >20% to meet FF

Plant Stats

- **5** GPM gas with **2.6** C_2/C_3 ratio
  - Higher Heating Value (HHV) match at 1,073
  - Due to incremental C_3, deeper rejection is an option
- Processor ↑ $2.7 million/year

230 MM	GSP	RSV
C_2%	17.0%	11.3%
C_3%	91.8%	99.0%
C_4%	98.5%	100.0%
Revenue-Utility-Processing/Year	221.5M	224.2M

Contracts

- **FF:** Fixed Fee (stable for processors), $0.65 / mscf
- **Percent of Index:** ↑↑risk / reward for processors
- **Percent of Proceeds (Gas + Liquids):** Mild R/R ~ >16.2% to meet FF
- **Percent of Liquids:** Medium R/R ~ >39.5% to meet FF
- Percentage contracts require ↑ to match fixed fee, due to ↓ richness and ↑ C_2/C_3 ratio.

Monetization
RSV
Cost & ROI

The Cost:

- RSV modifications + residue compression + turnkey adders
  - ~ $8 million^{+} assumed.

The Payback (ethane negative market):

- Fixed fee payback: 0.4 to 1.5 years with capacity upgrades, or…
- Without capacity upgrades with ROI < 5 years,
  - Processing fee ↑ by $0.03/ mscf ($0.65 to $0.68 / mscf)
  - Get paid for incremental propane

Controlling the Narrative

Alternative:

- Kicker incentives for greater contract recoveries are sometimes part of fixed fee contracts, but more commonly from C_2 perspective.
- RSV Fixed Fee processor with kicker, considering both C_2 and C_3 gains, is better.
  - ***A curve of rejection-based contract could maximize the kicker.***

Expectation versus Execution

7.2 GPM but… C_2/C_3 ratio increases from 1.23 to 2.65

- It's not leaner, it's just rich in the wrong places…
- Higher Heating Value (HHV) Issues = > C_2 required
  - Pivots RSV from 15% C_2 to 47% C_2 to hit < 1,080 HHV
  - *Benefit: Since RSV loses less C_3, then deeper rejection can occur.*
    - *GSP is closer to 51% required recovery.*
    - *The revenue on gas and liquids is nearly identical.*
- Composition Limited: Volume of C_3+ is lower. Profitability is diminished.
  - Higher POL contracts required: ↑ to 29% to meet fixed fee rate of a 1.23 ratio gas.
    - Ask for 50% more liquids.

Conclusions

- Percentage of profit / liquid contracts are subject to C_2/C_3 sensitivity
  - If not varied based on C_2/C_3 ratio are subject to higher risk
- Fixed fee is unaffected, but the liquid volume is reduced by 23%
  - Kicker therefore is lower and ROI longer

C_2 in the Green: RSV was made for this

- Rejection recollection, due to HHV target of 1,047 HHV, the 7.2 GPM gas performs as follows →
- Recovery
  - Economics are per previous 94% GSP, 99% RSV
  - Most GSP plants are going to only see 90% to 92%
    - Ethane economics pivot, and highest percentage recovery is not always best.
  - Incremental ethane doesn't always add up the way incremental propane does.

230 MM	GSP	RSV
C_2%	25.5%	14.9%
C_3%	93.9%	98.9%

	September 2018	July 2020	June 2022	May 2023	July 2023
Nat Gas ($/MMBTU)	$ 3.00	$ 1.72	$ 7.67	$ 2.15	$ 2.55
Ethane ($/MMBTU)	$ 7.95	$ 3.23	$ 9.67	$ 3.07	$ 4.80
Adjusted Ethane (T&F) ($/MMBTU)	$ 6.44	$ 1.72	$ 8.16	$ 1.56	$ 3.29
RSV vs GSP Rejection	3.4M$	3.2M$	9.4M$	7.5M$	3.5M$
RSV vs GSP Recovery	3.2M$	0.1M$	0.7M$	-0.1M$	0.8M$
Suggested Operation	RSV Rec	RSV Rej	RSV Rec	RSV Rej	RSV Rec
Rec vs Rej RSV	44.2M$	-0.7M$	3.4M$	-8.6M$	8.7M$

*$0.10/gal transport + fractionation ~$1.51/MMBTU

*Rejection +21.5 GPM C_3

https://www.eia.gov/energyexplained/hydrocarbon-gas-liquids/prices-for-hydrocarbon-gas-liquids.php

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Conclusions and Findings

- RSV plants > C_3 recovery across all performance modes.
- RSV has a quick ROI of 2 to 5 years even in a C_2 negative market.
- Alternatively, a larger nameplate can help pay for the process in less than 1 to 2 years.
- RSV Rejection economics for 230MM can yield $3 million to $9 million / year in C_3 revenue; depending on richness, level of rejection, and C_2/C_3 ratio.
- GPM alone is not enough to define POP or POL contracts, C_2 / C_3 ratio is key.
- RSV in a GSP mode, may have higher nameplate.
- C_3 stability is key for profitability and should make its way into contracts.
- A plant that pivots between a focus on nameplate, C_2 recovery, and C_3 stability is more flexible; therefore, desirable than classic GSP.

Questions?

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Thank You

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2023
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