

How Produced Water's Economic Value is Evolving in the Permian Basin



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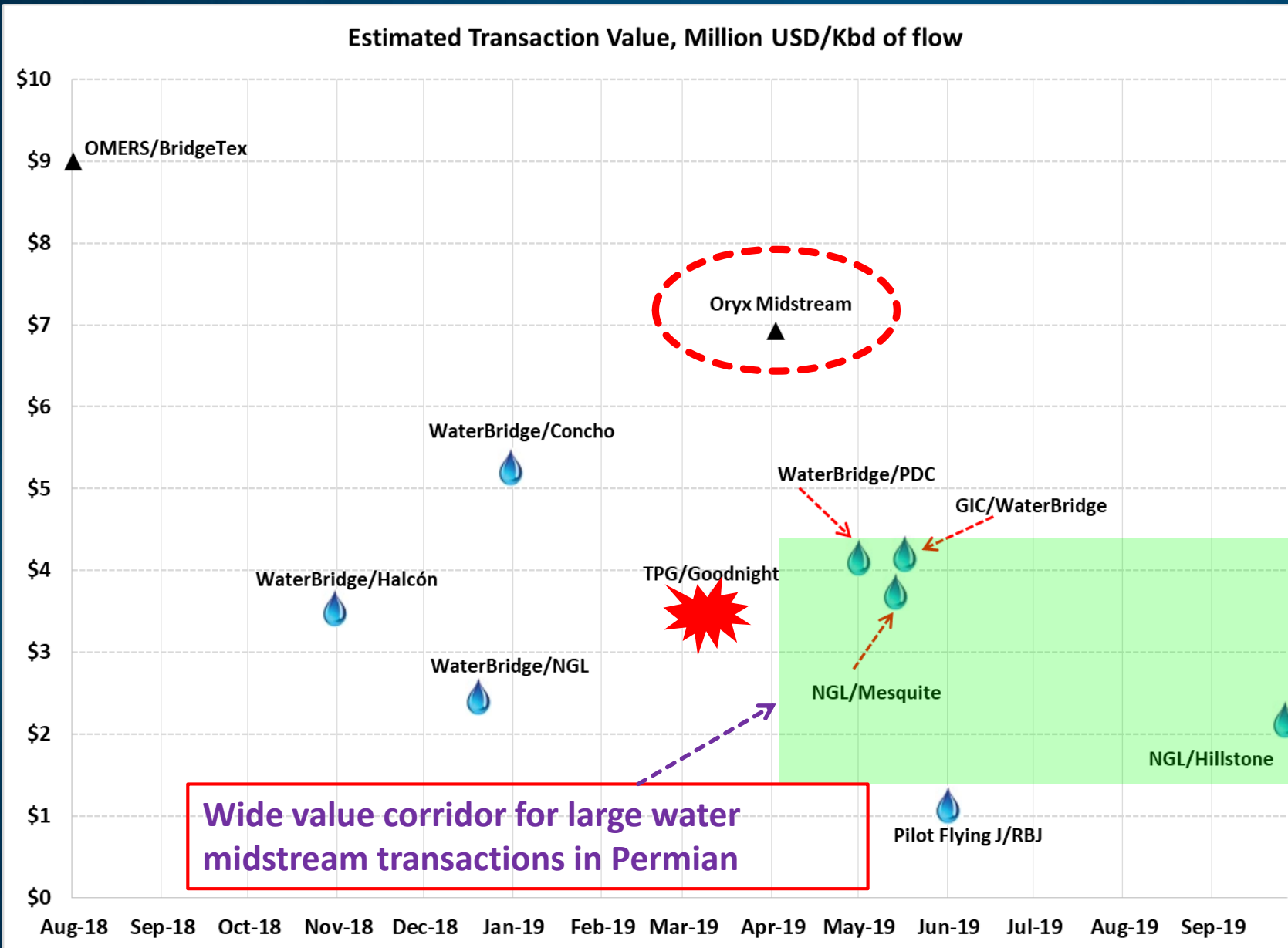
Gabriel Collins, "How Produced Water's Economic Value is Evolving in the Permian Basin," Shale Play Water Management, 22 October 2019, Houston, TX.

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Mr. Collins holds a membership interest in Cactus Water Services, LLC. This relationship is covered by a Rice University conflict of interest management and monitoring plan.

Recent Valuations From Selected Permian Basin Water and Crude Midstream Transactions



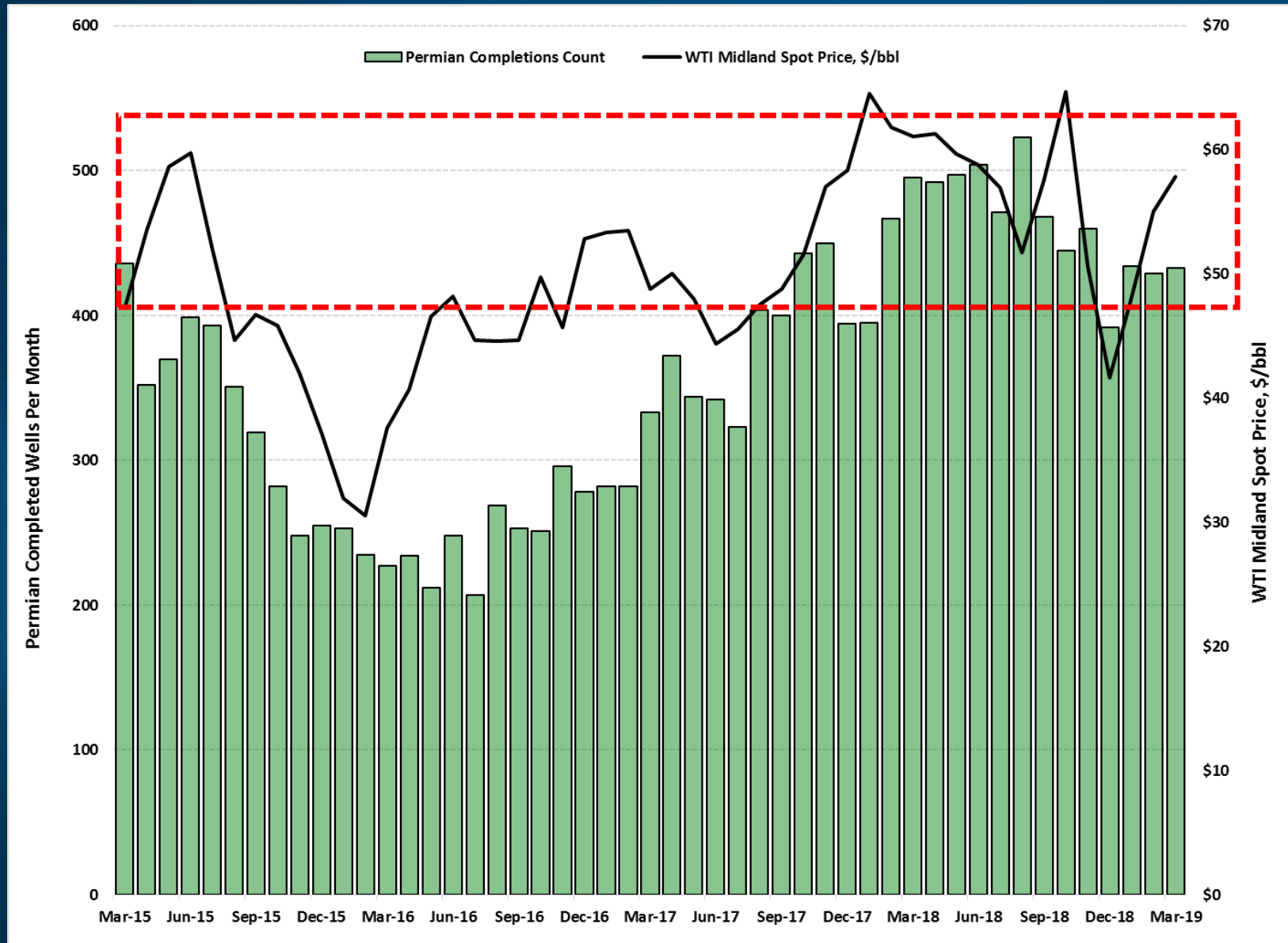
Some distinctions between the crude gatherers and water midstreams:

1. Acreage footprint size
 - A. Oryx gathers from nearly 1 million dedicated acres
 - B. Most water midstreams are only a fraction of that
2. More consolidation in the market
3. Underlying value of the commodity being transported
4. Volume of the commodity that must be handled (3.5X multiple of oil & gas production for UC, 10X for conventional)
5. Produced water is only now beginning to be viewed as a valuable commodity

Why Is The Valuation Corridor So Wide? Part 1

**Hint: It's a new marketplace..and
Permian water midstreams are
long-term derivative oil traders.**

It's Rough Being an Associated Commodity: Volatility is A Core Theme



Source: EIA FracFocus, Author's Analysis

- Volatility really starts to bite when you are dealing with a derivative commodity that you currently cannot hedge.



Source: Discover Wildlife

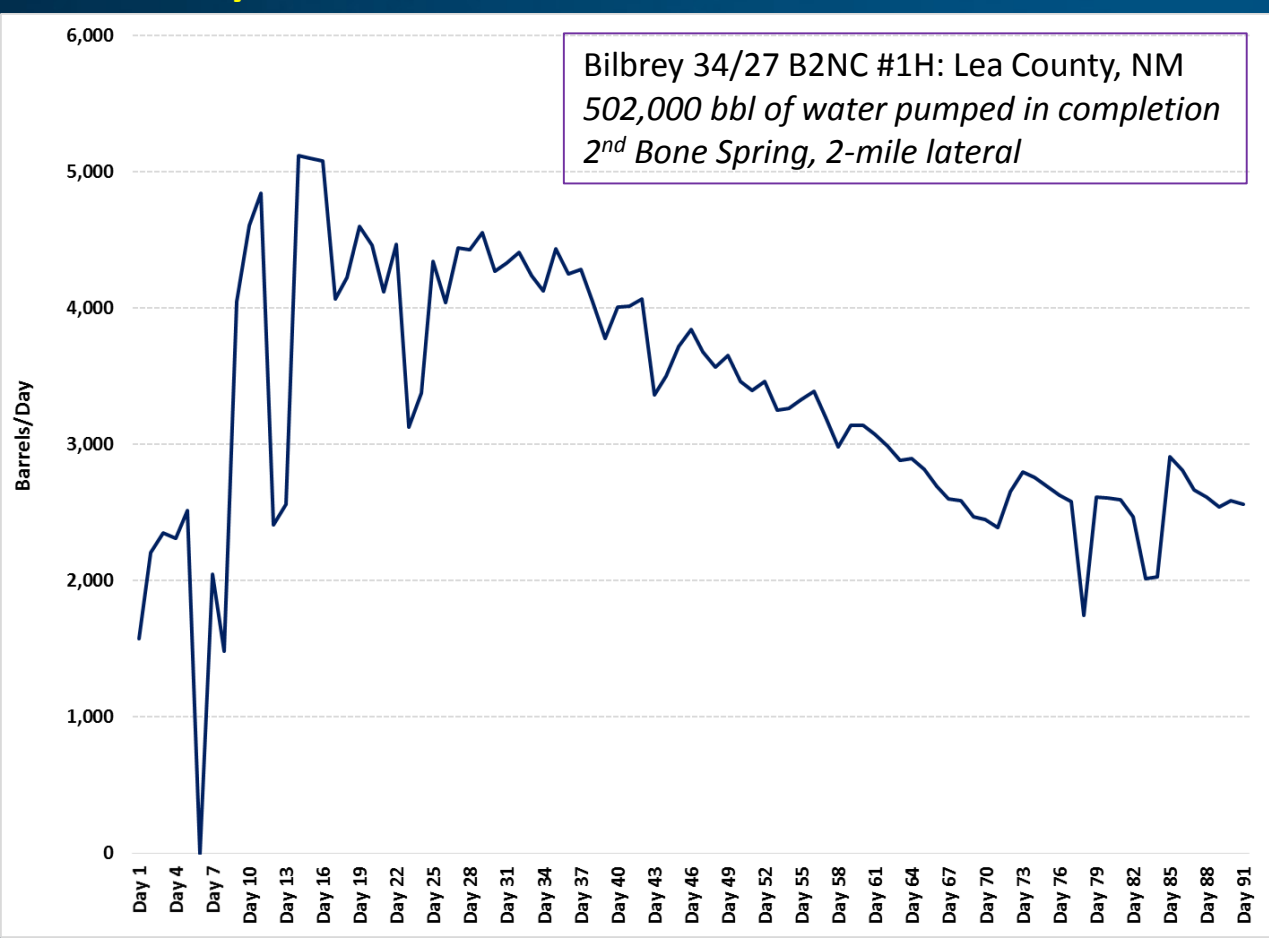
Significant Exposure to Commodity Price Volatility and Drilling Program Swings



Source: The New Yorker

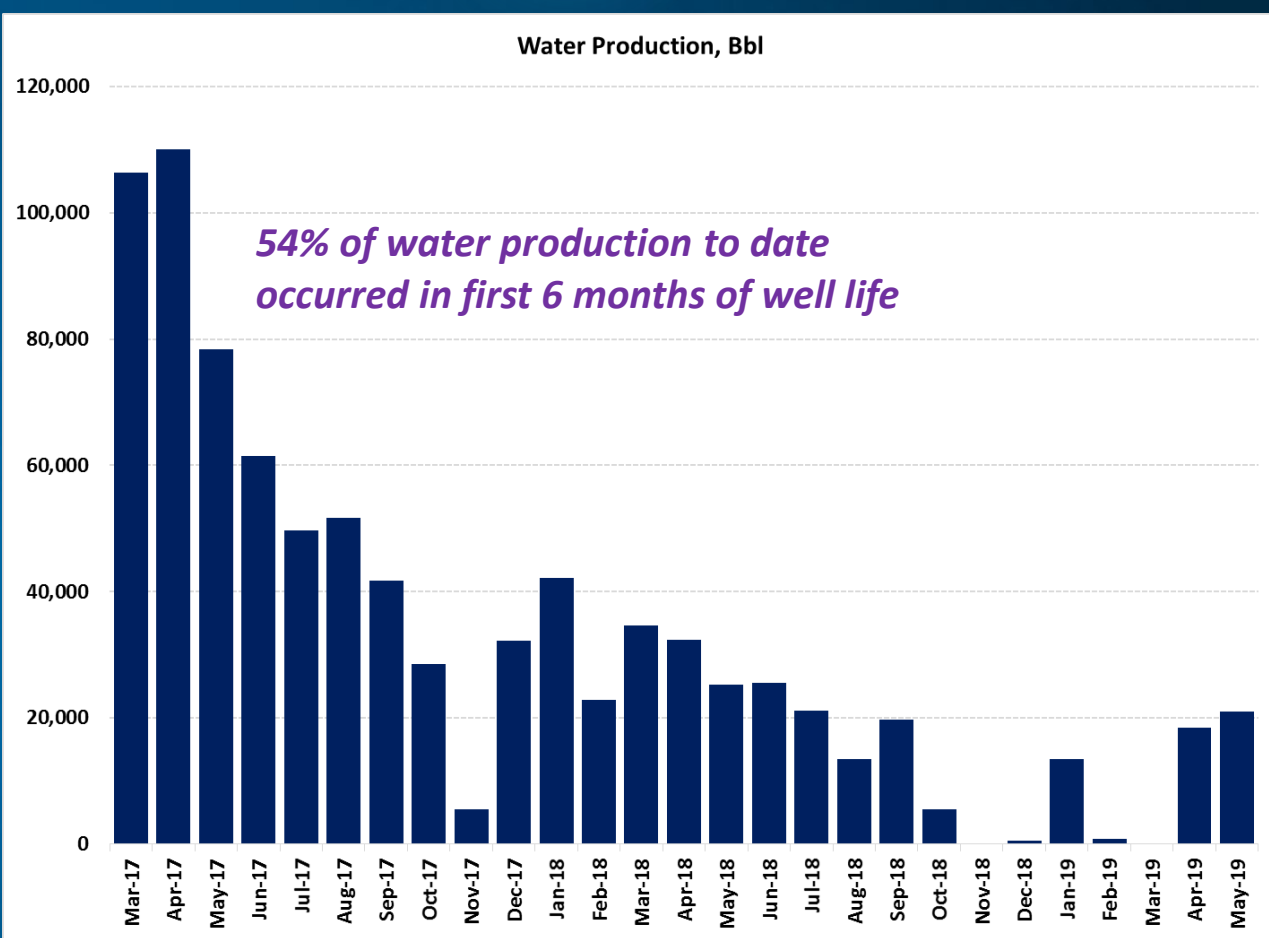
Frontloaded Water Volumes Turbocharge The Impacts of Commodity Price Volatility

First 90 Days of Well Life



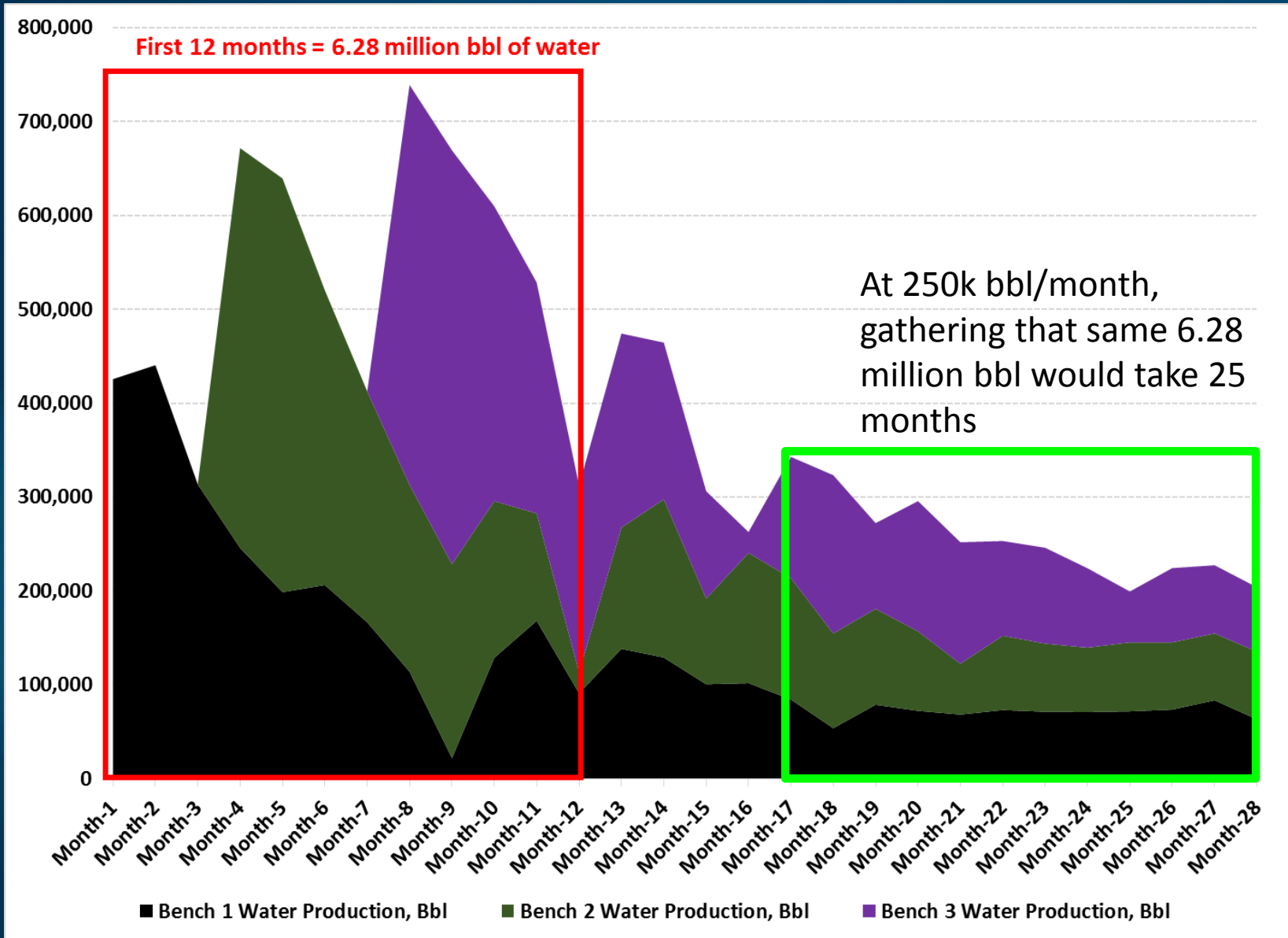
Source: Well Invoice Data, NM OCD

Well Life To Date



Developing multiple benches simultaneously or doing “cube” style developments can potentially intensify frontloading of water volumes.

Volume Intensity: What a Multi-Bench Permian Completion Could Look Like



- ▶ Volume intensity has distinct operational and financial implications.
- ▶ If a water project is going to deliver anything approaching the “unlevered mid-teens” return rates cited by certain capital sponsors, capturing the upfront flow spikes is essential.
- ▶ The longer-term, lower-intensity water flows still have great economic value but are likely to be valued much more like a “utility play” that assumes returns closer to 6-7% per year. Such assets still offer great portfolio value, but probably not to private equity. They might however, interest the pension funds and other capital pools that PE gets money from and we could see more direct investments in the oilfield water space by large institutional long-term investor pools as the sector matures.

Associated Commodity With A Twist: You Have To Handle It—And Do So Expediently!



Source: PRI



Source: Bloomberg

Why Is The Valuation Corridor So Wide? Part 2

**Hint: Great Minds Don't
Necessarily Think Alike**

How Are Sector Participants Thinking About Water Assets?

Sold!

- ▶ “We've got a very strong long-term commercial contract that underlies the deal to handle our produced water in Eddy County. Also similar to those crude deals we're partnering with a very sophisticated operating team that has a dominant regional footprint and for all that we get the benefits of really high level of service handling all of our produced water volumes. They also bring with them the needed infrastructure to allow large scale water recycling like you've referenced, which I think will be a driver of savings in the future. And then we'll have a 20% equity investment that gives our shareholders exposure to a growing competitive business and we see as a table on terms of how it goes from here.” — Tim Leach, CEO, Concho Resources, 2Q2019 Earnings Call

Want to sell

- ▶ “As it pertains to water there's no real update since the last quarter. Process is still ongoing. We're working with our advisers. Both have a decision by end of the year. But I'll say we're very encouraged by the level of interest in that specific asset.” — Ryan Dalton, CFO, Parsley Energy 2Q2019 Earnings Call
- ▶ “Rewind all the way back up to right in the middle of Stateline and in the heart of the basin. The water discussions are fast and furious. You can bet we have call -- had a call yesterday just inquiring about what our plans are. And we're very opportunistic. We watch these things and look for how do we create the most value, at the same time, most importantly, protect that upstream E&P business, because you could do something really flashy and cash in some money on one of these deals and really live to regret it quarter after quarter after quarter if that counterparty is not performing.” — Clay Gaspar, President & COO, WPX Energy, 2Q2019 Earnings Call

Might sell

- ▶ “And then water, as we mentioned in the past, we're evaluating it now and we'll make it -- the Board will make a decision in 2020.” — Scott Sheffield, CEO, Pioneer Natural Resources, 2Q 2019 Earnings Call
- ▶ “...I'll say again, that there may, indeed be a point in time, we're monetizing some of our midstream assets make sense to us. Right now, I'd say the value we get out of it is the operating cost, access to water for recycling and a really good environmental footprint with the way we've designed the water infrastructure. With these monetization needs, it ultimately becomes a tradeoff of CapEx of OpEx.” — Thomas Jorden, CEO, Cimarex, 2Q 2019 Earnings Call

Doubling down on self-owned infrastructure

- ▶ “Capital is trending to the low side of expectations, so assuming the trend continues, any realized savings if spent will likely be directed to two areas, water, oil and gas infrastructure to lower our operating expenses...” — Billy Helms, COO, EOG Resources, 2Q 2019 Earnings Call

Why Is The Valuation Corridor So Wide? Part 3

**So what can we potentially
actually agree on?**

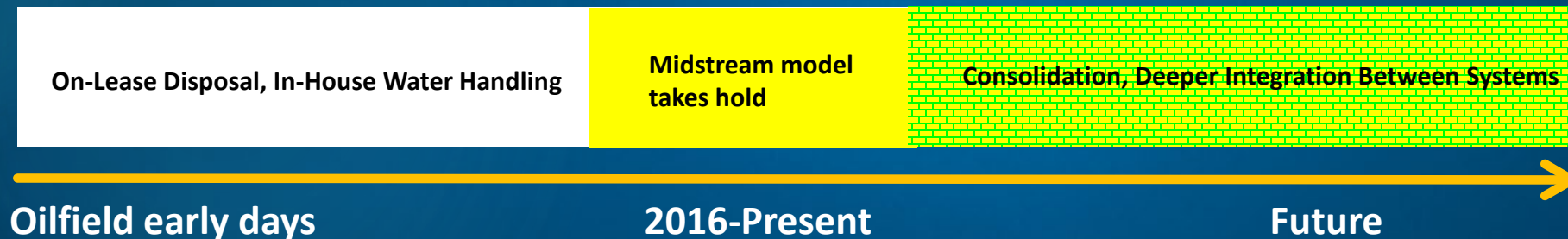
Produced Water Is Transitioning From a Liability Into an Asset



Source: http://grouches.wikia.com/wiki/File:Oscar_the_Grouch_old_banana_peels.jpg

Fundamental Approaches

- 1) By-Product as refuse to be gotten rid of—and a cost avoidance opportunity
- 2) By-Product as a cash flow generator.
- 3) **By-Product as a cash flow generator with some commodity resale value**
- 4) **By-Product as a standalone, independently valuable commodity in its own right.**



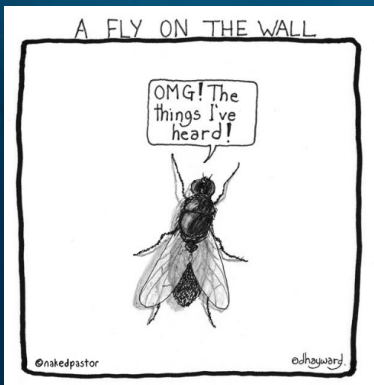
By-Product as Refuse to Be Gotten Rid Of

- ▶ “We are water companies subsidized by the oil revenues.”—paraphrase of anecdotes periodically overheard at various conferences over past two years.
- ▶ The response in one word? “NO!”
- ▶ Water poses a logistical challenge for energy producers.
- ▶ It also creates sizeable economic opportunities.

Musonoie-T17 open pit mine in DRC—2.66% copper content by mass in ore. So the miner moves about 97 lbs of rock for every pound of copper recovered



Source: Katanga Mining Limited



Now imagine if miners like this told the investment community that “we are in the rock moving business and are just subsidized by the copper.”

Produced Water Becoming a Commodity in the Permian



The Northern Delaware Basin already has “Pipeline Grade” produced water commercially available.



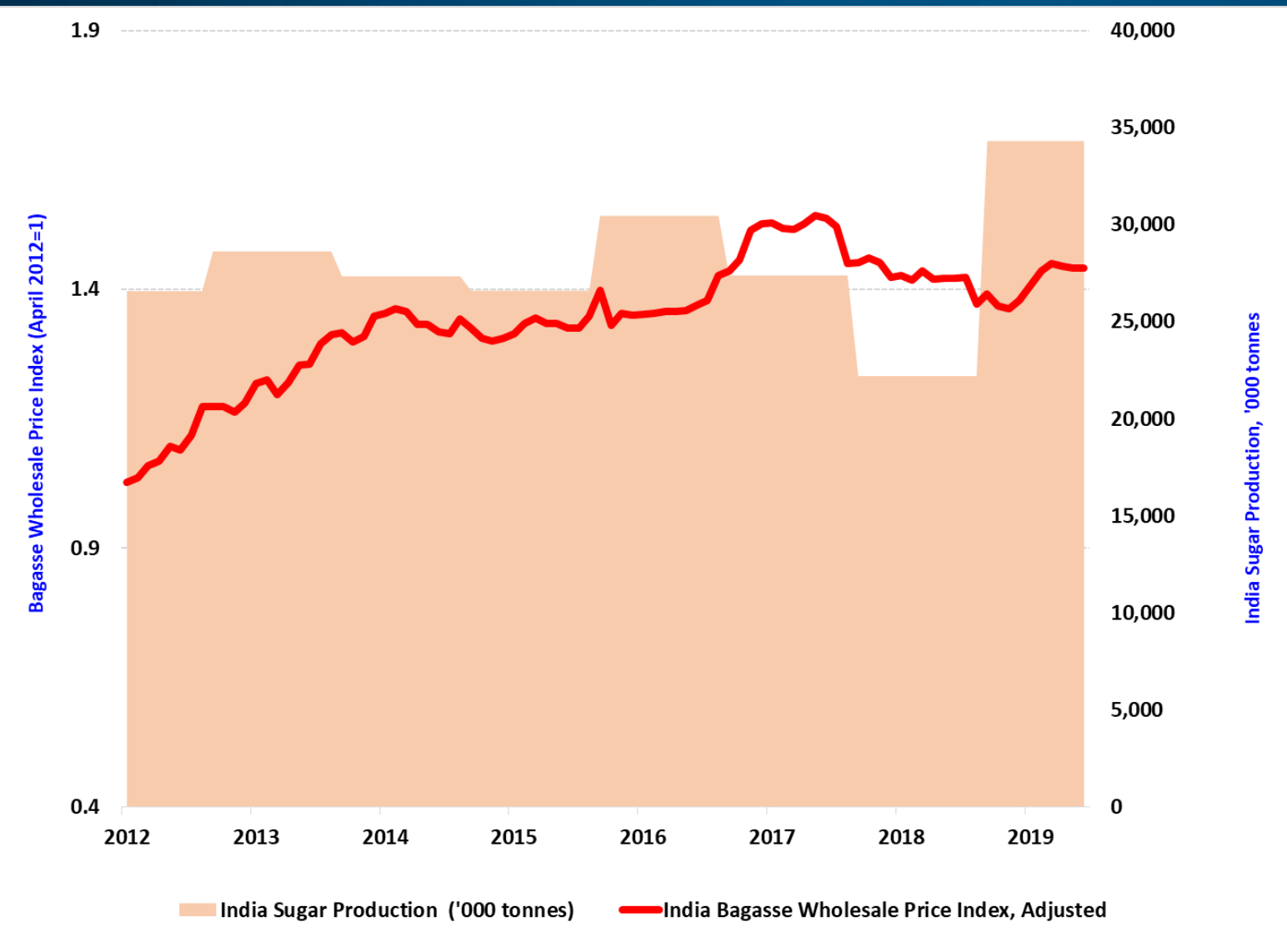
RISER: XEC-ENGINEERED ACCESS FOR WATER REUSE



The Waste Product Begins to Find a Use

Economics of By-Product Commodities: Sugarcane Bagasse

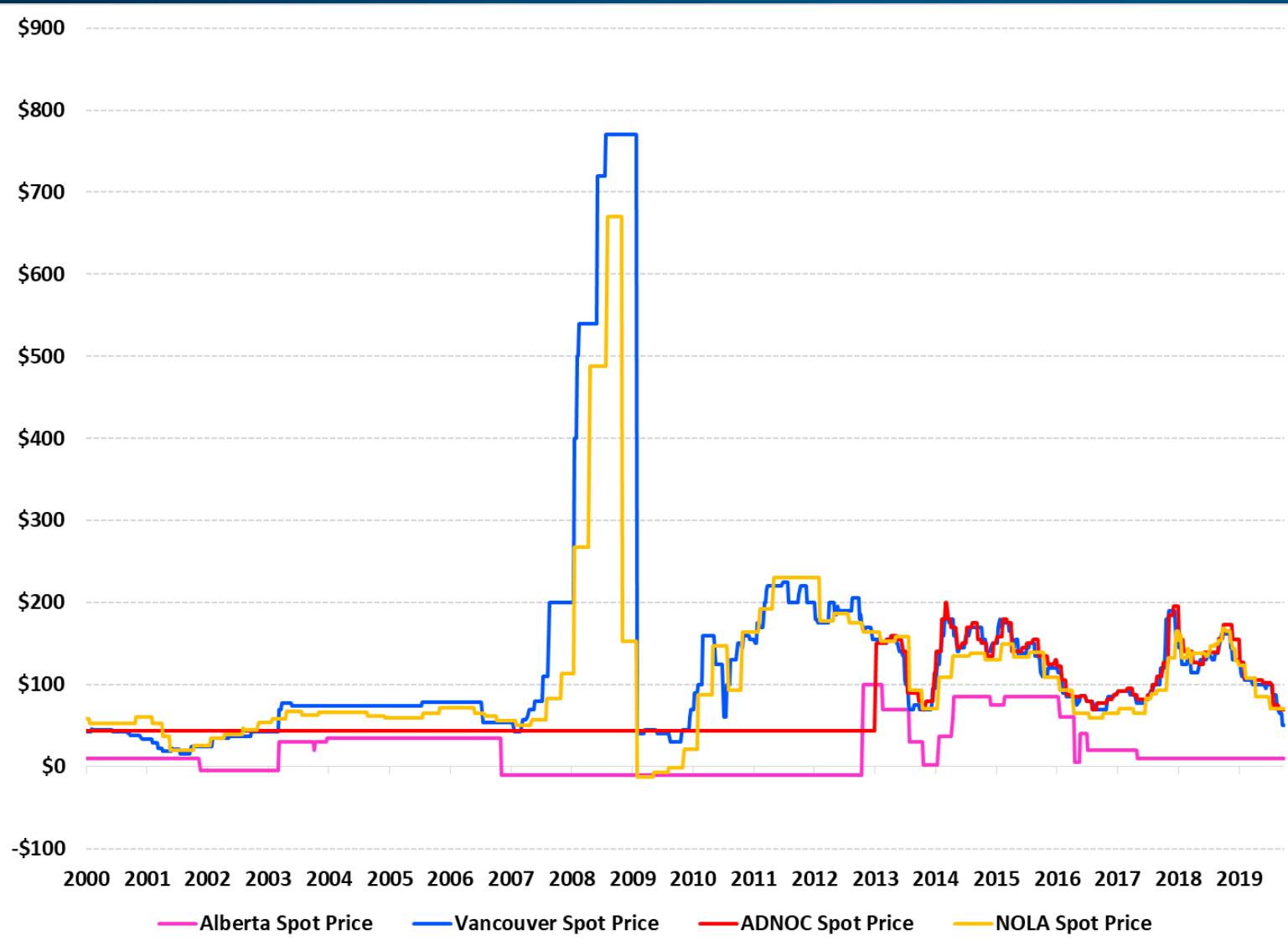
Bagasse Prices vs. Sugar Production—Indian Market



- ❖ Indian internal sources indicate that for every 100 tonnes of sugarcane a processing facility crushes, it obtains 10 tonnes of sugar, 4.5 tonnes of molasses, and 30 tonnes of bagasse (i.e. leftover cellulosic stalks).
- ❖ Of that 30 tonnes, 24 are burnt onsite to power the mill and 6 tonnes are sold, primarily to the paper and pulp industry.
- ❖ Bagasse demand is primarily driven by sugar mill power needs (i.e. leveraged to processing facility use) but the other subset of consumption--paper pulp raw material demand--is fundamentally independent of the sugar market. This further suggests that bagasse prices will be influenced both by paper production levels and by the global market conditions for pulp and pulp-making woods.

Economics of By-Product Commodities: Associated Sulfur

Sulfur Spot Prices, USD/metric ton

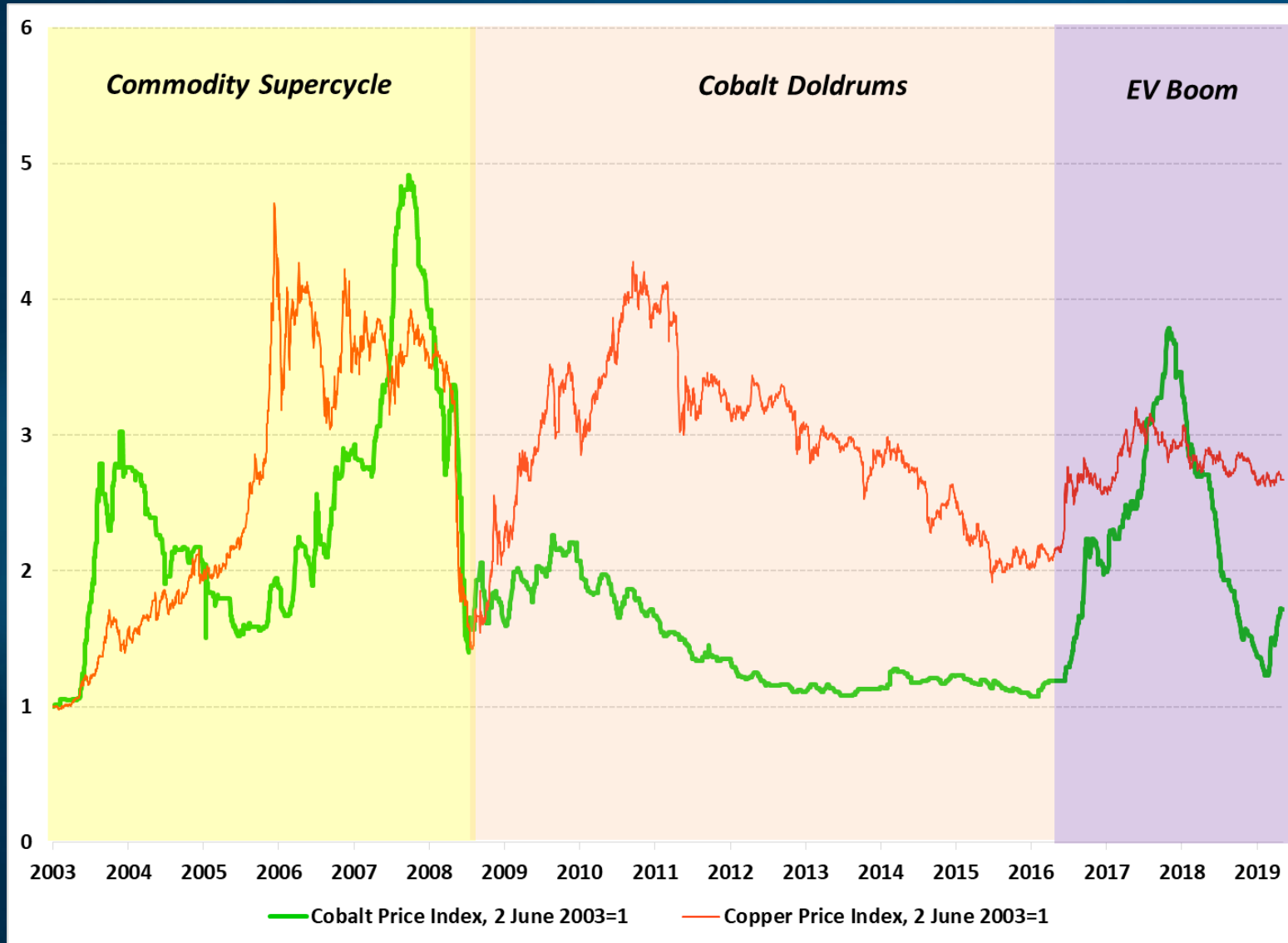


- ❖ Most of the world's sulfur is produced as a by-product of oil & gas activities (i.e. removal of entrained sulfur to make petroleum fuels more environmentally friendly).
- ❖ Sulfur is also in high demand as an independent commodity for end uses that transcend the oil & gas from which it is originally sourced. In particular, sulfur is the raw material for production of sulfuric acid, the world's most widely used industrial chemical.
- ❖ The sulfur prices shown here also illustrate a concept that is becoming increasingly critical in the oilfield water space: access to cost-competitive transportation options.

**The By-Product Becomes Valuable as
Standalone Commodity**

Economics of By-Product Commodities: Copper & Cobalt

China Shanghai Changjiang Cobalt and Copper Spot Prices, Indexed



- ▶ 90% of the global commodity supply is a by-product of copper or nickel production. Approximately 55% of cobalt produced globally comes from primary copper production, with 35% from primary nickel production. (“Lithium and cobalt—a tale of two commodities,” McKinsey & Company, Metals and Mining June 2018)
- ▶ Unlike produced water, whose main demand source is driven by oil & gas activity, there are important demand outlets for cobalt that in many cases have relatively little to do with copper.

At What Price Would Treated Produced Water Become Practically Useful to Farmers?

For Biofuel Crops

Probably \$0.10/bbl or less, assuming a 75% freshwater/25% treated PW irrigation blend

Alamo switchgrass grows well in TX climates and can be a feedstock for cellulosic ethanol production.



Source: USDA

For the Highest Value “Non-Food” Crops

Approximately \$0.40/bbl, assuming a 75% freshwater/25% treated PW irrigation blend

Opium cultivation assuming that farmer sells morphine base instead of raw opium, such as that being harvested below by a farmer in southern Afghanistan.

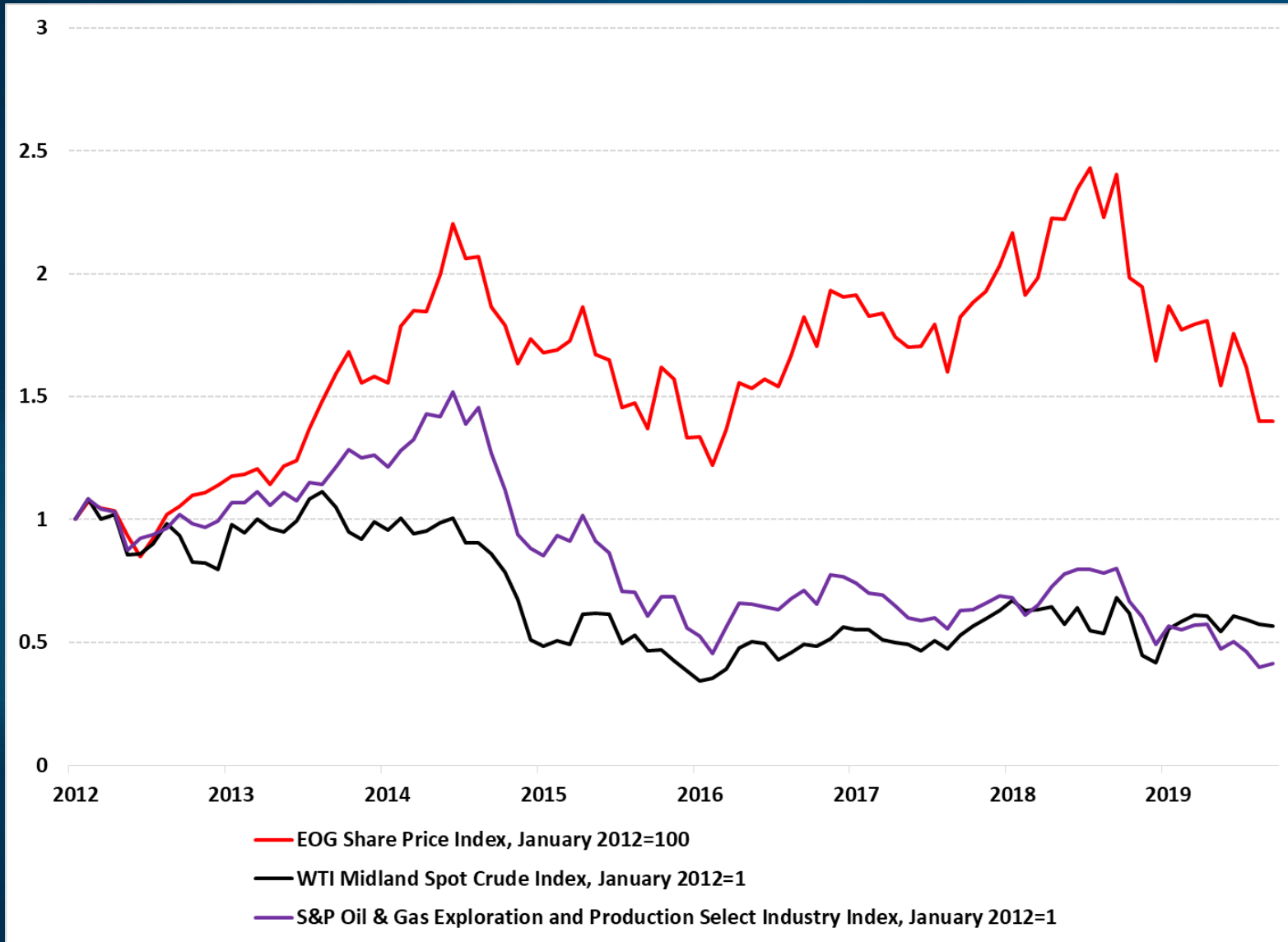


Source: NPR

Disclaimer: The opium example is for illustrative purposes only.

What Investors Likely Want to See

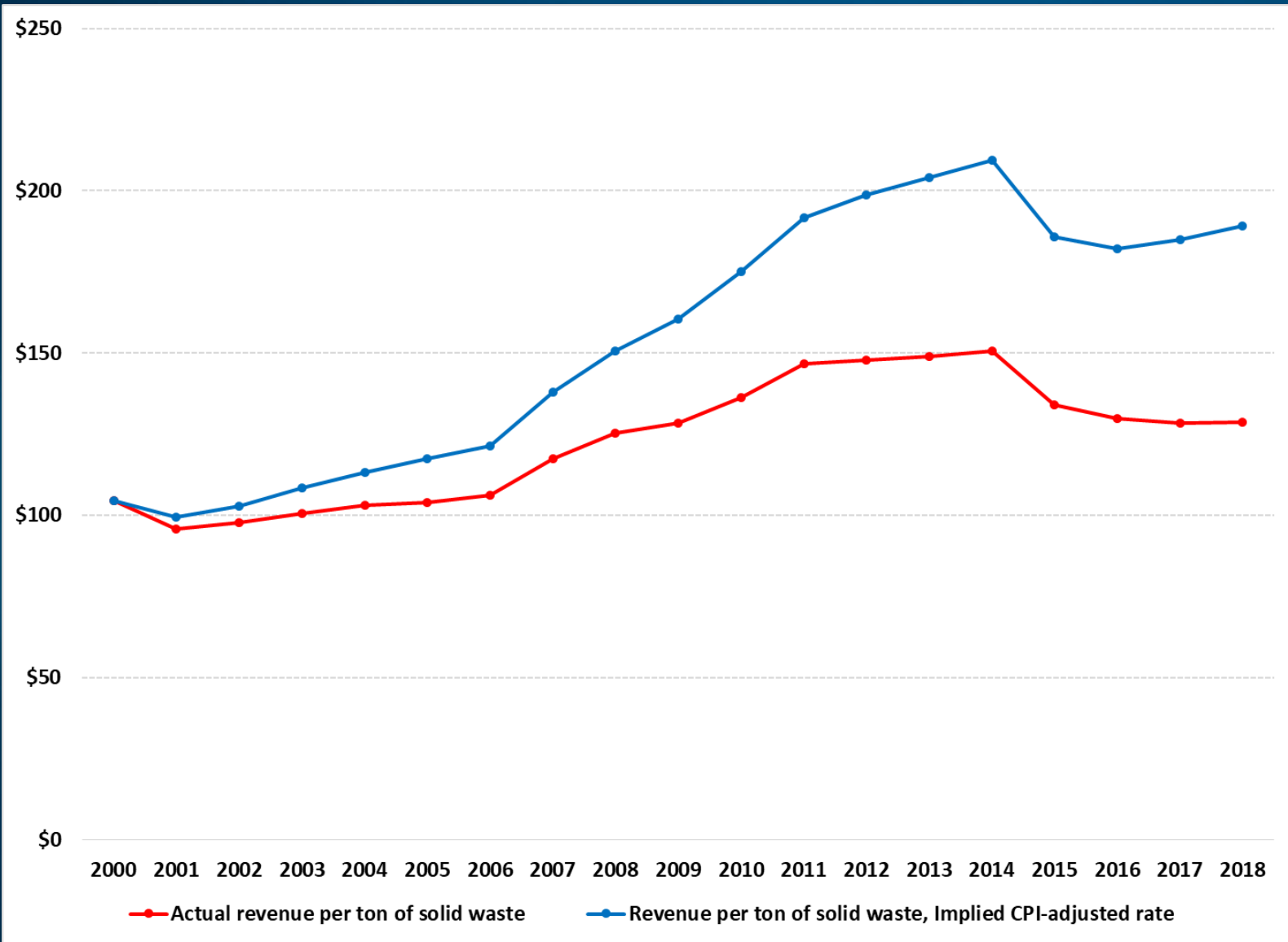
Getting Uplift Beyond the Raw Underlying Commodity Price



Source: Bloomberg, Author's Analysis

Economics of Municipal Refuse Hauling: Network and Scale Effects

Revenue per ton of landfilled solid waste, USD



- ▶ Actual revenue change over 18 years was +23%.
- ▶ If rates had been recalculated each January based on the reported Consumer Price Index (CPI) level, there would have been an 81% revenue increase.
- ▶ While preliminary, this suggests that broader and more deeply integrated oilfield water management systems may be able to simultaneously deliver acceptable investor returns while also helping their E&P customers to manage costs below the underlying economy-wide rate of inflation.

Greater Oilfield Water Infrastructure Connectivity: The Case for a 'Hydrovascular' Network In the Permian Basin



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Please cite as:

Gabriel Collins, "Greater Oilfield Water Infrastructure Connectivity: The Case for a 'Hydrovascular' Network In the Permian Basin," **Produced Water Society Conference, 7 August 2019, Midland, TX.**

Thank you!

Cutting-Edge Texas Groundwater and Oilfield Water Research

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