Introduction
Overview

Appalachia Upstream 2020 - Year in Review

- Commodity Pricing
  - Select regional basis locations
  - Product pricing

- Drilling Rig Activity
  - Review of weekly rig activity
  - Locations spud
  - Vertical well activity

- Production Volumes
  - Unconventional production
  - Split by formation, state, and operator

- Mergers & Acquisitions
  - Over $2 Billion in regional transactions
  - Review of material acquisitions

- Upstream Employment
  - Trends of upstream hiring and layoffs
  - Employment production “efficiency”
  - ESG
Commodity Pricing

Select Northeast Natural Gas Basis Pricing Locations

- **Basis Pricing**
  - Contract Price = Natural Gas Price + Basis
  - Reflection of supply and demand dynamics within a pipeline network

- Several locations throughout Appalachia
  - 5 shown on map used for examples

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Source - EIA, Bertison-George, Mudrock Energy
Commodity Pricing
Natural Gas Monthly Overview

- Henry Hub ↑ $1 from 2020 low
- Regional Basis Decrease Erases Henry Hub Price Increase

Source - EIA, Bertison-George, Gathercog.com, Mudrock Energy
Commodity Pricing
Basis Example

- **Dominion South**
  - Basis remained negative in 2020
  - January - August
    - Range -$0.33 to -$0.42
  - September - December
    - Range -$1.10 to -$1.45

- **Average 2020 Price relatively consistent with a price of $1.33**
  - Expanded basis differential wiped out year-end Henry Hub price increases

Source - EIA, Bertison-George, Mudrock Energy
Commodity Pricing
Liquids Monthly Overview

COVID & Shale Bust

Oil Price Recovered to ~75% of start of 2020

Source - EIA
Note - NGPL based on EIA monthly data; WTI based on EIA weekly data
Commodity Pricing

Summary

- Commodity price recovery observed toward end of 2020

- Regional natural gas prices remained depressed
  ▪ Basis blowout vs Henry Hub

- Oil returned to ~75% of pre-COVID shut-downs by year-end

Price Summary

- $2.04/mcf average
  ▪ $1.63 - $2.61 (Henry Hub)

- $39.39/bbl average
  ▪ $3.32 - $61.74 (WTI)

- $4.38/bbl average
  ▪ $2.85 - $5.24 (NGPL)

Source - EIA
Note - Henry Hub & NGPL based on EIA monthly data; WTI based on EIA weekly data
Drilling Activity
Appalachia - All Rigs
Weekly Activity 2020 vs 2019

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Source - Baker Hughes, Mudrock Energy
Note - Values rounded to the closest integer. (YOY value calculated from basin total, not from rounded integers)
Appalachia - All Rigs
Weekly Activity 2020 vs 2019

2019

Source - Baker Hughes, Mudrock Energy
Rig Weeks
- Sum of weekly rigs per county
- Example: 2 rigs active in county for 8 weeks = 16 rig weeks

Highlights areas with the most drilling activity
- Majority of rigs focused in Northeast PA & Southwest Tri-state Region
Horizontal Wells

2020 Locations Spud

- **Marcellus Top 5 Counties**
  - Susquehanna, PA - (17%)
  - Bradford, PA ------ (15%)
  - Washington, PA --- (11%)
  - Tyler, WV ---------- (11%)
  - Greene, PA -------- (11%)

- **Utica Top 5 Counties**
  - Jefferson, OH ----- (23%)
  - Belmont, OH ------ (22%)
  - Harrison, OH ------ (16%)
  - Monroe, OH -------- (10%)
  - Cameron, PA ------ (10%)

Source - IHS Markit, Mudrock Energy
Horizontal Wells
Spud per Formation - 2020

- Marcellus Wells Spud
  - 76% in Pennsylvania
  - 24% in West Virginia

- Utica Wells Spud
  - 79% in Ohio
  - 14% in Pennsylvania
  - 7% in West Virginia

Source - IHS Markit, Mudrock Energy
Horizontal Wells
Spud per Operator - 2020

- Top Hz Drillers Appalachia
  - SWN ------ (13%)
  - CHK ------ (12%)
  - EQT ------ (10%)
  - Cabot ---- (9%)
  - Antero --- (8%)

- Top Hz Drillers per State
  - Ohio
    - Encino (38%), Ascent (34%), Gulfport (10%), Montage (10%)
  - Pennsylvania
    - CHK (19%), Cabot (14%), EQT (14%)
  - West Virginia
    - Antero (38%), SWN (30%), Tug Hill (11%)

- Record Length Marcellus Well
  - Olympus Energy Midas 6M - 20,060 ft completed lateral

Source - IHS Markit, Mudrock Energy, Olympus Energy
Vertical Wells
2020 Locations Spud

- PA Top Counties
  - Warren, PA ------ (44%)
  - McKean, PA ----- (31%)
  - Forest, PA ------- (21%)

- Ohio Top Counties
  - Cuyahoga, OH -- (25%)
  - Summit, OH ----- (17%)
  - Auglaize, OH ---- (17%)
Vertical Wells
Spud per Formation - 2020

- **Pennsylvania Wells Spud**
  - Focused on Upper Devonian sandstone formations
  - Oriskany well listed as a development well
    - Likely associated with a storage field

- **Ohio Wells Spud**
  - Scattered throughout the state targeting various reservoirs

**Source** - IHS Markit, Mudrock Energy
Vertical Wells
Spud per Operator - 2020

- Top Vt Drillers Appalachia
  - Cameron - (27%)
  - MSL ------ (14%)
  - Mead ------ (6%)
  - Pennhills - (6%)
  - Curtis ------ (5%)

- Top Vt Drillers per State
  - Ohio
    - EOS (25%), Discovery (17%), Myers (17%)
  - Pennsylvania
    - Cameron (33%), MSL (17%), Mead (8%), Pennhills (8%)
  - West Virginia
    - No Vertical Wells Spud

Source - IHS Markit, Mudrock Energy
Drilling Activity

Summary

- Drilling focused in Northeast PA & Southwest Tri-state Region
- Most active operators are Southwestern, Chesapeake, and EQT
- Vertical drilling focused on shallow oil
  - Most activity within Allegheny National Forest

Spud Year-over-year

- Marcellus ↓35%
- Utica ↓42%
- Vertical Wells ↓73%

Source - Baker Hughes, IHS Markit, Mudrock Energy
Marcellus Gas Production

2020 Exit Rate (Mmcf/d)

- Highest Volumes Produced in Northeast PA & Southwest Tri-state Region
- Marcellus Top 5 Gas Producing Counties
  - Susquehanna, PA
  - Washington, PA
  - Greene, PA
  - Bradford, PA
  - Tyler, WV

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020
Utica Gas Production
2020 Exit Rate (Mmcf/d)

- Highest Volumes Produced in Eastern OH
- Utica Top 5 Gas Producing Counties
  - Belmont, OH
  - Monroe, OH
  - Jefferson, OH
  - Harrison, OH
  - Marshall, WV

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020
All Unconventional Gas Production

2020 Exit Rate (Mmcf/d)

- Appalachia All Unconventional
  - 34.0 bcf/d (↑4%)
- Ohio -------------- 6.4 (↓13%)
- Pennsylvania ---- 20.7 (↑7%)
- West Virginia ---- 6.9 (↑15%)

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020
All Unconventional Gas Production
Exit Rate Change 2020 vs 2019 (Mmcf/d)

- Appalachia All Unconventional
  (Values 2020 vs 2019)
  • +1.2 bcf/d (↑4%)

- Ohio
  • -1.0 bcf/d (↓13%)
    • Guernsey Co., -0.0 bcf/d
    • Jefferson Co., -0.4 bcf/d

- Pennsylvania
  • +1.3 bcf/d (↑7%)
    • Bradford Co., +0.5 bcf/d
    • Susquehanna Co., -0.2 bcf/d

- West Virginia
  • +0.9 bcf/d (↑15%)
    • Tyler Co., +0.7 bcf/d
    • Ritchie Co., -0.2 bcf/d

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020
Marcellus Oil Production
2020 Exit Rate (Mbbl/d)

- Highest Volumes Produced in Northwest WV & Southwest PA
- Marcellus Top 5 Oil Producing Counties
  - Marshall, WV
  - Ohio, WV
  - Tyler, WV
  - Washington, PA
  - Brooke, WV

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate)
Utica Oil Production

2020 Exit Rate (Mbbl/d)

- Highest Volumes Produced in Eastern OH

- Utica Top 5 Oil Producing Counties
  - Guernsey, OH
  - Harrison, OH
  - Carroll, OH
  - Belmont, OH
  - Noble, OH

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate)
All Unconventional Oil Production
2020 Exit Rate (Mbbl/d)

- Appalachia All Unconventional
  - 118 mbbl/d (↓ 16%)
- Ohio ------------ 50.3 (↓ 32%)
- Pennsylvania --- 14.2 (↓ 1%)
- West Virginia --- 53.3 (↑ 3%)

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate)
All Unconventional Oil Production
Exit Rate Change 2020 vs 2019 (Mbbl/d)

- Appalachia All Unconventional (Values 2020 vs 2019)
  - -22.6 mbbl/d (↓ 16%)
- Ohio
  - -23.8 mbbl/d (↓ 32%)
    - Noble Co., -0.2 mbbl/d
    - Guernsey Co., -11.8 mbbl/d
- Pennsylvania
  - -0.1 mbbl/d (↓ 1%)
    - Butler Co., +0.4 mbbl/d
    - Washington Co., -0.7 mbbl/d
- West Virginia
  - +1.3 mbbl/d (↑ 3%)
    - Tyler Co., +7.2 mbbl/d
    - Brooke Co., -5.1 mbbl/d

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate)
All Unconventional Water Production

2020 Exit Rate (Mbbl/d)

- Water Production
  - Higher volumes of water production typically indicate areas of recent activity

- Top 5 Counties
  - Washington, PA
  - Tyler, WV
  - Greene, PA
  - Belmont, OH
  - Monroe, OH

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020
All Unconventional Gas Production
Operator Exit Rate 2020 (Bcf/d)

- Top Producers Appalachia
  ▪ EQT ----------- 5.3 (↑ 8%)
  ▪ Antero --------- 3.3 (↑ 14%)
  ▪ Chesapeake --- 3.1 (↑ 23%)
  ▪ Cabot --------- 2.8 (↓ 5%)
  ▪ SWN ----------- 2.7 (↑ 17%)

- Top Producers per State
  ▪ Ohio
    ▪ Ascent, Gulfport, Encino
  ▪ Pennsylvania
    ▪ EQT, Chesapeake, Cabot
  ▪ West Virginia
    ▪ Antero, SWN, Tug Hill

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
Marcellus continues to drive gas volumes from the basin
- 77% of 2020 exit rate
- 10% YOY growth

Utica growth slowed in 2020
- 22% of 2020 exit rate
- -12% YOY growth

Other formations account for 1% of 2020 exit rate

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
All Unconventional Oil Production
Operator Exit Rate 2020 (Mbbl/d)

- Top Producers Appalachia
  - SWN -------------- 21.2 (↓ 12%)
  - Ascent ----------- 18.7 (↓ 38%)
  - Encino ----------- 17.6 (↓ 15%)
  - Antero ----------- 16.4 (↑ 41%)
  - EQT -------------- 9.5 (-)

- Top Producers per State
  - Ohio
    - Ascent, Encino, Montage
  - Pennsylvania
    - Range, EQT, PennEnergy
  - West Virginia
    - SWN, Antero, Tug Hill

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate) (Pct 2020 vs 2019)
All Unconventional Oil Production

Exit Rate 2020 (Mbbl/d) per Formation

- Marcellus surpassed the Utica to lead in oil volumes from the basin
  - 58% of 2020 exit rate
  - -1% YOY growth
- Utica growth slowed in 2020
  - 41% of 2020 exit rate
  - -31% YOY growth
- Other formations account for 1% of 2020 exit rate

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate) (Pct 2020 vs 2019)
Production

Summary

- Gas production continues to grow within the basin
  - Growth led by the Marcellus Shale
  - Utica Shale volumes shrank

- Oil production volumes dropped in 2020
  - Largest drop was in Ohio and the Utica Shale
  - West Virginia Marcellus volumes increased

- Top drillers correspond with the top producers for 2020

Exit Volume Rates

- 34.0 bcf/d (↑4%)
- 118 mbbl/d (↓16%)

Leading Operators

- EQT 5.3 bcf/d (↑8%)
- SWN 21.2 mbbl/d (↓12%)

Source - PA DEP, ODNR, WV DEP, IHS Markit, Mudrock Energy
2020 Exit Rate based on reports - OH 4Q 2020, PA 12/2020, WV 12/2020 (Oil Production includes reported Oil and Condensate) (Pct 2020 vs 2019)
Mergers & Acquisitions
Mergers & Acquisitions

EQT & Chevron - Announced Oct. 2020

- $735 MM
  - $1,410/flowing mcfe
  - 6.5x midstream multiple (LTM EDITDA)

- 450 mmcfe/d
  - 75% gas / 25% liquids
  - 55% PA / 45% WV (Marshall Co.)

- ~550 Gross Wells
  - 505 Marcellus / 35 Utica / 10 Upper Devonian
  - 480 PA / 70 WV
  - ~100 Wells in progress

- ~335,000 net Marcellus acres
  - 125,000 net EQT core (70,000 undeveloped)

- Midstream Assets
  - 31% ownership in Laurel Mountain Midstream
  - 2 water systems (1 PA / 1 WV)

Source - EQT
Mergers & Acquisitions
Seneca & Shell - Announced May 2020

- $504 MM
  - ~$1,250/flowing mcf
    - Based on 6.5x multiple on midstream estimated NTM

- ~220 mmcfe/d
  - Dry gas
  - Northern Pennsylvania

- ~350 Gross Wells
  - Marcellus & Utica

- ~400,000 net acres
  - 200,000 net Tioga Co. contiguous to Seneca

- Midstream Gathering Assets
  - 142 miles of gathering pipelines, compression, & facilities
  - 300 Mdth/d capacity

Source - National Fuel Gas, Mudrock Energy
Mergers & Acquisitions

Northern (NOG) & Reliance - Announced Feb. 2021

- $126.4 MM (Adjusted due to exercised preferential rights)
  - <$1,500/flowing mcfe
  - Non-operated assets
- ~80 mmcfe/d net (2021E)
  - Dry Gas
- ~100 Net Wells
  - ~22 Net wells in progress
  - ~230 Net undeveloped locations
- ~62,000 net acres
- EQT is the operator of the asset following the closing of the Chevron acquisition

Source - Northern Oil & Gas
Mergers & Acquisitions
Diversified & EQT + Carbon Energy - Announced May 2020

- $235 MM
  - ~$1,500/flowing mcfe
    - Based on 6.5x multiple on 3rd-party revenue

- 108 mmcfe/d (6:1 conversion)
  - 99% gas

- ~7,000 Net Wells
  - ~6,900 Conventionals / 80 Unconventional
  - 13 Unconventional DUCs

- ~1,400,000 net acres

- Midstream Assets
  - ~4,900 miles of pipeline
  - Large commercial/industrial customers
  - Two gas storage fields in WV (~3.5 bcf capacity)

Source - Diversified Gas & Oil, Mudrock Energy
Mergers & Acquisitions
Sixth Street Partners & Antero - Announced June 2020

- $402 MM
  - $300MM at closing
  - $102MM contingent on volume thresholds
    - 1st 50% contingent payment has been received

- 1.25% Overriding royalty interest
  - All existing producing wells

- 3.75% Overriding royalty interest
  - In Wells completed over the next three years

- Reversionary interest
  - Following a 13% IRR and 1.5x cash-on-cash return
  - Antero will receive an 85% reversionary interest in the ORRI and Sixth Street will keep 15%

- Operations
  - ~1,200 producing wells

Source - Antero Resources
Mergers & Acquisitions

Bankruptcy Notes

- Keybank Acquires EdgeMarc - Announced Mar. 2020
  - BK OREO (affiliate of KeyBank, the secured lender under EdgeMarc's DIP credit facility) entered into a settlement agreement to acquire EdgeMarc's Butler Co., PA assets
    - $90MM
    - 48 Wells/22,000 net acres
    - ~62 mmcfe/d (12/2020)
      - (~85 mmcfe/d - LOLA press release)
    - 18 DUCs

- Chesapeake: filed Chapter 11 June 2020
  - $11.8B total debt (not including intercompany loans)
  - Emerged and relisted on Nasdaq February 2021

- Gulfport Energy: filed Chapter 11 Nov. 2020
  - $2.3B total debt

Mar. 2021 - Sold LOLA Energy
  - Undisclosed terms
Mergers & Acquisitions

Summary

- Over $2 Billion in transactions
- EQT remains the dominant driver in Appalachia
  - 3 major deals involved EQT
- Other large regional operators quiet in 2020 including:
  - Cabot
  - Range Resources
  - CNX
  - SWN

Apparent Valuations

- $1,250-1,500/flowing mcfe
- 6.5x midstream multiple
- Acreage = little to no value ascribed at purchase
Upstream Employment
Upstream Employment
40 Year E&P Employment Data (1980 - 2020)

40-year High
Shale Peak
40-year Low

Source - BLS
2010's Hiring Boom

30 Year E&P and OFS Employment Data (1990 - 2020)

- Upstream Shale Peak
- OFS Much Higher Employment with Shale Development

Source - BLS
Commodity Price Response

30 Year E&P and OFS Employment Data (1990 - 2020)

- Source - BLS, EIA

- OPEC Supply Cuts
- 2014 Price Collapse
- Great Recession
- Shale Bust & COVID

- 230k
- 135k
- 85k
YOY % Change

30 Year E&P and OFS Employment Data (1990 - 2020)

- Reductions are quick
- Recovery lower

Source - BLS, EIA
Employment Production “Efficiency”
30 Year E&P and OFS Employment Data (1990 - 2020)

- Pre-shale era ~1,500
- Shale Employment Peak
- Early shale ~1,000
- Back to pre-shale

Source - BLS, EIA
Employment Production “Efficiency”
Similar Trends Observed With All Products

Gas Ratio Comparison

Oil Production Only

Gas Production Only

Source - BLS, EIA
Employment Production “Efficiency”
Era comparison: Pre-shale vs Shale

- **Pre-shale**
  - US O&G Industry in decline
  - Low employment & production

- **Early-shale**
  - Massive expansion of frac and drilling fleets + associated services (OFS Boom)
  - High employment with growing production volumes

- **Peak?-shale**
  - Operations efficiencies + years of layoffs across upstream sector
  - Focus on core assets
  - Less efficient equipment retired

**Source - BLS, EIA**
Employment Production “Efficiency”

Era comparison: Pre-shale vs Shale

- **Future-shale**
  - Will recent improvements be maintained with lower employment levels?
  - Can technological advances drive efficiency higher?

- **Drilling**
  - New MWD tools and bits continue to improve drilling rates
  - Can more automation like SLB’s “Rig of the Future” drive more hands off the pad site?

- **Completions**
  - Will technology drive down NPT and increase efficiency
  - Companies like EKU are developing new systems to address operations

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**Annual Average Values**

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- Source - BLS, EIA
Environmental, Social, and Governance
Investment Drying Up for Traditional O&G Companies

- Responsibly Sourced Gas (RSG)
  - Many regional operators looking to become certified
  - 10 certified gas transactions completed in the US
  - Examples include:
    - New Jersey Natural Gas with Southwestern Energy
    - Virginia Natural Gas aims to hit 100% RSG
    - Chesapeake has partnered with Project Canary for a multi-basin RSG
    - EQT has partnered with Project Canary and introduced plans to obtain Equitable Origin and MiQ certification in SWPA

- Rice SPAC - $1.2B Renewable Gas Deal
  - Combines Aria Energy and Archaea Energy
  - Currently around a dozen landfill projects with 20 in planning
  - Low production volumes, but contracted for -$15/mcf
  - Evaluating the manufacturing of “green hydrogen” on site and sequestering CO2 below the landfills

- Carbon Capture and Storage Projects
  - Oxy announced it is moving forward with the first commercial direct air CO2 capture project
    - CO2 will be captured from the air and sequestered within the Permian Basin oil fields
  - Exxon is proposing a $100B or more CCS project along the Houston Ship Channel

“As you take a look at what’s going on in the U.S. today, ESG is coming to the front of almost everything that every corporation is doing,”
- Merrill Miller Jr. (Chairman JV Baker Hughes/Akastor ASA)
Pricing
- Commodity prices recovery toward end of 2020
- Basis blowout vs Henry Hub kept regional prices depressed
- Oil returned to 75% of pre-COVID shut-downs

Drilling
- Weekly average ↓ 39 rigs/wk vs 2019
- Spuds YOY - Marcellus ↓35%, Utica ↓42%, Vertical Wells ↓73%

Production
- Gas volume rates ↑4%
- Oil volume rates ↓16%
- Appalachia production continues to be driven by the Marcellus Shale
- 4 of the top 5 gas operators increased production

Acquisitions
- Over $2 Billion in transactions
- $1,250-1,500/flowing mcfe
- EQT remained active throughout the year
- Other large regional operators quiet in 2020

Employment
- Latest downturn has seen the loss of ~135,000 upstream employees
- Recovery will be slower and likely below past levels
- ESG initiatives are imperative to companies looking to grow with investment
  - Individual investors and Private Equity are pushing change across the energy landscape
Current Updates

- **Pricing**
  - Polar Vortex across the country in February created a demand and price spike
  - Henry Hub prices and regional basis points have since retreated back to recent trends
  - Oil prices continued to rise with Saudi Arabia voluntary production cuts and COVID vaccine rollout

- **Drilling activity**
  - Slow addition of rigs in 2021
  - Up 7 rigs from end of year

- **Production**
  - Likely to continue to grow at a moderate pace throughout the basin

- **Employment**
  - Reductions in force have continued in 2021, including Repsol locally
Thank you

Contact Information

- MLBC
- Anthony Romeo
- Abby Veigel
- Chuck Saffer

MudrockEnergy.com

- Presentation & updates
- Weekly rig update
- Monthly newsletter
- Other maps & reports

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