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JOBSOHIO

Shale Investment Dashboard in Ohio Q1 and Q2 2024

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Executive Summary

This report presents findings from an investigation into shale-related investment in Ohio. The investment estimates are cumulative from January through June of 2024. Prior investments have been included in previous reports that are available from Cleveland State University. [1] Subsequent reports will estimate additional investment since the date of this report. Investment in Ohio into the Utica during the first half of 2024 can be summarized as follows:

Total Estimated Upstream Utica Investment: January – June 2024

Lease Renewals and New Leases	$52,478,000
Drilling	$1,635,920,000
Roads	$24,338,600
Lease Operating Expenses	$173,177,122
Royalties	$735,980,000
Total Estimated Upstream Investment	**$2,621,893,722**

Total Estimated Midstream Investment: January – June 2024

Gathering Lines	$106,020,000
Compression and Dehydration	$129,733,000
Total Estimated Midstream Investment	**$235,753,000**

Total Estimated Downstream Investment: January – June 2024

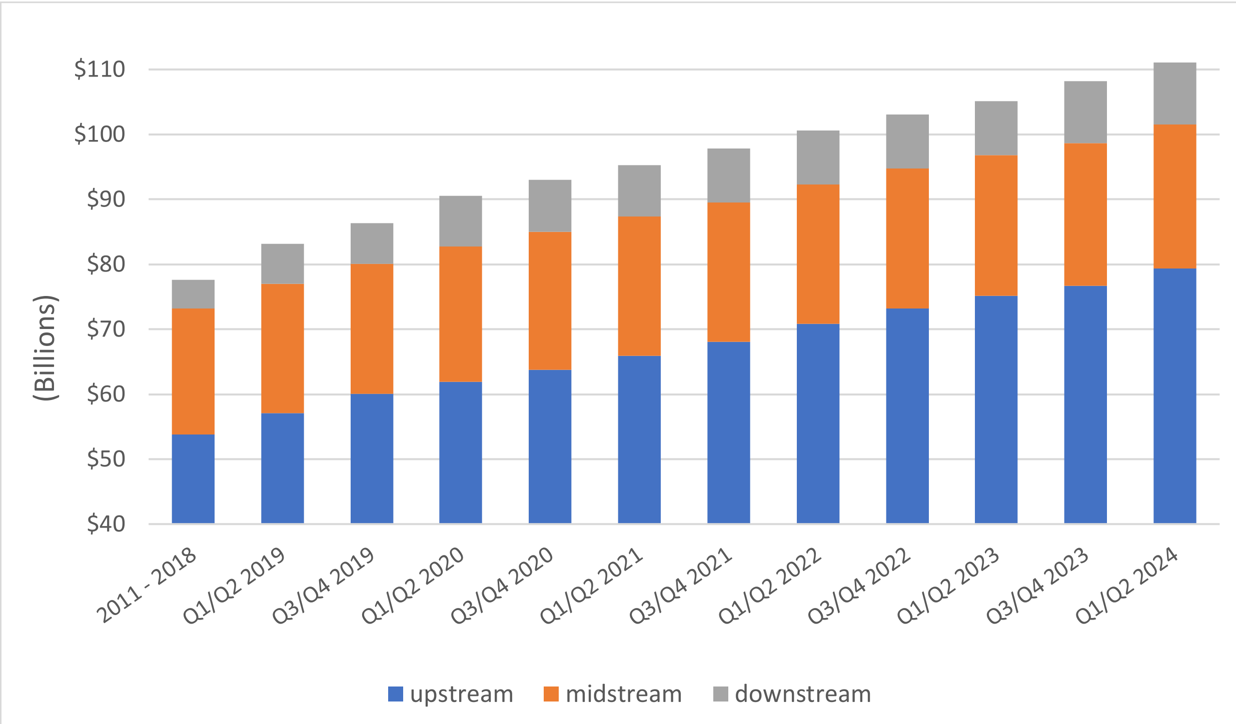
Combined Heat and Power Plants	$5,789,910
Total Estimated Downstream Investment	**$5,789,910**

Total investment from January through June 2024 was approximately $2.9 billion, including upstream, midstream, and downstream. Indirect downstream investment, such as development of new manufacturing as a result of lower energy costs, was not investigated as part of this Study. Together with previous investment to date, cumulative shale-related oil and gas investment in Ohio through June of 2024 is estimated to be around $111.1 billion. Of this, $79.3 billion has been in upstream, $22.2 billion in midstream, and $9.5 billion in downstream industries.[2] Figure 1 shows the growth in cumulative shale-related investment for Ohio since the release of the first Shale Dashboard.

[1] The sixteen previous reports on shale investment in Ohio up to December 2024 can be found at https://levin.csuohio.edu/epc

[2] Numbers may not add up precisely due to rounding.

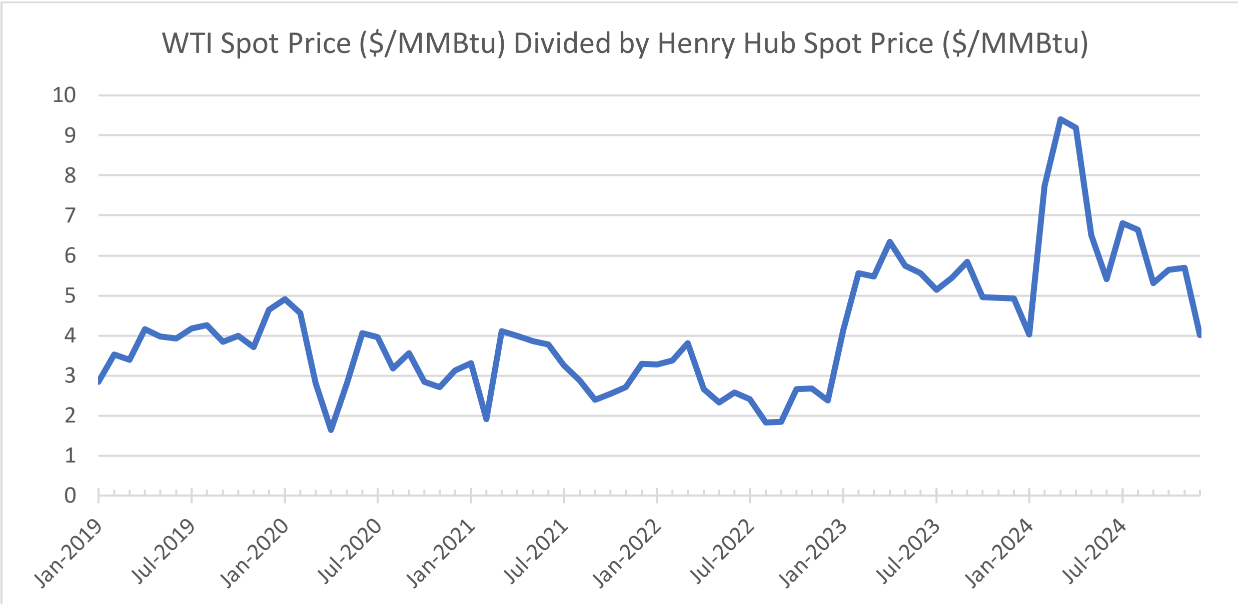
Figure 1: Cumulative Shale Investment in Ohio Over Time



Overall upstream investments were up by nearly $1.1 billion in the first half of 2024 compared to the second half of 2023, reflecting a sharp increase in drilling activity. Also, royalties rose slightly in the first half of the Study period (+3.8%) even though overall gas-equivalent production was down narrowly (-1.6%) compared to the previous 6-month period. This was due to oil's increasing share of production in the Utica.

Oil has been trading at a price that is 4 to 9 times higher than the price of natural gas over the last few years, on an MMBtu basis. (*See* Figure 2). Utica-wide royalties therefore increase as oil comes to represent a larger share of gas-equivalent production, even if the overall amount of production remains constant or even declines somewhat. That said, oil still comprised a relatively small share of shale production in the state. During the first half of 2024, it represented 7.5% of gas-equivalent Utica production. However, depending on the county, oil can constitute a much larger share of production. Table 1 shows total production for the nine highest shale-producing counties, along with oil's share of gas-equivalent production for each one.

Figure 2: Price Ratio of Crude Oil to Natural Gas ($/MMBtu Basis)



Data Source: EIA (2025). Assumes 5.8 MMBtu per barrel of crude oil.

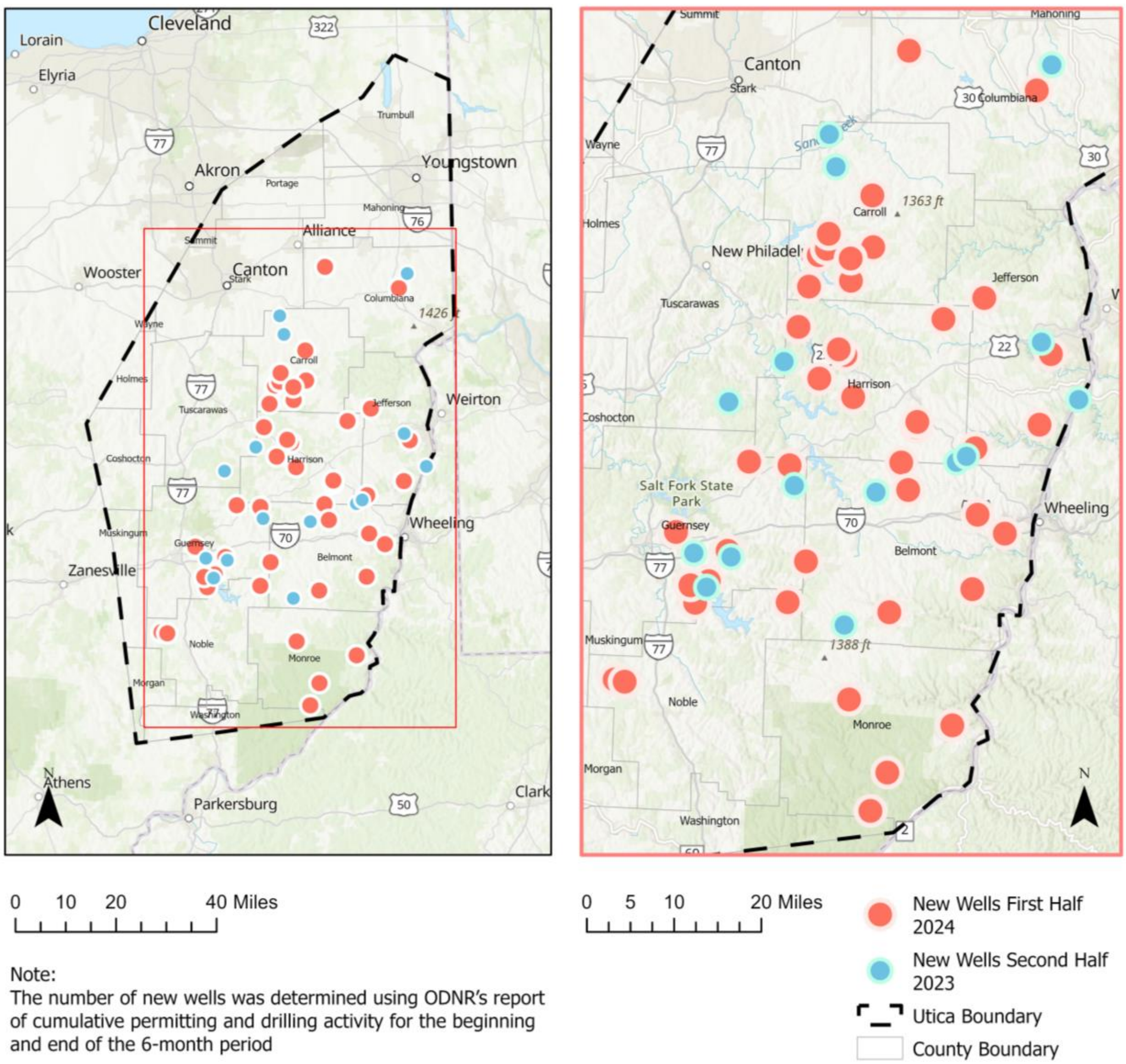
Table 1: Oil's Share of Total Production by County for January – June 2024

County	Total Oil & Gas Production (Bcfe)	Oil's Share of Gas-Equivalent Production
BELMONT	304.2	0.4%
JEFFERSON	237.6	0.0%
HARRISON	200.5	10.8%
MONROE	158.6	0.4%
CARROLL	79.6	27.0%
GUERNSEY	63.6	42.5%
COLUMBIANA	50.6	9.1%
NOBLE	40.4	9.2%
TUSCARAWAS	10.2	57.8%

Data Source: ODNR (2025).

Figure 3 shows the geographic distribution of the new wells drilled in the first half of 2024 compared to the second half of 2023, with nearly three times as many new wells developed between January and June of 2024 compared to the previous 6-month period. More than half of these new wells in the first half of 2024 fall within the Utica's Shale's oil window, which extends diagonally through western Carroll and Harrison Counties and into the eastern portions of Guernsey County. Indeed, among the more than 100 new wells drilled between January and June of 2024—many of which are concentrated along this corridor—15 produced more than 100,000 barrels of oil over the full year, placing them in the top 3% of Utica wells for 2024 oil production.

Figure 3: New Wells in the First Half of 2024 and the Second Half of 2023



Note:
The number of new wells was determined using ODNR's report of cumulative permitting and drilling activity for the beginning and end of the 6-month period

Data from the Ohio Department of Natural Resources Division of Oil and Gas (ODNR) show that 143 new wells were drilled during the first and second quarters of 2024. ODNR production data also indicate that total gas-equivalent shale production in the first half of 2024 was 1.5% lower than the second half of 2023. This decline was driven by a 2.1% decrease in natural gas output. In contrast, oil production rose by 6.5% over the same period.

For the first half of 2024, Carroll County had the highest number of new wells with 29, followed by Harrison County with 28, Guernsey County with 22, Monroe County with 18, Belmont County with 16, and Jefferson County with 14. Noble County had 9 new wells while Columbiana County had 7. No other new wells were drilled during the first six months of 2024.

Ascent and EAP Ohio were the top producers for Q1 and Q2 of 2024, having produced 471 and 211 billion cubic feet equivalent (Bcfe), respectively. Gulfport was third in production at 191 Bcfe. SWN Production (Southwestern) and Antero produced 85 Bcfe and 46 Bcfe, respectively. Rice Drilling had the sixth highest production during the Study period at 43 Bcfe. These six companies represented 91% of total production in Ohio for the first half of 2024. Altogether, 1.1 trillion cubic feet of natural gas and 15.2 million barrels of oil were produced in the first six months of 2024.

The first half of 2024 saw midstream investment of $235.8 million, a modest decline from the $290 million reported for the second half of 2023, but notably higher than the $172 million identified for the first half of 2023. Midstream investment during the Study period went toward gathering system buildout and transportation, with $106.0 million spent on gathering lines and $129.7 million spent on compression and dehydration.

There was little new Ohio downstream investment that resulted directly from shale in the first half of 2024. One 2.4-megawatt combined heat and power (CHP) plant was installed, representing an estimated investment of $5.8 million. Additional natural gas-based generation will forthcoming: more than 1 gigawatt of natural gas generation—representing over $1 billion of investment—has recently come before the Ohio Power Siting Board for approval, largely to serve data centers. The growing electricity demand from AI-driven data centers will likely accelerate additional investments for natural gas-based power generation.[3]

[3] This Study reports on shale-related development activity incurred during the first half of calendar year 2024. However, recent (as of June 2025) events not discussed herein are likely to impact future shale development in Ohio. For example, in May of 2025 EOG Resources acquired Encino Acquisition Partners and its 675,000 net acres in Ohio for $5.6 billion. See Reuters. (2025, May 30). *Shale Producer EOG Boosts Utica Footprint with $5.6 Billion Encino Deal*. https://www.reuters.com/business/energy/eog-resources-buy-encino-acquisition-partners-56-billion-2025-05-30/. See also: World Oil. (2024, October 6). *Chesapeake, Southwestern Complete $7.4 Billion Merger, Rebrand as Expand Energy*. https://worldoil.com/news/2024/10/6/chesapeake-southwestern-complete-7-4-billion-merger-rebrand-as-expand-energy/; *Summit Midstream Exits Utica Shale in $625 Million Deal with MPLX*. https://www.reuters.com/markets/deals/summit-midstream-partners-sell-utica-assets-mplx-625-mln-2024-03-22/; and *EQT Closes on Acquisition of Equitrans Midstream Corp*. https://www.bizjournals.com/pittsburgh/news/2024/07/22/eqt-equitrans-midstream-together.html. These and other important transactions will be examined in future Shale Development reports.

1. INTRODUCTION

This is the seventeenth CSU study reporting investment resulting from oil and gas development in Ohio related to the Utica and Point Pleasant formations (hereinafter, the "Utica").[4] This analysis looks at investments made in Ohio between July 1 and December 31, 2024, separately considering the upstream, midstream, and downstream portions of the industry. For the upstream part, the Study Team estimated spending primarily based upon the likely costs of drilling new and operating existing wells, together with royalties and lease bonuses.

For midstream estimates, the Study Team looked at new infrastructure built during the relevant time period downstream of production, from gathering to the point of hydrocarbon distribution. This included pipelines, processing, natural gas liquid storage, and intermodal transloading facilities.

For the downstream analysis, the Study Team considered those industries that directly consume large amounts of oil, natural gas or natural gas liquids. Since hydrocarbon consumption may or may not be related to shale development, the examination of downstream investment has been limited to those projects that have been deemed by the Study Team to be dependent on, or directly the result of, the large amount of oil and gas being developed in the region as a result of the Marcellus and Utica shale formations.

This seventeenth Study includes as Appendix A the cumulative investment made in Ohio resulting from shale development, based upon all previous reports that tracked total investment from early 2011 through June 2024.[5] The methodology for determining the investments is set forth in Appendix B, and has been updated since the last report. Subsequent reports will include incremental spending on a six-month basis.

2. SHALE INVESTMENT UPDATES

A. Upstream Development

1. Overview.

A total of 143 new wells were listed by the Ohio Department of Natural Resources as "drilled," "drilling," or "producing" during the period of January 1 to June 30, 2024.[6] This represents a

[4] This and other Investment Dashboard reports include drilling into the Marcellus and other shale units, but these comprise a very small portion of shale development in Ohio to date. This will be revisited as necessary in future iterations of the Investment Dashboard reports.

[5] *See fn 1, supra*.

[6] The number of new wells was determined using ODNR's report of cumulative permitting and drilling activity for the beginning and end of the 6-month period (*see* https://ohiodnr.gov/business-and-industry/energy-resources/oil-and-gas-wells/horizontal-wells). Wells are assigned an American Petroleum Institute API number, which is included in the ODNR reports. Wells were considered new if they had a status of drilled, drilling, or producing at the end of the 6-month period but did not have any one of these status designations at the beginning of it.

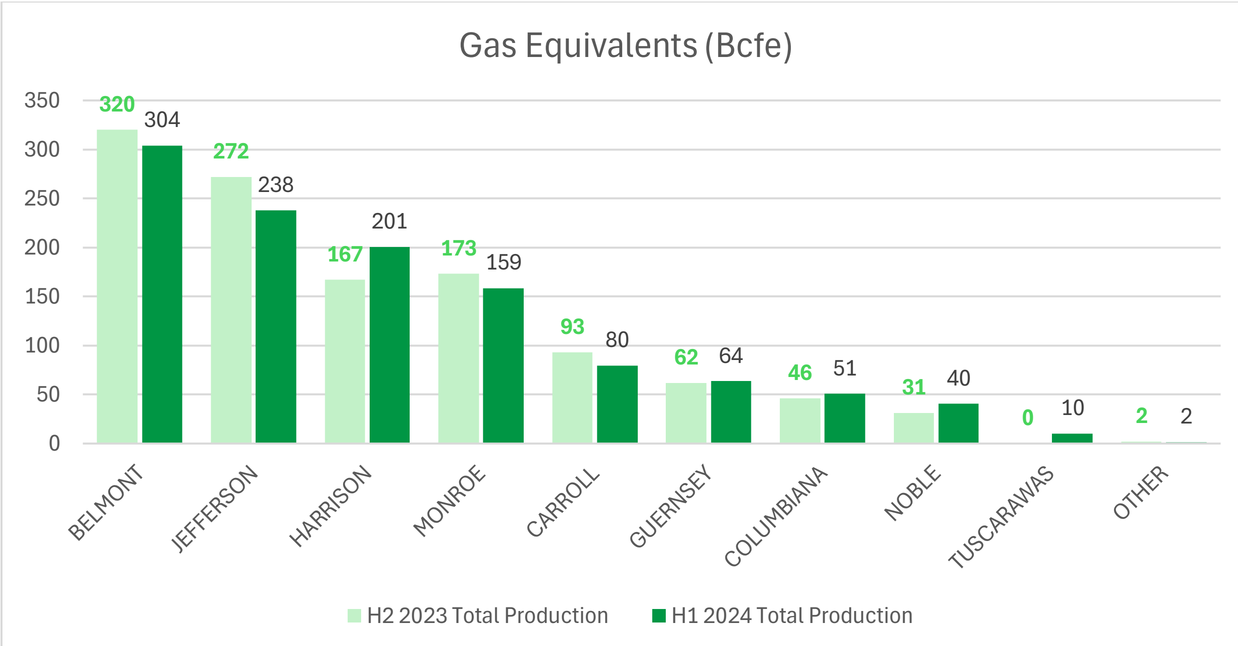
nearly 3-fold increase in new well development compared to the second half of 2023. The total number of producing wells in the Utica was 3,178 on June 30, 2024, a 3.7% increase from December 2024. Total shale-related oil and gas production in billion cubic feet equivalent (Bcfe) for this period was 1,147 Bcfe, led by Belmont County with 304 Bcfe. Jefferson County was second with 238 Bcfe, followed by Harrison and Monroe Counties with 201 and 159 Bcfe, respectively.[7]

The Ohio Department of Natural Resources (ODNR), Division of Oil and Gas Resources Management, issues weekly reports on well status and quarterly reports on production. The ODNR production reports for the first and second quarters of 2024 provide the foundation for the upstream analyses presented in this Study.

The Utica is currently identified by the ODNR as producing in eighteen eastern Ohio counties with the vast majority (nearly 99%) of producing wells located in eight counties, stretching from Columbiana in the north, to Monroe and Noble at the southern end of the play. Total production in quarters 1 and 2 for 2024 is set forth by county and operator in Figures 4 and 5 below. (Figure 4 includes a comparison of total production by county for the first half of 2024 and the preceding 6-month period.) Total cumulative production in billions of cubic feet equivalent (Bcfe) by county and by operator through June 2024 can be found in Appendix A as Figures 8 and 9.

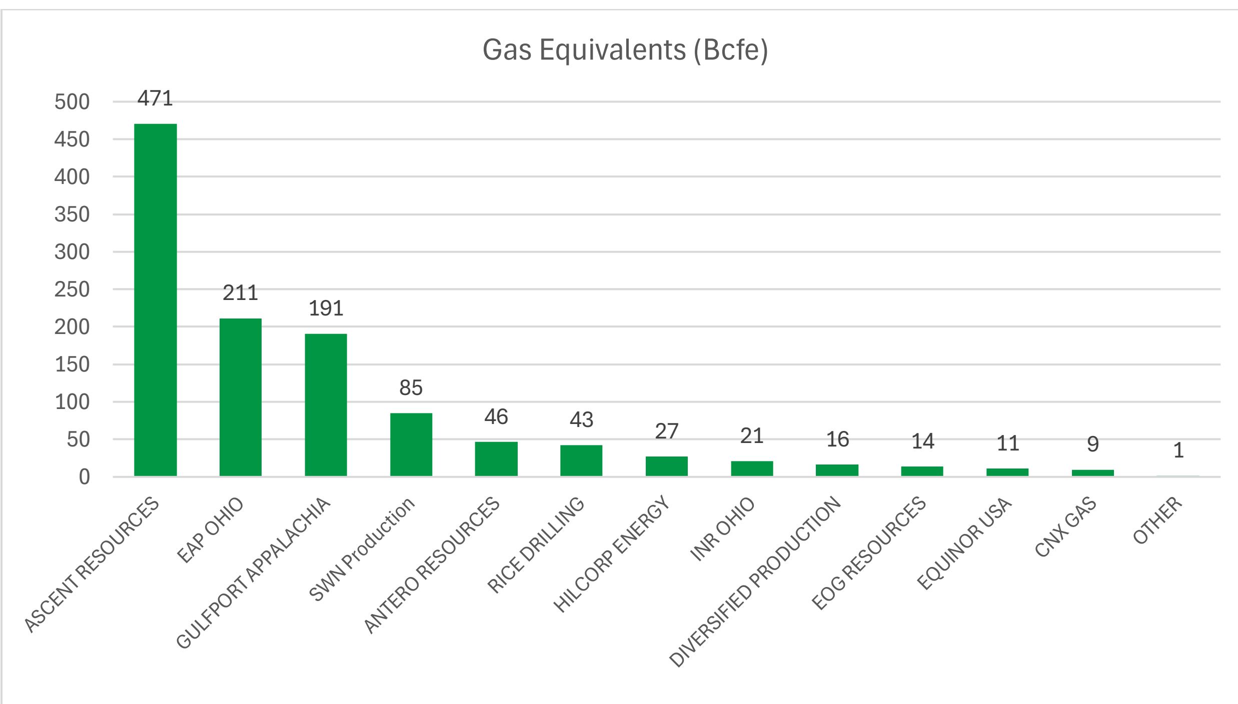
Figure 4: Production by County for First Half 2024 and Second Half 2024

[7] Production is reported to the ODNR at the wellhead as gas measured in thousands of cubic feet (Mcf) and as oil measured in barrels (bbl). The Utica also produces significant volumes of natural gas liquids (NGLs) such as ethane, propane, butane and natural gasoline. These NGLs are separated from the natural gas stream at midstream cryogenic and fractionation plants and not included in the ODNR production reports. For the purposes of this Study, oil and gas production is combined as gas equivalents (Mcfe) based on the energy content of oil and gas, measured as British thermal units (Btu). Gas equivalents were calculated using the following formula: Gas Equivalents (Mcfe) = Oil (bbl) x 5.659 Mcf/bbl + Gas (Mcf).



Data Source: ODNR (2024).

Figure 5: Production by Operator for Q1 and Q2 of 2024



Data Source: ODNR (2024).

2. Production Analysis.

Production can be summarized using tables that show gas equivalent production measured in billions of cubic feet equivalent as a function of time. This summary, for both production in the first and second quarters of 2024, and also for cumulative production since 2011, is set forth in Table 2. Table 3 sets forth production by county for the first half of 2024. Figure 6 sets forth the geographic distribution of production for the same period.

Table 2: Ohio's Shale Production by Reporting Period

Year	Quarter	Production Wells	Gas (Mcfe)	Oil (bbl)	Gas Equivalents (Mcfe)	Gas Equivalents % Change from Previous Quarter
2024	2	3,489	526,591,624	8,013,287	571,938,815	-0.5
2024	1	3,390	534,029,105	7,227,503	574,929,544	-1.0
2023	4	3,355	536,767,896	7,789,411	580,848,173	-0.5
2023	3	3,281	547,039,311	6,527,247	583,977,002	1.6
2023	2	3,135	535,540,115	6,921,158	574,706,949	-2.4
2023	1	3,074	551,830,848	6,549,638	588,895,250	2.8
2022	4	3,033	539,681,875	5,855,323	572,817,148	-0.6
2022	3	3,014	548,326,581	4,908,109	576,101,570	0.8
2022	2	2,921	543,019,311	5,018,523	571,419,133	1.3
2022	1	2,850	541,815,020	3,957,294	564,209,347	-5.8
2021	4	2,817	576,496,677	3,912,593	598,638,041	5.2
2021	3	2,764	547,540,443	3,781,319	568,938,927	-0.6
2021	2	2,805	549,211,398	4,154,041	572,332,375	-0.2
2021	1	2,752	548,129,151	4,543,462	573,417,606	-6.4
2020	4	2722	586,878,969	4,625,639	612,624,813	-1.3
2020	3	2688	588,630,465	5,713,477	620,431,107	3.6
2020	2	2643	569,396,136	5,182,481	598,723,796	-2.6
2020	1	2573	581,634,083	5,887,032	614,948,797	-14.1
2019	4	2524	677,685,505	6,818,682	716,272,426	0.2
2019	3	2470	673,962,146	7,200,304	714,708,666	10
2019	2	2365	614,218,362	5,813,755	647,118,402	1.4
2019	1	2277	609,452,391	5,073,536	638,163,531	-8.4
2018	ANNUAL	2201	2,354,848,381	19,786,375	2,466,819,477	--
2017	ANNUAL	1866	1,721,550,621	16,298,234	1,813,857,486	--
2016	ANNUAL	1492	1,386,584,598	17,847,818	1,487,651,097	--
2015	ANNUAL	1248	923,908,838	20,698,159	1,041,039,721	--
2014	ANNUAL	810	449,966,930	10,893,625	511,613,948	--
2013	ANNUAL	371	99,050,302	3,635,419	119,623,141	--
2012	ANNUAL	82	12,831,292	635,874	16,429,703	--
2011	ANNUAL	9	2,561,524	46,326	2,823,683	--
Total			**19,479,179,898**	**215,315,644**	**20,696,019,674**	--

Source: ODNR (2024).

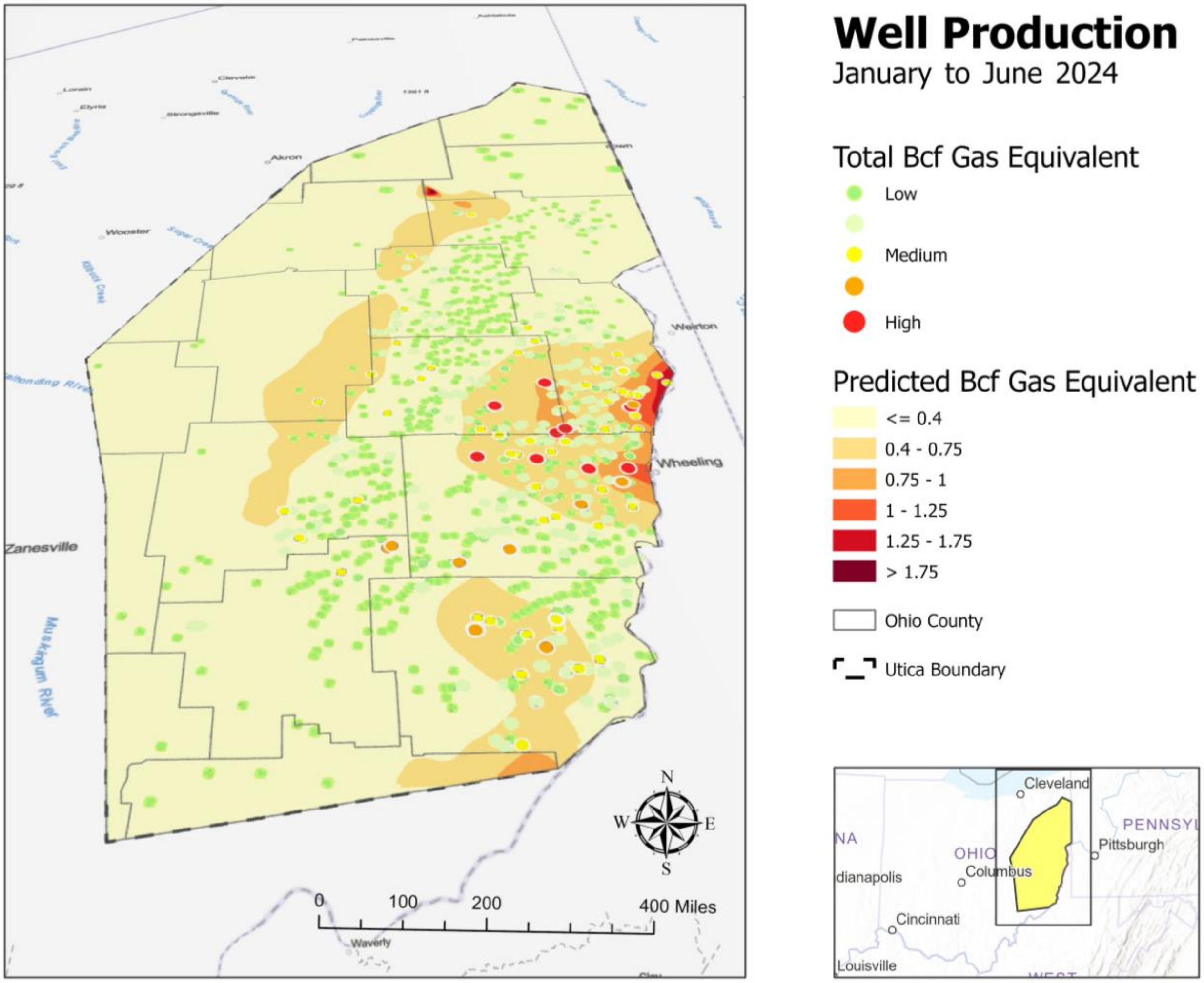
Table 3: Production by County for January – June 2024

County	Gas (Mcfe)	Oil (bbl)	Gas Equivalents (Mcfe)	Production Wells[8]
BELMONT	303,023,754	202,638	304,170,482	698
CARROLL	58,134,056	3,790,393	79,583,890	570
COLUMBIANA	45,982,000	815,724	50,598,182	174
COSHOCTON	12,830	115	13,481	1
GUERNSEY	36,587,466	4,775,847	63,613,984	309
HARRISON	178,829,103	3,835,919	200,536,569	548
JEFFERSON	237,639,591	5	237,639,619	391
MAHONING	377,657	2,064	389,337	12
MONROE	157,990,700	112,495	158,627,309	501
MORGAN	36,166	1,675	45,645	3
MUSKINGUM	135,173	1,235	142,162	2
NOBLE	36,668,453	654,763	40,373,757	193
PORTAGE	143,884	713	147,919	3
STARK	25,066	249	26,475	3
TRUMBULL	119,800	942	125,131	7
TUSCARAWAS	4,312,285	1,041,770	10,207,661	14
WASHINGTON	582,983	4,243	606,994	11
WAYNE	19,762	0	19,762	1
Total	**1,060,620,729**	**15,240,790**	**1,146,868,360**	**3,440**

Source: ODNR (2024).

[8] Represents the average number of production wells for the first and second quarters of 2024.

Figure 6: Distribution of Gas Equivalent Production for January – June 2024



Note: *Predicted Bcf Gas Equivalent* refers to the estimated average production for any random well located within one of the six color-coded spatial zones in the underlying contour plot.

Of the 3,454 total wells identified from the ODNR records for cumulative drilling activity as of June 2024, 204 were in the process of drilling, 72 wells had been drilled and were awaiting markets, and 3,178 were in the production phase.[9] (*See* Table 4, Ohio Utica Well Status.) Belmont County continued to lead in total wells. (*See* Table 5.)

[9] The discrepancy between the number of "Producing" wells in Table 4 and "Production" wells in Table 3 is due to how wells are reported in the ODNR's *Shale Well Drilling & Permitting* and *Well Production* spreadsheets. For a particular point in time, a given well may be classified as non-producing in the spreadsheet for cumulative activity yet have a record of production in the well production spreadsheet. Further, the Study Team has not sought to identify wells that may be listed as producing, but in fact are not.

Table 4: Ohio Utica Well Status as of June 2024

Well Status	No. of Wells
Drilled	72
Drilling	204
Producing	3,178
Total	3,454

Source: ODNR (2024)

Table 5: Well Status by County (June 2024)

County	Drilled	Drilling	Producing	Total
ASHLAND	1	0	0	1
BELMONT	15	28	665	708
CARROLL	1	25	546	572
COLUMBIANA	10	17	138	165
COSHOCTON	1	0	1	2
GUERNSEY	2	24	293	319
HARRISON	5	36	510	551
JEFFERSON	1	29	372	402
KNOX	1	0	0	1
MAHONING	1	0	12	13
MEDINA	1	0	0	1
MONROE	17	25	421	463
MORGAN	0	0	2	2
MUSKINGUM	0	0	2	2
NOBLE	1	15	181	197
PORTAGE	7	0	2	9
STARK	4	0	2	6
TRUMBULL	3	1	7	11
TUSCARAWAS	1	4	12	17
WASHINGTON	0	0	11	11
WAYNE	0	0	1	1
Total	**72**	**204**	**3,178**	**3,454**

B. Upstream Investment Estimates

Upstream investments have been broken down into four areas: investments into drilling, including road construction associated with well development; lease operating (post-production) expenses; new lease and lease renewal bonuses; and royalties on hydrocarbon production. The methodology used for each calculation is set forth in Appendix B. Average drilling costs were updated for this study, based upon reports from publicly traded operating companies. A recent review of ODNR drilling surveys indicated that the average well depth and horizontal length between northern and southern counties remains negligible. Based on an average lateral length of 14,300 ft. for the eight most active shale-producing counties in Ohio over the last two years, and average drilling and completion costs of $800 per lateral foot for operators in the Utica during 2024, we assumed an average drilling cost of $11.4 million per well.[10]

This section covers upstream investments between January – June 2024. Cumulative upstream investments to date in Ohio, including 2011 through the first half of 2024, are set forth in Table 18 of Appendix A.

1. Investments into Drilling.

The following tables set forth estimated investments for the Study period made into drilling shale wells in Ohio. Carroll and Harrison Counties were the leaders in new upstream investment, with 29 and 28 new wells and an investment of around $336.7 million and $325.1 million, respectively, between January – June 2024. Guernsey was third, with 22 new wells, and approximately $255.4 million invested. Monroe and Belmont were fourth and fifth with upstream investment of $209 million and $185.8 million for 18 and 16 new wells (*See* Table 6.) Jefferson, Noble and Columbiana Counties had 14, 9 and 7 new wells in the first half of 2024, respectively, and a total of $348.3 million invested. Road-related investments for this version of the Shale Investment Dashboard reflect average road costs per well determined from the Ohio Oil and Gas Association's (OOGA) 2017 report *Ohio's Oil & Gas Industry Road Improvement Payments*, in conjunction with OOGA's *2022 Community Impact/Sustainability Report*.[11] Based on information from these reports, and after adjusting for recent inflation, road costs related to drilling were assumed to be $170,200 per well.[12]

[10] *See* Upstream Methodology in Appendix B.

[11] OOGA's 2017 report indicated that oil and gas companies in Ohio had spent $300 million on roads from 2011 through 2017. OOGA's 2022 report indicated that cumulative spending by the industry on roads had reached $400 million by the end of 2021. This suggests that $100 million was spent on roads from 2018 through 2021, a period during which the Study Team tracked 846 new wells, indicating an average investment of $118,200 per well.

[12] Producers have experienced recent increases in drilling and completion costs. Road construction costs rose around 20% annually on average from 2021-2024 according to the Federal Highway Administration's construction cost index (*see* https://www.fhwa.dot.gov/policy/otps/nhcci/). Producers in the Appalachian Basin similarly reported spending on road improvements that, in conjunction with the number of new wells these companies drilled annually since 2021, resulted in a cost per well for road upgrades that increased by no less than 20% annually from 2021-2023. The average per well investment of $118,200 for road improvements was adjusted to reflect this price level increase for road construction. *See* https://www.anteroresources.com/esg. *See also* https://esg.eqt.com/social/economic-and-societal-impacts/#giving-back-to-our-communities

EAP Ohio was the leading operator during the six-month period, with 57 new wells and an estimated $659.5 million invested. Ascent recorded the second highest investment, with 34 new wells and an estimated $393.4 million invested. Gulfport and INR Ohio drilled 13 new wells each, for a total estimated investment of $300.8 million. EOG invested approximately $92.6 million across 8 new wells, followed by Diversified Production with $81 million for 7 new wells. Equinor and Hilcorp recorded a total investment of $115.7 million for 5 new wells each (*See* Table 7.)

Table 6: Estimated Upstream Shale Investment by County, January – June 2024

County	New Wells	Drilling ($)	Roads ($)	Total Amount ($)
BELMONT	16	183,040,000	2,723,200	185,763,200
CARROLL	29	331,760,000	4,935,800	336,695,800
COLUMBIANA	7	80,080,000	1,191,400	81,271,400
GUERNSEY	22	251,680,000	3,744,400	255,424,400
HARRISON	28	320,320,000	4,765,600	325,085,600
JEFFERSON	14	160,160,000	2,382,800	162,542,800
MONROE	18	205,920,000	3,063,600	208,983,600
NOBLE	9	102,960,000	1,531,800	104,491,800
Total	**143**	**1,635,920,000**	**24,338,600**	**1,660,258,600**

Source: The Authors (2024)

Table 7: Estimated Upstream Shale Investment in Ohio by Company, January – June 2024

Operator	New Wells	Drilling ($)	Roads ($)	Total Amount ($)
ANTERO RESOURCES	1	11,440,000	170,200	11,610,200
ASCENT RESOURCES	34	388,960,000	5,786,800	394,746,800
DIVERSIFIED PRODUCTION	7	80,080,000	1,191,400	81,271,400
EAP OHIO	57	652,080,000	9,701,400	661,781,400
EOG RESOURCES	8	91,520,000	1,361,600	92,881,600
EQUINOR USA ONSHORE	5	57,200,000	851,000	58,051,000
GULFPORT APPALACHIA	13	148,720,000	2,212,600	150,932,600
HILCORP ENERGY	5	57,200,000	851,000	58,051,000
INR OHIO	13	148,720,000	2,212,600	150,932,600
Total	**143**	**1,635,920,000**	**24,338,600**	**1,660,258,600**

Source: The Authors (2024)

2. Lease Operating Expenses.

Post-production investments have been estimated on a half-year basis, assuming an average cost of $0.151/Mcf-equivalent.[13] This estimate is based upon recent operator reports.[14] These investments are set forth below. Belmont County and Jefferson County led the lease operating expense investment, with an estimated $45.9 million and $35.9 million invested, respectively.

Table 8: Estimated Lease Operating Expenses for January – June 2024 by County

County	Gas Equivalents (Mcfe)	Lease Operating Expense for Period
BELMONT	304,170,482	$45,929,743
JEFFERSON	237,639,619	$35,883,583
HARRISON	200,536,569	$30,281,022
MONROE	158,627,309	$23,952,724
CARROLL	79,583,890	$12,017,167
GUERNSEY	63,613,984	$9,605,712
COLUMBIANA	50,598,182	$7,640,325
NOBLE	40,373,757	$6,096,437
TUSCARAWAS	10,207,661	$1,541,357
OTHER	1,516,906	$229,053
TOTAL	**1,146,868,360**	**$173,177,122**

[13] Previous reports relied on a per-well rule-of-thumb to calculate lease operating expenses, which attributed an equal amount to both low- and high-producing wells. A production-based rule of thumb more accurately captures the expenses that companies are likely to incur while operating wells.

[14] The per-Mcfe rule-of-thumb for lease operating expenses is based on average production costs for Ascent's and Gulfport's Utica operations in the first half of 2024 as reported in quarterly financial statements for both companies. *See* Appendix B.

Table 9: Estimated Lease Operating Expenses for January – June 2024 by Operator

Operator	Gas Equivalents (Mcfe)	Lease Operating Expense for Period
ASCENT RESOURCES	470,720,286	$71,078,763
EAP OHIO	211,220,131	$31,894,240
GULFPORT APPALACHIA	191,083,431	$28,853,598
SWN Production	85,218,756	$12,868,032
ANTERO RESOURCES	46,453,693	$7,014,508
RICE DRILLING	42,532,873	$6,422,464
HILCORP ENERGY	26,739,779	$4,037,707
INR OHIO	20,895,828	$3,155,270
DIVERSIFIED PRODUCTION	16,471,995	$2,487,271
EOG RESOURCES	13,871,094	$2,094,535
EQUINOR USA	10,772,847	$1,626,700
CNX GAS	9,441,371	$1,425,647
OTHER	1,446,277	$218,388
TOTAL	**1,146,868,360**	**$173,177,122**

3. Royalties.

Royalty investments have been estimated on a per quarter basis, assuming the formulas set forth in Appendix B. Total estimated royalties spent on Ohio properties between January and June 2024 were $736 million, or about 3.8% higher than the amount dispersed in the second half of 2023. The breakdown by quarter for oil, residue gas (i.e., gas left after extracting liquids), and natural gas liquids is set forth in Tables 10, 11, and 12 below. The average price for natural gas was $1.64/MMBtu during the first half of 2024, up from $1.46 in the second half of 2023.[15] Regional oil prices increased from an average of $67.11/bbl during the first quarter of 2024 to $69.22/bbl for the second quarter.[16] For comparison, regional oil prices averaged $72.43 and $66.17 per barrel in the third and fourth quarters of 2023, respectively.

[15] Reflects average natural gas prices over the respective periods across the Columbia Gas and Eastern Gas South (formerly Dominion South) trading hubs as derived from Intercontinental Exchange (ICE) trade data published in regular weekly market reports by Snyder Brothers Gas Marketing. *See* https://www.snyderbrothersinc.com.
[16] Reflects average prices reported by Ergon for Marcellus-Utica light crude (https://ergon.com). *See* Appendix B.

Table 10: Total Royalties from Oil, January – June 2024 (in millions)

Year	Quarter	Oil Price $/bbl	Oil Royalty (20%) $/bbl	Royalty ($mm)
2024	2	$69.22	$13.84	$110.94
2024	1	$67.11	$13.42	$97.01
			Subtotal	**$207.95**

Table 11: Total Royalties from Residue Gas, January – June 2024 (in millions)

Year	Quarter	Residue Gas Price $/Mcf	Residue Gas Royalty (20%) $/Mcf	Royalty ($mm)
2024	2	1.85	$0.37	$171.30
2024	1	1.76	$0.35	$165.88
			Subtotal	**$337.18**

Table 12: Total Royalties from Natural Gas Liquids, January – June 2024 (in millions)

Year	Quarter	NGL Price $/bbl	NGL Royalty (20%) $/bbl	Royalty ($mm)
2024	2	20.77	4.15	$96.23
2024	1	20.13	4.03	$94.62
			Subtotal	**$190.85**

4. Lease Renewals and New Leases.

New leases and lease renewal investments have been estimated for the Utica region based upon the drilling activity of the top six drilling companies in the region. These six companies have together drilled over 88% of the Utica wells to date, and it is assumed that they likewise control over 88% of the leases. The estimated investments into new leases and lease renewals are set forth below in Table 13.

There are several potential sources of error in these estimates. Because operators do not report lease bonus information, the Study Team was required to estimate investments into lease bonuses based upon some industry rules of thumb, together with information found in public leases. One important rule of thumb we deployed in estimating lease bonus investment is that "primary" lease terms average about 5 years. The primary term is that period of time during which the operator may conduct drilling operations but hold the lease without producing. Once a lease is drilled and production begins, the lease moves into its "secondary term," and may be thereafter "held by production" (HBP) for the life of that production. Using this rule of thumb, we determined that each operator will, on average, every year replace about 20% of its undeveloped acreage that is not HBP.

However, it is possible to hold undeveloped acreage without producing it. This can be done through the process of unitization. An operator may, for instance, have a 750-acre unit that is designed to drain a reservoir by 3 wells draining 250 acres each. The operator may drill the first well and begin to pay royalties therefrom to all the unit leases, thereby moving all the unit leases into HBP status, even though only one third of the reservoir is actually producing. Under this scenario, 500 acres would be classified as "undeveloped acreage," while 250 acres would be "developed acreage."

Most operators report undeveloped acreage.[17] However, they generally do not distinguish what portions of their undeveloped acreage are HBP or under primary term. Some do, however, report what percentage of their overall acreage is HBP, and this number can be used to estimate the likely acreage of leases that required bonuses. Based on the most recent annual financial reports for Antero, Ascent, and Gulfport, the Study Team found that on average 13% of a Utica operator's net Utica acreage was not classified as "Held-By-Production." Accordingly, for purposes of this Study, and using the 5-year primary term assumption, we assumed that operators, on average, paid lease bonuses on 20% of such non-HBP acreage for the year (i.e. ~3% of the total net acreage), and 10% over the half-year Study period.

Another important assumption is the lease bonus rate. For this Study, we have assumed bonuses to average \$5000/acre lease for renewals and new leases. From 2013-2019, this was a pretty conservative number in the Utica, and therefore likely to still be conservative for renewals of older leases. There is evidence that in 2020 new lease bonus rates were depressed due to sustained low natural gas prices. More recent publicly reported information on lease bonuses suggests, however, that \$5000/acre continues to be a reasonable estimate.[18] The Muskingum Watershed Conservancy District, for example, leased mineral rights in 2024 on acreage in Carroll County for \$5,500/acre, the same bonus rate it agreed to in 2022 on acreage in Harrison County.[19]

One additional factor that may make the lease bonus estimate inaccurate is the use of only "net" non-HBP lease acreage data to avoid possible double counting of leases. Operating companies often collaborate on development with non-operators but report only their own portion of the lease. However, bonuses must be paid on the "gross" lease acreage. So long as the non-

[17] *Undeveloped acreage* is defined by operators as that acreage on which wells have not been drilled or completed to a point that would permit the production of economic quantities of oil and natural gas regardless of whether the acreage contains proved reserves. Accordingly, undeveloped acreage can have a wide range of meaning, ranging from highly speculative to proven. Operators use a different, more rigorous classification system to account for proven or potential reserves.

[18] The bonus of \$10,250/acre received by ODNR for a lease awarded in early 2024 to drill under Salt Fork State Park in Guernsey County is likely an outlier. *See* Ohio Department of Natural Resources. (2024, February 27). *State Commission Awards Leasing Rights Following Competitive Bidding Process*. https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/news/leasing-rights

[19] *See* Canton Repository. (2024, October 25). *MWCD Approves New Oil and Gas Lease at Leesville Lake in Carroll County*. https://www.cantonrep.com/story/news/local/2024/10/25/mwcd-approves-oil-and-gas-lease-with-encino-at-leesville-lake/75839522007. *See also* Muskingum Watershed Conservancy District. (2022, May 20). *MWCD Negotiates Oil and Gas Lease with Encino Energy*. https://www.mwcd.org/news/2022/05/20/mwcd-negotiates-oil-and-gas-lease-with-encino-energy

operators are among the top six operators (which is commonly the case), their own net acreage reports will capture all the acreage. But if they are not, the acreage will not be captured, and the bonuses estimated herein will be under reported.

Table 13: Total Estimated Investments into New Leases and Lease Renewals January – June 2024 (in millions)

Operator	Acreage not held for production[20]	Estimated Bonus Investment ($mm)
ANTERO RESOURCES[21]	7,536	$3.8
ASCENT RESOURCES[22]	44,167	$22.1
EAP OHIO[23]	22,272	$11.1
GULFPORT ENERGY[24]	10,410	$5.2
RICE DRILLING (EQT)[25]	12,134	$6.1
SOUTHWESTERN ENERGY (SWN)[26]	8,437	$4.2
Total	**104,956**	**$52.5**

C. Estimated Midstream Investments

Midstream investment includes natural gas processing and fractionation facilities, including rail and transloading facilities for storing and handling natural gas liquids. Midstream also includes transmission and gathering pipelines, storage facilities, compressor stations (including compressor engines), dehydration units, and generators installed as part of these stations.

Pipeline investments were estimated using mileage and size information from the Public Utilities Commission of Ohio, and cost information from the Interstate Natural Gas Association of America

[20] Antero and Southwestern did not distinguish between Ohio, Pennsylvania, and West Virginia acreage for their Appalachia operations in their FY2024 10-K reports. EAP Ohio is privately held and does not release this sort of annual financial report. Gross developed acreage in Ohio for these companies was assumed to be equivalent to the total acreage for their horizontal drilling units in the state, data for which is available through the ODNR's Oil & Gas Well Viewer at https://gis.ohiodnr.gov/mapviewer/?config=oilgaswells. For operators who *do* file 10-K reports in which Appalachian acreage is differentiated by state (Ascent, Gulfport, and Rice Drilling), this estimate for gross developed acreage has been within ±10% of the actual amount. Total net acreage for Antero, Southwestern Energy, and EAP Ohio was estimated based on the average ratio of total-net-acres-to-gross-developed-acres in Ohio for Ascent, Gulfport, and Rice Drilling.

[21] Fourteen percent of Antero's total net Ohio acreage was assumed to not be held by production as this was the percentage of the company's overall net Appalachian acreage not held by production in FY2024 based on its most recently filed 10-K.

[22] Twelve percent of Ascent's total net Ohio acreage was not held by production based on the company's FY2024 Consolidated Financial Statements.

[23] *See fn 21, supra.* Approximately 5% of EAP's acreage in Ohio is not held by production (*see* https://encinoenergy.com/utica-oil/).

[24] Fourteen percent of Gulfport's net Ohio acreage was not held by production based on its FY2024 10-K.

[25] Acreage not held by production was not identified in the FY2024 10-K for Rice Drilling or Southwestern Energy. This percentage was assumed to be 11%, which was the average for Antero, Ascent, EAP Ohio, and Gulfport.

[26] *Id.*

(INGAA). Similarly, compressor station investments were based on estimated cost per unit of power output for the region as obtained from the INGAA. A full description of the methodology can be found in Appendix B.

Additional investment information was collected from midstream company investor presentations, news reports, and other sources including Ohio EPA permits. Table 14 summarizes midstream investments identified by the Study Team for the first half of 2024. Some costs related to these projects may have occurred outside the six-month window for this study. However, because the investments cannot easily be separated and tracked while construction is ongoing, the investments are treated as though made entirely during the Study period if construction on the project was begun then.

Table 14: Midstream Investment, January – June 2024

Company	Additions to Infrastructure	Total Amount ($mm)
Ascent Resources	• 180 MMscfd of dehydration in Harrison County	$7.68
Blue Racer Midstream	• 1.33 miles of 10.75" gathering pipeline	$4.16
Cardinal Gas Services (Williams)	• 6.70 miles of 8.63" gathering pipeline • 2.98 miles of 10.75" gathering pipeline • 1.17 miles of 12.75" gathering pipeline	$30.58
DT Midstream	• 2,500 hp of compression at Belle Valley Compressor Station in Noble County	$14.35
EOG Resources	• 3.37 miles of 12.75" gathering pipeline • 9.90 miles of 20" gathering pipeline • 15,400 hp of compression at Blackbird Compressor Station in Carroll County	$158.70
Summit Midstream	• 3,360 of compression at Buckeye Compressor Station in Belmont County	$19.29
Utica Gas Services (Williams)	• 0.39 miles of 8.63" gathering pipeline	$0.99
	Total	**$235.75**

Source for Gathering Line Mileage and Diameter Data: PUCO Gathering Construction Reports (2025).

Midstream investments of $236 million for the first half of 2024, while down somewhat compared to the $290 million tallied for the second half of 2023, nonetheless remained strong, topping $200 for the second consecutive 6-month period and marking the second such period since the onset of COVID. Investment in this segment during the Study period was focused on gathering systems and transportation, with $106 million spent on gathering lines and $122 million on compression.

Midstream operators have seen increasing utilization of processing capacity compared to just a few years ago.[27] However, the near-term outlook for capital spending by these companies in the region remains fixed on gathering and transportation, indicating that there will be adequate processing capacity over the next few years.[28] Midstream investment will instead likely be focused in a couple of areas, in addition to the ongoing building of gathering systems: utilizing "trapped" natural gas that cannot adequately access interstate pipeline networks for uses within the state, particularly for power generation in response to increasing electricity demand and data center development; and alleviating bottlenecks in takeaway capacity to allow Utica gas to make its way more efficiently to markets outside the region.

Such projects include a mixture of midstream and downstream spending for Williams' proposed $1.6 billion Project Socrates for power generation in New Albany, OH, including the associated gas pipeline infrastructure.[29] This suite of two 200 MW facilities has a targeted in-service date for the second half of 2026. Projects related to takeaway include the Borealis pipeline project, which would connect Utica gas to the Texas Gas Transmission system and delivery to the Gulf Coast via a 180-mile pipeline extension from Lebanon, OH just north of Cincinnati to Clarington, OH in Monroe County.[30] Further details on this pipeline expansion have not been released, but an interstate pipeline extension of this length would likely represent hundreds of millions of dollars in midstream spending, if not a billion-dollar investment.

These and other midstream projects to be included in future shale reports are listed below in Table 15. Cumulative midstream investments through the end of June 2024 are set forth in Table 19 in Appendix A.

[27] MPLX, for example, reported capacity utilization in the Utica for the first quarter of 2022 of 32% for its gas processing complexes and 61% for its C2 fractionation facilities that separate out ethane. In the first quarter of 2025, capacity utilization for these gas processing complexes and fractionation facilities rose to 73% and 84%, respectively. *See* MPLX. (2022, May 3). *First Quarter 2022 Earnings Conference Call*. https://www.mplx.com/content/documents/mplx/investor_center/2022/MPLX_1Q22_Conf_Call_Slides.pdf. *See also* MPLX. (2025, May 6). *First Quarter 2025 Earnings Conference Call*. https://www.mplx.com/content/documents/MPLX/investor_center/2025/MPLX_1Q25_Slides_e.pdf.

[28] *Id*. *See also* The Williams Companies. (2025, May 6). *Williams 1st Quarter 2025 Earnings Call*. https://investor.williams.com/static-files/672114a5-9813-461d-a604-dadd6be871e0

[29] See The Williams Companies. (2025, March 3). *Current Report on Form 8-K*. https://investor.williams.com/node/25641/html. *See also* The Williams Companies. (2025). *Socrates Power Solutions Facilities*. https://www.williams.com/expansion-project/socrates-power-solution-facilities/

[30] *See* Natural Gas Intelligence. (2025, April 3). *Texas Gas Gauging Support to Move More Appalachian Natural Gas to Midwest, Gulf Coast Markets*. https://naturalgasintel.com/news/texas-gas-gauging-support-to-move-more-appalachian-natural-gas-to-midwest-gulf-coast-markets.

Table 15: Future Ohio Midstream Projects

Project	Description	Estimated Construction Start
Additional gathering system buildout[31]	• 9.3 miles of gathering pipeline with 13" avg. diameter in Carroll, Columbiana, Harrison, and Tuscarawas Counties • 34,400 hp of compression in Columbiana and Harrison Counties	Second half of 2024
Borealis pipeline extension[32]	• Texas Gas, a subsidiary of Boardwalk Pipelines, announced an open season to test support for this pipeline expansion. Open season runs April 1-30, 2025. Project is to take Marcellus and Utica gas to demand centers across service territory from Ohio to Louisiana	N/A
Socrates power solution facilities[33]	• Supportive pipeline to deliver Utica gas to two 200 MW power generation facilities in New Albany, OH	Second half of 2025

D. Downstream Development

1. Combined Heat and Natural Gas Power Plants

Over the past sixteen reports, we have noted 8 new natural gas-powered power plants in Ohio that were in the construction or operational stages since 2015. The seven of these plants that are currently operational consumed 141.2 Bcf of natural gas for power generation during the first half of 2024, or the equivalent of about 13% of Ohio Utica gas production for this period.[34]

These seven plants generated 22,364 gigawatt hours of electricity over the first six months of 2024, or the equivalent of about 34% of the electricity consumed in Ohio across all sectors during the Study period.[35]

Increasing demand for electricity, particularly by data centers which are the largest drivers of projected load growth in the region, has led to renewed development of natural gas power

[31] Pipeline estimate reflects construction starts through the end of December 2024 as gathered from the PUCO's Gathering Construction Reports. Compression and dehydration estimates reflect projects receiving Final Issuance of Permit-to-Install and Operate from Ohio EPA as of December 31, 2024.
[32] U.S. EIA. (2025, April 24). *Natural Gas Pipeline Projects Database*. https://www.eia.gov/naturalgas/pipelines/EIA-NaturalGasPipelineProjects_Apr2025.xlsx
[33] *See fn 30, supra.*
[34] *See* Energy Information Administration. (2025, May 22). *Form EIA-923 Detailed Data with Previous Form Data (EIA-906/920)*. https://www.eia.gov/electricity/data/eia923. Form EIA-923 data include monthly and annual fuel consumption and electricity generation at the power plant level.
[35] *Id. See also* See also Public Utilities Commission of Ohio. (2025, May 1). *Electric Choice Activity Dashboard*. https://app.powerbigov.us/view?r=eyJrIjoiZTliZDEzNGEtZjlhYi00YWEzLThjZjktMGZmNDg4OWE4ZDFkIiwidCI6IjUwZjhmY2M0LTk0ZDgtNGYwNy04NGViLTM2ZWQ1N2M3YzhhMiJ9

generation in Ohio.[36] Since the beginning of 2025, over 1 gigawatt of new generation—primarily concentrated in and around New Albany, OH—has come before the Ohio Power Siting Board via either a submitted application, or a notice that an application will be submitted by July 1 of this year.[37] Investment for these projects will be included in a future shale report as they progress through approval and development.

Low natural gas prices are expected to also support further development of combined heat and power (CHP) plants in the region. Designed primarily for heat or steam with electricity as a byproduct, CHP systems improve overall efficiency. This includes Ohio State University's 106 MW CHP plant, included in a previous Shale Dashboard, which should be fully operational by February 2026.[38]

During the first half of 2024, one gas-fueled CHP system with a power output of around 2.4 MW received a final permit-to-install and operate at Abbott Nutrition just north of Dayton. Investment for this installation—estimated at $5.8 million—is included in this report.[39]

The 8 current and projected future natural gas-powered facilities, along with the CHP project at Ohio State that is currently under construction, are set forth in Figure 7 below.

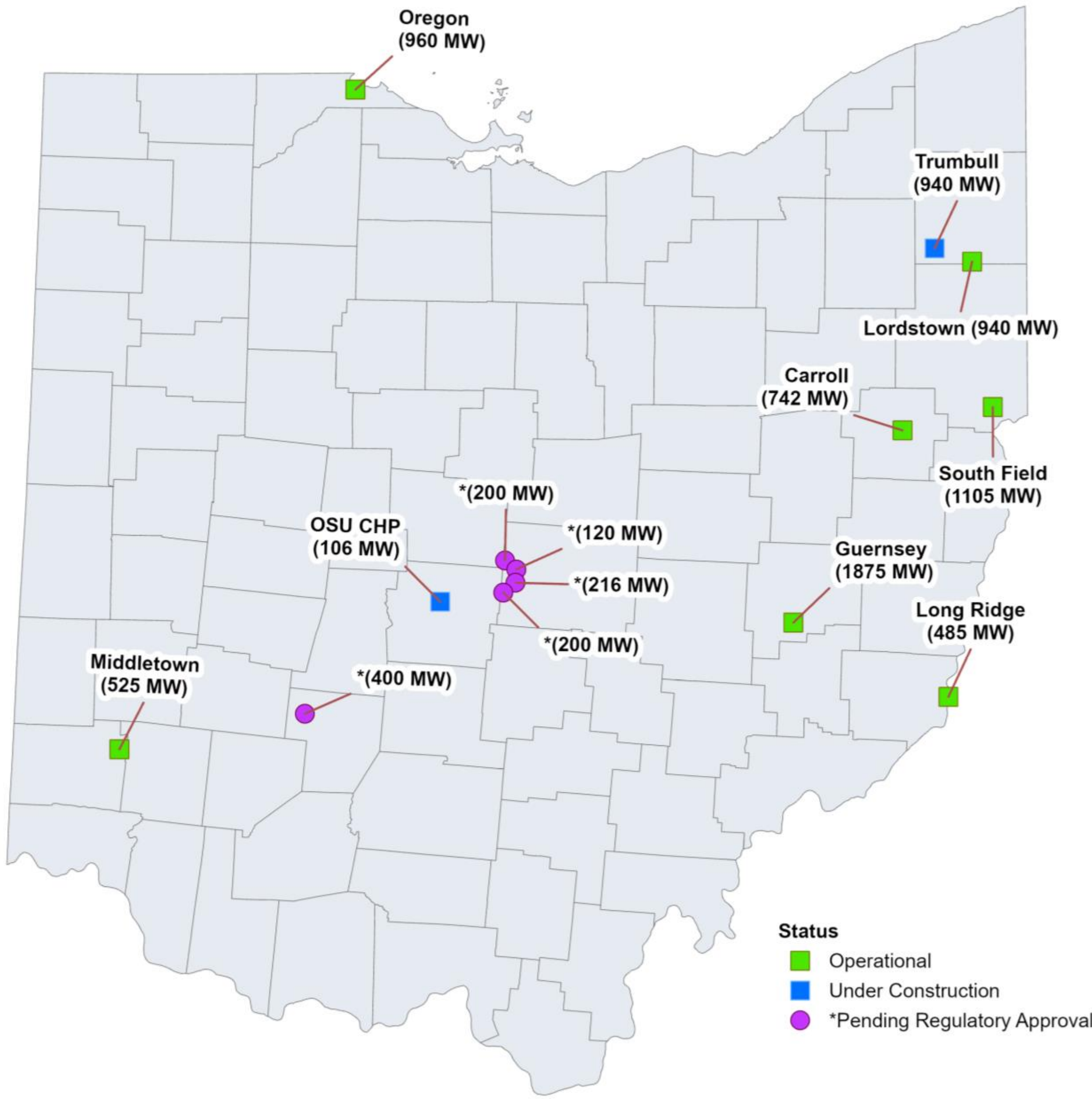
[36] *See* PJM. (2025, January 30). *2025 Long-Term Load Forecast Report Predicts Significant Increase in Electricity Demand*. https://insidelines.pjm.com/2025-long-term-load-forecast-report-predicts-significant-increase-in-electricity-demand/

[37] *See* PUCO. (2025, May 22). *Gas Generation & CHP Case Status*. https://opsb.ohio.gov/wps/wcm/connect/gov/8ca88169-317b-46ee-9a05-9008e18d7bee/Natural+Gas+Map+and+Stats05222025.pdf?MOD=AJPERES&CONVERT_TO=url&CACCACH=ROOTWORKSPACE.Z18_JQGCH4S04P41206HNUKVF31000-8ca88169-317b-46ee-9a05-9008e18d7bee-psmWoa4. The five *pending* and *pre-application* gas generation projects currently before the OPSB are New Albany Energy Center, Socrates South, Socrates North, Bluegrass, and PowerConneX II.

[38] See Ohio State University Board of Trustees. (2025, May 2). *Master Planning and Facilities Committee Meeting*. https://trustees.osu.edu/sites/default/files/documents/2025/04/0.%20PUBLIC%20Materials%20-%20MPF%20-%2005.02.25.pdf

[39] Abbott Nutrition received a permit to install an Avus2000e NG at its Tipp City, OH facility. This power plant has a net power output of 2,443 kW according to the DoE's CHP eCatalog. The U.S. EPA's Excel-based CHP Screening Tool estimates total capital costs of $5,789,910 for a system with an average load of 2,443 kW and default values for monthly fuel use and annual operating hours that are representative of the Food and Kindred Products major industry group. *See the following:* 1) Ohio EPA. (2024, February 9). *Ohio EPA Public Notice* [Abbott Nutrition – Tipp City]. https://notices.epa.ohio.gov/notices-view/196106; 2) U.S. Department of Energy. (2022). *2G Energy Inc.: AVUS 2000E NG* [Combined Heat & Power eCatalog]. https://chp.ecatalog.ornl.gov/package/272-PR1-ZC44114; 3) U.S. EPA. (2025, March 19). *CHP Screening Tool*. https://www.epa.gov/chp/chp-screening-tool

Figure 7: Existing and Projected Natural Gas Power Plants



Source: Ohio Power Siting Board (2025)

2. Other Downstream Investment

No other significant downstream investments took place in the first half of 2024. However, in the second half of 2024 U-Haul expanded its network of liquefied petroleum gas (LPG) fueling stations in Ohio, opening six such stations throughout the state.[40] This represents around $2 million of downstream investment that will be included in the next shale report.[41]

Ohio is poised to see continued growth in a variety of natural gas-based power generation as energy-intensive data centers continue to expand. AEP Ohio, for example, received approval from the PUCO in May 2025 to install and operate two behind-the-meter solid oxide fuel cells running on natural gas at Amazon and Cologix data centers in Franklin and Licking Counties. Each installation is expected to be around 20 MW.[42] AEP has an agreement in place with Bloom Energy to deploy up to 1 GW of solid oxide fuel cells for data centers, with 100 MW already on order.[43]

These and other projects falling within the scope of downstream activities will be tracked for inclusion in future shale reports.

Cumulative downstream investments reported to date in Ohio, including 2011 through the first half of 2024, are set forth in Table 20 in Appendix A. An outline of the key products and processes for this sector within the shale gas value chain is set forth in Appendix B.

3. CONCLUSION

Total upstream shale investment in Ohio was up (+67.9%) for the first half of 2024 compared to the second half of 2023. This increase is largely attributable to a significant increase in drilling activity, with nearly three times as many new wells being drilled during the first six months of 2024 compared to the second half of 2023. Belmont County led all counties in production for the second consecutive Study period. More northerly Carroll County had the highest number of new wells developed, displacing Jefferson County which had led all counties in new well development for all of 2023. Altogether, upstream shale investment totaled $2.6 billion for the first half of 2024.

Midstream investment, while down moderately (-18.8%) from spending during the second half of 2023, remained consistent with the broader upward trend seen throughout the post-COVID recovery. Operators continued to expand their gathering and transportation capacity, with an estimated investment of $106.0 million for gathering lines, $122.1 million for compression, and

[40] Alternative Fuels Data Center. (2025). *Locate Stations* [Station Data by State]. https://afdc.energy.gov/data_download

[41] Costs for equipment purchases and site work for U-Haul's LPG refueling stations are estimated at $300,000 per station. *See* U-Haul. (2025). *Propane AutoGas Trip Planner* [U-Hawul Business Accounts for Autofuel Fleets]. https://www.uhaul.com/Propane/AutoGas

[42] *Id*. The applications submitted to the PUCO withhold the exact output for these systems, but each one includes a layout of a 20 MW installation for illustrative purposes.

[43] *Id*.

$7.7 million for dehydration. Details on potential higher-value investments in this segment are likely to emerge soon as projects advance to meet rising in-state electricity demand and alleviate constraints on gas takeaway capacity to markets outside the region.

The first half of 2024 saw a pause in downstream investment, with only one major new project, a CHP plant, representing an investment of $5.8 million moving forward. However, this will soon change. Rising electricity demand—driven largely by data center growth—is spurring renewed investment in natural gas power generation. Since early 2025, over 1 GW of new capacity has been proposed in Ohio, primarily near New Albany, with additional details forthcoming as projects move through regulatory review. As data center demand rises, natural gas-based hydrogen and fuel cells are also emerging as solutions for reliable power generation.

Altogether, shale-related investment in Ohio for the first half of 2024, including upstream, midstream, and downstream, was just under $2.9 Billion. Cumulative total shale related investment since 2012 is around $111.1 billion.

About the Study Team

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About the Energy Policy Center
The Energy Policy Center is housed within the Levin College of Public Affairs and Education at Cleveland State University. The mission of the EPC is to help overcome social and institutional barriers to the implementation of solutions to energy challenges by providing an objective channel for the free exchange of ideas, the dissemination of knowledge, and the support of energy related research in the areas of public policy, economics, law, business and social science. For more information, go to https://levin.csuohio.edu/epc.

4. APPENDICES

APPENDIX A. CUMULATIVE OHIO SHALE INVESTMENT

Figure 8: Total Utica Production in Bcfe (Gas Equivalence) by County through June 2024

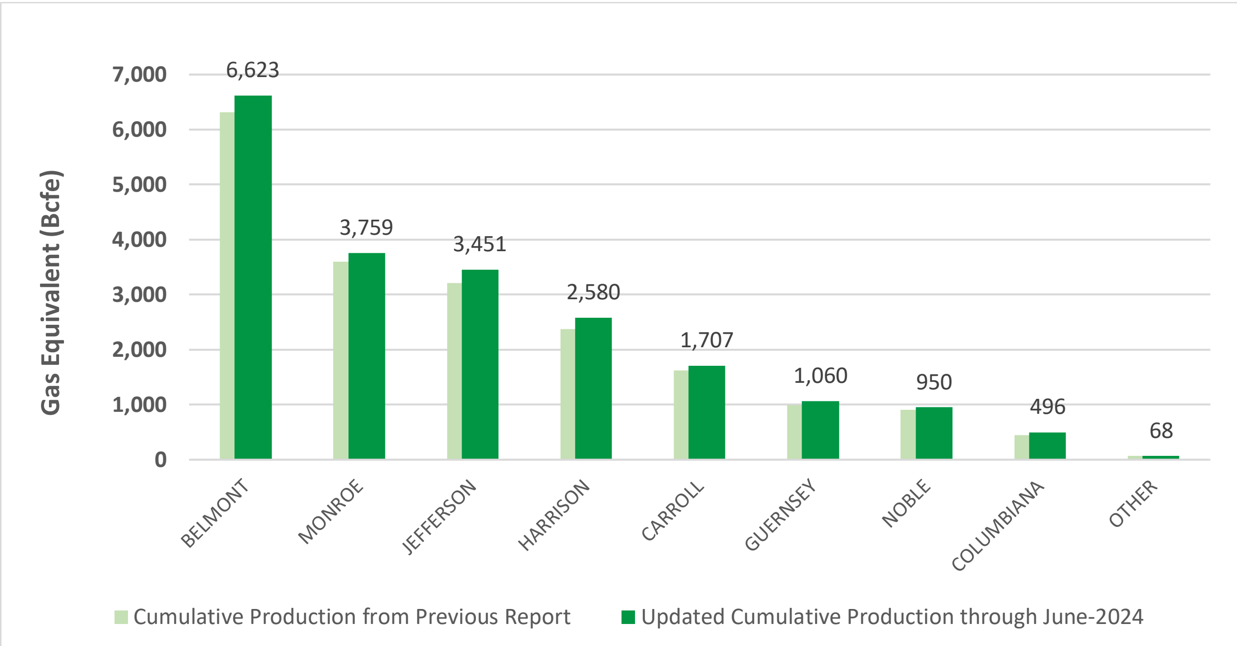


Figure 9: Total Utica Production in Bcfe by Operator through June 2024

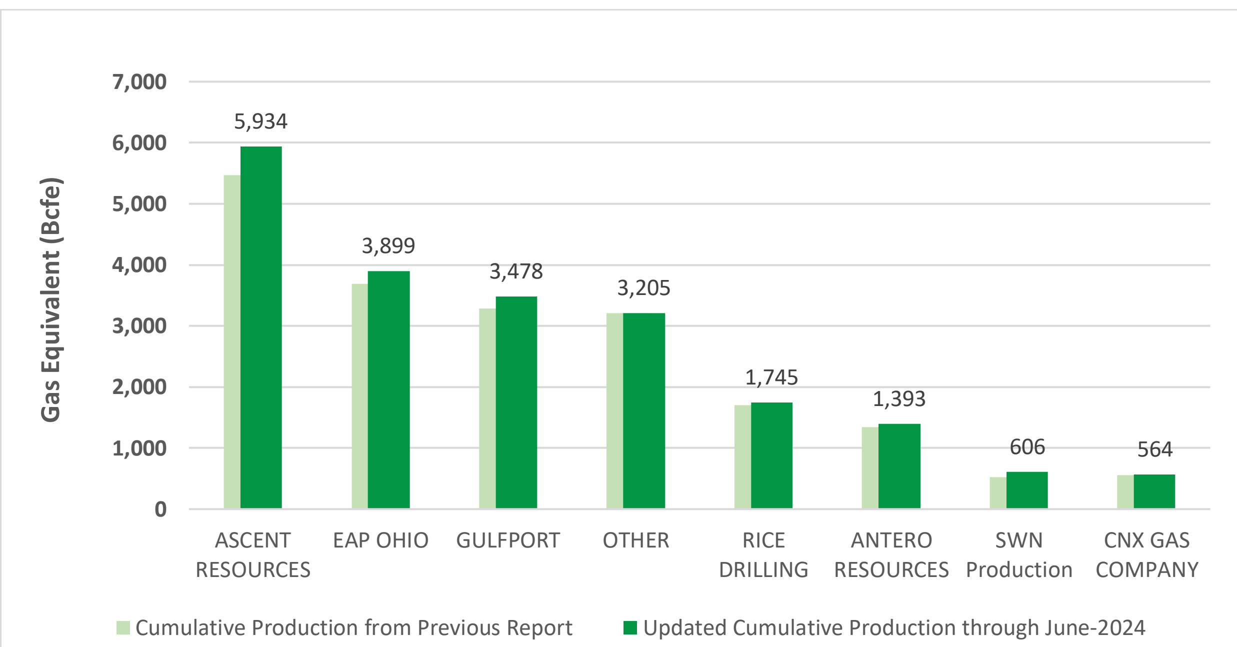
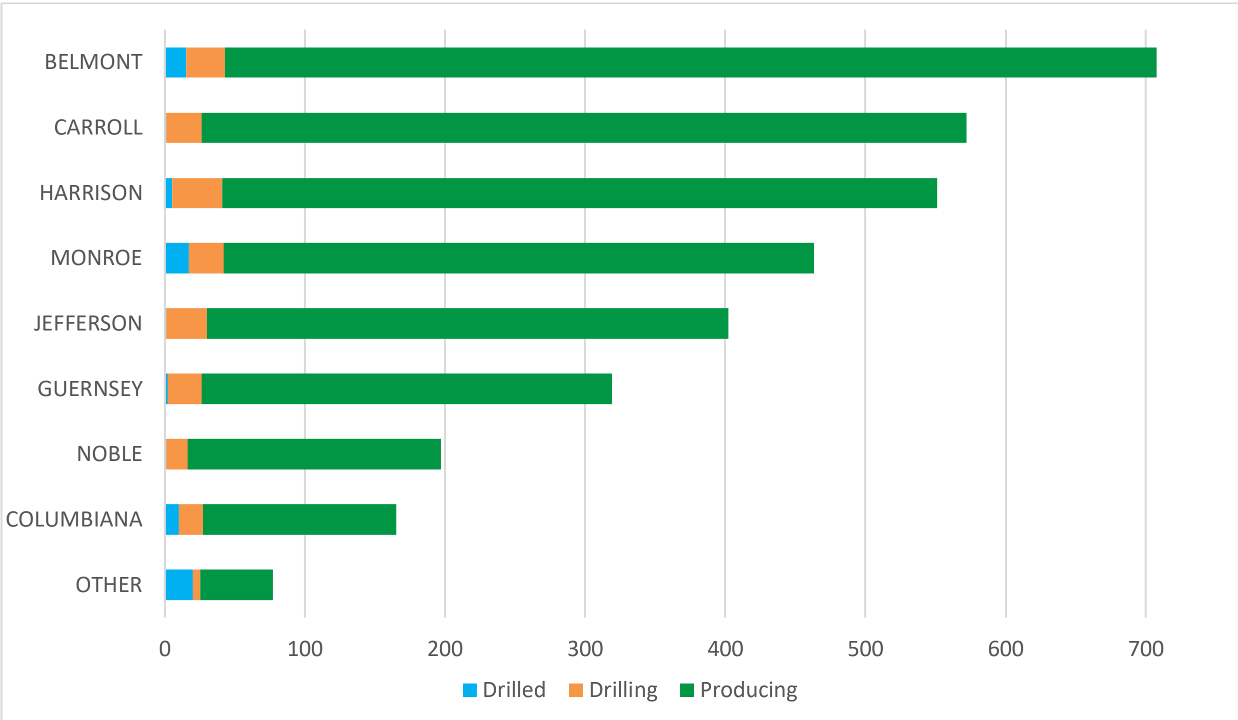


Figure 10: Cumulative Number of Wells by County through June 2024



Source: Ohio Department of Natural Resources (June 2024)

Figure 11: Distribution of Gas Equivalent Production for 2011 through June 2024

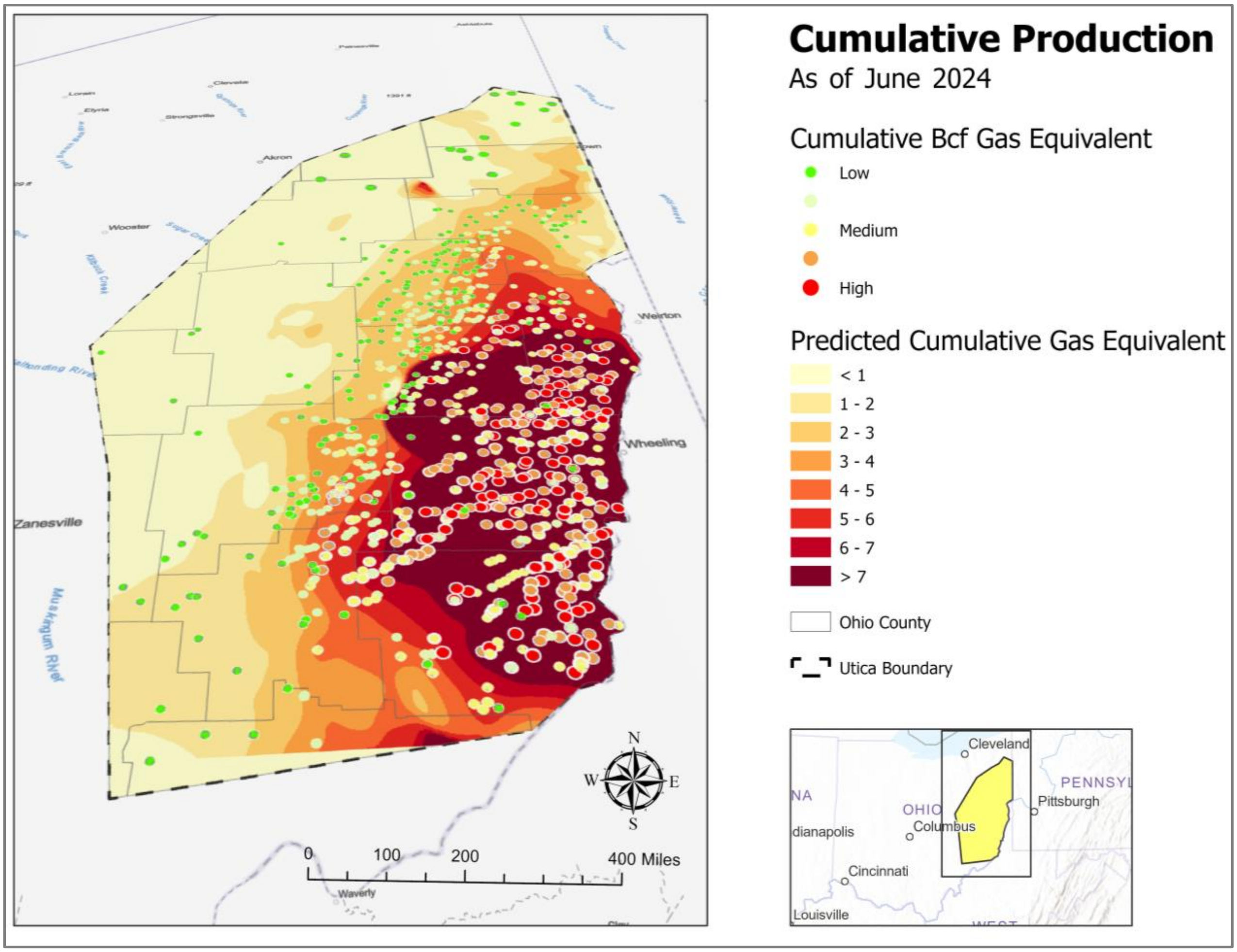
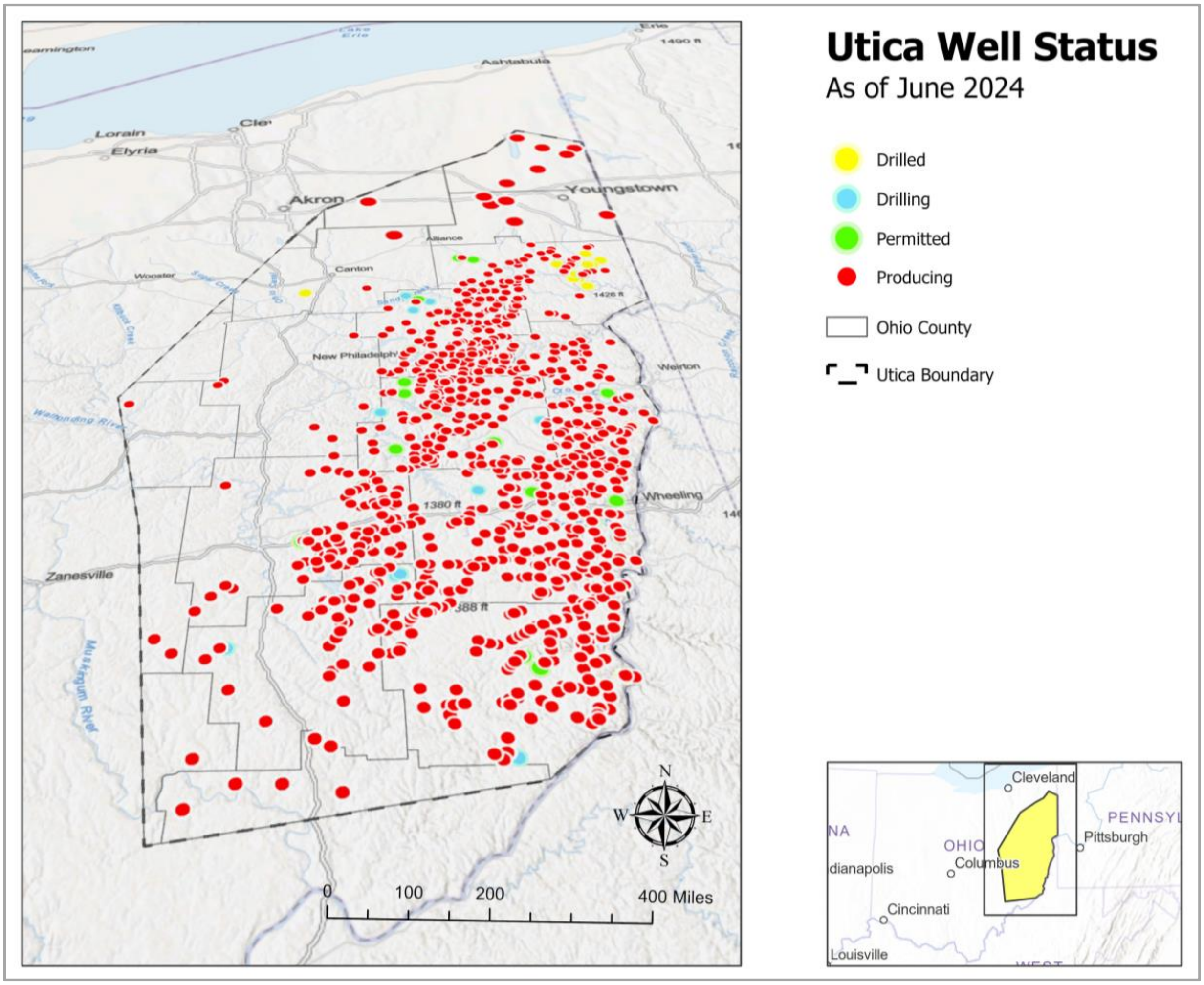


Figure 12: Distribution of Utica Wells by Status as of June 2024



Source: ODNR (2024)

Table 16: Utica Upstream Companies Drilling in Ohio as of June 30, 2024

Operator	Cumulative no. of Wells
EAP OHIO LLC	1,022
ASCENT RESOURCES UTICA LLC	933
GULFPORT APPALACHIA LLC	459
ANTERO RESOURCES CORPORATION	243
SWN PRODUCTION (OHIO) LLC	219
RICE DRILLING D LLC	149
INR OHIO LLC	100
HILCORP ENERGY COMPANY	76
EQUINOR USA ONSHORE PROPERTIES INC.	47
CNX GAS COMPANY LLC	46
EOG RESOURCES INC.	41
DIVERSIFIED PRODUCTION LLC	38
PIN OAK ENERGY PARTNERS LLC	25
GEOPETRO LLC	17
GULFPORT ENERGY CORPORATION	12
NORTHWOOD ENERGY CORP	6
HOLBROOK LLC	4
CHESAPEAKE EXPLORATION LLC	3
DEVON ENERGY PRODUCTION CO LP	3
UTICA RESOURCE OPERATING LLC	2
BRAMMER ENGINEERING INC	2
SUMMIT PETROLEUM INC	2
EQT PRODUCTION COMPANY	2
BP AMERICA PRODUCTION COMPANY	1
ECLIPSE RESOURCES I LP	1
AMERICAN ENERGY UTICA LLC	1
Grand Total	**3,454**

Note: Cumulative Number of Wells are calculated based upon the total number Drilled, Drilling, and Producing. Source: ODNR (June 30, 2024).

Table 17: Total Lease Operating Expenses through June 2024 (in millions)

Year	Period	Production Wells	Lease Operating Expenses for Period ($mm)
2024	Q1 and Q2	3,440	173.2
2023	Q3 and Q4	3,318	186.4
2023	Q1 and Q2	3,105	194.3
2022	Q3 and Q4	3,024	150.2
2022	Q1 and Q2	2,886	178.6
2021	Q3 and Q4	2,791	151.8
2021	Q1 and Q2	2,806	205.7
2020	Q3 and Q4	2,705	206.1
2020	Q1 and Q2	2,610	266.2
2019	Q3 and Q4	2,497	262.2
2019	Q1 and Q2	2,273	228.0
2018	Q3 and Q4	2,200	231.0
2018	Q1 and Q2	1,874	191.2
2017	Q3 and Q4	1,818	121.8
2017	Q1 and Q2	1,588	141.3
2016	Q3 and Q4	1,467	101.2
2016	Q1 and Q2	1,355	97.6
2015	Annual	1,034	148.9
2014	Annual	612	88.1
2013	Annual	237	34.1
2012	Annual	82	3.0
2011	Annual	9	0.3
		Total	**3,379.5**

Table 18: Cumulative Utica-Related Upstream Investments in Ohio through June 2024

Estimated Investments	Total Amount
Mineral Rights	$25,978,407,000
Drilling	$33,599,720,000
Roads	$1,169,914,730
Lease Operating Expenses	$3,361,248,729
Royalties	$15,201,042,000
Total	**$79,310,332,459**

Table 19: Cumulative Utica-Related Midstream Investments in Ohio through June 2024

Estimated Investments	Total Amount
Midstream Gathering	$8,483,529,000
Processing Plants	$1,259,300,000
Fractionation Plants	$1,697,360,000
NGL Storage	$261,000,000
Rail Loading Terminals	$150,270,000
Transmission Pipelines	$10,367,236,000
Total	**$22,218,695,000**

Table 20: Cumulative Utica-Related Downstream Investments in Ohio through June 2024

Estimated Investments	Total Amount
Petrochemical Plants and Refineries	$679,443,000
Other Industrial Plants	$760,000,000
Natural Gas Refueling Stations	$81,975,000
Natural Gas Power Plants	$7,642,500,000
Combined Heat and Power (CHP) Plants	$383,159,910
Total	**$9,547,077,910**

APPENDIX B. METHODOLOGY

1. Upstream Methodology.

Investment into the upstream for this fourth report has been broken down into four categories.

a. Wells and Related Roads. The first category is investment into wells and includes one-time investments into drilling and road construction related to well development. They were estimated as:

- Drilling:
  - Drilling and completion costs of $11.4 mm/well. [44]
  - Equivalent true vertical depth (TVD) for wells in all counties.
  - Average drilling and completion costs of $800 per lateral foot.[45]
  - Average lateral length of 14,300 ft.[46]
- Roads: average investments - $170,200 per well based on recent OOGA reports after adjusting for inflation.[47]

The number of new wells developed in the Study period were accounted for by subtracting the number of wells in the drilled, drilling, and producing categories as of January 1, 2024, from the number existent as of June 30, 2024. This information was downloaded from the ODNR's weekly *Combined Utica/Point Pleasant Shale Permitting Report*.[48]

b. Lease Operating Expense. The second estimated upstream cost identified by operators is the "lease operating expense." This includes post-production costs such as the storage, processing and disposal of produced water, among other expenses. Lease operating expenses for Utica wells were estimated to be a production-based $0.167/Mcf-equivalent. This average expense was developed by the Study Team based on an analysis of Ascent's and Gulfport's lease operating expenses in the Utica for the first half of 2024 as reported in their quarterly financial statements.[49]

[44] Previous shale reports distinguished between drilling costs for northern counties (Carroll, Harrison, Jefferson, Columbiana, Trumbull, Mahoning and Tuscarawas) and southern counties (Noble, Guernsey, Belmont, Monroe and Washington) based on the assumption that the Utica is deeper in the south, requiring more expensive drilling in over-pressured formations. The Study Team conducted a review of drilling surveys associated with ODNR completion reports for new wells drilled since January 2022 and found a difference in mean true vertical depth between northern and southern counties of less than 500 ft., which would likely not lead to significant cost differences. The same review of drilling surveys indicated that laterals for new wells in southern counties were less than 600 ft. longer on average than laterals in northern counties, which likewise would probably not lead to significant cost differences.

[45] Estimated drilling costs per lateral foot in the Appalachian Basin based on drilling and completion costs for Ascent Resources, Antero Resources, and Southwestern Energy as reported in quarterly earnings releases and annual 10-K filings for 2024, available at the following: https://www.ascentresources.com/investors; https://www.anteroresources.com/investors; https://ir.swn.com/CorporateProfile/default.aspx.

[46] Calculated using well completion reports obtained from the ODNR's *Ohio Oil & Gas Well Database*.

[47] *See fn 13, supra.*

[48] Ohio Department of Natural Resources. (2024). *Horizontal Wells.* https://ohiodnr.gov/business-and-industry/energy-resources/oil-and-gas-wells/horizontal-wells

[49] *See* Ascent Resources' financial reports at https://ascentresources.com/financials. *See also* Gulfport Energy's financial reports at https://www.gulfportenergy.com/investors/sec-filings/quarterly-reports.

c. Oil and Gas Production Royalties. A third area of upstream investment, royalty calculation, is more complicated. The estimate is based upon the total production over the six-month period and the likely price received for sales of the hydrocarbon during that same period. However, because much of the natural gas has been processed, Ohio Department of Natural Resources production records cannot be readily converted to royalty payments. Accordingly, a number of assumptions are required to estimate the royalties paid. These include estimating the local market conditions at the time hydrocarbons were sold. Royalties were estimated on a per quarter basis for Utica production based upon the hydrocarbon content for a typical Utica well.

To estimate the royalties, the following assumptions were made based upon industry interviews, industry investor presentations, and Energy Information Agency reports:

- Production for each well was similar to that found in the wet gas region, and not the dry gas or condensate regions. This represents the average situation.
- The average production shrinkage after processing was 12%, thereby making the residue gas volume 88% of the total natural gas production. [50]
- The residue energy content was around 1.1 MMBtu/Mcf.[51]
- Residue gas in the Utica was selling at an average price of $1.60/MMBtu for Q1 and $1.68
- /MMBtu for Q2.[52] These prices were used to estimate royalties.
- Around 44 barrels of liquids were recovered per million cubic feet of gas produced.[53]
- Natural gas liquids were selling for around 30% of the listed price for Marcellus-Utica light crude oil.[54]
- Oil in the Utica region was selling for $67.11 and $69.22 per barrel, on average, during the first and second quarters of 2024, respectively.[55]
- Royalty rates are 20% of gross production.

d. New and Renewal Lease Bonuses. Finally, a fourth form of upstream investment was estimated: new and renewal lease bonuses. For this purpose, we assumed that the average new lease or renewal bonus paid was $5000/acre, and that the typical lease has a five-year primary term. In prior studies, based upon the assumption that most undeveloped acreage was in the primary term of the least, we assumed that approximately 20% of the undeveloped acreage

[50] Based on industry interviews, experts citing API 12.3, Manual of Petroleum Measurements and Standards.
[51] EIA estimates a conversion rate of 1.037 MMBtu/Mcf (*see* https://www.eia.gov/tools/faqs/faq.php?id=45&t=8). However, industry interviews suggest 1.1 is closer to the average conversion for the Utica Shale.
[52] Reflects average price across the Columbia Gas and Eastern Gas South trading hubs as derived from ICE trade data published by Snyder Brothers Gas Marketing at https://www.snyderbrothersinc.com. Hub prices reflect the delivered price of natural gas and so do not require further deductions for transportation costs. *See* https://www.eia.gov/todayinenergy/detail.php?id=18391
[53] Based on industry data.
[54] Based on industry interviews. Ascent recently indicated that it expects NGL prices to range from between 27.5% and 32.5% of the WTI price for crude oil. *See* Ascent's Q4 2023 earnings release at https://www.ascentresources.com/news/ascent-resources-reports-fourth-quarter-and-full-year-2023-operating-and-financial-results-and-issues-initial-2024-guidance.
[55] *See* Marcellus/Utica prices for light crude at http://ergon.com/prices. More than 95% of Ohio oil production is light crude by API gravity. *See* https://www.eia.gov/petroleum/production/xls/api-history.xlsx

identified will need to be renewed each year or is otherwise new.[56] Since this Study covered six months, we assumed that half of this 20% was renewed or new during the Study period. However, as units have developed in the Utica, we have changed this estimate going forward to assume that 25% of the operator's total acreage is in its primary term, and that 20% of this acreage must be renewed or replaced very year (10% for a six-month period). This estimate may be high insofar as companies are not renewing or replacing all their primary term acreage. However, it may also be low insofar as the studies have only identified net acreage for the top six to nine operators in Ohio and may not be capturing all of the non-operator net acreage. (Acreage status is typically reported in company 10-K and other financial statements).

2. Midstream Methodology.

Midstream investments include pipeline construction (intrastate, gathering lines and inter-state), processing plants (compression, dehydration, fractionation, and others), natural gas liquid storage facilities, and railroad terminals and transloading facilities. Midstream expenditures were estimated based upon a combination of midstream company investor reports, media reports, and industry "rules of thumb" obtained from industry interviews, government reports, and industry trade journals. Estimated investments were then compared against investor presentations and other information gleaned from public sources to confirm their accuracy. Interviews were also used to confirm ranges of expenditures.

a. Processing plants. Processing plant information was obtained by searching a wide range of resources including Ohio and US EPA permit databases, news agencies, and company web sites and presentations. For purposes of estimating the investments for midstream processing plants, rules of thumb were developed based upon facility throughput capacities. These rules of thumb were applied to the processing plants that have been built in Ohio, using the throughput capacity estimates cited in permit documents, or made available from public literature. Likewise, rules of thumb based upon throughput capacity were used to estimate investments downstream of the processing plants, such as storage facilities and loading terminals. Dehydration processing plants were estimated using average cost per Mcf capacity for similarly designed and recently built plants in the Appalachian region.

Compressor station investments were calculated based on the horsepower rating listed in Ohio EPA air permit data and estimated construction costs per horsepower of $5,741 for the Midwest Region as projected by the Interstate Natural Gas Association of America (INGAA) for 2024 after adjusting for inflation.[57]

[56] This estimate was confirmed through industry interviews. New operator undeveloped acreage reports are likely to be made available over time that may suggest these estimates could be either too high or too low.

[57] *See* The INGAA Foundation, Inc. (2018). *North America Midstream Infrastructure through* 2035. https://ingaa.org/wp-content/uploads/2018/06/34703.pdf. INGAA's projections for midstream infrastructure costs are in 2016 dollars. These projections were converted to 2023 dollars using the Bureau of Labor Statistics' Producer Price Index for *Other Pipeline Transportation* (available at https://fred.stlouisfed.org/series/PCU48694869).

The approximate capital cost for TEG dehydration units based on throughput was obtained from Carroll's *Natural Gas Hydrates: A Guide for Engineers* (2014, 3rd ed.). Facilities receiving a final permit-to-install or permit-to-install-and operate were assumed to be constructed during the same 6-month period in which the permit was issued by the Ohio EPA.

The following assumptions were used to estimate midstream-related investments:

- Processing Plants.
    - $400,000 per MMcf/d throughput
    - $80 MM per 200 MMcf/d plant (typical skid size)
- Fractionation Plants: $3,542 per bbl/d[58]
- Storage Tankage: $80 MM for 1 Bcf/d throughput
- Rail Loading Terminals: $40 MM for 1 Bcf/d throughput

b. Pipelines. Pipeline investments were estimated by applying "inch-mile" cost estimates to known pipeline diameter and length for both inter- and intrastate projects. Interstate pipeline diameters and mileage can be determined from Federal Energy Regulatory Commission data. These estimates were confirmed from investor presentations, when available. Intrastate mileage and diameter were determined using data for gathering system construction that was obtained from the Public Utilities Commission of Ohio.

For this report, up-to-date cost projections for natural gas transmission and gathering line pipelines, per inch-mile, was obtained from the INGAA. The estimated cost for natural gas pipelines for the Midwest Region as used in this analysis was $291,698 per inch-mile, which included labor, raw materials, and permitting costs, as projected by the INGAA for 2024 after adjusting for inflation.[59]

No investments into distribution lines were included in the Study since it is assumed that these have not grown as a direct result of shale development. For pipelines carrying liquids, the investment assumption is that expenditures will be comparable to those seen for gas pipelines. These were also corroborated by industry investor reports.

3. Downstream Methodology.

For estimating downstream expenditures, the Study Team relied upon publicly available reports gathered from news media, trade association publications, company websites and investor presentations. The Study Team also used interviews, and Ohio EPA permits and public notices

[58] The Study Team reviewed the published investment costs and throughput capacities of eight different fractionation facilities that have been developed since 2018, all of which are in Texas. The assumed unit cost for fractionation reflects the median investment per barrel of processing capacity per day for these eight facilities. *See* the following examples: Targa Resources Inc.'s Mont Belvieu fractionation facilities (https://www.naturalgasintel.com/targa-building-two-new-fractionation-trains-at-mont-belvieu/); Phillip 66's Sweeny fractionation facilities (https://s22.q4cdn.com/128149789/files/doc_presentations/2019/11/Investor-Day-Slides-for-Website-11.06.2019-vF.pdf).
[59] *See fn 58, supra*.

to identify projects and support investment estimates. Search terms included identified company names, and key words associated with specific facility types and industries.

As of this report, downstream investment is categorized into eight categories:

- Natural Gas Power Plants
- Combined Heat and Power Plants
- Ethane Cracker Plants
- Methanol Plants
- Refineries
- Natural Gas refueling stations
- Petrochemical Plants
- Other industrial plants with natural gas inputs

NAICS codes used to generate keywords for searches included the following:
3251 – Basic Chemical Manufacturing
3252 – Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing
3253 – Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
3255 – Paint, Coating, and Adhesive Manufacturing
3259 – Other Chemical Product and Preparation Manufacturing
3261 – Plastics Product Manufacturing

Downstream activities include the deployment of processes that turn hydrocarbons— natural gas (methane) and natural gas liquids (ethane, propane, butanes)—into higher-valued fuels and petrochemicals. Shale gas may be monetized into numerous resulting value-added products. Figure 13 shows the primary intermediates and products that can be manufactured from the main hydrocarbon components in shale gas as part of downstream production.[60]

[60] *See* U.S. Department of Energy. (June 2020). *The Appalachian Energy and Petrochemical Renaissance: An Examination of Economic Progress and Opportunities*. https://www.energy.gov/sites/prod/files/2020/06/f76/Appalachian%20Energy%20and%20Petrochemical%20Report_063020_v3.pdf

Figure 13: Shale/Natural Gas Value Chain for Petrochemicals