CORNERSTONE RESEARCH

Economic and Financial Consulting and Expert Testimony

Characteristics of U.S. Natural Gas Transactions

Insights from FERC Form 552 Submissions as of May 16, 2017

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The views expressed in this report are solely those of the authors, who are responsible for the content, and do not necessarily represent the views of Cornerstone Research.

Table of Figures and Appendices

The Federal Energy Regulatory Commission (FERC) receives and compiles the most comprehensive information on trading activity and pricing methods in U.S. natural gas trading markets. The information, collected from market participants' FERC Form 552 submissions, provides a database of trading activity that spans both physical and financial trading by a range of companies, from producers to end users.

By supplementing the data with proprietary classifications of market participants, Cornerstone Research adds deeper insight into market activities and characteristics across the various types of participants. See Appendix 1 for additional information.

2016 Executive Summary

For the second consecutive year, the amount of natural gas traded in the United States increased (as measured by Form 552 submissions).[1] This brings 2016 above the 2012 level, although still below the 2011 peak. Overall trading volume rose more than 5 percent. The natural gas fixed-price volume potentially reported[2] to price-index publishers decreased 6 percent.

FERC Submissions

- Trading activity totaled 130,012 tBtu. (page 5)
- In 2016, there were 711 respondents, 31 more than in 2015.[3] (page 5)

Trading Activity According to Form 552 and Futures Exchanges

- Aggregate trading of natural gas contracts increased on the two main futures exchanges: CME Group Inc. (CME) and Intercontinental Exchange (ICE). (page 6)
- CME's volume increased for the second year in a row (17 percent in 2016) while ICE's volume declined 2.2 percent. (page 6)
- The percentage of FERC 552 volume based on next-month transactions decreased 10 percentage points from 2008 to 2016. Next-month transactions volume has been replaced by next-day transactions. (page 11)
- For the sixth consecutive year, the volume of FERC 552 transactions dependent on indices increased relative to the volume of fixed-price transactions that form the indices. (page 12)

Reporting to Price-Index Publishers

- In 2016, 15 percent of Form 552 respondents reported transaction information to the price-index publishers for themselves or at least one affiliate. (page 13)
- For the second consecutive year, companies chose not to report more than half of the reportable fixed-price volume. (page 13)
- Reporting to price-index publishers was inconsistent across industry segments in 2016. (page 15)
- The volume of these reported transactions indicates that, on average, a molecule of natural gas was traded through approximately 2.6 transactions from production to consumption.[4]

"The volume of fixed-price natural gas potentially reported to price-index publishers has decreased every year since 2011."

Nicole Moran
Senior Manager
Cornerstone Research

Trends in Natural Gas Production and Consumption

Despite a small decrease in natural gas production in 2016, the U.S. Energy Information Administration (EIA) projects that production will increase by approximately 4 percent annually through 2020. The projected increase is partially due to improved extraction technology and capital-intensive projects, such as liquefaction export terminals and petrochemical plants.[5]

The expansion of LNG export facilities and accessible natural gas is driving forecasts for increased U.S. exports.

Production from shale gas and tight oil plays has increased substantially over the past five years, and the EIA predicts that these sources will account for nearly two-thirds of total U.S. natural gas production by 2040.[6] Overall, the EIA forecasts that natural gas production may account for nearly 40 percent of U.S. energy production by 2040.[7]

The United States is expected to become a net exporter of natural gas by 2020, largely due to rapid liquefied natural gas (LNG) market expansion.[8] The first shipment of LNG from the lower 48 states occurred in February 2016, from Cheniere Energy's Sabine Pass Liquefaction Project in Louisiana to Brazil.

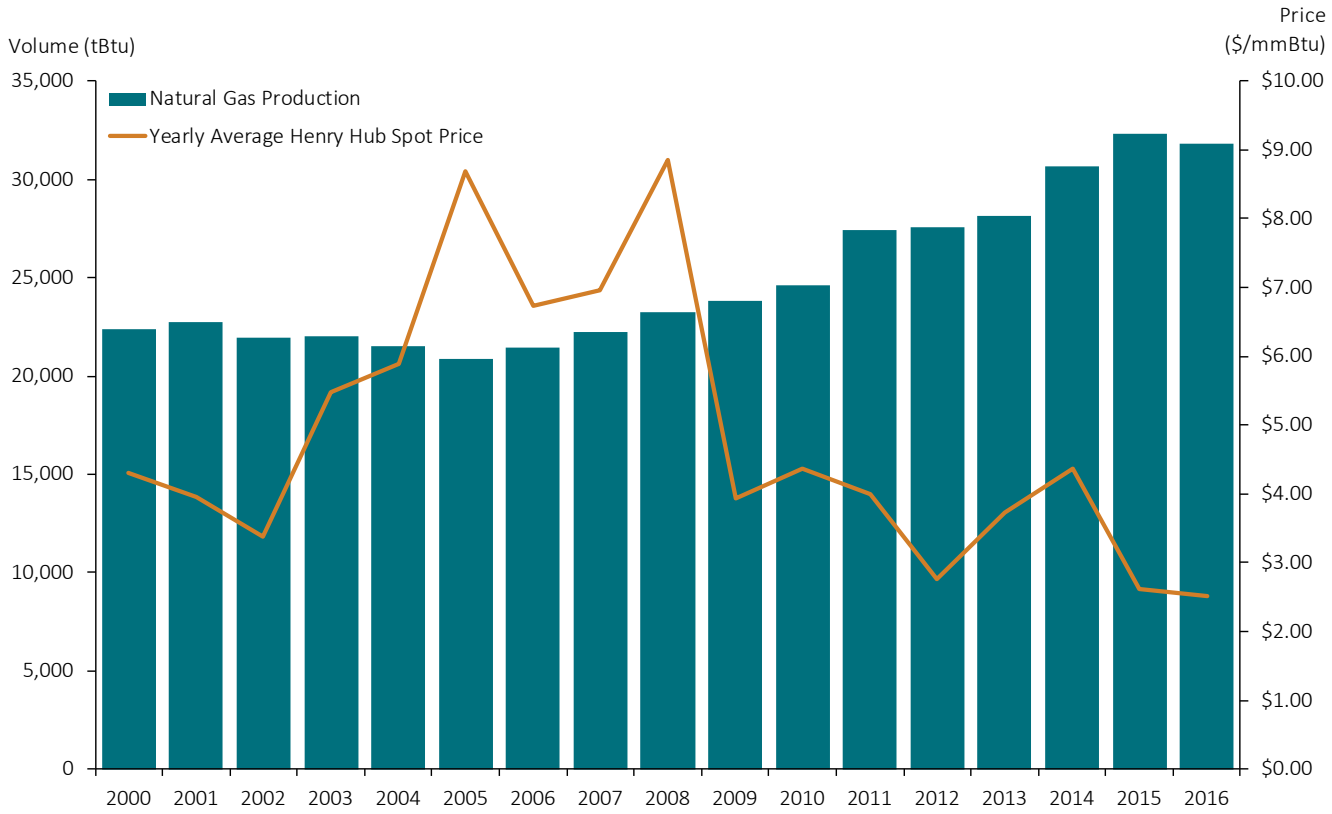
The EIA expects natural gas consumption to decrease slightly in the near term but increase by about 17 percent from 2022 to 2040.[9]

Natural Gas

- Annual marketed production decreased by 1.6 percent in 2016, the first decrease since 2005.
- The decrease was partly due to a decline in natural gas prices from an annual average of $2.62 in 2015 to $2.52 in 2016.[10]
- However, the Henry Hub spot price increased in the second half of 2016. The EIA expects Henry Hub spot prices to continue to increase through 2030 and stabilize at approximately $5 through 2040.[11]

U.S. natural gas production decreased for the first time since 2005.

Figure 1: U.S. Natural Gas Marketed Production and Natural Gas Price
2000–2016



Source: U.S. Energy Information Administration (EIA)
Note: One tBtu equals one million mmBtu.

Liquefied Natural Gas

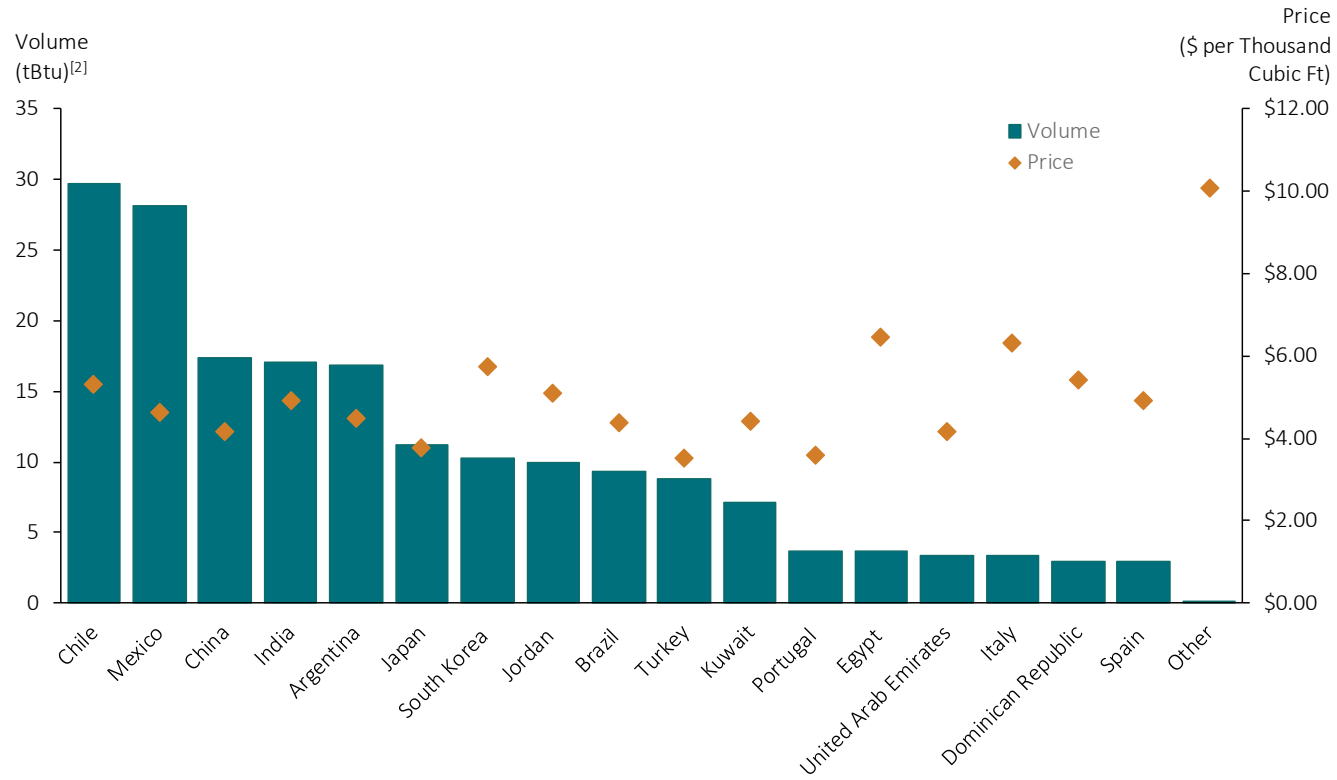
The year 2016 was significant for U.S. LNG exports. The first shipment of LNG from the lower 48 states occurred in February 2016, from Cheniere Energy's Sabine Pass Liquefaction Project in Louisiana to Brazil. Cheniere Energy's Sabine Pass Liquefaction Project is currently the only operational LNG export facility in the lower 48 states. Four further LNG export projects are expected to be completed by 2020.[12]

In addition, in the summer of 2016, the first LNG carrier passed through the newly opened third set of Panama Canal locks, opening up the more direct route for U.S. Gulf Coast LNG to Asia.[13]

Approximately one-third of LNG exports was sent to Chile and Mexico.

- The United States exported approximately 187 tBtu of LNG in 2016. At just 8 percent, LNG exports were still a small fraction of total U.S. natural gas exports in 2016.[14] The remaining 92 percent was exported via natural gas pipeline.
- The majority of LNG exports went to South America (30 percent), the Middle East (16 percent), and Asia (30 percent).[15]
- In 2016, only 5 percent of U.S. LNG exports went to Europe.[16] This contrasts with speculation last year that Europe would emerge as a large buyer of U.S. LNG.[17]
- Contracting practices in the LNG market have also become more flexible. This includes the benchmarks used to price LNG (e.g., natural gas versus crude oil lined contracts[18]) and export destinations as well as expanded flexibility on the destination of the cargoes exported.[19]

Figure 2: U.S. Liquefied Natural Gas Exports by Country and LNG Prices
2016



Source: U.S. Energy Information Administration (EIA)

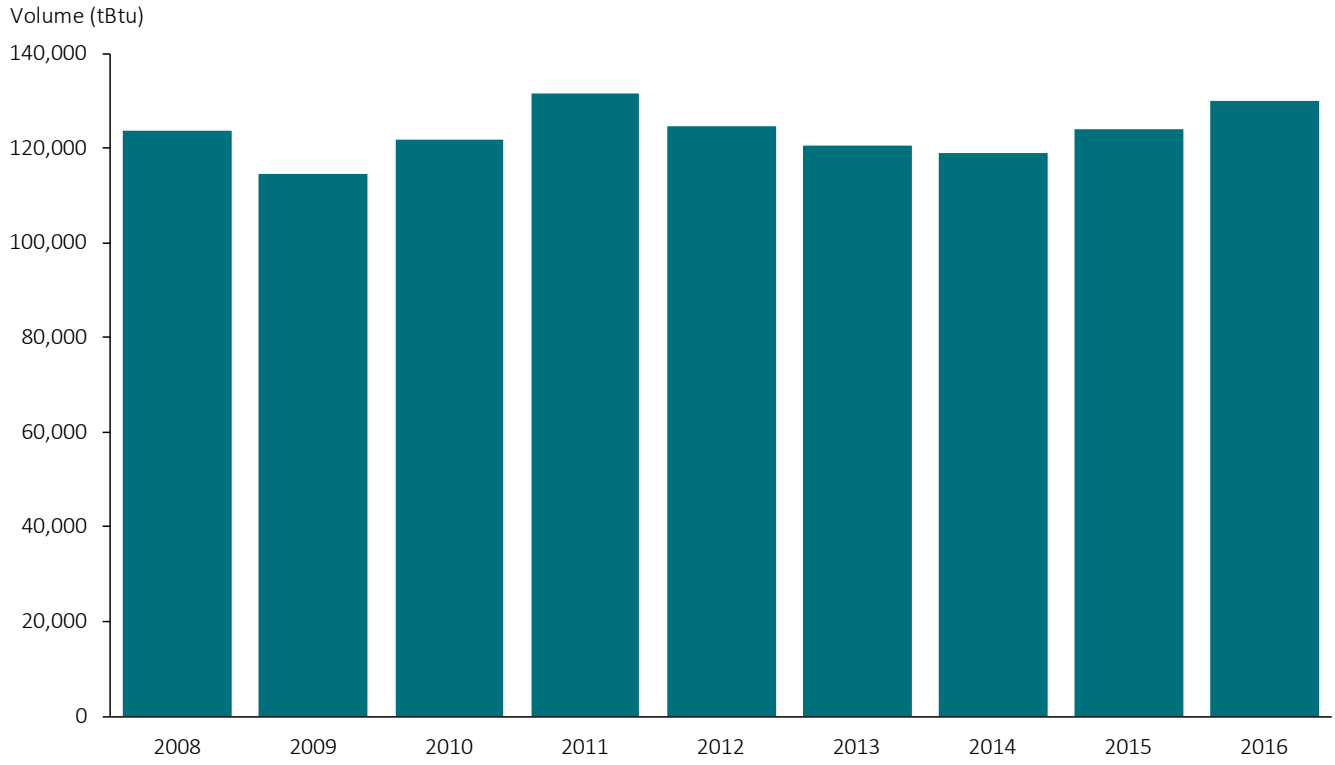
Note: Other includes Barbados Vessel Exports and Canada Truck Exports. Mexico includes vessel and truck exports. Volumes are converted from millions of cubic feet to tBtu using the Natural Gas Exports Heat Content reported by the EIA. LNG prices are export-location specific.

Market Volume

- Total Form 552 volume grew in 2016 for the second year in a row, increasing by nearly 5 percent from 2015 and 9.3 percent from 2014.
- The 2016 trading activity reported in the Form 552 submissions totaled 130,012 tBtu transacted by 711 respondents, 31 more respondents than submitted 2015 trading data.
- Form 552 volumes in 2016 represented a minimum of 65,442 tBtu of trading volume.[20]

Both the number and total volume of Form 552 submissions increased for the second year in a row.

Figure 3: Total Reported Volume
2008–2016



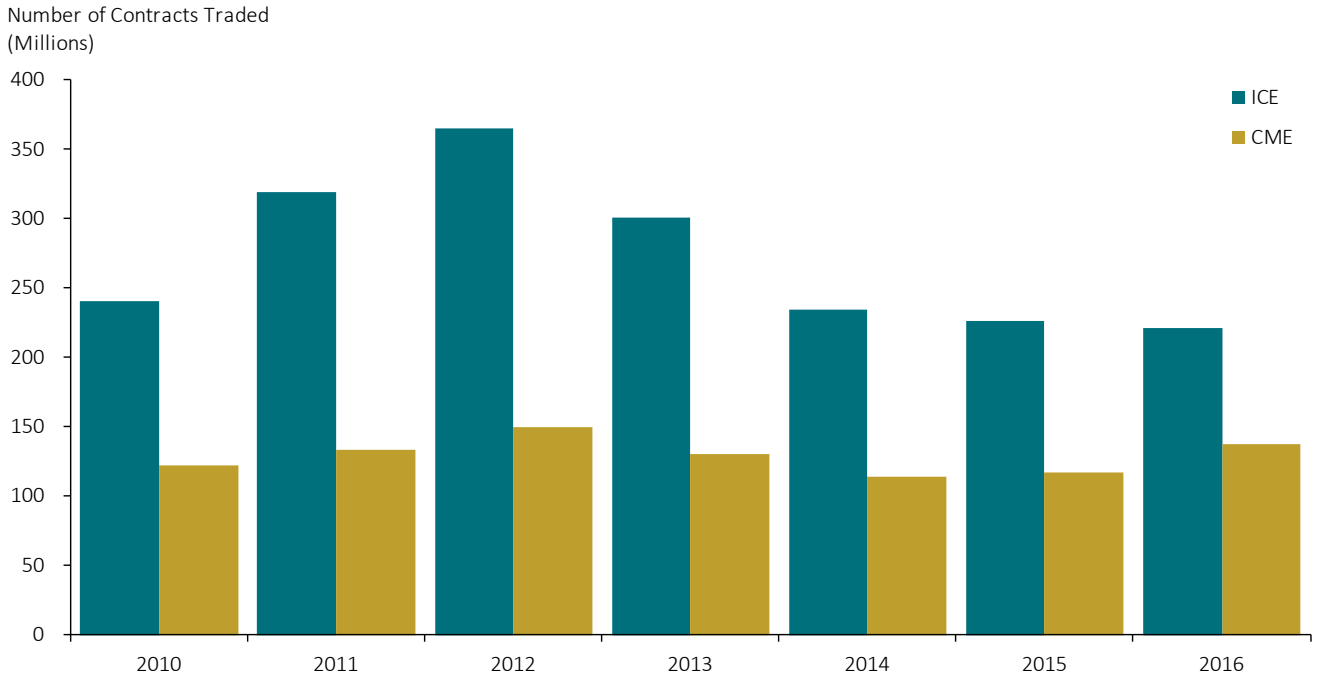
Source: FERC Form 552 submissions as of May 16, 2017
Note: One tBtu equals one million mmBtu.

Exchange Trading

- For the first time in three years, aggregate trading of natural gas contracts rose in 2016, due to a large increase in trading on CME.
- In 2016, trading on CME was 17 percent greater compared to 2015. This marks the second year of increased CME trading.[21]
- CME stated the increase in overall energy contract volume on its platform was due to "high volatility within the energy markets." In particular, it highlighted "the Organization of Petroleum Exporting Countries decision to cut oil supplies as well as the U.S. presidential and congressional elections, which created uncertainty surrounding the new administration's proposed policies for the energy markets."[22]
- ICE natural gas contracts traded fell 2.2 percent from 2015 to 2016. This decrease was the smallest in the last four years.
- ICE attributed the declines to "lower price volatility related to high natural gas supplies."[23]
- Natural gas is also traded on other platforms, including NASDAQ.[24] Approximately one million natural gas contracts were traded on NASDAQ in 2016, far less than on ICE and CME.[25]

CME's volume increased for the second year in a row (17 percent in 2016) while ICE's volume declined 2.2 percent.

Figure 4: ICE and CME Futures and Options Natural Gas Trading 2010–2016



Source: ICE Form 10-Ks; CME 10-Ks

Note: Due to ICE's conversion of swaps to futures in October 2012, the ICE 10-K reports an aggregated total of natural gas futures, options, and cleared OTC contracts. In its 2012 10-K, ICE provides comparable totals for 2011 and 2010 to reflect the 2012 reclassification. From 2012 forward, the figures reflect worldwide contract volume; prior to 2012, the totals reflect only North America contract volume. In 2012 and 2013, the only years where both estimates are available from ICE, the non–North America contract volume accounts for less than 3 percent of total contracts traded. The figures reported by CME represent the average daily volume of its natural gas products, and they have been multiplied by 250 to convert them to annual values. The contract sizes between ICE and CME are not directly comparable. Contract sizes may differ across products, for example the CME Henry Hub Natural Gas Futures contract is 10,000 mmBtu and the ICE Henry LD1 Fixed Price Future contract is 2,500 mmBtu.

Cornerstone Research Proprietary Classification of Market Participants

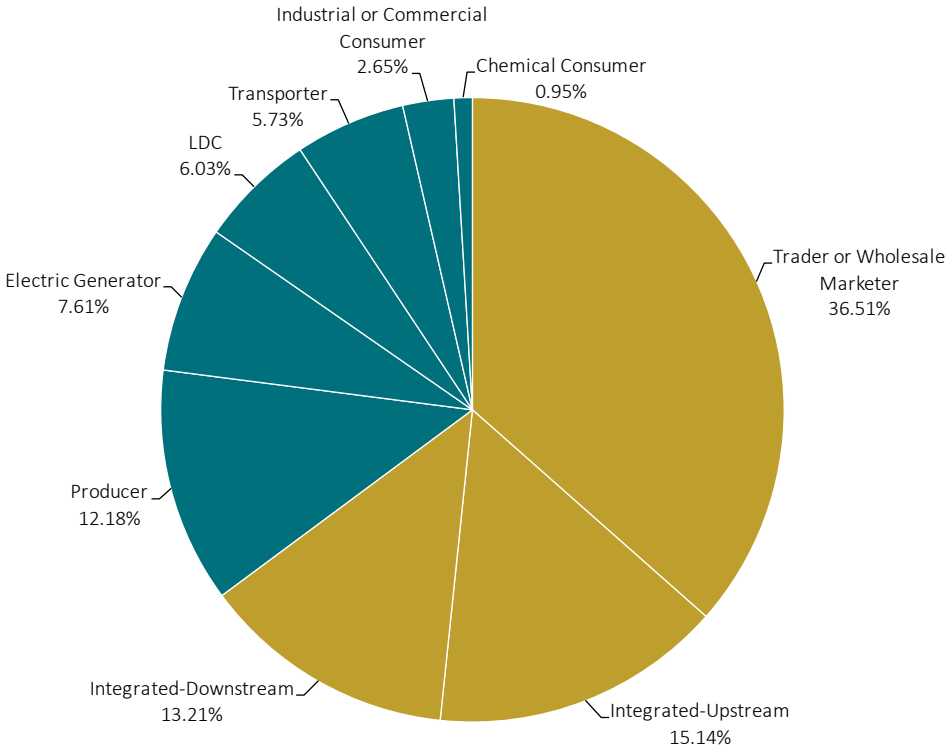
Natural Gas Market Participants

Cornerstone Research supplements FERC Form 552 data with proprietary research that classifies the respondent companies by industry segments. Companies are classified by their primary natural gas business activity, yielding a unique overview of the natural gas market.

- Large integrated-upstream and integrated-downstream companies and traders or wholesale marketers accounted for approximately 65 percent of Form 552 natural gas volume in 2016.
- In contrast, industrial or commercial consumers and chemical consumers accounted for less than 4 percent of the Form 552 volume.
- These percentages have remained relatively consistent over the past seven years. However, since 2012, the share of volume for large integrated companies and traders or wholesale marketers has decreased from 72 percent to 65 percent.

The share of volume for large integrated companies and traders or wholesale marketers has decreased since 2012.

Figure 5: Transaction Volume by Company Category
2016



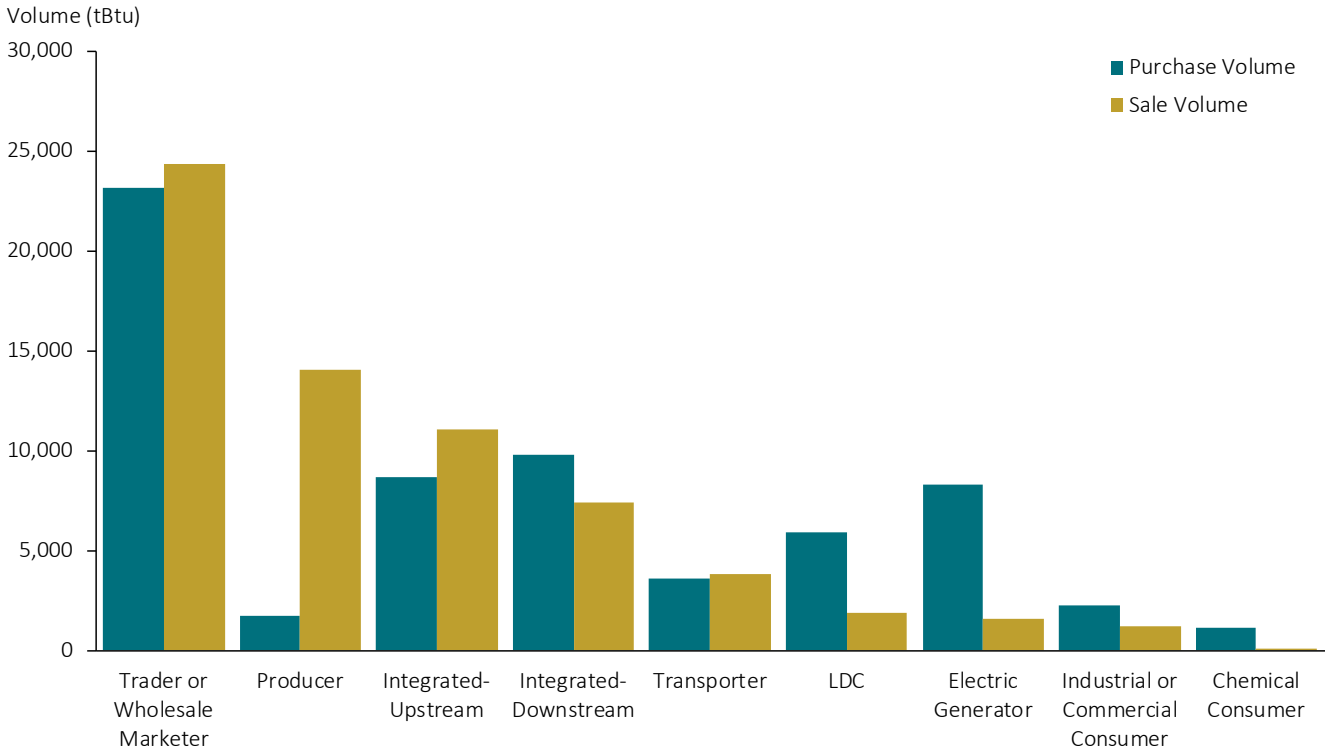
Source: FERC Form 552 submissions as of May 16, 2017
Note: Percentages may not add up to 100 percent due to rounding.

As would be expected, companies primarily engaging in "upstream" or "downstream" activities are strong net sellers or buyers of natural gas, respectively, while "midstream" companies buy and sell in equal amounts.

- The breakdown of Form 552 purchases and sales by company category showed that integrated-upstream companies and producers sold more natural gas than they purchased in 2016.
- Local distribution companies (LDCs), integrated-downstream companies, electric generators, industrial or commercial consumers, and chemical consumers purchased more than they sold.
- Consistent with their business models, traders or wholesale marketers and transporters purchased and sold approximately equal amounts.

Electric generators and LDCs were the largest net purchasers of natural gas.

Figure 6: Purchase and Sale Volume by Company Category
2016



Source: FERC Form 552 submissions as of May 16, 2017
Note: One tBtu equals one million mmBtu.

The list of 20 companies with the largest total transaction volumes indicates that the U.S. natural gas market has a large number of diverse participants. These 20 companies tend to be consistent from year to year—15 of the top 20 companies in 2016 were also among the leading companies in 2015.

- The top 20 companies accounted for 56,366 tBtu out of 130,012 tBtu, or approximately 43 percent of volume reported on Form 552 submissions in 2016. This share of volume is consistent with the three prior years, although it is below the average of 47 percent from 2011 to 2012.
- BP Energy Company had the largest physical volumes for the ninth consecutive year at 8,697 tBtu, a small decrease from 8,772 tBtu in 2015. Its volume was almost 75 percent more than the second-largest trader's volume.
- Five companies fell from the top 20 companies by volume: BG Energy Merchants LLC fell from 10 to 30, Anadarko Petroleum Corporation fell from 17 to 22, Enterprise Products Partners L.P. fell from 18 to 21, Iberdrola Energy Services LLC, renamed as Enstor Energy Services LLC, fell from 19 to 24, and South Jersey Resources Group LLC fell from 20 to 23.
- Mercuria Energy America Inc., Direct Energy Marketing Inc., Concord Energy LLC, and DTE Energy Trading Inc. entered the top 20 this year. AGL Resources Inc. was renamed as Southern Company Gas and remained fifth. Energy Transfer Partners L.P., ranked ninth this year, was excluded from last year's report because it filed after the analysis was completed. Its 2015 form had total volume of 1,979 tBtu, which would have ranked Energy Transfer Partners sixth in the 2015 report.

The overall increase in trading volumes did not affect market concentration.

Figure 7: Top 20 Companies by Total Reported Volume
2016
(Sorted by Total Volume, in tBtu)

Company Name	Any Affiliates Report to Index Publishers	Total Buy Volume	Total Sale Volume	Net Volume	Total Transaction Volume	Volume Reportable to Indices[2]
BP Energy Company	Y	4,236	4,461	-226	8,697	1,956
Tenaska Marketing Ventures	Y	2,462	2,513	-51	4,975	1,399
Shell Energy North America (US) L.P.	Y	2,223	2,374	-151	4,598	861
Macquarie Energy LLC	Y	2,213	2,189	25	4,402	1,192
Southern Company Gas	N	2,338	1,966	371	4,304	731
ConocoPhillips Company	Y	1,746	2,095	-349	3,841	676
CenterPoint Energy Inc.	N	1,346	1,039	307	2,385	164
J. Aron & Company	Y	1,183	1,159	25	2,342	790
Energy Transfer Partners L.P.	Y	786	1,237	-451	2,023	410
Chevron U.S.A. Inc.	Y	886	1,089	-202	1,975	303
Twin Eagle Resource Management LLC	N	927	1,020	-92	1,947	322
Natural Gas Exchange Inc.	N	973	973	0	1,947	891
EDF Trading North America LLC	N	923	960	-37	1,883	471
Exelon Generation Company LLC	N	1,043	709	334	1,752	717
Mercuria Energy America Inc.	N	888	832	56	1,721	375
Direct Energy Marketing Inc.	N	1,020	577	443	1,597	289
Chesapeake Energy Corporation	N	161	1,435	-1,273	1,596	105
Concord Energy LLC	Y	764	736	28	1,500	220
DTE Energy Trading Inc.	N	729	769	-40	1,498	222
Pacific Summit Energy LLC	N	721	665	56	1,386	270
Top 20 Companies by Total Volume		27,569	28,797	-1,229	56,366	12,362
All Other Companies		37,002	36,644	358	73,647	14,103
Total for All Companies		64,571	65,442	-871	130,012	26,465

Source: FERC Form 552 submissions as of May 16, 2017

Note:
1. Numbers may not add up to totals due to rounding. One tBtu equals one million mmBtu.
2. Volume Reportable to Indices includes the sum of fixed-price next-month purchases and sales, fixed-price next-day purchases and sales, and physical-basis-transaction volume reported on Form 552.

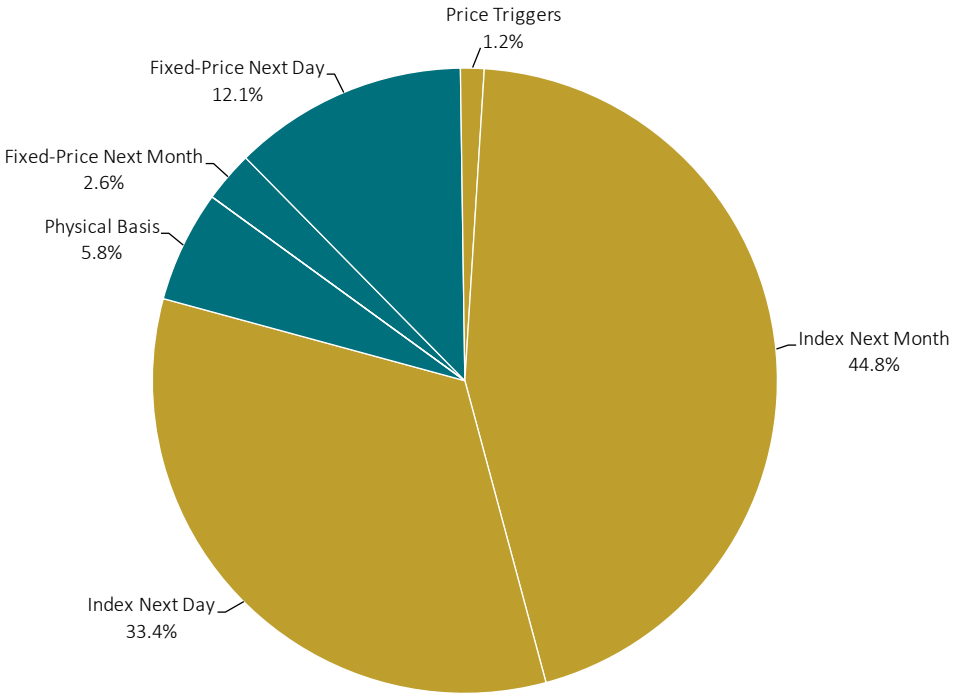
Transaction Types

Since 2013, the index-priced transactions have comprised an increasing fraction of overall Form 552 transactions each year while the portion of transactions that have fixed prices has steadily declined.[26]

- From 2012 to 2016, index-price transactions increased from approximately 72 percent to 79 percent of all Form 552 transactions.
- Since 2011, transactions that reference the monthly index have been the most prevalent among index-priced transactions and accounted for nearly 45 percent of all Form 552 transactions in 2016.
- Combined fixed-price and index-priced transactions covered by Form 552 were split relatively equally between next-month transactions (47 percent) and next-day transactions (46 percent).[27]
- Price triggers were the least prevalent transaction type, comprising approximately 1 percent of Form 552 transactions.

Index-priced transactions accounted for a majority of Form 552 transactions.

Figure 8: Transaction Volume by Transaction Type
2016



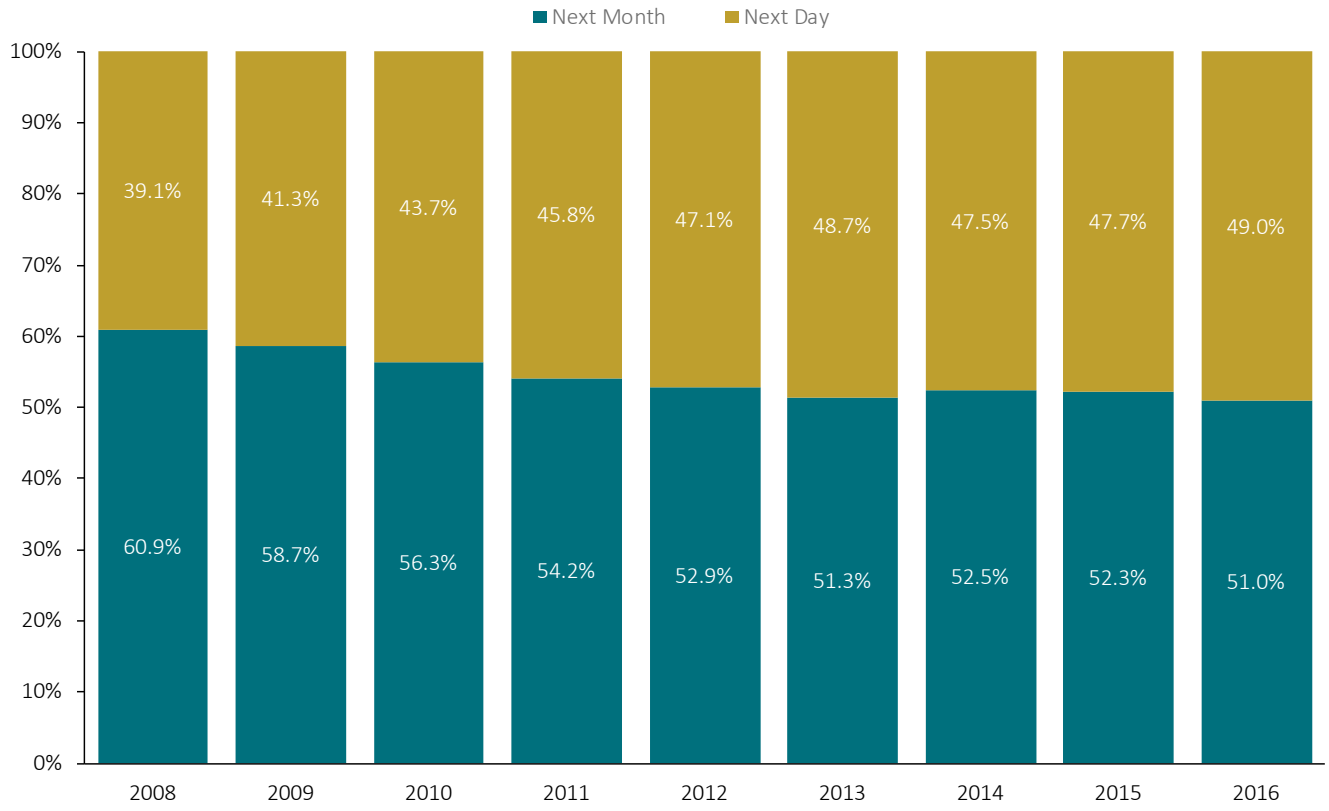
Source: FERC Form 552 submissions as of May 16, 2017
Note: Percentages may not add up to 100 percent due to rounding.

Next-day transactions have increased as a percentage of total fixed-price and index-priced transaction volume[28] since 2008, while the volume of next-month transactions has declined relative to fixed-price transactions.

- The percentage of volume based on next-month transactions has decreased by slightly more than 10 percentage points from 2008 to 2016 (from 60.9 percent to 51 percent).
- Next-month transaction volume has been displaced by next-day transactions, with the majority of the change occurring between 2008 and 2012, when next-day transactions grew by 8 percentage points.
- The relative growth in next-day transactions may indicate a shift in industry contracting and risk management practices.

The growing popularity of next-day transactions relative to next-month transactions may reflect a shift in industry practices.

Figure 9: Next-Month and Next-Day Transaction Volume across Both Fixed-Price and Index-Priced Transactions 2008–2016



Source: FERC Form 552 submissions as of May 16, 2017
Note: Percentages may not add up to 100 percent due to rounding.

Volume and Depth of Reporting to Price-Index Publishers

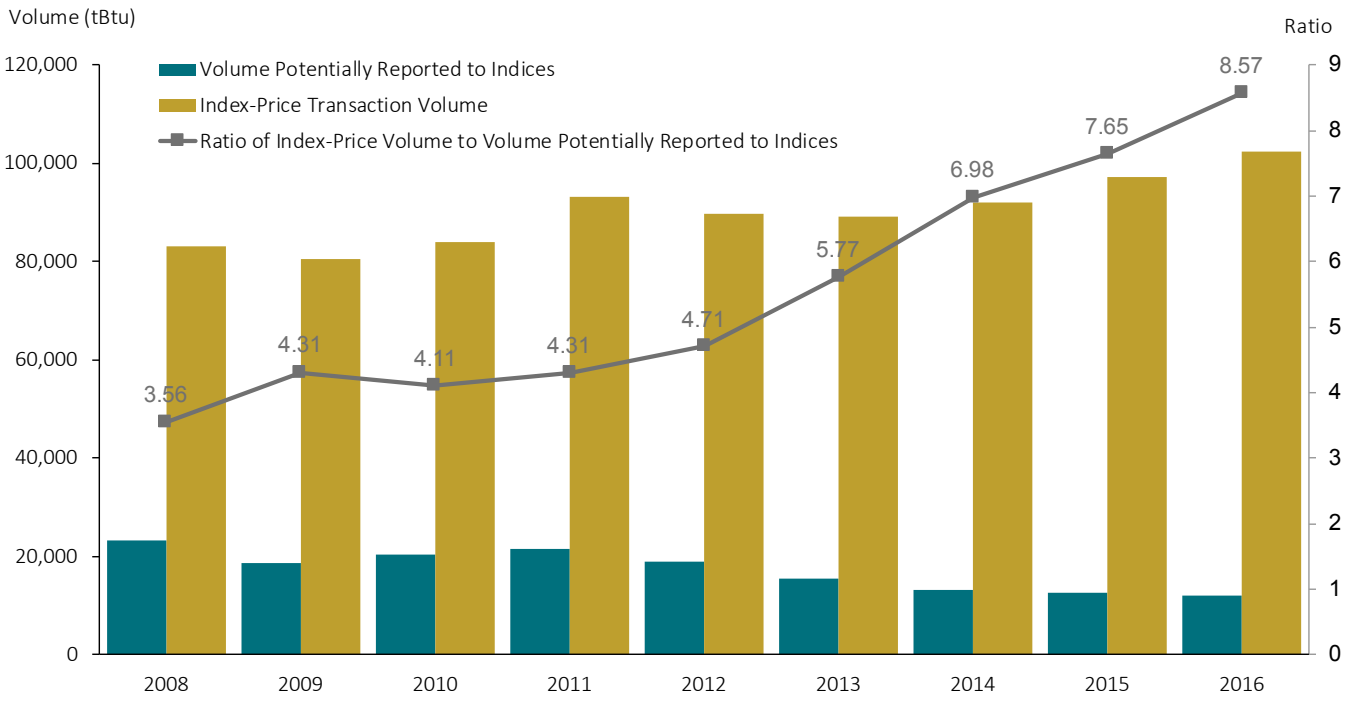
In Order 704, FERC commented that understanding the relative sizes of the volume of index-price transactions and reporting-eligible, fixed-price transactions was a core purpose of mandating Form 552 submissions.[29]

- For the sixth year in a row, the ratio of index-priced volume dependent on indices relative to volume potentially reported to indices increased.[30]
- The growth in this ratio resulted from a 5 percent increase in the volume of index-priced transactions and a 6 percent decrease in the fixed-price volume potentially reportable to indices.

The ratio of transactions dependent on indices to fixed-price transactions that form the indices continued to increase.

- The year 2016 witnessed both the largest volume of index-priced transactions and the lowest volume potentially reported to indices since the inception of Form 552 reporting.
- In 2016, the ratio of index-priced transactions to potentially reported fixed-price transactions was the largest since Form 552 data were first collected for 2008.
- To help address the shrinking number of reported transactions, price-index publisher Platts entered into an agreement with ICE to receive anonymized natural gas transactions for use in Platts's daily natural gas assessments.[31] Platts began incorporating ICE's physical gas trades into the price assessments in late May 2017.[32] With this agreement, a company does not actually need to report to index publishers in order to have its trades incorporated into an index.

Figure 10: Volumes Potentially Reported to Indices versus Transaction Volumes Priced Based on Indices 2008–2016



Source: FERC Form 552 submissions as of May 16, 2017

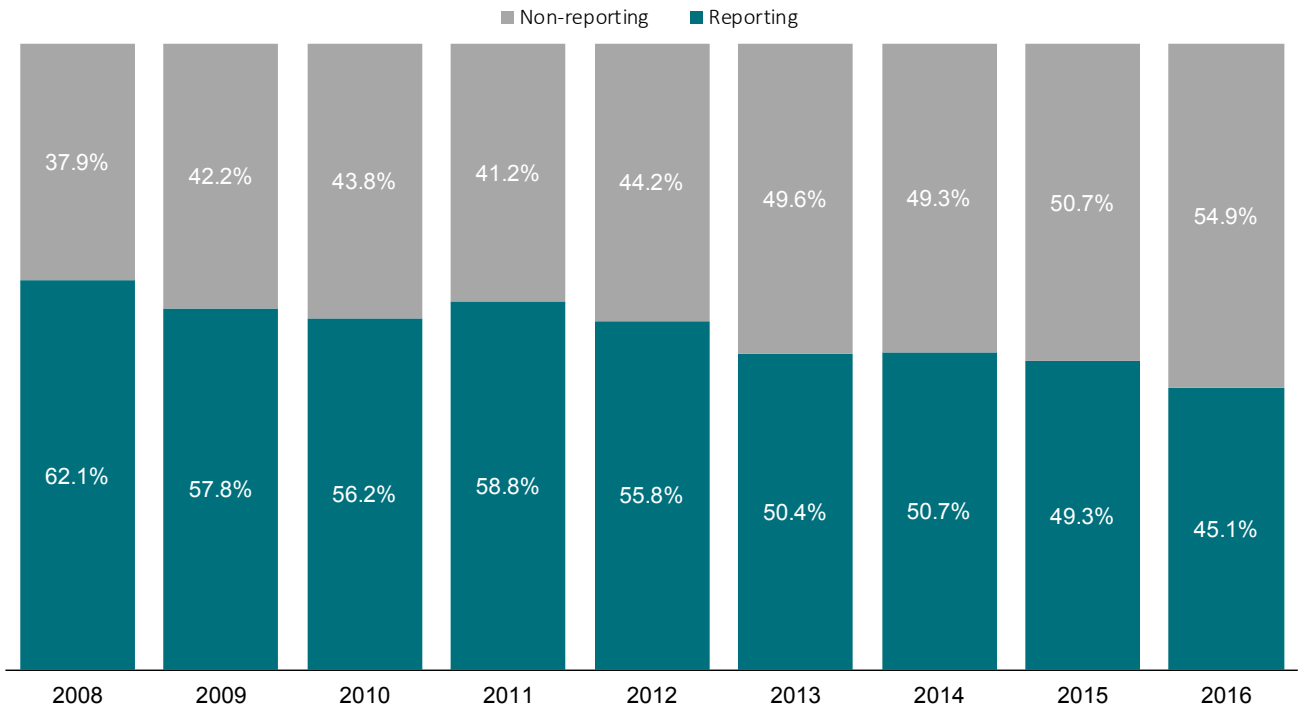
Note: Reportable volume is the sum of fixed-price next-month purchases and sales, fixed-price next-day purchases and sales, and physical-basis-transaction volume reported on Form 552. Companies that did not enter information regarding their price reporting were assumed to not report. One tBtu equals one million mmBtu.

Form 552 submissions also provide information on which companies had volume eligible to be reported (i.e., fixed-price transactions[33]), and whether they reported that volume to the indices.

- The percentage of fixed-price volume transacted by non-reporting companies increased by more than 4 percentage points from 2015 to 2016. This is the second consecutive year that companies that chose not to report fixed-price volume to the indices had a higher percentage of fixed-price volume than companies that chose to report.
- Of the 711 respondents in 2016, only 110 (just over 15 percent) reported transaction information to the price-index publishers for themselves or at least one affiliate.
- The reporting companies accounted for 45 percent of the reporting-eligible, fixed-price volume in 2016, compared to over 60 percent in 2008.

Only 15 percent of respondents reported transaction information to price-index publishers.

Figure 11: Fixed-Price Volume by Reporting versus Non-reporting Companies
2008–2016



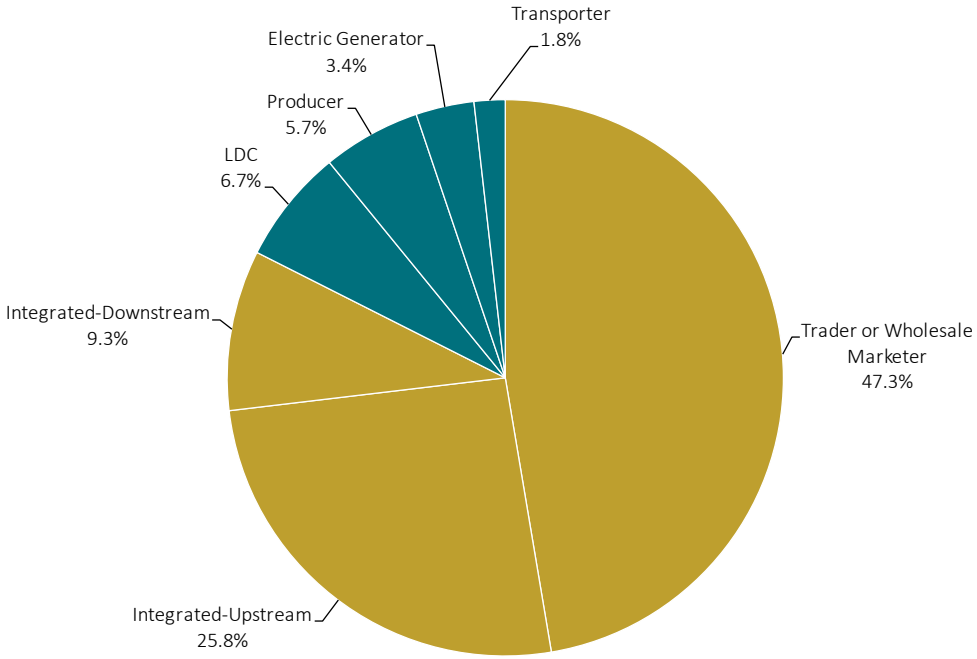
Source: FERC Form 552 submissions as of May 16, 2017

Note: Reportable volume is the sum of fixed-price next-month purchases and sales, fixed-price next-day purchases and sales, and physical-basis-transaction volume reported on Form 552. Companies that did not enter information regarding their price reporting were assumed to not report. Percentages may not add up to 100 percent due to rounding.

- Integrated-upstream companies and traders or wholesale marketers accounted for approximately 73 percent[34] of the fixed-price volume potentially reported to the price-index publishers in 2016.
- In 2016, nine of the top 20 companies by volume reported to index publishers, one fewer company than in 2015.
- These nine companies accounted for 65 percent[35] of the fixed-price volume potentially reported to price-index publishers.

Traders or wholesale marketers and integrated-upstream firms traded 73 percent of the potentially reported fixed-price volume in 2016.

Figure 12: Fixed-Price Volume for Entities Reporting to Price-Index Publishers by Company Type
2016



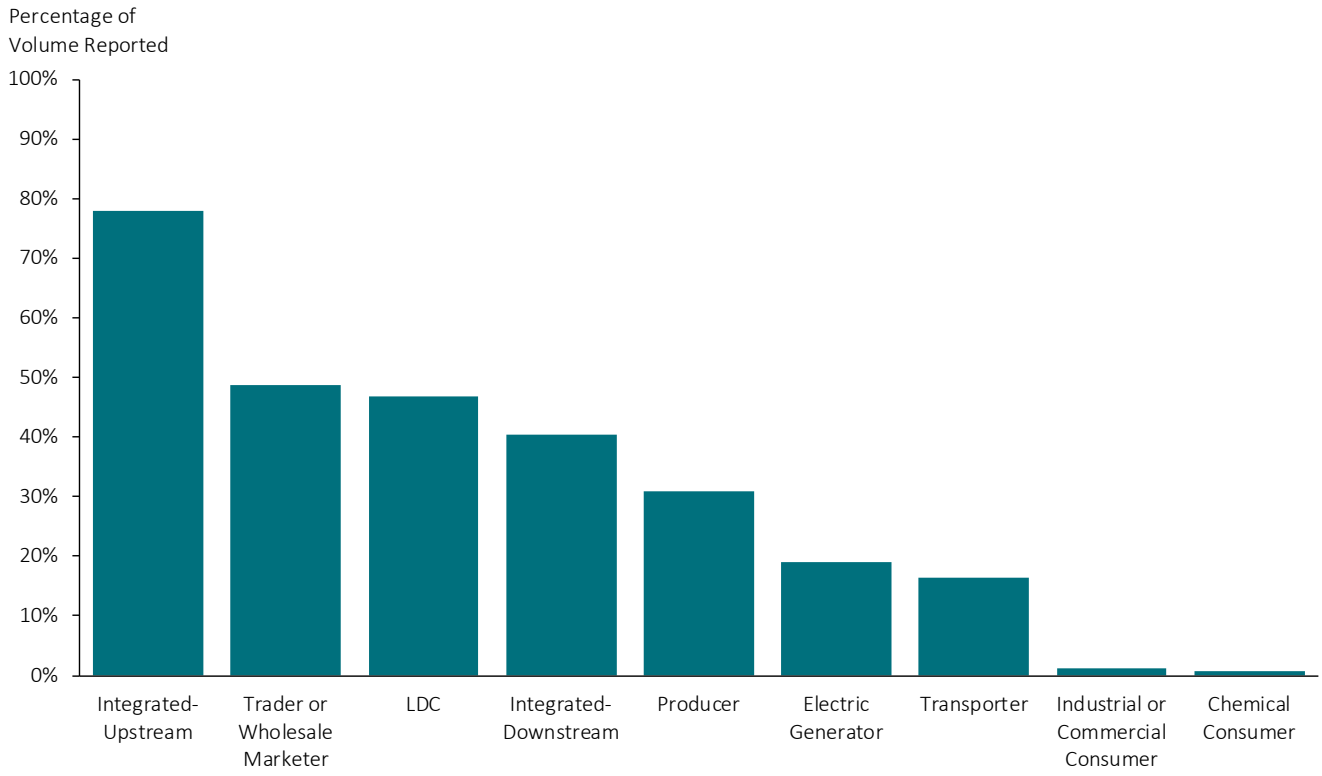
Source: FERC Form 552 submissions as of May 16, 2017
Note: Industrial or commercial consumer and chemical consumer companies reported less than 0.20 percent of reportable volume and are excluded.

The proportion of volume reported by each industry segment in 2016 has remained roughly constant for the last two years.

- Integrated-upstream companies reported 78 percent of fixed-price transaction volume in 2016, a decrease of 10 percentage points from 2015 and 12 percentage points from 2014.
- Traders or wholesale marketers, LDCs, integrated-downstream companies, and producers reported between 30 percent and 50 percent of fixed-price transaction volume to indices.
- Chemical consumers and industrial or commercial consumers combined reported 2 percent of their fixed-price transaction volume to indices.

Fixed-price transactions reported by integrated-upstream companies decreased by 10 percentage points.

Figure 13: Percentage of Fixed-Price Volume Reported to Price-Index Publishers by Company Category
2016



Source: FERC Form 552 submissions as of May 16, 2017
Note: Of the 711 respondents in 2015, 110 indicated they reported transaction information to price-index publishers for themselves or at least one affiliate.

Glossary

Btu: A British thermal unit (Btu) is the amount of heat energy needed to raise the temperature of one pound of water by one degree Fahrenheit. Millions of this unit are written as mmBtu, and trillions as tBtu.

CME Group Inc. (CME): A "diverse derivatives marketplace… The company provides a marketplace for buyers and sellers, bringing together individuals, companies and institutions that need to manage risk or that want to profit by accepting risk." http://www.cmegroup.com/company/history/.

Downstream: "A term used in the petroleum industry referring to the refining, transportation, and marketing side of the business." http://www.energy.ca.gov/glossary/glossary-d.html.

EIA: U.S. Energy Information Administration. "EIA provides a wide range of information and data products covering energy production, stocks, demand, imports, exports, and prices; and prepares analyses and special reports on topics of current interest." http://www.eia.gov/about/.

FERC Form 552: Annual Report of Natural Gas Transactions. "FERC Form No. 552 collects transactional information from natural gas market participants. The filing of this information is necessary to provide information regarding physical natural gas transactions that use an index and transactions that contribute to, or may contribute to gas price indices. This form is considered to be a non-confidential public use form." https://www.ferc.gov/docs-filing/forms/form-552/form-552.pdf.

Fixed price: "A 'Physical Natural Gas Transaction' price determined by agreement between buyer and seller and not benchmarked to any other source of information." https://www.ferc.gov/docs-filing/forms/form-552/form-552.pdf.

Fixed-price, next-day transaction: "[D]elivery of natural gas pursuant to a transaction executed prior to NAESB [North American Energy Standards Board] nomination deadline (11:30 am Central Prevailing Time) on one day for uniform physical delivery over the next pipeline day." https://www.ferc.gov/docs-filing/forms/form-552/form-552.pdf.

Fixed-price, next-month transaction: "[D]elivery of natural gas pursuant to a transaction executed during the last five business days of one month (bidweek) for uniform physical delivery over the next month." https://www.ferc.gov/docs-filing/forms/form-552/form-552.pdf.

Henry Hub: A principal natural gas trading hub in North America, with connections to nine interstate and four intrastate pipelines. Henry Hub serves as the delivery point for the U.S. natural gas futures contract traded on the New York Mercantile Exchange (NYMEX). https://www.theice.com/publicdocs/ICE_NatGas_Brochure.pdf; http://www.cmegroup.com/trading/energy/natural-gas/natural-gas_contract_specifications.html.

Intercontinental Exchange Inc. (ICE): A "network of regulated exchanges and clearing houses for financial and commodity markets." https://www.intercontinentalexchange.com/index.

Index price: "A price obtained from an industry publication, which is intended to represent an average price of gas delivered to a specific point on the pipeline at or during a specified period of time." http://www.uniongas.com/storage-and-transportation/resources/additional-info/glossary.

Liquefied natural gas (LNG): Natural gas (primarily methane) that has been liquefied by reducing its temperature to negative 260 degrees Fahrenheit at atmospheric pressure. http://www.eia.gov/tools/glossary/index.cfm?id=L.

Local distribution company (LDC): "A legal entity engaged primarily in the retail sale and/or delivery of natural gas through a distribution system that includes main lines (that is, pipelines designed to carry large volumes of gas, usually located under roads or other major right-of-ways) and laterals (that is, pipelines of smaller diameter that connect the end user to the mainline). Since [the] structuring of the gas industry, the sale of gas and/or delivery arrangements may be handled by other agents, such as producers, brokers, and marketers that are referred to as 'non-LDC.'" http://www.eia.gov/tools/glossary/index.cfm?id=L.

Midstream: Activity involving "pipelines, processing plants, and storage facilities." http://www.ferc.gov/market-oversight/guide/energy-primer.pdf.

Physical-basis transactions: "[T]ransactions in which the basis value is negotiated on one of the first three days of bidweek and the price is set by the final closing value of the near-month NYMEX Natural Gas Futures contract plus or minus the negotiated basis. These transactions are for uniform physical delivery over the next month." https://www.ferc.gov/docs-filing/forms/form-552/form-552.pdf.

Price trigger: According to FERC Form 552, a trigger agreement is "a NYMEX trigger transaction that is contingent upon a futures contract that trades on an exchange, resulting in an automatic physical trade at an agreed upon price." https://www.ferc.gov/docs-filing/forms/form-552/form-552.pdf.

Shale gas: "Natural gas produced from wells that are open to shale formations. Shale is a fine-grained, sedimentary rock composed of mud from flakes of clay minerals and tiny fragments (silt-sized particles) of other materials. The shale acts as both the source and the reservoir for the natural gas." https://www.eia.gov/tools/glossary/index.php?id=S.

Tight gas: "Tight gas refers to natural gas reservoirs locked in extraordinarily impermeable, hard rock, making the underground formation extremely 'tight.'" http://www.rigzone.com/training/insight.asp?insight_id=346.

Tight oil: "Oil produced from petroleum-bearing formations with low permeability such as the Eagle Ford, the Bakken, and other formations that must be hydraulically fractured to produce oil at commercial rates." http://www.eia.gov/tools/glossary/index.cfm?id=T.

Upstream: "A term used in the petroleum industry referring to the exploration and production side of the business." http://www.energy.ca.gov/glossary/glossary-u.html.

Appendices

Appendix 1: Background on the Energy Policy Act of 2005, Form 552 Submissions, and Cornerstone Research's Proprietary Analysis

In 2005, Congress passed the Energy Policy Act of 2005 (EPAct 2005), which authorized FERC to "facilitate price transparency in markets for the sale or transportation of physical natural gas in interstate commerce" (§ 316). The EPAct 2005 allowed FERC to issue rules to "provide for the dissemination, on a timely basis, of information about the availability and prices of natural gas sold at wholesale and in interstate commerce to the Commission, State commissions, buyers and sellers of wholesale natural gas, and the public" (§ 316). After an extensive rule-making process, FERC issued Order 704-A, which established reporting requirements.

In the summer of 2009, FERC received the first round of Form 552 submissions covering 2008 natural gas transactions from more than 1,121 respondents. On June 17, 2010, FERC issued Order 704-C, which provides for slightly revised reporting rules that ease some reporting requirements.[36] For 2016 natural gas transactions, Form 552 submissions covered 711 firms.

The data contained on the Form 552 submissions, described more fully in Appendix 2, provide a unique view into the size and nature of the physical natural gas market. First, these forms quantify the number of trade participants and trade volumes of firms that report to the price-index publishers. Second, the data provide insight into the relative proportion of fixed-price and index-price transactions. Third, while FERC did not request information on all natural gas transactions, the data yield an outline of the size of the physical natural gas market, especially at the trading and wholesale levels.

Cornerstone Research supplements the FERC Form 552 data with proprietary research that classifies the respondent companies by industry segments. These industry segments are producer, transporter, electric generator, industrial or commercial consumer, chemical consumer, trader or wholesale marketer, LDC, integrated-downstream, and integrated-upstream.[37] The latter two categories capture companies that span multiple industry segments.[38]

Appendix 2: Data Submitted to FERC

Order 704-C requires natural gas market participants with purchases or sales of physical "reportable" natural gas of at least 2.2 tBtu in the prior calendar year to report these activities on Form 552. Specifically, these market participants must submit volumes of physical natural gas transactions that "are only those transactions that refer to an index, or that contribute to, or could contribute to the formation of a gas index during the calendar year."[39] Order 704-A (p. 9) further clarifies that the transactions that could be reported to an index publisher means any "bilateral, arms-length, fixed-price physical natural gas transactions between nonaffiliated companies at all trading locations."

Order 704-C excludes any transaction that does not depend on a published price index or that could not be reported to an index-price publisher. The criteria for reporting to an index-price publisher specifically exclude transactions for balance-of-month supply, intraday trades consummated after the pipeline nomination deadline, monthly fixed-price transactions conducted prior to bidweek, fixed-price transactions for terms longer than one month, and fixed-price transactions including other services or features (such as volume flexibility) that would render them ineligible for price reporting. Further, Order 704-C excludes transactions by affiliates from the submission requirements.

While respondents aggregate their reported transaction volumes across locations and for the entire calendar year, they must submit purchase and sale volumes separately for each of the following types of transactions: fixed-price for next-day delivery, index-price referencing next-day indices, fixed-price for next-month delivery, index-price referencing next-month indices, transactions with price triggers,[40] and physical-basis transactions.[41] In addition to volumes of physical transactions, market participants are required to state whether or not they report transaction information to the price-index publishers.

Endnotes

[1] Data as of May 16, 2017, were used for all respondents except for Energy Transfer Partners L.P., which submitted on May 30, 2017.

[2] The phrase "potentially reported" is used because a company may state on Form 552 that it reports to index publishers but not all of its subsidiaries, affiliates, or locations report. In addition, not all fixed-priced transactions have a corresponding published index to which they can be reported.

[3] A respondent is considered to be a unique reporting company-respondent combination as reported on the FERC Form 552.

[4] Calculated as minimum trading volume of 65,442 tBtu from Figure 7 divided by 26,172 tBtu EIA natural gas delivered to consumers. "U.S. Natural Gas Consumption by End Use," EIA, http://www.eia.gov/dnav/ng/NG_CONS_SUM_DCU_NUS_A.htm. Converted to trillion Btu (tBtu) from million cubic feet (MMcf). 1 cubic foot = 1,036 Btu, the annual Total Consumption conversion factor in the EIA time series "Approximate Heat Content of Natural Gas (Btu per Cubic Foot)," https://www.eia.gov/dnav/ng/ng_cons_heat_dcu_nus_a.htm.

[5] "Annual Energy Outlook 2017," EIA, January 5, 2017, p. 54, https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf.

[6] Ibid., p. 58.

[7] Ibid., p. 14.

[8] Ibid., pp. 17–18.

[9] Ibid., p. 54. See also "Annual Energy Outlook 2017 Table: Energy Consumption by Sector and Source," EIA, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=2-AEO2017&region=1-0&cases=ref2017&start=2017&end=2040&f=A&linechart=ref2017-d120816a.138-2-AEO2017.1-0&map=ref2017-d120816a.4-2-AEO2017.1-0&ctype=linechart&chartindexed=1&sid=ref2017-d120816a.95-2-AEO2017.1-0&sourcekey=0.

[10] "U.S. Crude Oil and Natural Gas Production Both Fell in 2016," EIA, March 8, 2017, https://www.eia.gov/todayinenergy/detail.php?id=30252.

[11] "Annual Energy Outlook 2017," EIA, January 5, 2017, p. 55, https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf.

[12] Ibid., p. 66.

[13] "First-Ever LNG Vessel Transits the Expanded Panama Canal, Ushering in New Era for the Segment and Global LNG Trade," Canal de Panamá, July 25, 2016, http://micanaldepanama.com/expansion/2016/07/first-ever-lng-vessel-transits-the-expanded-panama-canal-ushering-in-new-era-for-the-segment-and-global-lng-trade/.

[14] Total U.S. natural gas exports in 2016 were 2,315 tBtu. "U.S. Natural Gas Exports and Re-Exports by Country," EIA, https://www.eia.gov/dnav/ng/ng_move_expc_s1_a.htm.

[15] South American countries include Argentina, Brazil, and Chile. Middle Eastern countries include Jordan, Kuwait, Turkey, and the United Arab Emirates. Asian countries include China, India, Japan, and South Korea.

[16] European countries imported a total of 9.96 tBtu LNG from exports to Portugal (3.7 tBtu), Spain (2.93 tBtu), and Italy (3.33 tBtu). 9.96 tBtu / 186 tBtu = 5 percent.

[17] For example, the version of this report published on July 13, 2016, discussed that "Cheniere Energy stated that it expects to ship up to half of its LNG exports to Europe." *Characteristics of U.S. Natural Gas Transactions: FERC Form 552 Submissions as of May 2016*, Cornerstone Research, 2016, p. 3, https://www.cornerstone.com/Publications/Reports/Characteristics-of-US-Natural-Gas-Transactions-2016.

[18] "Perspectives on the Development of LNG Market Hubs in the Asia Pacific Region," EIA, March 2, 2017, https://www.eia.gov/analysis/studies/lng/asia/.

[19] Naureen S. Malik, "Tanker's U-Turn Shows How Shale is Changing World Gas Trade," Bloomberg, March 7, 2017, https://www.bloomberg.com/news/articles/2017-03-08/tanker-s-u-turn-shows-how-shale-boom-is-changing-world-gas-trade.

[20] To the extent that both parties to a transaction submit a Form 552, the total submitted volume will be double the volume of that transaction. For example, a trade for 10,000 mmBtu between two companies, each submitting a Form 552, will add 20,000 mmBtu to the total volume. The minimum volume that could be represented by Form 552 is the maximum of the buy and sale totals shown in Figure 7. Adding the buy and sale volume can double count transactions if both the buyer and seller file a Form 552. A potential limitation of this is that estimating volume with only sales or only purchases may underrepresent the volume of transactions represented by Form 552, since some transactions involve market participants that do not submit a Form 552.

[21] The figures reported by CME represent the average daily volume of its natural gas products, and they have been multiplied by 250 to convert them to annual values. CME reports the total number of contracts, and the volume represented by each contract may vary in size. See CME Form 10-Ks.

[22] CME 2016 10-K, p. 39.

[23] ICE 2016 10-K, p. 48.

[24] "Nasdaq Futures Products," NASDAQ, http://business.nasdaq.com/nasdaq-futures/products.

[25] "Exchange Volume by Class," OCC, https://www.theocc.com/webapps/volbyclass-reports.

[26] Data do not cover all transactions in the OTC market, since Form 552 excludes certain types of non-index-price transactions. See Appendix 2.

[27] Calculated based on Figure 8, index next month plus fixed-price next month: 44.8 percent + 2.6 percent = 47.4 percent; index next day plus fixed-price next day: 33.4 percent + 12.1 percent = 45.5 percent.

[28] Physical basis and price trigger trades are not included in this analysis.

[29] Order 704 (Appendix 1, p. 4) states that Form 552 submissions should be used "to determine important volumetric relationships between (a) the fixed price, day-ahead or month-ahead transactions that form price indices; and (b) transactions that use price indices. Without the most basic information about these volumetric relationships, the Commission has been hampered in its oversight and its ability to assess the adequacy of price-forming transactions."

[30] Calculated based on Figure 10, volume potentially reported to index publishers divided by the volume of index-price transactions: 102,359 ÷ 11,946 = 8.57.

[31] "S&P Global Platts and Intercontinental Exchange (ICE) to Improve Natural Gas Price Transparency and Bolster North America Benchmarks," S&P Global Platts, November 21, 2016, https://www.platts.com/pressreleases/2016/112116; Alexander Osipovich, "ICE, Platts Shore Up Shaky Natural Gas Indexes," *Wall Street Journal*, November 21, 2016, https://www.wsj.com/articles/ice-platts-shore-up-shaky-natural-gas-indexes-1479733201?mg=id-wsj.

[32] "S&P Global Platts Announces North America Natural Gas Assessment Methodology Details Following Its Agreement with Intercontinental Exchange to Improve Price Transparency and Bolster Benchmarks," S&P Global Platts, February 9, 2017, https://www.platts.com/pressreleases/2017/020917.

[33] For the purposes of this analysis, Physical Basis transactions are also included in the category of fixed-priced volume.

[34] Calculated based on Figure 12, integrated-upstream plus traders or wholesale marketers: 25.8 percent + 47.3 percent = 73.1 percent.

[35] Calculated based on Figures 7 and 10, top 20 companies with volume reportable to indices and an affiliate that reports to index publishers divided by total volume potentially reported to index publishers: 7,806 ÷ 11,946 = 65.4 percent. From Figure 7, nine of the top 20 companies have any affiliates that report to index publishers, which totals 7,806. From Figure 10, the 2016 volume potentially reported to indices represented by the smaller bar totals 11,946.

[36] Among other minor revisions, Order 704-C exempts transactions involving unprocessed natural gas as well as cash-out and imbalance transactions. Further, for 2009, companies that hold blanket marketing certificates, but do not meet the minimum transaction volume threshold, are no longer required to file a Form 552. For 2008, more than 300 companies filed a Form 552 and did not report any transaction volume. For 2009, only 16 companies filed a Form 552 without reporting transaction volumes.

[37] The categorization process is necessarily judgmental and was based on company websites and financial filings. Companies were categorized as closely as possible to their most significant natural gas market activity.

[38] Since these integrated companies typically have a focus at either the industry segment that is upstream (such as production, gathering, or processing) or downstream (such as electric generation, marketing to wholesale users, or industrial consumption), two categories were created to allow for investigation of any differences between these types of companies.

[39] FERC Form 552 (2016 version). Note that Form 552 covers only physical natural gas transactions. Financial transactions, such as swaps and options, are excluded, as are futures contracts, whether or not they are taken to physical delivery.

[40] FERC includes NYMEX plus contracts among trigger contracts. In these contracts, the price is typically set at a specified index value as a default. The buyer, however, has the option to fix (or trigger) the price at any given point in time based on the prevailing market prices.

Typically, the buyer can fix the price at the prevailing NYMEX price for the delivery month plus a predetermined premium. When they are triggered, these contracts become fixed-price trades. Thus, while trigger contracts are initially dependent on an index price, they often shed this dependence and give the buyer the price certainty of a fixed-price transaction.

[41] Physical-basis transactions are physical transactions that have prices set as a predetermined amount plus the NYMEX settlement price. The price-index publishers state that they incorporate physical-basis transactions into their price assessments.

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