ENERGY LOGISTICS & DISTRIBUTION

Industry In-Sight™

FALL / WINTER 2018




JORDAN KNAUFF & COMPANY

ENERGY EQUIPMENT & INFRASTRUCTURE ALLIANCE

The Voice of the Energy Supply Chain

ENERGYBUILDERS

IN THIS REPORT

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

All charts in this report are updated to the latest information available at the time of publication. Due to differing reporting dates for various data used throughout the report, all charts are not updated to the same ending period.

INTRODUCTION ... About This Report

We are pleased to offer this periodic report which provides a comprehensive compilation of energy information, insights and data. It aggregates critical planning and forecasting information from a myriad of sources into one resource for energy supply chain analysts and decision-makers.

The energy supply chain is an increasingly complex network of upstream, midstream and downstream providers of construction, equipment, materials and services. As shale gas-oil and renewable energy continue to expand in the U.S., additional infrastructure is needed to connect the new sources to the current network of pipelines, storage and transmission stations. Current and new members of the supply chain will need to expand in order to build and service the additional infrastructure.

We define the Energy Logistics & Distribution Industry as any energy production, transportation and storage activities that take place from the well-head to the refinery or gas processing plant through delivery to the end user. Industry members include: producers and distributors of oil and natural gas, natural gas liquids, refined fuels and propane; energy storage and pipeline operators; oil and gas field services; producers and distributors of lubricants, oils, greases and fluids; service contractors, capital equipment manufacturers; materials suppliers; as well as logistics, transportation and maintenance providers.

Segments covered in this Industry In-Sight™ include:

- Crude oil and refined products, natural gas, liquefied natural gas (LNG), natural gas liquids including propane and heating/fuel oil, as well as drilling activity.
- Renewables, including solar, wind, hydropower and ethanol.
- Logistics, including storage and terminals, pipelines, trucking, shipping and rail.
- Economic and financial data pertinent to the Energy Logistics & Distribution Industry.

It is our intention that this publication will provide value in the following areas:

- **Aggregate Information** – The Data Center provides comprehensive statistics on the Energy Logistics & Distribution Industry including, among others: prices (domestic and international), production, consumption, inventory, imports/exports, LNG terminals, drilling activity, solar and wind capacities, energy consumption by sector and source, tank and underground storage capacities and utilization, pipeline mileage and trucking conditions. In all, the report offers more than 70 individual charts covering these topics and more. All charts in this report are updated to the latest information available at the time of publication.
- **Input to Business Decisions** – As a relevant and informative reference for use when contemplating decisions that will have a meaningful impact on your business. Accordingly, we welcome any input, feedback and suggestions to help us include meaningful and timely topical content in future publications. We especially would like to receive suggestions for ideas on Hot Topics in the Energy Logistics & Distribution Industry.
- **Identification of Opportunities** – The breadth of information provided will enable owners and operators of energy logistics businesses to track developments in energy segments outside of their day-to-day focus.
- **Public and Transaction Comparables by Segment** – This section provides the tracking of a cross-section of publicly-traded companies and transactions in various segments of the Energy Logistics & Distribution Industry. The data include operating metrics, such as revenues and EBITDA (earnings before interest, taxes, depreciation and amortization); and valuation analyses such as total enterprise value / latest twelve months revenues and total enterprise value / latest twelve months EBITDA.

Thank you for taking the time to review this Energy Logistics & Distribution Industry In-Sight™. Our goal is to provide the most comprehensive and beneficial information possible. Please forward your feedback and suggestions to any member of the Jordan Knauff & Company or Energy Equipment and Infrastructure Alliance team members listed on the last two pages of this report.

INTRODUCTION

Who is the Energy Equipment & Infrastructure Alliance (EEIA)?

EEIA ... The Voice of the Energy Supply Chain

The energy supply chain is over 120,000 companies in sixty industries, annually contributing more than $170 billion to the U.S. economy, with hundreds of thousands of workers in communities throughout every state of the union. They provide construction, well services, capital equipment, supplies, logistics, professional services and technology in support of energy operations. They build energy infrastructure including production sites, transmission infrastructure, pipelines, storage facilities, processing plants and export terminals.

The shale energy revolution is transforming prosperity, security and quality of life in America. In a few short years, it has brought rising employment, income and opportunity to workers and businesses of all sizes and in all fifty states, often to communities that until recently have known limited prospects for growth. It has given Americans a cleaner environment, lower energy costs, renewed national competitiveness and energy security.

Creating a supportive public and policymaker environment for this miracle depends on active public engagement by energy supply chain stakeholders -- the non-oil and gas companies where energy-driven jobs and opportunities are greatest.

EEIA is that voice. We mobilize and lead the North American supply chain in pursuit of government policies that support full development of our energy resources, while protecting public health, safety and the environment. We also work for widespread public support for energy development.

The Energy Equipment & Infrastructure Alliance (EEIA) is active on all fronts: federal and state legislative, regulatory, judicial and public opinion. Our strength is based upon the supply chain's enormous fifty-state contributions to jobs, economic growth and community prosperity. We conduct economic research that measures and reports the facts about the energy supply chain's tremendous contributions to the American economy.

We are an organization of leading supply chain companies, trade associations and labor organizations. We are the voices of the businesses and workers of America's energy miracle.




INTRODUCTION

Who is Jordan Knauff & Company (JKC)?

JKC was founded in 2001 to undertake a distinct mission: to assemble and maintain a staff of top-notch investment banking personnel and offer their knowledge and experience to provide the best available investment banking services to middle-market companies, the entrepreneurs that lead them and the financial entities that transact with them. JKC has been active within the Energy Logistics & Distribution Industry as operators, investors, board members and investment bankers prior to the firm's founding in 2001.

On a combined basis, over the course of their careers our employees have completed over 200 transactions as investors, owners, operators, buyers, sellers and investment bankers of middle-market businesses across a variety of industries. The majority of our firm's broad transaction experience has been with private companies owned by one shareholder, a partnership, a family or private equity investors.

Experience has taught us that the owners and executives of middle-market businesses tend to have very different needs and goals in capital transactions from those that are common to capital events related to larger companies. Our personnel apply their considerable expertise to accomplish important goals: delivery of successful outcomes for our clients. Pursuant to that, we direct and manage all aspects of the capital transaction process, assist our clients with the management of important constituents (employees, customers, vendors and lenders), act as a teammate to other important client advisors (legal counsel, accountant, tax advisor) and collaborate with transaction counsel in the negotiations with the parties on the other side of the transaction.

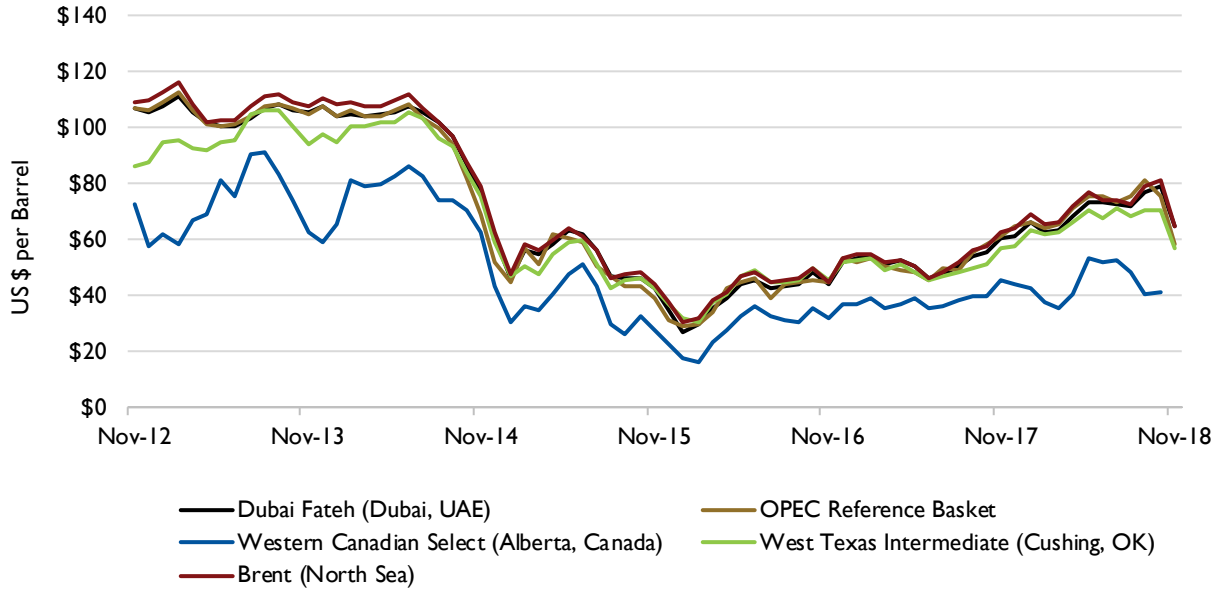
The Services We Provide

- Sell Companies: Generate a liquidity event on behalf of the owner(s) through whole, majority, or minority sale of assets, stock or units.
- Raise Capital: Representation of companies, management teams and entrepreneurs in the raising of senior debt, mezzanine debt or equity capital. Proceeds may be used for a variety of reasons, including, among others, recapitalizations, funding of growth, funding of acquisitions or liquidity for owners and investors.
- Acquisition Advisory: Assistance in sourcing and closing acquisitions -- whether it be a single transaction or a series of acquisitions as part of a consolidation strategy in an Industry Development Project™ (IDP) - a proprietary method for assisting private equity groups, companies or private investors that want to pursue multiple non-auction transactions within a single industry.
- Strategic Business Services: A suite of services for middle-market business owners and executives. Comprised of three components – Company Specific Valuation, Capital Road Map® and Strategic Industry Analysis – these services can be packaged together or used on an à la carte basis.

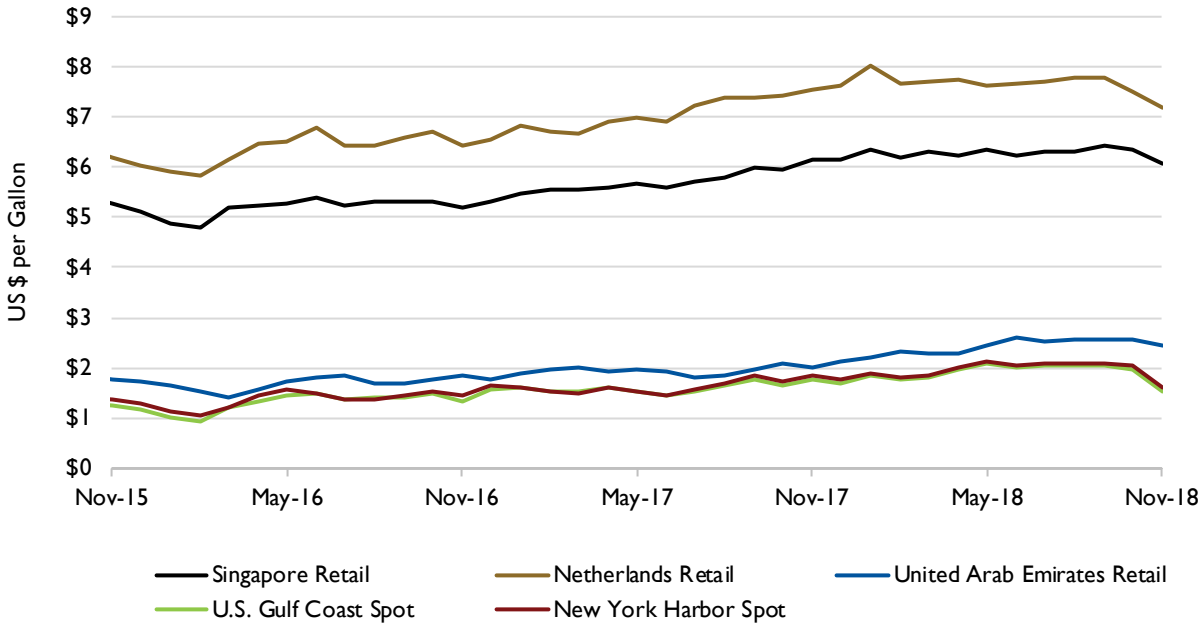
DATA CENTER

OIL

CRUDE OIL PRICES (MONTHLY AVERAGE) (1)



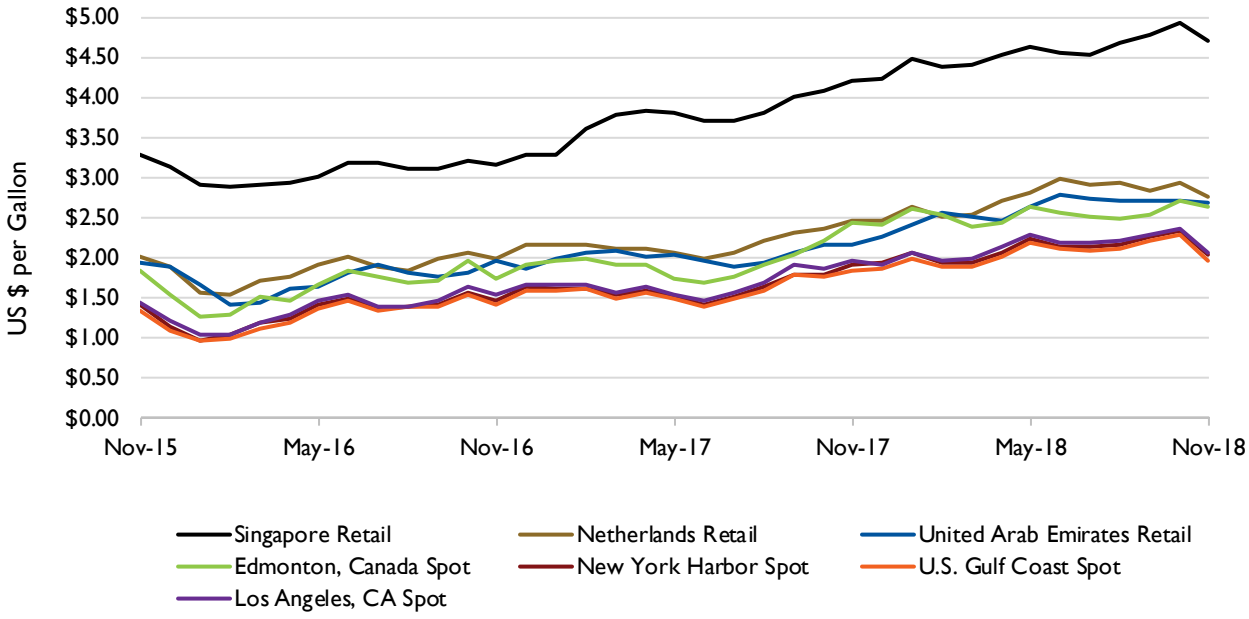
GASOLINE PRICES (MONTHLY AVERAGE) (2)



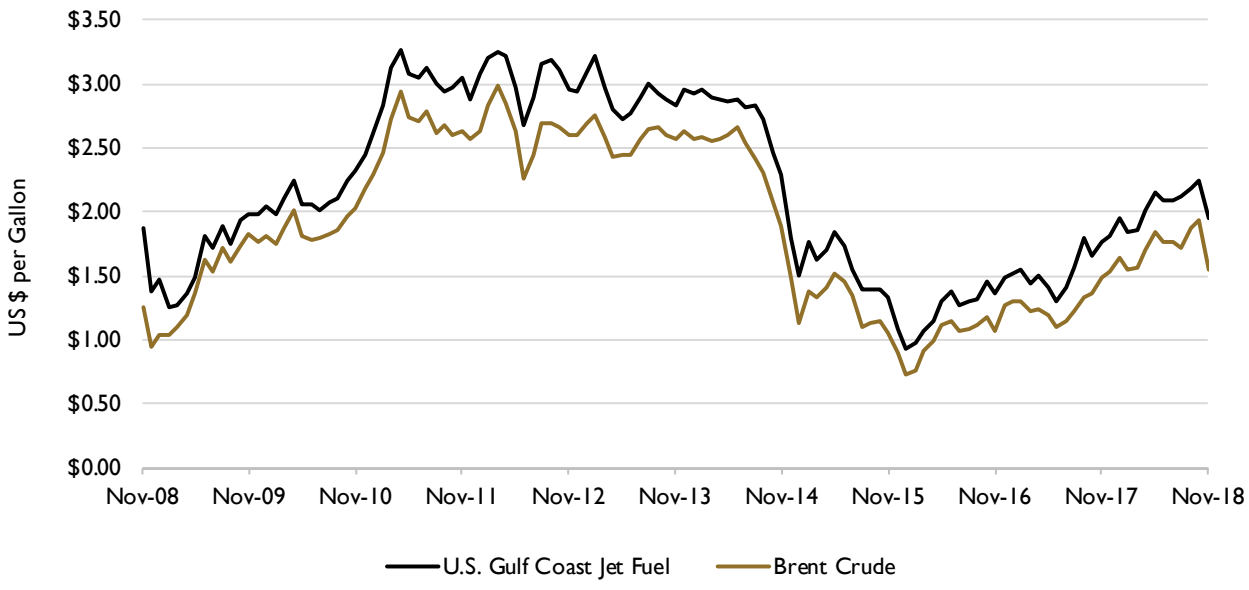
DATA CENTER

OIL

DIESEL PRICES (MONTHLY AVERAGE) (3)



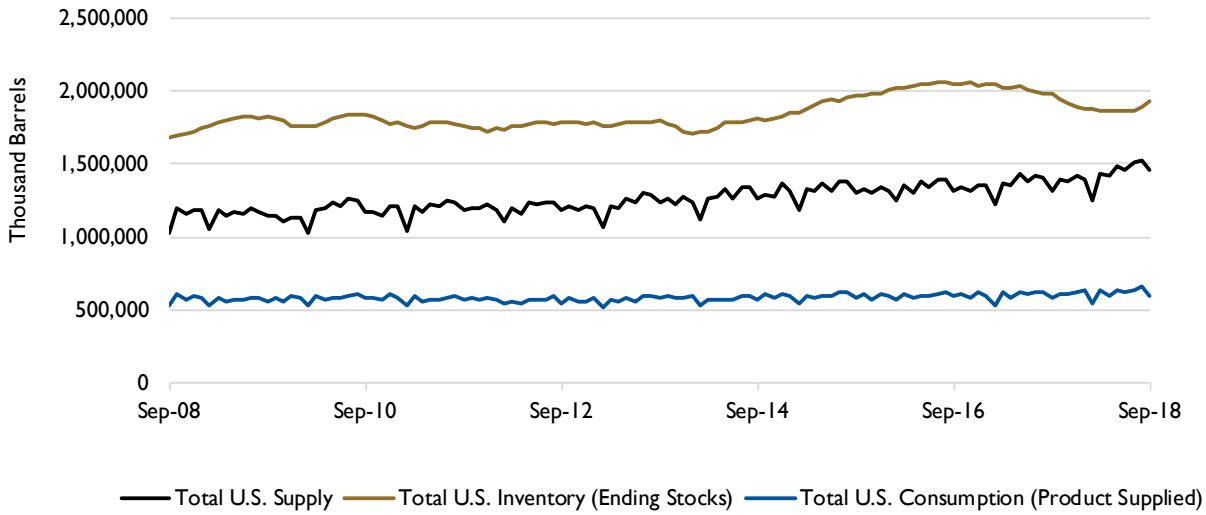
JET FUEL PRICES (MONTHLY AVERAGE) (4)



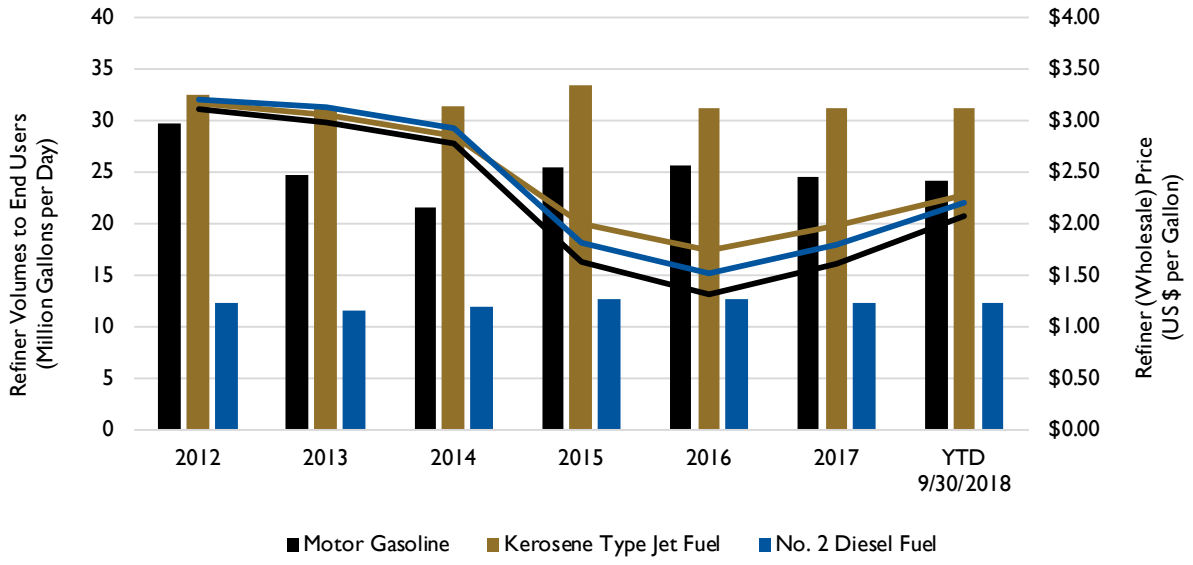
DATA CENTER

OIL

U.S. Crude Oil and Petroleum Products Supply, Inventory and Consumption (Monthly) (5)



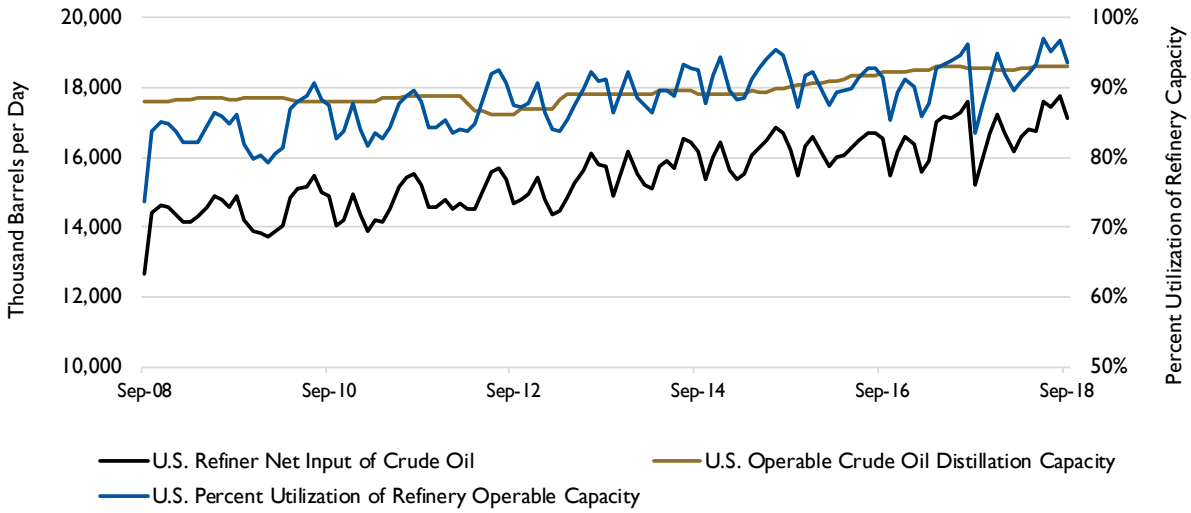
U.S. Refinery Volumes and Wholesale Prices of Petroleum Products (Annual Average) (6)



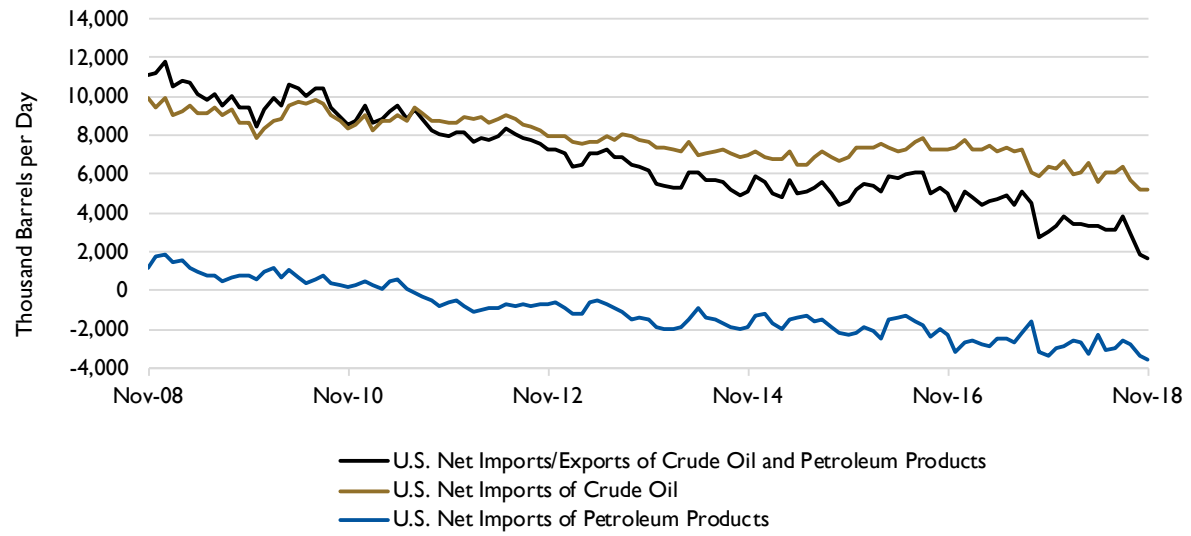
DATA CENTER

OIL

U.S. Crude Oil Refinery Input, Distillation Capacity and Refinery Utilization (Monthly Average) (7)



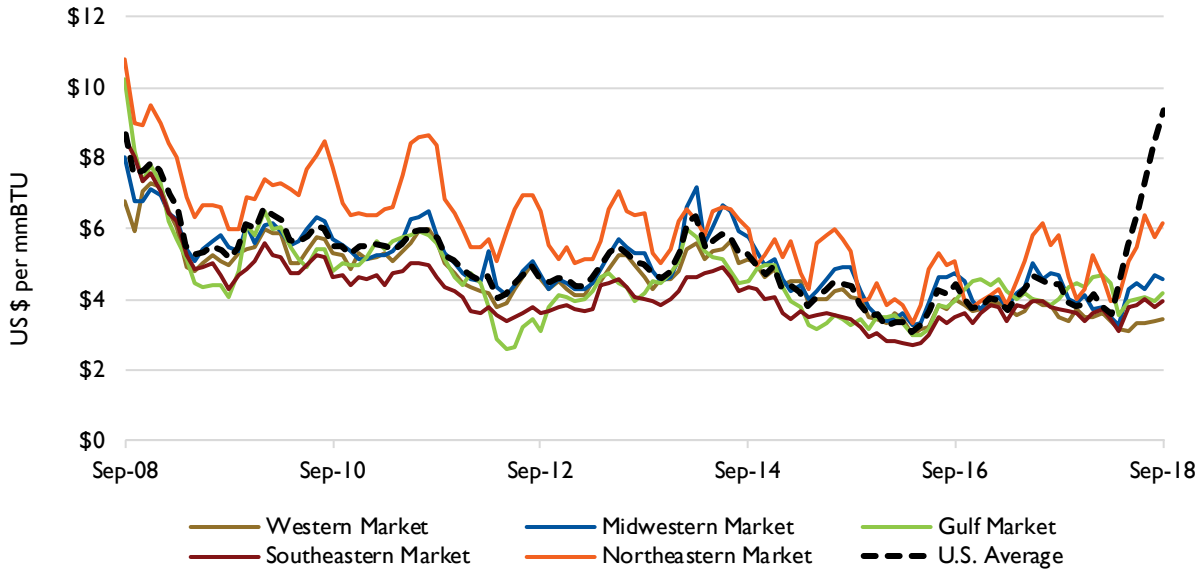
U.S. Crude Oil and Petroleum Products Imports and Exports (Monthly Average) (8)



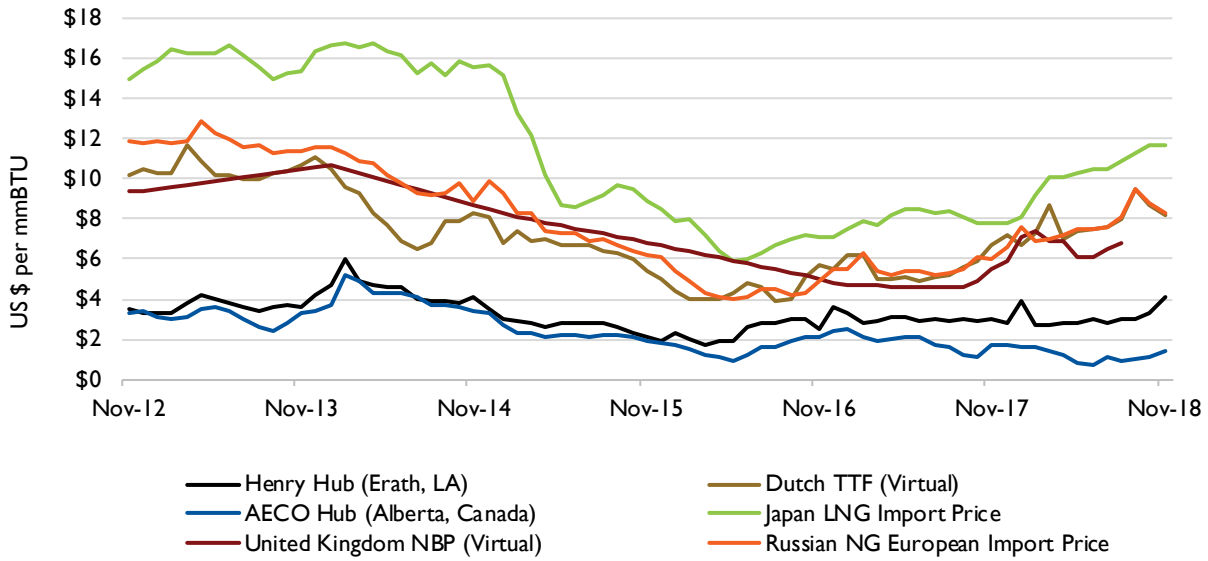
DATA CENTER

NATURAL GAS

DOMESTIC NATURAL GAS CITYGATE PRICES PER REGION (MONTHLY AVERAGE) (9)



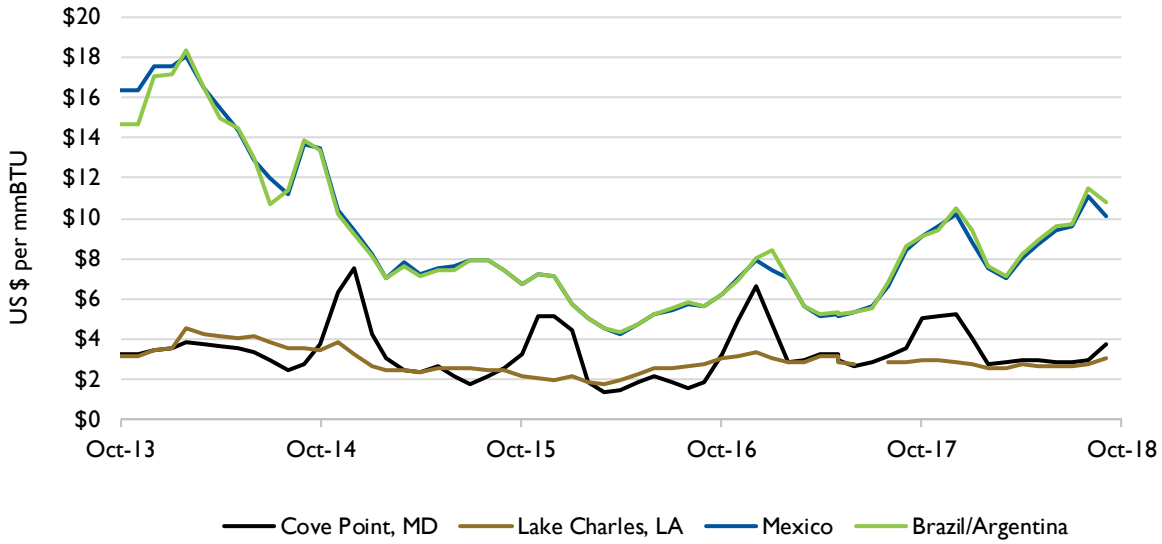
INTERNATIONAL NATURAL GAS PRICES (MONTHLY AVERAGE) (10)



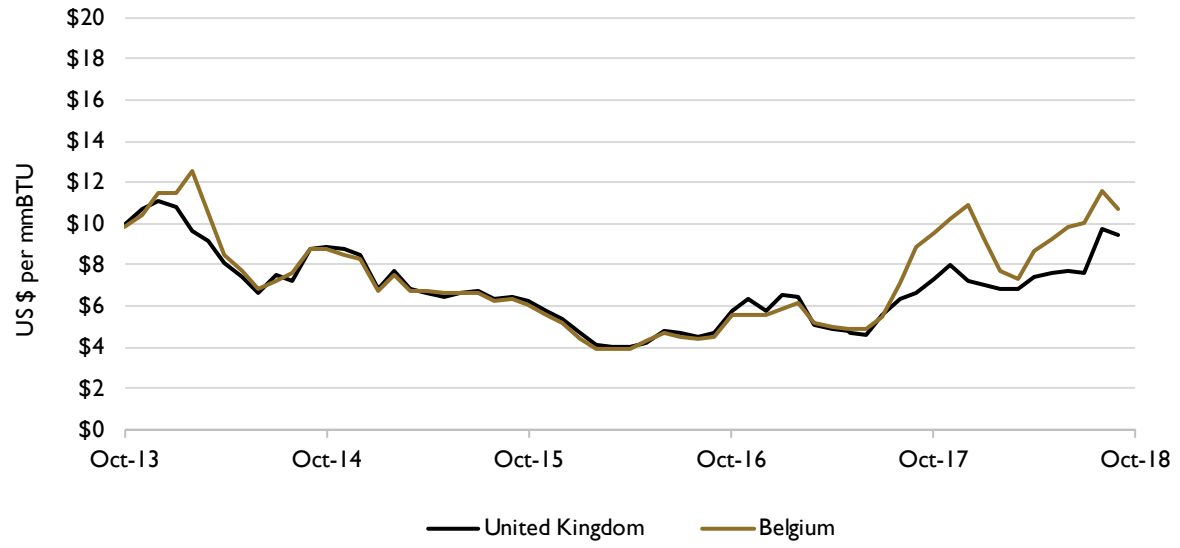
DATA CENTER

NATURAL GAS

AMERICAS LIQUEFIED NATURAL GAS PRICES (MONTHLY AVERAGE) (11)



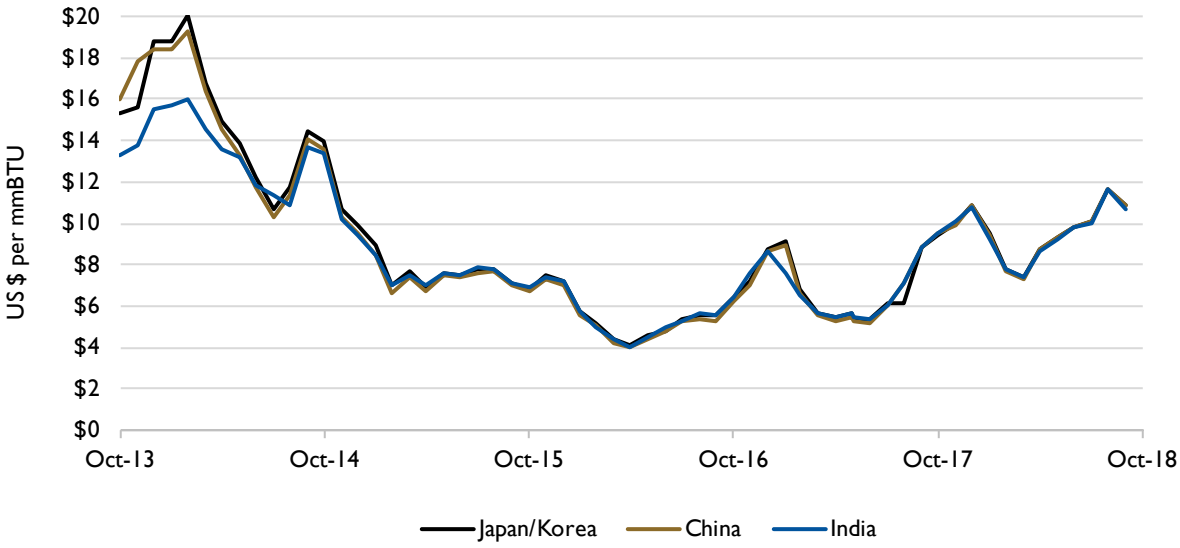
WESTERN EUROPE LIQUEFIED NATURAL GAS PRICES (MONTHLY AVERAGE) (12)



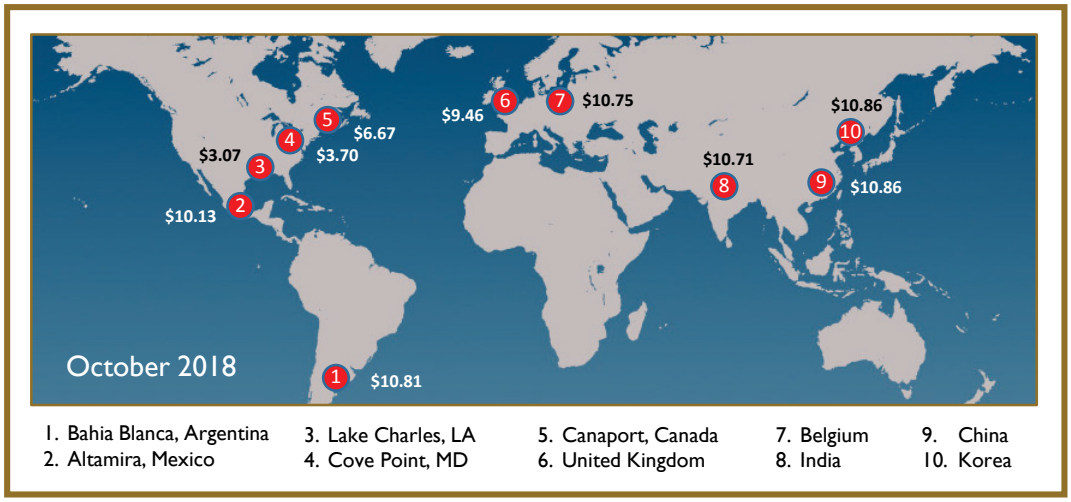
DATA CENTER

NATURAL GAS

ASIA LIQUEFIED NATURAL GAS PRICES (MONTHLY AVERAGE) (13)



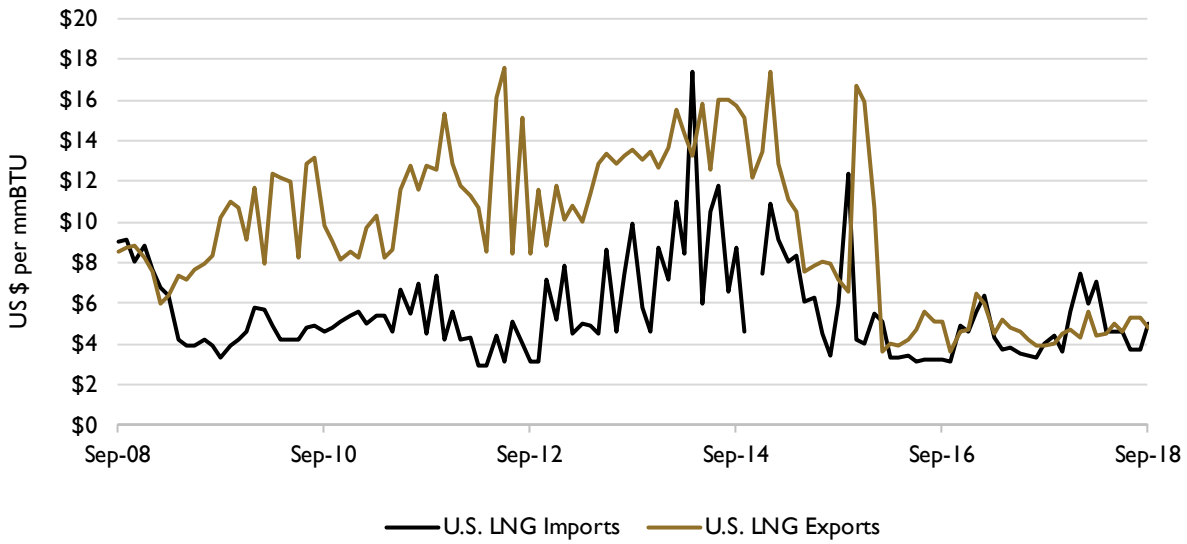
WORLD LIQUEFIED NATURAL GAS PRICES MAP (MONTHLY AVERAGE) (14)



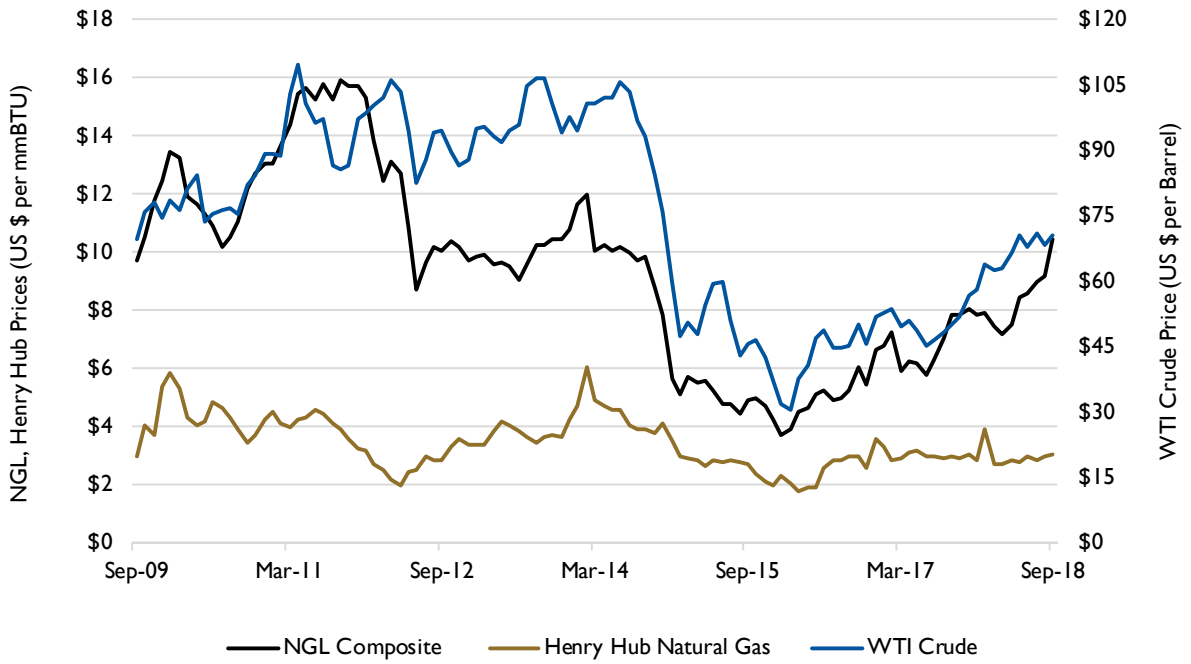
DATA CENTER

NATURAL GAS

U.S. IMPORT / EXPORT LIQUEFIED NATURAL GAS PRICES (MONTHLY AVERAGE) (15)



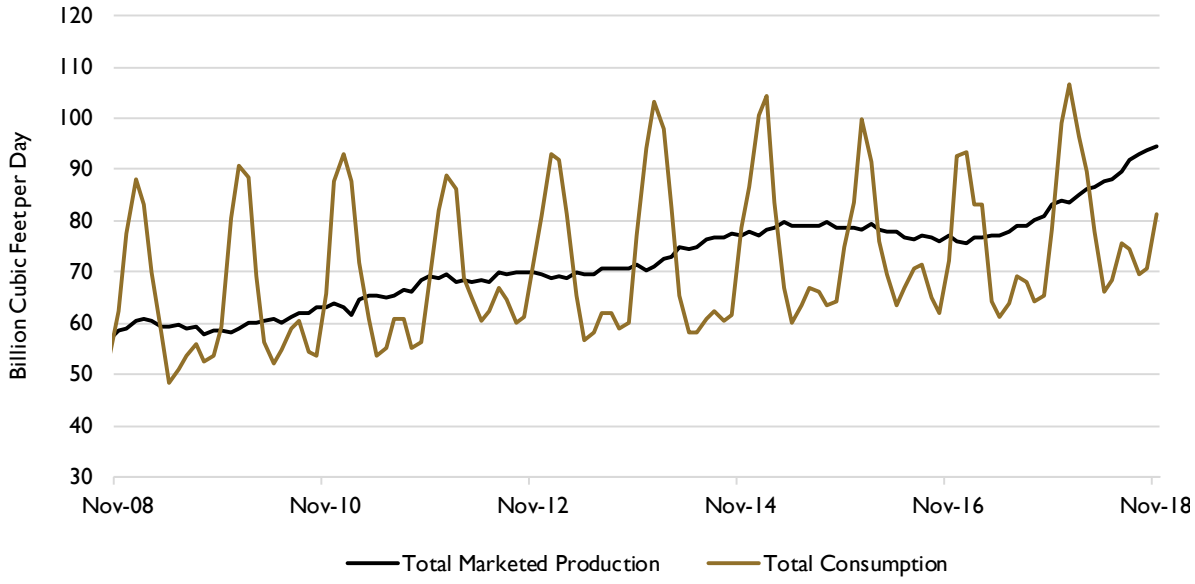
NATURAL GAS PLANT LIQUIDS PRICES (MONTHLY AVERAGE) (16)



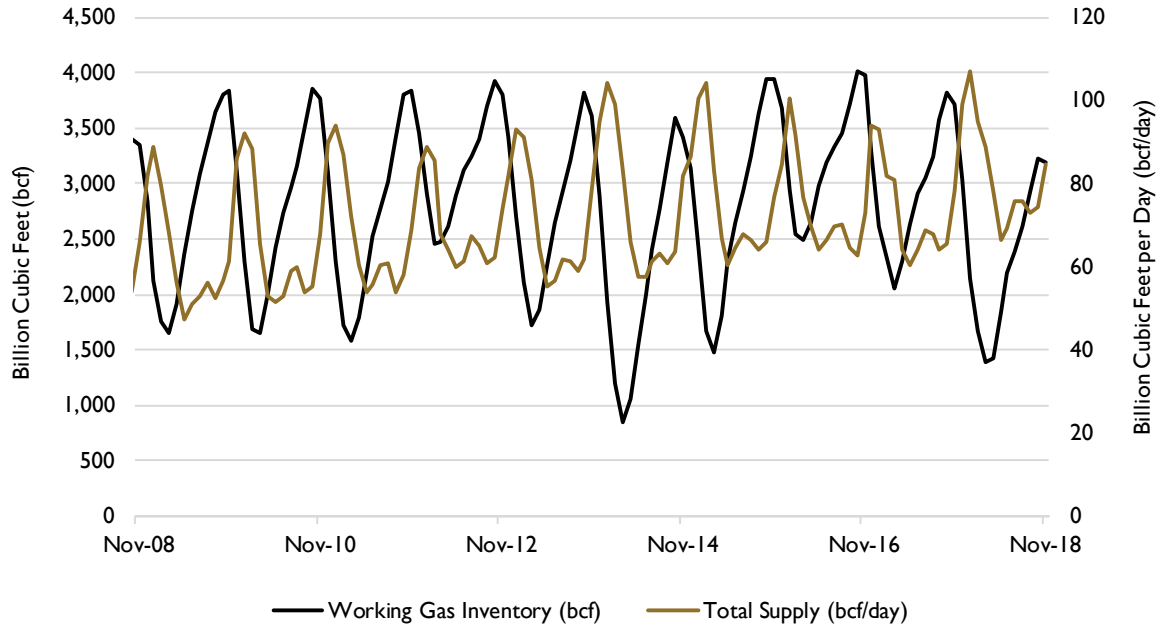
DATA CENTER

NATURAL GAS

U.S. Natural Gas Production and Consumption (Monthly) (17)



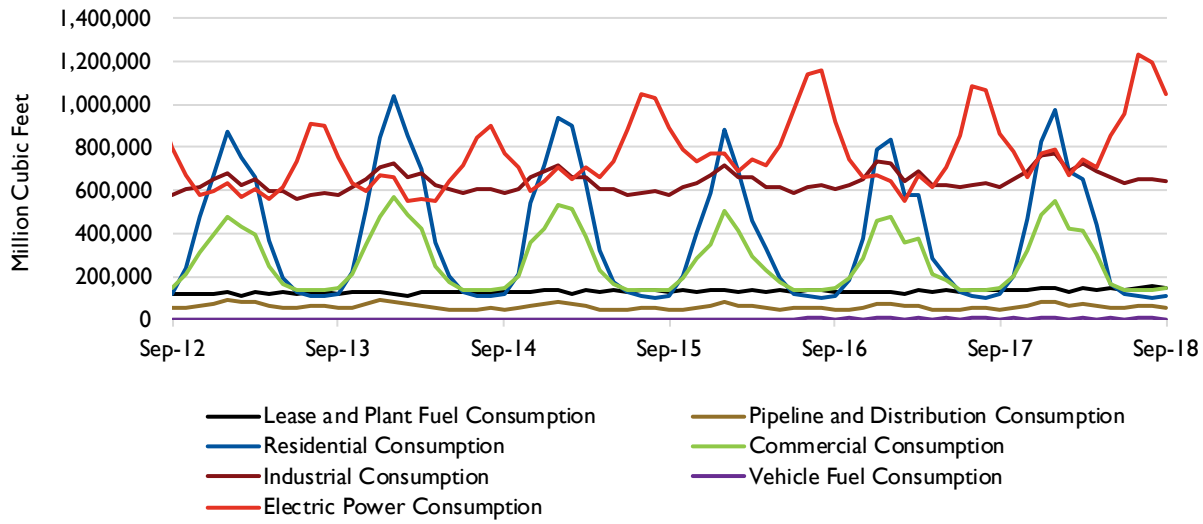
U.S. Natural Gas Supply and Inventory (Monthly) (18)



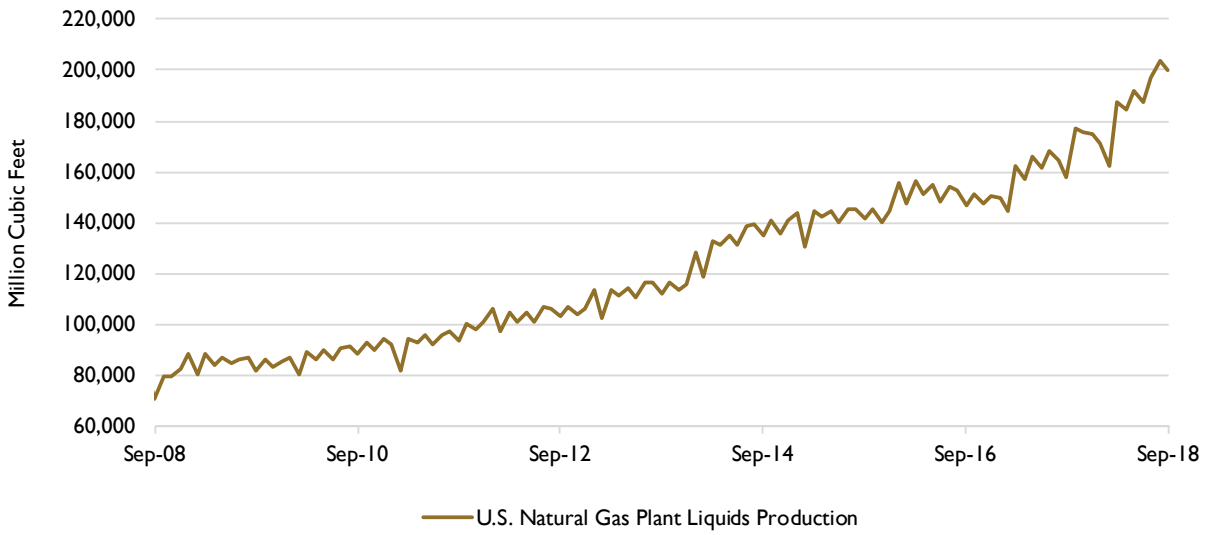
DATA CENTER

NATURAL GAS

U.S. NATURAL GAS CONSUMPTION BY END USE (MONTHLY) (19)



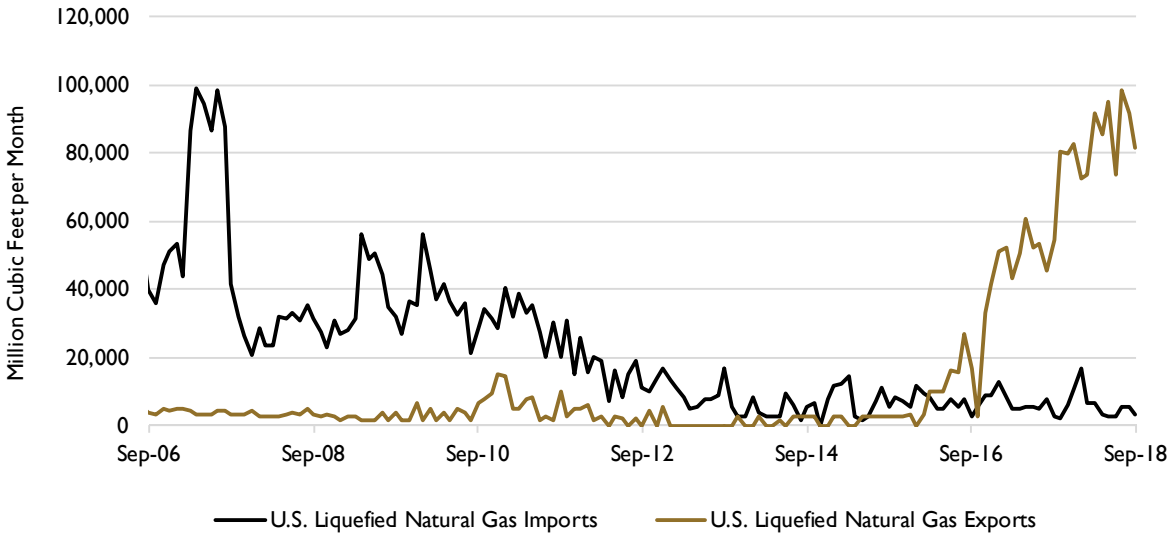
U.S. NATURAL GAS PLANT LIQUIDS PRODUCTION (MONTHLY) (20)



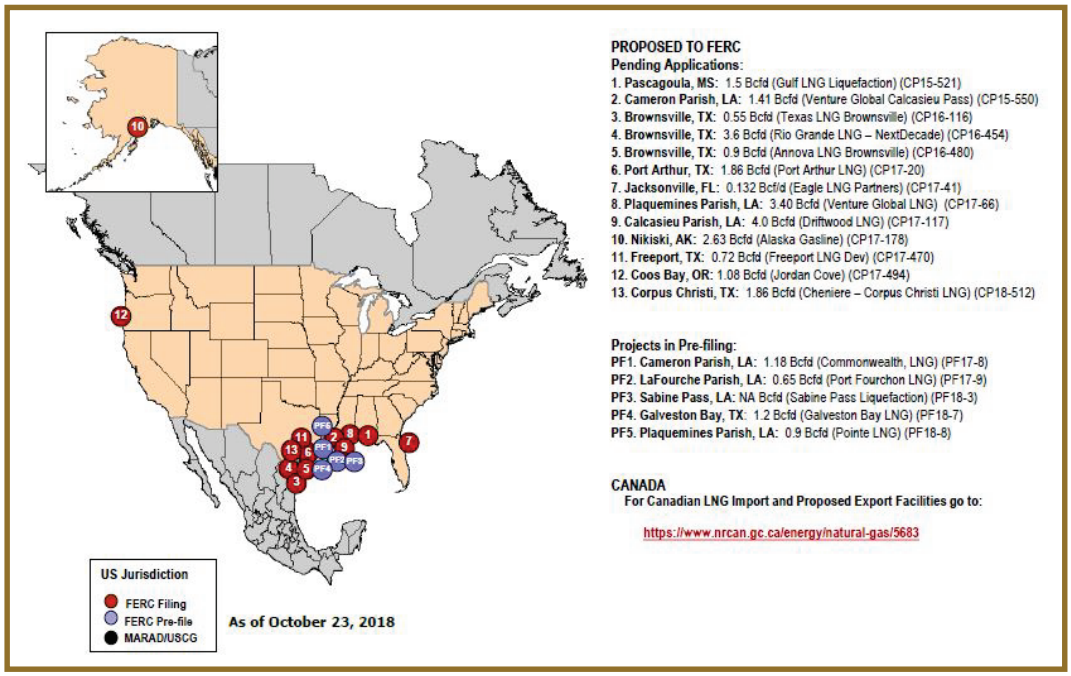
DATA CENTER

NATURAL GAS

U.S. LIQUEFIED NATURAL GAS IMPORT AND EXPORT VOLUMES (MONTHLY) (21)



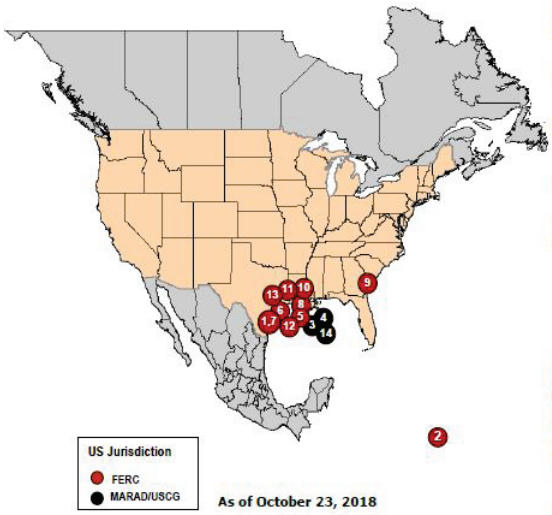
NORTH AMERICAN LNG EXPORT TERMINALS – *PROPOSED* (22)



DATA CENTER

NATURAL GAS

NORTH AMERICAN LNG IMPORT/EXPORT TERMINALS – *APPROVED* (23)



Import Terminals

U.S.

APPROVED - UNDER CONSTRUCTION - FERC
1. **Corpus Christi, TX:** 0.4 Bcfd (Cheniere – Corpus Christi LNG) (CP12-507)

APPROVED – NOT UNDER CONSTRUCTION - FERC
2. **Salinas, PR:** 0.6 Bcfd (Aguirre Offshore GasPort, LLC) (CP13-193)

APPROVED - NOT UNDER CONSTRUCTION - MARAD/Coast Guard
3. **Gulf of Mexico:** 1.0 Bcfd (Main Pass McMoRan Exp.)
4. **Gulf of Mexico:** 1.4 Bcfd (TORP Technology-Bienville LNG)

Export Terminals

U.S.

APPROVED - UNDER CONSTRUCTION - FERC
5. **Hackberry, LA:** 2.1 Bcfd (Sempra–Cameron LNG) (CP13-25)
6. **Freeport, TX:** 2.14 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction) (CP12-509) (CP15-518)
7. **Corpus Christi, TX:** 2.14 Bcfd (Cheniere – Corpus Christi LNG) (CP12-507)
8. **Sabine Pass, LA:** 1.40 Bcfd (Sabine Pass Liquefaction) (CP13-552) ★
9. **Elba Island, GA:** 0.35 Bcfd (Southern LNG Company) (CP14-103)

APPROVED – NOT UNDER CONSTRUCTION - FERC
10. **Lake Charles, LA:** 2.2 Bcfd (Southern Union – Lake Charles LNG) (CP14-120)
11. **Lake Charles, LA:** 1.08 Bcfd (Magnolia LNG) (CP14-347)
12. **Hackberry, LA:** 1.41 Bcfd (Sempra - Cameron LNG) (CP15-560)
13. **Sabine Pass, TX:** 2.1 Bcfd (ExxonMobil – Golden Pass) (CP14-517)

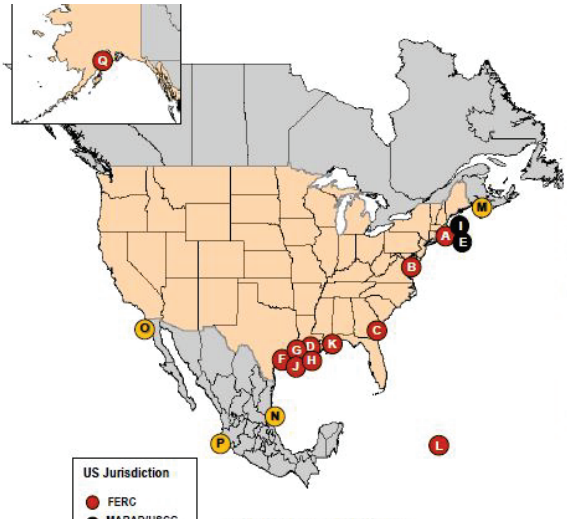
APPROVED – NOT UNDER CONSTRUCTION – MARAD/Coast Guard
14. **Gulf of Mexico:** 1.8 Bcfd (Delfin LNG)

CANADA
For Canadian LNG Import and Proposed Export Facilities go to:

https://www.nrcan.gc.ca/energy/natural-gas/5683

★Trains 5 & 6 with Train 5 under construction

NORTH AMERICAN LNG IMPORT/EXPORT TERMINALS – *EXISTING* (24)



Import Terminals

U.S.
A. Everett, MA: 1.035 Bcfd (GDF SUEZ - DOMAC)
B. Cove Point, MD: 1.8 Bcfd (Dominion - Cove Point LNG)
C. Elba Island, GA: 1.6 Bcfd (El Paso - Southern LNG)
D. Lake Charles, LA: 2.1 Bcfd (Southern Union - Trunkline LNG) ★
E. Offshore Boston: 0.8 Bcfd (Excelerate Energy – Northeast Gateway)
F. Freeport, TX: 1.5 Bcfd (Cheniere/Freeport LNG Dev.)★
G. Sabine, LA: 4.0 Bcfd (Cheniere/Sabine Pass LNG)★
H. Hackberry, LA: 1.8 Bcfd (Sempra - Cameron LNG)
I. Offshore Boston, MA: 0.4 Bcfd (GDF SUEZ – Neptune LNG)
J. Sabine Pass, TX: 2.0 Bcfd (ExxonMobil – Golden Pass) (Phase I & II)
K. Pascagoula, MS: 1.5 Bcfd (El Paso/Crest/Sonangol - Gulf LNG Energy LLC)
L. Peñuelas, PR: 0.3 Bcfd (EcoElectrica)

CANADA
M. Saint John, NB: 1.0 Bcfd (Repsol/Fort Reliance - Canaport LNG)

MEXICO
N. Altamira, Tamulipas: 0.7 Bcfd (Shell/Total/Mitsui – Altamira LNG)
O. Baja California, MX: 1.0 Bcfd (Sempra – Energia Costa Azul)
P. Manzanillo, MX: 0.5 Bcfd (KMS GNL de Manzanillo)

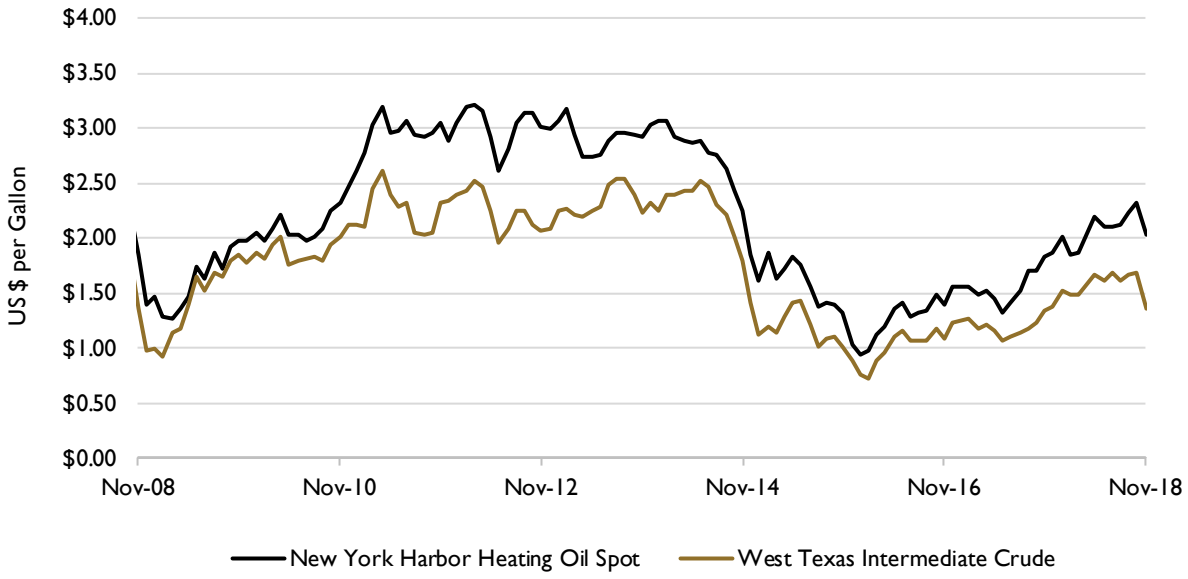
Export Terminals

U.S.
B. Cove Point, MD: 0.82 Bcfd (Dominion–Cove Point LNG) (CP13-113)
G. Sabine, LA: 2.8 Bcfd (Cheniere/Sabine Pass LNG – Trains 1, 2, 3 & 4)
Q. Kenai, AK: 0.2 Bcfd (ConocoPhillips)

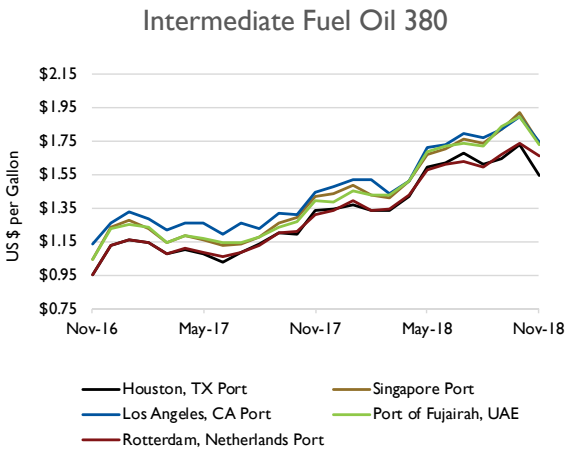
DATA CENTER

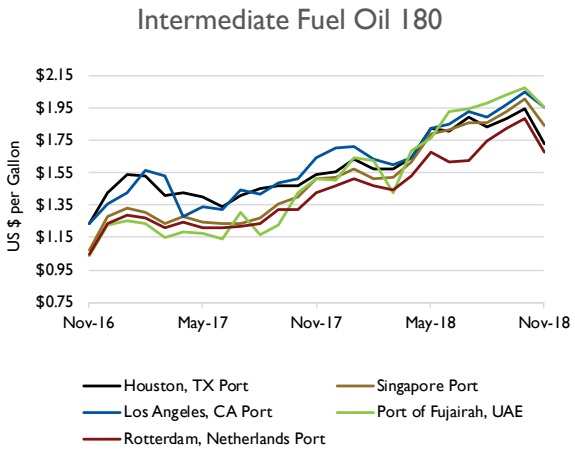
PROPANE AND HEATING/FUEL OIL

HEATING OIL PRICES (MONTHLY AVERAGE) (25)



INTERMEDIATE FUEL OIL AKA "BUNKER FUEL" PRICES (MONTHLY AVERAGE) (26)

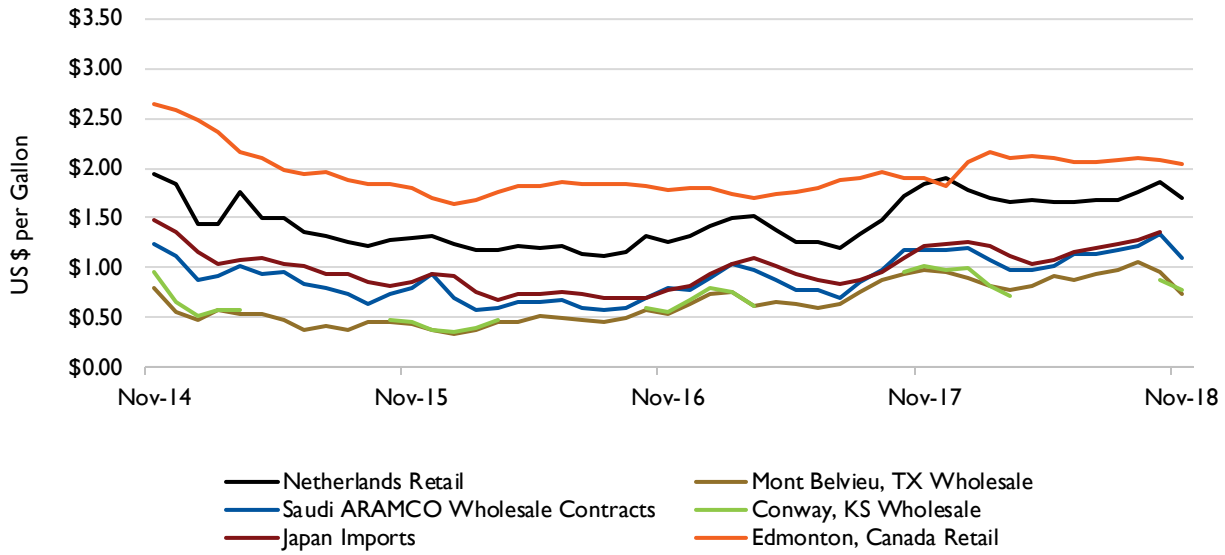




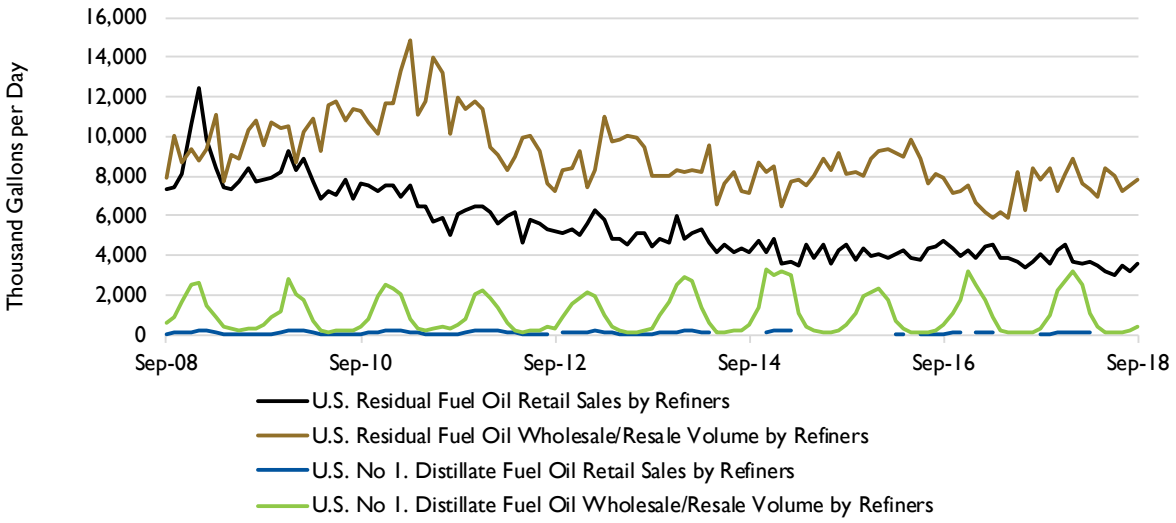
DATA CENTER

PROPANE AND HEATING/FUEL OIL

PROPANE PRICES (MONTHLY AVERAGE) (27)



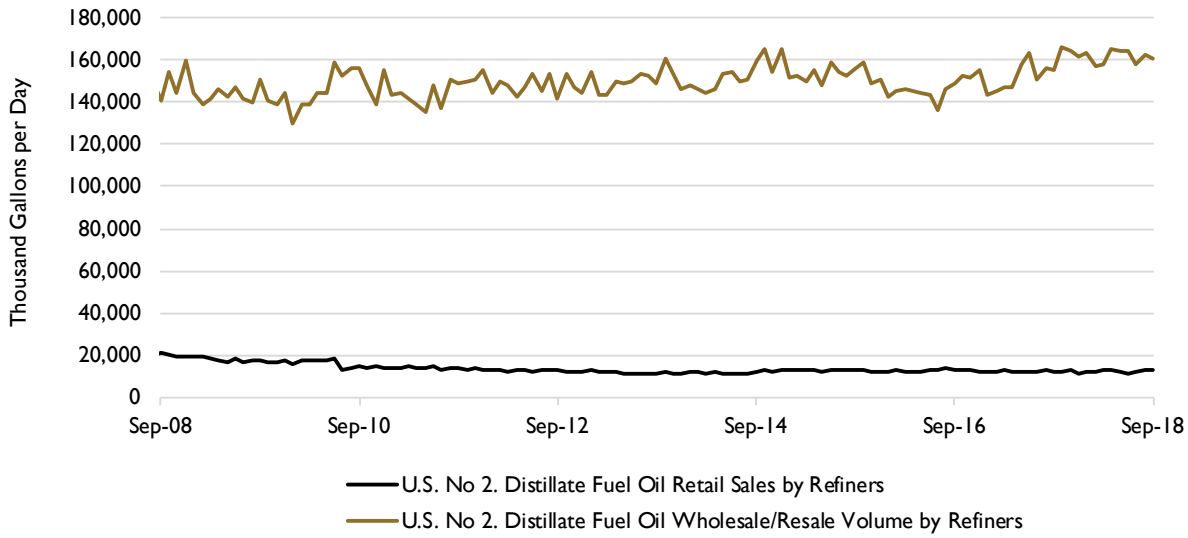
NO. 1 DISTILLATE FUEL OIL, RESIDUAL FUEL OIL WHOLESALE, RETAIL SALES VOLUME BY REFINERS (MONTHLY) (28)



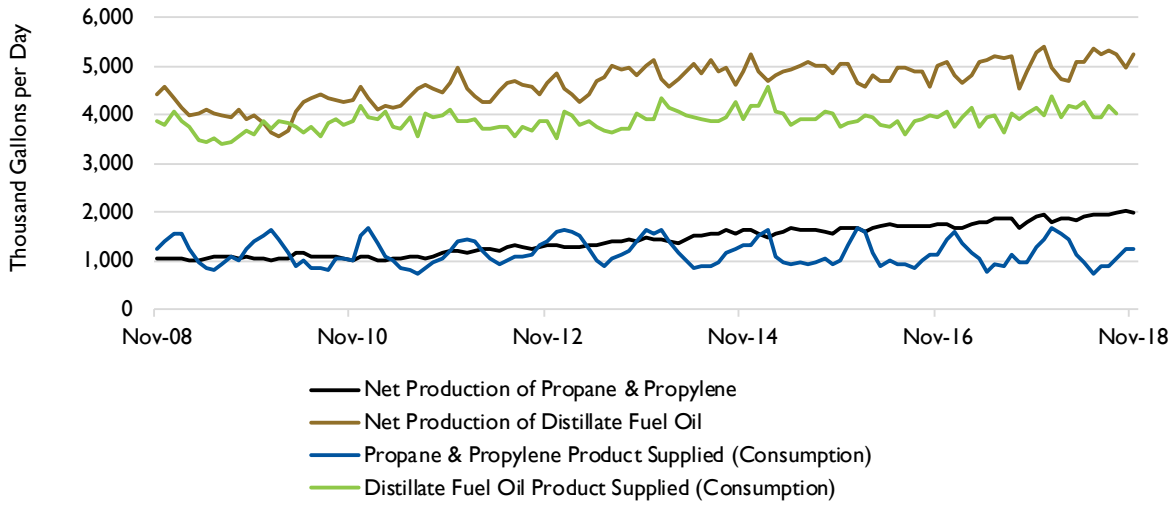
DATA CENTER

PROPANE AND HEATING/FUEL OIL

No. 2 Distillate Fuel Oil Wholesale, Retail Sales Volume by Refiners (Monthly) (29)



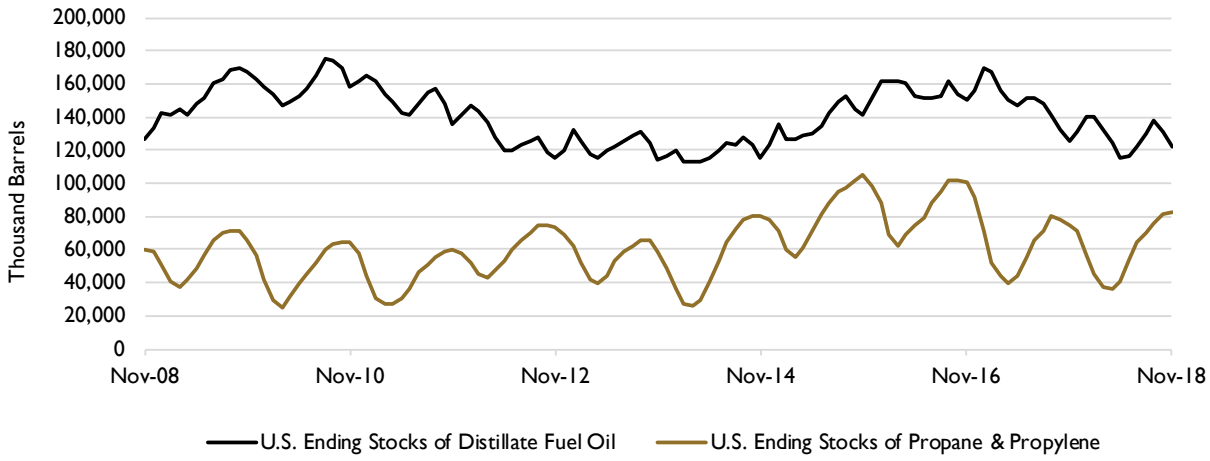
Propane & Propylene and Distillate Fuel Oil Production and Consumption (Monthly) (30)



DATA CENTER

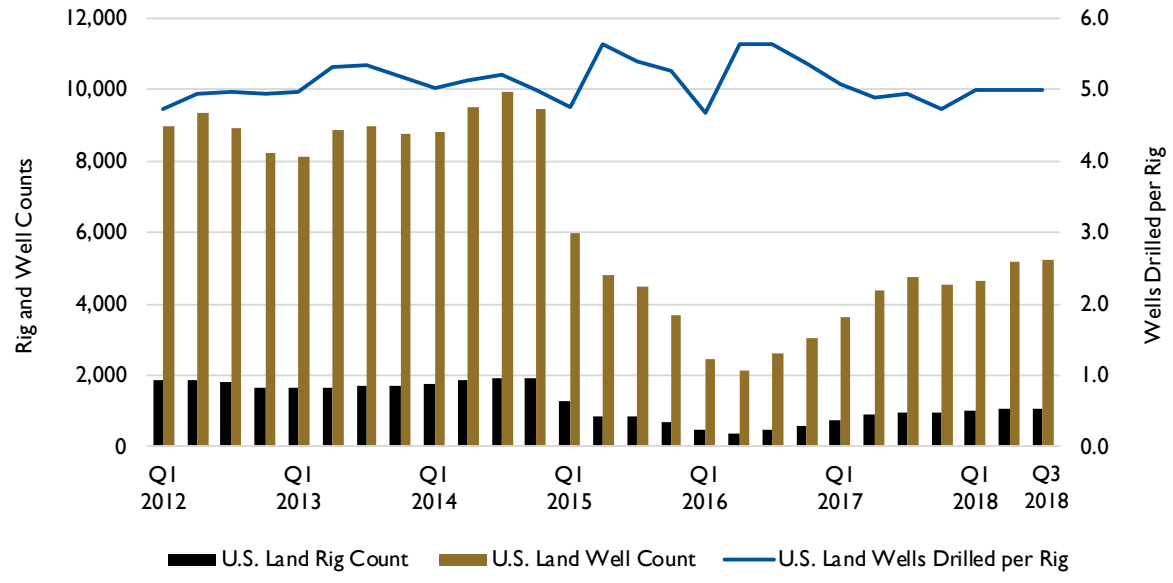
PROPANE AND HEATING/FUEL OIL

U.S. Ending Stocks of Propane & Propylene and Distillate Fuel Oil (Monthly Average) (31)



DRILLING ACTIVITY

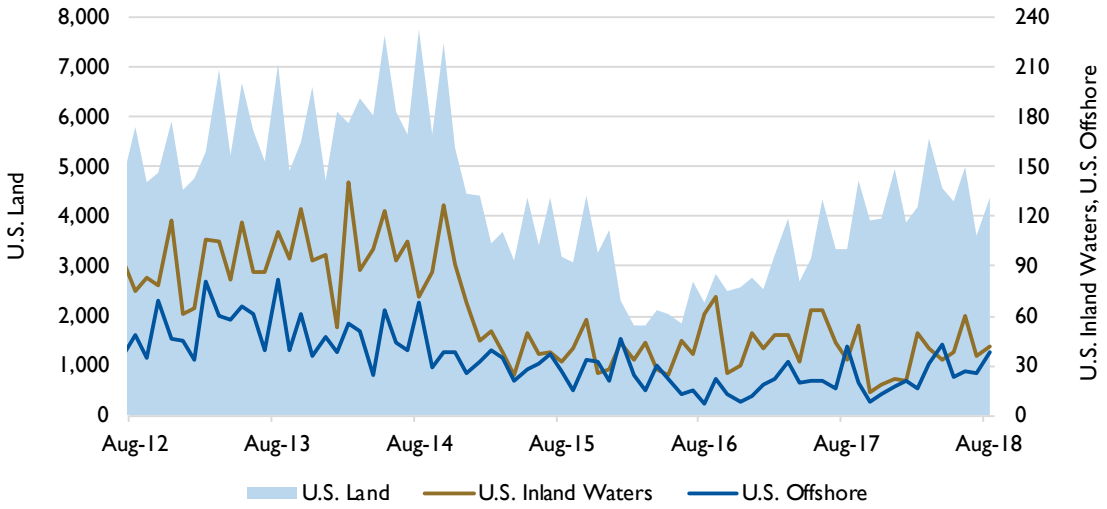
U.S. Land Well Count, Rig Count and Wells per Rig (Quarterly) (32)



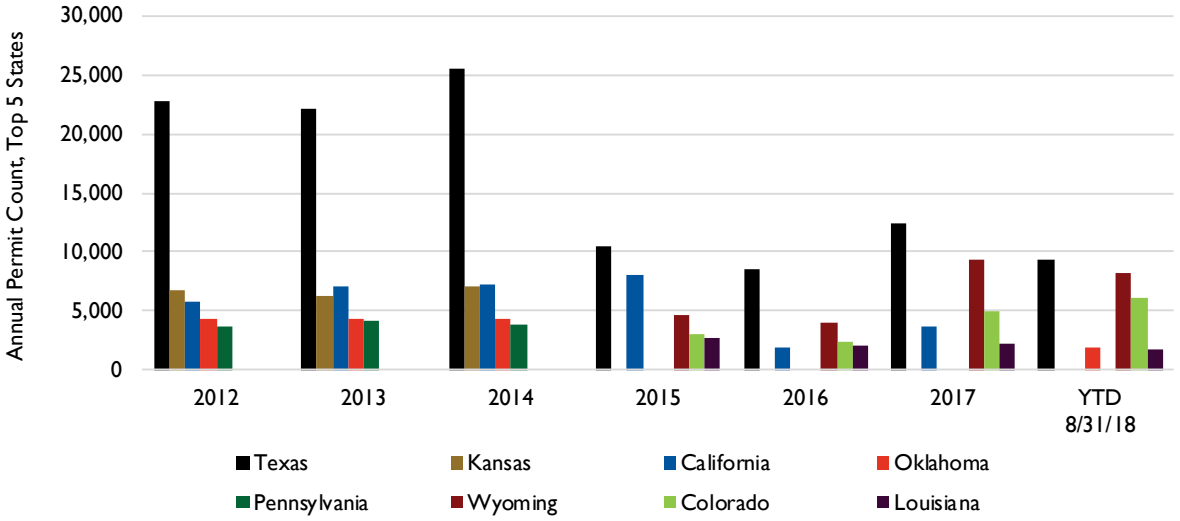
DATA CENTER

DRILLING ACTIVITY

U.S. DRILLING PERMITS (MONTHLY) (33)



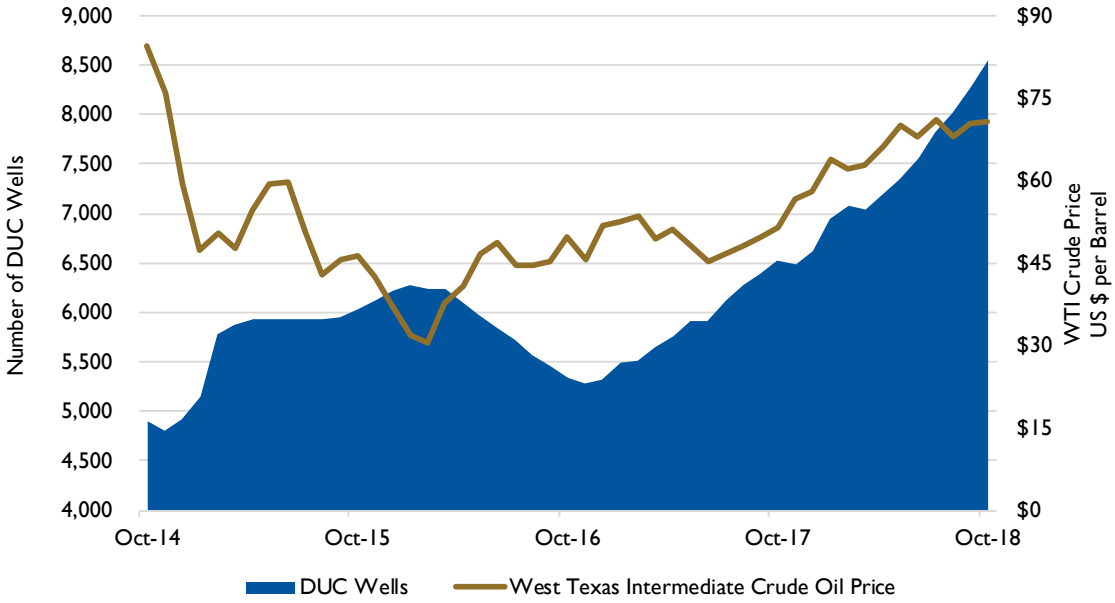
U.S. DRILLING PERMITS, TOP 5 STATES (ANNUAL) (34)



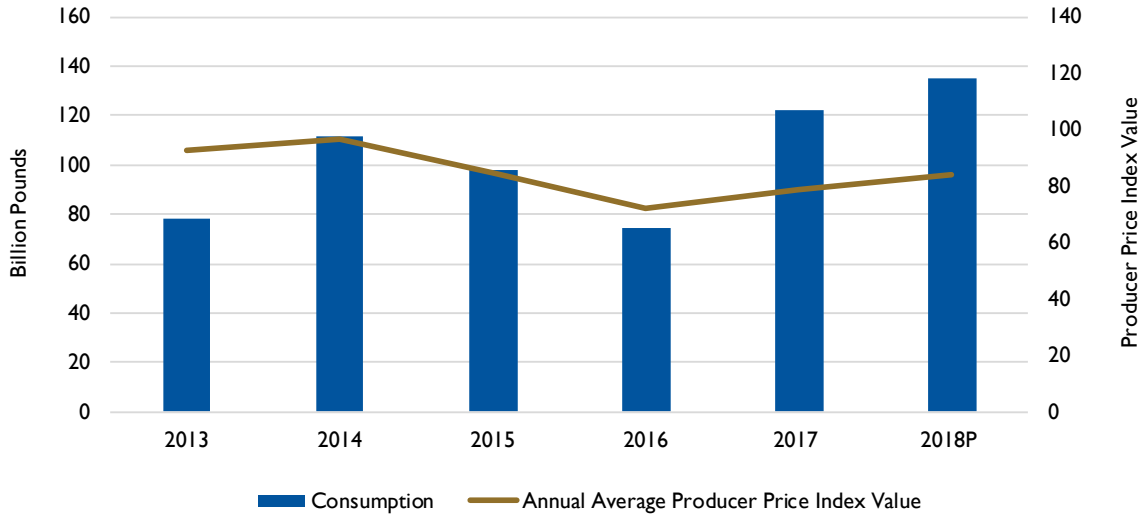
DATA CENTER

DRILLING ACTIVITY

DRILLED BUT UNCOMPLETED (DUC) WELLS VS. CRUDE OIL PRICE (MONTHLY) (35)



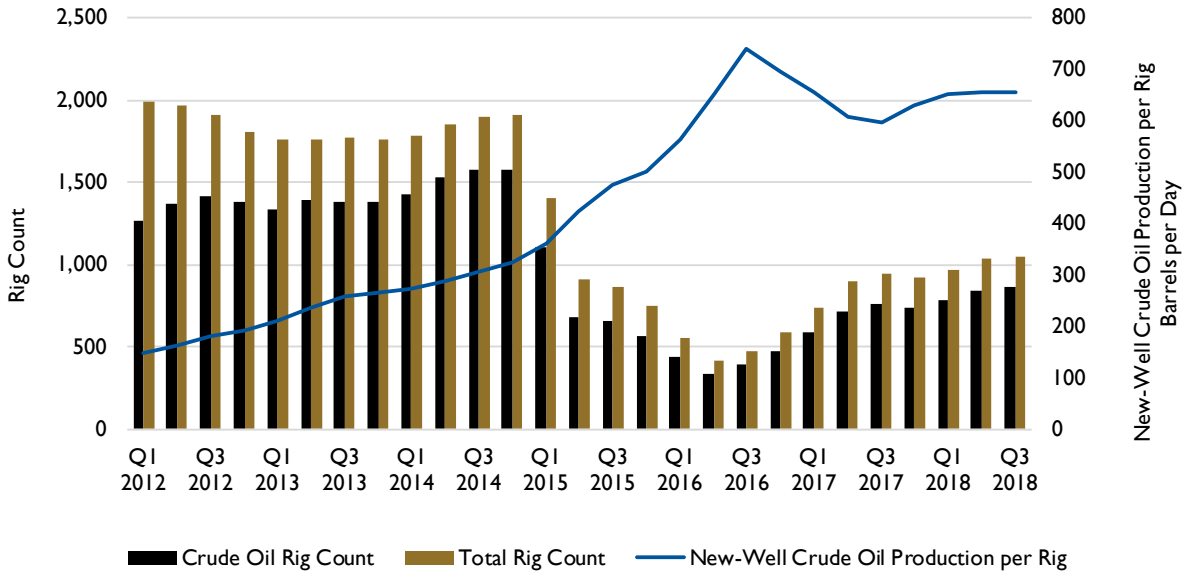
HYDRAULIC FRACTURING SAND CONSUMPTION AND PRODUCER PRICE INDEX (ANNUAL) (36)



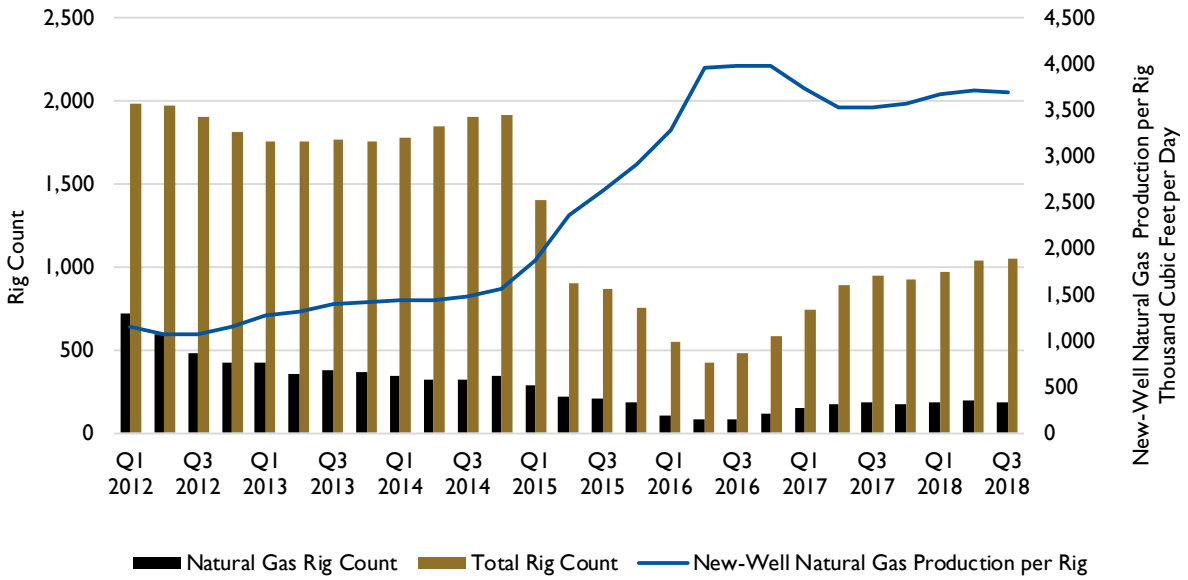
DATA CENTER

DRILLING ACTIVITY

CRUDE OIL PRODUCTION, RIG COUNT AND PRODUCTION PER RIG (QUARTERLY) (37)



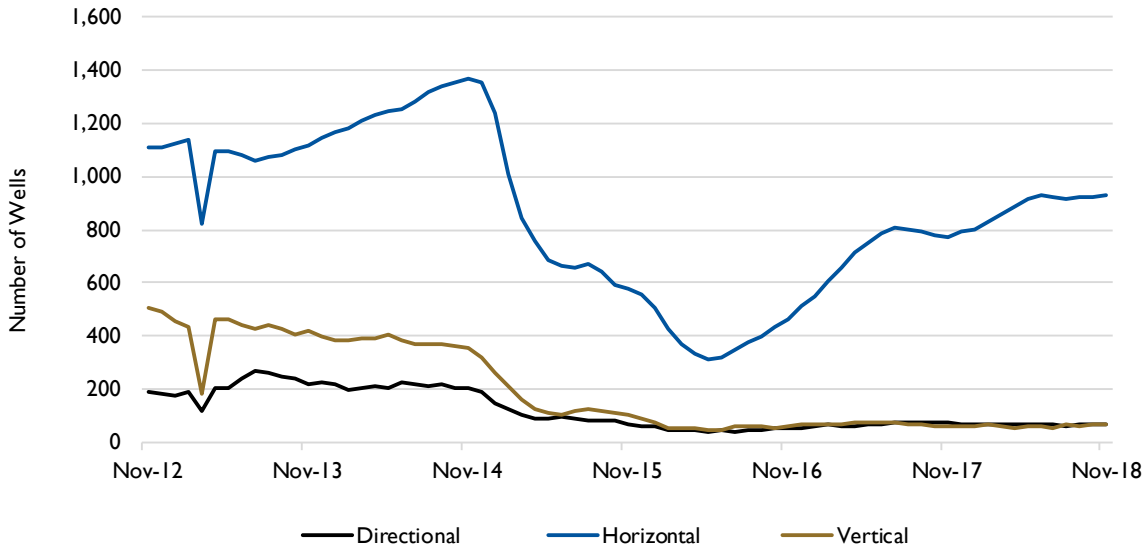
NATURAL GAS PRODUCTION, RIG COUNT AND PRODUCTION PER RIG (QUARTERLY) (38)



DATA CENTER

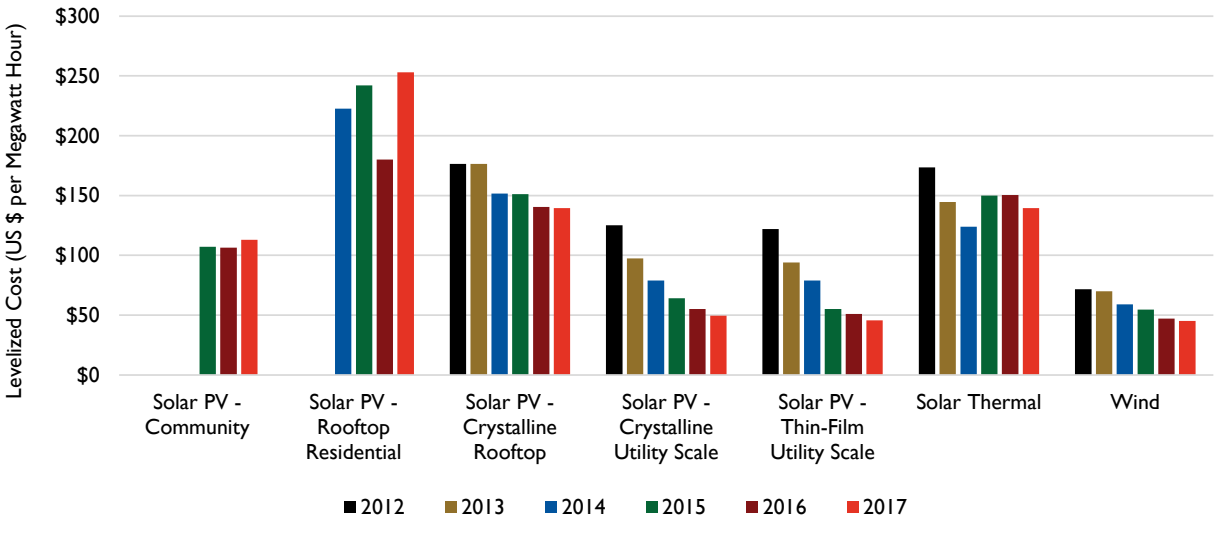
DRILLING ACTIVITY

U.S. DRILLING RIGS BY TYPE (MONTHLY) (39)



RENEWABLES

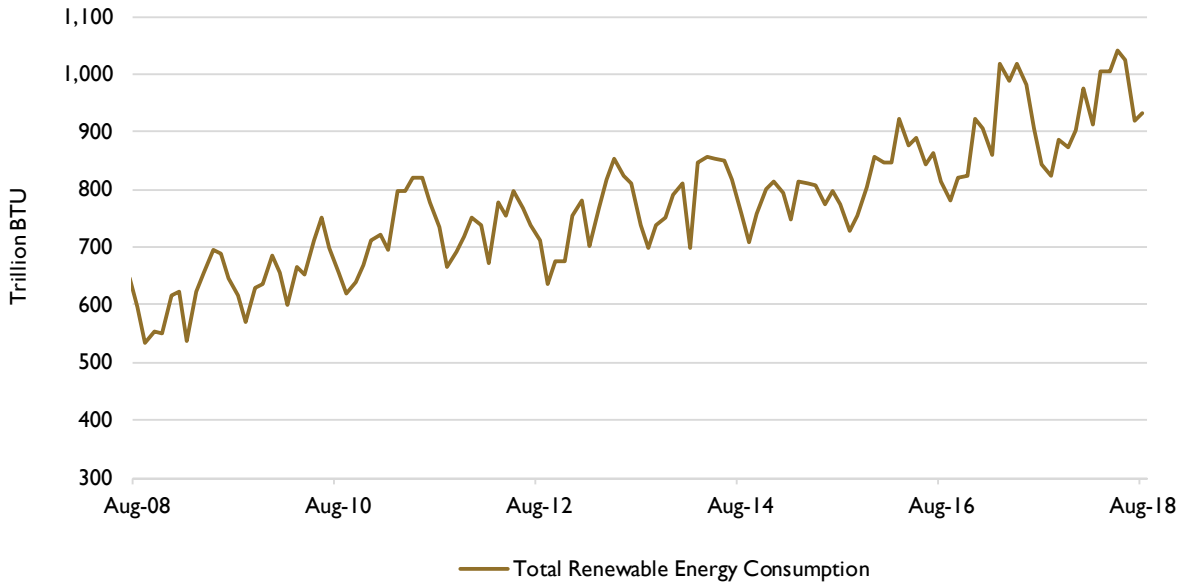
WIND AND SOLAR PRICES (ANNUAL AVERAGE) (40)



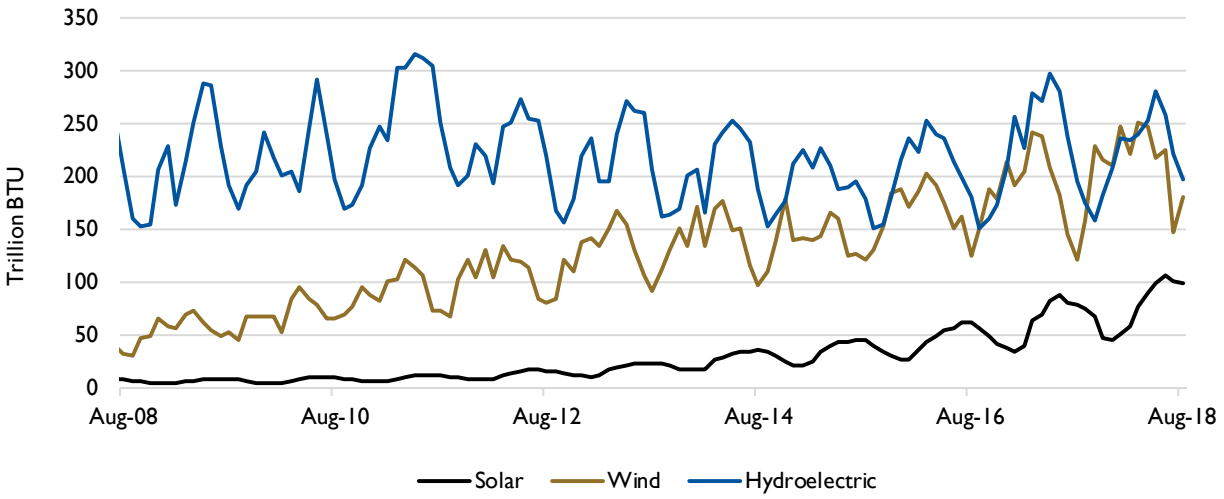
DATA CENTER

RENEWABLES

U.S. TOTAL RENEWABLE ENERGY CONSUMPTION (MONTHLY) (41)



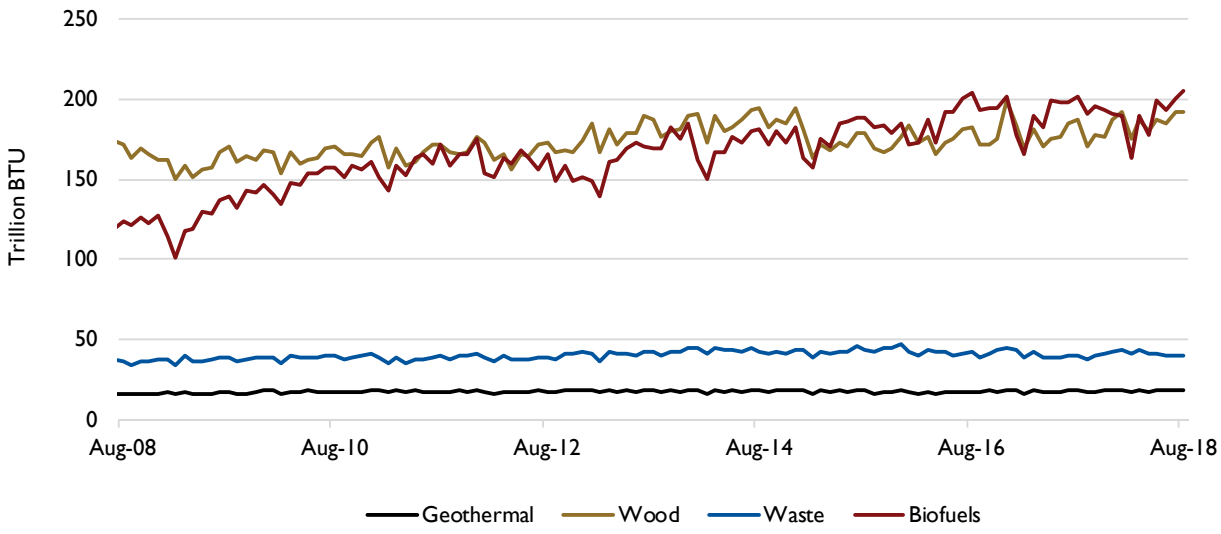
U.S. SOLAR, WIND AND HYRDOELECTRIC ENERGY CONSUMPTION (MONTHLY) (42)



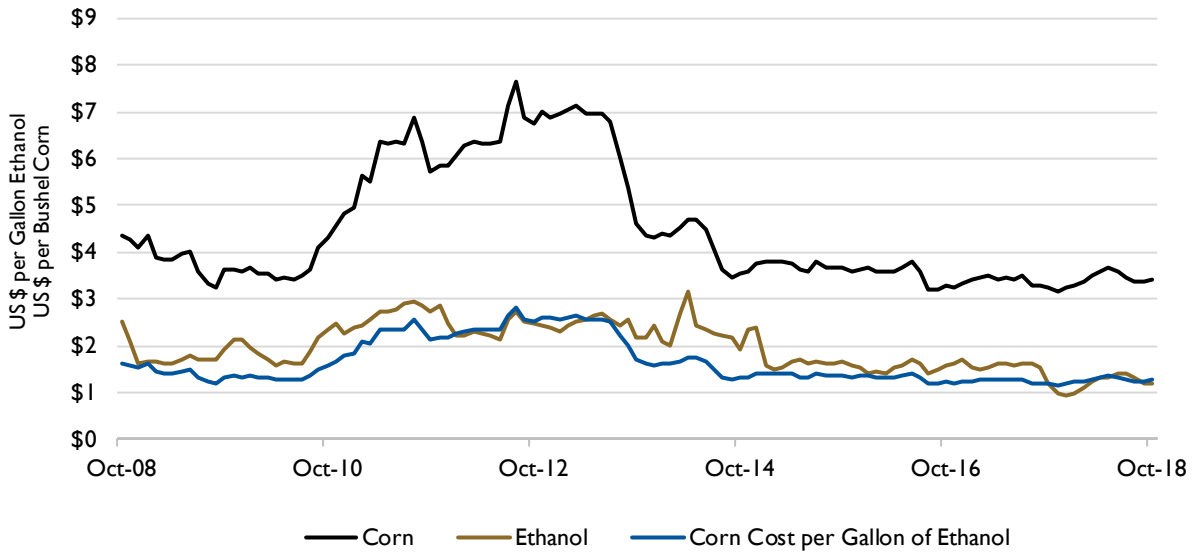
DATA CENTER

RENEWABLES

U.S. Wood, Waste, Biofuels and Geothermal Energy Consumption (Monthly) (43)



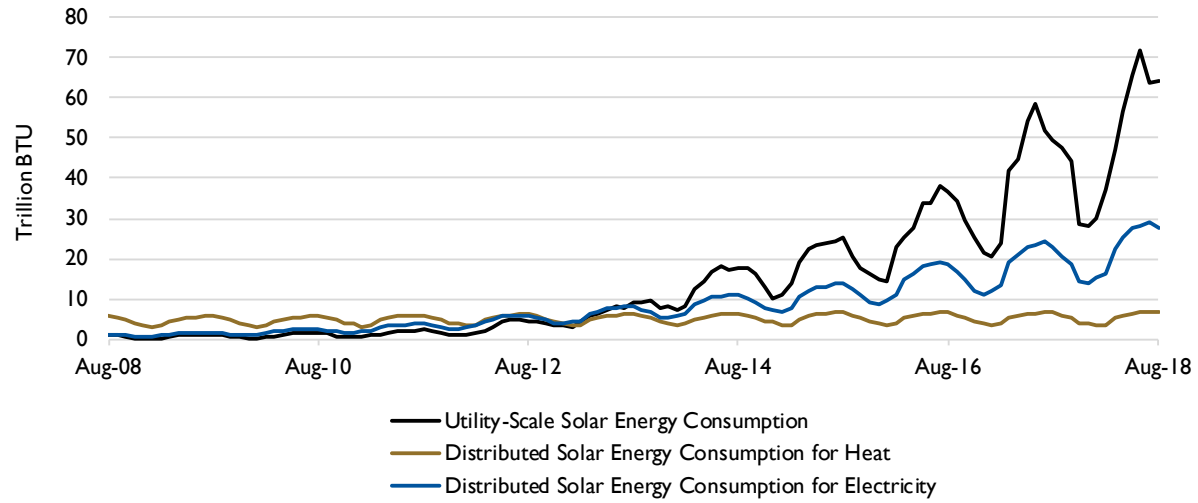
Corn and Ethanol Prices and Corn Cost per Gallon of Ethanol (Monthly Average) (44)



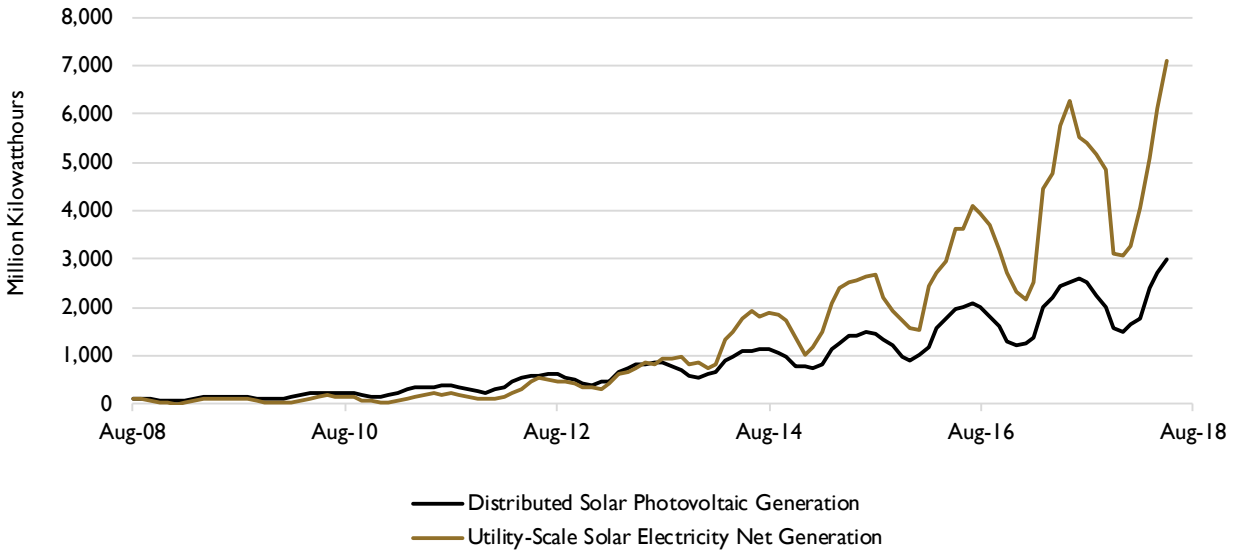
DATA CENTER

RENEWABLES

U.S. Solar Energy Consumption (Monthly) (45)



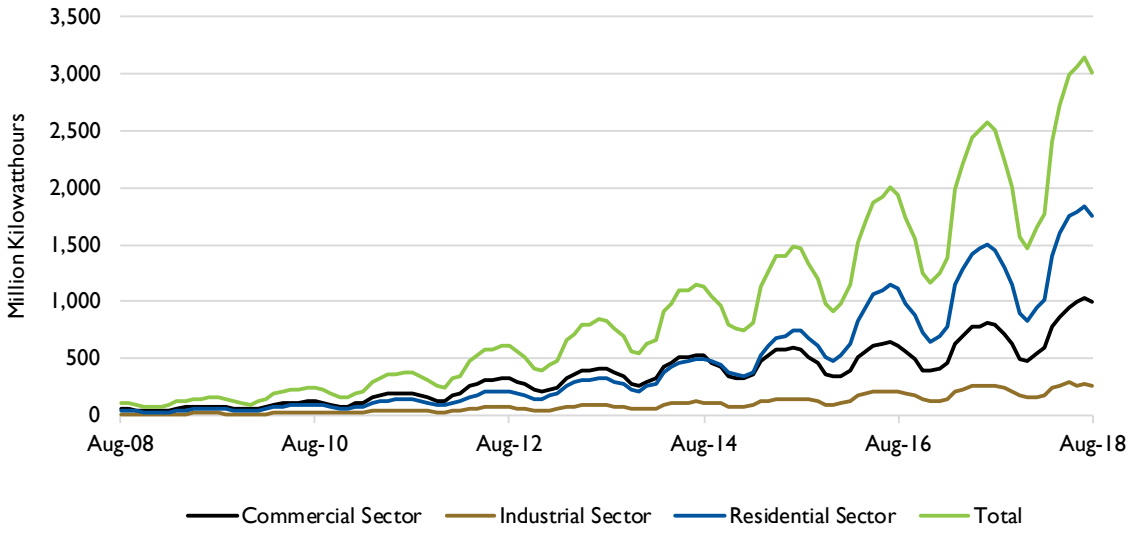
U.S. Solar Energy Net Generation (Monthly) (46)



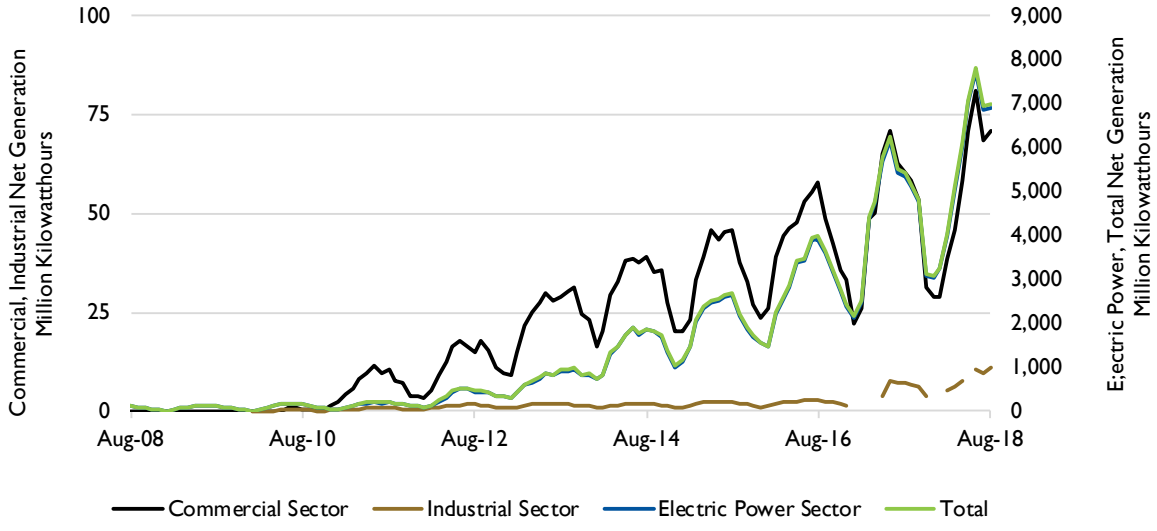
DATA CENTER

RENEWABLES

DISTRIBUTED SOLAR PHOTOVOLTAIC GENERATION BY SECTOR (MONTHLY) (47)



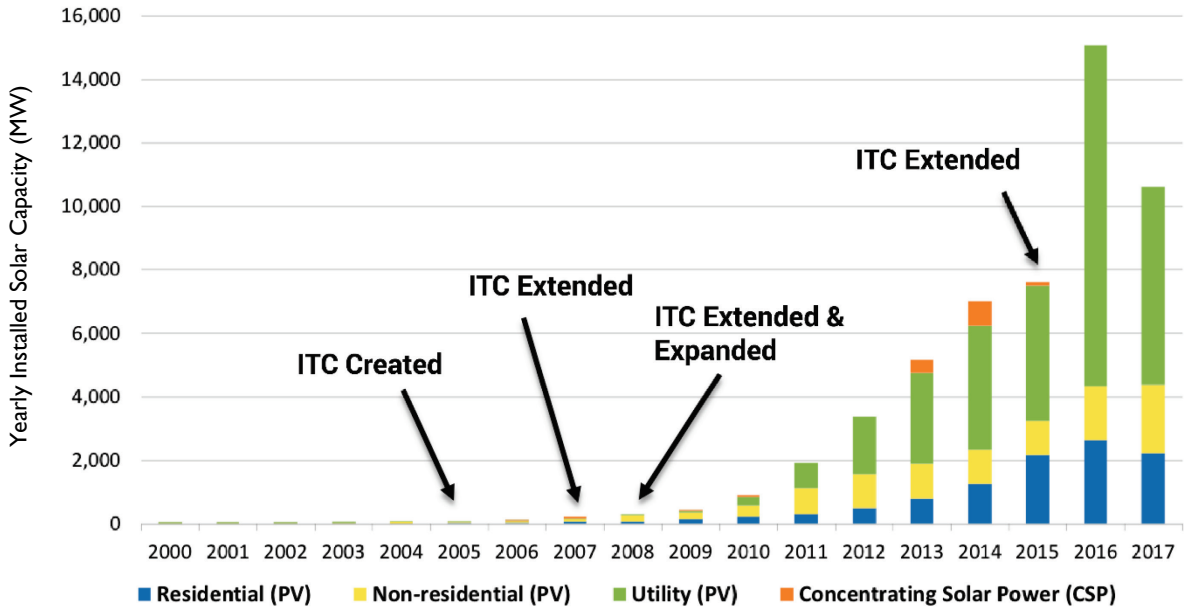
UTILITY-SCALE SOLAR ELECTRICITY NET GENERATION BY SECTOR (MONTHLY) (48)



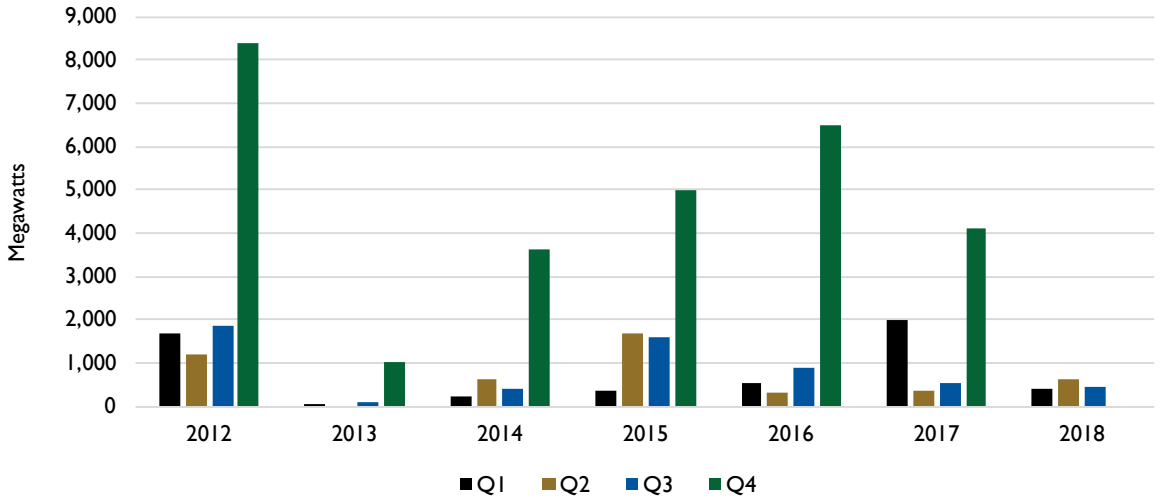
DATA CENTER

RENEWABLES

U.S. Solar Capacity Installations (Annual) (49)



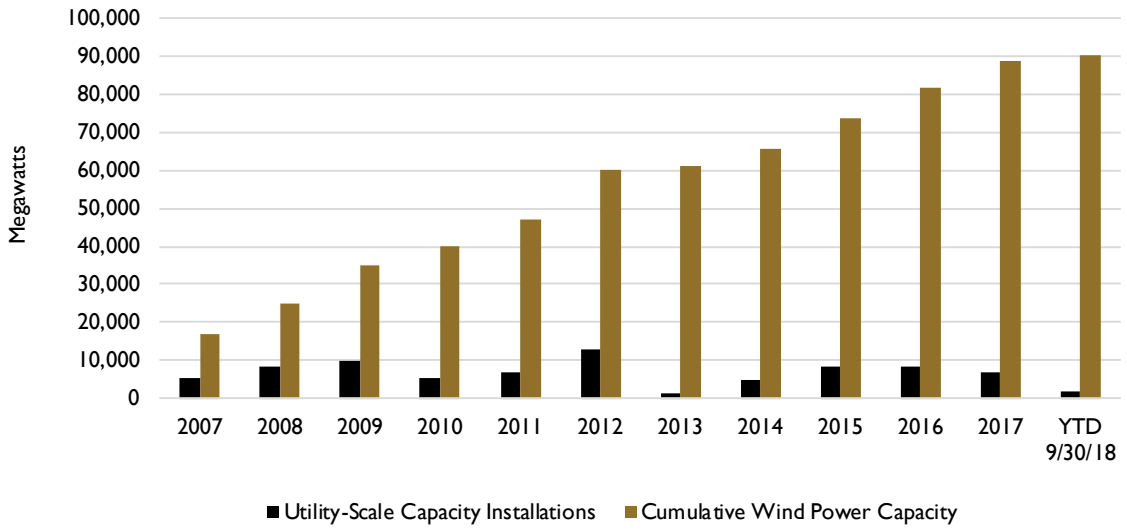
U.S. Wind Power Capacity Installations (Quarterly) (50)



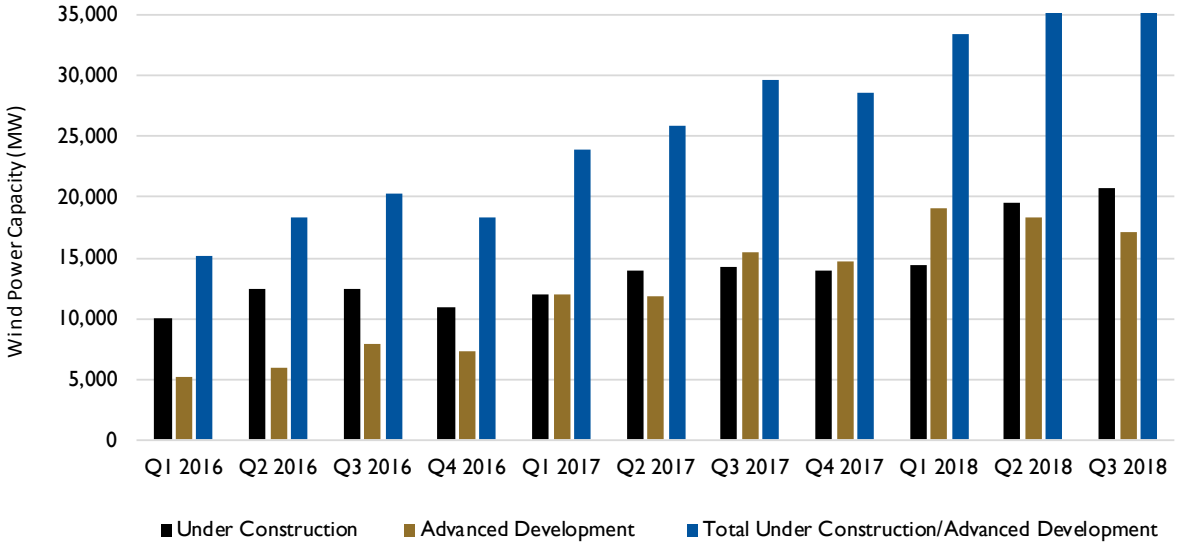
DATA CENTER

RENEWABLES

UTILITY-SCALE WIND POWER CAPACITY INSTALLATIONS (ANNUAL) (51)



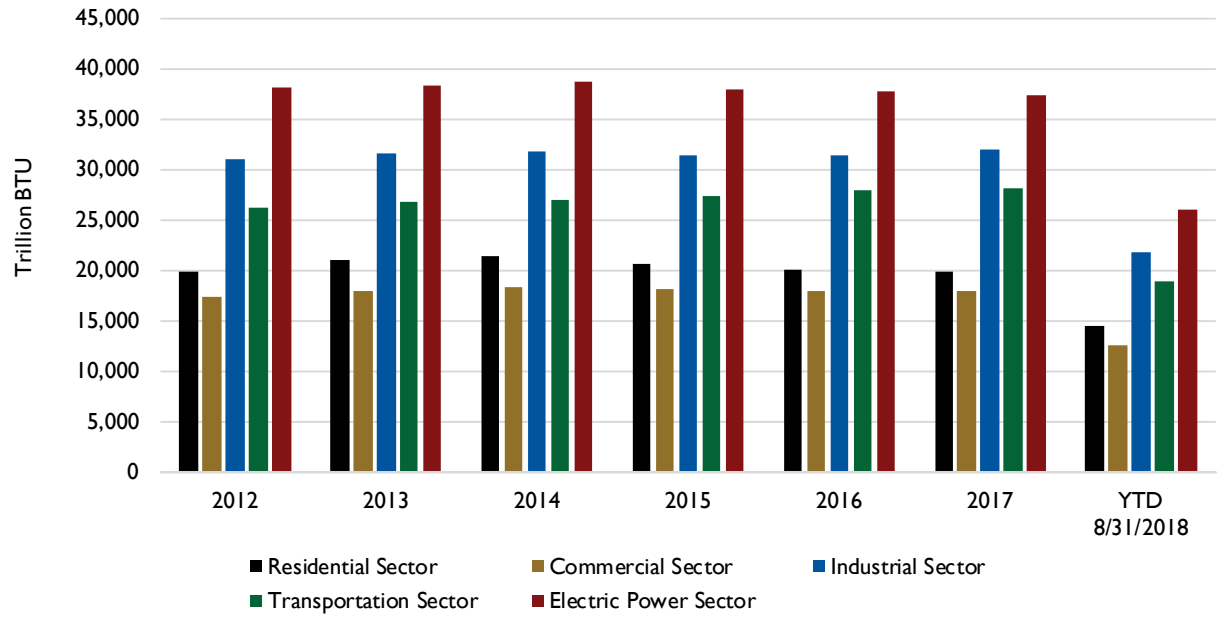
WIND POWER UNDER CONSTRUCTION OR IN ADVANCED DEVELOPMENT (QUARTERLY) (52)



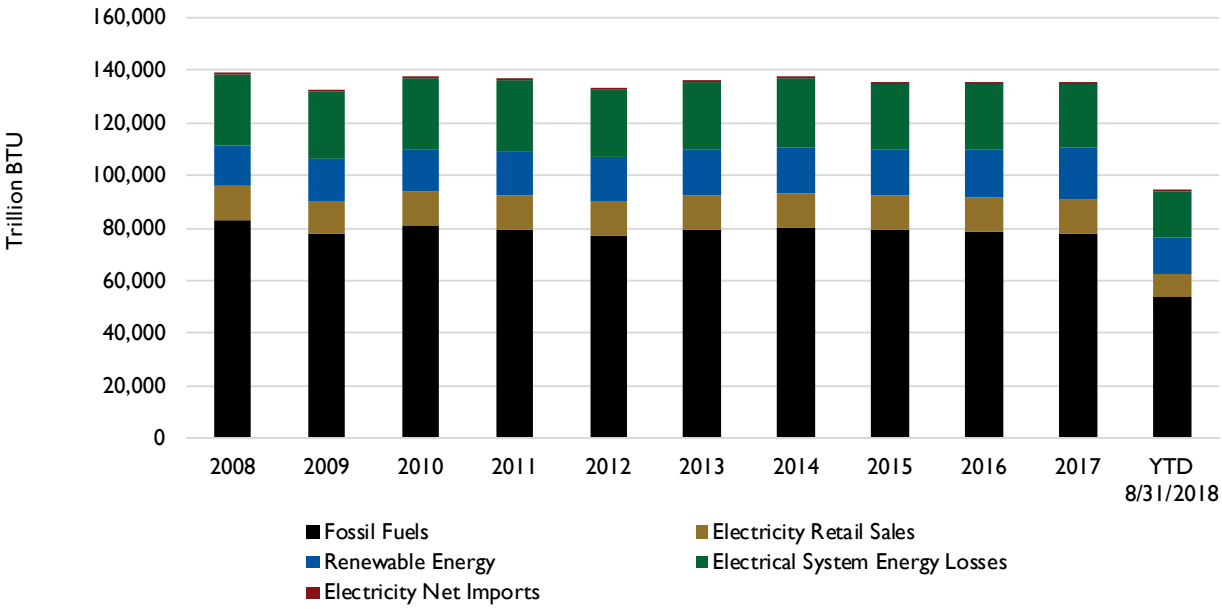
DATA CENTER

U.S. AGGREGATED ENERGY CONSUMPTION

ENERGY CONSUMPTION BY SECTOR (ANNUAL) (53)



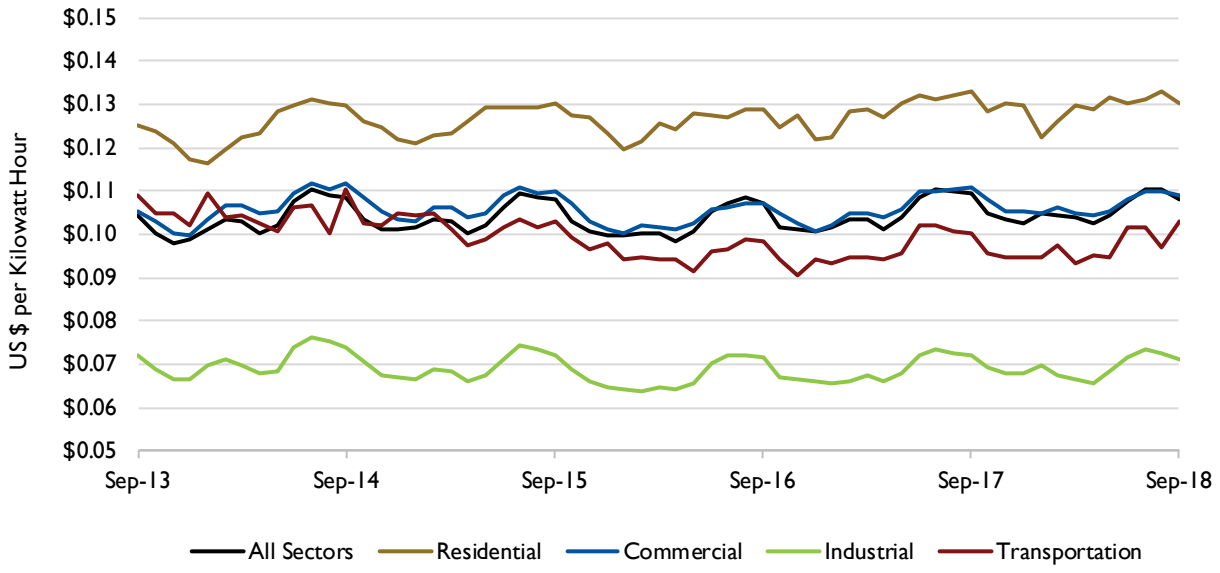
ENERGY CONSUMPTION BY SOURCE (ANNUAL) (54)



DATA CENTER

U.S. AGGREGATED ENERGY CONSUMPTION

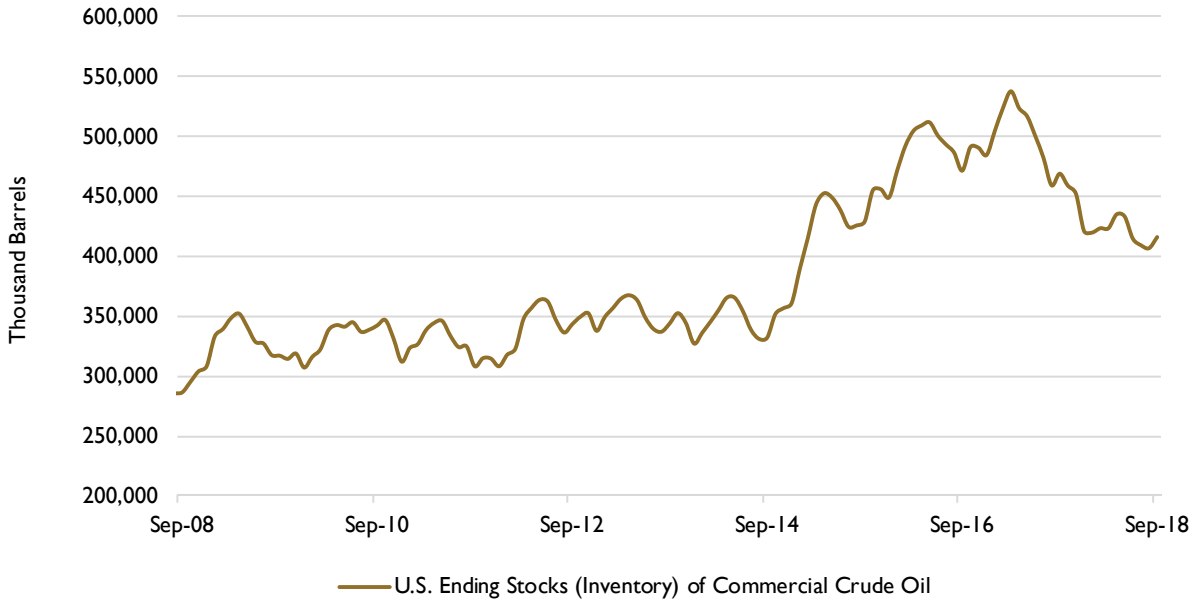
ELECTRICITY PRICES BY SECTOR (MONTHLY AVERAGE) (55)



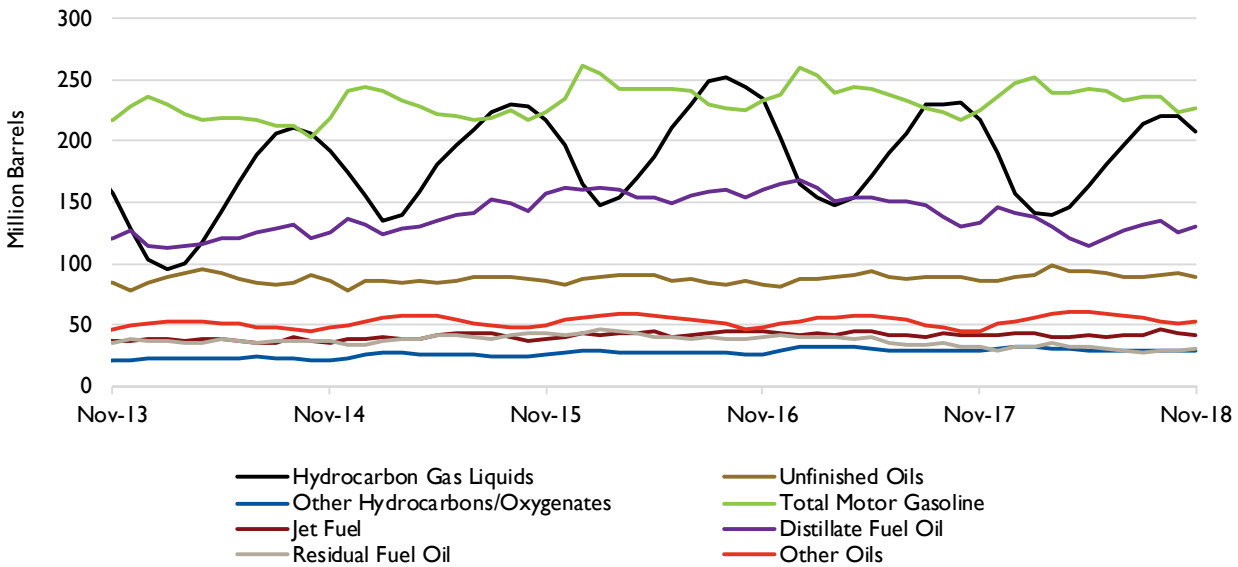
DATA CENTER

LOGISTICS - STORAGE AND TERMINALS

COMMERCIAL CRUDE OIL INVENTORY (MONTHLY) (56)



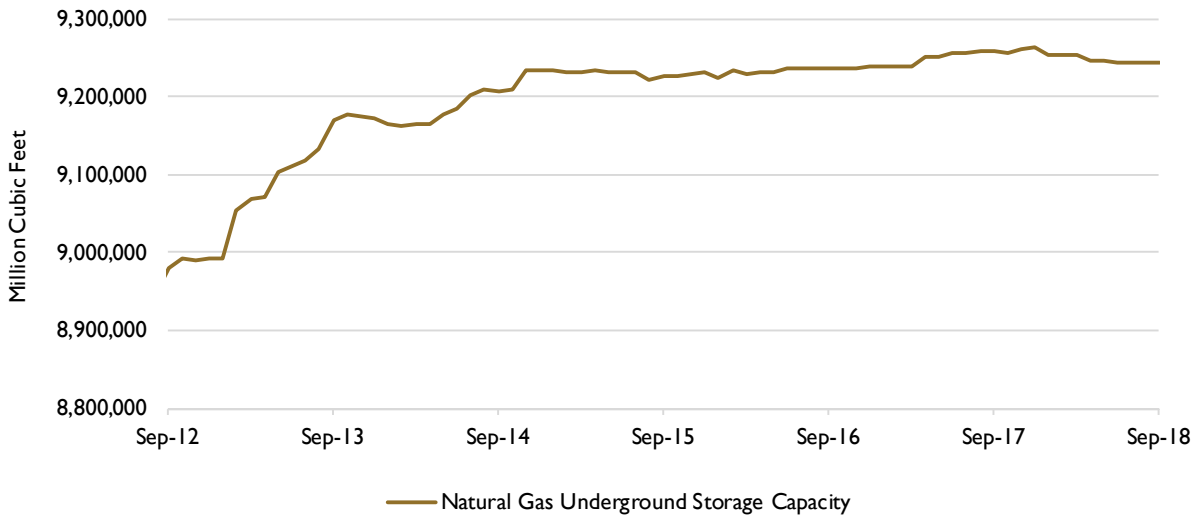
PETROLEUM AND OTHER LIQUIDS COMMERCIAL INVENTORY (MONTHLY) (57)



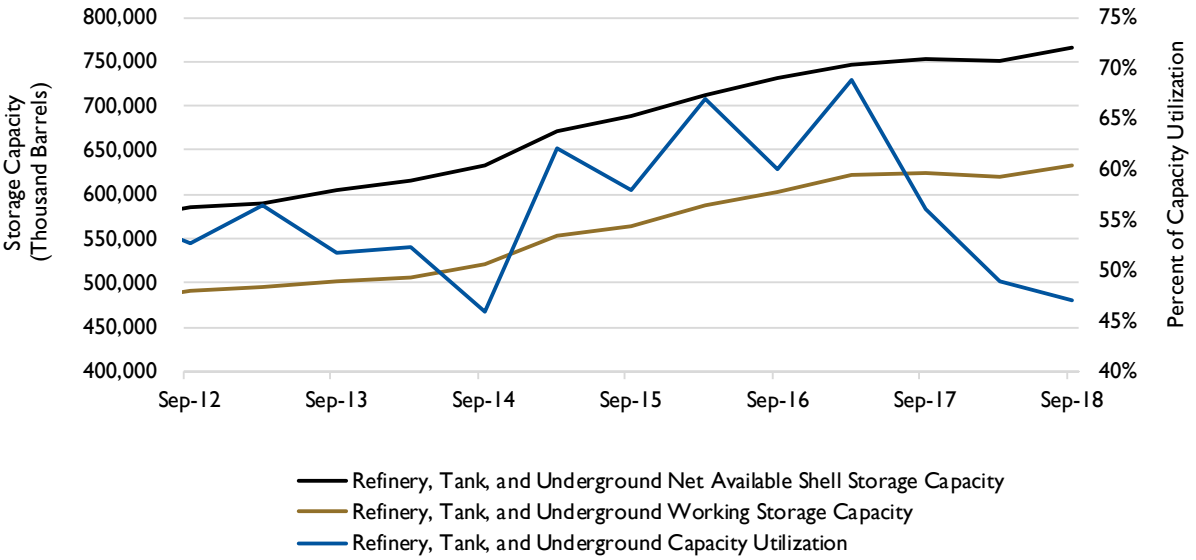
DATA CENTER

LOGISTICS - STORAGE AND TERMINALS

NATURAL GAS UNDERGROUND STORAGE CAPACITY (MONTHLY) (58)



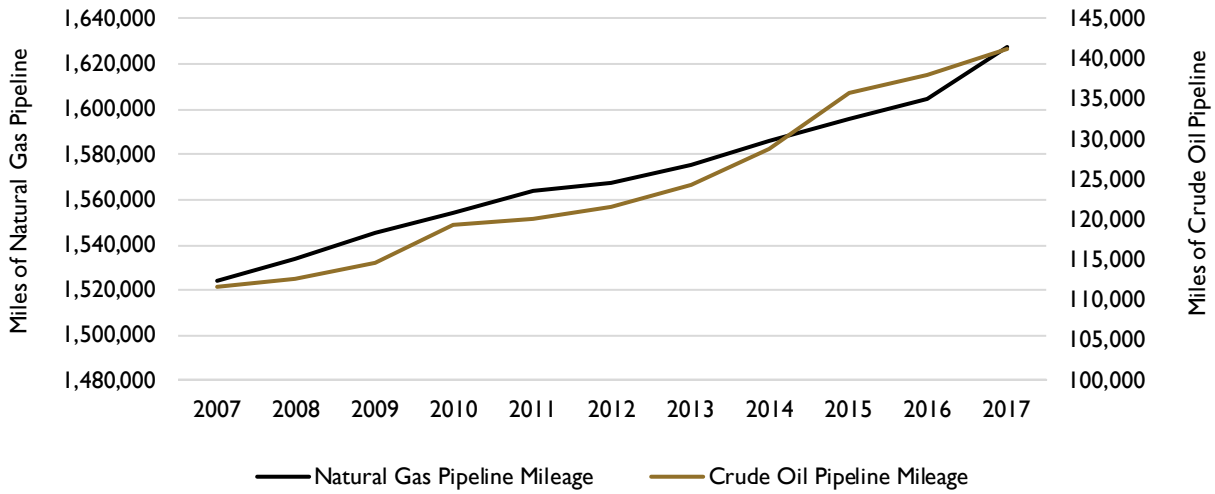
COMMERCIAL CRUDE OIL REFINERY, TANK AND UNDERGROUND STORAGE CAPACITY AND UTILIZATION (MONTHLY) (59)



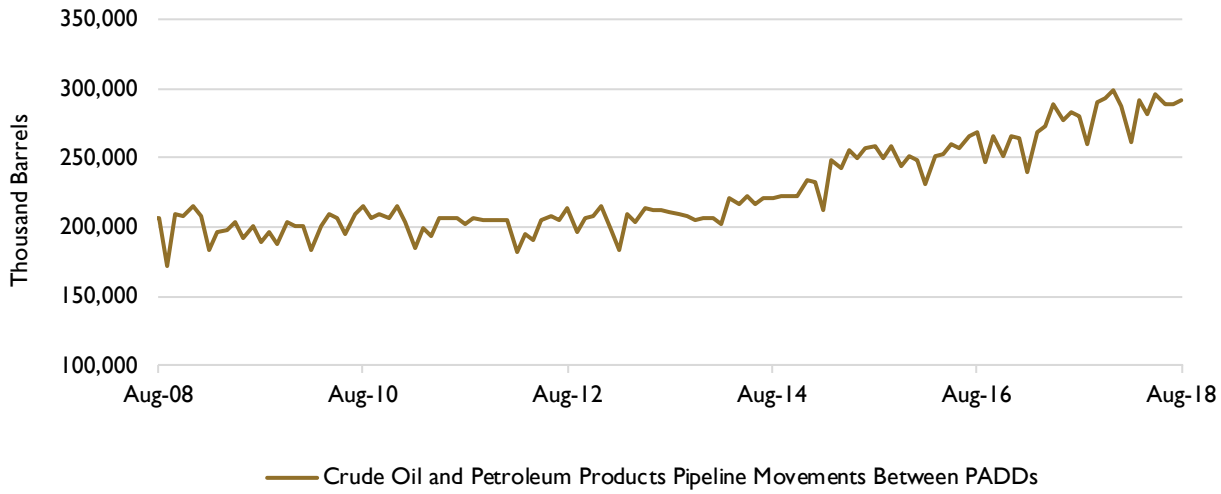
DATA CENTER

LOGISTICS - PIPELINES

CRUDE OIL AND NATURAL GAS PIPELINE MILEAGE (ANNUAL) (60)



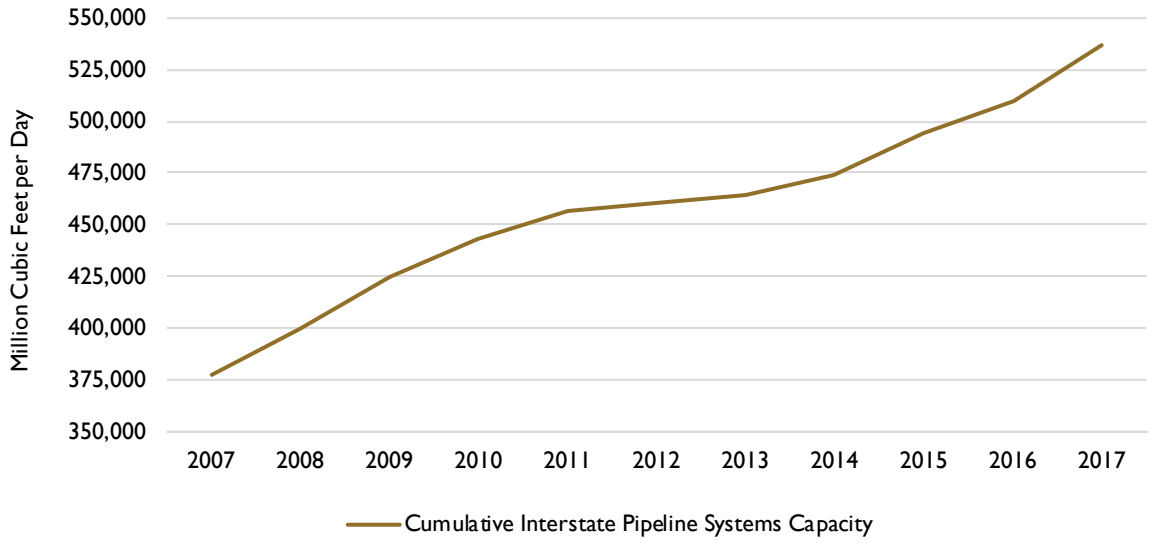
CRUDE OIL AND PETROLEUM PRODUCTS PIPELINE MOVEMENTS BETWEEN PETROLEUM ADMINISTRATION FOR DEFENSE DISTRICTS (PADDS) (MONTHLY) (61)



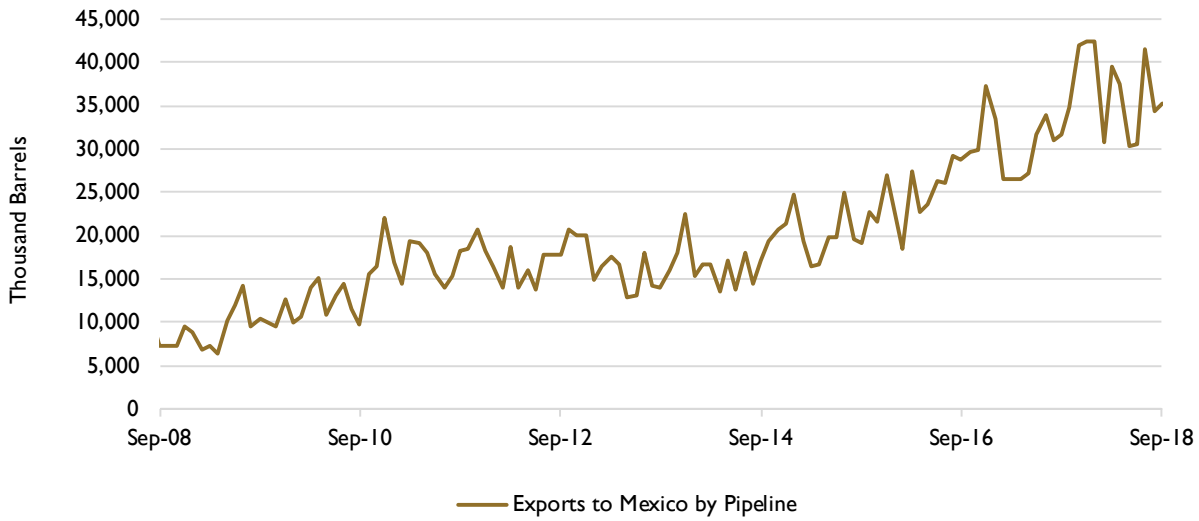
DATA CENTER

LOGISTICS - PIPELINES

NATURAL GAS CUMULATIVE INTERSTATE PIPELINE SYSTEMS CAPACITY (ANNUAL) (62)



CRUDE OIL AND PETROLEUM PRODUCTS EXPORTS TO MEXICO (MONTHLY) (63)

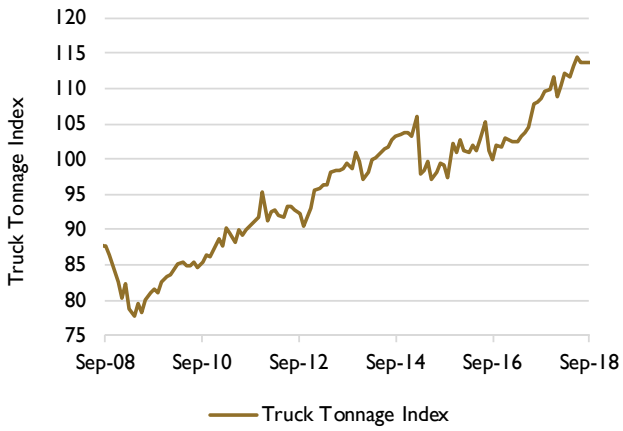


DATA CENTER

LOGISTICS - TRUCKERS

TRUCK TONNAGE INDEX (MONTHLY) (64)

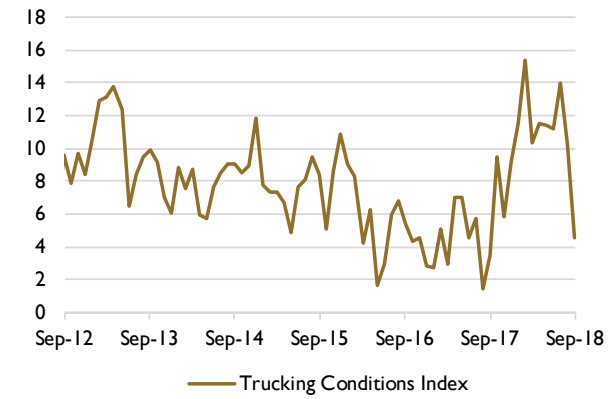
MEASURES GROSS TONNAGE OF FREIGHT



HEAVY TRUCK SALES (MONTHLY) (65)

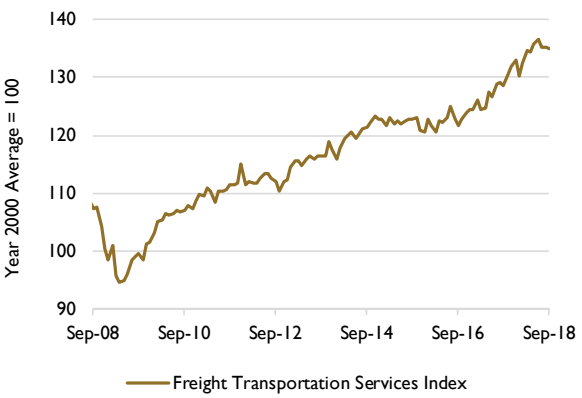
TRUCKING CONDITIONS INDEX (MONTHLY) (66)

INCLUDES FRIGHT VOLUMES, RATES, FLEET CAPACITY, BANKRUPTCIES, FUEL PRICE AND FINANCING



FREIGHT TRANSPORTATION SERVICES INDEX (MONTHLY) (67)

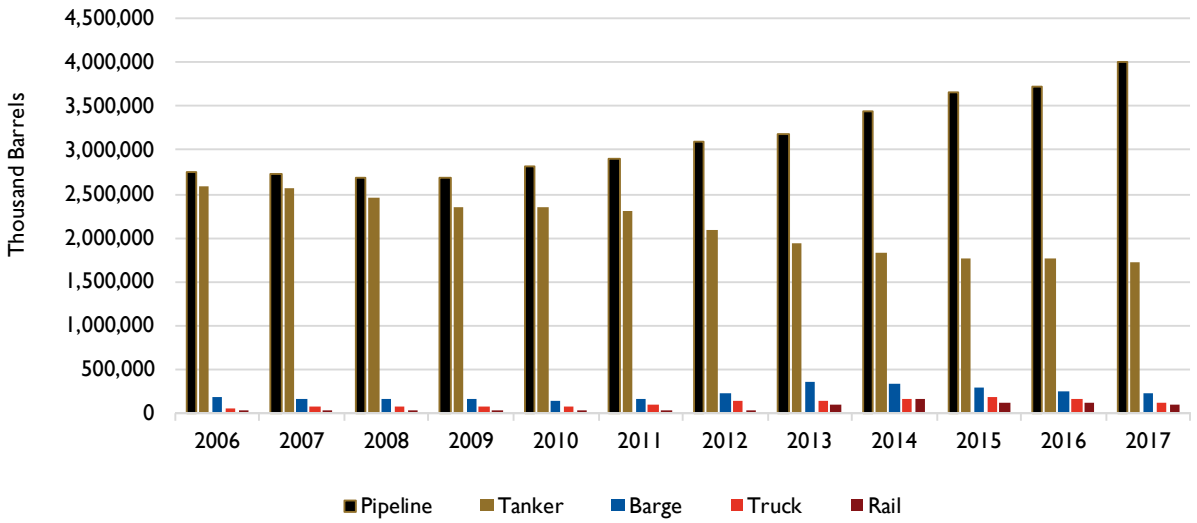
INCLUDES TRUCKING, RAIL, WATERWAYS, PIPELINES AND AIR FRIGHT



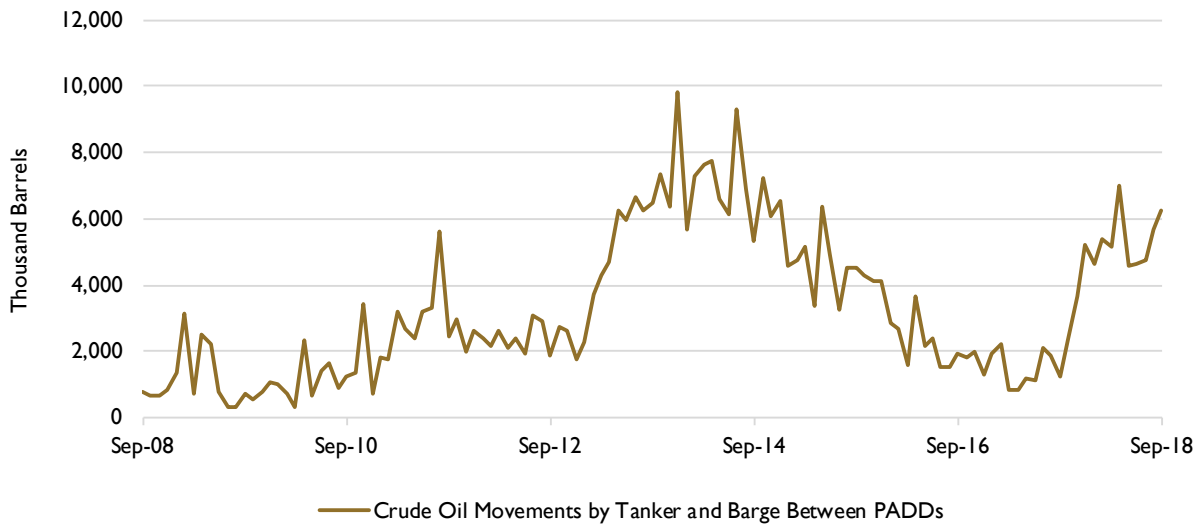
DATA CENTER

LOGISTICS - SHIPPING

CRUDE OIL REFINERY RECEIPTS BY TRANSPORTATION METHOD (ANNUAL) (68)



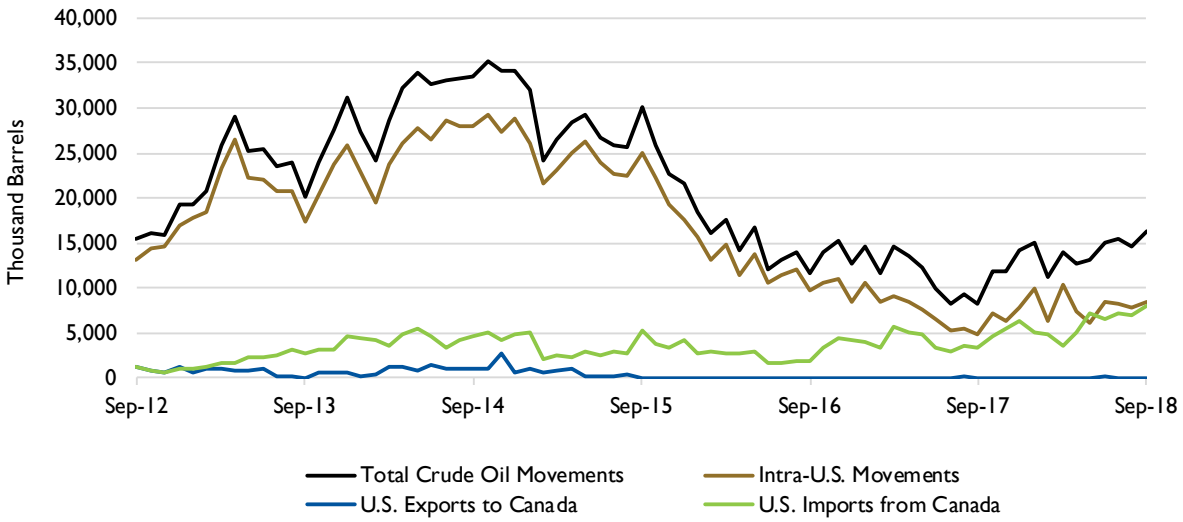
CRUDE OIL MOVEMENTS BY TANKER AND BARGE BETWEEN PETROLEUM ADMINISTRATION FOR DEFENSE DISTRICTS (PADDS) (MONTHLY) (69)



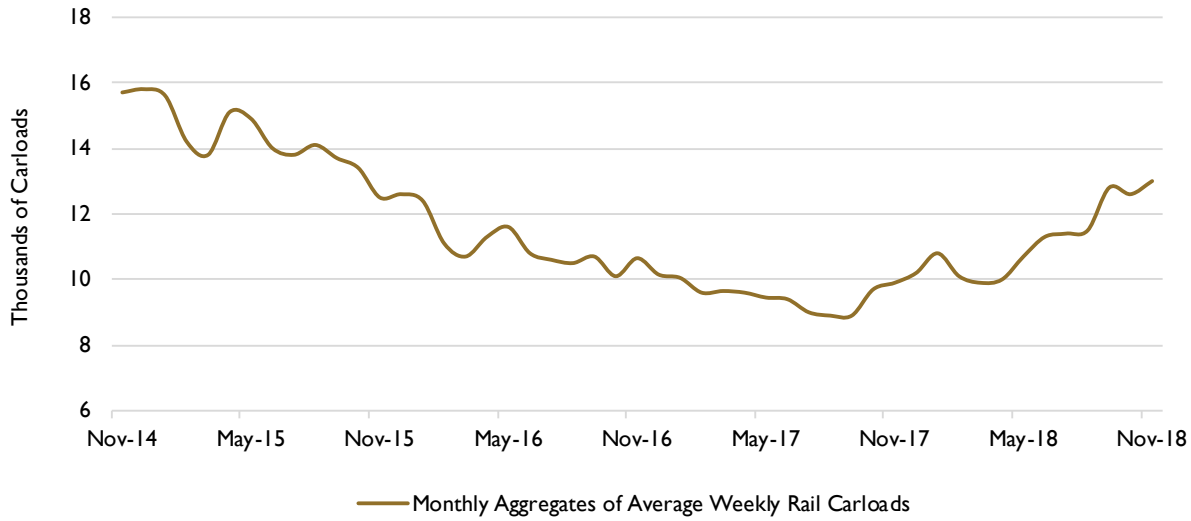
DATA CENTER

LOGISTICS - RAIL

MOVEMENTS OF CRUDE OIL BY RAIL (MONTHLY) (70)



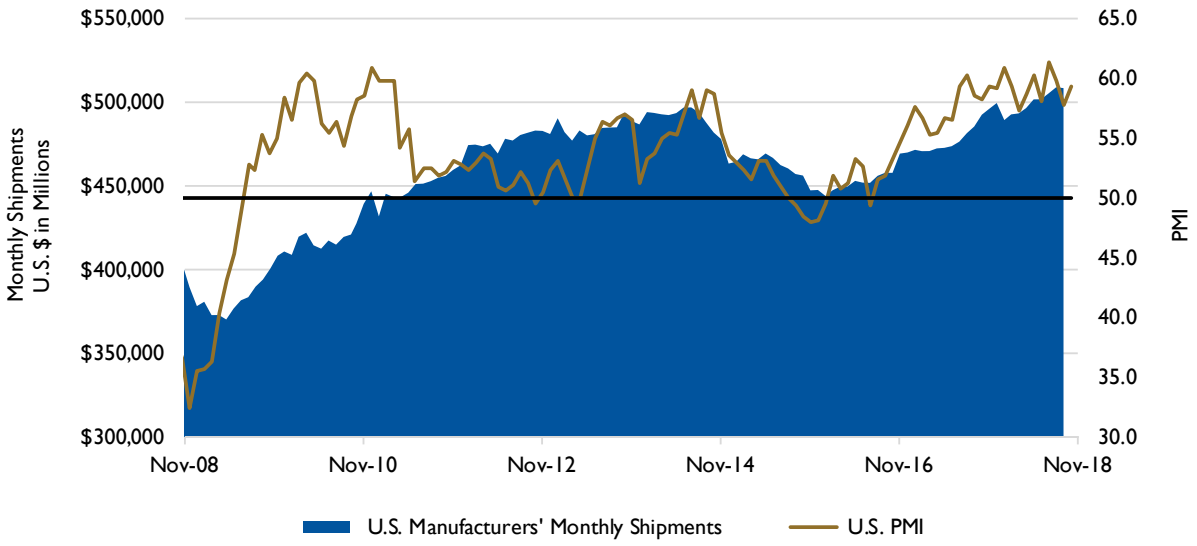
AVERAGE WEEKLY RAIL CARLOADS OF PETROLEUM AND PETROLEUM PRODUCTS (MONTHLY AGGREGATE) (71)



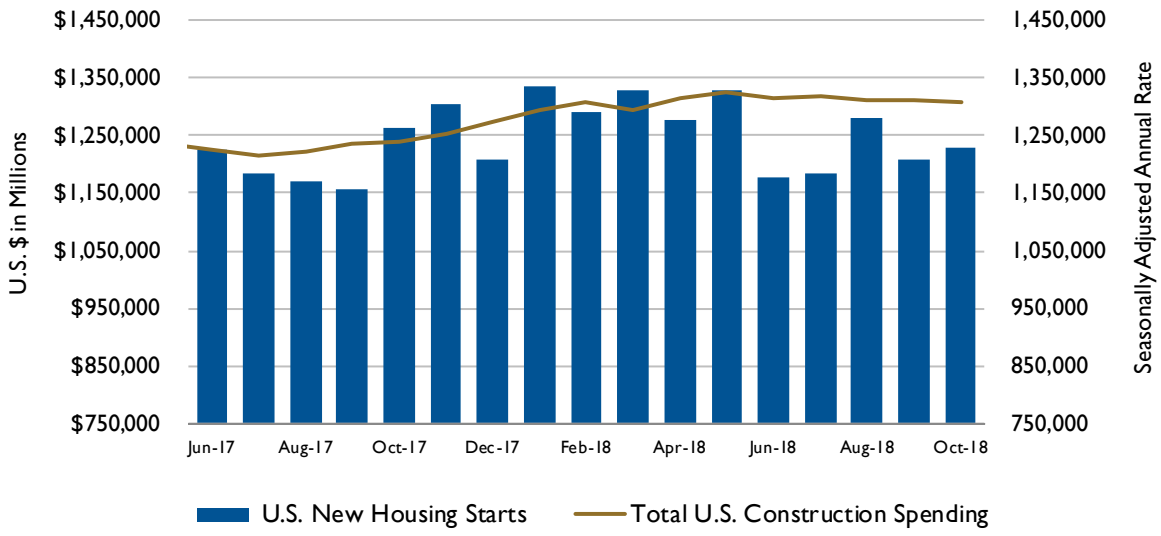
DATA CENTER

ECONOMIC / FINANCIAL

U.S. Manufacturers' Monthly Shipments and U.S. Purchasing Managers' Index (PMI) (Monthly) (72)



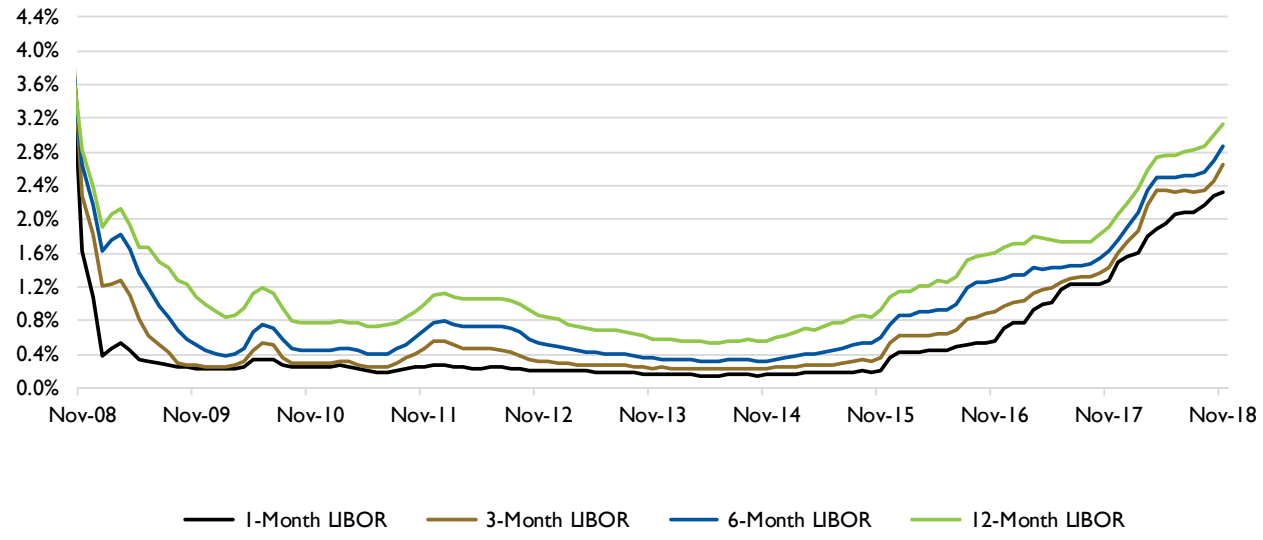
U.S. New Housing Starts and Total U.S. Construction Spending (Monthly) (73)



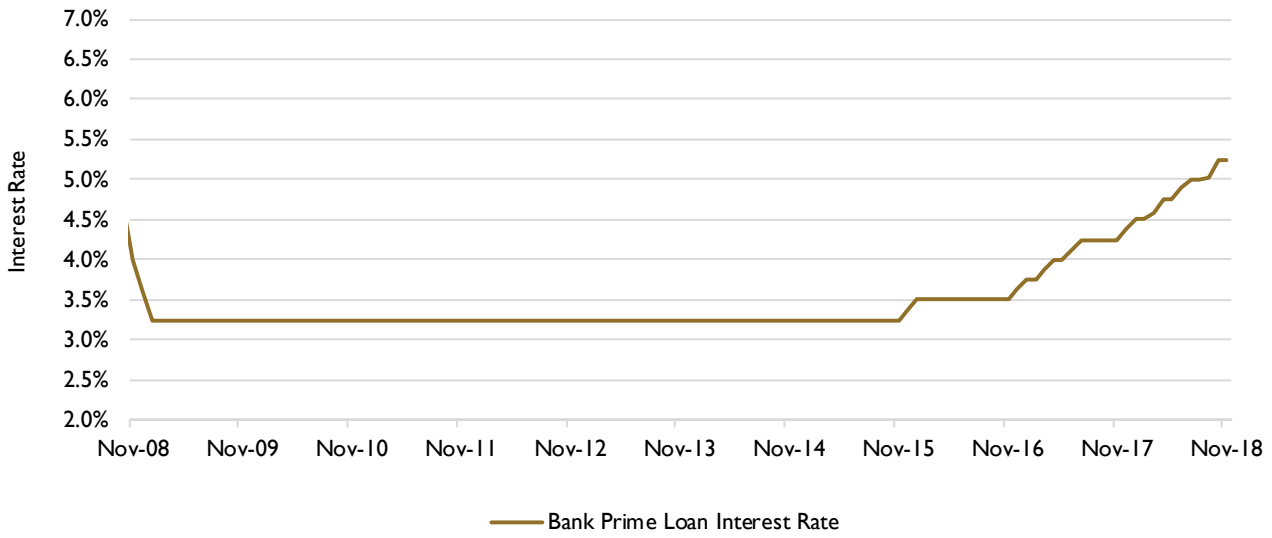
DATA CENTER

ECONOMIC / FINANCIAL

LONDON INTERBANK OFFERED RATE (LIBOR) (MONTHLY AVERAGE) BASED ON U.S. DOLLAR (74)



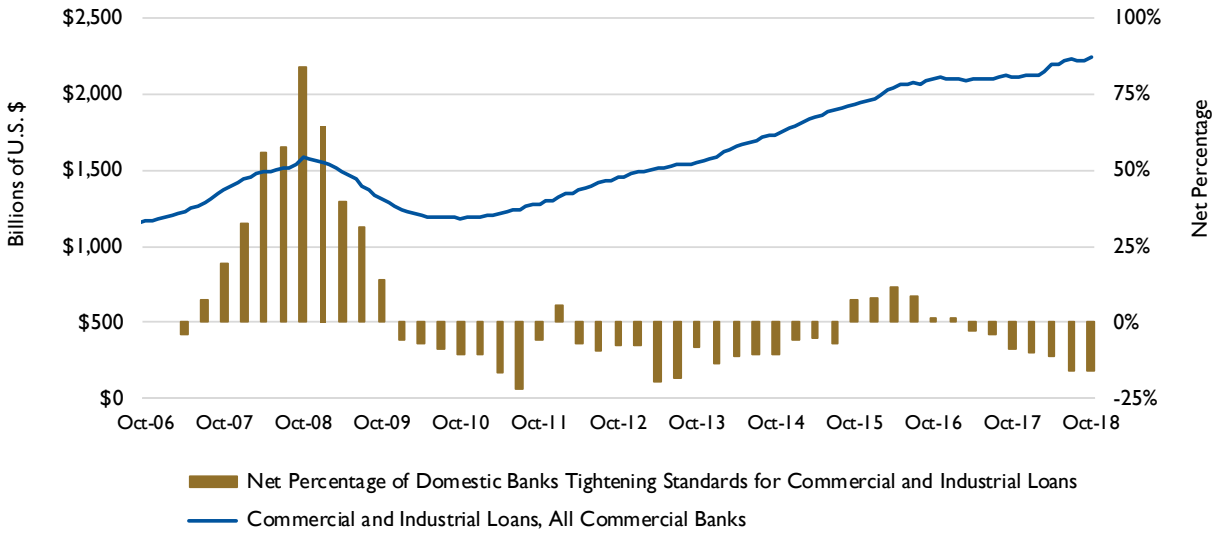
BANK PRIME LOAN INTEREST RATES (MONTHLY AVERAGE) (75)



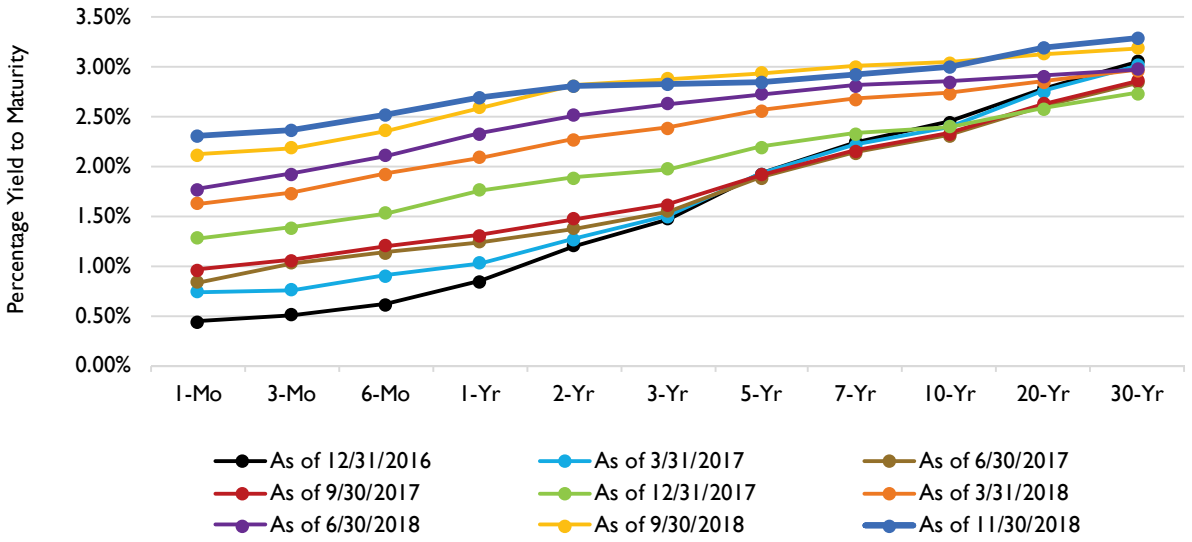
DATA CENTER

ECONOMIC / FINANCIAL

COMMERCIAL AND INDUSTRIAL LOANS VS. BANKING STANDARDS (QUARTERLY, MONTHLY) (76)



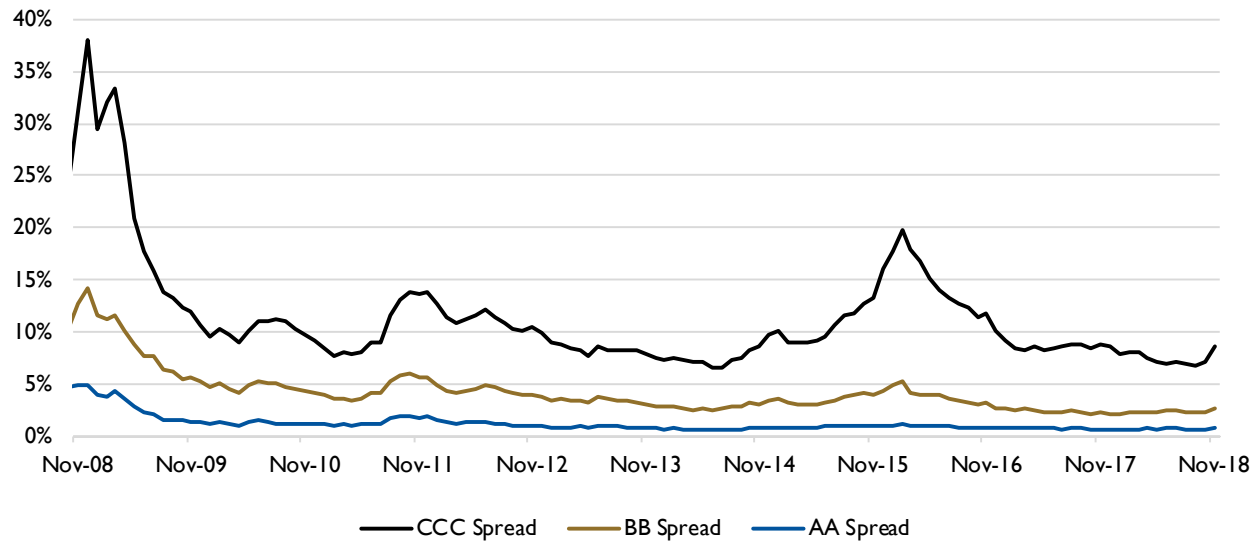
U.S. TREASURY YIELD CURVE (MONTHLY, ANNUAL) (77)



DATA CENTER

ECONOMIC / FINANCIAL

CORPORATE SPREADS TO TREASURIES BY QUALITY
(MONTHLY AVERAGE) (78)



DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

ABBREVIATIONS & ACRONYMS

AECO – Alberta Energy Company
ARAMCO – Saudi Arabian Oil Company, formerly the Arabian-American Oil Company
BCF – Billion cubic feet
BTU – British thermal unit
CIF – Costs, insurance and freight
CMT – Constant maturity treasury
DUC – Drilled but uncompleted wells
EBITDA – Earnings before interest, taxes, depreciation and amortization
IFO – Intermediate fuel oil
ITC – Investment Tax Credit
LCOE – Levelized cost of energy
LIBOR – London Interbank Offered Rate
LNG – Liquefied natural gas
LPG – Liquefied petroleum gas
mmBTU – Millions of British Thermal Units
MTBE – Methyl tertiary butyl ether
MW – Megawatt
NBP – National Balancing Point
NGPL – Natural gas plant liquids
NYMEX – New York Mercantile Exchange
OAS – Option-adjusted spread
OPEC – The Organization of Petroleum Exporting Countries
PADD – Petroleum Administration for Defense District
PG&E – Pacific Gas & Electric
PMI – U.S. Purchasing Managers Index
PV – Photovoltaic
SoCal – Southern California
SPR – Strategic Petroleum Reserve
TETCO-M3 – Texas Eastern Transmission Corporation Pipeline Zone M3
TTF – Title Transfer Facility
UAE – United Arab Emirates
WTI – West Texas Intermediate crude oil

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

DEFINITIONS

Biofuels – liquid fuels and blending components produced from biomass feedstocks, used primarily for transportation.

British Thermal Unit (BTU) – A traditional unit of heat; it is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

Ending Stocks – A proxy for inventory, defined as the total volume of a given commodity held in storage (leases, refineries, processing plants, pipelines, terminals, tank farms) at the end of the last day of a given month.

Distillate Fuel Oil – A general classification for a variety of petroleum fractions produced in petroleum distillation operations. Included within this classification are No. 1, No. 2 and No. 4 diesel fuels (used in on-highway and off-highway diesel engines), as well as No. 1, No. 2 and No. 4 fuel oils (used primarily for space heating and electric power generation).

Distributed Solar Energy – Refers to solar energy generated by small-scale photovoltaic generation plants. Small-scale is defined as a plant with capacity below one megawatt.

Index – A figure in a system or scale representing the average value of specified prices, shares, or other items as compared with some reference figure.

Intermediate Fuel Oil – Also known as IFO and Bunker Fuel, fuel utilized by ships and barges to facilitate international exchange of various commodities across an array of industries.

Investment Tax Credit – A federal policy tax incentive that supports the deployment of solar energy in the United States.

LIBOR – The London Interbank Offered Rate is the average interest rate at which leading banks borrow funds of a sizeable amount from other banks in the London market.

Liquefied Natural Gas – Natural gas that has been cooled to a liquid state, at about -260°Fahrenheit, for shipping and storage.

Liquefied Petroleum Gas – A group of hydrocarbon gases, primarily propane, normal butane and isobutene, derived from crude oil refining or natural gas processing.

Natural Gas Liquids – A group of hydrocarbons including ethane, propane, normal butane, isobutene and natural gasoline. Generally include natural gas plant liquids and all liquefied refinery gases except olefins.

Natural Gas Plant Liquids – Ethane, propane, butane, isobutane, pentane and pentane plus.

Petroleum Administration for Defense District (PADD) – A geographic aggregation of the 50 States and the District of Columbia into five Districts. PADD 1 is the East Coast region, PADD 2 is the Midwest region, PADD 3 is the Gulf Coast region and PADD 5 is the West Coast region.

Petroleum Products – Obtained from the processing of crude oil (including lease condensate), natural gas and other hydrocarbon compounds. Petroleum products include unfinished oils, liquefied petroleum gases, pentanes plus, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas and miscellaneous products.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

DEFINITIONS

Product Supplied – A widely utilized proxy for consumption of petroleum products, measuring the disappearance of said products from primary sources. Primary sources include, among others, refineries, processing plants, blending plants, pipelines and bulk terminals.

Propylene – Petrochemical feedstock that is recovered from refinery or petrochemical processes. It is an olefinic hydrocarbon that is gaseous at standard temperature and pressure.

Residual Fuel Oil – The general classification for heavy oils that remain after lighter oils are distilled away in the process of petroleum refining.

Spot vs. Wholesale Price – "Spot" prices are defined by the U.S. Energy Information Administration as, "the price for a one-time open market transaction for immediate delivery of a specific quantity of a product at a specific location where the commodity is purchased 'on the spot' at current market rates."

In this report, certain charts contain both "spot" and "wholesale" prices for given commodities alongside each other within the same chart. In these instances, the wholesale prices shown are, in fact, wholesale market "spot" prices. Thus, the terms are interchangeable in charts where both terms are present in describing respective price series.

Strategic Petroleum Reserve (SPR) – An emergency fuel storage of crude oil maintained by the United States Department of Energy for use during periods of major supply interruption.

Virtual Trading Point – Commodity trading center created to service a specific geographic region but does not have a physical location.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

DESCRIPTIONS

General Conversion Information

- International pricing data for various commodities were converted by JKC from the units utilized by the original data source (in the form of currency value per unit of energy content or volume) to appropriate domestic units (in the form of U.S. dollars per common domestic unit of energy content or volume) in order to allow for convenient, informative comparison of international and domestic commodity price series through displaying them on a singular chart in consistent units. Appropriate domestic units for a given commodity are determined by whatever units are most commonly utilized in the United States to denote prices of that commodity, per the U.S. Energy Information Administration.
- International currency units were converted to U.S. dollars using historical exchange rates published by x-rates.com.
- Energy content and volume conversion factors differ by commodity. International energy content or volume units were converted using the various sources listed below:
  - Google.com In-Browser Unit Converter
    - Alberta Energy Co. Hub Natural Gas – gigajoules to mmBTU
    - Dutch TTF Hub Natural Gas – megawatt hours to mmBTU
    - Houston; Los Angeles; Rotterdam; Singapore; Port of Fujairah, UAE IFO 380, IFO 180 Bunker Fuel – liters/kilogram to gallons per metric ton
  - Iowa State University Liquid Fuel Measurements and Conversions
    - Netherlands Retail LPG – liters to metric tons, metric tons to barrels
    - Saudi ARAMCO Propane – metric tons to barrels
    - Japan Propane Imports – metric tons to barrels
    - Holland Retail Gasoline – liters to gallons
    - Singapore Retail Gasoline – liters to gallons
    - UAE Gasoline – liters to gallons
    - Edmonton Diesel Fuel – liters to gallons
    - Singapore Retail Diesel – liters to gallons
    - Holland Retail Diesel – liters to gallons
    - UAE Diesel – liters to gallons
  - Official Nebraska Government Website
    - Netherlands Retail LPG – barrels to gallons
    - Saudi ARAMCO Propane – barrels to gallons
    - Japan Propane Imports – barrels to gallons
  - Lanka IOC Oil Company
    - Houston; Los Angeles; Rotterdam; Singapore; Port of Fujairah, UAE IFO 380, IFO 180 Bunker Fuel – density, in liters per kilogram

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

CHART NOTES

All charts in this report are updated to the latest information available at the time of publication. Due to differing reporting dates for various data used throughout the report, all charts are not updated to the same ending period.

(1) Crude Oil Prices

- Sources: U.S. Energy Information Administration (Brent, West Texas Intermediate), IndexMundi via WorldBank (Dubai Fateh), Alberta.ca Economic Dashboard (Western Canadian Select), OPEC.org and Quandl.com (OPEC Reference Basket).
- The Organization of Petroleum Exporting Countries (OPEC) reference basket is a composite of the following blends of crude oil: Saharan Blend (Algeria), Girassol (Angola), Oriente (Ecuador), Zafiro (Equatorial Guinea), Rabi Light (Gabon), Iran Heavy (Islamic Republic of Iran), Basra Light (Iraq), Kuwait Export (Kuwait), Es Sider (Libya), Bonny Light (Nigeria), Qatar Marine (Qatar), Arab Light (Saudi Arabia), Murban (United Arab Emirates), Merey (Venezuela).
- All prices are spot or wholesale.

(2) Gasoline Prices

- Sources: U.S. Energy Information Administration (New York Harbor, U.S. Gulf Coast), Trading Economics (Singapore, Netherlands Retail), United Arab Emirates Ministry of Energy (UAE Retail).
- New York Harbor Spot, U.S. Gulf Coast Spot, Netherlands Retail and Singapore Retail all represent the price history of conventional gasoline in their respective locations. United Arab Emirates Retail represents an aggregate of unleaded 95, unleaded 98 and unleaded 91 prices in the United Arab Emirates.

(3) Diesel Prices

- Sources: U.S. Energy Information Administration (U.S. Gulf Coast, New York Harbor, Los Angeles, CA), Ec.euopa.eu European Commission (Netherlands Retail), Knoema.com (Singapore Retail), United Arab Emirates (UAE Retail).
- New York Harbor, U.S. Gulf Coast and Los Angeles, CA prices represent ultra-low sulfur No. 2 diesel.
- Edmonton, Canada price represents low-sulfur diesel.
- Singapore Retail, United Arab Emirates Retail and Netherlands Retail prices represent conventional gasoil found at the pump. Gasoil is an alternative term for diesel commonly used throughout Europe.
- Netherlands Retail prices exclude taxes, Singapore Retail prices include taxes.

(4) Jet Fuel Prices

- Source: U.S. Energy Information Administration.
- All prices are spot or wholesale prices.

(5) U.S. Crude Oil and Petroleum Products Supply, Inventory and Consumption

- Source: U.S. Energy Information Administration.
- Crude Oil and Petroleum Products consist of natural gas plant liquids (ethane, propane, butane, isobutane, pentane), other liquids (hydrogen, oxygenates and renewable fuels like fuel ethanol, motor and aviation gasoline blending components, unfinished oils) and finished petroleum products (motor gasoline, aviation gasoline, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, napthas, lubricants, waxes, petroleum cokes, asphalt and road oil, still gas, miscellaneous products).
- Supply is comprised of field production, renewable fuels and oxygenate plant net production, refinery and blender net production, imports and net Petroleum Administration for Defense District (PADD) receipts. Net PADD receipts represent the net volume of product movement into and out of each PADD by tanker, barge and pipeline.
- Ending Stocks is a proxy for inventory and is defined as primary stocks held in storage as of midnight on the last day of the month. Primary stocks include products held in storage at, or in, leases, refineries, natural gas processing plants, pipelines, tank farms and bulk terminals with the capacity to store at least 50,000 barrels or that can receive product by tanker, barge or pipeline. Ending Stocks include volumes in the Strategic Petroleum Reserve (SPR) maintained by the Federal Government for use during periods of major supply interruption.
- Product Supplied is a proxy for consumption as it measures the disappearance of said product from primary sources, including refineries, processing plants, blending plants, pipelines and bulk terminals.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(6) U.S. Refinery Volumes and Wholesale Prices of Petroleum Products

- Source: U.S. Energy Information Administration Petroleum Marketing Monthly.

(7) U.S. Crude Oil Refinery Input, Distillation Capacity and Refinery Utilization

- Source: U.S. Energy Information Administration Petroleum Supply Weekly.
- Net Input is defined as gross inputs less gross production. Crude Oil Refinery Net Input values are monthly aggregates of weekly net input averages, measured in thousands of barrels per day. The resulting values are represented as monthly average refinery inputs, measured in thousands of barrels per day.
- Refinery Capacity refers to the maximum amount of crude oil designed to flow into the distillation (or crude) unit of the refinery. Operable Capacity is equal to the sum of operating and idle capacity. Idle Capacity is capacity that is not in operation, not under active repair, and can be placed in operation within 30 days.

(8) U.S. Crude Oil and Petroleum Products Imports and Exports

- Source: U.S. Energy Information Administration Petroleum Supply Monthly.
- U.S. Net Imports of Petroleum Products data fall below zero at which point the U.S. becomes a net exporter.

(9) Domestic Natural Gas Citygate Prices per Region

- Source: U.S. Energy Information Administration.
- The prices shown are "Citygate" prices. A Citygate is defined as "a point or measuring station at which a distributing gas utility receives gas from a natural gas pipeline company or transmission system." The Citygate price represents the benchmark price for a given region, accounting for all costs of acquisition, storage, and transportation of gas as well as other charges associated with local distribution companies obtaining the gas for sale to end-users.
- The Western market contains Oregon, Washington, California, Nevada, Arizona, New Mexico, Utah, Wyoming, Colorado, Montana, and Idaho.
- The Midwestern market contains North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Minnesota, Iowa, Missouri, Arkansas, Wisconsin, Michigan, Illinois, and Indiana.
- The Gulf market contains Texas and Louisiana; the Southeastern market contains Florida, Mississippi, Alabama, Georgia, Tennessee, North Carolina, and South Carolina.
- The Northeastern market contains Kentucky, Virginia, West Virginia, Ohio, Pennsylvania, New York, Vermont, New Hampshire, Maine, Massachusetts, Rhode Island, Connecticut, Delaware, New Jersey, and Maryland.

(10) International Natural Gas Prices

- Sources: U.S. Energy Information Administration (Henry Hub), NGX Clearinghouse (AECO Hub), BP Statistical Review of World Energy 2017 (United Kingdom NBP), World Bank via Index Mundi (Russian NG European Import Price), Knoema via World Bank (Japan LNG Import), my.Elexys.be Market Information (Dutch TTF).
- Henry Hub serves as the primary global pricing benchmark.
- Alberta Energy Company (AECO) Hub serves North America.
- United Kingdom National Balancing Point (NBP) serves the British Isles.
- Dutch Title Transfer Facility (TTF) serves continental Europe.
- Virtual Trading Point (Virtual) does not have a physical location and was created to serve a specific region.
- Japan LNG Import Price represents aggregate import prices of liquefied natural gas in Japan and is a price benchmark serving the Asia-Pacific region. The price includes costs, insurance and freight (CIF).
- All price benchmarks above represent gaseous state natural gas transported by pipeline, with the exception of Japan LNG Import Price, which represents liquid state natural gas transported by ship.
- All prices are spot or wholesale.

(11), (12), (13) and (14) Liquefied Natural Gas Prices

- Sources: Federal Energy Regulatory Commission (U.S., Mexico, Belgium, India), World Bank via Bluegold Research (Brazil/Argentina, Japan/Korea, China, United Kingdom).
- All prices are "landed" prices. Landed price is the price received at the regasification terminal and is based on a netback calculation that removes the costs of pipeline transportation, regasification, waterborne shipping and liquefaction, so as to best represent the effective price to the producer or seller at a specific location or defined point.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(15) U.S. Import / Export Liquefied Natural Gas Prices
- Source: U.S. Energy Information Administration.
- All prices are spot or wholesale.

(16) Natural Gas Plant Liquids Prices
- Source: U.S. Energy Information Administration.
- Natural gas liquids spot prices at Mont Belvieu, TX.
- Natural Gas Plant Liquids (NGPL) Composite price includes ethane, propane, butane, isobutane and natural gasoline. Daily closing spot prices for each component are averaged into a monthly series, then weighted according to the portion of a representative natural gas plant liquids barrel that they occupy. The NGPL Composite price excludes natural gas liquids produced at crude oil refineries.

(17) U.S. Natural Gas Production and Consumption
- Source: U.S. Energy Information Administration.
- Marketed Production is equal to gross withdrawals of natural gas from production reservoirs, less gas used for reservoir re-pressuring, nonhydrocarbon gases removed in treating and processing operations, and quantities vented and flared (gas that is disposed of by release into the atmosphere).

(18) U.S. Natural Gas Supply and Inventory
- Source: U.S. Energy Information Administration.
- Working Gas is defined as the total amount of natural gas in storage less the amount of base gas. Base gas is the amount of gas intended as permanent inventory.

(19) U.S. Natural Gas Consumption by End Use
- Source: U.S. Energy Information Administration.

(20) U.S. Natural Gas Plant Liquids Production
- Source: U.S. Energy Information Administration.
- Natural Gas Plant Liquids Production refers to the sum of all production of ethane, propane, butane, isobutane, pentane and pentane plus.

(21) U.S. Liquefied Natural Gas Import and Export Volumes
- Source: U.S. Energy Information Administration.

(22), (23) and (24) North American LNG Import / Export Terminals – Proposed, Approved and Existing
- Source: Federal Energy Regulatory Commission.

(25) Heating Oil Prices
- Source: U.S. Energy Information Administration.
- Spot prices of No 2. heating oil at New York Harbor, alongside the spot prices of West Texas Intermediate crude oil for comparison purposes.

(26) Intermediate Fuel Oil aka "Bunker Fuel" Prices
- Source: Ship & Bunker.
- Intermediate Fuel Oil, also known as IFO and Bunker Fuel, is fuel utilized by ships and barges to facilitate international exchange of various commodities across an array of industries, including energy. It is classified in the maritime field by its viscosity, measured in centistokes. IFO 380 has a maximum viscosity of 380 centistokes, while IFO 180 has a maximum viscosity of 180 centistokes. IFO 380 is comprised of 98% residual fuel oil and 2% distillate fuel oil. IFO 180 is comprised of 88% residual fuel oil and 12% distillate fuel oil.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(27) Propane Prices

- Sources: U.S. Energy Information Administration (Conway, KS and Mont Belvieu, TX spot prices), Government of Canada National Energy Board (Edmonton, Canada trading hub prices), Ec.euopa.eu European Commission (Netherlands Retail prices), LPG Australia and news articles (Saudi ARAMCO contract prices), Knoema.com and Petroleum Association of Japan (Japan Imports prices).
- Conway, KS and Mont Belvieu, TX retail prices are propane prices, while Saudi ARAMCO Contracts and Japan Imports are liquefied petroleum gas (LPG) prices. Netherlands Retail and Edmonton, Canada retail prices are auto propane and exclude taxes.
- Propane and LPG prices are represented on the same chart due to the fact that propane is dealt in international marketplaces as LPG, and is referred to as LPG in many European and Asian countries. LPG is comprised of a mixture of propane and butane.
- Conway, KS wholesale prices are typically available only for the winter months (October through March), during which propane demand is driven by cold weather, therefore, the data series displayed is intermittent.

(28) No. 1 Distillate Fuel Oil, Residual Fuel Oil Wholesale, Retail Sales Volume by Refiners

- Source: U.S. Energy Information Administration.
- No. 1 Distillate Fuel Oil consists of No. 1 diesel fuel and No. 1 fuel oil. The former is used in high-speed diesel engines, including those used by metropolitan buses and smaller automobiles. No. 1 fuel oil is utilized primarily as fuel for portable outdoor stoves and heaters.
- Residual Fuel Oil is the general classification for heavy oils that remain after lighter oils are distilled away in the process of petroleum refining. Residual Fuel Oil includes No. 5 and No. 6 fuel oils. The former is used in steam-powered vessels, and the latter is used for electric power generation, space heating, vessel bunkering and industrial processes.
- All wholesale and retail sales volumes refer to those sold by refiners only.

(29) No. 2 Distillate Fuel Oil Wholesale, Retail Sales Volume by Refiners

- Source: U.S. Energy Information Administration.
- No. 2 Distillate Fuel Oil consists of No. 2 diesel fuel and No. 2 fuel oil (heating oil). No. 2 diesel fuel is utilized in on-and-off highway diesel engines, including those used by railroad locomotives, trucks, automobiles and agricultural machinery. No. 2 fuel oil (heating oil) is used for space heating and moderate capacity industrial/commercial burner units.
- All wholesale and retail sales volumes refer to those sold by refiners only.

(30) Propane & Propylene and Distillate Fuel Oil Production and Consumption

- Source: U.S. Energy Information Administration.
- Distillate Fuel Oil is a general classification for a variety of petroleum fractions produced in petroleum distillation operations. Included within this classification are No. 1, No. 2 and No. 4 diesel fuels (used in on-highway and off-highway diesel engines), as well as No. 1, No. 2 and No. 4 fuel oils (used primarily for space heating and electric power generation).
- Propylene is an important petrochemical feedstock that is recovered from refinery or petrochemical processes. It is an olefinic hydrocarbon that is gaseous at standard temperature and pressure.
- Product Supplied is a proxy for consumption as it measures the disappearance of said product from primary sources, including refineries, processing plants, blending plants, pipelines and bulk terminals.

(31) U.S. Ending Stocks of Propane & Propylene and Distillate Fuel Oil

- Source: U.S. Energy Information Administration.
- Distillate Fuel Oil is a general classification for a variety of petroleum fractions produced in petroleum distillation operations. Included within this classification are No. 1, No. 2 and No. 4 diesel fuels (used in on-highway and off-highway diesel engines), as well as No. 1, No. 2 and No. 4 fuel oils (used primarily for space heating and electric power generation).
- Propylene is an important petrochemical feedstock that is recovered from refinery or petrochemical processes. It is an olefinic hydrocarbon that is gaseous at standard temperature and pressure.
- Ending Stocks are defined as the total volume of a propane and propylene/distillate fuel oil held in storage as of the last day of the period. Ending Stocks are monthly averages of Ending Stocks reported at the end of each week during that month, not the amount of Ending Stocks reported at the end of the month. The resulting values are represented as monthly average inventory levels.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(32) U.S. Land Well Count, Rig Count and Wells per Rig

- Source: Platts S&P Global Quarterly Well Count Report.
- Well and rig count data include only those on United States land. Thus, no offshore data is included.
- Platts RigData U.S. Land Rig Count methodology states that a rig is added to the count every time a new oil platform, or rig, is set up on a given site, or every time an existing rig moves to a new location and drills on that site.
- Platts RigData derives U.S. Land Well Count data through tracking new drilling permits and drilling activity only. Thus, the wells comprising the U.S. Land Well Count do not necessarily have to be completed or produce oil or gas in order to be included. For this reason, the well count represented overstates the amount of completed and producing wells that exist on U.S. land.

(33) U.S. Drilling Permits

- Source: Platts RigData.
- Total number of drilling permits issued per month on U.S. Land, U.S. Inland Waters and U.S. Offshore, respectively.

(34) U.S. Drilling Permits, Top 5 States

- Source: Platts RigData.
- The five states that issued the highest number of drilling permits each year.

(35) Drilled but Uncompleted Wells vs. Crude Oil Price

- Source: U.S. Energy Information Administration Drilling Productivity Report.
- Drilled but Uncompleted (DUC) Wells are oil and gas wells that have been drilled but haven't gone through the process of completion (the process of installing well casing, tubing and other equipment that prepares a well for production). The number of DUC wells has significant implications on the domestic supply response to crude oil price changes. If crude oil prices decrease, it is theoretically likely that the amount of DUC wells will increase, and vice versa in an increasing crude oil price scenario. Therefore, the West Texas Intermediate Crude price is tracked for comparative purposes.

(36) Hydraulic Fracturing Sand Consumption and Producer Price Index

- Sources: IHS Markit (consumption), U.S. Bureau of Labor Statistics (producer price index).
- Hydraulic Fracturing Sand is sand utilized as a proppant in the process of hydraulic fracturing to help facilitate the extraction of oil and gas from subsurface rock formations.
- Total 2017 Hydraulic Fracturing Sand Consumption contains actual data for January through April 2017, while May through December 2017 consumption data is projected based on IHS Markit's ProppantIQ research.
- The Producer Price Index for Hydraulic Fracturing Sand measures the weighted average period-to-period change in the selling prices received by domestic producers of hydraulic fracturing sand.
- 2017 Producer Price Index shows annual average as of 9/29/2017.
- Hydraulic Fracturing Sand Producer Price Index Base = 100 at December 2012.

(37) and (38) Crude Oil and Natural Gas Production, Rig Count and Production per Rig

- Sources: U.S. Energy Information Administration Drilling Productivity Report (new-well crude oil and natural gas production per rig), Baker Hughes Inc. (rig count).
- New-Well Crude Oil or Natural Gas Production per Rig in each quarter represents the average of each month's value. New-well production per rig is estimated by dividing several trailing months of data on total production from new wells in each region by that region's monthly rig count, lagged by two months. New-well production per rig is intended to indicate an average rig's contribution to total crude oil production from new wells.
- The determination between a crude oil rig and a natural gas rig is made by the operating company at the time of issuance of the rig permit by the relevant state's permitting authority. The classification of a given rig as an oil or gas rig is based solely upon the operator's judgment after drilling an appraisal well and determining its specific hydrocarbon content. For example, if a well's production comes 50% from gas, 20% from Natural Gas Liquids and 30% from oil, it could either be listed as a gas rig, because gas comprises the largest share of hydrocarbons, or an oil rig because oil drives the well's economics. This determination is at the judgment of the operator.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(39) U.S. Drilling Rigs by Type

- Source: Baker Hughes North America Rotary Rig Count.
- A vertical well is a well that penetrates the earth vertically below the surface-mounted drilling platform, or the surface location of the well.
- A directional well is classified as one in which the surface location of the well is not vertically above the target reservoir. Thus, the well deviates horizontally from its surface location in order to reach the target reservoir, at a specific azimuth and incline. Azimuth measures the cardinal direction of the well's path relative to the surface location, and incline measures degrees of deviation from vertical.
- Per Baker Hughes methodology, a horizontal well is a type of directional well that deviates from vertical by greater than 80 degrees, or one in which the lower part of the wellbore is parallel to the "pay zone." The pay zone is the section of a reservoir that contains hydrocarbons that can be produced economically.

(40) Wind and Solar Prices

- Source: Lazard's Levelized Cost of Energy Analysis 2012-2016.
- The Levelized Cost of Energy (LCOE) is the net present value of the per-megawatt hour cost of building and operating a generating plant over an assumed financial life and duty cycle. It is utilized as a means of comparing the cost-competitiveness of various energy-generating technologies of unequal life spans, project sizes, capital profiles and capacities.
- The respective levelized costs of each generation technology for each year are a simple average of the high and low values of the cost range associated with that generating technology during that year.
- Solar PV refers to solar photovoltaic.
- Solar PV – Community refers to a solar power plant whose electricity is shared by more than one household.
- Solar PV – Rooftop Residential refers to a Solar PV system that has its solar panels mounted on the rooftop of a residential structure.
- Solar PV – Crystalline Rooftop refers to crystalline solar panels mounted on rooftops. Crystalline panels are a type of solar panel that achieves the photoelectric effect, the chemical process that converts solar (light) energy to electricity, through use of crystalline silicone solar cells.
- Solar PV – Crystalline Utility-Scale refers to a solar power plant that uses crystalline panels to generate power that is fed into the grid, supplying a utility with energy.
- Solar PV – Thin Film Utility-Scale refers to a solar power plant that uses thin-film solar panels to generate power that is fed into the grid, supplying a utility with energy. Thin-film panels differ from crystalline panels in that the photoemissive materials, those which produce an electric current when contacted by sufficient solar energy, are not cut from crystals.
- Solar Thermal refers to solar technology that generates thermal energy to heat water or other fluids, rather than generating electricity.

(41) U.S. Total Renewable Energy Consumption

- Source: U.S. Energy Information Administration Monthly Energy Review.
- Total Renewable Energy Consumption is comprised of hydroelectric, geothermal, solar, wind, wood, waste and biofuels.
- Waste refers to biomass waste and is organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw and other biomass solids, liquids and gases.
- Biofuels are liquid fuels and blending components produced from biomass feedstocks, used primarily for transportation. Biomass is organic, non-fossil material comprised of decayed biological matter.

(42) U.S. Solar, Wind and Hydroelectric Energy Consumption

- Source: U.S. Energy Information Administration Monthly Energy Review.

(43) U.S. Wood, Waste, Biofuels and Geothermal Energy Consumption

- Source: U.S. Energy Information Administration Monthly Energy Review.
- Biofuels are liquid fuels and blending components produced from biomass feedstocks, used primarily for transportation. Biomass is organic, non-fossil material comprised of decayed biological matter.

(44) Corn and Ethanol Prices and Corn Cost per Gallon of Ethanol

- Source: U.S. Department of Agriculture Economic Research Service (corn and ethanol price).

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(45) U.S. Solar Energy Consumption

- Source: U.S. Energy Information Administration Monthly Energy Review.
- Utility-scale solar energy refers to solar energy generated by plants with a capacity of at least one megawatt that is transmitted via the transmission grid to a high volume of consumers. Thus, Utility-Scale Solar Energy Consumption represents consumption of solar energy generated at plants with capacity of at least one megawatt.
- Distributed solar energy refers to solar energy generated by small-scale generating plants with capacity below one megawatt that is distributed over a specific locality with a small volume of consumers relative to utility-scale energy consumers. Thus, Distributed Solar Energy Consumption represents consumption of solar energy generated at small-scale generating plants.

(46) U.S. Solar Energy Net Generation

- Source: U.S. Energy Information Administration Monthly Energy Review.
- Distributed Solar Photovoltaic Generation refers to energy generated by small-scale photovoltaic generation plants. Small-scale is defined as a plant with capacity below one megawatt. Photovoltaic generation refers to solar energy generated by photovoltaic solar panels.
- Utility-Scale Solar Electricity Net Generation refers to generation of solar energy by plants with capacity equal to or above one megawatt. Net generation is defined as the amount of gross generation less electrical energy consumed by the generating plant for service or auxiliaries.

(47) Distributed Solar Photovoltaic Generation by Sector

- Source: U.S. Energy Information Administration Monthly Energy Review.
- Distributed Solar Photovoltaic Generation refers to energy generated by small-scale photovoltaic generation plants. Small-scale is defined as a plant with capacity below one megawatt. Photovoltaic generation refers to solar energy generated by photovoltaic solar panels.

(48) Utility-Scale Solar Electricity Net Generation by Sector

- Source: U.S. Energy Information Administration Monthly Energy Review.
- Utility-Scale Solar Electricity Net Generation refers to generation of solar energy by plants with capacity equal to or above one megawatt. Net generation is defined as the amount of gross generation less electrical energy consumed by the generating plant for service or auxiliaries.
- Gaps in the data represent periods for which there was no data reported, or the data value was trivially small and thus deemed unnecessary to report.

(49) U.S. Solar Capacity Installations

- Source: Solar Energy Industries Association Q1 2017 Solar Market Insight Report.
- The Investment Tax Credit (ITC) is a federal policy tax incentive that supports the deployment of solar energy in the United States. The ITC allows those who install a solar system to claim up to 30% of the price paid to install the system as a tax credit when filing Federal taxes, thereby significantly discounting the cost associated with transitioning to solar energy.

(50) U.S. Wind Power Capacity Installations

- Source: American Wind Energy Association U.S. Wind Energy Quarterly Market Report.
- Wind Power Generation Capacity Installations refers to non-utility-scale wind power capacity additions. Utility-scale is defined as installations of wind turbines larger than 100 kilowatts.

(51) Utility-Scale Wind Power Capacity Installations

- Source: American Wind Energy Association U.S. Wind Energy Quarterly Market Report.
- Utility-Scale Wind Capacity includes installations of wind turbines larger than 100 kilowatts. Capacity installations may not always equate to an equal increase in cumulative wind power capacity due to decommissioned, uprated and repowered wind turbines.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(52) Wind Power Under Construction or in Advanced Development

- Source: American Wind Energy Association (AWEA) U.S. Wind Energy Quarterly Market Report.
- AWEA defines projects as being "in advanced development" if it has not yet begun construction, but has either signed a power purchase agreement, announced a firm turbine order, or been announced to proceed under utility ownership.

(53) U.S. Aggregated Energy Consumption by Sector

- Source: U.S. Energy Information Administration.
- Energy consumed by the electric power sector is primary energy only. Primary energy is energy in its original form, before any transformation to secondary or tertiary forms of energy. For example, coal can be converted to synthetic gas and then to electricity. Under these circumstances, coal is primary energy, synthetic gas is secondary energy and electricity is tertiary energy.

(54) U.S. Aggregated Energy Consumption by Source

- Source: U.S. Energy Information Administration.
- Total consumption of each category of energy is as accurate as possible. However, some data is unavailable or unreported and, thus, some total consumption values may be understated.
- Fossil Fuels includes coal, petroleum-based products, natural gas and natural gas-based products.
- Renewable Energy includes conventional hydroelectric, solar, biomass, nuclear, geothermal and wind.
- Biomass is a renewable energy source derived from organic matter such as wood, crop waste, or garbage, with wood being the largest contributor.
- Fossil Fuels and Renewable Energy consumption represent consumption of primary energy, which is energy in its original form, before transformation to secondary or tertiary forms of energy. Thus, to arrive at total energy consumption, Electricity Retail Sales (representing consumption of secondary and tertiary forms of energy) is added alongside consumption of Fossil Fuels and Renewable Energy.
- Electrical System Energy Losses are a deduction from total energy consumption, and are incorrectly represented as positively contributing to total energy consumption. Thus, total energy consumption figures in each year are overstated by the amount of electrical system energy losses.

(55) Electricity Prices by Sector

- Source: U.S. Energy Information Administration.

(56) Commercial Crude Oil Inventory

- Source: U.S. Energy Information Administration.
- U.S. Ending Stocks of Commercial Crude Oil represents stocks (inventory) of crude oil held in storage for commercial use. This figure excludes both lease stock and volumes in the Strategic Petroleum Reserve (SPR). Lease stock is crude oil stored in tanks at sites where producers are drilling on leased land. They're excluded from total commercial crude oil inventory because they aren't yet available for commercial use. The SPR is petroleum maintained by the Federal Government for use during periods of major supply interruption.
- Ending stocks (inventory) are primary stocks of crude oil held in storage as of midnight on the last day of the month. Primary stocks include crude oil held in storage at, or in, leases, refineries, natural gas processing plants, pipelines, tank farms and bulk terminals with the capacity to store a minimum of 50,000 barrels of petroleum products or that can receive petroleum products by tanker, barge or pipeline.

(57) Petroleum and Other Liquids Commercial Inventory

- Source: U.S. Energy Information Administration.
- Hydrocarbon Gas Liquids (HGLs) are molecules of carbon and hydrogen in various combinations. HGLs include alkanes, or paraffins (ethane, propane, butane, isobutene, natural gasoline) and alkenes, or olefins (ethylene, propylene, butylene, isobutylene).
- Unfinished Oils are all oils that require further processing and are produced by partial refining of crude oil. Unfinished Oils include napthas and lighter oils, kerosene and light gas oils, heavy gas oils and residuum.
- Other Hydrocarbons/Oxygenates are substances that increase the amount of oxygen in various gasoline blends when added to them. This category includes fuel ethanol, methanol and methyl tertiary butyl ether (MTBE).
- Total Motor Gasoline includes finished motor gasoline and motor gasoline blending components.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

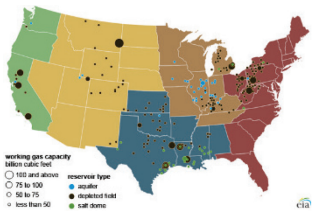
(57) Petroleum and Other Liquids Commercial Inventory (continued)

- Distillate Fuel Oil is a general classification for a variety of petroleum fractions produced in petroleum distillation operations. Included within this classification are No. 1, No. 2 and No. 4 diesel fuels (used in on-highway and off-highway diesel engines), as well as No. 1, No. 2 and No. 4 fuel oils (used primarily for space heating and electric power generation).
- Residual Fuel Oil is the general classification for heavy oils that remain after lighter oils are distilled away in the process of petroleum refining. Residual Fuel Oil includes No. 5 and No. 6 fuel oils. The former is used in steam-powered vessels, and the latter is used for electric power generation, space heating, vessel bunkering and industrial processes.
- Other Oils include aviation gasoline blending components, finished aviation gasoline, kerosene, petrochemical feedstocks, special napthas, lubricants, waxes, petroleum coke, asphalt and road oil, still gas and miscellaneous products.

(58) Natural Gas Underground Storage Capacity

- Source: U.S. Energy Information Administration.
- Underground Storage Capacity refers to total natural gas storage capacity in underground storage facilities called "salt domes," which are caverns hollowed out in subsurface salt formations. Salt domes are the primary means of natural gas storage in the United States.

U.S. Underground Natural Gas Storage Facilities by Type (July 2015)



(59) Commercial Crude Oil Refinery, Tank and Underground Storage Capacity and Utilization

- Source: U.S. Energy Information Administration.
- Commercial Crude Oil Storage Capacity refers to working storage capacity. Working capacity is the volume difference between a crude oil storage tank's maximum safe fill capacity and the volume below which pump suction is ineffective, called tank bottoms.
- Crude Oil Shell Storage Capacity is the design capacity of a petroleum storage tank. It includes tank bottoms, working storage capacity and contingency space. Contingency space is defined as available storage space above the defined maximum operating inventory level that remains empty during normal operations. Shell Storage Capacity is always greater than or equal to working storage capacity.
- Crude Oil Storage Capacity data is released only twice per year for the months of March and September. Thus, the data series excludes inventory levels for all months other than March and September of each year.

(60) Crude Oil and Natural Gas Pipeline Mileage

- Source: Pipeline and Hazardous Materials Safety Administration.
- The chart includes information from only Federal Energy Regulatory Commission-regulated pipeline companies.
- Crude Oil Pipeline Mileage represents total mileage of pipelines dedicated to the transport of crude oil and those dedicated to the transport of petroleum products. Pipeline Mileage for crude oil includes trunk lines only.
- Pipeline Mileage for natural gas includes both trunk and gathering lines.
- Trunk lines are synonymous with transmission lines, which are large, cross-country pipelines that move oil or gas from producing areas to refineries. Gathering lines are pipelines that transport oil or gas from the area in which it was produced to a storage facility which acts as an intermediate stop before transportation by truck, railcar, or trunk line.

(61) Crude Oil and Petroleum Products Pipeline Movements Between Petroleum Administration for Defense Districts (PADDs)

- Source: Federal Reserve Bank of St. Louis, with data provided by the U.S. Energy Information Administration.
- Crude Oil and Petroleum Products Pipeline Movements Between PADDs represents the total volume of crude oil and petroleum products transported between each PADD. The data does not include movements within each PADD.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(62) Natural Gas Cumulative Interstate Pipeline Systems Capacity

- Source: U.S. Energy Information Administration.
- Cumulative Interstate Capacity refers to capacity of natural gas pipelines crossing between states. Thus, capacity of intrastate pipelines is not included and the data should not be interpreted as representing total capacity of natural gas pipelines.

(63) Crude Oil and Petroleum Products Exports to Mexico

- Source: U.S. Energy Information Administration.
- Petroleum Products include pentanes plus, liquefied petroleum gases, unfinished oils, finished motor gasoline, motor gasoline blending components, oxygenates, fuel ethanol, distillate fuel oil, kerosene, kerosene-type jet fuel, special napthas, residual fuel oil, waxes, petroleum coke, asphalt and road oil, lubricants and miscellaneous products.

(64) Truck Tonnage Index

- Source: U.S. Department of Transportation, Bureau of Transportation Statistics.
- The Truck Tonnage Index measures the gross tonnage of freight that is transported by motor carriers for a given month. The Index serves as an indicator of shipping activity in the United States.
- Created by the U.S. Department of Transportation, Bureau of Transportation Statistics via information published in the American Trucking Association (ATA) Monthly Truck Tonnage Report.
- In January 2018, ATA revised the seasonally adjusted index back five years as part of its annual revision. In addition, ATA re-indexed the seasonally adjusted and not seasonally adjusted tonnage indexes to 2015 = 100 back to 1973.

(65) Heavy Truck Sales

- Source: Federal Reserve Bank of St. Louis.
- Heavy Trucks are trucks with more than 14,000 pounds gross vehicle weight.

(66) Trucking Conditions Index

- Source: FTR Transportation Intelligence.
- The Trucking Conditions Index summarizes the status of the trucking industry through tracking changes in six major conditions including freight volumes, freight rates, fleet capacity, fleet bankruptcies, fuel price and financing.
- An index value greater than zero represents a positive environment in the truck market, and an index value below zero represents a negative environment. An index value above 10 is a sign that volumes, prices and margin are in a solidly favorable range.

(67) Freight Transportation Services Index

- Source: Federal Reserve Bank of St. Louis.
- The Freight Transportation Services Index measures the output of the for-hire freight transportation industry and consists of data from for-hire trucking, rail, inland waterways, pipelines and air freight.

(68) Crude Oil Refinery Receipts by Transportation Method

- Source: U.S. Energy Information Administration.
- Refinery Receipts by Pipeline, Tanker, Barge, Truck and Rail refer to total volumes of crude oil of domestic and international origin that are in transit to, or received by, domestic refineries. Volumes of crude oil in transit via pipeline are excluded from receipts. Foreign crude oil is included in receipts only after entry through customs.
- Refinery inputs track volumes of crude oil that are entered into refining processes (e.g., distillation units, cokers, etc.).
- The volume difference between refinery receipts and refinery inputs is that which is in transit but not yet received by refineries plus that which has been received and is held in bonded storage, awaiting entry into refining processes.

(69) Crude Oil Movements by Tanker and Barge Movements Between Petroleum Administration for Defense Districts (PADDs)

- Source: U.S. Energy Information Administration.
- The data series shown on the chart is an aggregate of all crude oil movements between Petroleum Administration for Defense Districts (PADDs). This includes crude oil movement from PADD 1 to PADD 2 and PADD 3; PADD 2 to PADD 1 and PADD 3; and PADD 3 to PADD 1, PADD 2 and PADD 5.
- PADD 1 is the East Coast region, PADD 2 is the Midwest region, PADD 3 is the Gulf Coast region and PADD 5 is the West Coast region.

DATA CENTER: ABBREVIATIONS & ACRONYMS, DEFINITIONS, DESCRIPTIONS AND CHART NOTES

(70) Movements of Crude Oil by Rail
- Source: U.S. Energy Information Administration.

(71) Average Weekly Rail Carloads of Petroleum and Petroleum Products
- Source: Association of American Railroads.
- Monthly aggregates of the average weekly number of rail carloads transporting petroleum and petroleum products in the United States.
- Excludes the U.S. operations of Canadian railroads.

(72) U.S. Manufacturers' Monthly Shipments and U.S. Purchasing Managers' Index (PMI)
- Sources: For Manufacturers' Monthly Shipments - U.S. Census Bureau Manufacturers' Shipments, Inventories and Orders Survey; and for U.S. Purchasing Managers' Index (PMI) – Institute for Supply Management Manufacturing Report on Business®.
- A PMI above 50 represents expansion within the manufacturing sector compared with the prior month.

(73) U.S. New Housing Starts and Total U.S. Construction Spending
- Source: U.S. Census Bureau.

(74) London Interbank Offered Rate (LIBOR), Based on U.S. Dollar
- Source: ICE Benchmark Administration Limited via the Federal Reserve Bank of St. Louis.
- The London Interbank Offered Rate is the average interest rate at which leading banks borrow funds of a sizeable amount from other banks in the London market. LIBOR is the most widely used benchmark or reference rate for short term interest rates. The chart values are monthly percent averages of daily figures and are not seasonally adjusted.

(75) Bank Prime Loan Interest Rates
- Source: Federal Reserve Bank of St. Louis.
- The Bank Prime Loan Interest Rate is that posted by a majority of top 25 (by assets in domestic offices) insured, U.S.-chartered commercial banks. Prime is one of several base rates used by banks to price short-term business loans.
- The chart values are monthly percent averages of daily figures and are not seasonally adjusted.

(76) Commercial and Industrial Loans vs. Banking Standards
- Source: Federal Reserve Bank of St. Louis.
- Net Percentage of Domestic Banks Tightening Standards for Commercial and Industrial Loans to large and middle-market firms. Quarterly, not seasonally adjusted.
- Commercial and Industrial Loans, All Commercial Banks. Monthly, seasonally adjusted.

(77) U.S. Treasury Yield Curve
- Source: U.S. Treasury.
- U.S. Treasury Yield Curve rates are commonly referred to as Constant Maturity Treasury (CMT) rates. Yields are interpolated by the U.S. Treasury from the daily yield curve.
- The curve, which relates the yield on a security to its time to maturity, is based on the closing market bid yields on actively traded U.S. Treasury securities in the over-the-counter market.

(78) Corporate Spreads to Treasuries by Quality
- Source: Federal Reserve Bank of St. Louis.
- Corporate Spreads to Treasuries represent the spread, or difference, between the yield curve of an index of corporate bonds of a given rating category and the spot rate U.S. Treasury curve. The spot rate U.S. Treasury curve is a yield curve that uses U.S. Treasury spot rates rather than yields, and represents the rate for a zero-coupon U.S. Treasury bond.
- The corporate bond yield indexes are Bank of America Merrill Lynch Option-Adjusted Spread (OAS) Indexes for all bonds with a given investment rating of AA, BB or CCC or below that are publically issued in the U.S. domestic market. Each respective OAS index is calculated using each constituent bond's OAS, weighted by market capitalization. A bond's OAS is the bond's yield spread relative to the risk-free rate of return, typically the U.S. Treasury securities yield, adjusted to account for an embedded option.

HOT TOPICS

A GREAT WAY TO FIGHT CLIMATE CHANGE? SEND AMERICAN LNG TO CHINA AND INDIA

The recently-released U.S. 4th National Climate Assessment (NCA4) now sits alongside the UN Intergovernmental Panel on Climate Change (IPCC) report, both predicting climate catastrophe later in the century if we don't take drastic measures today to reduce greenhouse gas (GHG) emissions.

These reports' dire predictions, together with new leadership in the U.S. House of Representatives, promise to put climate at the top of Congress' agenda. We can expect to see any policy initiative that touches energy infrastructure vetted against some kind of climate impact test. It's important for builders and stakeholders in infrastructure to stay in front of this debate with strong messages that show the public and policymakers how natural gas can have a hugely positive impact on climate change. Here's a message to consider as you do so.

Everyone wants a stable, hospitable climate. Many people and organizations in the United States have become passionate advocates for lowering greenhouse gas emissions to help achieve that end. Some have taken up aggressive activist opposition to production, transportation and consumption of fossil fuels in the U.S. and Canada as their cause. They are well-funded and increasingly effective in slowing or stopping projects in the courts and regulatory bodies, and recently gained ground at the ballot box.

In trying to take down natural gas, they are aiming at the wrong target. Natural gas has been the biggest contributor to GHG reduction for the past decade and can be for decades to come. They should be cheering it on – especially the U.S. production complexes, the pipelines, the power plants and the terminals needed to bring much more of it to market. Especially critical is LNG exports to other countries – particularly in Asia – which will grow their economies and provide more energy to their increasingly prosperous citizens one way or another. Without access to LNG, they will rely on the only other energy source available economically in large quantities: locally mined coal.

To illustrate the potential for natural gas to fight climate change, we ran some numbers from the authoritative 67th BP Statistical Review of World Energy (June 2018). From 2007 to 2017 the U.S. and Europe combined to reduce their carbon dioxide emissions by 1.5 billion tons annually, from 10.7 to 9.2 billion tons, in large part due to increased use of natural gas for power generation. Over the same period, China and India combined to increase their CO2 emissions from 8.6 to 11.6 billion tons. In other words, by 2017, for every ton of CO2 emission removed from the atmosphere by the U.S. and Europe, China and India together added back two tons.

HOT TOPICS

A GREAT WAY TO FIGHT CLIMATE CHANGE? SEND AMERICAN LNG TO CHINA AND INDIA (CONTINUED)

Over the same period, the U.S. and Europe combined to reduce coal consumption from about 1.5 billion tons to 1 billion tons annually. Conversely, China and India combined to increase their coal consumption from about 2.9 billion tons to 3.7 billion tons. So while the U.S. and Europe reduced their coal consumption by 462 million tons annually, China and India together added 790 million tons and now burn almost four times the amount of coal used in the U.S. and Europe. Since almost all coal is used for power generation, one can see that these two Asian countries are cancelling out progress made in the U.S. and Europe on CO2 reduction, by a factor of two, to fuel their growing demand for electricity.

Neither Asian country now has access to nearly enough regionally-produced natural gas to turn these numbers in the right direction. But U.S. LNG could fuel much of their growing power needs. Both countries also have plans to invest heavily in new generation capacity. If natural gas were available, gas rather than coal-fired generators could be built and run much more cheaply, efficiently and cleanly, as is happening now in the United States.

U.S. natural gas and LNG are not part of the problem of climate change. They are part of the cleaner energy solution.

HOT TOPICS

HOW DOMESTIC PRODUCERS ARE COPING WITH LOWER OIL PRICES

The behavior of oil prices in 2018 has been a reminder that oil markets are seldom predictable. According to The U.S. Energy Information Administration crude oil spot price data, West Texas Intermediate (WTI) crude started the year cents above $60 per barrel, rallied to a four-year high of $77 per barrel by late June, hit $76.40 on October 3rd, before embarking on a steady descent that has seen WTI average daily losses of nearly $0.38 per barrel per day en route to a closing price of $51.07 on December 10th. To put this pivot into context, prices entered a bear market on November 8th just five weeks after reaching a near four-year high on October 3rd, and have fallen approximately 16% since then.

These price gains were underpinned by three factors. First, pipeline bottlenecks in U.S. shale-producing regions, primarily the Permian Basin in West Texas, intensified in the wake of record domestic production that saw the United States usurp its foreign counterparts to become the world's largest crude oil producer. Second, the Trump Administration withdrew from the Joint Comprehensive Plan of Action (JCPOA) with Iran which, in tandem with plummeting Venezuelan production and stumbling numbers from other OPEC stalwarts like Angola, provoked fears of global supply shortages. The third factor supporting price gains was strong economic growth in the U.S. In October, these upward pressures were unseated by global oversupply and a retrenchment in global economic growth, triggering the plunge.

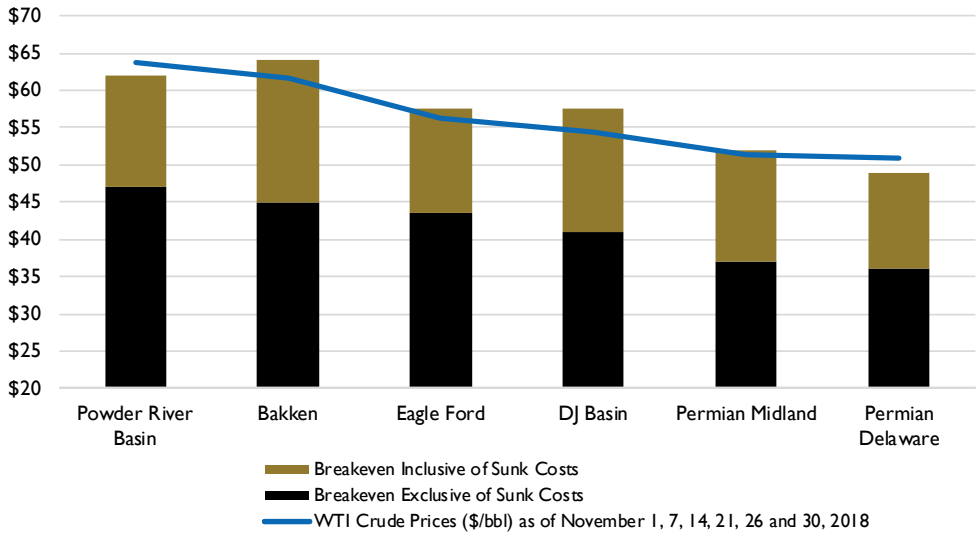
One particular group that finds this market pivot unwelcome is domestic producers, who throughout the year had, on aggregate, produced world-beating quantities of oil in a price environment reminiscent of that which they enjoyed pre-2014. Interestingly though, many operators claim the ability to make a profit, even when prices are around $50 per barrel. Per The Wall Street Journal (WSJ), "…companies… have promised that they have thousands of wells that they can drill profitably even at $40 per barrel. Some have even said they can generate returns on investment of 30%." Eyebrows naturally raise at such an assertion given that during 2017, when prices averaged about $50 per barrel, profits averaged 1.3% of revenue. This misalignment, WSJ states, is rooted in the fact that operators base such claims on a metric called breakeven, defined as "…the selling price frackers need to generate a small profit on individual wells or projects." The breakeven metric doesn't account for sunk costs, or costs which have already been expended (land, overhead, infrastructure, etc.), because such costs are irrelevant to the decision to undertake the drilling of a new well because they've already been deployed. Hence the profit discrepancy between their verbal and corporate statements, as the corporate bottom line does account for these costs.

In assessing the claims of domestic operators amidst this new price environment, consider Figure 1 on the next page.

HOT TOPICS

HOW DOMESTIC PRODUCERS ARE COPING WITH LOWER OIL PRICES (CONTINUED)

Figure 1 – Oil Production Breakeven Points vs. November Oil Prices



Source: R.S. Energy Group/WSJ.

While an OPEC production cut, which may be on the horizon, would certainly benefit domestic producers who only recently saw higher prices manifest in their bottom lines, it would be short-sighted to discount their ingenuity in finding ways to operate profitably at today's price level. Throughout the 2015 to 2017 time period, oil prices fluctuated within the $30 per barrel and $60 per barrel range, prompting the industry to invest heavily in a quest for operational efficiencies that would enhance their resilience to low prices.

The industry first targeted big-data analytics, which delivered long-overdue efficiencies through implementing end-to-end digitalization of field operations. The use of sensors, robotics, control systems, and analytic insights drive cost-savings and higher margins through intelligent maintenance, workflow automation, improved labor utilization, etc.

A second source of largely unrealized efficiency gains concerns wastewater treatment. Water is both an input to, and an output of, the hydraulic fracturing (fracking) process, and the ratio of produced water to produced hydrocarbons ranges, on average, from four-to-one to ten-to-one. For perspective, in producing an average of 3.6 million barrels per day of oil in November, the Permian Basin alone produced approximately 14 to 36 million barrels of wastewater every day. The produced water is riddled with toxins that mandate a complex treatment and disposal process, historically involving truck transportation to a remote treatment facility, treatment, and disposal in an injection well. This process accounts for a staggering 25% of a well's lease operating expense in the Permian Basin, even before considering estimates that the combination of surging production and the trucking shortage could inflate the cost of production by $6 per barrel, according to WSJ.

HOT TOPICS

HOW DOMESTIC PRODUCERS ARE COPING WITH LOWER OIL PRICES (CONTINUED)

Recognizing this inefficiency, capital has flocked to the aid of operators via financing for private wastewater treatment companies. A subset of these companies has provided a short-term solution through constructing pipelines that connect producing regions with remote treatment facilities, streamlining wastewater transportation through improving volume capacity at a fraction of the cost of trucking. It is a short-term solution because it perpetuates the use of controversial injection wells. The long-term solution is technology that allows on-site treatment and recycling of wastewater. While this technology has existed for decades, it is hardly ubiquitous. Technological advancements in wastewater recycling, in conjunction with increasing social and regulatory pressure on injection wells, make improving recycling technology a major objective for domestic producers.

Ultimately, opinion is divided regarding the fitness of domestic operators to deliver consistent profits at the questionable $50 per barrel price level. According to a recent Reuters article, on one hand, "…The reality is a lot of them get scared at $50, and their banks get scared at $50." The contrary outlook "…sees an industry just now poised to move out of its costly development phase and into…'harvesting mode,' pulling profit from past investments." We will stay tuned for further developments.

Sources:

"Shale's Growing Profits at the Mercy of OPEC Cuts, Trump Tweets," Reuters, December 10, 2018.
"Oil on Cusp of Bear Market as Supply Worries Persist," MarketWatch, November 8, 2018.
"The Rise and Fall of Oil Prices in 2018," Petroleum Economist, December 12, 2018.
"Not Your Father's Oil and Gas Business," Strategy&, PwC US, 2016.
"The Next Big Bet in Fracking: Water," The Wall Street Journal, August 22, 2018.
"Fracking Water's Dirty Secret—Recycling," Scientific American, 2018.
"Big Fracking Profits at $50 a Barrel? Don't Bet on It," The Wall Street Journal, December 4, 2018.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

PETROLEUM PRODUCTS

EQUITY COMPARABLES (1)

Petroleum Products (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Calumet Specialty Products Partners, LP	$3,533	$198	5.6%	$6.40	64.3%	$493	$2,178	0.6x	11.0x	8.5x
Chevron Corporation	153,071	30,173	19.7	122.28	91.3	234,306	266,319	1.7x	8.8x	0.9x
CVR Energy, Inc.	6,979	633	9.1	40.22	84.4	3,492	4,929	0.7x	7.8x	0.7x
EnLink Midstream Partners, LP	7,420	1,046	14.1	18.64	95.8	6,530	12,593	1.7x	12.0x	4.0x
Gibson Energy Inc.	5,898	287	4.9	15.80	98.4	2,277	3,235	0.5x	11.3x	3.5x
Exxon Mobil Corporation	278,412	39,725	14.3	85.02	95.2	359,959	404,060	1.5x	10.2x	0.9x
HollyFrontier Corporation	17,363	2,212	12.7	69.90	83.9	12,211	14,182	0.8x	6.4x	0.6x
Keyera Corp.	3,365	595	17.7	26.77	88.0	5,576	7,086	2.1x	11.9x	2.9x
Marathon Petroleum Corporation	77,690	6,391	8.2	79.97	90.4	36,067	53,198	0.7x	8.3x	2.1x
Parkland Fuel Corporation	11,096	582	5.2	33.58	98.8	4,462	5,990	0.5x	10.3x	2.9x
Phillips 66	108,773	4,650	4.3	112.72	90.9	52,332	64,236	0.6x	13.8x	2.2x
NuStar Energy LP	1,903	643	33.8	27.80	67.8	2,976	7,552	4.0x	11.7x	5.2x
Valero Energy Corporation	108,953	6,266	5.8	113.75	89.6	48,617	54,260	0.5x	8.7x	0.9x
Median			**9.1%**		**90.4%**			**0.7x**	**10.3x**	**2.2x**
Mean			**11.9%**		**87.6%**			**1.2x**	**10.2x**	**2.7x**

SELECTED TRANSACTIONS

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/22/2018	EnLink Midstream Partners, LP (NYSE:ENLK)	EnLink Midstream, LLC (NYSE:ENLC)	$12,923.5	1.7x	12.2x
8/1/2018	Energy Transfer Partners, LP (NYSE:ETP)	Energy Transfer Equity, LP (NYSE:ETE)	$69,412.3	2.1x	10.8x
4/30/2018	Andeavor (NYSE:ANDV)	Marathon Petroleum Corporation (NYSE:MPC)	$35,103.0	0.9x	12.7x
11/8/2017	Alon USA Partners, LP	Delek US Holdings, Inc. (NYSE:DK)	$1,050.4	0.5x	5.9x
2/2/2017	ONEOK Partners, LP	ONEOK, Inc. (NYSE:OKE)	$23,722.4	2.7x	12.9x
4/5/2017	Houghton International Inc.	Quaker Chemical Corporation (NYSE:KWR)	$1,415.4	-	11.8x
10/14/2016	Alon USA Energy, Inc.	Delek US Holdings, Inc. (NYSE:DK)	$1,488.1	0.3x	16.6x
9/25/2016	LANXESS Solutions US Inc.	LANXESS Deutschland GmbH	$2,450.7	-	8.2x

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

NATURAL GAS

EQUITY COMPARABLES (1)

Natural Gas (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Alliant Energy Corporation	$3,517	$1,217	34.6%	$42.57	93.5%	$9,952	$15,713	4.5x	12.9x	4.6x
AltaGas Ltd.	2,581	598	23.2	15.90	68.4	4,230	7,685	3.0x	12.8x	13.5x
Atmos Energy Corporation	3,116	1,084	34.8	93.91	98.6	10,443	13,811	4.4x	12.7x	3.4x
Avista Corporation	1,423	459	32.3	50.56	95.6	3,321	5,238	3.7x	11.4x	4.3x
Baytex Energy Corp.	821	354	43.1	2.90	60.2	1,606	2,957	3.6x	8.4x	4.3x
Calumet Specialty Products Partners, LP	3,533	198	5.6	6.40	64.3	493	2,178	0.6x	11.0x	8.5x
Cenovus Energy Inc.	16,538	1,773	10.7	10.03	87.4	12,328	19,767	1.2x	11.1x	3.5x
Chesapeake Utilities Corporation	697	136	19.5	83.90	92.3	1,374	1,857	2.7x	13.7x	3.8x
Corning Natural Gas Holding Corporation	34	9	26.1	18.10	88.3	55	108	3.2x	12.3x	5.5x
Crestwood Equity Partners LP	4,133	285	6.9	36.75	90.6	2,617	4,966	1.2x	17.5x	5.9x
Dominion Energy Midstream Partners, LP	763	498	65.2	17.90	53.3	2,266	7,955	10.4x	16.0x	5.4x
EnLink Midstream Partners, LP	7,420	1,046	14.1	18.64	95.8	6,530	12,593	1.7x	12.0x	4.0x
Enbridge Energy Partners, LP	2,300	1,461	63.5	10.99	67.3	4,758	17,526	7.6x	12.0x	5.1x
Enterprise Products Partners LP	35,779	6,188	17.3	28.73	95.6	62,515	88,552	2.5x	14.3x	4.2x
Epsilon Energy Ltd.	27	14	50.7	1.93	74.4	106	95	3.5x	7.0x	(1.0)x
Eversource Energy	8,309	2,604	31.3	61.44	92.9	19,469	33,784	4.1x	13.0x	5.4x
Genesis Energy, LP	2,944	544	18.5	23.78	89.6	2,915	7,443	2.5x	13.7x	6.8x
National Fuel Gas Company	1,593	728	45.7	56.06	93.6	4,818	6,591	4.1x	9.1x	2.6x
New Jersey Resources Corporation	2,915	306	10.5	46.10	96.3	4,070	5,386	1.8x	17.6x	4.7x
Northwest Natural Holding Company	725	234	32.3	66.90	95.1	1,927	2,724	3.8x	11.6x	3.8x
MDU Resources Group, Inc.	4,487	626	14.0	25.69	86.7	5,036	6,847	1.5x	10.9x	3.0x
OGE Energy Corp.	2,260	809	35.8	36.32	96.2	7,254	10,455	4.6x	12.9x	3.8x
ONE Gas, Inc.	1,632	448	27.5	82.28	99.0	4,321	5,687	3.5x	12.7x	3.3x
ONEOK, Inc.	13,249	2,175	16.4	67.79	94.2	27,879	36,222	2.7x	16.7x	4.1x
RGC Resources, Inc.	66	19	28.5	26.71	84.6	213	269	4.1x	14.4x	3.8x
South Jersey Industries, Inc.	1,397	341	24.4	35.27	97.5	3,008	6,101	4.4x	17.9x	9.4x
Southwest Gas Holdings, Inc.	2,834	588	20.7	79.03	91.0	3,883	5,940	2.1x	10.1x	3.6x
Summit Midstream Partners, LP	499	255	51.1	14.30	62.3	1,049	2,517	5.0x	9.9x	4.6x
Targa Resources Corp.	10,589	1,263	11.9	56.31	98.5	12,701	19,256	1.8x	15.2x	4.6x
TransCanada Corporation	10,360	5,728	55.3	40.43	80.2	36,932	76,597	7.4x	13.4x	6.2x
Valener Inc	54	0	0.0	14.77	82.0	579	727	13.6x	NM	NM
Median			**26.1%**		**91.0%**			**3.5x**	**12.8x**	**4.3x**
Mean			**28.1%**		**86.0%**			**3.9x**	**12.8x**	**4.8x**

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

NATURAL GAS

SELECTED TRANSACTIONS (1)

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/22/2018	EnLink Midstream Partners, LP (NYSE:ENLK)	EnLink Midstream, LLC (NYSE:ENLC)	$12,923.5	1.7x	12.2x
8/27/2018	Blue Ridge Mountain Resources, Inc. (OTCPK:BRMR)	Eclipse Resources Corporation (NYSE:ECR)	$348.0	3.6x	12.8x
8/1/2018	Energy Transfer Partners, LP (nka:Energy Transfer Operating, LP)	Energy Transfer Equity LP (nka:Energy Transfer LP (NYSE:ET))	$69,430.8	2.1x	10.9x
5/17/2018	Williams Partners LP (NYSE:WPZ)	The Williams Companies, Inc. (NYSE:WMB)	$57,052.1	7.0x	14.1x
4/25/2018	Rice Midstream Partners LP (NYSE:RMP)	EQM Midstream Partners, LP (NYSE:EQM)	$2,443.1	7.7x	9.9x
11/1/2017	Southcross Energy Partners, LP (NYSE:SXE)	American Midstream Partners, LP (NYSE:AMID)	$624.1	1.0x	14.8x
7/19/2017	Avista Corporation (NYSE:AVA)	Hydro One Limited (TSX:H)	$5,332.4	3.7x	11.3x
5/15/2017	Ceiba Energy Services Inc. (TSXV:CEB)	Secure Energy Services Inc. (TSX:SES)	$28.2	4.3x	30.3x
4/3/2017	Rockies Express Pipeline LLC	Tallgrass Energy Partners, LP (NYSE:TEP)	$4,043.9	-	7.3x
2/21/2017	Delta Natural Gas Company, Inc. (NasdaqGS:DGAS)	PNG Companies LLC	$260.2	3.7x	13.7x
2/1/2017	ONEOK Partners, LP	ONEOK, Inc. (NYSE:OKE)	$23,721.4	2.3x	12.9x
1/25/2017	WGL Holdings, Inc. (NYSE:WGL)	AltaGas Ltd. (TSX:ALA)	$6,634.5	2.7x	15.3x

(1) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

PROPANE AND HEATING/FUEL OIL

EQUITY COMPARABLES (1)

Propane and Heating/Fuel Oil (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
AmeriGas Partners, LP	$2,823	$617	21.9%	$39.51	81.7%	$3,674	$6,468	2.3x	10.5x	4.5x
Ferrellgas Partners, LP	2,073	207	10.0	2.21	42.3	215	2,188	1.1x	10.6x	9.9x
NGL Energy Partners LP	22,174	346	1.6	11.60	65.7	1,416	4,758	0.2x	13.7x	7.2x
Spire Inc.	1,965	448	22.8	73.55	88.8	3,727	6,097	3.1x	13.6x	5.9x
Star Group, LP	1,630	107	6.5	9.77	86.1	522	621	0.4x	5.8x	0.9x
Suburban Propane Partners, LP	1,344	283	21.1	23.53	87.0	1,445	2,704	2.0x	9.5x	4.4x
UGI Corporation	7,651	1,616	21.1	55.48	99.2	9,646	14,130	1.8x	8.7x	2.6x
Median			**21.1%**		**86.1%**			**1.8x**	**10.5x**	**4.5x**
Mean			**15.0%**		**78.7%**			**1.6x**	**10.4x**	**5.1x**

SELECTED TRANSACTIONS

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/18/2018	Propane Distribution Assets of Musco Fuel & Propane LLP	Superior Plus Corp. (TSX:SPB)	$14.5	-	-
10/11/2018	Salathe Gas Company, LLC/North Star Exchange, Inc.	Ferrellgas Partners, LP (NYSE:FGP)	-	-	-
9/18/2018	Propane Distribution and Other Assets of Porco Energy Corp	Superior Plus Corp. (TSX:SPB)	$15.5	-	-
9/14/2018	United Liquid Gas Company	Superior Plus Corp. (TSX:SPB)	-	-	-
7/12/2018	Diamond Propane, Inc.	Ferrellgas Partners, LP (NYSE:FGP)	-	-	-
5/30/2018	NGL Propane, LLC	Superior Plus Energy Services, Inc.	$900.0	-	10.6x
2/14/2018	Propane Distribution Assets and the Fuels and Lubricants Business of Hi-Grade Oil Co.	Superior Plus Energy Services, Inc.	-	-	-
9/27/2017	Canwest Propane Ltd.	Superior Plus LP	$352.1	-	-
9/5/2017	Service Plus Propane, Inc.	Ferrellgas Partners, LP (NYSE:FGP)	-	-	-
8/8/2017	Dixie Fuel Company, Inc.	Revere Gas Inc.	-	-	-
7/5/2017	Yankee Propane Inc. And Virginia Propane, Inc.	Superior Plus Corp. (TSX:SPB)	$31.5	-	-
5/11/2017	Bell-Gaz ltée	Groupe Filgo-Sonic	-	-	-
3/15/2017	Valley Center Propane, LLC	Ferrellgas Partners, LP (NYSE:FGP)	-	-	-

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

DRILLING

EQUITY COMPARABLES (1)

Drilling (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
AKITA Drilling Ltd.	$66	($12)	(18.2)%	$4.56	70.4%	$181	$176	2.6x	NM	NM
Baker Hughes, a GE company	22,491	2,558	11.4	33.83	89.6	13,926	39,439	1.8x	15.4x	1.0x
CES Energy Solutions Corp.	930	107	11.5	3.30	58.0	880	1,198	1.3x	11.2x	3.4x
Diamond Offshore Drilling, Inc.	1,172	333	28.4	20.00	91.2	2,749	4,303	3.7x	12.9x	4.5x
Ensco plc	1,761	295	16.8	8.44	96.6	3,690	7,942	4.5x	26.9x	14.8x
Ensign Energy Services Inc.	836	134	16.1	4.82	79.6	757	1,336	1.6x	10.0x	4.2x
Halliburton Company	23,999	4,457	18.6	40.53	70.0	35,662	44,081	1.8x	9.9x	1.9x
Helmerich & Payne, Inc.	2,494	619	24.8	68.77	91.7	7,492	7,635	3.1x	12.3x	0.3x
Independence Contract Drilling, Inc.	105	17	16.0	4.94	90.1	189	246	2.4x	14.7x	3.9x
National Oilwell Varco, Inc.	8,024	707	8.8	43.08	87.8	16,483	18,129	2.3x	25.6x	2.0x
Precision Drilling Corporation	1,131	255	22.5	3.45	83.7	1,014	2,283	2.0x	9.0x	4.8x
Rowan Companies plc	942	147	15.6	18.83	97.6	2,392	3,770	4.0x	25.6x	10.0x
Secure Energy Services Inc.	2,270	125	5.5	6.54	86.2	1,060	1,325	0.6x	10.6x	2.4x
Trinidad Drilling Ltd.	461	111	24.2	1.43	87.7	391	761	1.7x	6.8x	3.4x
Unit Corporation	833	334	40.1	26.06	89.7	1,410	2,161	2.6x	6.5x	1.7x
Xtreme Drilling Corp.	60	4	6.1	1.47	79.2	110	123	2.0x	33.2x	3.3x
Median			**16.0%**	**87.7%**				**2.1x**	**12.3x**	**3.4x**
Mean			**15.5%**	**84.3%**				**2.4x**	**15.4x**	**4.1x**

SELECTED TRANSACTIONS

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/8/2018	Rowan Companies plc (NYSE:RDC)	Ensco plc (NYSE:ESV)	$3,941.6	4.2x	26.0x
8/27/2018	Blue Ridge Mountain Resources, Inc. (OTCPK:BRMR)	Eclipse Resources Corporation (NYSE:ECR)	$347.9	3.6x	12.8x
8/13/2018	Trinidad Drilling Ltd. (TSX:TDG)	Ensign Energy Services Inc. (TSX:ESI)	$714.0	1.7x	8.5x
2/15/2018	Layne Christensen Company (NasdaqGS:LAYN)	Granite Construction Incorporated (NYSE:GVA)	$491.9	1.0x	16.5x
5/30/2017	Atwood Oceanics, Inc. (NYSE:ATW)	Ensco plc (NYSE:ESV)	$1,759.6	2.2x	4.7x
5/19/2017	Savanna Energy Services Corp.	Total Energy Services Inc. (TSX:TOT)	$458.2	1.4x	16.6x
12/12/2016	Seventy Seven Energy Inc.	Patterson-UTI Energy, Inc. (NasdaqGS:PTEN)	$1,878.9	-	18.8x
11/23/2016	Savanna Energy Services Corp.	Total Energy Services Inc. (TSX:TOT)	$362.5	1.4x	13.3x
5/19/2016	FMC Technologies, Inc.	TechnipFMC plc (NYSE:FTI)	$6,803.9	-	8.4x

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

LUBRICANTS AND GREASES

EQUITY COMPARABLES (1)

Lubricants and Greases (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Albemarle Corporation	$3,311	$953	28.8%	$99.78	68.8%	$10,821	$11,672	3.5x	12.2x	1.1x
Ashland Global Holdings Inc.	3,743	590	15.8	83.86	96.8	5,235	7,585	2.0x	12.9x	3.8x
Clean Harbors, Inc.	3,190	467	14.7	71.58	98.7	4,015	5,410	1.7x	11.6x	2.9x
CSW Industrials, Inc.	334	69	20.7	53.70	93.9	844	853	2.6x	12.4x	0.2x
FMC Corporation	4,488	1,214	27.1	87.18	88.3	11,737	14,508	3.2x	11.9x	2.1x
Ingevity Corporation	1,085	302	27.8	101.88	95.6	4,284	4,960	4.6x	16.4x	2.3x
Kraton Corporation	2,030	390	19.2	47.15	87.3	1,503	3,125	1.5x	8.0x	3.9x
NewMarket Corporation	2,311	367	15.9	405.51	92.7	4,644	5,294	2.3x	14.4x	1.8x
Ocean Bio-Chem, Inc.	43	5	12.1	4.08	71.5	38	42	1.0x	8.1x	1.2x
Quaker Chemical Corporation	867	122	14.0	202.21	99.2	2,696	2,671	3.1x	22.0x	(0.4)x
Stepan Company	2,001	226	11.3	87.01	95.7	1,960	1,991	1.0x	8.8x	0.1x
Synalloy Corporation	261	30	11.7	22.85	92.1	201	254	1.0x	8.3x	1.8x
Trecora Resources	279	25	9.0	14.00	89.7	340	442	1.6x	17.6x	4.2x
Valvoline Inc.	2,285	433	18.9	21.51	83.9	4,103	5,253	2.3x	12.1x	2.8x
Median			**15.8%**		**92.4%**			**2.2x**	**12.2x**	**2.0x**
Mean			**17.6%**		**89.6%**			**2.2x**	**12.6x**	**2.0x**

SELECTED TRANSACTIONS

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
9/13/2018	MPM Holdings Inc. (OTCPK:MPMQ)	KCC Corporation (KOSE:A002380); SJL Partners; Wonik QnC Corporation (KOSDAQ:A074600)	$2,664.9	1.0x	7.4x
8/15/2018	KMG Chemicals, Inc.	Cabot Microelectronics Corporation (NasdaqGS:CCMP)	$1,606.5	3.5x	13.5x
4/5/2017	Houghton International Inc.	Quaker Chemical Corporation (NYSE:KWR)	$1,415.4	1.8x	11.8x
1/31/2017	Sealweld Corporation	KMG Electronic Chemicals Luxembourg Holdings Sarl; KMG Industrial Lubricants Canada, Inc.	$17.3	1.4x	6.6x
9/25/2016	LANXESS Solutions US Inc.	LANXESS Deutschland GmbH	$2,450.7	1.4x	8.2x
4/1/2015	Valves Inc. of Texas	KMG Chemicals, Inc. (NYSE:KMG)	$38.9	3.2x	11.4x

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

SOLAR

EQUITY COMPARABLES (1)

Solar (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Boralex Inc.	$357	$219	61.4%	$13.95	72.0%	$1,243	$3,689	10.3x	16.8x	11.1x
Capital Power Corporation	904	490	54.2	22.06	96.8	2,259	3,879	4.3x	7.9x	3.3x
NextEra Energy Partners, LP	812	529	65.1	48.50	95.7	2,634	7,756	9.6x	14.7x	6.6x
NRG Energy, Inc.	11,178	2,714	24.3	37.40	99.9	11,316	28,619	2.6x	10.5x	2.2x
TerraForm Power, Inc.	689	443	64.3	11.55	81.3	2,415	8,902	12.9x	20.1x	12.6x
Vivint Solar, Inc.	294	(32)	(11.0)	5.20	84.6	617	1,734	5.9x	NM	NM
Median			**57.8%**		**90.1%**			**7.7x**	**14.7x**	**6.6x**
Mean			**43.1%**		**88.4%**			**7.6x**	**14.0x**	**7.2x**

SELECTED TRANSACTIONS

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
2/5/2018	8point3 Energy Partners LP (NasdaqGS:CAFD)	Capital Dynamics, Inc.	$1,671.3	23.8x	17.0x
12/11/2017	Canadian Solar Inc. (NasdaqGS:CSIQ)	Shawn (Xiaohua) Qu and Hanbing Zhang	$3,109.4	1.1x	15.4x
5/4/2017	Up to 20 Megawatts of Solar Energy Power Generation Assets	Kontrol Energy Corp. (CNSX:KNR)	$22.6	-	4.1x
3/7/2017	TerraForm Global, Inc. (NasdaqGS:GLBL)	Orion US Holdings 1 LP	$1,651.8	6.6x	17.2x
1/20/2016	Capstone Infrastructure Corporation	Irving Infrastructure Corp.	$1,435.1	-	12.7x
12/3/2014	Hawaiian Electric Industries, Inc. (NYSE:HE)	NextEra Energy, Inc. (NYSE:NEE)	$4,398.8	1.3x	8.5x

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

WIND

EQUITY COMPARABLES (1)

Wind (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Algonquin Power & Utilities Corp.	$1,645	$649	39.4%	$10.34	92.8%	$4,898	$9,222	5.6x	14.2x	5.5x
Avangrid, Inc.	6,346	1,907	30.1	47.93	87.9	14,811	20,999	3.3x	11.0x	3.2x
Boralex Inc.	357	219	61.4	13.95	72.0	1,243	3,689	10.3x	16.8x	11.1x
Brookfield Renewable Partners LP	2,859	1,739	60.8	30.28	86.1	9,464	27,891	9.8x	16.0x	6.3x
Innergex Renewable Energy Inc.	399	270	67.5	10.04	85.9	1,333	4,474	11.2x	16.6x	11.2x
NextEra Energy Partners, LP	812	529	65.1	48.50	95.7	2,634	7,756	9.6x	14.7x	6.6x
Northland Power Inc.	1,214	900	74.1	16.79	85.7	2,973	9,321	7.7x	10.4x	6.3x
Pattern Energy Group Inc.	470	266	56.5	19.87	79.7	1,953	5,106	10.9x	19.2x	8.5x
TerraForm Power, Inc.	689	443	64.3	11.55	81.3	2,415	8,902	12.9x	20.1x	12.6x
TransAlta Renewables Inc.	339	204	60.3	8.90	79.8	2,335	3,136	9.3x	15.4x	3.8x
Median			**61.1%**		**85.8%**			**9.7x**	**15.7x**	**6.5x**
Mean			**58.0%**		**84.7%**			**9.0x**	**15.4x**	**7.5x**

SELECTED TRANSACTIONS

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/30/2017	Alterra Power Corp. (TSX:AXY)	Innergex Renewable Energy Inc. (TSX:INE)	$745.0	10.6x	31.0x
7/28/2017	Boralex Inc. (TSX:BLX)	Caisse de dépôt et placement du Québec	$3,437.5	12.5x	20.3x
6/19/2017	Pattern Energy Group Inc. (NasdaqGS:PEGI)	Public Sector Pension Investment Board	$4,313.7	12.2x	18.6x
3/7/2017	TerraForm Global, Inc. (NasdaqGS:GLBL)	Orion US Holdings 1 LP	$1,651.8	6.6x	17.2x
1/20/2016	Capstone Infrastructure Corp.	Irving Infrastructure Corp.	$1,435.1	-	12.7x

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

OIL AND GAS FIELD SERVICES

EQUITY COMPARABLES (1)

Oil and Gas Field Services (United States & Canada)

Company	LTM(2) Revenues	LTM(2) EBITDA	LTM(2) Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value(3)	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt(4)/ EBITDA
Archrock, Inc.	$880	$317	36.0%	$12.20	88.7%	$1,579	$3,031	3.4x	9.6x	4.8x
Baker Hughes, a GE company	22,491	2,558	11.4	33.83	89.6	13,926	39,439	1.8x	15.4x	1.0x
Blueknight Energy Partners, LP	306	57	18.5	2.10	35.3	85	(17)	(0.1)x	(0.3)x	4.8x
CARBO Ceramics Inc.	222	(28)	(12.7)	7.25	57.1	201	244	1.1x	NM	NM
Cathedral Energy Services Ltd.	121	2	1.7	0.56	36.1	28	30	0.2x	14.5x	0.9x
CES Energy Solutions Corp.	930	107	11.5	3.30	58.0	880	1,198	1.3x	11.2x	3.4x
Cypress Energy Partners, LP	295	20	6.8	7.20	84.7	86	174	0.6x	8.7x	3.2x
Dawson Geophysical Company	165	14	8.5	6.19	73.7	142	104	0.6x	7.4x	(2.4)x
Eco-Stim Energy Solutions, Inc.	71	(24)	(33.9)	0.28	17.3	21	34	0.5x	NM	NM
ENGlobal Corporation	56	(4)	(6.7)	1.02	69.4	28	23	0.4x	NM	NM
Enservco Corporation	49	4	8.8	0.79	52.7	43	67	1.4x	15.6x	5.8x
Ensign Energy Services Inc.	836	134	16.1	4.82	79.6	757	1,336	1.6x	10.0x	4.2x
Enterprise Group, Inc.	28	3	10.1	0.33	67.5	18	23	0.8x	8.1x	1.9x
Essential Energy Services Ltd.	149	13	9.0	0.40	63.4	57	72	0.5x	5.4x	1.3x
High Arctic Energy Services Inc	160	43	26.9	3.21	89.1	165	142	0.9x	3.3x	(0.3)x
Hyduke Energy Services Inc.	24	(7)	(29.6)	0.03	13.3	2	8	0.3x	NM	NM
Innospec Inc.	1,436	186	13.0	76.75	92.2	1,874	2,037	1.4x	10.9x	0.7x
Keane Group, Inc.	2,152	376	17.5	12.37	62.4	1,356	1,598	0.7x	4.3x	0.7x
Matrix Service Company	1,140	22	1.9	24.65	95.7	666	602	0.5x	27.7x	(3.4)x
McDermott International, Inc.	5,350	682	12.7	18.43	67.7	3,328	5,994	1.1x	8.8x	4.3x
Mullen Group Ltd.	947	136	14.3	11.87	88.2	1,245	1,593	1.7x	11.7x	2.8x
Newpark Resources, Inc.	903	94	10.5	10.35	88.8	937	1,063	1.2x	11.3x	1.4x
North American Construction Group Ltd.	279	61	21.9	9.80	95.6	245	342	1.2x	5.6x	1.8x
Parkland Fuel Corporation	11,096	582	5.2	33.58	98.8	4,462	5,990	0.5x	10.3x	2.9x
Pioneer Energy Services Corp.	575	80	14.0	2.95	46.5	229	631	1.1x	7.8x	5.1x
Precision Drilling Corporation	1,131	255	22.5	3.45	83.7	1,014	2,283	2.0x	9.0x	4.8x
Profire Energy, Inc.	46	10	21.2	3.19	60.2	153	140	3.0x	14.4x	(1.5)x
ProPetro Holding Corp.	1,593	313	19.7	16.49	72.1	1,378	1,456	0.9x	4.6x	0.0x
Secure Energy Services Inc.	2,270	125	5.5	6.54	86.2	1,060	1,325	0.6x	10.6x	2.4x
Select Energy Services, Inc.	1,471	227	15.4	11.84	53.9	939	1,318	0.9x	5.8x	0.2x
Shawcor Ltd.	1,147	127	11.1	19.10	82.0	1,339	1,365	1.2x	10.7x	0.5x
Smart Sand, Inc.	203	50	24.7	4.11	37.2	171	214	1.1x	4.3x	0.9x
STEP Energy Services Ltd.	593	103	17.3	4.48	36.3	298	516	0.9x	5.0x	2.3x
USA Compression Partners, LP	489	258	52.9	16.51	85.6	1,591	3,712	7.6x	14.4x	6.7x
Xtreme Drilling Corp.	60	4	6.1	1.47	79.2	110	123	2.0x	33.2x	3.3x
Median			**11.5%**		**72.1%**			**1.1x**	**9.6x**	**1.9x**
Mean			**11.1%**		**68.2%**			**1.3x**	**10.3x**	**2.1x**

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

EQUIPMENT AND PHYSICAL TECHNOLOGY

EQUITY COMPARABLES (1)

Equipment and Physical Technology (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
AKITA Drilling Ltd.	$66	($12)	(18.2)%	$4.56	70.4%	$181	$176	2.6x	NM	NM
Aveda Transportation and Energy Services Inc.	170	13	7.8	0.80	98.1	47	104	0.6x	7.9x	4.4x
CSI Compressco LP	384	85	22.1	5.15	63.9	223	857	2.2x	10.1x	7.7x
Enerflex Ltd.	1,305	174	13.3	12.79	88.9	1,133	1,273	1.0x	7.3x	0.7x
Exterran Corporation	1,366	203	14.9	26.53	78.7	958	1,342	1.0x	6.6x	1.9x
Forum Energy Technologies, Inc.	1,039	60	5.8	10.35	57.7	1,123	1,551	1.5x	25.9x	7.3x
Gardner Denver Holdings, Inc.	2,642	572	21.7	28.34	74.6	5,643	7,237	2.7x	12.6x	2.6x
Geospace Technologies Corporation	76	(5)	(7.2)	13.70	73.2	186	147	1.9x	NM	NM
Gulf Island Fabrication, Inc.	198	(41)	(20.6)	9.95	71.3	150	110	0.6x	NM	NM
Halliburton Company	23,999	4,457	18.6	40.53	70.0	35,662	44,081	1.8x	9.9x	1.9x
Hanwei Energy Services Corp.	8	(0)	(3.7)	0.03	63.6	5	10	1.2x	NM	NM
Helix Energy Solutions Group, Inc.	745	164	22.0	9.88	94.9	1,463	1,633	2.2x	9.9x	0.7x
ION Geophysical Corporation	163	17	10.4	15.55	47.9	218	292	1.8x	17.3x	5.4x
Key Energy Services, Inc.	521	24	4.7	11.44	62.2	232	424	0.8x	17.4x	8.2x
McCoy Global Inc.	35	(4)	(10.7)	0.87	54.6	24	18	0.5x	NM	NM
Mitcham Industries, Inc.	35	(18)	(52.0)	4.15	90.8	50	60	1.7x	NM	NM
Nabors Industries Ltd.	2,984	722	24.2	6.16	69.5	2,202	5,618	1.9x	7.8x	4.6x
National Oilwell Varco, Inc.	8,024	707	8.8	43.08	87.8	16,483	18,129	2.3x	25.6x	2.0x
Natural Gas Services Group, Inc.	66	22	33.9	21.10	71.9	276	214	3.2x	9.6x	(2.8)x
Parker Drilling Company	468	65	13.9	2.98	13.8	28	493	1.1x	7.6x	7.7x
PHX Energy Services Corp.	221	19	8.7	2.44	95.5	142	148	0.7x	7.7x	0.2x
RigNet, Inc.	235	24	10.0	20.35	84.6	394	434	1.8x	18.3x	2.1x
RPC, Inc.	1,772	407	23.0	15.48	57.2	3,326	3,231	1.8x	7.9x	(0.3)x
Schlumberger Limited	32,815	6,942	21.2	60.92	75.8	84,321	99,286	3.0x	14.3x	2.1x
SEACOR Holdings Inc.	758	147	19.4	49.41	83.7	900	1,214	1.6x	8.3x	1.1x
Solaris Oilfield Infrastructure, Inc.	165	99	59.8	18.89	78.8	487	601	3.6x	6.1x	0.1x
Strad Energy Services Ltd.	89	17	19.1	1.28	94.3	73	78	0.9x	4.6x	0.3x
Superior Drilling Products, Inc.	18	5	25.0	3.19	94.1	78	87	4.7x	18.8x	1.4x
TechnipFMC plc	12,913	1,767	13.7	31.25	89.3	14,153	12,465	1.0x	7.1x	(0.9)x
TerraVest Industries Inc.	185	24	12.9	8.39	98.6	146	219	1.2x	9.2x	3.0x
TETRA Technologies, Inc.	1,014	131	12.9	4.51	88.3	567	1,490	1.5x	11.4x	6.1x
Weatherford International plc	5,805	(128)	(2.2)	2.71	59.5	2,702	10,263	1.8x	NM	NM
ZCL Composites Inc.	139	19	13.9	5.64	52.9	172	173	1.3x	9.0x	0.2x
Median			**13.3%**		**74.6%**			**1.7x**	**9.4x**	**1.9x**
Mean			**10.5%**		**74.4%**			**1.7x**	**11.5x**	**2.6x**

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

OIL AND GAS FIELD SERVICES AND EQUIPMENT AND PHYSICAL TECHNOLOGY

SELECTED TRANSACTIONS (1)

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/29/2018	Adler Hot Oil Service, LLC.	Enservco Corporation (AMEX:ENSV)	$12.5	0.7x	4.3x
6/5/2018	Xtreme Drilling Corp. (TSX:XDC)	AKITA Drilling Ltd. (TSX:AKT.A)	$155.0	2.8x	-
5/1/2018	KLX Inc. (NasdaqGS:KLXI)	Aviall Inc.	$4,482.9	-	15.7x
4/16/2018	Aveda Transportation and Energy Services Inc. (TSXV:AVE)	Daseke Companies, Inc.	$2,139.8	0.7x	4.8x
1/16/2018	USA Compression Partners, LP (NYSE:USAC)	Energy Transfer Partners, LP (NYSE:ETP); Energy Transfer Equity, LP (NYSE:ETE)	$2,033.4	7.3x	14.3x
1/2/2018	Archrock Partners, LP	Archrock, Inc. (NYSE:AROC)	$2,405.5	4.3x	10.5x
12/11/2017	Pure Technologies Ltd.	Xylem Inc. (NYSE:XYL)	$395.2	4.0x	26.5x
5/19/2017	Savanna Energy Services Corp.	Total Energy Services Inc. (TSX:TOT)	$458.2	1.8x	16.6x
5/15/2017	Ceiba Energy Services Inc.	Secure Energy Services Inc. (TSX:SES)	$27.2	4.5x	29.2x
4/24/2017	Flowchem Ltd.	KMG Chemicals, Inc. (NYSE:KMG)	$495.0	N/A	11.5x
3/13/2017	Amec Foster Wheeler plc (LSE:AMFW)	John Wood Group PLC (LSE:WG.)	$4,032.4	0.6x	10.6x
12/12/2016	Seventy Seven Energy Inc.	Patterson-UTI Energy, Inc. (NasdaqGS:PTEN)	$1,878.9	3.1x	18.8x
10/13/2016	Critical Flow Solutions Inc.	CIRCOR International, Inc. (NYSE:CIR)	$214.0	1.8x	8.6x

(1) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

STORAGE AND TERMINALS

EQUITY COMPARABLES (1)

Storage and Terminals (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Alliant Energy Corporation	$3,517	$1,217	34.6%	$42.57	93.5%	$9,952	$15,713	4.5x	12.9x	4.6x
AltaGas Ltd.	2,581	598	23.2	15.90	68.4	4,230	7,685	3.0x	12.8x	13.5x
Blueknight Energy Partners, LP	306	57	18.5	2.10	35.3	85	(17)	(0.1)x	(0.3)x	4.8x
Buckeye Partners, LP	3,980	906	22.8	35.71	59.8	5,477	10,483	2.6x	11.6x	5.6x
Chart Industries, Inc.	1,210	155	12.8	78.33	97.5	2,428	2,794	2.3x	18.0x	2.3x
EnLink Midstream, LLC	7,420	1,043	14.0	16.45	82.3	2,980	10,582	1.4x	10.2x	4.1x
EQM Midstream Partners, LP	1,341	1,085	80.9	52.78	67.7	6,358	9,156	6.8x	8.4x	3.2x
Gibson Energy Inc.	5,898	287	4.9	15.80	98.4	2,277	3,235	0.5x	11.3x	3.5x
Green Plains Partners LP	106	69	65.5	14.90	73.1	474	610	5.8x	8.8x	2.0x
Magellan Midstream Partners, LP	2,634	1,161	44.1	67.72	89.3	15,453	20,074	7.6x	17.3x	3.5x
MPLX LP	5,571	2,681	48.1	34.68	88.1	27,537	40,561	7.3x	15.1x	4.8x
NuStar Energy LP	1,903	643	33.8	27.80	67.8	2,976	7,552	4.0x	11.7x	5.2x
Spectra Energy Partners, LP	2,104	1,070	50.9	35.71	78.1	17,316	25,720	12.2x	24.0x	8.1x
Median			**33.8%**		**78.1%**			**4.0x**	**11.7x**	**4.6x**
Mean			**34.9%**		**76.9%**			**4.5x**	**12.5x**	**5.0x**

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

STORAGE AND TERMINALS

SELECTED TRANSACTIONS (1)

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
10/22/2018	EnLink Midstream Partners, LP (NYSE:ENLK)	EnLink Midstream, LLC (NYSE:ENLC)	$12,923.5	1.7x	12.2x
9/19/2018	Dominion Energy Midstream Partners, LP (NYSE:DM)	Dominion Energy, Inc. (NYSE:D)	$10,405.4	13.6x	19.7x
8/1/2018	Energy Transfer Partners, LP (NYSE:ETP)	Energy Transfer Equity, LP (NYSE:ETE)	$69,412.3	2.1x	10.8x
7/30/2018	Four Corners Area Assets	Harvest Midstream Company	$1,125.0	-	13.2x
7/10/2018	Transmontaigne Partners LP (NYSE:TLP)	TLP Acquisition Holdings LLC	$1,254.3	6.1x	11.5x
6/29/2018	Boardwalk Pipeline Partners, LP	Boardwalk GP LP	$6,792.1	5.3x	8.3x
5/29/2018	Dorian LPG Ltd. (NYSE:LPG)	BW LPG Limited (OB:BWLPG)	$1,164.3	8.0x	20.9x
5/17/2018	Enbridge Energy Partners, LP (NYSE:EEP)	Enbridge (U.S.) Inc.	$15,925.8	6.6x	10.1x
4/30/2018	Andeavor (NYSE:ANDV)	Marathon Petroleum Corporation (NYSE:MPC)	$35,101.9	0.9x	12.7x
4/26/2018	Rice Midstream Partners LP (NYSE:RMP)	EQM Midstream Partners, LP (NYSE:EQM)	$2,443.1	7.7x	9.9x
3/26/2018	Tallgrass Energy Partners, LP (NYSE:TEP)	Tallgrass Equity, LLC	$4,176.5	6.4x	6.9x
8/29/2017	Arc Logistics Partners LP (NYSE:ARCX)	Zenith Energy U.S. Logistics Holdings, LLC	$658.0	6.2x	10.4x
8/14/2017	Western Refining Logistics, LP (NYSE:WNRL)	Andeavor Logistics LP (NYSE:ANDX)	$1,842.8	0.8x	14.4x
6/19/2017	Rice Energy Inc. (NYSE:RICE)	EQT Corporation (NYSE:EQT)	$10,239.2	9.9x	34.1x
6/2/2017	AMTROL Inc.	Worthington Steel of Michigan, Inc.	$283.0	1.1x	7.4x
5/18/2017	PennTex Midstream Partners, LP	Energy Transfer Partners, LP (NYSE:ETP)	$562.6	7.3x	18.9x
5/15/2017	Ceiba Energy Services Inc. (TSXV:CEB)	Secure Energy Services Inc. (TSX:SES)	$28.2	4.3x	30.3x
4/4/2017	World Point Terminals, LP (NYSE:WPT)	World Point Terminals Inc.	$611.3	5.9x	10.0x
2/1/2017	ONEOK Partners, LP	ONEOK, Inc. (NYSE:OKE)	$23,721.4	2.7x	12.9x

(1) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

PIPELINES

EQUITY COMPARABLES (1)

Oil and Gas Pipelines (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Antero Midstream Partners LP	$957	$602	63.0%	$28.66	83.9%	$5,361	$6,786	7.1x	11.3x	2.5x
ATCO Ltd.	3,869	1,380	35.7	29.20	79.6	3,342	13,714	3.5x	9.9x	5.8x
Blueknight Energy Partners, LP	306	57	18.5	2.10	35.3	85	(17)	(0.1)x	(0.3)x	4.8x
Buckeye Partners, LP	3,980	906	22.8	35.71	59.8	5,477	10,483	2.6x	11.6x	5.6x
Crestwood Equity Partners LP	4,133	285	6.9	36.75	90.6	2,617	4,966	1.2x	17.5x	5.9x
Enable Midstream Partners, LP	3,287	958	29.1	16.84	87.4	7,293	11,366	3.5x	11.9x	4.0x
Enbridge Energy Partners, LP	2,300	1,461	63.5	10.99	67.3	4,758	17,526	7.6x	12.0x	5.1x
Enbridge Inc.	36,905	8,041	21.8	32.24	79.3	55,599	120,437	3.3x	15.0x	6.1x
Energy Transfer LP	51,965	7,937	15.3	17.43	90.1	20,188	96,278	1.9x	12.1x	5.6x
Enterprise Products Partners LP	35,779	6,188	17.3	28.73	95.6	62,515	88,552	2.5x	14.3x	4.2x
EQGP Holdings, LP	1,341	1,086	81.0	20.83	67.8	6,300	12,280	9.2x	11.3x	3.2x
EQM Midstream Partners, LP	1,341	1,085	80.9	52.78	67.7	6,358	9,156	6.8x	8.4x	3.2x
Genesis Energy, LP	2,944	544	18.5	23.78	89.6	2,915	7,443	2.5x	13.7x	6.8x
Gibson Energy Inc.	5,898	287	4.9	15.80	98.4	2,277	3,235	0.5x	11.3x	3.5x
Inter Pipeline Ltd.	1,996	969	48.5	17.33	80.2	6,740	10,873	5.4x	11.2x	4.2x
Kinder Morgan Canada Limited	540	302	55.9	13.17	85.2	1,378	3,467	6.4x	11.5x	(11.1)x
Kinder Morgan, Inc.	13,995	5,919	42.3	17.73	89.4	39,127	78,617	5.6x	13.3x	5.8x
ONEOK, Inc.	13,249	2,175	16.4	67.79	94.2	27,879	36,222	2.7x	16.7x	4.1x
Plains All American Pipeline, LP	32,874	1,891	5.8	25.01	90.3	18,147	30,336	0.9x	16.0x	5.0x
Sanchez Midstream Partners LP	71	25	34.7	7.10	53.6	109	636	8.9x	25.7x	7.3x
SemGroup Corporation	2,498	326	13.0	22.05	71.2	1,743	4,575	1.8x	14.0x	7.8x
Southcross Energy Partners, LP	621	60	9.7	0.58	23.7	46	578	0.9x	9.6x	8.6x
Summit Midstream Partners, LP	499	255	51.1	14.30	62.3	1,049	2,517	5.0x	9.9x	4.6x
Targa Resources Corp.	10,589	1,263	11.9	56.31	98.5	12,701	19,256	1.8x	15.2x	4.6x
TC PipeLines, LP	603	501	83.1	30.33	53.1	2,163	4,553	7.6x	9.1x	4.4x
The Williams Companies, Inc.	8,710	3,649	41.9	27.19	80.8	32,883	60,025	6.9x	16.4x	6.1x
TransCanada Corporation	10,360	5,728	55.3	40.43	80.2	36,932	76,597	7.4x	13.4x	6.2x
Western Gas Equity Partners, LP	2,065	997	48.3	29.94	69.8	6,555	13,386	6.5x	13.4x	4.5x
Western Gas Partners, LP	2,065	997	48.3	43.68	80.3	6,666	11,044	5.3x	11.1x	4.4x
Median			**34.7%**		**80.2%**			**3.5x**	**12.0x**	**4.8x**
Mean			**36.0%**		**76.0%**			**4.3x**	**12.6x**	**4.6x**

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

PIPELINES

SELECTED TRANSACTIONS (1)

Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
11/8/2018	Western Gas Partners, LP (NYSE:WES)	Western Gas Equity Partners, LP (NYSE:WGP)	$13,427.9	6.5x	12.0x
10/9/2018	Antero Midstream Partners LP (NYSE:AM)	Antero Midstream GP LP (NYSE:AMGP)	$7,359.7	7.7x	11.5x
9/28/2018	American Midstream Partners, LP (NYSE:AMID)	ArcLight Capital Partners, LLC	$1,858.9	2.5x	20.9x
7/10/2018	Transmontaigne Partners LP (NYSE:TLP)	TLP Acquisition Holdings LLC	$1,254.3	6.1x	11.5x
5/17/2018	Williams Partners LP	The Williams Companies, Inc. (NYSE:WMB)	$57,090.5	7.0x	14.1x
3/26/2018	Tallgrass Energy Partners, LP (NYSE:TEP)	Tallgrass Equity, LLC	$4,176.5	6.4x	6.9x
8/15/2017	Western Refining Logistics, LP (NYSE:WNRL)	Andeavor Logistics LP (NYSE:ANDX)	$1,843.8	0.8x	14.4x
12/20/2016	Howard Midstream Partners, LP	Alberta Investment Management Corporation	$1,394.7	4.3x	14.4x
11/21/2016	Sunoco Logistics Partners LP	Energy Transfer Partners, LP (NYSE:ETP)	$15,527.3	1.5x	13.7x
10/24/2016	JP Energy Partners LP	American Midstream Partners, LP (NYSE:AMID)	$465.0	-	11.3x
5/31/2016	Rose Rock Midstream, LP	SemGroup Corporation (NYSE:SEMG)	$1,649.9	-	10.4x
2/1/2016	Dominion Energy Questar Corporation	Dominion Energy, Inc. (NYSE:D)	$6,092.9	-	9.7x

(1) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

TRUCKERS

EQUITY COMPARABLES (1)

Truckers (United States & Canada)

Company	LTM[2] Revenues	LTM[2] EBITDA	LTM[2] Margin	Stock Price 09/30/18	% of 52-Week High	Market Cap	Total Enterprise Value[3]	TEV / LTM Revenues	TEV / LTM EBITDA	Net Debt[4]/ EBITDA
Adams Resources & Energy, Inc.	$1,716	$20	1.2%	$42.46	83.9%	$179	$54	0.0x	2.7x	(6.4)x
ArcBest Corporation	3,030	227	7.5	48.55	94.4	1,247	1,269	0.4x	5.6x	0.2x
Covenant Transportation Group, Inc.	816	128	15.6	29.06	82.6	533	679	0.8x	5.3x	1.7x
Daseke, Inc.	1,423	149	10.5	8.02	55.2	517	1,119	0.8x	7.5x	4.4x
Heartland Express, Inc.	630	153	24.4	19.73	78.3	1,616	1,510	2.4x	9.8x	(0.8)x
Hess Corporation	6,177	2,499	40.5	71.58	96.6	21,452	26,353	4.3x	10.5x	1.5x
J.B. Hunt Transport Services, Inc.	8,287	1,131	13.7	118.94	90.3	13,005	13,995	1.7x	12.4x	0.9x
Knight-Swift Transportation Holdings Inc.	5,309	901	17.0	34.48	66.4	6,141	6,887	1.3x	7.6x	1.0x
Landstar System, Inc.	4,488	358	8.0	122.00	94.8	5,013	4,977	1.1x	13.9x	(0.3)x
Marten Transport, Ltd.	766	147	19.2	21.05	71.1	1,151	1,129	1.5x	7.7x	(0.2)x
Old Dominion Freight Line, Inc.	3,908	963	24.6	161.26	94.7	13,223	13,127	3.4x	13.6x	(0.1)x
P.A.M. Transportation Services, Inc.	506	77	15.2	65.09	93.0	394	573	1.1x	7.5x	2.4x
Patriot Transportation Holding, Inc.	114	11	9.3	19.23	80.8	64	47	0.4x	4.4x	(1.6)x
Parkland Fuel Corporation	11,096	582	5.2	33.58	98.8	4,462	5,990	0.5x	10.3x	2.9x
Roadrunner Transportation Systems, Inc.	2,225	(23)	(1.0)	0.84	8.6	32	521	0.2x	NM	NM
Ryder System, Inc.	8,115	1,889	23.3	73.07	81.0	3,880	9,784	1.2x	5.2x	3.3x
Saia, Inc.	1,581	229	14.5	76.45	87.8	1,946	2,100	1.3x	9.2x	0.5x
Schneider National, Inc.	4,847	647	13.3	24.98	81.8	4,421	4,473	0.9x	6.9x	0.0x
TFI International Inc.	3,789	491	12.9	36.27	95.7	3,190	4,398	1.2x	9.0x	2.3x
Titanium Transportation Group Inc.	137	16	11.5	1.28	69.2	47	96	0.7x	6.0x	2.6x
Universal Logistics Holdings, Inc.	1,389	116	8.4	36.80	97.7	1,045	1,303	0.9x	11.2x	2.7x
USA Truck, Inc.	516	45	8.7	20.23	69.4	163	254	0.5x	5.6x	2.1x
Werner Enterprises, Inc.	2,379	403	16.9	35.35	80.4	2,532	2,617	1.1x	6.5x	0.3x
YRC Worldwide Inc.	5,053	249	4.9	8.98	51.0	306	1,040	0.2x	4.2x	2.8x
Median			**13.1%**		**82.2%**			**1.0x**	**7.5x**	**1.0x**
Mean			**13.6%**		**79.3%**			**1.2x**	**7.9x**	**1.0x**

(1) Matching public companies to middle-market companies is an imperfect comparable analysis due to the variables of size, equipment, markets, etc. Nonetheless JKC's research has yielded this list as the closest available.
(2) LTM is defined as last twelve months.
(3) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.
(4) Net Debt is defined as total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

TRUCKERS

SELECTED TRANSACTIONS (1)

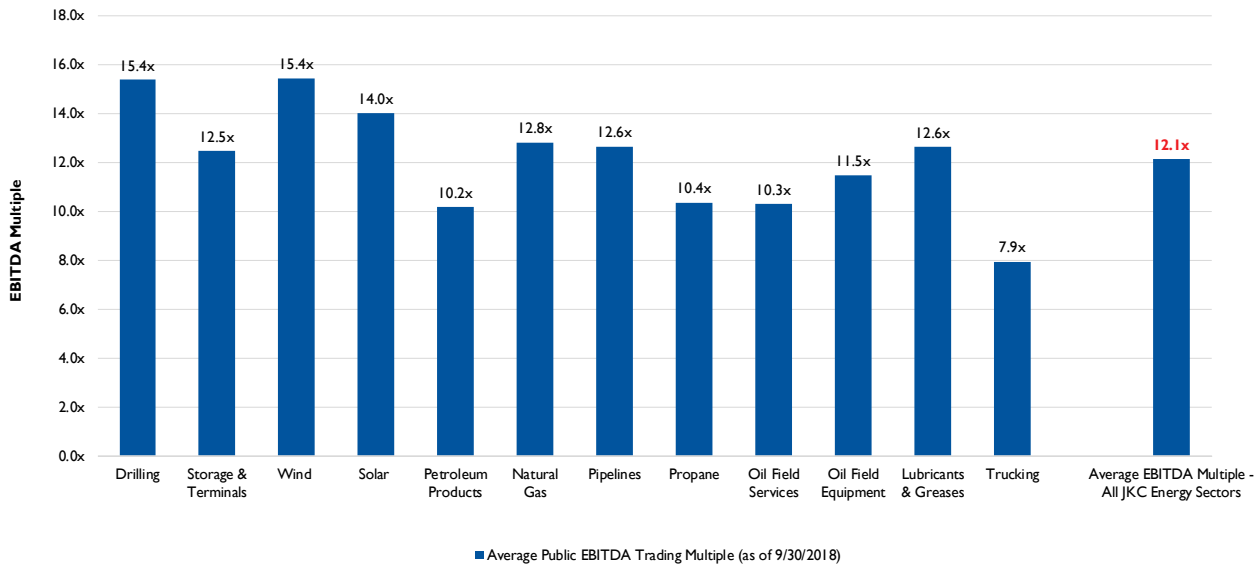
Announced / Closed Date	Target(s)	Acquirer	Total Enterprise Value (TEV)	TEV / Revenues	TEV / EBITDA
11/5/2018	CaseStack, Inc.	Hub Group, Inc. (NasdaqGS:HUBG)	$255.0	1.1x	11.6x
8/31/2018	Mode Transportation, LLC	York Capital Management	$238.5	-	10.0x
12/7/2017	Keen Transport, Inc.	Wallenius Wilhelmsen ASA (OB:WALWIL)	$64.0	0.8x	6.4x
7/19/2016	Span-Alaska Transportation, Inc.	Matson Logistics, Inc.	$197.6	-	9.4x
5/2/2016	Trimac Transportation Ltd.	Trimac Corporation	$215.9	-	5.9x
9/9/2015	Con-way Inc.	XPO Logistics, Inc. (NYSE:XPO)	$3,057.0	-	6.2x
8/17/2015	Liberty International Inc.	Janel Corporation (OTCPK:JANL)	$2.3	-	26.6x
7/28/2015	Stagecoach Cartage and Distribution, LLC	Roadrunner Transportation Systems, Inc. (NYSE:RRTS)	$40.0	-	5.7x
5/25/2015	Hodges Trucking Company, LLC	Rodan Transport (U.S.A.) Ltd.	$42.0	-	3.0x
5/6/2015	Quality Distribution Inc.	Apax Partners LLP	$823.3	-	12.0x
5/4/2015	Bridge Terminal Transport Inc.	XPO Logistics, Inc. (NYSE:XPO)	$100.0	-	8.1x
4/21/2015	Command Transportation, LLC	Echo Global Logistics, Inc. (NasdaqGS:ECHO)	$391.0	-	10.6x
1/20/2015	Wheels Group Inc.	Radiant Global Logistics Ltd.	$80.1	-	13.5x

(1) Total Enterprise Value is defined as market capitalization plus total debt less cash and cash equivalents.

PUBLIC AND TRANSACTION COMPARABLES BY SEGMENT

AVERAGE PUBLIC EBITDA TRADING MULTIPLES

ALL JKC ENERGY SECTORS (AS OF 9/30/2018)



FACTOIDS: LITTLE-KNOWN FACTS AND STATS

Petroleum Products

- On August 28, 1859, George Bissell and Edwin L. Drake made the first successful use of a drilling rig on a well drilled especially to produce oil, at a site on Oil Creek near Titusville, Pennsylvania. The Drake well is often referred to as the "first" commercial oil well in the U.S., marking the beginning of the modern phase of the petroleum industry. (1)
- About 75 workers are directly employed by the drilling of one well, although only four to seven may be on duty at the rig at any given time. The actual number can vary considerably, depending on the type of well being drilled.(2)

Natural Gas (3)

- Natural gas's share of global total energy demand grew 22% in 2017, reaching a record share.
- Since 1990, global natural gas consumption has grown at an average of 6.3% per year. Consumption growth has been even stronger in China, averaging 13.1% per year over the past 20 years.

Propane and Heating/Fuel Oil

- China was the third-largest destination for U.S. propane exports in 2017, behind only Japan and Mexico. Overall, about half of U.S. propane exports went to Asian countries in 2017, displacing supplies from Middle Eastern countries.(4)
- Heating oil accounts for 25% of a barrel of crude, the second largest cut after gasoline.(5)

(1) American Oil & Gas Historical Society.
(2) Petroleum Services Association of Canada.
(3) International Energy Agency.
(4) U.S. Energy Information Administration.
(5) Smart Touch Energy.

FACTOIDS: LITTLE-KNOWN FACTS AND STATS

Lubricants and Greases (1)

- Many greases are formulated to have specific properties unique to the application for which they are intended. Electric motors take one general type of grease, while flexible couplings require a very different type, and automotive wheel bearings require yet another type of grease.
- An additive is any substance added to a lubricant to modify its properties. Typical examples are antioxidants, corrosion inhibitors, anti-wear and extreme pressure additives.

Solar (2)

- In 2018, a new solar project was installed in the U.S. every 100 seconds.
- Five years ago, the solar industry installed 3,000 megawatts of capacity annually. In 2018, the U.S. solar market will be more than three times larger – with over 10,000 megawatts installed.

Wind

- Siemens built the first commercial offshore wind turbine 30 years ago. Its blades were 5 meters long, producing just 30 kilowatts of power. The latest model has 75 meter blades, producing 6 megawatts (25,000 times as much) – enough to power 6,000 homes.(3)
- In 2017, $107.2 billion was invested in wind power globally, making it one of the fastest growing industrial segments in the world.(4)

(1) National Lubricating Grease Institute.
(2) Solar Energy Industries Association.
(3) OVO Energy.
(4) Global Wind Energy Council.

FACTOIDS: LITTLE-KNOWN FACTS AND STATS

Oil and Gas Field Services (1)

- Global capital expenditures in the oil and gas field services market among the 100 largest countries is expected to grow around 4.3% in 2018.
- The increasing need to improve productivity from mature and new reserves, the increasing focus on developing unconventional hydrocarbons, and increasing investments in deepwater and ultra-deepwater projects, are driving demand in the global oil and gas field services market.

Equipment and Physical Technology (2)

- Investment in digital technologies by energy companies has risen sharply over the last few years. For example, global investment in digital electricity infrastructure and software has grown by over 20% annually since 2014, reaching $47 billion in 2016.
- Widespread use of digital technologies could decrease oil and gas production costs between 10% and 20%, through advanced processing of seismic data, use of sensors, and enhanced reservoir modelling. Technically recoverable oil and gas resources could be boosted by around 5% globally, with the greatest gains expected in shale gas.

Storage and Terminals

- The underground natural gas storage profile of the Midwest Region is the largest in the U.S. The cold winters, large population centers, large natural gas pipeline systems and available geology, all contribute to major storage development in the region over the past century.(3)
- The first instance of natural gas successfully being stored underground occurred in Weland County, Ontario, Canada, in 1915. In the United States, the first storage facility was developed just south of Buffalo, New York, in 1916. By 1930, there were nine storage facilities in six different states.(4)

(1) Mordor Intelligence.
(2) International Energy Agency.
(3) U.S. Energy Information Administration..
(4) Naturalgas.org..

FACTOIDS: LITTLE-KNOWN FACTS AND STATS

PIPELINES

- The first hydrocarbon pipelines in recorded history were in China, in 500 BC, and they were made of bamboo. (1)
- Pigs inspect pipelines. Not the farm animals, but robotic devices called pigs because of the squealing sound they make when they travel through the pipelines. Smart pigs, developed in the 1960s, are used to evaluate the inside of the pipeline and ensure that they are safe.(2)

TRUCKERS (3)

- The average big rig carries 80,000 pounds of freight at one time. That's 40 tons of goods and products.
- Over-the-road truck engines are designed to travel more than one million miles before being retired, whereas car engines are expected to go just 200,000 miles.

(1) Canadian Energy Pipeline Association).
(2) Interstate Natural Gas Association of America.
(3) HNI Risk Advisors.

JORDAN KNAUFF & COMPANY
ENERGY LOGISTICS & DISTRIBUTION TEAM

G. COOK JORDAN, JR.
Managing Principal
Office (312) 254-5901
cj@jordanknauff.com

DAVID A. KAKAREKA
Vice President of Transaction Management
Office (312) 254-5907
dkakareka@jordanknauff.com

LORI A. CALLAWAY
Vice President of Research and Publications
Office (312) 254-5914
lcallaway@jordanknauff.com

ABOUT JORDAN KNAUFF & COMPANY

Jordan Knauff & Company was founded in 2001 to undertake a distinct mission: to assemble and maintain a staff of top-notch investment banking personnel and offer their knowledge and experience to provide the best available investment banking services to middle-market companies, the entrepreneurs who lead them and the financial entities that transact with them. On a combined basis, over the course of their careers our employees have completed over 200 transactions as investors, owners, operators, buyers, sellers and investment bankers of middle-market businesses across a variety of industries. The majority of our firm's broad transaction experience has been with private companies owned by one shareholder, a partnership, a family or private equity investors.

JKC JORDAN KNAUFF & COMPANY

200 West Madison Street, Suite 980
Chicago, Illinois 60606-3414
tel: (312) 254-5900 ▪ *fax*: (312) 254-5999
web: www.jordanknauff.com

MEMBER FINRA, SIPC

ENERGY EQUIPMENT & INFRASTRUCTURE ALLIANCE

TOBY MACK
President and Chief Executive Officer
(202) 870-7715
tmack@eeia.org

MARTI DE GRAAF
Executive Vice President and Chief Operating Officer
(312) 806-0664
mdegraaf@eeia.org

ABOUT THE ENERGY EQUIPMENT & INFRASTRUCTURE ALLIANCE

EEIA is a Washington, D.C.-based trade association representing the North American natural gas and petroleum production, transportation and processing infrastructure supply chain. That supply chain is comprised of 60 industries that provide construction, equipment, materials, services and supplies to energy infrastructure and operations. EEIA advocates for sound legislative and regulatory policies at the federal and state levels. Our members include companies, trade associations and labor organizations operating in the energy sector. We advocate for our industries both directly with policymakers, and through mobilization of business leaders and workers to act and speak for the value and benefits of full and responsible development of our energy resources in their communities and with their political leaders.

ENERGY EQUIPMENT & INFRASTRUCTURE ALLIANCE

The Voice of the Energy Supply Chain

ENERGYBUILDERS

601 Pennsylvania Avenue NW
Suite 900
Washington, DC 20004
(202) 870-7715
info@eeia.org ▪ www.eeia.org