

# Year-in-Review: 2015

## Energy Infrastructure Events and Expansions

Office of Electricity Delivery and Energy Reliability  
U.S. Department of Energy



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## **For Further Information**

This report was prepared by the Office of Electricity Delivery and Energy Reliability under the direction of Patricia Hoffman, Assistant Secretary, and Devon Streit, Deputy Assistant Secretary.

Specific questions about this report may be directed to John Ostrich, Office of Electricity Delivery and Energy Reliability ([john.ostrich@hq.doe.gov](mailto:john.ostrich@hq.doe.gov)).

Contributors include Kevin DeCorla-Souza, Shravan Amin, Matt Gilstrap, and CeCe Coffey of ICF International.

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## Abbreviations

|        |  |
|--------|--|
| AER    | Alberta Energy Regulator   |
| b/d    | Barrels per day  |
| bbl    | Barrel(s)  |
| Bcf    | Billion cubic feet   |
| Bcf/d  | Billion cubic feet per day   |
| bcm    | Billion cubic meters   |
| BIP    | Biofuel Infrastructure Partnership                                 |
| CARBOB | California Reformulated Gasoline Blendstock for Oxygenate Blending |
| CDU    | Crude distillation unit  |
| CHOPS  | Cameron Highway Oil Pipeline System                                |
| CN     | Canadian National Railway  |
| DHS    | U.S. Department of Homeland Security                               |
| DOE    | U.S. Department of Energy  |
| DOT    | U.S. Department of Transportation                                  |
| EAD    | Energy Assurance Daily   |
| EGT    | Enable Gas Transmission  |
| EIA    | U.S. Energy Information Administration                             |
| EPA    | U.S. Environmental Protection Agency                               |
| ERCOT  | Electric Reliability Council of Texas                              |
| ES&D   | Electric Supply & Demand   |
| ESE    | East Side Expansion Project  |
| ESP    | Electrostatic precipitator   |
| FCCU   | Fluid catalytic cracking unit                                      |
| FERC   | U.S. Federal Energy Regulatory Commission                          |
| FRA    | Federal Railroad Administration                                    |

|            |  |
|------------|--|
| FTA        | Free Trade Agreement                                     |
| GW         | Gigawatt   |
| HOS        | Hours-of-service   |
| ICS-CERT   | Industrial Control Systems Cyber Emergency Response Team |
| ISER       | Infrastructure Security and Energy Restoration           |
| ISO        | Independent system operator                              |
| KCC        | Keathley Canyon Connector                                |
| kV         | Kilovolts  |
| LNG        | Liquefied natural gas                                    |
| LOOP       | Louisiana Offshore Oil Port                              |
| LPG        | Liquefied petroleum gases                                |
| MATS       | Mercury and Air Toxics Standards                         |
| MMb/d      | Million barrels per day                                  |
| MMBtu      | Million British thermal units                            |
| MMcf/d     | Million cubic feet per day                               |
| MMgal/year | Million gallons per year                                 |
| mph        | Miles per hour   |
| MTBE       | Methyl tertiary-butyl ether                              |
| MW         | Megawatts  |
| MWh        | Megawatt-hour  |
| NERC       | North American Electric Reliability Corporation          |
| NGL        | Natural gas liquid                                       |
| NRC        | U.S. Nuclear Regulatory Commission                       |
| NTSB       | National Transportation Safety Board                     |
| NYMEX      | New York Mercantile Exchange                             |
| OCC        | Oklahoma Corporation Commission                          |

|           |  |
|-----------|--|
| OE        | Office of Electricity Delivery and Energy Reliability  |
| OPEC      | Organization of the Petroleum Exporting Countries      |
| OSHA      | Occupational Safety and Health Administration          |
| PADD      | Petroleum Administration for Defense District          |
| PDVSA     | Petróleos de Venezuela                                 |
| PG&E      | Pacific Gas & Electric                                 |
| PHMSA     | Pipeline and Hazardous Materials Safety Administration |
| PSE       | Puget Sound Energy                                     |
| PUD       | Public Utility District                                |
| RIN       | Renewable Identification Number                        |
| RVO       | Renewable volume obligation                            |
| SELA      | Southeast Louisiana                                    |
| SMECO     | Southern Maryland Electric Cooperative                 |
| SoCal Gas | Southern California Gas Company                        |
| SSCs      | Structures, systems, and components                    |
| TCEQ      | Texas Commission on Environmental Quality              |
| tcf       | Trillion cubic feet                                    |
| Transco   | Transcontinental Gas Pipeline Company                  |
| TVA       | Tennessee Valley Authority                             |
| USCG      | U.S. Coast Guard                                       |
| USDA      | U.S. Department of Agriculture                         |
| USW       | United Steelworkers                                    |
| WTI       | West Texas Intermediate                                |
| YIR       | Year-in-Review   |



# 1. Introduction

The 2015 Year-in-Review (YIR) provides a summary of significant energy disruptions and infrastructure changes that occurred in the United States in 2015. The report also provides an overview of major international events that had an impact on global energy markets.

## 1.1 Background and Organization

The 2015 YIR is based primarily on information reported in [Energy Assurance Daily](#) (EAD) between January 1, 2015 and December 31, 2015.<sup>1</sup> EAD contains summaries of energy sector highlights and is published Monday through Friday by the U.S. Department of Energy (DOE) Office of Electricity Delivery and Energy Reliability (OE), Infrastructure Security and Energy Restoration (ISER) Division. For the summaries of certain major events, information is drawn from emergency situation and emergency spot reports, which are also published by ISER.

Events and developments reported in EAD are grouped by energy sector: Electricity, Petroleum, and Natural Gas. The Other News section includes information related to coal, biofuels, and energy policy. These sections primarily cover events and developments in the United States, but also include relevant events and developments in Canada and Mexico that affect the United States due to the interdependencies among North American energy markets. Events and developments outside of North America that have a significant impact on global energy markets are reported in the International News section. EAD reports events and developments that meet a specific threshold of impact or importance to the energy supply (see Appendix A for selection criteria). A special section, Major Developments, reports on events that disrupt energy service to a large segment of the population and/or damage critical assets in the energy sector. The Major Developments section is only included in EAD when an event meets the criteria for a Major Development, or a unique case has been identified.

## 1.2 Data Sources and Limitations

EAD is derived from publicly available information and does not include classified or confidential data or information accessible only through subscription services. As a result, EAD—and by extension, the 2015 YIR—is not an exhaustive summary of all significant energy events.<sup>2</sup>

This report compares events and infrastructure changes that occurred in 2014 and 2015 to highlight a few selected trends, but these comparisons are based only on information captured

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<sup>1</sup> Unless noted otherwise, the source for all information in this report is EAD, <http://www.oe.netl.doe.gov/ead.aspx>.

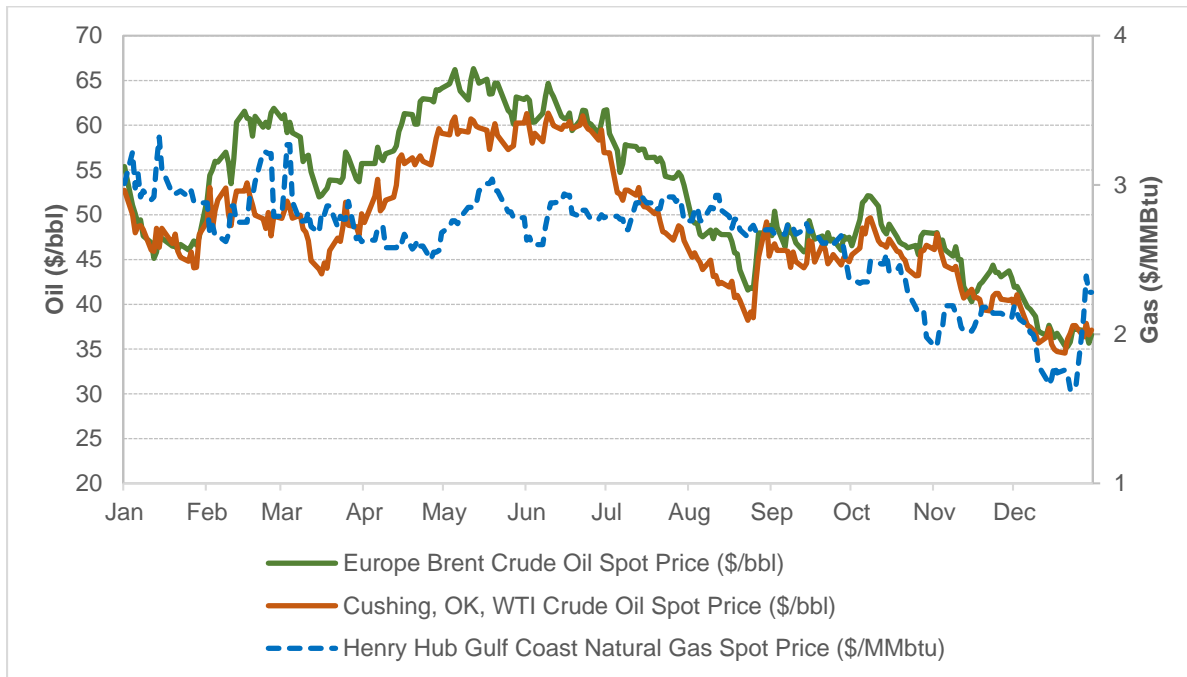
<sup>2</sup> For example, California and Texas State agencies release more energy information into the public domain than other States, thus distorting the balance of information published in favor of those States. Similarly, the U.S. Nuclear Regulatory Commission provides an abundance of public information on nuclear power plants. There is no equivalent reporting mechanism for coal, natural gas, or any other class of utility-scale power generation.

by EAD and other ISER reports, and are not a thorough analysis. Readers are advised to view the 2015 YIR as a snapshot of newsworthy events and broad trends that shaped the U.S. energy sector in 2015.

### **1.3 Financial and Economic Context**

EAD reports spot U.S. energy prices for crude oil (West Texas Intermediate [WTI]) and natural gas (Henry Hub). Figure 1 presents a time series of these prices in 2015, as well as the European North Sea Brent benchmark crude oil price. WTI is a crude oil produced in Texas and southern Oklahoma, which serves as a marker for pricing North American crude streams and is traded in the domestic spot market at Cushing, OK. WTI crude is the underlying commodity for the New York Mercantile Exchange's (NYMEX) oil futures contracts. Brent crude is a blended crude stream produced in the North Sea region that serves as a reference, or marker, for pricing a number of crude oils in the Atlantic market. Henry Hub is a natural gas pipeline hub in Louisiana that serves as the delivery point for the NYMEX natural gas futures contract.

**Figure 1. U.S. Oil and Gas Spot Prices, 2015**



Source: U.S. Energy Information Administration

In 2015, up until May and June, crude prices were on an upward, albeit a volatile, trend. In January, WTI and Brent dropped 16 percent, followed by a surge of 25 percent by mid-February. Prices began to fall again, and by mid-March, crude had fallen 16 percent. Crude prices rebounded from March to May and June. WTI reached a high of \$61.36 per barrel (bbl) in June and Brent crude prices peaked in May, reaching \$66.33/bbl. That represents a 40 percent increase since mid-March for WTI and a 28 percent increase for Brent. After peaking in May, crude oil prices began to drop at a rapid pace, and by December 31, WTI had fallen 30 percent and Brent had fallen 34 percent from January 1 levels. WTI recorded a low of \$34.55/bbl and Brent bottomed out at \$35.26 in late December. These prices marked the lowest prices in WTI and Brent since February 2009. The dramatic fall in oil prices, particularly in the second half of 2015, can largely be attributed to the glut in the world oil supply. Production from the Organization of the Petroleum Exporting Countries (OPEC) remained firm despite the falling prices and news of Iran returning to the oil market after a pending nuclear deal helped push prices further down. This left many U.S. oil producers in the red and they began cutting oil rigs. By the end of 2015, only around 530 rigs remained drilling for oil, down 65 percent from the roughly 1,500 oil rigs in production at the end of 2014.

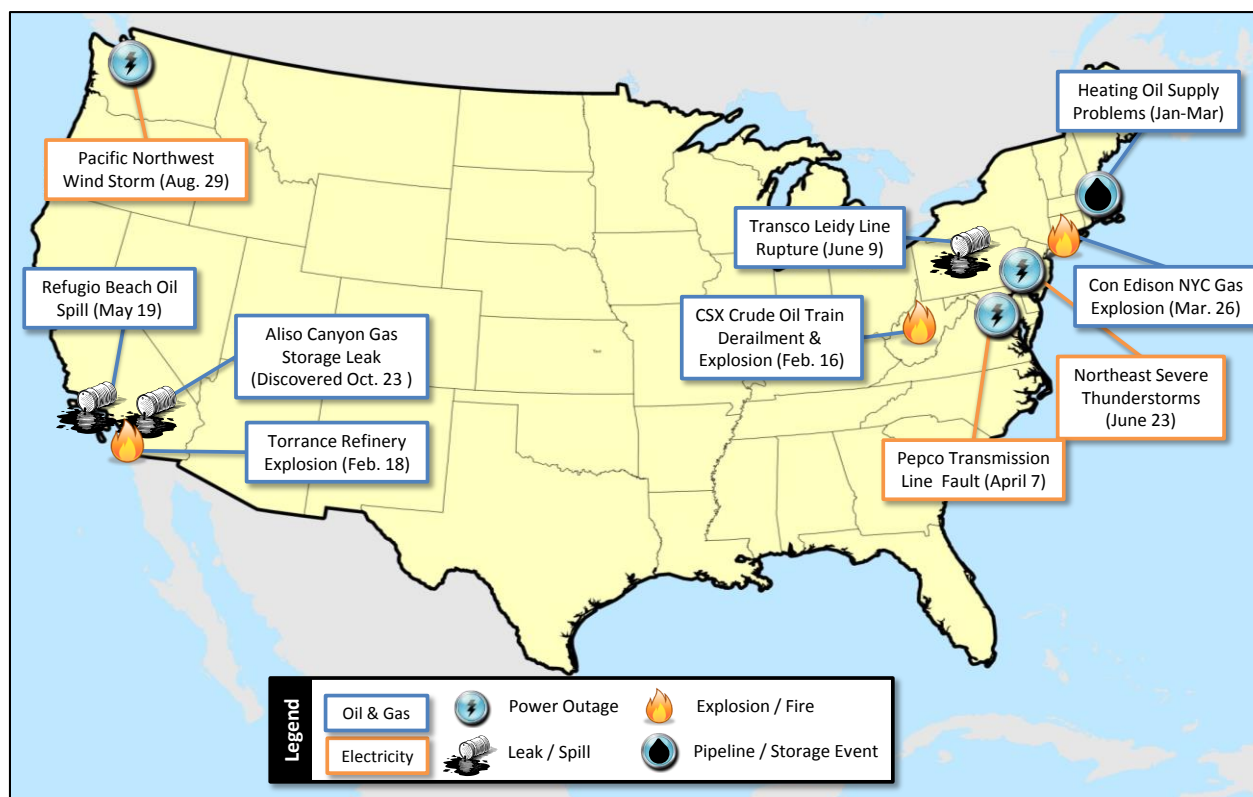
The Henry Hub natural gas price averaged \$2.62 per million British thermal units (MMBtu) in 2015—a 40 percent decrease in price from the 2014 average (\$4.37/MMBtu) and a 30 percent decrease in price from the 2013 average (\$3.73/MMBtu). This is largely due to supply outpacing demand in a booming North American production market from shale gas resources. A significantly colder-than-normal winter in the early months of 2015 led to significant price spikes, with the price of gas at Henry Hub reaching a high of \$3.32/MMBtu in January. Following the

winter, prices fell throughout the year and bottomed out at \$1.63/MMBtu in late December. Around the turn of the New Year, however, gas prices surged nearly 40 percent to \$2.28/MMBtu ahead of 2016, as cold weather led to a spike in gas demand. Natural gas rigs also took a hit in 2015. From the end of 2014 to the end of 2015, the natural gas rig count had dropped roughly 45 percent to 162 rigs.

## 2. Major Events

Major Events are events that disrupt energy service to a large segment of the population and/or damage critical assets in the energy sector. Major events can also involve energy infrastructure accidents that harm people, buildings, or the environment, and infrastructure changes or policy actions that impact U.S. energy markets. Ten unique energy events were identified as Major Events in 2015, compared with 12 events in 2014. Figure 2 maps these events and details on these events are summarized in the bullet points below.

Figure 2. 2015 Map of Major Events



### 2.1 Electricity

- **Pepco Transmission Line Fault at Substation in Maryland Impacts Power Supply to Washington, D.C., Area Buildings (April 7).** An electrical fault on a 230-kilovolt (kV) Pepco transmission line at the Ryceville substation in Charles County, MD, caused a severe low-voltage condition that knocked out power to 28,000 Pepco and Southern Maryland Electric Cooperative (SMECO) customers in Washington, D.C., and Maryland. The outages primarily impacted Federal Government and commercial customers whose internal protective equipment tripped by design, including the White House, the Capitol, and the State Department. The transmission line fault occurred at the jointly owned Ryceville substation, which serves as a connecting station between the SMECO and Pepco systems. The failure interrupted the flow of power to multiple locations and forced

offline three generating units, totaling 1,954 megawatts (MW) of capacity, including both units at the Calvert Cliffs Nuclear Power Plant. This led to a severe voltage reduction on the Pepco and SMECO systems, causing equipment at some customer facilities to respond to the dip in voltage by disconnecting from the grid. Some customers' building electrical systems transferred to their backup systems where such systems were installed and functional. The total load loss was approximately 532 MW for both Pepco and SMECO. Following the fault, SMECO rerouted power through its 230-kV system and all customers affected by the event were restored within 2 hours. Immediately following the system disturbance, the Pepco and PJM systems (PJM is the independent system operator serving the affected utilities) were stable, and no exceptional actions outside of normal emergency operating procedures were needed to maintain reliability. The Calvert Cliffs plant returned to service in 2 days and the failed Pepco transmission line was returned to service in 16 days. The U.S. Department of Homeland Security (DHS) investigated the incident but concluded that the event was not terror related or a criminal act.

- **Northeast Severe Thunderstorms and High Winds Knock Out Power to 888,000 Customers<sup>3</sup> (June 23):** A severe storm system moved across the Northeast, producing straight-line winds in excess of 70 miles per hour (mph), and a macroburst<sup>4</sup> with wind speeds of up to 85 mph lasting 5–20 minutes in Gloucester County, NJ, just south of Philadelphia. Strong macrobursts can cause tornado-force damage. The storm impacted 888,000 customers from Virginia to Massachusetts, with 280,000 outages reported by Atlantic City Electric in New Jersey and 250,000 outages reported by PECO in Pennsylvania. For Atlantic City Electric, the outages exceeded those from either the June 2012 derecho or Superstorm Sandy. Atlantic City Electric reported extensive damage to the utility's electrical infrastructure, including significant damage to 20 high-voltage transmission lines and 5 substations, as well as 372 downed wires. In addition, Atlantic City Electric noted difficulties in accessing some damage locations due to closed roads in the hardest hit areas. By June 27, 4 days after the storm had hit, the vast majority of Atlantic City Electric customers had their power restored; however, additional heavy rains hampered the utility's restoration efforts. Atlantic City Electric completed restoration on June 29.
- **Pacific Northwest and British Columbia Wind Storm Knocks Out Power to 1.2 Million Customers (August 29):** A severe wind storm knocked out power to 1.2 million customers primarily in western British Columbia and Washington State, with the greatest damage reported in the Vancouver and Seattle areas. Wind gusts of up to 70 mph were reported, downing trees, power lines, and transmission circuits. Power was restored to the majority of customers 3 days after the storm. BC Hydro, which reported 710,000 outages, indicated that the storm was the single largest outage event in the company's history. In Washington State, Puget Sound Energy (PSE) reported 224,000 outages,

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<sup>3</sup> A *customer* is not synonymous with a person. One customer is typically one account. A household of four could be considered one customer. The term *power outage* is used synonymously with *customer* in this document.

<sup>4</sup> A *macroburst* is a downburst with a diameter of greater than 2.5 miles. A *downburst* is a strong downdraft, which includes an outburst of potentially damaging winds on or near the ground.

while Snohomish County Public Utility District (PUD) reported 175,000 outages. PSE said that the storm was the largest storm to impact its service territory in 10 years and Snohomish County PUD said that the storm was the strongest summer storm to ever hit its service area. Both utilities reported widespread wind damage that impacted infrastructure, with PSE reporting more than 2,000 damage locations.

## 2.2 Natural Gas

- **Con Edison Gas Explosion Destroys Three Buildings, Kills Two People in New York City (March 26):** A gas explosion and the resulting fire destroyed 3 buildings, killed 2 people, and injured 19 more in the East Village neighborhood of Manhattan. As a precautionary measure following the blast, Con Edison shut off gas service to 187 residential and 32 commercial customers in the area. In addition, 11 nearby buildings were evacuated for several days. The explosion occurred shortly after Con Edison investigators had inspected a new 4-inch-diameter gas pipeline serving an apartment building. The blast was suspected to have occurred as a result of an illegal pipeline tap put in place by the building's landlord. The incident came nearly a year after a gas leak linked to Con Edison caused an explosion that killed eight people in East Harlem. In that incident, New York regulators determined that Con Edison failed to adhere to nearly a dozen gas safety requirements.
- **Transco Declares *Force Majeure* After Rupture on Leidy Line in Pennsylvania, Warns of Potential Supply Impacts to the Northeast (June 9):** Transcontinental Gas Pipeline Company (Transco) declared *force majeure*<sup>5</sup> after a rupture shut flows on its 24-inch-diameter Leidy Line B near Unityville, PA. The incident forced about 130 residents to be temporarily evacuated from their homes. Line B is one of three parallel pipes that make up the Leidy Line, which carries up to 3.5 billion cubic feet per day (Bcf/d) of gas from the Marcellus Shale area to Transco's mainline system in northern New Jersey. Line B was shut between Columbia and Lycoming counties in Pennsylvania on June 9; however, additional segments of the line were taken out of service on June 19 as part of the restoration process. Subsequently, in notes to shippers, Transco said that it would be operating various segments of its Leidy system at reduced pressure to comply with an operating plan outlined by the Pipeline Hazardous Materials Safety Administration (PHMSA). Transco noted that the lower pressure might limit the availability of non-firm capacity and could impact firm services during periods of high-capacity utilization. In addition, Transco noted that the reduced pressures would reduce operating flexibility in Zone 6, which includes Delaware, Maryland, Pennsylvania, New Jersey, and the New York City area. In October, Transco announced that it expected to continue operating the system at reduced pressures through the second quarter of 2016.
- **Uncontrolled Gas Release at Aliso Canyon Storage Field Prompts Indefinite Shutdown, Raises Gas and Electric Reliability Concerns in Southern California (Beginning October 23):** A suspected rupture in a 62-year-old well casing

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<sup>5</sup> *Force majeure* is a clause in a contract that frees parties from liability or obligation when an extraordinary event or circumstance beyond the control of the parties prevents them from fulfilling their obligations.

approximately 500 feet below ground led to an uncontrolled release of natural gas from Southern California Gas Company's (SoCal Gas) Aliso Canyon underground storage facility in northwestern Los Angeles County. The Aliso Canyon site, which is the largest of four storage sites in the Los Angeles Basin, has a working gas capacity of 86 Bcf and a maximum deliverability of 1.86 Bcf/d, accounting for nearly two-thirds of the State's storage capacity and half of the of State's deliverability from storage. After discovering the leak on October 23, SoCal Gas made seven unsuccessful attempts to plug the well before it commenced a lengthy relief well operation to intercept the affected well approximately 8,500 feet below ground to plug, seal, and permanently abandon the well. From the time the leak was discovered in October until February 18, 2016, when the leak was confirmed sealed, the well released an estimated 5.4 Bcf of natural gas into the atmosphere. More than 4,500 families who lived near Aliso Canyon were temporarily relocated due to odors from the leak and California issued an emergency declaration in response to the event. The State ordered SoCal Gas to do everything it could to stop the leak, complete a comprehensive safety review of all 115 wells at the facility, and cap working gas storage volumes at Aliso Canyon at 15 Bcf, or roughly 18 percent of total capacity. As of March 2016, it is unclear whether or when new injections will be allowed. The California Independent System Operator (ISO) and several State regulatory agencies are currently assessing the gas and electric system reliability risks should Aliso Canyon be shut down for an extended period.

## 2.3 Petroleum

- **Severe Cold Affects Heating Oil Supply and Distribution in the Northeast (January–March):** Beginning in early January and continuing through early March 2015, the Northeast region experienced an extended period of bitter cold temperatures that led to a large increase in heating oil demand, disrupted operations at regional refineries, and froze waterways and ports that are used for marine transportation of heating oil. Cold weather-related shutdowns and operational issues at East Coast refineries resulted in a 24.9 percent decline in East Coast refinery utilization from the end of January to the end of February. Unprecedented thick ice and freezing in Northeast ports and waterways delayed marine deliveries, leading to a sharp drawdown in stocks of heating oil and other products at terminals along the Hudson River in New York; along bays, creeks, and channels around Long Island; and along the Weymouth Fore River south of Boston Harbor in Massachusetts. The U.S. Coast Guard (USCG) worked diligently to remove ice and keep critical public ports and waterways open, while several terminal operators hired ice-breaking tugs to remove buildup around private docks. Downstream of the terminals, heavy snow buildup on roads, driveways, and on residential tanks delayed truck deliveries of heating oil to end-use customers. Several Northeast States issued emergency declarations due to heating oil shortages, waiving hours-of-service (HOS) regulations for truckers moving heating oil and other products.
- **CSX Train Hauling Bakken Crude Oil Derails, Catches Fire in West Virginia (February 16):** Twenty-five cars of a 109-car CSX Corporation train hauling North Dakota Bakken crude derailed near Mount Carbon, WV, with 9 or 10 cars exploding at



intervals of about every half hour. At least one tank car fell into a tributary of the Kanawha River, and another car slammed into a house and burst into flames. The accident forced the evacuation of 100–125 residents of homes near the site; however, no injuries were reported. West Virginia issued a state of emergency for Kanawha and Fayette counties after the derailment. Cleanup activities lasted several days as the fires burned themselves out. Heavy snow and freezing temperatures hindered efforts to deal with the incident. The derailed train was transporting crude oil to Yorktown, VA, where Plains All American Pipeline operates a crude oil transloading terminal, which receives oil by train, stores it, and loads it onto barges for further delivery to East Coast refineries.

- **Explosion at ExxonMobil's Torrance Refinery Curbs California Gasoline Supply (February 18):** A massive explosion at ExxonMobil's 149,500-barrels per day (b/d) Torrance refinery near Los Angeles caused structural damage to the plant's 100,000-b/d fluid catalytic cracking unit (FCCU), a key secondary processing unit that—prior to the blast—had produced about 20 percent of the gasoline supply in Southern California. The California market requires a boutique blend of gasoline—CARBOB (California Reformulated Gasoline Blendstock for Oxygenate Blending)—that is not widely produced outside the State. Following the blast, the price of gasoline in Los Angeles surged to 18-month highs on fears that the local gasoline supply would tighten. After the incident, Exxon said that it continued to operate units not affected by the explosion; however, the damaged FCCU remained offline for the remainder of the year because California safety regulators prohibited Exxon from restarting the unit until the company could prove that it was safe to do so. In late September, after abandoning plans to restart the refinery at reduced rates, Exxon announced that it would sell the refinery to PBF Energy. The deal is expected to close in mid-2016 after the refinery is restored to full working order. In January 2016, the U.S. Chemicals Safety Board reported that an ongoing investigation into the Torrance incident revealed multiple process safety management deficiencies that led to the explosion. The explosion occurred during unplanned maintenance, when hydrocarbon vapors unknowingly accumulated within piping and process equipment supporting the FCCU, resulting in an explosion when the vapors migrated to an ignition source in the FCCU's electrostatic precipitator (ESP), which is a supporting unit used to control air pollution from FCCU's atmospheric emissions.
- **Refugio Beach Crude Oil Spill and PHMSA Investigation Indefinitely Shut Down Plains All American Pipeline System, Exxon Offshore Production in California (May 19):** A major crude oil spill along Santa Barbara County's Refugio State Beach, and subsequent investigations, resulted in the indefinite closure of Plains All American Pipeline L.P.'s All American Pipeline system and production shut-ins at three ExxonMobil offshore oil platforms. The Plains system consists of two mainline segments: the 10-mile, 150,000-b/d Line 901 that moves crude along the coastline from ExxonMobil's Las Flores Canyon Processing Facility—the onshore receipt point for crude produced at Exxon's offshore Santa Ynez field—to the Gaviota pipeline junction. From Gaviota, the 130-mile, 300,000-b/d Line 903 transports crude north to Phillips 66's 44,500-b/d Santa Maria upgrading facility, and through further interconnections, to refineries in both northern and southern California. On May 19, a rupture along Line 901

leaked an estimated 2,400 to 3,300 bbl, of which an estimated 500 bbl spilled into the Pacific Ocean, prompting the company to shut down the system. The spill resulted in an oil slick extending at least 9 miles along the coastline and 50 yards into the ocean, and the Governor of California issued a county emergency proclamation directing State resources to aid in the cleanup effort. PHMSA investigators later determined that the spill was caused by corrosion and several mechanical pump failures and restart attempts that led to pressure spikes on the line on the morning of the incident. In June, with no outlet for its offshore crude, Exxon was forced to shut-in production from its Santa Ynez field and close its Las Flores Canyon facility. In August, the company confirmed that Line 901 would remain shut down for the rest of 2015. In November, PHMSA ordered the company to also shut down and purge its 300,000-b/d Line 903 after further investigations revealed similar corrosion characteristics.

### 3. Energy Disruptions

This section provides a summary of disruptions reported in EAD in 2015. Energy disruptions that occurred in 2015 are grouped into five categories: electricity, natural gas, petroleum, biofuels, and cybersecurity.

#### 3.1 Electricity Disruptions

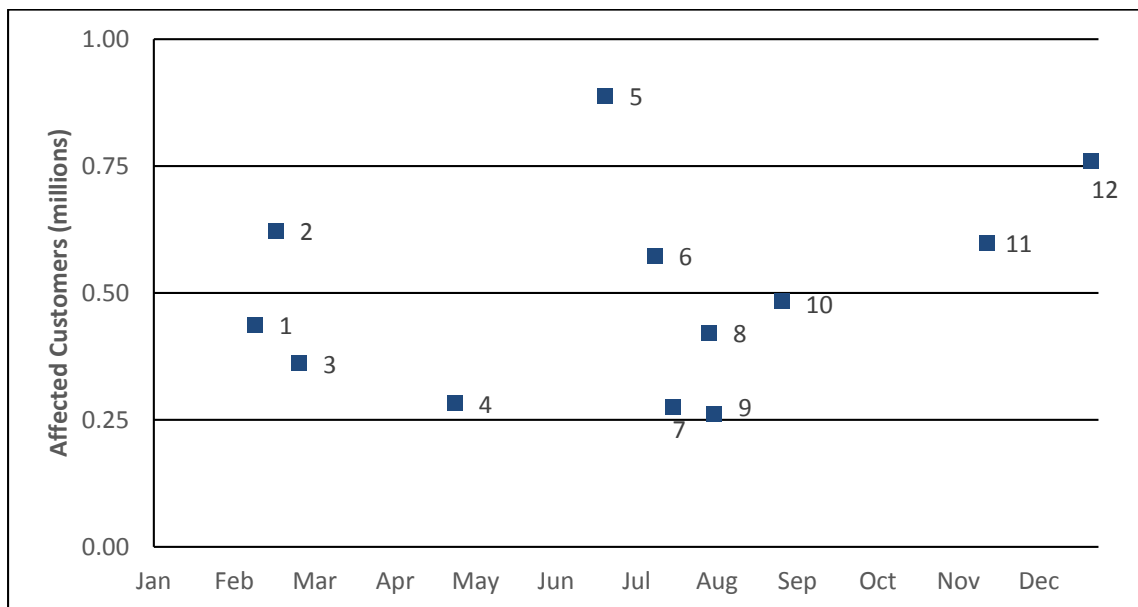
The following three sections discuss disruptions in the electricity sector related to customer power outages, power plant outages, and impacts on other electric industry assets.

##### 3.1.1 Customer Outages

###### 3.1.1.1 Large-Scale Outage Events

Figure 3 shows large-scale electricity outage events that occurred in the United States in 2015. There were 12 outage events that resulted in a loss of power to 250,000 or more customers, compared with 15 such events in 2014. All 12 of the large-scale events in 2015 were weather-related. No event in 2015 resulted in power outages for more than 1 million U.S. customers (although one event knocked out power to more than 1 million U.S. and Canadian customers combined). By comparison, 2014 had two storms that disrupted power to more than 1 million U.S. customers.

**Figure 3. Large-Scale U.S. Electric Customer Outage Events, 2015<sup>6</sup>**



<sup>6</sup> The total outages reported for each event reflects the sum of event-related outages, as reported by each utility. The outages reported by each utility may be *peak* outages (the highest number of customers without power at any given point in time) or *total affected* customers (the total number of customers reported without power at one time or another over the course of an event).

The 12 events in 2015 that affected more than 250,000 U.S. customers were as follows:

1. **Northern and Central California Thunderstorms (February 6–8):** Two large storms with heavy rain and strong winds affected 437,000 Pacific Gas & Electric (PG&E) customers in Northern and Central California in early February. Wind gusts of up to 60 mph were reported, downing trees and power lines. PG&E said that it had more than 2,000 personnel working around-the-clock dedicated to storm response and service restoration, and brought in crews from Washington and Arizona to assist. Power was restored to customers within a few days of the storm's passing.
2. **Southeast Winter Storm (February 15–17):** In mid-February, a winter storm producing snow and ice moved across the Southeast from Arkansas to North Carolina, knocking out power to 622,000 customers over 3 days. Georgia Power, which reported 190,000 outages, said that it had more than 3,500 crews and other resources working on restoration. Duke Energy reported 191,000 customers without power in North Carolina and South Carolina. Duck River Electric reported that one of the Tennessee Valley Authority's 161-kV transmission poles fell on the Boynton Valley substation in Tennessee. The majority of the customers had their power restored within 4 days of the storm's passing.
3. **Southeast Winter Storm (February 25–26):** In late February, a snowstorm bringing heavy wet snow and high winds, took out power to 361,000 customers across the Southeast from eastern Texas to Virginia. Duke Energy experienced more than 224,000 customer outages in North Carolina and South Carolina after the storm downed trees and power lines.
4. **Louisiana-Texas-Arkansas Thunderstorms (April 27):** In late April, 283,000 customers lost power after strong thunderstorms moved through Louisiana, Texas, and Arkansas. Entergy Louisiana, the hardest hit utility, reported 176,000 customers without power. The company brought additional crews from outside the affected area.
5. **Northeast Heavy Winds and Thunderstorms (June 23):** In June, severe storms impacted the Northeast, producing winds of up to 70 mph from Virginia to Connecticut. In southern New Jersey, a macroburst was reported with winds of up to 85 mph lasting between 5 and 20 minutes. The storm impacted 888,000 customers. Atlantic City Electric, the hardest hit utility, requested additional crews to aid in the restoration effort. By June 29, Atlantic City Electric had restored all power to its customers.
6. **Midwest and Ohio Valley Thunderstorms (July 12–14):** Over 2 days in mid-July, two lines of heavy thunderstorms knocked out power to 573,000 customers in the Midwest and Ohio Valley, with outages reported from Minnesota to western Virginia. Appalachian Power in West Virginia and Virginia, and Duke Energy in Ohio and Kentucky each reported 100,000 or more power outages. While the extent of the damage caused by falling trees and power lines was extensive, the majority of the customers had their power restored by July 17.
7. **Minnesota-Wisconsin Thunderstorms (July 18):** On July 18, 250,000 Xcel Energy customers and 26,000 We Energies customers were without power after a major line of thunderstorms moved through Minnesota and Wisconsin. Wind gusts of up to 60 mph were reported. By the afternoon of July 19, power was restored to all customers.

8. **Midwest and Ontario Thunderstorms (August 2–3):** Severe thunderstorms moved across Wisconsin, Illinois, Michigan, Ohio, and Ontario in early August. A total of 420,801 customers were without power in the United States and 61,537 customers were without power in Ontario. Commonwealth Edison had 90,000 customer outages in Illinois and Consumers Energy in Michigan had 170,000 outages. Heavy winds and rain downed trees and power lines. By August 7, most of the customer power outages had been restored.
9. **New York and New England Thunderstorms (August 4):** A total of 261,000 customers were without power in southeast New York and New England after a line of thunderstorms passed through the region on August 4. Isolated wind gusts of more than 60 mph were reported along with severe lightning. National Grid in Rhode Island was the hardest hit utility, with more than 120,000 customers affected. Power was restored to nearly all customers by August 6.
10. **Pacific Northwest and British Columbia Storms (August 29):** In late August, severe thunderstorms took out power to more than 1.2 million customers in the U.S. Pacific Northwest and British Columbia. The State of Washington had 477,000 customer outages, Oregon had 7,000 outages, and British Columbia had 710,000 outages. Figure 3 above does not show outages in British Columbia; only U.S. outages are shown. Power was restored to the majority of customers 2 days following the storm.
11. **Pacific Northwest Thunderstorms (November 17–18):** A strong storm packing powerful winds knocked out power to 599,000 customers in the U.S. Pacific Northwest, as well as an additional 73,000 customers in British Columbia. The affected U.S. States were Washington, Oregon, Idaho, and Montana. Avista experienced 180,000 power outages in Idaho and Washington, nearly half of its total customer base. Puget Sound Energy (PSE), the hardest hit utility, had 210,000 customers without power in northwest Washington. Three days after the storm had passed, several utilities in Washington State were continuing to restore power to their customers.
12. **Central U.S. Winter Storm (December 27–28):** 761,000 customers were without power as a powerful winter storm bringing freezing rain, sleet, snow, and strong winds passed through the Central United States, affecting electric utilities from New Mexico and Texas in the south to as far north as Michigan and as far east as western Pennsylvania. Oklahoma and Illinois were the hardest hit States, with 285,000 and 221,000 power outages, respectively. Crews were called in from regions that were not hit by the storm. By December 31, the majority of the power outages were restored.

From a seasonal perspective, the summer months of June through August accounted for half (six) of the large-scale outage events in the United States in 2015. These summer storms averaged nearly 484,000 outages per event. Winter-related storms, which occurred in February and December, and involved snow or ice, were responsible for 3 of the 12 large-scale outage events. These events averaged more than 606,000 outages per event.

#### 3.1.1.2 Small- and Medium-Scale Outage Events

In addition to large-scale outage events, EAD also reports outage events affecting between 10,000 and 250,000 customers. In 2015, there were a total of 138 small- and medium-scale

outage events, not including the large-scale events discussed above (see Figure 4). This is an increase from 2014, which experienced a total of 119 such events. An increase in equipment failures, accidents, and natural events accounts for this large increase. Unlike 2014, the winter months in 2015 saw an increased concentration of outage events.

**Figure 4. Small- and Medium-Scale U.S. Electric Customer Outage Events, 2015<sup>7</sup>**

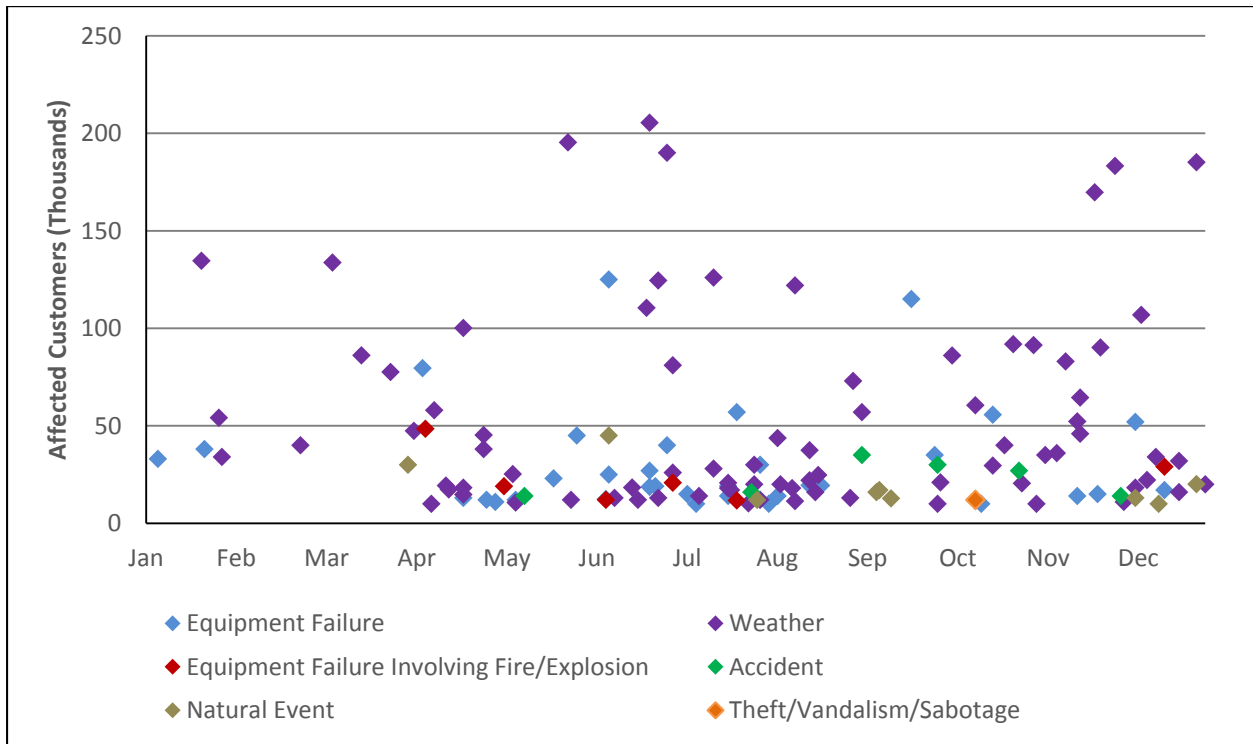
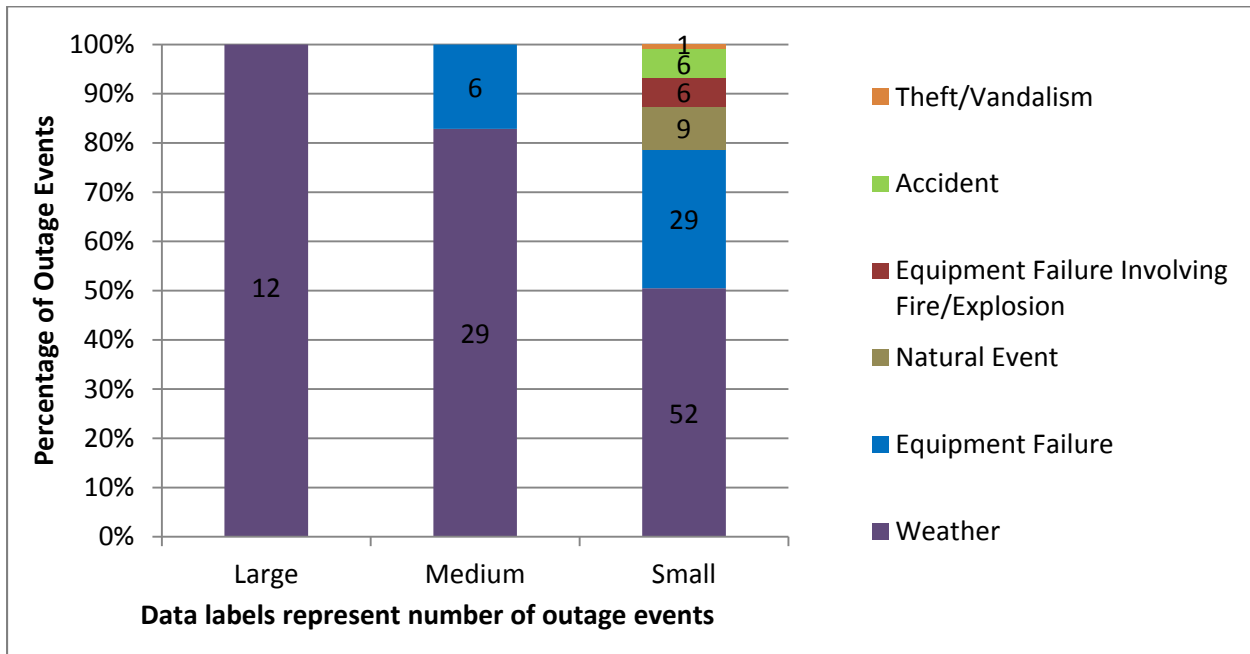


Figure 5 breaks down the number of medium- and small-scale customer outage events by event cause. Note that the graph also includes the 12 large-scale events discussed in the earlier section. While all 12 of the large-scale events were weather related, only 50 percent of the small-scale events were caused by weather. In 2015, equipment failure accounted for 28 percent of all small-scale outages and 23 percent of the total outages. Equipment failures involving fires and explosions accounted for 6 percent of all small-scale outages and 4 percent of the total outages during the year. Civilian car crashes resulted in four small-scale outages in 2015. A tree-trimming incident and a drifted U.S. Department of Defense blimp event were two other accident-related outages in 2015. These six accident events are shown in the graph below. Natural events accounted for 6 percent of all outages in 2015. Of the nine natural events that occurred in 2015, five were due to animals interfering with electrical equipment, three were caused by wildfires, and one was due to a fallen tree unrelated to a weather event.

<sup>7</sup> Natural events include animal interference (e.g., squirrels, snakes, birds), wildfires, and vegetation impacts that are not the result of a storm. Weather events are storm-based events.

**Figure 5. U.S. Electric Customer Outage Events by Cause and Magnitude, 2015**



Note: Large: ≥ 250,000 customers; Medium: 50,000–249,999 customers; Small: 10,000–49,999 customers.

### 3.1.2 Power Plant Outages

Unlike customer outages, reporting on power plant outages is less comprehensive because public information on power plant outages is not consistently reported. In 2015, EAD reported 344 outages at U.S. power plants caused by unplanned (or forced) events by equipment failure or weather-related incidents. This is a large increase from 2014, which had 221 reported power plant outages.

### 3.1.3 Physical Attacks and Sabotage

In November 2014, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection of Dominion’s 2,162-MW Millstone nuclear plant in Connecticut and discovered a security-related violation. Due to the sensitive nature of the violation, the NRC did not specify the nature of the violation or provide any other details regarding the incident. In April 2015, the NRC finalized its decision and determined that the violation was significant enough to be “greater than green.” The NRC uses a four-tiered color-coded system to categorize the severity of safety findings, with green being the lowest, followed by white, yellow, and red. The NRC said that it would increase its oversight of Millstone, including assigning additional inspections of security systems and procedures. Three NRC resident inspectors were assigned to the plant on a day-to-day basis, and additional inspectors were brought in periodically to examine specific areas. NRC officials added that the security of the plant was not in question and that the inspectors ensured that corrective actions were taken immediately.<sup>8</sup>

<sup>8</sup> <http://www.theday.com/article/20150402/NWS01/150409813>

## 3.2 Natural Gas Disruptions

In 2015, EAD reported numerous disruptions to natural gas assets, including both upstream and downstream assets. Most of these outages were caused either by shut-ins resulting from fires and explosions or damage resulting from severe storms that impacted natural gas infrastructure.

### 3.2.1 Upstream

Several events had notable impacts on upstream natural gas assets in 2015, including wells and platforms, flow lines and gathering lines, and processing plants. These disruptions, which were caused primarily by accidental ruptures and equipment failure, are listed below.

- **Parsley Energy Reports Explosion Kills 3 Workers at Oil and Gas Field in West Texas (March):** An explosion killed three people and injured one at an oil and gas field in West Texas on March 10. The Federal Occupational Safety and Health Administration (OSHA) investigated the rig explosion about 50 miles south of Midland that involved contractors at the Mason Well Service firm and cited Mason for violations resulting in the death of its three employees.
- **Oasis Petroleum Plugs Oil and Gas Well in North Dakota After October 17 Blowout (October):** Oasis Petroleum Inc. said that on October 20 it successfully plugged a blowout in North Dakota after losing control of a well 3 days beforehand. The well leaked more than 67,000 gallons of oil, as well as brine and natural gas. Oasis crews pumped more than 33,000 gallons of a bentonite clay and water mixture down the well to permanently plug it and prevent the uncontrollable outward flow of liquids. A light sheen was observed on the White Earth River and containment booms were deployed to prevent hazardous liquids from migrating downstream to the Missouri River. Personnel from the North Dakota Oil and Gas Division and the Department of Health remained on site until no further monitoring was required.

### 3.2.2 Midstream and Downstream

In 2015, several events had notable effects on the midstream and downstream natural gas sector, including natural gas transmission, distribution, and service pipelines.

- **Con Edison Gas Explosion Destroys Three Buildings, Kills Two People in New York City (March):** A gas explosion and the resulting fire destroyed 3 buildings, killed 2 people, and injured 19 more in the East Village neighborhood of Manhattan. As a precautionary measure following the blast, Con Edison shut off gas service to 187 residential and 32 commercial customers in the area. In addition, 11 nearby buildings were evacuated for several days. The explosion occurred shortly after Con Edison investigators had inspected a new 4-inch-diameter gas pipeline serving an apartment building. The blast was suspected to have occurred as a result of an illegal pipeline tap put in place by the building's landlord. The incident came nearly a year after a gas leak linked to Con Edison caused an explosion killing eight people in East Harlem. In that incident, New York regulators determined that Con Edison failed to adhere to nearly a dozen gas safety requirements.



- **Transco Declares *Force Majeure* After Rupture on Leidy Line in Pennsylvania, Warns of Potential Supply Impacts to the Northeast (June):** Transco declared *force majeure* after a rupture shut down flows on its 24-inch-diameter Leidy Line B near Unityville, PA. The incident forced about 130 residents to be temporarily evacuated from their homes. Line B is one of three parallel pipes that make up the Leidy Line, which carries up to 3.5 billion cubic feet per day (Bcf/d) of gas from the Marcellus Shale area to Transco's mainline system in northern New Jersey. Line B was shut down between Columbia and Lycoming counties in Pennsylvania on June 9; however, additional segments of the line were taken out of service on June 19 as part of the restoration process. Subsequently, in notes to shippers, Transco said that it would be operating various segments of its Leidy system at reduced pressure to comply with an operating plan outlined by PHMSA. Transco noted that the lower pressure might limit the availability of non-firm capacity and could impact firm services during periods of high-capacity utilization. In addition, Transco noted that the reduced pressures would reduce operating flexibility in Zone 6, which includes Pennsylvania, New Jersey, Maryland, Delaware, and the New York City area. In October, Transco announced that it expected to continue operating the system at reduced pressures through the second quarter of 2016.
- **Energy Transfer Partners' Natural Gas Pipeline Ruptures, Catches Fire in South Texas (June):** State officials investigated the cause of the explosion of a 42-inch-diameter Energy Transfer Partners' natural gas pipeline in South Texas on June 14. The pipeline was used to transport natural gas from wells in the Eagle Ford shale formation to a processing station in Jackson County, about 50 miles away. Gas from the pipeline had been rerouted and seven homes had been evacuated by fire officials as a precautionary measure.
- **Alliance Pipeline Shuts Down Its 1.6-Bcf/d Natural Gas Mainline in Western Canada (August):** Alliance Pipeline shut down its natural gas mainline in Western Canada on August 7 after poisonous hydrogen sulfide gas entered the mainline pipeline system. The gas was tainted through an operational upset that Keyera, an upstream operator, stated occurred during maintenance at its 250-million cubic feet per day (MMcf/d) Simonette processing plant in northwestern Alberta 2 days earlier. A number of shippers were forced to suspend production while the Alliance mainline was out of commission, including Long Run, Trilogy Energy, and others. Laterals to the mainline were shut down as well. The 2,391-mile Alliance Pipeline is owned by an Enbridge affiliate and Veresen, and delivers natural gas from Western Canada and North Dakota's Williston Basin to the Chicago market hub. Alliance announced on August 9 that controlled flaring of the natural gas took place at two locations in the Alameda and Arcola areas of southeast Saskatchewan over the course of several days. The pipeline restarted on August 12, with the *force majeure* lifted and full contract services resumed on August 13. In total, the mainline was out of service for 6 days.
- **Compressor Station Explosion Damages SELA Natural Gas Lateral in Louisiana (October):** On October 8, Williams Companies reported that an explosion at a compressor station on its Southeast Louisiana (SELA) Lateral in Gibson, LA, killed three contractors and severely injured two others. SELA, which gathers gas from the Gulf of Mexico and transports it onshore for processing, is part of the Transco system that carries natural gas from the Gulf Coast to the Northeast. SELA was out-of-service for planned maintenance at the time of the incident and the return of the lateral, which was

initially scheduled for October 12, was delayed indefinitely. Before the maintenance outage, SELA was flowing 190-MMcf/d. On November 9, Williams announced that the section of the SELA pipeline that was shut down following the explosion would be returned to service in the first quarter of 2016, barring future complications.

- **Uncontrolled Gas Release at Aliso Canyon Storage Field Prompts Indefinite Shutdown, Raises Gas and Electric Reliability Concerns in Southern California (Beginning October):** A suspected rupture in a 62-year-old well casing approximately 500 feet below ground led to an uncontrolled release of natural gas from SoCal Gas's Aliso Canyon underground storage facility in northwestern Los Angeles County. The Aliso Canyon site, which is the largest of four storage sites in the Los Angeles Basin, has a working gas capacity of 86 Bcf and a maximum deliverability of 1.86 Bcf/d, accounting for nearly two-thirds of the State's storage capacity and half of the of State's deliverability from storage. After discovering the leak on October 23, SoCal Gas made seven unsuccessful attempts to plug the well before it commenced a lengthy relief well operation to intercept the affected well approximately 8,500 feet below ground to plug, seal, and permanently abandon the well. From the time the leak was discovered in October until February 18, 2016, when the leak was confirmed sealed, the well released an estimated 5.4 Bcf of natural gas into the atmosphere. More than 4,500 families who live near Aliso Canyon were temporarily relocated due to odors from the leak and California issued an emergency declaration in response to the event. The State ordered SoCal Gas to do everything it could to stop the leak, complete a comprehensive safety review of all 115 wells at the facility, and cap working gas storage volumes at Aliso Canyon at 15 Bcf, or roughly 18% of total capacity. As of March 2016, it is unclear whether or when new injections will be allowed. The California ISO and several State regulatory agencies are currently assessing the gas and electric system reliability risks should Aliso Canyon be shut down for an extended period.
- **Fire, Explosion Shuts Down Western Gas' Ramsey Natural Gas Processing Plant in West Texas (December):** On December 3, a fire and subsequent explosion damaged the liquid handling facilities and amine treating units at Western Gas Partner's 300-MMcf/d Ramsey gas processing plant. The 100-MMcf/d Train II, which sustained the majority of the damage, was expected to return to service by the end of 2016. The 200-MMcf/d Train III sustained only minor damage was expected to return to full service by the end of the second quarter of 2016. There was no damage to the 200-MMcf/d Trains IV and V, which were under construction at the time of the incident, and still expect to commence operations by mid-2017. There were only two minor injuries associated with the blast, but OSHA opened an investigation in order to identify the cause of the fire and blast. The investigation is expected to last well into 2016 with no clear timeline for completion.
- **Enable Gas Declares *Force Majeure* on Its Line OM-1 in Arkansas (December):** On December 28, Enable Gas Transmission (EGT) issued a *force majeure* due to unstable soil affecting an 18-mile section of its Line OM-1 in northwest Arkansas. The company said that it had taken the section of Line OM-1 out of service while it assessed the extent of potential damage to the affected line and performed any necessary repairs. Enable Gas reported that flooding at regulator stations had prompted operations to reduce pipeline pressure on its BT-3, BT-38, and BM-26 natural gas pipelines in Arkansas. The

company said that line pressures would return to normal once flood waters have receded.

### 3.3 Petroleum Disruptions

In 2015, multiple events significantly disrupted the petroleum supply chain, including assets related to production, transportation, and refining. This section highlights significant disruptions that affected the United States over the course of the year. This section also identifies instances where State governments issued HOS waivers to fuel truck drivers to expedite the movement of fuel during periods of tight supply.

While most of these events took place within the United States, some took place in Canada at assets that affect U.S. petroleum supply. Other international disruptions that affect global energy markets, but do not directly affect supply to the United States, are covered in section 4.1.

#### 3.3.1 Upstream

In 2015, hurricanes were not a major factor affecting oil production and the industry only suffered minor interruptions to upstream output. However, there were several explosions and other issues that inflicted fatal injuries.

- **Refugio Beach Crude Oil Spill and PHMSA Investigation Indefinitely Shut Down Plains All American Pipeline System, Exxon Offshore Production in California (May 19):** A major crude oil spill along Santa Barbara County's Refugio State Beach, and subsequent investigations, resulted in the indefinite closure of Plains All American Pipeline, L.P.'s All American Pipeline system and production shut-ins at three ExxonMobil offshore oil platforms. The Plains system consists of two mainline segments: the 10-mile, 150,000-b/d Line 901 that moves crude along the coastline from ExxonMobil's Las Flores Canyon Processing Facility—the onshore receipt point for crude produced at Exxon's offshore Santa Ynez field—to the Gaviota pipeline junction. From Gaviota, the 130-mile, 300,000-b/d Line 903 transports crude north to Phillips 66's 44,500-b/d Santa Maria upgrading facility, and through further interconnections, to refineries in both northern and southern California. On May 19, a rupture along Line 901 leaked an estimated 2,400 to 3,300 bbl, of which an estimated 500 bbl spilled into the Pacific Ocean, prompting the company to shut down the system. The spill resulted in an oil slick extending at least 9 miles along the coastline and 50 yards into the ocean, and the Governor of California issued a county emergency proclamation directing State resources to aid in the cleanup effort. PHMSA investigators later determined that the spill was caused by corrosion and several mechanical pump failures and restart attempts that led to pressure spikes on the line on the morning of the incident. In June, with no outlet for its offshore crude, Exxon was forced to shut-in production from its Santa Ynez field and close its Las Flores Canyon facility. In August, the company confirmed that Line 901 would remain shut down for the rest of 2015. In November, PHMSA ordered the company to also shut down and purge its 300,000-b/d Line 903 after further investigations revealed similar corrosion characteristics.

- Flooding Halts Exploration and Production Operations in Oklahoma (May 29):** A widespread flooding event halted oil and gas exploration and production operations across Oklahoma, prompting operators to shut down sites in advance of the flood, and resulted in extensive infrastructure damage. The Oklahoma Corporation Commission (OCC) initially responded to at least four incidents of inundated tank batteries, one of which washed into the Washita River. In addition, an out-of-service Kinder Morgan oil pipeline leaked an unknown amount of hydrocarbon liquids after turbulent waters and debris cracked one of the pipeline's fittings. Kinder Morgan said that it worked with OCC and the U.S. Environmental Protection Agency (EPA) to dig up the line, seal off the pipeline, and begin remediation efforts.
- Tropical Storm Bill Forces Offshore Gulf of Mexico Operators to Evacuate Non-Essential Personnel (June 15–16):** A tropical storm in the Gulf of Mexico forced several operators, including Chevron and Shell, to evacuate non-essential personnel from offshore platforms; however, production levels were not impacted by the storm. Chevron and Shell were among the first operators to evacuate non-essential workers; however, they said that production levels remained normal. Enterprise Products Partners, which operates offshore pipelines from several platforms, including Anadarko's 120,000-b/d Marco Polo platform, evacuated 20 employees and contractors from three Gulf of Mexico oil and natural gas platforms. In addition, an unrelated technical issue on a junction platform briefly shut down Enterprise's Cameron Highway Oil Pipeline System (CHOPS), which forced BP to temporarily suspend crude oil output from its Mad Dog and Atlantis oilfields early on June 16. Onshore, LyondellBasell deployed sandbags at its refining and chemical facilities in Houston, and only essential personnel were due at Shell's 327,000-b/d Deer Park and Motiva's 603,000-b/d Port Arthur refineries in Texas.
- Emulsion Spill Shuts Nexen Energy's Long Lake Oil Sands Operation in Alberta (July 15–September 17):** An automated monitoring system at Nexen Energy's Long Lake oil sands facility failed to detect a pipeline breach for nearly 2 weeks, resulting in a 31,500-bbl oil emulsion spill, which was discovered July 15, forcing the facility to shut down. Prior to the shutdown, Long Lake was producing about 50,000 b/d of raw bitumen, which was upgraded on site into synthetic crude oil. The widespread environmental and safety impacts associated with the emulsion spill prompted the Alberta Energy Regulator (AER) to suspend 15 on-site pipeline licenses on August 28, which required Nexen to immediately shut-in its producing well pads, as well as 95 pipelines carrying natural gas, crude oil, salt water, fresh water, and emulsion, until it could provide sufficient documentation to ensure the safe operation of its infrastructure. By September 17, Nexen had received AER permission to restore normal production levels, but AER required that 45 pipelines remain shut down for further investigation.
- Wildfire Shuts Down 233,000 b/d of Alberta Oil Sands Production (May 23–June 11):** The Burnt Lake Wildfire, which scorched more than 33,000 hectares of forest lands across northeastern Alberta, forced two producers to shut-in 233,000 b/d of oil sands production, or roughly 10 percent of the total Canadian oil sands output, for more than 3 weeks. Beginning May 23, Cenovus Energy, Inc. halted operations and evacuated personnel from its 135,000-b/d Foster Creek site. Canadian Natural Resources, Ltd. shut down production and evacuated personnel from its 80,000-b/d Primrose site and

reduced output by 18,000 b/d at its 30,000-b/d Kirby South site. Although the oil sands facilities were not damaged by the wildfire, the widespread blaze closed the only access road to the projects. Both companies restored all sites to normal production levels by June 11.

- **Chevron Delays Installation of Big Foot Platform in Deepwater Gulf of Mexico After Subsea Tendons Sink (May 29–31):** Chevron indefinitely postponed the installation of its deepwater Big Foot platform less than 3 months after deployment when nine subsea installation tendons—used for buoyancy support—sunk to the ocean floor from May 29–31. The dry-tree extended tension-leg platform, which features an onboard drilling rig, and production capacity of 75,000 b/d of oil and 25 MMcf/d of natural gas, was towed back to South Texas from the Walker Ridge offshore area by October 2015.

### 3.3.2 Refineries

**There were 865 incidents reported in EAD in 2015. In many of these incidents, portions of refinery’s equipment or process systems were affected; however, those events may or have materially impacted output from the refinery.**

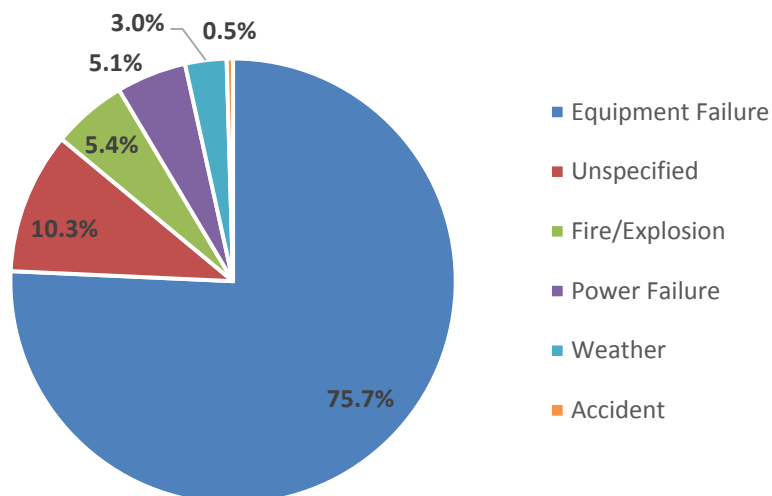
Figure 6 breaks down these reported incidents by type: fire/explosion, equipment failure, power failure, weather, accident, and unspecified. It is important to note that the classification of these incidents is based on the initial report by the company. Followup reports detailing the events and specific causes are uncommon unless a major disruption is involved (e.g., the explosion at ExxonMobil’s Torrance refinery).

The fire/explosion category includes incidents involving fires or explosions, but these incidents may have initially been caused by an equipment failure, operator error, or other causes; the specific cause may not be known or reported at the time of the report. Equipment failures are events where one or more pieces of refinery equipment fail. This could be a pipe rupture, valve failure, instrumentation failure, etc. Equipment failures that involve fires or explosions are not included in this category. Weather-related events are events where the refinery is damaged or impacted directly by weather (e.g., cold weather causes equipment to freeze up or a lightning strike damages refinery equipment) or where the refinery lost power due to a weather-related event (e.g., a lightning strike that impacts transmission equipment within the refinery or an external power supplier). Other refinery power outages—those not initially caused by weather events—are classified as power failures. Accidents are events where worker fatalities occur or human error is involved during refinery maintenance or other work. Included in this category, for example, is a barge collision, which may disrupt the supply of crude to a refinery, forcing the refinery to reduce rates. Unspecified events include flaring or emissions events for which the company had not provided a cause. In many cases, unspecified events are due to an operator error or an equipment failure.<sup>9</sup>

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<sup>9</sup> Texas and California provide extensive reporting of refinery outages as input for EAD; outages in other regions are sourced from other public documents. While the outage reporting is not comprehensive, the distribution of incident types is believed to reflect the results nationwide.

**Figure 6. U.S. Refinery Incidents by Type, 2015**



Note: There were 865 refinery incidents reported in 2015.

Equipment failures are the leading type of refinery incidents. Specific notable events at refineries are discussed below, including several major incidents that impacted refinery production and a nearly 5-month refinery workers strike that threatened to affect production at 12 U.S. refineries across the country.

- **Severe Cold Affects Refinery Production in the Northeast (January–March):** Beginning in early January and continuing through early March 2015, the Northeast region experienced an extended period of bitter cold temperatures that led to a large increase in heating oil demand, disrupted operations at regional refineries, and frozen waterways and ports that are used for marine transportation of heating oil. Cold weather-related shutdowns and operational issues at East Coast refineries resulted in a 24.9 percent decline in East Coast refinery utilization from the end of January to the end of February. Unprecedented thick ice and freezing in Northeast ports and waterways delayed marine deliveries, leading to a sharp drawdown in stocks of heating oil and other products at terminals along the Hudson River in New York; along bays, creeks, and channels around Long Island; and along the Weymouth Fore River south of Boston Harbor in Massachusetts. The USCG worked diligently to remove ice and keep critical public ports and waterways open, while several terminal operators hired ice-breaking tugs to remove buildup around private docks. Downstream of the terminals, heavy snow buildup on roads, driveways, and on residential tanks delayed truck deliveries of heating oil to end-use customers. Several Northeast States issued emergency declarations due to heating oil shortages, waiving HOS regulations for truckers moving heating oil and other products.

- Refinery Workers Stage Nationwide Strike (February 1–June 23):** From February to late June, the United Steelworkers (USW) union staged a strike affecting 12 petroleum refineries with a 20 percent share of the operable U.S. refining capacity. The strike involved disputes between local USW branches and U.S. oil refiners over workplace safety issues, multi-year wage increase plans, and general measures to preserve USW roles in the face of cheaper, short-term contract work arrangements. Although the walkouts briefly affected normal staffing arrangements and prompted one precautionary refinery closure, there were no lasting impacts on regional refinery production, and national refinery utilization levels remained high during the strike relative to 5-year averages. By March 12, nearly a month and a half into negotiations, the USW and major oil companies tentatively agreed on a national contract structure covering about 30,000 workers over 4 years; however, the agreement would have to be ratified at the local union branch level, which prolonged negotiations at some facilities into June. Table 1 below lists the capacities and contract negotiation periods for refineries that were involved in the strike.

**Table 1. Refineries Involved in USW Refinery Strike, 2015**

| Region                     | Operator       | Refinery Location | Operable Capacity (b/d) | Strike Date                                  | Ratification Date | Duration (Days) |
|----------------------------|----------------|-------------------|-------------------------|--|-------------------|-----------------|
| <b>Midwest (PADD 2)</b>    | Marathon       | Catlettsburg, KY  | 242,000                 | 2/01   | 4/03              | 62              |
|                            | BP             | Whiting, IN       | 413,500                 | 2/08   | 5/11              | 93              |
|                            | BP             | Toledo, OH        | 135,000                 | 2/08   | 6/03              | 116             |
|                            | <b>Total</b>   |                   | <b>790,500</b>          | <b>= 21% of PADD 2 Operable Capacity</b>     |                   |                 |
| <b>Gulf Coast (PADD 3)</b> | LyondellBasell | Houston, TX       | 263,776                 | 2/01   | 5/07              | 96              |
|                            | Marathon       | Galveston Bay, TX | 451,000                 | 2/01   | 6/23              | 143             |
|                            | Shell          | Deer Park, TX     | 327,000                 | 2/01   | 3/26              | 54              |
|                            | Motiva         | Port Arthur, TX   | 600,250                 | 2/20   | 3/17              | 26              |
|                            | Motiva         | Norco, LA         | 238,000                 | 2/21   | 3/12              | 20              |
|                            | Motiva         | Convent, LA       | 235,000                 | 2/21   | 3/12              | 20              |
|                            | <b>Total</b>   |                   | <b>2,115,026</b>        | <b>= 23% of PADD 3 Operable Capacity</b>     |                   |                 |
| <b>West Coast (PADD 5)</b> | Tesoro         | Carson, CA        | 251,000                 | 2/01   | 3/23              | 51              |
|                            | Tesoro         | Martinez, CA*     | 166,000                 | 2/01   | 3/24              | 52              |
|                            | Tesoro         | Anacortes, WA     | 145,000                 | 2/01   | 3/23              | 51              |
|                            | <b>Total</b>   |                   | <b>562,000</b>          | <b>= 19% of PADD 5 Operable Capacity</b>     |                   |                 |
| <b>U.S. Total</b>          |                |                   | <b>3,467,526</b>        | <b>= 20% of Total U.S. Operable Capacity</b> |                   |                 |

\* A section of the Tesoro Martinez refinery had been offline for maintenance and was just days away from restart when the strike began. As a precautionary measure, Tesoro shut down the rest of refinery by February 6 and operated the facility as a terminal until its local agreement was ratified.

Note: The Shell Deer Park Chemical Plant and Marathon Houston Cogeneration Facility in Texas were also affected by the strike.

Sources: USW, U.S. Energy Information Administration, Reuters, Motiva Enterprises

- Explosion at ExxonMobil's Torrance Refinery Curbs California Gasoline Supply (February 18):** A massive explosion at ExxonMobil's 149,500 b/d Torrance refinery near Los Angeles caused structural damage to the plant's 100,000-b/d FCCU, a key secondary processing unit that—prior to the blast—had produced about 20 percent of

the gasoline supply in Southern California. The California market requires a boutique blend of gasoline—CARBOB—that is not widely produced outside the State. Following the blast, the price of gasoline in Los Angeles surged to 18-month highs on fears that local gasoline supply would tighten. After the incident, Exxon said that it continued to operate units not affected by the explosion; however, the damaged FCCU remained offline for the remainder of the year as California safety regulators prohibited Exxon from restarting the unit until the company could prove that it was safe to do so. In late September, after abandoning plans to restart the refinery at reduced rates, Exxon announced that it would sell the refinery to PBF Energy. The deal is expected to close in mid-2016 after the refinery is restored to full working order. In January 2016, the U.S. Chemicals Safety Board reported that an ongoing investigation into the Torrance incident revealed multiple process safety management deficiencies that led to the explosion. The explosion occurred during unplanned maintenance, when hydrocarbon vapors unknowingly accumulated within piping and process equipment supporting the FCCU, resulting in an explosion when the vapors migrated to an ignition source in the FCCU's ESP, which is a supporting unit used to control air pollution from the FCCU's atmospheric emissions.

- **ExxonMobil Cuts Rates at Baytown Refinery After Vessel Collision Shuts Down Houston Ship Channel Section, Delays Crude Shipments (March 9–12):** ExxonMobil was forced to cut crude runs at its 560,500-b/d Baytown, TX, refinery after a chemical tanker hauling 216,000 bbl of methyl tertiary-butyl ether (MTBE) collided with a bulk carrier near Morgan's Point on the Houston Ship Channel, effectively blocking crude supply by tanker to the refinery's dock facilities. The USCG kept the affected section closed for nearly 4 days, isolating the collision site with a containment boom, remediating the spill with dense foam, and removing the remaining MTBE from the damaged tanker. ExxonMobil reported that production was cut on the third day of the incident. No other refiners reported impacts from the closure. By March 12, the USCG had salvaged the vessels and reopened the waterway.
- **Phillips 66 Louisiana Refineries Struggle With Power Outages (April 4–May 15):** Third-party power outages caused four unplanned shutdowns between Phillips 66's two Louisiana refineries during April and early May. The 247,000-b/d Alliance refinery was shut down after losing power on April 4, April 28, and May 8, while the 234,900-b/d Lake Charles refinery lost power on May 15. Only the April 28 power failure was a result of severe weather. Each shutdown lasted approximately 3 days.
- **Power Loss Shuts Down Valero's Memphis Refinery for 10 Days (June 7–16):** A third-party power interruption on June 7, due to an unspecified malfunction, led to an unplanned shutdown at Valero's 180,000-b/d Memphis, TN, refinery. The refinery required unplanned maintenance in order to restore the facility to normal operations. By June 16, the refinery had restarted all units except for the 65,000-b/d FCCU, which was returning to normal production after workers cleared parts of the unit that were plugged by catalyst during the unplanned shutdown.
- **Extended CDU Outage at BP's Whiting Refinery Impacts Midwest Gasoline Markets (August 8–25):** Extensive process piping leaks shut down a 240,000-b/d crude distillation unit (CDU) at BP's 413,500-b/d Whiting, IN, refinery—the largest in Petroleum



Administration for Defense District (PADD) 2—for more than 2 weeks, putting upward pressure on Midwest gasoline prices. BP initially estimated that repairs could take more than a month, and said that it was conducting a thorough examination to determine the extent of the leaks and whether the piping was more susceptible to corrosion from heavy, sour crude or other substances running through the unit. On August 20, reports surfaced indicating a revised restart date the following week, easing price pressure on Midwest gasoline markets. By August 26, the CDU had restarted and ramped up to 80 percent capacity. The U.S. Energy Information Administration (EIA) estimated the gasoline production loss to be between 120,000 b/d and 140,000 b/d, based on May 2015 PADD 2 refinery yield data and press reports of the refinery running at 40 percent capacity, or about 165,000 b/d of its rated capacity.

### 3.3.3 Transportation and Storage

Crude oil and petroleum products are transported by pipeline, marine vessel, rail, and truck, with storage tanks located at every level of the supply chain. In 2015, transportation and storage outages mainly resulted from accidents, leaks, and equipment failures. The following incidents were some of the most significant of 2015.

#### 3.3.3.1 Crude-by-Rail

- **CN Crude Oil and Petroleum Distillates Train Derailment, Fire Closes Mainline Route for 4 Days in Ontario (February 14):** A defective rail, a broken rail joint, and a broken wheel caused 29 tank cars to derail February 14 on Canadian National Railway's (CN) mainline route 50 miles southwest of Timmins, Ontario. The derailment closed the frequented mainline segment for nearly 4 days. The train's two locomotives were hauling 100 Class DOT-111 tank cars to Valero's 265,000-b/d Jean-Gaulin refinery in Quebec, of which 68 were loaded with synthetic crude oil and 32 were loaded with petroleum distillates. During the derailment, multiple tank cars were breached, releasing product and igniting a large fire that initially involved seven tank cars. Following the incident, additional product was released from damaged tank cars; a total of 21 tank cars sustained fire damage, ranging from minor to severe; and about 900 feet of railway track was destroyed. CN notified shippers of delays on the obstructed mainline segment from Quebec to Manitoba, and resumed operations on route 4 days after the derailment.
- **CSX Crude Oil Train Derailment, Explosion Closes Rail Line for 10 Days in West Virginia (February 16):** A vertical split head rail defect along a CSX rail line near Mount Carbon, WV, caused 27 tank cars of a 109-car train hauling Bakken crude oil to derail, triggering a series of powerful explosions. The accident prompted a State emergency proclamation leading to the evacuation of hundreds of local residents, took down a transmission line knocking out power to about 900 electric customers, shut down the rail line for 10 days, and re-routed up to five train shipments of crude oil through traditional Norfolk Southern coal rail lines. The CSX train was hauling Bakken crude oil in Class CPC-1232 tank cars to a Plains All American Pipeline transload terminal in Yorktown, VA. The rail line was shut down for 10 days as crews allowed the fires to burn out, responded to the oil spills, cleared debris, and reopened the tracks

- **BNSF Crude Oil Train Derails, Catches Fire in Illinois (March 5):** A broken wheel rim led to a 21-tank car BNSF derailment and a 5-car fire near Galena, IL, on March 5. The 103-car train was hauling Bakken crude oil in Class CPC-1232 tank cars to Philadelphia Energy Solutions' 335,000-b/d refinery in Philadelphia, PA. A total of 21 cars derailed, 7 were damaged, and 5 caught fire. BNSF notified shippers of potential delays and resumed the route to normal operations 3 days after the incident.
- **CN Crude Oil Train Derails, Catches Fire in Ontario (March 7):** A broken rail within a newly installed plug rail joint led to the derailment of 38 CN tank cars and a fire on March 7 near Gogama, Ontario. The train's two locomotives were hauling 94 Class DOT-111 tank cars loaded with synthetic crude oil bound for Valero's 265,000-b/d Jean-Gaulin refinery in Quebec City, Quebec. A total of 38 cars derailed, several of which were breached, releasing product and igniting a large pool fire that destroyed about 700 feet of railway track and a steel rail bridge crossing the Makami River. At least five of the tank cars entered the waterway and five tank cars exhibited thermal tears from exposure to the pool fire.
- **CN Train Hauling Refinery Cracking Stock Derails, Spills Cargo in Manitoba (March 11):** Thirteen CN tank cars hauling bituminous refinery cracking stock derailed on a mainline segment near Gregg, Manitoba. No fires were associated with the incident; however, the derailed tank cars released about 8,000 gallons. This derailment was significant as it marked the third CN derailment in less than a week—a CN train hauling several empty hazardous liquids tank cars derailed on March 5 near Gogama, Ontario, days before the fiery March 7 derailment also near Gogama.
- **BNSF Train Derails, Catches Fire in North Dakota (May 6):** A BNSF train hauling 109 Class CPC-1232 tank cars loaded with Bakken crude oil derailed and caught fire near Heimdal, ND. Six tank cars carrying approximately 180,000 gallons derailed and ignited. After removing the damaged cars and repairing a section of damaged track, BNSF resumed normal operations on the mainline route 2 days after the derailment.
- **Thermal Misalignment Derails BNSF Crude Oil Train in Montana (July 16):** Thermal misalignment along a BNSF route near Culbertson, MT, caused a 22-tank car derailment, releasing about 35,000 gallons of Bakken crude oil. Thermal track misalignment occurs under prolonged exposure to sunlight, causing the heated steel in rail tracks to expand and buckle, which can disrupt the continuity of the railway and cause derailments.

### 3.3.3.2 Crude Pipelines

- **Crude Oil Storage Fire Shuts Down Enbridge's North Dakota Pipeline System (January 1–2):** A massive fire at a crude oil storage terminal in McKenzie County, ND, forced Enbridge to temporarily shut down its 210,000-b/d North Dakota pipeline system, which spans 826 miles from Plentywood, MT, to Clearbrook, MN. The blaze affected 8 of the 12 storage tanks at the facility operated by Enbridge subsidiary Tidal Energy Marketing. During the fires, there were no spills or injuries reported; however, Enbridge shut down the pipeline system as a precautionary measure. On January 2, the company reported the system had been restarted.

- Crude Oil Leak Into Yellowstone River in Montana Shuts Down Bridger’s Poplar Pipeline for Nearly 4 Months (January 17–April 30):** A northern section of Bridger Pipeline’s 42,000-b/d Poplar Pipeline system was shut down for nearly 4 months after an exposed section buried beneath the Yellowstone River near Glendive, MT, ruptured and leaked an estimated 960 bbl of Bakken crude oil into the river on January 17. The 340-mile pipeline system delivers crude oil from the Bakken oil patch in North Dakota and Montana to a terminal in Baker, MT. Due to elevated benzene levels in the river from the spill, approximately 6,000 Glendive residents were without a potable water supply until January 23. By March 6, PHMSA approved a partial restart of the system at reduced operating pressure after the company installed a replacement pipeline, which was buried deeper underneath the river bed to prevent future exposure. On April 30, Bridger received approval to return the affected section back to normal operations.
- Leak Shuts Down Sunoco’s 300,000-b/d West Texas Gulf Crude Oil Pipeline in Texas (February 25–26):** A 50-bbl oil leak temporarily shut down Sunoco’s 300,000-b/d West Texas Gulf pipeline between its Blum Pump Station and Wortham facilities, halting the flow of Permian Basin production from Colorado City to Wortham, and pressuring crude prices for deliveries into Midland. The operator notified shippers that the pipeline returned to normal operations after shutting down just a day earlier due to a system anomaly.
- Pump Station Crude Leak Shuts Down Plains’ Capwood Pipeline for 2 Weeks in Illinois (July 10–23):** A 100-bbl synthetic crude oil leak from a pipeline fitting at Plains’ Pocahontas Pump Station temporarily shut down its 277,000-b/d Capwood pipeline, which transports crude from the Patoka pipeline junction to Phillips 66’s 336,000-b/d Wood River, IL, refinery and nearby barge terminals on the Mississippi River. The Wood River refinery was not impacted by the shut-in. By July 23, PHMSA permitted Plains to restart the pipeline; however, the Pocahontas pumping station remained offline for investigation.
- Minor Crude Spill in Missouri Shuts Down Enbridge’s Spearhead and Flanagan South Pipeline Systems (August 11–13):** A 1-bbl leak from Enbridge’s 193,300-b/d Spearhead crude oil pipeline forced the company to shut down the line, as well as its adjacent 600,000-b/d Flanagan South crude oil pipeline, which both deliver Canadian crude oil from Illinois to the storage hub in Cushing, OK. Enbridge restored normal operations on the Flanagan South pipeline by the evening of August 12 after confirming that the leak was confined to the Spearhead pipeline. Meanwhile, crews worked simultaneously to excavate the ruptured Spearhead section and worked with regulators on a repair and restart timeline.
- Enbridge Briefly Shuts Down Crude Oil Line 9 Twice to Deal With Protestors in Canada (December 7, 21):** Protestor raids on remote valve stations in Quebec and Ontario forced Enbridge to briefly shut down its 300,000-b/d Line 9 crude oil pipeline on two separate occasions during the month of December. Line 9 moves crude oil from Sarnia, Ontario, to Montreal, Quebec. On December 7, three protestors broke into a fence-protected site in Quebec, tampered with pipeline valve equipment, and chained themselves to equipment within the site. Enbridge shut down the pipeline as a precaution and the protesters were removed by police. On December 21, Enbridge shut

down the pipeline for safety reasons due to an on-site protest at a valve facility in Sarnia, Ontario, which was safely contained by local authorities. On both occasions, Enbridge anticipated a restart within a few hours of the incidents and reported no impacts on its deliveries.

- **Mississippi River Flooding Prompts Precautionary Closures of Ozark and Platte Crude Pipeline Systems to Wood River, IL (December 29, 2015 – January 5, 2016):** Major flood-stage conditions on the Mississippi River near St. Louis, MO, prompted precautionary closures of Enbridge's Ozark and Spectra's Platte pipelines, which transport crude oil east beneath the river to Wood River, IL, where Phillips 66 operates a 336,000-b/d refinery. The 215,000-b/d Ozark pipeline originates in Cushing, OK. The 164,000-b/d Platte pipeline originates in Casper, WY; however, capacity is 145,000 b/d between Guernsey, WY, and Wood River. Citing no damage to the pipeline and adverse weather conditions, Enbridge shut down its line, which crosses the river between West Alton, MO, and Hartford, IL, from December 29 to January 5. Similarly, Spectra shut down its line as a precautionary measure from December 30 to January 3. Phillips 66 reported that its Wood River refinery was not affected by the flooding event nor the pipeline closures.

### 3.3.3.3 Product Pipelines

- **Hours-of-Service Waivers Issued for Wisconsin Propane Carriers Due to Service Interruptions on Mid-America's East Blue Pipeline (January 9–10):** Wisconsin's Governor declared a propane emergency on January 9, waiving HOS regulations for operators of commercial motor vehicles transporting propane within the State. The waiver noted that Mid-America Pipeline's 53,000-b/d East Blue pipeline, which supplies propane from the hub in Conway, KS, to terminals in Janesville, WI; Dubuque, IA; and Rockford, IL, had service interruptions due to removing off-specification product from the pipeline. Wisconsin issued the waiver as a precautionary measure after an inventory backup at the Janesville terminal made it difficult for propane transporters to meet demand and comply with HOS requirements. The East Blue pipeline resumed service to most terminals on January 8, and the Janesville terminal resumed normal operations on January 10.
- **Distillate Spill Shuts Down Colonial Pipeline's Line 2 in South Carolina (April 12–14):** A breach in Colonial's main distillate pipeline prompted a 40-hour shutdown while crews repaired the affected section and responded to the spill in Laurens County, SC. The 1.16-million barrels per day (MMb/d) pipeline, which transports distillates from Houston, TX, to Greensboro, NC, was repaired and restarted by the morning of April 14 with no need to replace any sections on the line.
- **System Integrity Issue Temporarily Suspends Operations on Colonial Pipeline's Line 3 (June 23–24):** Colonial said that its 850,000-b/d Line 3 resumed full and normal operations after it was briefly shuttered to address a system integrity issue. Line 3 ships segregated batches of mixed, refined products from the company's Greensboro, NC, breakout storage terminal to delivery points along the East Coast as far north as Linden, NJ.

- Gasoline Spill Shuts Down Colonial Pipeline’s Lines 3 and 4 in Virginia (September 21–25):** A 75-bbl gasoline spill in Centreville, VA, impacted mixed-product pipeline operations on Colonial’s northern mainline system for 5 days in September. Both the 885,000-b/d Line 3 and 504,000-b/d Line 4 were shut down initially until the breach could be located and excavated for repairs. Line 3 runs from Greensboro, NC, to Linden, NJ, while Line 4 runs from Greensboro, NC, to Sykesville, MD. By the evening of September 23, Colonial had isolated the leak to a section on Line 4 and restored normal service on Line 3. Colonial worked with Federal, State, and local authorities to excavate and repair the affected section of Line 4, and respond to the spill. Colonial was permitted to resume service on Line 4 by the evening of September 25.
- Flooding Shuts Colonial Pipeline’s Line 2 Cedar Bayou Injection Facility Near Houston, TX (November 3–16):** Heavy rains in the Houston area flooded Colonial’s Cedar Bayou injection station, shutting down the facility for more than 2 weeks. The shutdown affected shippers on Colonial’s 1.16-MMb/d Line 2, which ships distillates from Houston, TX, to Greensboro, NC. After floodwaters receded, Colonial made repairs and restored operations at the facility. During the closure, affected shippers were required to source distillates from other injection points downstream from the Cedar Bayou station. The 1.37-MMb/d Line 1, which ships gasoline, was not impacted by the incident.

### 3.3.4 Hours-of-Service Exemptions

Hours-of-service (HOS) regulations (49 CFR Part 395) restrict the amount of time that drivers are allowed to operate commercial vehicles and mandate time-off requirements between shifts to ensure on-road safety. To provide vital supplies and transportation services to a disaster area in the United States, emergency declarations may be issued by the President, Governors of States, or the U.S. Department of Transportation (DOT). These declarations trigger the temporary suspension of certain Federal safety regulations, including HOS, for motor carriers and drivers engaged in specific aspects of the emergency relief effort.<sup>10</sup> In some cases, these exemptions are issued in order to maintain the supply of critical fuels, such as propane, heating oil, gasoline, and diesel fuel. EAD tracks HOS exemptions to identify events that have triggered States to enact emergency management measures. Table 2 summarizes the HOS exemptions issued by States in 2015, which were issued to alleviate supply shortages caused by extreme winter weather, infrastructure outages, and other demand factors. The extremely cold weather and high demand for heating fuels during the first months of 2015 forced a number of States to issue HOS waivers.

**Table 2. Hours-of-Service Exemptions, 2015**

| State       | Start Date | End Date  | Days |
|-------------|------------|-----------|------|
| Arkansas    | 2/18/2015  | 3/18/2015 | 29   |
| Connecticut | 1/26/2015  | 2/25/2015 | 31   |

<sup>10</sup> <http://www.fmcsa.dot.gov/emergency>

| State                 | Start Date | End Date  | Days |
|-----------------------|------------|-----------|------|
|                       | 2/25/2015  | 3/09/2015 | 13   |
| <b>Delaware</b>       | 2/07/2015  | 2/10/2015 | 4    |
|                       | 2/17/2015  | 2/20/2015 | 4    |
|                       | 2/24/2015  | 2/27/2015 | 4    |
| <b>Kentucky</b>       | 2/15/2015  | –         |      |
|                       | 3/05/2015  | 3/19/2015 | 15   |
| <b>Louisiana</b>      | 2/23/2015  | 3/24/2015 | 30   |
| <b>Maine</b>          | 1/09/2015  | 1/23/2015 | 15   |
| <b>Maryland</b>       | 2/16/2015  | 2/21/2015 | 6    |
|                       | 2/23/2015  | 3/25/2015 | 31   |
| <b>Massachusetts</b>  | 1/28/2015  | 2/07/2015 | 10   |
|                       | 2/06/2015  | 2/21/2015 | 16   |
|                       | 2/10/2015  | 2/21/2015 | 12   |
|                       | 2/22/2015  | 3/07/2015 | 14   |
| <b>New Hampshire</b>  | 1/26/2015  | 2/07/2015 | 13   |
|                       | 2/06/2015  | 3/08/2015 | 31   |
|                       | 2/06/2015  | 3/08/2015 | 31   |
| <b>New Jersey</b>     | 2/02/2015  | 2/15/2015 | 14   |
|                       | 2/16/2015  | 3/17/2015 | 30   |
| <b>New Mexico</b>     | 1/15/2015  | 1/29/2015 | 15   |
| <b>New York</b>       | 1/08/2015  | 1/15/2015 | 8    |
|                       | 1/26/2015  | 2/27/2015 | 33   |
|                       | 1/28/2015  | 3/06/2015 | 38   |
| <b>North Carolina</b> | 2/16/2015  | 3/18/2015 | 31   |
|                       | 2/23/2015  | 3/25/2015 | 31   |
| <b>Ohio</b>           | 2/20/2015  | 3/06/2015 | 15   |
|                       | 3/06/2015  | 3/13/2015 | 8    |
| <b>Oklahoma</b>       | 1/09/2015  | 2/07/2015 | 30   |
| <b>Pennsylvania</b>   | 2/16/2015  | 3/28/2015 | 41   |
| <b>Rhode Island</b>   | 1/26/2015  | 1/28/2015 | 3    |
|                       | 2/24/2015  | 3/09/2015 | 14   |
| <b>South Carolina</b> | 2/24/2015  | 3/26/2015 | 31   |
| <b>Tennessee</b>      | 2/18/2015  | 3/30/2015 | 41   |
| <b>Texas</b>          | 1/08/2015  | 1/12/2015 | 5    |
| <b>Vermont</b>        | 2/04/2015  | 2/19/2015 | 16   |
|                       | 2/19/2015  | 3/07/2015 | 17   |
| <b>Virginia</b>       | 2/16/2015  | 3/25/2015 | 38   |
| <b>Wisconsin</b>      | 1/09/2015  | 1/26/2015 | 18   |

Sources: The National Propane Gas Association (<http://www.npga.org>), U.S. DOT, Federal Motor Carrier Safety Administration (<http://www.fmcsa.dot.gov>), State waiver information  
Note: "Days" count start and end dates as full days.

### 3.4 Biofuel Disruptions

EAD and the trade press reported several notable disruptions affecting biofuel refineries and the supply chain in 2015. These disruptions included ethanol unit train derailments and bio-refinery fires.

- **Fourteen Canadian Pacific Railcars Carrying Ethanol Derail in Iowa, Leak Reaches Mississippi River (February):** Fifteen cars and two engines of an 81-car train derailed on February 4 in a rural area north of Dubuque, IA. Fourteen of the 15 cars carried ethanol. Eight cars leaked, three cars caught fire, and three other cars fell into the Mississippi River. In total, 55,000 gallons of ethanol were either spilled or burned off. Canadian Pacific (CP) said that it was unclear how much ethanol had leaked into the Mississippi River, but that they worked to monitor the environmental impact and offloaded fuel from the train. Federal and State environmental agencies worked with the company to set up ethanol monitoring sites downriver. The fires had been extinguished by February 5, and no injuries were reported. The train was headed east on CP tracks.
- **Two Fires Damage Renewable Energy Group's Geismar, LA, Biorefinery (April, September):** Renewable Energy Group (REG) reported fires at its 75-MMgal/year Geismar, LA, hydrocarbon diesel biorefinery on April 2 and September 3. Following the fire on April 2, the company estimated that it would take 2–4 months to restore operations. The company said that the damage appeared to be contained to a limited area of the production facility. The company decided to incorporate a 1-month maintenance shutdown that was previously scheduled for the summer to bring filtration and other upgrades online during the restoration time period. A second fire hit the plant on September 4, injuring four workers; however, structural damage to the plant was far less severe than during the April 2 event. In October, REG said that it expected to bring the biorefinery back online at the end of January 2016.
- **Explosion Shuts Down POET's Glenville Ethanol Plant in Minnesota (June):** POET's 45-MMgal/year Glenville ethanol plant was shut down June 21 after an explosion occurred and injured two people. It was not reported when the plant returned to normal operations.
- **BNSF Train Carrying Ethanol Derails in South Dakota (September):** On September 19, 10 BNSF railcars carrying ethanol derailed in rural South Dakota, starting a fire and forcing detours on the company's main track. The portion of the track remained out of service and no estimate was given for when it would reopen. The company said that it would use other routes.
- **BNSF Freight Train Derails and Spills Ethanol Into Mississippi River in Wisconsin (November):** On November 7, a BNSF freight train derailed along the Mississippi River about 2 miles north of Alma, WI. Several roads were closed and a temporary voluntary evacuation of the area was established. At least 25 cars went off the tracks, including several tanker cars of ethanol, of which five reportedly spilled an estimated 20,000 gallons of ethanol into the Mississippi River. BNSF said that railroad crews contained the leaks from five tanker cars and placed containment booms along the shoreline. The tracks resumed service by November 9.

### 3.5 Cybersecurity

EAD reported five notable cybersecurity news items in 2015:

- **DHS and USCG Begin Monitoring Marine and Offshore Energy Sector Cyber Threats (2014):**<sup>11</sup> DHS and the USCG in late 2014 announced that they would develop cybersecurity regulations for the marine and offshore energy sectors. These regulations would address concerns over cyber risks and vulnerabilities among vessels and facilities subject to the Maritime Transportation Security Act of 2002. The regulations would create standards and minimum requirements for companies working in the marine and offshore energy industries. Prior to the Act, most of the existing regulations have been focused on data breach events, such as the theft of credit card and Social Security numbers, instead of a cyberattack on offshore infrastructure.
- **Report Released Analyzing the Impact of a Cyberattack on the Power Grid (July):** A report released in July by Lloyd's and the University of Cambridge calculated that a cyberattack that shuts down parts of the Nation's power grid could cost as much as \$1 trillion to the U.S. economy. The report indicated that company executives are worried about security breaches and the effectiveness and value of cyber insurance. The scenario includes the impact of 93 million people left without power in New York City and Washington, D.C. The hypothetical attack caused a rise in mortality rates and a drop in trade. The report also cited that there have been 15 suspected cyberattacks on the U.S. power grid since 2000. The U.S. Industrial Control System Cyber Emergency Response Team said that 32 percent of its responses in 2014 to cyber security threats to critical infrastructure occurred in the energy sector.
- **Reports Indicated 159 Successful Cyber Intrusions to U.S. DOE Systems Over a 4-Year Period (September):** Incident reports submitted by Federal officials and contractors since late 2010 to DOE's Joint Cybersecurity Coordination Center show that 1,131 cyberattacks aimed at DOE computer systems occurred over a 48-month period ending in October 2014. Between 2010 and 2014, reports indicated that there was a consistent barrage of attempts to breach the security of critical information systems that contained sensitive data about the Nation's power grid, nuclear weapons stockpile, and energy labs. Of the 1,311 attempted cyber intrusions, 159 were successful.
- **U.S. DOE Funds Research Centers to Protect Power Grid From Cyberattacks (October):** In October, DOE announced that it was dedicating more than \$34 million to the establishment of two major research endeavors aimed at protecting the Nation's power grid against hackers and other cyber threats. About \$12.2 million will go to a research center led by the University of Arkansas, while another \$22.5 million will be shared among the members of the University of Illinois Cyber Resilient Energy Delivery Consortium. Both will look into ways of protecting power grid elements—from the hardware that runs transformers to the software that power companies use—from cyberattacks.

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<sup>11</sup> The story in which this information was released was published in March 2015, thus it is included in the 2015 YIR.



- **EnergyTech2015 Conference (November–December):** Energy experts attended the EnergyTech2015 conference, which ran from November 30 to December 2 at Cleveland State University. Experts discussed the vulnerability of the U.S. electric grid to disaster and attack.

## 4. Infrastructure Changes

This section focuses on significant changes to energy infrastructure in 2015, including new projects, expansions, closures, and sales. Infrastructure changes are typically driven by a number of factors, including changing demand, the emergence of new supply sources, the age and condition of existing infrastructure, underlying economic conditions, and regulatory requirements. As noted in section 1.2, EAD summarizes the day's news on energy disruptions and energy infrastructure using public sources, but it is not a comprehensive survey or database service. Despite this limitation, infrastructure changes reported in EAD highlight important developments and trends in U.S. energy markets.

### 4.1 Electricity

The following sections discuss changes in the electric industry and are categorized into the following topics: environmental regulations, power plant additions, nuclear power developments, and transmission infrastructure.

#### 4.1.1 Environmental Regulations Impacting Infrastructure Developments

Environmental regulations have the potential to significantly alter the electric infrastructure landscape of the United States. In late June, the U.S. Supreme Court ruled 5–4 to overturn EPA's Mercury and Air Toxics Standards (MATS),<sup>12</sup> which were designed to reduce the amount of mercury and other emissions from coal-fired power plants. The court found that EPA should have taken the cost of implementing the rules into consideration when developing the regulations. The MATS rule was finalized in December 2011, and was designed to protect the public's health by reducing emissions of toxics from power plants. They were the first Clean Air Act standards issued. Based on the court's ruling, EPA is required to reanalyze its findings of the costs associated with complying with MATS and submit another proposal.

In August 2015, President Barack Obama announced the final Clean Power Plan, citing climate change as the greatest threat facing the world. The objective of the plan was to reduce emissions of carbon dioxide from existing power plants by 32 percent nationwide (below 2005 levels) by 2030.<sup>13</sup> The President said that the Clean Power Plan would help reduce Americans' energy bills, improve the health of vulnerable populations nationwide, and encourage a shift to renewable energy from coal-fired electricity. The plan faced intense scrutiny by the industry both before and after its release, including the following notable developments reported by EAD:

- **D.C. Circuit Court Rejects Industry and State Challenge to EPA's Proposed Clean Power Plan (June):** In early June, prior to the release of the final Clean Power Plan, the D.C. Circuit Court rejected an industry and State challenge to EPA's Clean Power Plan Proposed Rule. A three-judge panel said that the various lawsuits objecting to the plan were premature because the regulation has not yet been finalized. More than a dozen States and coal company Murray Energy Corporation had urged the court to block the

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<sup>12</sup> EPA MATS Rule: <http://www3.epa.gov/mats>

<sup>13</sup> Clean Power Plan: <https://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants>

EPA proposal. The challengers had argued, in part, that the Clean Air Act prohibits the Federal Government from regulating power plants as proposed under section 111(d) of the Clean Air Act because the facilities are already regulated under a separate section of the Act.

- **ERCOT Releases Report on Potential Clean Power Plan Impacts (October):** In October, the Electric Reliability Council of Texas (ERCOT) released an updated Analysis of the Impacts of the Clean Power Plan, based on the final rule released by the EPA in August. The ERCOT study results indicated that the plan could result in the retirement of at least 4,000 MW of coal-fired generation capacity in the ERCOT region, possibly beginning as soon as 2022. ERCOT anticipated that the impacts of these changes could increase retail power prices by up to 16 percent by 2030, not including the impacts of new transmission projects or other investments that could be needed to support compliance. The report also highlighted ERCOT's specific concerns associated with the future generation mix and transmission needs. The report noted that the retirement of a large portion of dispatchable<sup>14</sup> generation capacity, combined with the addition of a large amount of generation from intermittent solar and wind sources, could affect the reliability of all generation resources as the system works together to maintain a balanced grid. On February 9, 2016, the U.S. Supreme Court stayed implementation of the Clean Power Plan pending judicial review.

#### 4.1.2 Coal Retirements

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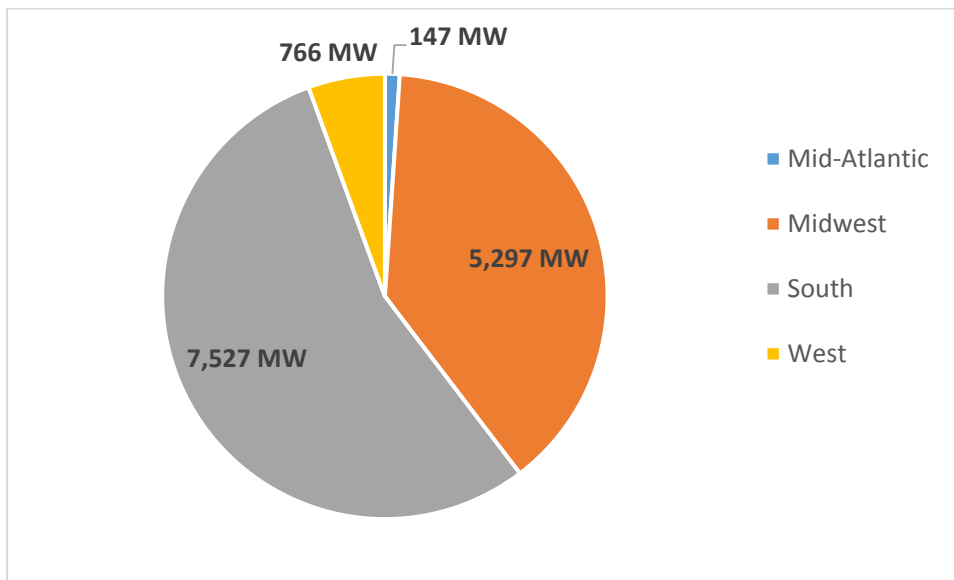
<sup>14</sup> Dispatchable generation refers to sources of electricity that can be dispatched at the request of power grid operators or the plant owner (i.e., generating plants that can be turned on or off, or can adjust their power output accordingly in response to an order).

Figure 7 shows coal-fired generation that was retired in 2015 by region. A total of 13.7 gigawatts (GW) of coal-fired capacity was retired in 2015. Some of the biggest unit retirements included the 1,016-MW Harlee Branch Station in Georgia, the 800-MW Big Sandy Station in Kentucky, the 585-MW Muskingum River Station in Ohio, and the 500-MW Tanners Creek Station in Indiana.<sup>15</sup> Regionally, the Midwest and the South had the greatest level of retirements, totaling 12.8 GW between the two regions (7.5 GW in the South and 5.3 GW in the Midwest).

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<sup>15</sup> The capacities represented here are of the sum of the individual units within the entire power station that have retired in 2015. Other units of the mentioned power plants may still be operating, either by coal or converted to gas.

**Figure 7. Retired Coal-fired Generation Capacity, 2015**



Source: Energy Information Administration, Electric Power Monthly

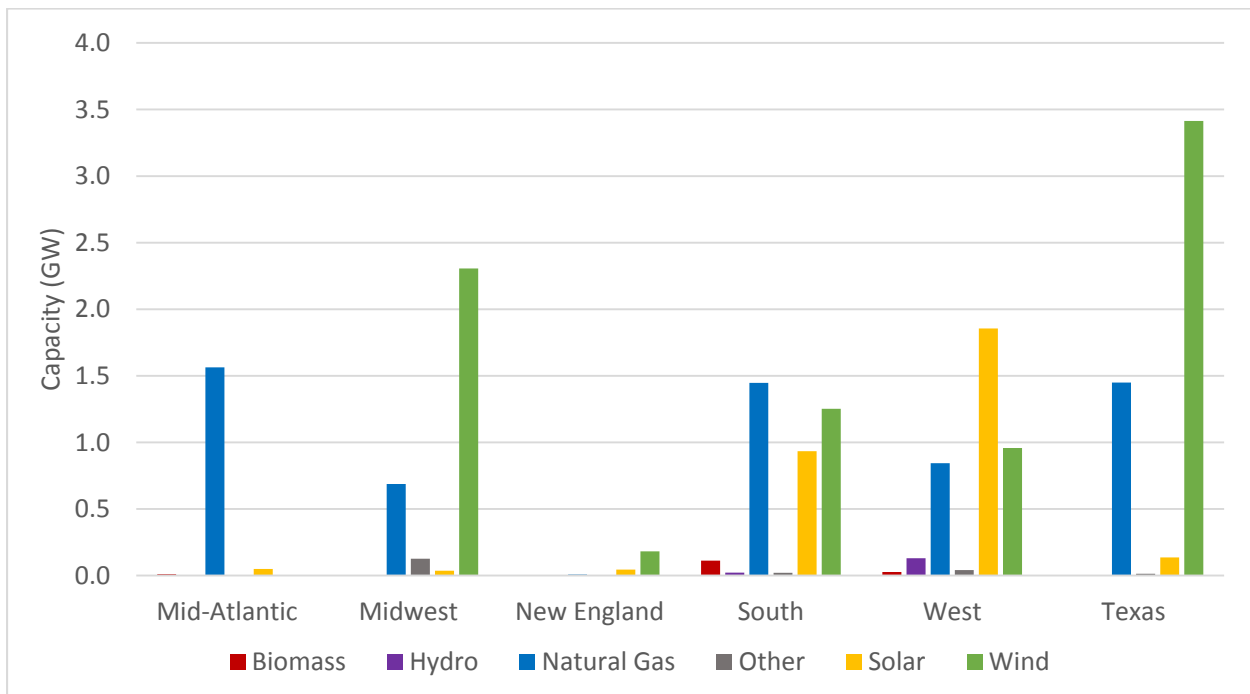
### 4.1.3 Capacity Additions

More than 17.7 GW of new electric generation capacity came online in 2015. Of this, 46 percent (8.1 GW) was wind, 34 percent (6 GW) was natural gas, and 17 percent (3 GW) was solar. Hydroelectric, biomass, utility-scale electric storage batteries, and other types accounted for the rest of the newly in-service capacity.

Figure 8 below shows the breakdown of new capacity that came online in 2015 by region and fuel type. The States that had the most new capacity of any type were Texas (5 GW), New Jersey (1.6 GW), California (1.5 GW), Oklahoma (1.3 GW), and Colorado (1 GW). While there was a high concentration of wind in Texas (3.4 GW) and Oklahoma (1.2 GW), there were several notable natural gas-fired power plants that came online in 2015. The 315-MW Woodbridge Energy Center in New Jersey came online in November, Panda Power Funds' 312-MW Temple Power Station in Texas came online in May, and the 285-MW Newark Energy Center in New Jersey came online in September. The largest wind plants that came online in

2015 include the Jumbo Road farm in Texas, and the Balko Wind and Kay Wind projects in Oklahoma, each with a 300-MW generating capacity.

**Figure 8. Capacity Placed in Service, 2015**



Source: Energy Information Administration, Electric Power Monthly

#### 4.1.4 Nuclear Power Plants

This section discusses some of the major changes to the nuclear power industry in 2015.

##### 4.1.4.1 Nuclear Infrastructure and Upgrades

Below is a list of several major events affecting nuclear power plants that were discussed in EAD in 2015. They include proposed new nuclear units, upgrades at existing units, uprates, and license extensions:

- **Two 1,117-MW Reactors Under Construction at V.C. Summer Nuclear Plant in South Carolina Delayed More Than 1 Year (March):** In March, SCANA Corp. said that delays in construction of two new units at its V.C. Summer Nuclear Station will drive project costs up \$1.2 billion. As a result, completion of each of the two 1,117-MW reactors is expected to be delayed a little more than a year, from 2018 to 2019 for Unit 2 and from 2019 to 2020 for Unit 3. SCANA outlined the delays in a filing with the South Carolina Public Service Commission. The filing warns that the price estimates may still rise further, as discussions continue with the developers.
- **DTE Energy Receives NRC Approval for New Nuclear Unit at Its Fermi 2 Plant in Michigan (May):** DTE Energy received approval from the NRC for a license to construct and operate a new 1,550-MW nuclear energy facility, Fermi 3, on the site of the existing 1,170-MW Fermi 2 Nuclear Power Plant in Newport, MI. The company has not committed to building the new plant, but will keep the option open for long-term planning purposes.
- **Georgia Power Completes 500-kV Switchyard for Its 2,234-MW Vogtle Nuclear Unit Expansion in Georgia (June):** Georgia Power announced in June the latest milestone in the construction of Vogtle Units 3 and 4—the recently completed redesign of the existing 500-kV switchyard for Vogtle Units 1 and 2. The 500-kV switchyard takes energy from the plant and feeds it to the power grid. The 500-kV redesign included the addition of four new breakers, associated disconnect switches, and a new relay protection scheme. In January, the company announced several delays that might push the in-service date of Unit 3 to mid-2019 and Unit 4 to mid-2020.
- **TVA’s 2,300-MW Sequoyah Nuclear Power Plant in Tennessee Receives License Renewal (September):** In September, NRC approved operating license extensions for Sequoyah nuclear power plant Units 1 and 2 in Tennessee through 2041 after determining that the Tennessee Valley Authority (TVA) had an adequate aging<sup>16</sup> program in place.
- **TVA Receives Operating License for Its 1,150-MW Watts Bar Nuclear Unit 2 Under Construction in Tennessee (October):** TVA announced in October that it received an operating license from NRC for its Watts Bar Unit 2 nuclear reactor under construction in Spring City, TN. With the license, TVA can prepare to load the initial fuel, which would require several weeks of work with ongoing NRC inspections and reviews. The unit is on schedule to be in operation by June 2016.
- **FirstEnergy’s 908-MW Davis-Besse Nuclear Power Station in Ohio Receives Operating License Renewal (December):** In December, NRC approved a 20-year operating license extension for the Davis-Besse Nuclear Power Station in Oak Harbor, OH, allowing the unit to operate until 2037. NRC’s decision to renew Davis-Besse’s license came following extensive safety and environmental reviews, public meetings,

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<sup>16</sup> Nuclear aging refers to two different types of time-dependent changes: (1) physical aging of structures, systems, and components (SSCs), such as the gradual degradation of their physical characteristics; and (2) obsolescence of SSCs (e.g., technology becoming out-of-date in comparison with current technology). Aging management seeks to maintain plant integrity and take corrective measures before loss of integrity or functional capability occurs.

Source: [http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1373\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1373_web.pdf)

and comments. The plant's original license was set to expire on April 22, 2017; however, FirstEnergy submitted a license renewal application to NRC in 2010.

#### 4.1.4.2 Nuclear Retirements

Several power companies faced major retirement decisions in 2015:

- **Exelon Delays Closure Decision on Quad Cities and Byron Nuclear Power Plants in Illinois for 1 Year (September):** Exelon Corporation announced in September that it would defer any decisions about the future operations of its Quad Cities and Byron nuclear plants for 1 year, after analysis of the present and future economics of the plants. As a result, the company plans to continue operating its 855-MW Quad Cities Nuclear Unit 1 and 855-MW Nuclear Unit 2 through at least May 2018. The 1,163-MW Byron Nuclear Unit 1 and 1,131-MW Nuclear Unit 2 are already obligated to operate through May 2019.
- **Entergy to Close Its 688-MW Pilgrim Nuclear Power Station in Massachusetts by 2019 (October):** Entergy Corporation announced in October that it will close its Pilgrim Nuclear Power Station in Plymouth, MA, no later than June 1, 2019, due to poor market conditions, reduced revenues, and increased operational costs. The company notified ISO New England Inc. (ISO-NE) that as of that date, Pilgrim would not participate as a capacity resource in the market. The exact timing of the shutdown depends on several factors, including further discussion with ISO-NE, and will be decided in the first half of 2016. Pilgrim began generating electricity in 1972.
- **Entergy to Close Its 813-MW FitzPatrick Nuclear Power Plant in New York by Early 2017 (November):** Entergy Corporation announced in November that it would close the James A. FitzPatrick Nuclear Power Plant in Scriba, NY, in late 2016 or early 2017. Entergy reported to the New York ISO and to the New York State Public Service Commission that it would retire the plant at the end of the current fuel cycle. The company said that its decision to close the plant is based on the continued deteriorating economics of the facility. The key drivers cited by the company include significantly reduced plant revenues due to low natural gas prices and a poor market design that fails to properly compensate nuclear generators like FitzPatrick for their benefits, as well as high operational costs.
- **New York to Develop Plan to Keep Upstate Nuclear Reactors in Service (December):** In December, New York Governor Andrew Cuomo directed State energy regulators to develop a process to prevent the premature retirement of upstate nuclear power plants. He made the announcement as part of a plan to enact a new clean energy standard mandating that 50 percent of all electricity consumed in the State by 2030 result from clean and renewable energy sources. During the transition to a cleaner energy future, the Governor wants the upstate nuclear reactors to remain in service. There are four nuclear reactors in Upstate New York—two at Exelon's 1,937-MW Nine Mile Point, one at Exelon's 582-MW Ginna, and one at Entergy's 852-MW FitzPatrick. Entergy had said in November that it would shut down FitzPatrick in late 2016 or early 2017. Exelon warned in 2014 that it would close Ginna after a power purchase agreement with Rochester Gas & Electric expires in March 2017.



#### 4.1.5 Transmission Expansion

According to the 2015 North American Electric Reliability Corporation (NERC) Electric Supply & Demand (ES&D),<sup>17</sup> nearly 21,000 miles of transmission lines were either in the “proposed” or “under construction” phases as of December 2015, when the ES&D was released. The table also includes projects that were in the “delayed” status. It is important to note that these are not 21,000 additional miles from the 24,000 miles that were reported proposed/under construction in 2014 (2014 YIR). Table 3 below breaks down these proposed projects by NERC Assessment Area. Refer to the footnote for a map of NERC Assessment Areas. The list below includes transmission lines that may originate or terminate in Canada or Mexico, but have sections within U.S. borders.

**Table 3. Proposed Transmission Projects, 2015<sup>18</sup>**

| <b>NERC Assessment Area</b> | <b>Miles</b>  |
|-----------------------------|---------------|
| ERCOT                       | 984           |
| FRCC                        | 519           |
| MAPP                        | 242           |
| MISO                        | 5,473         |
| New England                 | 550           |
| New York                    | 199           |
| PJM                         | 2,259         |
| SERC                        | 554           |
| SPP                         | 1,619         |
| WECC                        | 8,571         |
| <b>Total</b>                | <b>20,970</b> |

The online dates of these projects range from 2015 to 2027. In 2016, more than 5,200 miles of transmission projects are scheduled to be operational. From 2017 to 2020, an additional 6,700 miles are scheduled to be operational. NERC also categorizes transmission projects that are in the “conceptual” phase. As of December 2015, conceptual projects accounted for an additional 5,700 miles of lines.

#### 4.2 Natural Gas Projects

Domestic dry natural gas production increased to 74.2 Bcf/d in 2015, up 5.3 percent from 2014. This growth rate is the third largest in the past decade, behind only the 7.4 percent increase in 2011 and the 6.3 percent increase in 2014.<sup>19</sup> Production increased in 2015 despite rig counts for gas-directed drilling falling precipitously from the previous year’s level due, in part, to increased

<sup>17</sup> NERC, ES&D, 2015: <http://www.nerc.com/pa/RAPA/ESD/Pages/default.aspx>

<sup>18</sup> NERC, ES&D, 2015. A map of NERC Assessment Areas can be found at [http://www.nerc.com/AboutNERC/keyplayers/Documents/2015\\_NERC\\_Assessment\\_Areas.png](http://www.nerc.com/AboutNERC/keyplayers/Documents/2015_NERC_Assessment_Areas.png)

<sup>19</sup> U.S. Energy Information Administration, U.S. Dry Natural Gas Production, <http://www.eia.gov/dnav/ng/hist/n9070us2m.htm> (Released 1/29/2016).

rig productivity, which allows more production with fewer rigs.<sup>20</sup> Productivity has increased by concentrating drilling in the most productive basins and drilling more wells per well pad. Between December 2014 and December 2015, the natural gas rig count fell from 340 to 162, a decline of more than 50 percent.<sup>21</sup>

Much of the new drilling in 2015 was concentrated in the Marcellus and Utica shale plays in the Northeast. Continued growth in this region has led to constraints on outbound pipeline capacity, driving interest in new pipeline projects to nearby demand centers.

U.S. natural gas prices remained low in 2015, continuing to support the economics for exports, including pipeline exports to Mexico and liquefied natural gas (LNG) exports to overseas markets. However, lower oil prices have decreased the value of LNG exports as the price of natural gas in many export markets is tied to the price of oil. By the end of 2015, construction was nearly complete on the first phase of the Sabine Pass, LA, liquefaction facility, with LNG exports expected to begin in the first quarter of 2016. Exports to Mexico continued to grow in 2015 as new pipelines were added to serve the growing power load across the border. The United States exported more than 2.9 Bcf/d to Mexico via pipeline in 2015, up nearly 45 percent from 2014.<sup>22</sup>

#### 4.2.1 Upstream Natural Gas Gathering and Processing

Upstream natural gas infrastructure includes natural gas wells, the low-pressure gathering pipelines that serve those wells, and the natural gas processing plants that strip out impurities and entrained liquids from the natural gas stream to produce “pipeline quality” or “dry” gas that is suitable for consumption in home appliances, power plants, and industrial facilities. In 2015, EAD reported on 14 projects that involved either the construction of new gas processing facilities or expansions to existing facilities. These projects were at various stages of development. New capacity was primarily concentrated in areas with active shale plays: Marcellus and Utica (Ohio and Pennsylvania); Bakken (North Dakota and Wyoming); and Eagle Ford (South Texas) and Permian (West Texas and New Mexico), as well as Oklahoma and Louisiana. Significant upstream natural gas gathering and processing developments reported in EAD included the following:

- **Tall Oak Midstream Announces New Natural Gas Gathering and Processing System in Oklahoma’s STACK Play (January 6):** Tall Oak announced the construction of new gas gathering and processing capacity to serve producers in Oklahoma’s Sooner Trend, the Anadarko Basin, and Canadian and Kingfisher counties (STACK) play, which targets the Woodford and Mississippian-age shales. Tall Oak’s initial STACK system consists of 150 miles of natural gas gathering pipeline, multiple compressor stations, and its 100-MMcf/d Chisholm cryogenic processing plant.

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<sup>20</sup> [http://www.eia.gov/dnav/ng/ng\\_prod\\_sum\\_a\\_EPG0\\_FGW\\_mmcf\\_a.htm](http://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FGW_mmcf_a.htm);  
[https://ycharts.com/indicators/us\\_gas\\_rotary\\_rigs](https://ycharts.com/indicators/us_gas_rotary_rigs)

<sup>21</sup> YCharts, “U.S. Natural Gas Rig Count,” Baker Hughes: Baker Hughes North American Rotary Rig Count, March 2016, [https://ycharts.com/indicators/us\\_gas\\_rotary\\_rigs](https://ycharts.com/indicators/us_gas_rotary_rigs)

<sup>22</sup> [http://www.eia.gov/dnav/ng/ng\\_move\\_expc\\_s1\\_a.htm](http://www.eia.gov/dnav/ng/ng_move_expc_s1_a.htm)

- **Canyon Midstream Begins Operation of Its 105 MMcf/d James Lake Midstream System in the Texas Permian Basin (February 6):** In February, Canyon announced that its James Lake midstream system in the Permian Basin commenced commercial operations on December 1, 2014. Phase I of the James Lake system includes a 105-MMcf/d cryogenic gas processing plant in Ector County, TX; six field compressor stations; 60 miles of 12-inch-diameter trunkline; and 20 miles of low-pressure gathering lines in West Texas. Canyon expects Phase II of the James Lake system, which adds cryogenic gas processing capacity and additional trunkline, to begin operations in the first half of 2016.
- **Williams and DCP Midstream Announce First Gas From 400 MMcf/d-Keathley Canyon Connector in Ultra-Deepwater Gulf of Mexico (February 10):** The 20-inch, 209-mile Keathley Canyon Connector (KCC) deepwater gas gathering system, with a capacity exceeding 400 MMcf/d, serves producers in the central ultra-deepwater Gulf of Mexico, as does the South Timbalier Block 283 junction platform. The KCC system was constructed in depths of up to 7,200 feet of water approximately 300 miles south-southwest of New Orleans. Valuable for its proximity to other high-potential deepwater Gulf of Mexico gas plays, the system terminates at Discovery's existing 30-inch-diameter mainline.
- **PennTex Midstream Partners' 200-MMcf/d Mt. Olive Natural Gas Processing Plant Placed Into Service (September 14):** PennTex announced on September 14 that its Mt. Olive gas processing plant and related pipelines were placed into service, increasing the capacity of its northern Louisiana Terryville Complex to 400 MMcf/d. The Mt. Olive facility consists of a 200-MMcf/d cryogenic natural gas processing plant, onsite liquids handling facilities, and additional gas and natural gas liquid (NGL) pipelines. The 14-mile residue gas pipeline has throughput capacity of approximately 400 MMcf/d and provides market access for partner processing plants. The 41-mile NGL pipeline has throughput capacity of more than 36,000 b/d and provides NGL transportation to downstream markets.

#### 4.2.2 Natural Gas Transmission Pipelines

Natural gas transmission pipelines receive natural gas from production areas and deliver them to downstream consumers, including natural gas local distribution companies, power plants, and industrial users. EAD reported on several transmission pipelines that entered service in 2015, including:

- **ONEOK Partners and Fermaca to Construct Roadrunner Gas Transmission Export Pipeline From West Texas to Mexico (April 2):** In April, ONEOK Partners, L.P. and a subsidiary of Fermaca Infrastructure B.V. announced a joint venture project to construct the Roadrunner Gas Transmission pipeline project, which will run from Coynosa, TX, west to a new international border crossing connection at the U.S.-Mexico border near San Elizario, TX. The project will include approximately 200 miles of 30-inch-diameter pipeline capable of transporting up to 640 MMcf/d of natural gas. The pipeline is expected to be completed by 2019.
- **Williams Completes Rockaway Delivery Lateral and Northeast Connector Pipeline to New York City (May 15):** Williams completed its Rockaway Delivery Lateral and Northeast Connector projects on May 15, which both increase natural gas delivery

capacity to the Brooklyn and Queens boroughs of New York City. With a capacity of 647 MMcf/d, the lateral links Williams' Transco transmission pipeline and the National Grid distribution system. In addition, compression was added at three existing Transco facilities in New Jersey and Pennsylvania, allowing for an additional 100 MMcf/d of capacity between Station 195 and the Lateral.

- **Williams' Transco Completes 270 MMcf/d Virginia Southside Expansion (September 1):** Williams' Transco expanded its Southside natural gas pipeline to fuel new electric-power generation in Virginia and serve increasing local distribution demand in North Carolina. The Virginia Southside Expansion provides 270 MMcf/d of incremental transportation capacity over 100 miles of new 24-inch-diameter pipeline between the Transco mainline in Pittsylvania County, VA, and its termination in Brunswick County, VA. Compression capacity exceeding 21,000 horsepower was added to Transco's Station 165 to support the new line.
- **Columbia Gas Transmission Places East Side Expansion Project Into Service in New Jersey, Pennsylvania (October 2):** Columbia Pipeline Group—along with Columbia Pipeline Partners, L.P.—announced on October 2 that their subsidiary, Columbia Gas Transmission, LLC, placed its East Side Expansion Project (ESE) in service. ESE comprises two natural gas pipelines, which add 312 MMcf/d of capacity to the Columbia system. The project also includes modifications and upgrades to certain compressor station facilities in Pennsylvania.
- **Williams Completes Leidy Southeast Expansion in Pennsylvania and New Jersey (4Q 2015):** The Leidy Southeast Expansion Project increases Transco pipeline's natural gas carrying capacity by 525 MMcf/d, allowing greater volumes of natural gas to be delivered from the Marcellus shale play to coastal demand centers. To complete the project, approximately 30 miles of additional pipe loops were constructed in Pennsylvania and New Jersey, in addition to modifying existing pipeline facilities. The project was completed just before the 2015–2016 winter heating season.

### 4.2.3 Liquefied Natural Gas Export Terminals

Low domestic natural gas prices and continued growth in U.S. natural gas production combine to maintain a strong economic incentive to export LNG from the United States. The first phase of Cheniere Energy's Sabine Pass LNG export project in Louisiana—the first terminal designed to liquefy and export natural gas from the continental United States—was commissioned in October and in December, and natural gas pipeline shipments to the facility commenced as the plant prepared to enter commercial service. When fully operational, the first four trains of the terminal will be able to liquefy and export up to 2.76 Bcf/d of natural gas.

As of January 6, 2016, there were 16 LNG export projects in the United States whose proposals either had been approved by FERC or were pending review. Seven of these projects were approved—six of which are under construction—while nine were pending review. An additional 13 projects were recorded by FERC as being in the “pre-filing” stages.<sup>23,24</sup> While these projects are categorized discretely by FERC, it is worth noting that many projects—both proposed and in pre-filing—represent conversions and expansions to existing LNG import terminals or planned

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<sup>23</sup> <http://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-export.pdf>

<sup>24</sup> <http://www.ferc.gov/industries/gas/indus-act/lng/lng-approved.pdf>

expansions to future LNG export terminals, and that the construction of LNG import/export facilities is commonly completed in phases. Table 4 summarizes the 16 export projects that have applied to FERC, including information on the proposed site, export capacity, target in-service date, and the status of FERC approval.

**Table 4. Proposed LNG Export Projects in the United States, 2015**

| Location                   | Project Name                                   | Site                     | Proposed Export Capacity (Bcf/d) | Target In-Service Date | FERC Project Status               |
|----------------------------|--|--------------------------|----------------------------------|------------------------|-----------------------------------|
| <b>Sabine (LA)</b>         | Cheniere/Sabine Pass LNG (Trains 1, 2, 3, & 4) | Existing Import Terminal | 2.76                             | Q1 2016                | In Service                        |
| <b>Hackberry (LA)</b>      | Sempra-Cameron LNG                             | Existing Import Terminal | 1.7                              | 2017                   | Approved – Under construction     |
| <b>Freeport (TX)</b>       | Freeport LNG                                   | Existing Import Terminal | 1.8                              | 2016                   | Approved – Under construction     |
| <b>Cove Point (MD)</b>     | Dominion-Cove Point LNG                        | Existing Import Terminal | 0.82                             | 2017                   | Approved – Under construction     |
| <b>Corpus Christi (TX)</b> | Cheniere-Corpus Christi LNG                    | Existing Import Terminal | 2.14                             | 2018                   | Approved – Under construction     |
| <b>Sabine Pass (LA)</b>    | Cheniere/Sabine Pass LNG (Trains 5 & 6)        | Existing Import Terminal | 1.4                              | 2016                   | Approved – Under construction     |
| <b>Lake Charles (LA)</b>   | Southern Union-Lake Charles LNG                | Existing Import Terminal | 2.2                              | 2016                   | Approved – Not under construction |
| <b>Sabine Pass (LA)</b>    | ExxonMobil-Golden Pass                         | Existing Import Terminal | 2.1                              | –                      | Pending                           |
| <b>Coos Bay (OR)</b>       | Jordan Cove Energy Project                     | Greenfield               | 0.9                              | 2019                   | Pending                           |
| <b>Astoria (OR)</b>        | Oregon LNG                                     | Greenfield               | 1.25                             | 2021                   | Pending                           |
| <b>Elba Island (GA)</b>    | Southern LNG Company                           | Existing Import Terminal | 0.35                             | 2018                   | Pending                           |
| <b>Lake Charles (LA)</b>   | Magnolia LNG                                   | Greenfield               | 1.07                             | 2018                   | Pending                           |
| <b>Pascagoula (MS)</b>     | Gulf LNG Liquefaction                          | Existing Import Terminal | 1.5                              | 2020                   | Pending                           |
| <b>Freeport (TX)</b>       | Freeport LNG (Expansion)                       | Existing Import Terminal | 0.34                             | 2018                   | Pending                           |
| <b>Cameron Parish (LA)</b> | Venture Global Calcasieu Pass                  | Existing Import Terminal | 1.41                             | 2019                   | Pending                           |
| <b>Hackberry (LA)</b>      | Sempra-Cameron LNG (Expansion)                 | Existing Import Terminal | 1.41                             | 2019                   | Pending                           |

Sources: FERC project lists last updated on January 6, 2016, <http://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-export.pdf>; <http://www.ferc.gov/industries/gas/indus-act/lng/lng-approved.pdf>. Target in-service dates were sourced from company websites.

In addition to receiving U.S. Federal Energy Regulatory Commission (FERC) approval, each project may also apply to the DOE Office of Fossil Energy for approval to export LNG to non-Free Trade Agreement (non-FTA) countries. DOE is currently reviewing all submitted applications and has approved 16 for export to non-FTA countries—including two applications each for Cameron LNG and Sabine Pass LNG expansions—as of January 27, 2016.<sup>25,26,27</sup>

## 4.3 Petroleum Projects

The continuing transformation of the North American petroleum landscape led to a variety of infrastructure changes in 2015 as transportation and storage infrastructure continues to catch up to growing sources of production, including shale oil formations such as the Bakken region in North Dakota, the Eagle Ford region in south Texas, and the Canadian oil sands in Alberta. Continuing a trend from recent years, in 2015, the industry relied increasingly on rail to move crude oil out of regions where pipeline capacity is lagging production, further utilized marine capacity to that same end, and developed new pipeline systems and reconfigured existing systems to move crude to market.

### 4.3.1 Crude Oil

#### 4.3.1.1 Gulf Coast Texas and Louisiana

- **Enterprise Commences Operations on ECHO to Beaumont/Port Arthur Lateral in Texas (January 7):** Enterprise Products Partners announced line fill operations on January 7 for its 100-mile, 780,000-b/d ECHO lateral crude pipeline, which connects its 800,000-bbl ECHO storage terminal near Houston to the Beaumont and Port Arthur refining markets. The lateral provides more destinations for crude flowing south from Cushing, OK, to Jones Creek, TX.
- **Plains, Delek Announce Caddo Crude Oil Pipeline From Texas to Louisiana (Announced March 23; Target Completion: Mid-2016):** Plains All American and Delek Logistics announced on March 23 a joint venture to build the 80,000-b/d Caddo crude oil pipeline from Longview, TX, to Shreveport, LA. The 80-mile, 12-inch-diameter pipeline will originate at the Plains Atlas Terminal in Longview and will move up to domestic crude oil to supply refineries in the Shreveport area and Delek Logistics' pipeline system supplying Delek US Holdings' 83,000-b/d El Dorado, AR, refinery. Under the agreement, Plains will construct and operate the Caddo pipeline. The pipeline is supported by long-term shipper commitments and is expected to be completed in mid-2016.
- **Shell Cancels Westward Ho Pipeline From Louisiana to Texas (Announced April 8):** Royal Dutch Shell shelved its Louisiana-to-Texas Westward Ho pipeline after years of delays, reductions in scope, and competition from new pipeline startups, including the 780,000-b/d ECHO lateral and the 700,000-b/d TransCanada MarketLink. Proposed in

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<sup>25</sup> <http://energy.gov/fe/2015-lng-export-compressed-natural-gas-cng-re-exports-long-term-natural-gas-applications>

<sup>26</sup> <http://energy.gov/fe/2016-lng-export-compressed-natural-gas-cng-re-exports-long-term-natural-gas-applications>

<sup>27</sup> <http://energy.gov/sites/prod/files/2016/02/f29/Summary%20of%20LNG%20Export%20Applications.pdf>

2011 at a top capacity of 900,000 b/d, Shell said that Westward Ho would move Gulf of Mexico and imported crudes from the St. James, LA, oil hub to Houston. The leg between Nederland, TX, and Houston would move up to 500,000 b/d, and the entire project was targeted to start in late 2015.

- **Magellan and TransCanada to Build HoustonLink Pipeline (Announced: April 14; Target Completion: 1Q 2017):** Magellan Midstream Partners, L.P. and TransCanada Corporation formed a joint venture in April to pursue the construction of a 9-mile, 24-inch-diameter pipeline, which would connect TransCanada's Houston terminal to Magellan's East Houston terminal, giving TransCanada's Keystone and MarketLink shippers access to Magellan's Houston and Texas City crude oil distribution system. TransCanada and Magellan anticipate the project to be operational during the first half of 2017.
- **TransCanada's Houston Lateral Project Delayed Due to Flooding (Target Completion: 2Q 2016):** The construction schedule of TransCanada's Houston lateral pipeline was delayed due to heavy rains and flooding in the Gulf Coast region. The project's completion was originally expected during the fourth quarter of 2015 but was pushed back to the second quarter of 2016. The pipeline will connect refining centers in the Houston area with TransCanada's 700,000-b/d Cushing MarketLink, which originates in Cushing, OK, and delivers crude to Nederland, TX.
- **Construction Commences on Bayou Bridge Pipeline From Texas to Louisiana (Announced: July 30; Target Completion: 1Q 2016):** In July, Phillips 66, Energy Transfer Partners, and Sunoco Logistics Partners announced a joint venture to construct the Bayou Bridge pipeline designed to deliver crude oil from the Phillips 66 and Sunoco Logistics Nederland, TX, terminals to the refining center in Lake Charles, LA. Construction is underway on the 30-inch-diameter pipeline, with the first segment of the pipeline from Nederland to Lake Charles expected to begin commercial operations in the first quarter of 2016. An expansion of the pipeline, contingent on shipper interest, would extend the line to terminals and refineries in and around St. James, LA. Sunoco Logistics will operate the system.
- **LOOP to Add 2.2 Million Barrels of Aboveground Storage in Louisiana (Announced: November 18; Target Completion: 3Q 2016, 2Q 2017):** Louisiana Offshore Oil Port (LOOP) expanded its Clovelly storage hub by constructing six aboveground storage tanks, equivalent to 2.2 million bbl of additional capacity. The first three tanks are slated to be operational by fall 2016, while the final three tanks are anticipated to be operational by spring 2017. Once completed, there will be 11.2 million bbl of aboveground storage at capacity to complement the hub's 60 million bbl of underground cavern storage. The Clovelly storage site is part of LOOP's crude oil pipeline system, which includes the Locap and Capline pipelines.

#### 4.3.1.2 West Texas and New Mexico

- **Plains Begins Service on Its 250,000-b/d Cactus Pipeline in Texas (April 2):** Plains All American announced that it had begun operations on its Cactus pipeline to move crude from the Permian Basin to the Texas Gulf Coast. The 298-mile pipeline ships crude from McCamey in West Texas to Gardendale in South Texas, where it



interconnects with pipelines delivering crude to Houston and Corpus Christi. Plains plans to expand the pipeline to 330,000 b/d with the addition of new pumping equipment in 2016.

- **Enterprise to Build New 540,000-b/d Midland-to-Sealy Crude Oil and Condensate Pipeline in Texas (Announced: April 30; Target Completion: 2Q 2017):** Enterprise Products Partners, L.P. announced that it executed long-term agreements supporting development of a new 416-mile, 24-inch-diameter pipeline to transport 540,000 b/d of crude oil and condensate from the company's Midland, TX, terminal to its Sealy storage facility west of Houston. From Sealy, the new pipeline would link to Enterprise's ECHO terminal through an interconnect with the Rancho II pipeline, which began service in September 2015. Through ECHO, customers will have direct access to every refinery in Houston, Texas City, Beaumont, and Port Arthur, as well as Enterprise's dock facilities. Service on the Midland-to-Sealy pipeline is expected to begin in the second quarter of 2017.
- **Enterprise Begins Service on Its Rancho II Pipeline in Texas (September 21):** Enterprise Products Partners, L.P. announced the start of service on its 480,000-b/d Rancho II pipeline between Sealy, TX, and its ECHO terminal in southeast Houston. The 88-mile, 36-inch-diameter pipeline will transport various grades of crude oil, condensate, and processed condensate from the Permian Basin and the Eagle Ford Shale.
- **Navigator Energy Begins Service on Big Spring Gateway Pipeline System in West Texas (September 24):** Navigator Energy began initial service in September on its Big Spring Gateway System (BSG System) in West Texas with an initial capacity of 40,000 b/d, making deliveries into the Sunoco Logistics-owned West Texas Gulf pipeline and Permian Express 2. The BSG System, serving customers in the Permian Basin region, was expected to be in full service in December 2015 with a throughput capacity of up to 160,000 b/d. Once completed, the system will have more than 250 miles of gathering pipeline, 200 miles of 6- to 16-inch-diameter transportation mainline, and 410,000 bbl of crude oil storage capacity. In addition to the Sunoco Logistics-owned pipelines, the BSG System will provide delivery into Alon's Big Spring refinery and the BridgeTex pipeline, providing a direct path to Texas Gulf Coast and Mid-Continent market centers.
- **Sunoco Begins Service on Permian Express II Pipeline in Texas (July 21):** Sunoco Logistics Partners commenced operations on its 200,000-b/d Permian Express II pipeline, which runs parallel to existing Sunoco pipeline systems between a tank terminal located north of Colorado City, TX, and its tank facility in Corsicana, TX.

#### 4.3.1.3 Midwest and Rocky Mountain Pipelines

- **Tesoro Agrees to Acquire Great Northern Midstream Assets in North Dakota (1Q 2016):** Tesoro agreed to acquire Great Northern Midstream, which owns and operates newly constructed crude oil pipeline, gathering systems, transportation, storage, and rail loading facilities in the Williston Basin of North Dakota. The transaction includes the 97-mile BakkenLink crude oil pipeline, which connects to several third-party gathering systems, as well as a proprietary 28-mile gathering system in the core of the Bakken shale play, supported by dedicated acreage. In addition, the transaction includes a 154,000-b/d rail loading and a 657,000-bbl storage facility in Fryburg, ND, which can

provide outbound deliveries to the West, East, and Gulf Coasts. The transaction is subject to customary closing conditions, including regulatory approval, and is expected to close in the first quarter of 2016.

- **Saddlehorn and Grand Mesa Merge DJ Basin Pipeline Projects (Mid-2016):** Saddlehorn Pipeline Company announced on November 18 that it was combining projects with Grand Mesa Pipeline, LLC for the construction of a 20-inch-diameter undivided joint interest pipeline, which will deliver various grades of crude oil from the DJ Basin to storage facilities in Cushing, OK, by mid-2016. The pipeline project, which will originate at a junction approximately 20 miles north of Saddlehorn's Platteville and Grand Mesa's Lucerne origins in Colorado, will have an initial capacity of 340,000 b/d.

#### 4.3.1.4 Gulf of Mexico

- **Shell Begins Appomattox Field Development in Gulf of Mexico (Announced: July 1; Target Completion: TBD):** Royal Dutch Shell began development of the Appomattox deepwater oil and gas field, some 80 miles off the coast of Louisiana, set to be the company's eighth and largest floating platform in the region. At its peak, the project is expected to reach peak production of around 175,000 b/d of oil equivalent. The infrastructure will consist of a semi-submersible, four-column production host platform, a subsea system featuring six drill centers, 15 producing wells, and 5 water injection wells.

### 4.3.2 Petroleum Products

#### 4.3.2.1 Refineries

- **Marathon Integrates Houston Area Refinery Operations to Increase Diesel Output (Announced: February 24; Target Completion: TBD):** Marathon Petroleum aims to integrate operations at its 451,000-b/d Galveston Bay and 84,000-b/d Texas City refineries as part of a plan to increase diesel fuel output. The company plans to construct a new diesel-producing hydrotreater and merge the processing capabilities of the Galveston Bay and adjacent Texas City facilities. In addition to the integration plan, Marathon planned to boost the facility export capacity to 400,000 b/d by the end of 2015, up from 345,000 b/d last year.
- **Calumet Commences Operations at Its 20,000-b/d Dakota Prairie Refinery in North Dakota (May 4):** Calumet Specialty Products Partners, L.P. commenced operations at the Dakota Prairie refinery in Dickinson, ND. The refinery is designed to process 20,000 b/d of locally sourced Bakken crude oil, resulting in a production slate that includes up to 7,000 b/d of diesel fuel sold to regional, North Dakota-based customers. The refinery is the first greenfield fuels refinery built in the United States in nearly 40 years.
- **PBF Acquires ExxonMobil Refineries in Louisiana and California (Target Completion: 2Q 2015, 2Q 2016):** PBF Energy, Inc. and affiliated subsidiaries entered definitive agreements in 2015 to acquire the 189,000-b/d Chalmette, LA, refinery and the 149,500-b/d Torrance, CA, refinery, both of which had ownership ties to ExxonMobil. After signing a definitive agreement on June 18, PBF successfully completed the acquisition of Chalmette Refining, LLC—a 50–50 ExxonMobil and Petróleos de Venezuela (PDVSA) joint-venture—on November 2. On September 30, PBF announced

that its subsidiary, PBF Energy Western Region, LLC, signed a definitive agreement to acquire the Torrance refinery and related logistics assets from ExxonMobil. In February 2015, the Torrance refinery experienced a massive explosion that severely damaged the refinery's FCCU and associated pollution control equipment, crippling gasoline production at the facility. The Torrance transaction, which is expected to close during the second quarter of 2016, is subject to customary closing conditions and regulatory approvals, as well as the successful restart of the refinery and repair of the FCCU and pollution control equipment.

- **Valero Increasing Light Crude Processing Capability at Houston and Corpus Christ Refineries in Texas (Target Completion: 4Q 2015, 1H 2016):** On December 14, the company said that a 70,000-b/d topping unit had commenced operations at its 205,000-b/d Corpus Christi refinery. The startup of a 90,000-b/d topping unit at its 100,000-b/d Houston refinery remained on track to commence operations during the first half of 2016. The topping units will not increase the overall production capacity at the refineries, but will increase Valero's capability for processing lighter crudes.
- **Tesoro to Shutter FCCU at Its Carson, CA, Refinery (Target Completion: 2017):** Tesoro said that it was planning to permanently shutter the 36,000-b/d FCCU at its 251,000-b/d Carson refinery near Los Angeles. The company said that it will close the unit down in 2017 when it integrates the Carson refinery operations with its nearby 104,500-b/d Wilmington refinery.
- **Motiva to Integrate Norco and Convent Refineries in Louisiana (Target Completion: 4Q 2016):** In March, Motiva Enterprises, LLC announced plans to construct a crude and intermediates pipeline system as the first step in a multi-phased project that will integrate its 238,000-b/d Norco and 235,000-b/d Convent refineries located on the Mississippi River between Baton Rouge and New Orleans, LA. The Norco refinery will be connected to the LOCAP terminal in St. James through a 34-mile, 24-inch-diameter crude pipeline. In addition, 6- and 12-inch-diameter intermediate pipelines will run about 35 miles each between the two refineries, supporting optimization of both plants' conversion units while improving logistics efficiency by alleviating dock congestion and creating spare capacity for additional product exports. When the pipelines are complete, in the fourth quarter of 2016, Motiva also plans to idle the 92,000-b/d FCCU at the Convent refinery, and reconfigure Norco's hydrocracker to process an additional 30,000 b/d of gas oil into premium diesel.

#### 4.3.2.2 Transportation

- **Philly Shipyard Constructing Jones Act Tankers for Kinder Morgan (Announced: October 14; Target Completion: 2016–2017):** Philly Shipyard said on October 14 that it had commenced construction activities on the third and fourth 50,000-dead weight ton (dwt) product tankers in a four-vessel order for American Petroleum Tankers, a Kinder Morgan subsidiary. When completed, each of the 600-foot tankers will have a carrying capacity of 14.5 million gallons (345,000 bbl) to transport crude oil or refined products. The company has planned deliveries for the first two tankers in 2016 and 2017.
- **Florida Fuel Connection to Build Louisiana Rail Terminal (Announced: July 28; Target Completion: 1Q 2017):** Florida Fuel Connection, LLC announced a project to

build a petroleum terminal and rail transportation facility in East Feliciana Parish, LA, for shipping gasoline and other fuels via rail to southeast Georgia and Florida. Anticipated to be operational by the first quarter of 2017, the company intends to transport 240,000 b/d of petroleum products, sourcing supply from the Colonial pipeline system near Baton Rouge.

#### 4.3.3 Natural Gas Liquids and Liquefied Petroleum Gases

- **Marathon Starts Up Condensate Splitter at Its Catlettsburg, KY, Refinery (May 29):** Marathon commenced operations on a 35,000-b/d condensate splitter at its 242,000-b/d refinery in Catlettsburg, KY. The splitter will split ultralight Utica shale crude into naphtha and other feedstocks.
- **Phillips 66 Starts Up NGL Fractionator at Its Sweeny, TX, Complex (December 8):** Phillips 66 said that it commenced operations at its new 100,000-b/d NGL fractionator at its Sweeny Complex located in Old Ocean, TX, which also houses a 247,000-b/d refinery. The unit, which is supported by 250 miles of new pipelines and a multimillion-barrel storage cavern complex, will supply purity ethane and liquefied petroleum gases (LPGs) to local petrochemical customers and the Mont Belvieu, TX, market hub. Phillips 66 will also have the capability to export LPG upon completion of its 150,000-b/d Freeport LPG export terminal in the second half of 2016.
- **Enterprise Increases Loading Capacity at Its Houston Ship Channel LPG Export Terminal in Texas (April 6):** Enterprise Products Partners, L.P. announced in April that the completion of an expansion project at its LPG export terminal on the Houston ship channel has increased the facility's capacity for loading fully refrigerated, low-ethane propane to 9 million bbl per month (an additional three ships per month). The company said that work was also progressing on construction of a new refrigeration train that would expand loading capability to 16 million bbl per month, which equates to about 29 vessels per month. The new train was expected to be completed in the fourth quarter of 2015.
- **Enterprise Completes Final Segment of Its Aegis Pipeline in Louisiana (December 30):** Enterprise Products Partners, L.P. announced on December 30 that it had completed construction, commissioned, and initiated operation of the final 162-mile portion of the Aegis ethane pipeline from Lake Charles, LA, to the Napoleonville, LA, area. The 270-mile, 20-inch-diameter Aegis system originates at Mont Belvieu, TX, which is home to more than 110 million bbl of Enterprise-owned storage capacity, as well as sufficient fractionation capacity.

#### 4.3.4 Regulation

- **U.S. DOT Announces Final Rule to Strengthen Safe Transportation of Flammable Liquids by Rail (May 1):** After a series of fiery derailments during the first half of 2015, U.S. DOT announced a final ruling on safe rail transportation focused on safety improvements designed to prevent accidents, mitigate consequences in the event of a derailment, and support emergency response. Developed by PHMSA and the Federal Railroad Administration (FRA), and in conjunction with the Canadian Transportation Ministry, the final rule unveils a new, enhanced tank car standard and an aggressive,

risk-based retrofitting schedule for older tank cars carrying crude oil and ethanol; requires a new braking standard for certain trains, offering a superior level of safety by potentially reducing the severity of an accident, namely the “pile-up effect”; designates new operational protocols for trains transporting large volumes of flammable liquids, such as routing requirements, speed restrictions, and information for local government agencies; and provides new sampling and testing requirements to improve classification of energy products placed into transport.

- **U.S. Commerce Department Approves Limited Exports of Light Crude Oil to Mexico in Exchange for Heavy Crude Oil Imports (August 14):** The U.S. Department of Commerce’s Bureau of Industry and Security approved several applications to export domestically produced crude oil to Mexico for the first time in history. The exports were allowed in exchange for imported Mexican oil. The August 14 announcement came more than 8 months after Pemex proposed to swap its heavy, sour crude oil for light, sweet U.S. imports to boost gasoline and distillate output from Mexico’s older refineries. In return, the United States would continue to import heavy Maya crude and medium-grade Isthmus crude, which are a better match for some U.S. Gulf Coast refiners equipped with significant coking and desulfurization capacity. The year-long license, which Pemex formally received on October 28, permits Pemex’s commercial branch, P.M.I. Comercio Internacional, to import up to 75,000 b/d of conventional U.S. light crudes with the possibility of receiving shale and condensate streams later on.
- **U.S. Government Lifts Crude Oil Export Ban (December 18):** After nearly 40 years of regulation, licensing restrictions on crude oil exports were lifted pursuant to section 101 of Division O of the Consolidated Appropriations Act, 2016, which was passed by the U.S. Congress and signed into law by President Obama on December 18. As a result, a Department of Commerce license is no longer needed to export crude oil. By December 23, Enterprise Products Partners announced an agreement with Vitol Group to provide pipeline and marine terminal services for loading a 600,000-bbl cargo of the sweet Eagle Ford crude at its Enterprise hydrocarbon terminal on the Houston ship channel during the first week of January 2016. By December 31, another Eagle Ford cargo departed NuStar’s North Beach terminal in the port of Corpus Christi, the result of another agreement between Vitol and ConocoPhillips.

#### 4.4 Biofuels

While ethanol producers experienced high profit margins in 2014, record low oil prices in 2015 put a lot of pressure on the biofuels market. Low oil prices make biofuels less attractive as a source for fuel compared to gasoline and other petroleum products. As oil prices plummeted toward \$30/bbl, prices for ethanol fell as well. Despite the suppressed market for oil and ethanol, ethanol production remained steady from 2014 to 2015. According to the EIA, ethanol fuel production remained consistently above 900,000 b/d and even reached above 1,000,000 b/d in November 2015.

#### 4.4.1 Biofuel Plants

Over the past few years, economic conditions, weather disruptions, and policy changes have affected the U.S. biofuels market. In 2015, EAD reported the completion of two commercial-scale biofuel ethanol plants, a restart of an ethanol plant, and the suspension of production at another plant:

- **Great River Energy’s Dakota Spirit AgEnergy Biorefinery Begins Operations in North Dakota (July):** On July 24, Great River Energy fully commercialized its Dakota Spirit AgEnergy biorefinery and was producing ethanol. The new 65-MMgal/year biorefinery is located next to Great River Energy’s Spiritwood Station in Spiritwood, ND, and utilizes steam from the combined heat and power plant and yellow corn from local farmers to produce ethanol, distillers grains, and fuel-grade corn oil.
- **Noble Group Restarts 100-MMGal/Year Sound Bend, IN, Ethanol Plant (September):** On September 1, Noble Group Ltd restarted Indiana’s oldest ethanol plant after a major reconstruction project. The plant had been idle since 2012. Noble purchased the plant in July 2013 and converted it from one that burns coal to one that burns natural gas, upgrading the fermentation process, installing new regenerative thermal oxidizers, and improving the evaporation equipment, including ethanol and steam generation.
- **Vireol Bio Energy Suspends Production at Its 48-MMGal/Year Hopewell, VA, Ethanol Plant (September):** In early September, Vireol Bio Energy suspended production at its Hopewell, VA, ethanol plant due to poor economics. Vireol stated that it would like to sell the site. Low gasoline prices were contributing to the plant’s struggles, according to Vireol, which began operations in April 2014.
- **DuPont Opens World’s Largest Cellulosic Ethanol Plant in Iowa (October):** DuPont opened a cellulosic biofuel facility in the City of Nevada, IA, on October 30. The facility has the capacity to produce 30 MMgal/year of clean fuel. The raw material used to produce the ethanol is corn stover—the stalks, leaves, and cobs left in a field after harvest. The majority of the fuel produced at the facility will be bound for California to assist in meeting the State’s Low Carbon Fuel Standard, a policy to reduce carbon intensity in transportation fuels.

#### 4.4.2 Policy Changes

In 2015, EAD reported a number of Federal policy and regulatory changes, and government initiatives that impacted the renewable fuel industry:

- **EPA Approves Argentina Joining Biofuel Credit Program:** In January, EPA approved a request from Argentina’s Biofuels Chamber (Carbio) for an Alternative Renewable Biomass Tracking Requirement, which sets out the environmental standards needed for foreign producers to join the U.S. Renewable Fuel Standards program. The approval comes 3 years after the South American country, the world’s top exporter of biodiesel made from soybean oil, applied to earn RIN (Renewable Identification Numbers)

alternative fuel credits, used by U.S. refiners, importers, and others to prove that they are complying with biofuel blending requirements.

- **FRA Sets New Rule on Crude Oil and Ethanol Trains:** On July 29, the Federal Railroad Administration released a new final rule aimed at preventing explosive rail disasters such as the 2013 oil train derailment that killed 47 people and destroyed part of Lac-Mégantic, Quebec. The latest regulation requires a parked train carrying crude oil, ethanol, or other dangerous contents to be secured by a trained railroad employee and verified by a qualified second employee. The new rule is directed specifically at trains left parked on main lines, side tracks, and in rail yards.
- **USDA Announces \$210 Million To Be Invested in Renewable Energy Infrastructure Through Biofuel Infrastructure Partnership:** The U.S. Department of Agriculture (USDA) announced in late October that it is partnering with 21 States through the Biofuel Infrastructure Partnership (BIP) to nearly double the number of fueling pumps nationwide that supply renewable fuels to American motorists. In May, USDA announced the availability of \$100 million in grants through BIP, and that to apply, States and private partners must match the Federal funding by a 1:1 ratio. USDA received applications requesting more than \$130 million, outpacing the \$100 million that was available. With the matching commitments by State and private entities, BIP is investing a total of \$210 million to strengthen the rural economy. The 21 States participating in BIP include Colorado, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Michigan, Minnesota, Missouri, Nebraska, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Texas, Virginia, West Virginia, and Wisconsin. The final awards are estimated to expand infrastructure by nearly 5,000 pumps at more than 1,400 fueling stations.
- **EPA Finalizes Increases in Renewable Fuel Levels:** In November, EPA announced final volume requirements under the U.S. Renewable Fuel Standard (RFS) program for the years 2014, 2015, and 2016, and final volume requirements for biomass-based diesel for 2014 to 2017. The final 2016 standard for cellulosic biofuel—the fuel with the lowest carbon emissions—is 230 million gallons, or seven times more, than the market produced in 2014. The final 2016 standard for advanced biofuel is nearly 1 billion gallons, or 35 percent higher than the actual 2014 volumes; the total renewable standard requires growth from 2014 to 2016 of more than 1.8 billion gallons of biofuel, which is 11 percent higher than 2014 actual volumes. Biodiesel standards grow steadily over the next several years, increasing every year to reach 2 billion gallons by 2017.

## 5. International Events

While EAD primarily focuses on domestic and related North American energy issues, it also reports international events with significant implications for global energy markets, or which may affect U.S. markets. This section highlights those international incidents and summarizes the status of major global infrastructure projects that were announced, are under construction, or placed into service during 2015. Due to the nature of international reporting and the focus of EAD, this should not be viewed as a complete summary of global events, but rather a summary of those events captured in EAD.

### 5.1 International Incidents and Disruptions

A number of international events affected global energy markets in 2015, primarily in oil-producing and politically unstable parts of the world. Significant energy events and disruptions from 2015 are listed below. Many of these stories reflect the activities of terrorist groups with the intent to disrupt energy supplies. These events continued throughout the year.

#### 5.1.1 Africa

- **Libyan Oil Production Drops Below 400,000 b/d Amid Recurrent Protests and Violence (2015):** Cycles of violence, protests, and unrest between two rival governments, armed factions, and the Islamic State continued to mar the Libyan oil sector in 2015. Es Sider and Ras Lanuf, Libya's two biggest oil ports, remained shut down throughout 2015. The two ports were shut down in December 2014. In February, Libya shut down its easternmost port, the Hariga port, due to a security guard strike related to payment issues. Protestors also shut down the small port of Brega in April; however, both the Hariga and Brega ports reopened later in the year. Libyan oil output dropped below 400,000 b/d several times throughout the year, producing just under 400,000 b/d by the end of 2015.
- **Leaks Cripple Nigeria's Trans Forcados Pipeline (2015):** Shell shut down its Trans Forcados pipeline once in early January due to vandalism and again in mid-January due to a leak. The pipeline remained shut down for a week after each shutdown. The pipeline transports Forcados crude oil from the Niger Delta region. In May, Shell declared *force majeure* on Forcados crude due to a series of leaks along the Trans Forcados pipeline. The *force majeure* was lifted in July. In September, Shell declared *force majeure* on the pipeline, again due to leaks. The *force majeure* lasted about 5 days.
- **BP's Oil Fields Offshore Angola Experience Equipment Failure-Related Problems (March–May):** On March 16, BP declared *force majeure* on oil output from its Saturno oil field, part of the Plutão, Saturno, Venus, and Marte (PSVM) oil field project located in waters off Angola, after a power loss. The Saturno field was restarted a week later; however, on April 14, BP declared *force majeure* on its Plutonio oil field following a trip of the communication management and control system. The *force majeure* was lifted on April 24. Also in April, BP again declared *force majeure* for 5 days on its Saturno oil field after experiencing production issues.



- **Deadly Explosion Hits Eni's Tebidaba-Clough Creek Pipeline in Nigeria (July):** An explosion in an Eni pipeline in Nigeria killed at least 13 people and injured 3 others on July 10. The men killed were part of a maintenance crew, including security and environment officials, carrying out repairs on the pipeline near the town of Azuzuama in the Niger Delta's Bayelsa state. An investigation confirmed that the explosion was caused by oil thieves.

### 5.1.2 Middle East

- **Iraqi Kurdistan's Kirkuk-Ceyhan Pipeline Crippled by Attacks and Technical Glitches (2015):** The 600,000-b/d Kirkuk-Ceyhan pipeline, which carries crude from Iraqi Kurdistan to the Turkish Mediterranean port of Ceyhan, was shut down nearly 10 times in 2015 as a result of technical problems, as well as attacks.
- **Yemen Civil War Disrupts Oil and Gas Sector (2015):** A civil war broke out following the collapse of Yemen's government in January. Soon after, Yemen declared *force majeure* on LNG deliveries from its Balhaf LNG export terminal due to deteriorating security conditions. The 6.7-million tons/year Balhaf terminal is operated by France's Total and ships LNG, primarily to Asia and to some European countries. The *force majeure* was lifted by the end of January. In late March, Yemen shut down its major seaports after fighting intensified. In April, Yemen shut down its 150,000-b/d Aden refinery. *Force majeure* was declared on all incoming crude oil and outgoing petroleum products from the Aden refinery. The refinery restarted in September at half its operating capacity, lifting the *force majeure* 5 months after it had been declared.
- **Iraq Regains Control of Baiji Refinery (2015):** After a series of back-and-forth battles, Iraqi forces, with the help of the U.S. and Shia militias, retook the refinery in October. The Baiji refinery had been seized by the Islamic State in June 2014. While the refinery had been secured, officials stated that it could take years to restart due to the extensive damage it experienced during the fighting.
- **Kuwait Shuts Down Shuaiba Oil Refinery After Fire (August):** Kuwait National Petroleum Company's (KNPC) 200,000-b/d Shuaiba refinery was shut down and evacuated after a large fire broke out in August. No injuries were reported. The fire was quickly brought under control and KNPC said that because of refined products in storage, the country's exports would not be affected by the shutdown. The Shuaiba refinery in southern Kuwait, commissioned in 1968, is due to be closed after the new 615,000-b/d Al Zour refinery comes on line by 2019.
- **Shah Deniz Gas Pipeline Flow Halted by Explosion in Turkey (August):** Gas flow on the Shah Deniz pipeline carrying natural gas from Azerbaijan was halted by an explosion in Turkey on August 24. Kurdish militants were suspected to have sabotaged the pipeline. Gas flow had been halted on August 3 due to maintenance and had only resumed on August 23, but had not yet reached capacity before the blast.
- **Islamic State and Syrian Government Fight for Major Oilfield (September):** In September, the Islamic State claimed that it had seized the Jazal oilfield, a report denied by the Syrian government. Jazal is a medium-sized field that lies to the northwest of the rebel-held city of Palmyra, close to a region that holds Syria's main natural gas fields

and extraction facilities. Reports have not confirmed whether the Jazal oilfield is currently controlled by the Syrian government or Islamic State militants.

### 5.1.3 Asia

- **Militant Attack Knocks Out Power to 140 Million People in Pakistan (January):** Eighty percent of Pakistan (140 million people) was left without power on January 25 when a power transmission line failed. The failure of the power transmission line was blamed on a militant attack on a transmission tower in the southwestern Baluchistan province. The blackout reportedly left two nuclear power plants offline. Power was restored to impacted customers within a day.
- **Massive Port Explosions in China Disrupt Oil Tanker Traffic (August):** Deadly explosions on August 13 in the northeast Chinese port city of Tianjin disrupted chemical and oil tanker traffic and killed more than 100 people. Dozens of oil and petrochemical products tankers were in the area; however, there were no major impacts to oil and gas supplies. Tianjin is home to some of China's strategic oil reserves.

### 5.1.4 Americas

- **Bomb Attacks Shut Down Colombia's Caño Limón and Transandino Pipelines (2015):** Since lifting a ceasefire in mid-May, leftist FARC (Revolutionary Armed Forces of Colombia) rebels began hitting, almost daily, at roadways, energy networks, and oil trucks and installations in Colombia. Ecopetrol's 485-mile, 220,000-b/d Caño Limón pipeline to the Coveñas port was shut down four times in 2015 due to bomb attacks. Two bomb attacks occurred in April. On June 17, leftist FARC rebels attacked the pipeline, which resulted in a shutdown of the pipeline and a spill that contaminated a nearby river. The pipeline outage lasted 67 days, the longest outage since the pipeline came online in the 1980s. In June, FARC also bombed the 185-mile, 190,000-b/d Transandino pipeline twice. The second attack, on June 21, spilled crude oil into a nearby river. In September, another rebel group, the National Liberation Army, allegedly attacked the Caño Limón pipeline and caused it to shut down.
- **FARC Attacks Cause Massive Power Outages in Colombia (May–June):** On May 31, about 400,000 Energy Enterprise of the Pacific customers in Buenaventura, Colombia, lost power after a key electrical tower was destroyed, an act military officials blamed on FARC rebels. The port of Buenaventura, Colombia's largest, handles most of the nation's foreign trade. On June 11, FARC attacked an energy pylon in the southern province of Caquetá, leaving 500,000 people without electricity.
- **Venezuela's Amuay and Cardon Oil Refining Complex Shut Due to Power Failure (October):** Petróleos de Venezuela's (PDVSA) 635,000-b/d Amuay and Cardon refining complex, the country's largest, was shut down by a power failure on October 1. President Nicolás Maduro attributed the failure to sabotage by opponents of his leftist government. PDVSA restored power several hours later; however, it took several days to return the refinery to normal operations.

### 5.1.5 Europe

- **Attack Cuts Power to 1.6 Million People in Crimea (November):** Around 1.6 million people in Crimea were left without electricity on November 22 after pylons carrying power lines to the Russia-annexed peninsula were blown up. It was not reported who had damaged the pylons; however, Russian officials blamed Ukrainian nationalists. Ukraine's Energy Minister said that four power lines had been damaged and that two districts of Ukraine's Kherson region were also left without power. State-run energy firm Ukrenergo said that it hoped to finish repairs on all of the damaged lines within 4 days of the attack.

## 5.2 International Infrastructure Projects

Major international infrastructure projects reported in EAD in 2015 focused primarily on the petroleum sector and were located in Africa, the Middle East, and the Americas. Significant infrastructure projects are summarized below.

### 5.2.1 Africa

- **Kenya, Uganda to Build Crude Oil Pipeline Through Kenya's North:** Kenya and Uganda, in August, agreed to build a 930-mile crude oil pipeline that would run from the Hoima District in Uganda through the Lokichar Basin in northern Kenya to a port in the coastal town of Lamu. Proponents for a southern route cited security concerns in the north, where bandits and Islamist militants carry out attacks sporadically.
- **Eni Discovers Supergiant Gas Field Offshore Egypt, Largest Ever Found in the Mediterranean Sea:** In late August, Eni made a supergiant gas discovery at its Zohr prospect, in the deep waters off Egypt. The discovery is located in the economic waters of Egypt's Offshore Mediterranean, in 4,757 feet of water, in the Shorouk block. The discovery could hold a potential 30 trillion cubic feet of lean gas in place, covering an area of about 39 square miles. In November, Egypt's oil minister announced that the country plans to start natural gas production at the Zohr field in 2017, a year ahead of schedule.
- **BP to Begin Gas Production at Egypt Concession in Early 2017:** BP announced in October that its North Alexandria concession<sup>28</sup> would begin gas production in early 2017 instead of the previously planned start date of mid-2017. The proposed production at the offshore concession is scheduled to be 450 MMcf/d in 2017, and will reach 1.2 Bcf/d by the end of 2019. BP was also awarded three new offshore exploration blocks in Egypt, and BP and its partners committed to an investment of \$229 million.
- **Shell Starts Production at Bonga Phase 3 Project in Nigeria:** In October, Shell announced that production had started at its Bonga Phase 3 project offshore Nigeria. Bonga Phase 3 is an expansion of the Bonga Main development, with peak production

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<sup>28</sup> A concession is a contract between a company and a government that gives the company the right to operate a business (e.g., oil field) with the government's jurisdiction. Concessions grant an area of land/water to a company and that company then owns all of the resources in the ground. Royalties or taxes can be collected by the government for the revenues earned from extracting the resources.

expected to be some 50,000 barrels of oil equivalent per day (boe/d). This will be transported through existing pipelines to the Bonga floating production storage and offloading facility, which has the capacity to process more than 200,000 b/d and 150 MMcf/d.

### 5.2.2 Middle East

- **Jordan and Iraq Change 150,000-b/d Oil Pipeline Route Due to Islamic State Fears:** In late July, Iraq and Jordan agreed to change the route of a proposed oil pipeline due to security fears over the Islamic State of Iraq and Syria (ISIS). The pipeline, when completed, will supply Jordan with around 150,000 b/d of oil from Iraq, which will use the same pipeline for exports to other countries. A gas pipeline will be laid alongside it.
- **Bahrain and Saudi Arabia Sign Contracts for New 350,000-b/d Oil Pipeline:** Saudi Arabia and Bahrain signed contracts in September to lay a new 350,000-b/d oil pipeline between the two countries, with the link due to be operational in 2018. Bahrain relies on output from the Abu Safa oil field that it shares with Saudi Arabia for the vast majority of its oil, and the new pipeline will replace an aging 230,000-b/d link and enable Bahrain Petroleum Company to expand the processing capacity of its 267,000-b/d Sitra refinery.
- **Iraq Seeks Investments for Integrated South Enhanced Oil Recovery Project:** In December, Iraq announced that it had approached PetroChina and ExxonMobil about investing in the Integrated South Project, which will consist of building oil pipelines, storage facilities, and a seawater supply project to inject water from the Persian Gulf to maintain pressure and enhance oil recovery. The project is an expansion of the Luhais, Nassiriya, Tuba, Nahr Bin Umar, and Artawi oilfields, which currently produce 240,000 b/d in total. The project would enhance production to 350,000 b/d in 2016.

### 5.2.3 Asia

- **Gazprom Starts Construction of Sila Sibiri Gas Pipeline From Russia to China:** Gazprom began the construction project of the Sila Sibiri pipeline from Yakutia, Russia, to China in April. The company said that construction work was being carried out according to schedule. The 30-year contract for the supply of up to 38 billion cubic meters of natural gas per year was signed with China National Petroleum Corporation in May 2014. Under the contract, deliveries are due to begin in 4 to 6 years.
- **Turkmenistan-Afghanistan-Pakistan-India Natural Gas Pipeline Achieves Major Milestones:** In 2015, three major milestones were reached in the Turkmenistan-Afghanistan-Pakistan-India natural gas pipeline (TAPI) project: an agreement on the TAPI holding company's share structure, the selection of a leader for the consortium, and the groundbreaking ceremony. The proposed 1,735-km pipeline would transport 33 billion cubic meters/year of natural gas from Turkmenistan's Galkynysh field, the second-largest gas field in the world, to Afghanistan, Pakistan, and India.

### 5.2.4 Americas

- **Pemex Announces Oilfield Discovery in Gulf of Mexico (June):** In June, Mexican state oil company, Pemex, said that it had discovered new shallow-water oil fields in the

southern Gulf of Mexico with total proven, probable, and possible reserves of 350 million bbl of crude equivalent. Pemex hopes to develop the fields to produce 200,000 b/d by mid-2018. As part of a reform ending Pemex's oil and gas monopoly, Mexico said that it would auction 14 oil and gas exploration and production blocks not far from the new fields.

- **Kinder Morgan Announces Expansion of Mier-Monterrey Pipeline Into Mexico:** In July, Kinder Morgan announced plans for an incremental firm natural gas transportation service of 700 MMcf/d on its Mier-Monterrey pipeline, which would expand capacity to approximately 1.340 Bcf/d. The expansion project, which would be completed by the fourth quarter of 2017, will consist of the looping of the existing Mier-Monterrey pipeline system from the Mexico-U.S. border to Huinalá, Nuevo León, Mexico, and a new lateral from Pesquería, Nuevo León, to Escobedo, Nuevo León.
- **Pacific Exploration & Production Announces Start of Operations of Puerto Bahía Port Facilities in Colombia (August):** Pacific Exploration & Production announced in August the start of operations in Puerto Bahía port facilities in Cartagena, Colombia. The terminal officially commenced liquid and general bulk transport operations on August 28, opening a multi-modal specialized port for the public. The terminal has an initial storage capacity of 2.4 million bbl for both naphtha and crude oil.

### 5.2.5 Europe

- **Lithuania Signs Non-Binding Deal to Import U.S. LNG:** In February, Lithuanian LNG importer, Litgas, announced that it had signed a non-binding agreement to purchase LNG from the United States' first LNG export terminal—Cheniere Energy's Sabine Pass LNG terminal in Texas. Lithuania opened a floating LNG import terminal in the port of Klaipeda in 2014 to reduce its dependence on Russian gas supplies. The first cargoes from Sabine Pass were expected to be delivered by late 2015. However, in January 2016, Lithuania said that it put import plans on hold because the U.S. LNG was too calorific for the country's gas system.
- **Statoil's Polarled Gas Pipeline First to Cross Arctic Circle In-Service (August):** In August, Statoil's Polarled gas pipeline became the first pipeline to take the Norwegian gas infrastructure across the Arctic Circle, opening a new gas highway from the Norwegian Sea to Europe. The 300-mile, 36-inch-diameter pipeline runs from Nyhamna in western Norway to the Aasta Hansteen field. Polarled was expected to begin shipping gas to Europe in fall 2015.

## Appendix A. Criteria for EAD Selection

| Asset or Sector Activity   | Type of Event or Disruption              | Criteria by EAD Category <sup>1</sup>                                 |   |
|--|--|---|---|
|  |  | Major Event   | Energy Sector Event   |
| End Use  | Power Outage, Restoration                | ≥ 250,000 customers   | 10,000–249,999 customers  |
| Power Plant  | Shutdown, Restart, New Capacity          | Depends on impact, typically > 2,000 MW                               | 100–1,999 MW  |
| Transmission Line  | Shutdown, Restart, New Capacity          | Depends on impact, typically > 500 kV                                 | 115–500 kV  |
| Substation   | Break-in, Damage, Shutdown               | –   | Copper theft or severe impact   |
| Refinery   | Shutdown, Restart, Flaring, New Capacity | ≥ 200,000 b/d   | < 200,000 b/d   |
| Production or Transportation <sup>2</sup>                              | Shutdown, Restart, Flaring, New Capacity | U.S./Canada: ≥ 200,000 b/d<br>Foreign: Depends on impact <sup>3</sup> | U.S./Canada: 10,000–199,999 b/d<br>Foreign: ≥ 25,000 b/d <sup>3</sup> |
| Exploration  | Oil Discovery                            | U.S./Canada: > 10 billion bbl   | U.S./Canada: 0.2–10 billion bbl<br>Foreign: ≥ 2 billion bbl           |
| U.S./Canada Gas Production, Processing, or Transportation <sup>2</sup> | Shutdown, Restart, New Capacity          | Depends on impact, typically > 500 MMcf/d or major explosion          | 100–500 MMcf/d  |
| Ethanol Plant, Biorefinery   | Shutdown, Restart, New Capacity          | Depends on impact, typically > 500 MMgal/year                         | 10–500 MMgal/year   |

Notes:

1. Criteria refer to the number of customers affected, or the impact on energy infrastructure (measured in volume or capacity).
2. Transportation includes pipelines, marine tankers, tanker trucks, import/export terminals, railroads, and other forms of transportation.
3. Foreign producers include only those countries that supply the United States.