

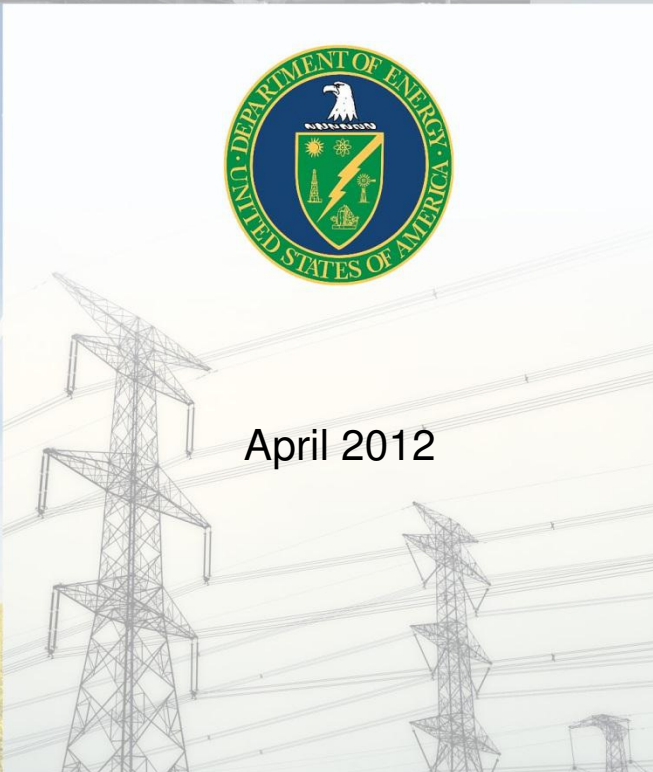


Year-in-Review: 2011

Energy Infrastructure Events and Expansions



Infrastructure Security and Energy Restoration
Office of Electricity Delivery and Energy Reliability
U.S. Department of Energy



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For Further Information

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Contents

1.	Introduction.....	4
1.1	Background and Organization.....	4
1.2	Data Sources and Limitations	5
1.3	Financial and Economic Context	5
2.	Major Developments.....	7
2.1	Summary of Incidents and Disruptions	7
2.2	Disruption Analysis	10
2.3	Electricity Disruptions	10
2.3.1	Customer Outages	10
2.3.2	Power Plant Outages.....	12
2.4	Natural Gas Disruptions	13
2.4.1	Production and Processing Plants	13
2.4.2	Pipelines.....	14
2.5	Petroleum Disruptions	15
2.5.1	Production	15
2.5.2	Refineries and Fractionators.....	16
2.5.3	Transportation	17
2.5.4	Hours-of-Service Exemptions	18
2.6	Biofuel Disruptions	19
2.7	Cyber Security	20
3.	Infrastructure Changes.....	21
3.1	Electricity	21
3.1.1	Coal-fired Plant Retirements.....	21
3.1.2	Coal- and Natural Gas-fired Plants – New Capacity	22
3.1.3	Renewable Plants – New Capacity	23
3.1.4	Nuclear Power Plants	24
3.1.5	Transmission Expansion and Smart Grid Implementation.....	26
3.2	Natural Gas Projects.....	27
3.2.1	Natural Gas Processing Plants	27
3.2.2	Natural Gas Pipelines	28
3.2.3	LNG Export Terminals	29
3.3	Petroleum Projects.....	29
3.3.1	Refineries	30
3.3.2	Transportation	30

3.4	Biofuels	32
3.4.1	New Biofuel Plants	32
3.4.2	Plants in Transition	33
3.4.3	Distribution Infrastructure.....	34
3.4.4	Policy Changes and Funding	35
4.	International Events	36
4.1	Incidents and Disruptions.....	36
4.2	Infrastructure Projects	37
4.2.1	Petroleum.....	37
4.2.2	Natural Gas	39
4.2.3	Renewables.....	39
Appendix A.	Criteria for EAD Story Selection.....	41
	Asset or Sector Activity (grouped by energy type)	41
	Type of Event or Disruption	41
	Criteria by Story Category ¹	41
Appendix B.	Major Developments, 2011.....	42
Appendix C.	Hours-of-Service Exemptions Citations.....	48
Appendix D.	Petroleum Infrastructure Projects.....	53
Appendix E.	Abbreviations	55

Figures

Figure 1.	U.S. Oil and Gas Spot Prices, 2011	6
Figure 1.	2011 Timeline for Major Stories	7
Figure 3.	Major U.S. Electric Customer Outage Events, 2010–2011	10
Figure 4.	U.S. Electric Customer Outage Events by Cause and Magnitude, 2011	12
Figure 5.	Unplanned Power Plant Outages, 2011	13
Figure 6.	U.S. Refinery Disruption Events by Cause, 2011	17
Figure 7.	New Power Plant Capacity in the United States, 2011	22
Figure 8.	Number of New and Proposed Renewable Energy Projects, 2011	24
Figure 9.	Capacity of New Natural Gas Processing Plant Projects by Shale Play	28
Figure 10.	Number of Proposed Biofuel Projects, 2011	33

Tables

Table 1.	Hours-of-Service Waivers Issued, 2011	19
Table 2.	Proposed LNG Export Terminal Projects	29

1. Introduction

The 2011 Year-in-Review (YIR) provides a summary of significant energy disruptions and infrastructure changes that occurred in the United States throughout 2011. The focus is on the United States, but international events that impacted the United States are also reported.

1.1 Background and Organization

The 2011 YIR is based primarily on information reported in the [Energy Assurance Daily](#) (EAD) between January 1, 2011 and December 31, 2011. The 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.

In 2011, stories were grouped by the level of impact on energy infrastructure into one of the following categories (see **Appendix A** for selection criteria):¹

- Major Development
- Energy Sector Stories (sub-divided into electricity, petroleum, natural gas, and other energy types)
- Energy Notes

Major Development stories describe events that disrupt energy service to a large segment of the population and/or damage critical assets in the energy sector. These events frequently show up in newspaper headlines and in television news reports. The EAD focuses on only the event's impact to the energy sector, and not on the widespread impact of the event. As an example, Hurricane Irene in August 2011 knocked out power to millions of customers, and this powerful storm was reported as a Major Development story for several days. While Hurricane Irene had many disastrous impacts, the focus of the EAD was on the magnitude of the initial power outage and the progress in restoring power to electricity customers.

Most events covered are not classified as Major Developments; rather, they fall into the Energy Sector Stories category. Energy Stories are based on significant events, but the level of disruption or damage is less widespread than a Major Development. Finally, Energy Notes describe noteworthy energy sector events whose impacts are typically confined to a relatively small geographic region.

¹ In 2012, the EAD story categories were revised to remove the "Energy Notes" section and add an "International News" section.

1.2 Data Sources² and Limitations

The EAD is derived from publicly available information. Classified or business-confidential data are not used, nor is information that is accessible only through subscription services. As a result, the EAD—and by extension, the 2011 YIR—should not be viewed as an exhaustive summary of all significant energy events.

The 2011 YIR is subject to regional or regulatory reporting differences. For example, California and Texas State agencies tend to release more energy information into the public domain than other States. This abundance of information can distort the balance of stories published, with more coverage appearing for California and Texas. Similarly, the U.S. Nuclear Regulatory Commission (NRC) provides an abundance of public information on nuclear power plants, including daily records on the operational status of all 104 nuclear power plants in the United States. There is no equivalent reporting mechanism for coal, natural gas, or any other class of utility-scale power generation. As a result, there is often a large number of nuclear power plant stories compared to coal and other plant types, even though coal accounts for significantly more electricity production in the United States—about 45 percent from coal-fired plants and about 20 percent from nuclear plants.³

Due to the limited scope of data sources used to support the EAD, readers are cautioned to not use data in the 2011 YIR to support detailed analyses. Comparisons between 2010 and 2011 are provided in the 2011 YIR to highlight a few selected trends, but these comparisons are based only on stories captured by the EAD and should not be viewed as rigorous comparisons between events that occurred in 2010 and 2011. Readers are advised to view the 2011 YIR as a snapshot of newsworthy events and broad trends that shaped the U.S. energy sector in 2011.

1.3 Financial and Economic Context

Price trends for crude oil and natural gas in 2011 are shown in Figure 1. Natural gas prices averaged between \$3.80 and \$5.00 per million British thermal units (MMBtu) through early June, and then began a steady decline to close the year at about \$3.00/MMBtu. This decline represents sustained increases in natural gas supply stemming from new natural gas production from the Marcellus and Utica Shale formations in the Appalachian region and the Eagle Ford Shale formations in South Texas. The increased supply coupled with a warmer-than-normal winter has lowered the market price to levels not seen since 2002.

² Unless noted otherwise, the source for all information in this report is the Energy Assurance Daily (www.oe.netl.doe.gov/ead.aspx).

³ <http://www.eia.gov/electricity/annual/html/table2.1a.cfm>

Figure 1. U.S. Oil and Gas Spot Prices, 2011

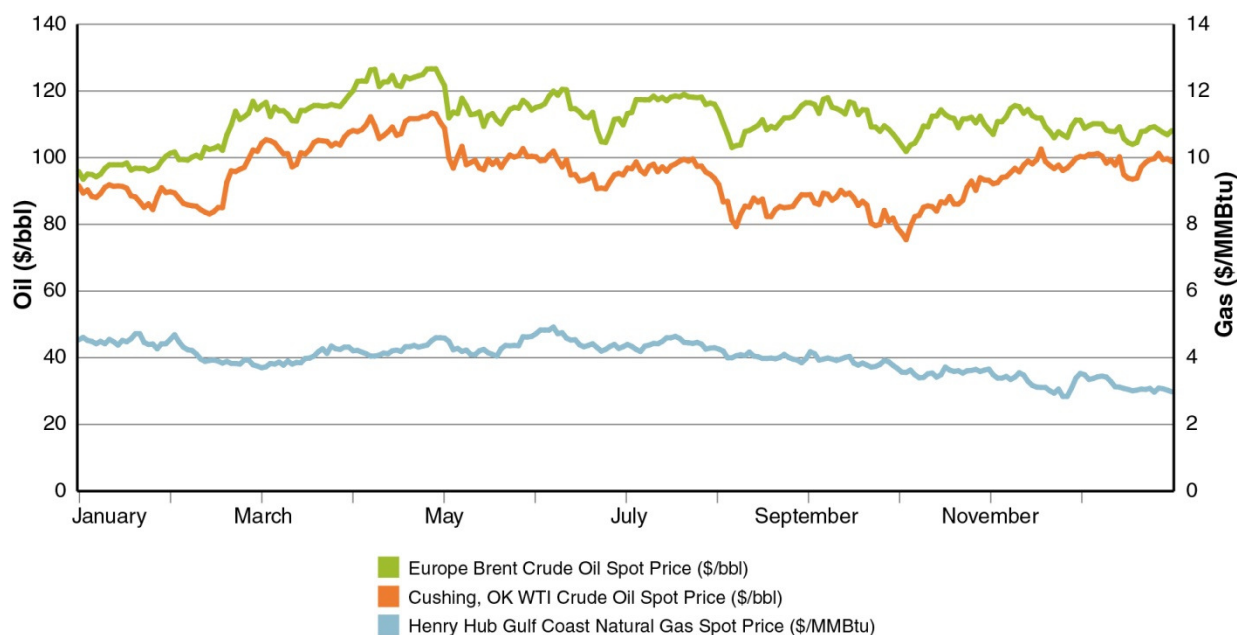


Figure 1 shows two crude oil benchmark prices: U.S. West Texas Intermediate (WTI) and North Sea Brent. Crude prices rose for both benchmarks through May 2011, driven primarily by the Libyan crisis and the Arab Spring unrest. Thereafter, the Brent price varied between \$110 and \$120 per barrel (bbl), while the WTI price declined to levels under \$80/bbl by early October before increasing to around \$100/bbl by the end of the year.

Historically, WTI has typically traded at a slight premium to Brent. In 2011, however, the market price for Brent was as much as \$28/bbl more than WTI. The reason for this departure from historical price trends was that crude oil inventories in Cushing, Oklahoma—the location used to determine WTI prices—grew substantially in 2011 as a result of crude production from the Williston Basin and Bakken field in North Dakota, production from other U.S. oil fields, and supplies from Western Canada. Lack of pipeline infrastructure out of Cushing to Gulf Coast refining centers resulted in inventory constraints, and Cushing crude had to be heavily discounted to move it by pipeline—and in some cases, by truck—to the Gulf Coast. As noted in **Section 4 (Infrastructure Changes)**, a large number of petroleum transportation projects were announced in 2011 to address these inventory constraints, and some have already been implemented (including railcar shipments of Bakken crude to the Gulf Coast). Significantly more pipeline capacity out of Canada and the Bakken and Eagle Ford regions may become available over the next 3 to 4 years.

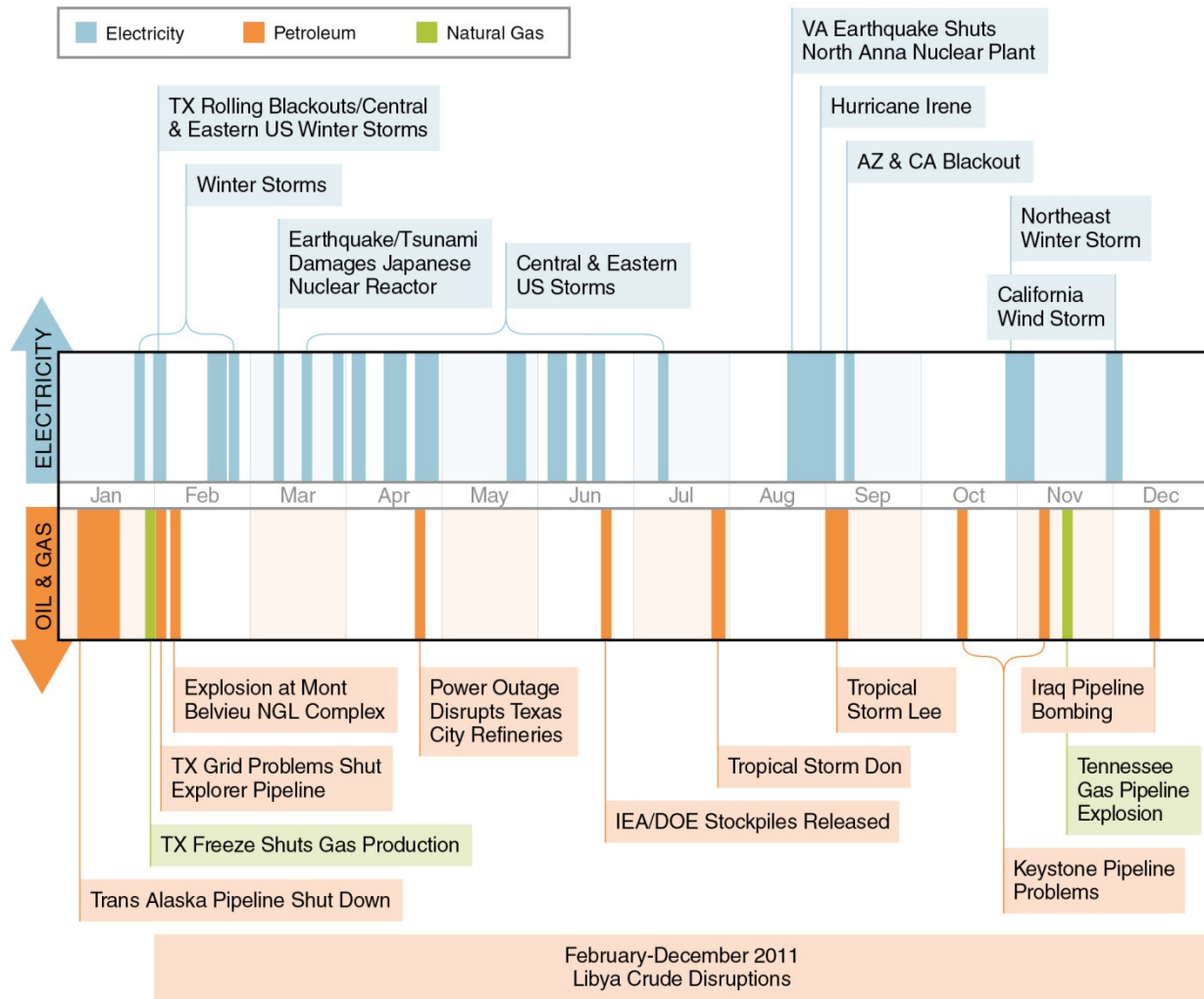
2. Major Developments

This section provides a summary of major incidents and disruptions reported in the Energy Assurance Daily (EAD) during 2011.

2.1 Summary of Incidents and Disruptions

In 2011, there were 37 unique energy events that met the criteria for a major disruption, including three events impacting international energy assets (see **Figure 2** for timeline, **Appendix A** for classification criteria, and **Appendix B** for a full list of all major developments). Disruptions to energy assets were primarily caused by weather or natural events, including hurricanes, tropical storms, snowstorms, tornadoes, and earthquakes. Equipment failure and human error were responsible for four disruptions.

Figure 2. 2011 Timeline for Major Stories



Twenty-seven major disruptions involved domestic electricity assets in 2011. Of these, the most significant were:

- Hurricane Irene, which knocked out power to more than 9.3 million customers along the East Coast and Puerto Rico in August;
- A severe winter storm, which knocked out power to 4.3 million customers in the Northeast in late October;
- A severe winter storm system across the Central and Eastern United States and rolling blackouts in Texas caused by freezing conditions—together affecting a peak of 2.4 million customers in early February;
- A string of ten powerful spring and summer thunderstorms that knocked out power to utility customers across the Central and Eastern United States from March to July, including a powerful wave of thunderstorms and a “Super Outbreak” of tornados in April, which knocked out power to 2.2 million customers; and
- A substation failure in Arizona in September, which tripped a major transmission line and knocked out power to 1.6 million customers in Southern California and western Arizona, and nearly 1.2 million customers in northwest Mexico.

In addition to these customer outage events, an August earthquake with its epicenter in Mineral, Virginia forced the shutdown of two nuclear reactors at Dominion Power’s 1,953 megawatt (MW) North Anna nuclear power plant. Both units at the plant remained shut until the NRC approved their restart in November.

Five major disruptions involved natural gas in 2011, and three of the most significant were:

- The February Texas freeze, which forced the shut-in of 600 million cubic feet per day (MMcf/d) of gas production in Texas;
- Tropical Storm Don in July, which shut-in an estimated 1.35 billion cubic feet per day (Bcf/d) of gas in the Gulf of Mexico; and
- Tropical Storm Lee in September, which shut-in a peak of 2.2 Bcf/d of gas production in the Gulf of Mexico.

Eight major disruptions involved domestic petroleum assets in 2011. The most significant of these disruptions were:

- A leak on the Trans-Alaska Pipeline System, which curtailed Alaska North Slope crude output by up to 600,000 barrels per day (b/d) for 9 days in January;
- An April power outage that shut units at three Texas City refineries—some for more than a week;
- Tropical Storm Lee in early September, which shut-in a peak of 846,670 b/d, or roughly 60 percent, of the oil production in the Gulf of Mexico, and forced the closure of the Louisiana Offshore Oil Port (LOOP); and

- Two brief shutdowns of TransCanada's 591,000 b/d Keystone Pipeline in October and November.

Three international events met the criteria for inclusion as major disruptions in the EAD. In late February, unrest in Libya led to a Civil War, which continued for much of the year, disrupting as much as 1.6 million barrels per day of crude output, and eventually prompting the International Energy Agency (IEA) and DOE to release 60 million barrels of crude oil over 2 months from emergency stockpiles. In March, an earthquake triggered a tsunami that heavily damaged the Fukushima-Dai'ichi nuclear power plant in Japan, and shut down eleven other nuclear plants as well as six refineries. In the wake of the disaster, regulators increased scrutiny at nuclear facilities around the world, including in the United States. In December, terrorists bombed a pipeline serving the Rumaila oilfield in Southern Iraq, cutting production by 700,000 b/d.

2.2 Disruption Analysis

Energy disruptions that occurred in 2011 are grouped into four energy sectors: electricity, natural gas, petroleum, and biofuels. A fifth cross-cutting category, cyber security, is discussed following the four energy sectors.

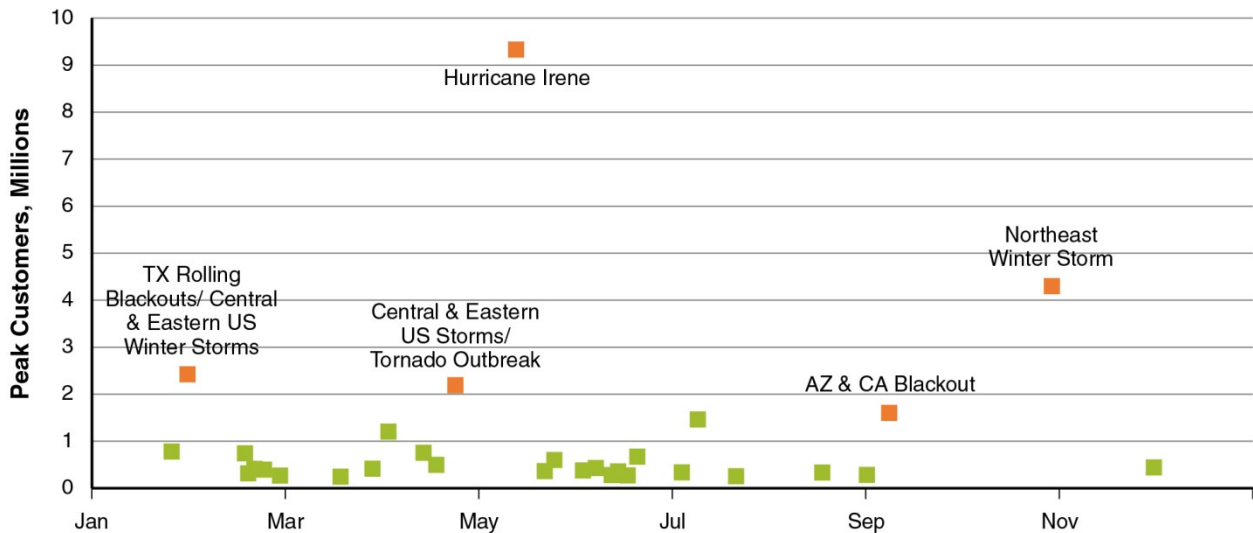
2.3 Electricity Disruptions

Electricity disruptions are discussed from two perspectives: customer outages and power plant outages.

2.3.1 Customer Outages

Power outages affecting a large number of utility customers occurred more frequently and affected a larger number of customers in 2011 compared to 2010 (see **Figure 3**). In 2010, there were 17 disruptions that affected 250,000 or more customers, with the largest outage affecting nearly 1.3 million customers. In 2011, there were 30 disruptions that affected 250,000 or more customers, with five of these outages affecting more than 1.5 million electricity customers. Twenty-nine of the 30 significant outages in 2011 were caused by weather, and one was man-made.

Figure 3. Major U.S. Electric Customer Outage Events, 2011



Five events with more than 1.5 million peak customer outages (noted in orange in **Figure 3**):

- 1. Hurricane Irene, 9.3 million customers, August 22–September 4:** Hurricane Irene was recognized as a major storm long before making landfall. When it did make landfall, it resulted in less coastal damage than anticipated, but Upstate New York and Vermont suffered severe flooding. Power outages occurred along Irene’s entire path, beginning

in the U.S. Virgin Islands and Puerto Rico and moving up the Eastern Seaboard from the Carolinas to New England before dissipating. Affected customers peaked at 8.38 million customers on the East Coast and 0.95 million in Puerto Rico.

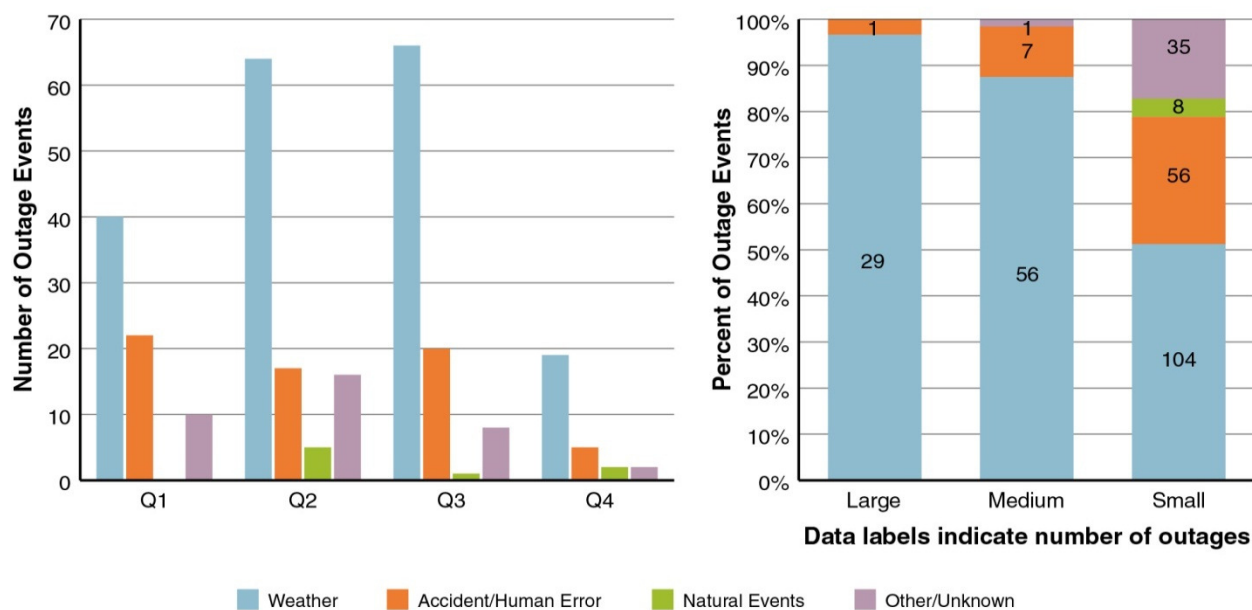
2. **Northeast Winter Storm, 4.3 million customers, October 29–November 7:** An unusually early snow storm shattered October snowfall records for many areas in the Mid-Atlantic and New England. The snow was very wet and heavy and occurred early enough that many trees still had their leaves. This caused many trees to fall, bringing down power lines.
3. **Texas Rolling Blackouts and Central & Eastern U.S. Winter Storms, 2.4 million customers, January 31–February 2:** Sustained low temperatures in Texas caused a number of problems for the Texas grid, ranging from freezing equipment and controls to loss of gas pressure and freezing water pipes, causing outages to power plant fuel and cooling systems. Fifty units totaling 7 gigawatts (GW) were forced out during the freeze, leading to rolling blackouts across the State, affecting about 1.2 million customers within Texas. As the storm system proceeded east, another 1.2 million customers were affected across the Midwest, Mid-Atlantic, and New England.
4. **Central & Eastern U.S. Storms and Tornado Super Outbreak, 2.2 million customers, April 25–28:** Tornadoes and other strong thunderstorms had already led to two large customer outages in the South and another in the Midwest in April 2011 when this tornado outbreak occurred.
5. **Arizona & California Blackout, 1.6 million customers, September 8:** In September, a worker error at an Arizona substation tripped a 500 kilovolt (kV) transmission line, cutting power to 1.6 million customers in Arizona and California, with the majority of customers located in the San Diego Gas & Electric service territory. In addition to the U.S. customer outages, this event caused nearly 1.2 million customer outages in Mexico.⁴ This event was the only non-weather-related outage to affect more than 250,000 customers in 2011.

As shown in **Figure 4**, the second quarter (2Q) and third quarter (3Q) had the highest number of outage events, which were driven primarily by weather events. Q2 and Q3 had 102 and 94 outage events, respectively, compared to 70 outage events in Q1 and 27 events in Q4. Outages caused by human error and accidents (including equipment failure) ranged from five in Q4 to 22 in Q3.

A breakdown of large, medium, and small disruptions in 2011 is shown in **Figure 4**. All but one of the 30 large disruptions were caused by weather. Weather events were also the dominant cause of medium-sized outages. Weather, however, was responsible for only about half of the smaller events, with the remainder caused by accidents, human error, other natural events, or unknown reasons.

⁴ Outage figures revised from those initially reported in the EAD to represent more accurate information reported by utilities after publication. "Pacific Southwest Outage." SDG&E. Presentation at Disaster Assistance and Recovery Forum. March 6, 2011. <http://bcl.uschamber.com/sites/default/files/SD%20Regional%20Forum%20-%20Earthquake%20Power%20Outage%20Challenges.pdf>

Figure 4. U.S. Electric Customer Outage Events by Cause and Magnitude, 2011



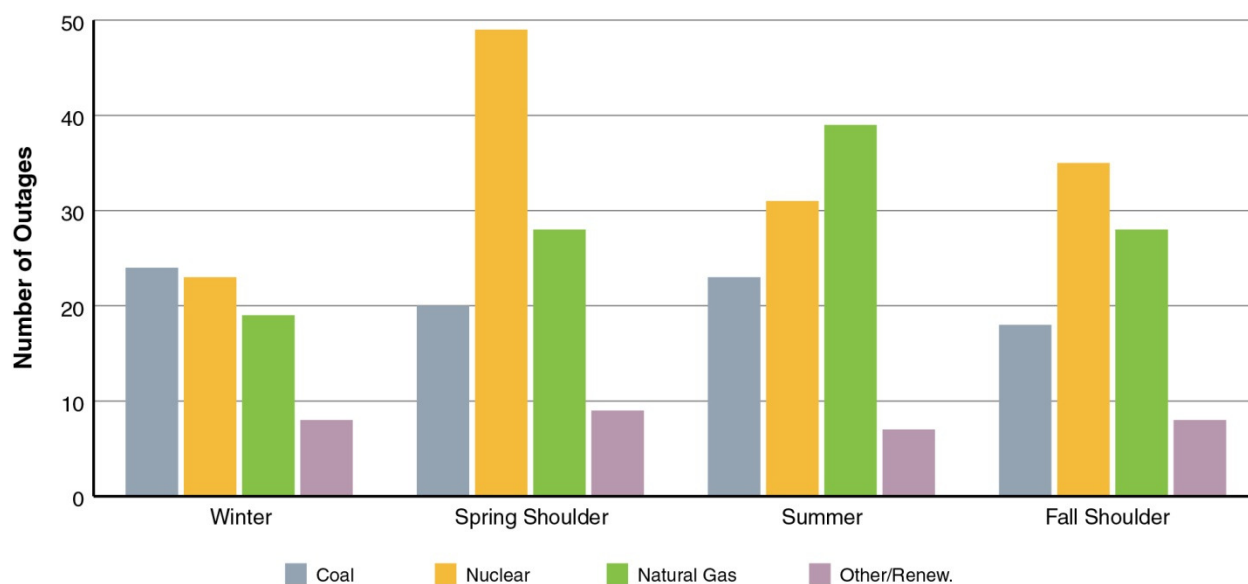
Notes: 1) Small 10,000-50,000
 2) Medium 50,000-250,000
 3) Large >250,000

2.3.2 Power Plant Outages

With the exception of nuclear plants, data on power plant outages are less comprehensive than data on customer outages. While significant customer outages are almost always widely reported by utilities and the media, power plant outages frequently do not receive the same level of attention. For coal, natural gas, hydroelectric, and other power plant outages, the EAD relies on publicly available industry newsletters, company announcements, and regulatory entities (e.g., the California Independent System Operator and the Texas Commission on Environmental Quality). As a result, the coverage of non-nuclear power plant outages varies substantially between States and regions, and between companies that own these assets. In contrast, scheduled and unscheduled outages of nuclear plants are closely tracked and reported by the U.S. Nuclear Regulatory Commission (NRC), and as a result outage data reported for nuclear plants is relatively comprehensive compared to information reported for coal- and natural gas-fired power plants.

Figure 5 shows U.S. power plant unplanned (or forced) outages, and outages where the cause was unknown or not reported. Based on reports in the Energy Assurance Daily (EAD) in 2011, outages for coal-fired units were relatively flat across the seasons and outages for natural gas-fired plants actually peaked during the high-demand summer months. Since natural gas-fired plants operate more often during the summer, it is not unusual to see more forced outages for natural gas-fired plants during this season. Because coal-fired plants operate at base load in most regions, forced outages are likely to occur in all seasons.

Figure 5. Unplanned Power Plant Outages, 2011



Note: Includes power plant outages where the cause was unknown or not reported.

2.4 Natural Gas Disruptions

Over the course of 2011, the EAD reported numerous disruptions to natural gas assets, including disruptions at natural gas processing plants, pipelines, platforms, fields, and wells. Most of these events were caused by equipment failure, power failure, or were weather-related. The number of significant events impacting natural gas infrastructure was more than twice as high in 2011 than in 2010. The 2010 Year-in-Review (YIR) highlighted seven significant disruptions to natural gas infrastructure, including two well explosions, three pipeline explosions, and an explosion at a liquefied natural gas (LNG) storage facility. In the 2011 YIR, 15 significant disruption events are highlighted, including 3 events impacting natural gas production and processing assets, and 12 events impacting natural gas pipelines.

2.4.1 Production and Processing Plants

Major disruptions to natural gas production and processing infrastructure were primarily weather-related. Smaller disruptions were largely caused by equipment failures or the loss of power. Major disruptions to natural gas production and processing infrastructure are summarized in the bullets below:

- Tropical Storm Lee:** Tropical Storm Lee, which moved through the Gulf of Mexico in early September, disrupted natural gas output for more than a week. Shut-ins peaked at 2.2 billion cubic feet per day (Bcf/d), or about 42 percent, of total natural gas output from platforms in the federally administered Gulf of Mexico.

- **Tropical Storm Don:** This storm moved through the Gulf in late July and forced the shut-in of an estimated 1.35 Bcf/d of natural gas production.
- **Texas Freeze:** In late January and early February extreme freezing conditions forced the shut-in of more than 600 million cubic feet per day (MMcf/d) of natural gas production in Texas, including 250 MMcf/d in the East Texas Basin, 220 MMcf/d in the Fort Worth Basin, and 215 MMcf/d in the Texas Gulf Coast basin.

2.4.2 Pipelines

Several high-pressure transmission pipelines experienced shutdowns in 2011, including several ruptures and explosions at the Tennessee Gas Pipeline, which experienced three explosions, and on the Pacific Gas & Electric (PG&E) pipeline system, which experienced two ruptures during pressure tests in California. The most significant natural gas pipeline events of 2011 are summarized in the bullets below:

- **Tennessee Gas Pipeline Explosions:** El Paso's Tennessee Gas Pipeline experienced three major explosions in 2011. An explosion in February in Ohio caused El Paso to declare force majeure on deliveries. An explosion on a 25-inch segment in Ohio in mid-November destroyed at least two buildings and started a number of fires. Two days after the blast, the Pipeline Hazardous Materials Safety Administration issued a corrective order against Tennessee Gas, ordering the company to reduce operating pressure by 20 percent. Just 3 days after the order, a third explosion ripped through the line in Mississippi, forcing the evacuation of 20 homes. The Tennessee Gas Pipeline stretches from the U.S. Gulf Coast to the Northeast and has multiple supply and delivery points along the way.
- **PG&E Pipeline Ruptures:** A 34-inch PG&E pipeline supplying the San Francisco Bay area ruptured in October while the company was conducting a pressure test prior to boosting gas levels to meet winter demand. The line is one of two major transmission lines that supply much of the San Francisco Bay Area's natural gas. The company planned to replace the line in about a week. A second PG&E pipeline, a 24-inch line near San Mateo, California, also ruptured during a pressure test in November.
- **TransCanada Pipeline Explosion:** A February explosion and ensuing fire shut two of three pipelines making up TransCanada's Canadian Mainline system in Ontario, Canada, reducing overall system flows by as much as 1.1 Bcf/d. One of the two lines sustained major damage and was out for weeks, while a second line was shut as a precautionary measure.
- **Gulf South Pipeline Fire:** A mid-February fire in a compressor station led the Gulf South Pipeline Company to reduce throughput by about 300 MMcf/d along its natural gas pipeline in Texas. The Gulf South Pipeline system transports natural gas throughout Texas, Louisiana, Mississippi, Alabama, and Florida.

- **Neptune Gas Plant Upset and Nautilus Pipeline Shutdown:** An upset at the Neptune gas processing plant in Louisiana forced Enbridge to shut its 600 MMcf/d Nautilus gas pipeline that serves offshore Louisiana gas producers.
- **CenterPoint Energy Pipeline Explosion:** A 20-inch pipeline in Minnesota operated by CenterPoint Energy exploded in March near one of the company's maintenance facilities. CenterPoint said that the incident did not impact deliveries to its customers.
- **ExxonMobil Pipeline Rupture:** An ExxonMobil subsea pipeline ruptured in September, forcing the company to shut-in 280 MMcf/d of natural gas production in the Gulf of Mexico.
- **Ruby Pipeline Fire:** In December, El Paso shut its 1.5 Bcf/d Ruby pipeline for several days and declared force majeure on deliveries after a fire broke out on ancillary equipment connected to one of the line's 42 valves in Utah. The line moves natural gas from western supply basins to markets in the U.S. West Coast.
- **Bison Pipeline Rupture:** TransCanada's Bison natural gas pipeline, which runs from Wyoming to North Dakota, ruptured in Wyoming in July, forcing the company to shut the line for repairs. The line was carrying 365 MMcf/d at the time of the incident, below its maximum capacity of 477 MMcf/d.

2.5 Petroleum Disruptions

In 2011, several major incidents in the petroleum sector triggered significant disruption to infrastructure assets across the petroleum supply chain. This section highlights major domestic incidents.

2.5.1 Production

Two major oil production disruptions of 2011 were caused by tropical storms impacting offshore production in the Gulf of Mexico.

Tropical Storm Lee: The Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) reported on September 2 the evacuation of 169 platforms and 16 rigs in the U.S. Gulf of Mexico due to Tropical Storm Lee. At its peak on September 6, 846,670 barrels per day (b/d) of oil production was shut-in, or about 60.5 percent of total U.S. Gulf of Mexico production. In addition, the Louisiana Offshore Oil Port (LOOP) was also shut due to poor sea conditions stemming from the storm. Oil operations in the Gulf were largely restored by September 9.

Tropical Storm Don: Offshore production companies began to evacuate platforms and rigs in the U.S. Gulf Coast on July 28. At its peak on July 29, 56 platforms and 4 rigs were evacuated, which shut-in 166,554 b/d of oil production, according to the Bureau of Ocean, Energy Management, Regulation and Enforcement (BOEMRE). According to news reports, however, 618,000 b/d of oil production was shut-in. Workers returned to the evacuated platforms on July 31 and August 1, after the storm had passed.

2.5.2 Refineries and Fractionators

Refinery outages triggered by weather impacts on the power grid caused several notable outages in the Gulf Coast region in 2011, and a major explosion occurred at the Mont Belvieu natural gas liquids (NGL) hub in Texas. This section gives a summary of those refinery outages, based on EAD reports.

Texas City, Texas Power Outages: Power outages across southeastern Texas on April 25–26 caused major issues for area refineries. In many cases, drought and wind conditions caused salt to build up on power line insulators, which led to outages. (Normally, rain washes away such build-ups.) The outages forced BP to shut all units at its 406,570 b/d Texas City refinery on April 25. The first of two crude distillation and cracking trains restarted on May 3, and the second came on-line towards the end of May. The power outages also shut most units at Valero's 225,000 b/d Texas City refinery on April 25–26, but operators were able to restore the facility to its normal processing rates by May 3. Units were also shut at Marathon's 76,000 b/d Texas City refinery and resumed normal operations on April 27. The refinery shutdowns forced Enterprise Product Partners and Genesis Energy to divert flows along their jointly-owned, 400,000 b/d Cameron Highway oil pipeline away from Texas City.

Port Arthur, Texas Lightning Strike: Valero's 287,000 b/d Port Arthur, Texas refinery was shut for nearly a month after a lightning strike on June 6. The lightning strike destroyed the motor on a wet gas compressor, which in turn shut the refinery's 100,000 b/d coker and its 175,000 b/d crude unit.

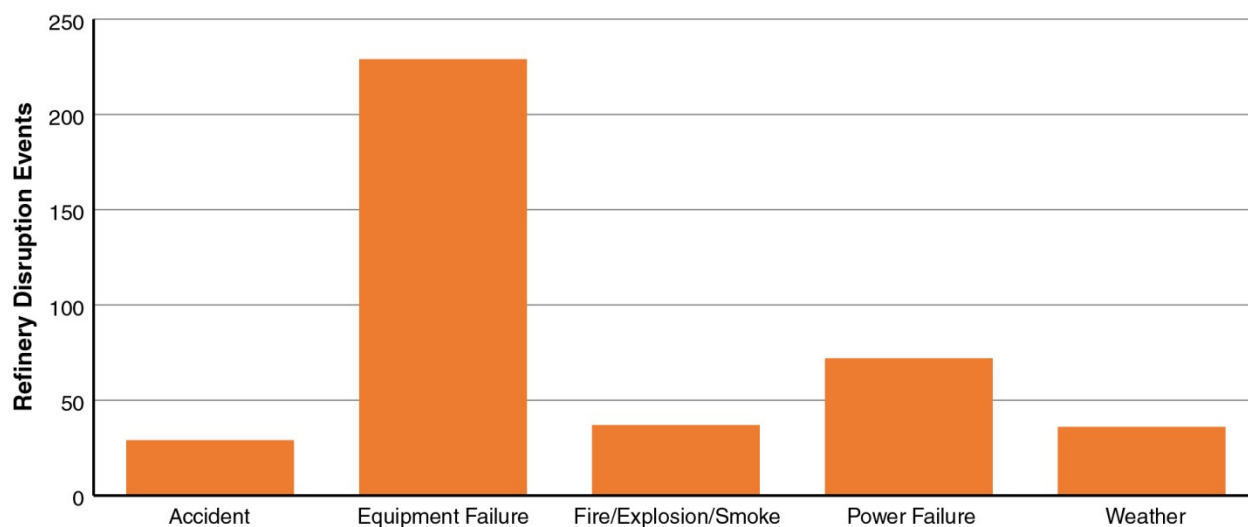
Ponca City, Oklahoma Thunderstorms: Thunderstorms caused power outages that affected ConocoPhillips' 198,400 b/d Ponca City refinery on August 8. The company began restarting the refinery on August 9, but restart operations were not complete until August 15.

Mont Belvieu, Texas Fractionator Explosion: On February 8, a pipeline explosion at Enterprise Products Partners' 305,000 b/d NGL fractionation facility in Mont Belvieu, Texas triggered a subsequent fire in the facility's NGL storage area. The fire was contained and extinguished, and two of the facility's four NGL fractionation units resumed operations on February 9. The event also caused ONEOK Partners to cease operations at its 160,000 b/d Mont Belvieu-1 fractionator, adjacent to the Enterprise complex, for precautionary reasons. The ONEOK fractionator reopened on February 9.

Figure 6 shows significant refinery disruption events in 2011 with a breakdown by cause.⁵ The most common cause for disruptions, as was the case in 2010, was equipment failure. Equipment failures include compressor outages, pump failures, equipment leaks, boiler system failures, and other mechanical failures. Following equipment failures, power failures were the next largest cause of disruptions. Power outage events highlight a critical interdependency between the petroleum and electric power industries.

⁵ The "cause" is determined by the initial action. For instance, if a transfer line leak leads to a fire, this would be classified as an "equipment failure" due to the initial cause of the line leaking.

Figure 6. U.S. Refinery Disruption Events by Cause, 2011



2.5.3 Transportation

Crude oil is largely transported by marine vessels or pipelines. These assets deliver the vast majority of the world's crude oil supply, including that of the United States. Pipelines are more susceptible to outage events as they can sprawl for thousands of miles across the country and rely heavily on other assets within the petroleum industry to function properly. The pipeline outages in 2011 stemmed from a variety of problems including weather, equipment malfunctions, and external issues (problems at assets adjacent to pipeline operations). The following pipeline and tanker incidents were some of the most notable and significant of 2011.

Alyeska Trans Alaska Pipeline System (TAPS) Leak: The 800-mile TAPS pipeline transports 640,000 b/d of crude oil from Prudhoe Bay, Alaska to the marine port in Valdez, Alaska. On January 8 a pipeline leak was discovered, forcing operators to fully shut the pipeline for 3 days. To prevent the pipeline and associated tanks from freezing, operators restarted the pipeline at a reduced rate on January 11, but shut it down again on January 15 to install a bypass pipe around the leak site. The pipeline shutdown forced oil producers in Prudhoe Bay to decrease their production to 12 percent of normal rates from 640,000 b/d to 75,600 b/d. Full production resumed January 17.⁶

TransCanada Keystone Pipeline Issues: TransCanada shut down its 591,000 b/d Keystone pipeline on October 13 due to a lack of storage at an Enbridge terminal in Superior, Wisconsin. The pipeline, which spans from Hardisty, Alberta to refineries in the Mid-Continent, was restored to service the next day, on October 14. The pipeline was shut again less than a month later on November 9 due to mechanical issues, but again it restarted the next day, on November 10.

Enterprise NGL Pipeline Spill: Flood waters from the Missouri River caused a 33,600 b/d Enterprise NGL pipeline leak in Iowa, spilling 140,000 gallons of natural gasoline into the

Missouri River on August 13. The 10-mile pipeline segment, which carries NGLs from Decatur, Nebraska to Onawa, Iowa, was immediately shut down following discovery of the leak. The pipeline was placed back into service in October following repairs.

Silvertip Pipeline Spill: ExxonMobil's 12-inch, 40,000 b/d Silvertip Pipeline spilled 42,000 gallons (1,000 barrels) of crude oil into the Yellowstone River in Montana on July 1 after river flooding exposed the pipeline to debris. The pipeline disruption caused supply outages at ExxonMobil's 60,000 b/d Billings, Montana refinery. The pipeline restarted on September 24. On October 10, ExxonMobil announced it had restored operations at the Billings refinery.

Tanker Hijackings: On February 9, Somali pirates hijacked a very large crude carrier (VLCC) about 220 miles off the coast of Oman in the Indian Ocean. The tanker was carrying about 2 million barrels of Kuwaiti crude oil destined for refineries on the U.S. Gulf Coast. Pirates held the VLCC for nearly 2 months until April 8, when the tanker was freed.

2.5.4 Hours-of-Service Exemptions

Hours-of-Service (HOS) regulations (49 CFR Part 395) restrict the amount of time drivers are allowed to operate commercial vehicles and mandate time-off requirements between shifts to ensure on-road safety. During emergency situations, State governments will often issue exemptions to these regulations, to maintain the supply of critical fuels such as heating oil, propane, gasoline, and diesel fuel. The EAD tracks HOS exemptions to identify events that have triggered States to enact emergency management measures.⁷

In 2011, 49 waivers were issued across 23 States, including legacy waivers issued as a result of winter weather in 2010 that continued into 2011 (see **Table 1**). The majority of exemptions were issued in States in the eastern and southern regions of the United States, though some States in the Mid-Continent and even New Mexico issued waivers. All the waivers in the winter 2010–2011 were issued because of winter storms or abnormally cold temperatures. The driver waivers issued in the latter half of 2011, however, were due to a variety of causes, including Hurricane Irene, Enterprise's pipeline leak, and demand surges in the Dakotas.

⁷ <http://www.fmcsa.dot.gov/rules-regulations/topics/hos/index.htm>

Table 1. Hours-of-Service Waivers Issued, 2011

State	Winter 2010–2011			Winter 2011–2012 (1)		
	Start Date	End Date	Days	Start Date	End Date	Days
Connecticut	1/5/2011	2/14/2011	41	10/29/2011	11/26/2011	29
Delaware	1/11/2011	1/14/2011	4			
Georgia	12/13/2010	1/20/2011	39			
Illinois	12/27/2010	1/30/2011	14 (2)			
Iowa				8/27/2011	Uncertain	N/A
Kansas	2/1/2011	Uncertain	N/A			
Maine	1/20/2011	2/16/2011	28			
Maryland	12/29/2010	1/30/2011	10 (2)	8/26/2011	9/16/2011	22
Massachusetts	1/28/2011	2/8/2011	12			
Missouri	1/31/2011	2/11/2011	12			
New Hampshire	1/19/2011	2/12/2011	25			
New Jersey	1/3/2011	2/15/2011	44			
New Mexico	1/19/2011	1/26/2011	7			
New York	12/8/2010	2/19/2011	74			
North Carolina	12/17/2010	2/9/2011	55	8/25/2011	12/15/2011	113
North Dakota				10/31/2011	11/15/2011	16
Ohio	2/4/2011	2/11/2011	7			
Oklahoma	2/1/2011	3/3/2011	30			
Pennsylvania	12/29/2010	2/7/2011	29 (2)			
Rhode Island	1/21/2011	2/11/2011	22			
South Carolina	12/14/2010	2/13/2011	62			
South Dakota				9/26/2011	11/30/2011	66
Virginia	12/16/2010	2/8/2011	55	8/25/2011	9/19/2011	26

Notes: 1) Winter 2011-2012 waivers only include waivers issued prior to December 31, 2011
 2) Illinois, Maryland, and Pennsylvania experienced multiple waiver events within the listed time period.
 3) Cells in gray indicate that no waiver event was issued during that time period.

Source: Data obtained from the National Propane Gas Association (www.NPGA.org) and State waiver information. See **Appendix C** for exemption citations.

2.6 Biofuel Disruptions

There were minimal disruptions at biofuel refineries reported in 2011, with the most significant being a 2-day outage at the Quad County Corn Processors’ ethanol plant in Iowa due to a tornado. The EAD reported four rail-related events in 2011. The most serious of these rail events occurred when half the railcars on a 62-railcar train carrying ethanol derailed in Arcadia, Ohio in February, and 8 of the derailed cars exploded. A 60-railcar train carrying ethanol derailed in Illinois in October, which also resulted in several cars exploding. Two railcars derailed and caught fire in Oregon in May, and two cars derailed in Texas in September, resulting in ethanol leaks.

2.7 Cyber Security

While cyber security remains a serious concern, 2011 passed without any major publically reported attacks on the U.S. energy infrastructure. The topic, however, is frequently discussed at high levels and several cyber security plans were proposed or announced in 2011, including:

- In January, the U.S. Government Accountability Office released a report describing how cyber security measures have been incorporated into the nationwide smart grid roll-outs and outlined key challenges that remain to be addressed.
- The North American Electric Reliability Corporation formed a task force in March to consider the impacts of a coordinated cyber attack on the reliability of the bulk power system.
- The NRC approved the cyber security plans of two nuclear plants, Indian Point in New York and Oyster Creek in New Jersey.
- The California Public Utility Commission proposed new rules to protect the security and privacy of consumer data collected by smart meters.
- Pike Research reported in August that electricity companies are expected to spend \$4.1 billion industry-wide from 2011 to 2018 on cyber security.
- The Massachusetts Institute of Technology released a study in December advocating the formation of a single Federal agency to address cyber security threats to the U.S. power grid, rather than the numerous groups currently overseeing the system's security.

In November, hackers were believed to have taken over the controls of a water plant in Springfield, Illinois and caused a water pump motor to burn out. However, it was later discovered that the pump had simply failed, and a contractor traveling in Russia had remotely logged into the plant's computer system, falsely suggesting a foreign intrusion. While the Illinois incident was a false alarm, oil company executives at the World Petroleum Congress in Doha in December reported that cyber attacks on their systems are becoming more frequent and more sophisticated.

3. Infrastructure Changes

The previous section provided a summary of significant disruptions in the energy sector during 2011. In this section, the focus is on changes to the energy infrastructure.

Disruptions and infrastructure changes can be viewed differently. With disruptions, the cause is frequently severe weather or equipment failure, leading to energy problems measured in hours or days. Following a disruption, the goal is to repair damaged assets as quickly as possible and return the infrastructure to the condition preceding the event.

Infrastructure changes are typically driven by underlying economic conditions or regulatory requirements. When business conditions driven by economic or regulatory factors lead to an infrastructure change—such as shutting down a refinery or installing a wind farm—the change is long-lasting, often times signaling a fundamental shift in the energy infrastructure.

3.1 Electricity

Changes in the electricity infrastructure are discussed under the following headings:

- Coal-fired Plant Retirements
- Coal- and Natural Gas-fired Plants – New Capacity
- Solar and Wind Plants – New Capacity
- Nuclear Power Plants
- Transmission Expansion and Smart Grid Implementation

3.1.1 Coal-fired Plant Retirements

Two significant air pollution rules released by the U.S. Environmental Protection Agency (EPA) in 2011 may impact coal-fired plants, potentially leading to early retirement for some coal-fired plants.

- The Mercury and Air Toxics Standards (MATS) rule seeks to regulate mercury and particulate matter emissions across the country. Until this rule was passed, there were no Federal standards to limit power plant emissions of mercury and other toxic metals. Plants will have 4 years from the start of the program to either install the necessary control technologies or retire.
- The Cross-State Air Pollution Rule (CSAPR) regulates regional sulfur dioxide and oxides of nitrogen emissions in eastern States and was finalized in July 2011. This rule is intended to replace the 2005 Clean Air Interstate Rule. While this rule was initially expected to take effect in January 2012, in December 2011 a Federal judge issued a stay of the 2012 implementation. Nonetheless, it is expected that some form of the rule will take effect in the near future.

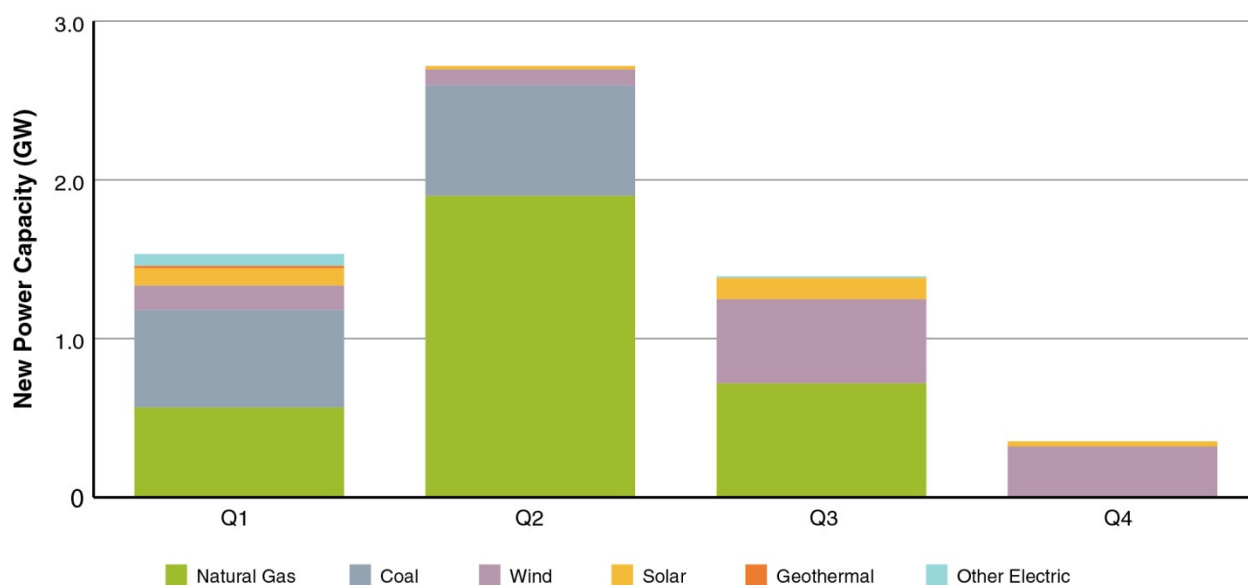
It is important to note that the U.S. coal fleet is aging and that natural gas prices are at relatively low levels. These economic factors, in addition to regulatory factors such as MATS and CSAPR, are also expected to drive coal-fired plant retirements.

During 2011, the Energy Assurance Daily (EAD) contained reports for 22 coal-fired plant retirements, totaling 11 gigawatts (GW) (compilation of announced, planned, and firm reports⁸). Most of the 22 coal-fired plant retirements were planned to take place by 2015, with some as late as 2025. The primary reason cited for these retirements was changes in EPA regulations. EPA regulations were mentioned as a reason for closure of 13 of the 22 retiring coal-fired plants. The announced retirements were concentrated in regions that currently have the most coal-fired capacity, like the Midwest and Southeast, but some announcements were for plants in Texas, Massachusetts, and Washington State. For perspective, there is about 310 GW of coal-fired capacity in the United States.

3.1.2 Coal- and Natural Gas-fired Plants – New Capacity

Figure 7 illustrates new power plant capacity that came on-line during 2011. Of the approximately 6 GW of capacity reported to have come on-line, just over half (3.2 GW) was natural gas-fired. The second quarter (Q2) showed the highest level of new natural gas capacity with 1.9 GW coming on-line.

Figure 7. New Power Plant Capacity in the United States, 2011



Two large coal-fired units came on-line in 2011, totaling 1.3 GW. In January, Wisconsin Energy began operating a 615 (megawatt) MW unit at its Oak Creek plant. In June, Longview Power began operating its new 695 MW plant in West Virginia.

⁸ “Announced” plants reflect plans to build at some point in the future. “Planned” plants are those where permitting or other approval processes have begun. “Firm” plants are those where site preparation or other construction activities have been initiated.

There were about 40 announcements of natural gas-fired plant builds reported in 2011, totaling nearly 20 GW. Many of these natural gas announcements are proposed plans to co-fire or convert existing coal-fired plants.

3.1.3 Renewable Plants – New Capacity

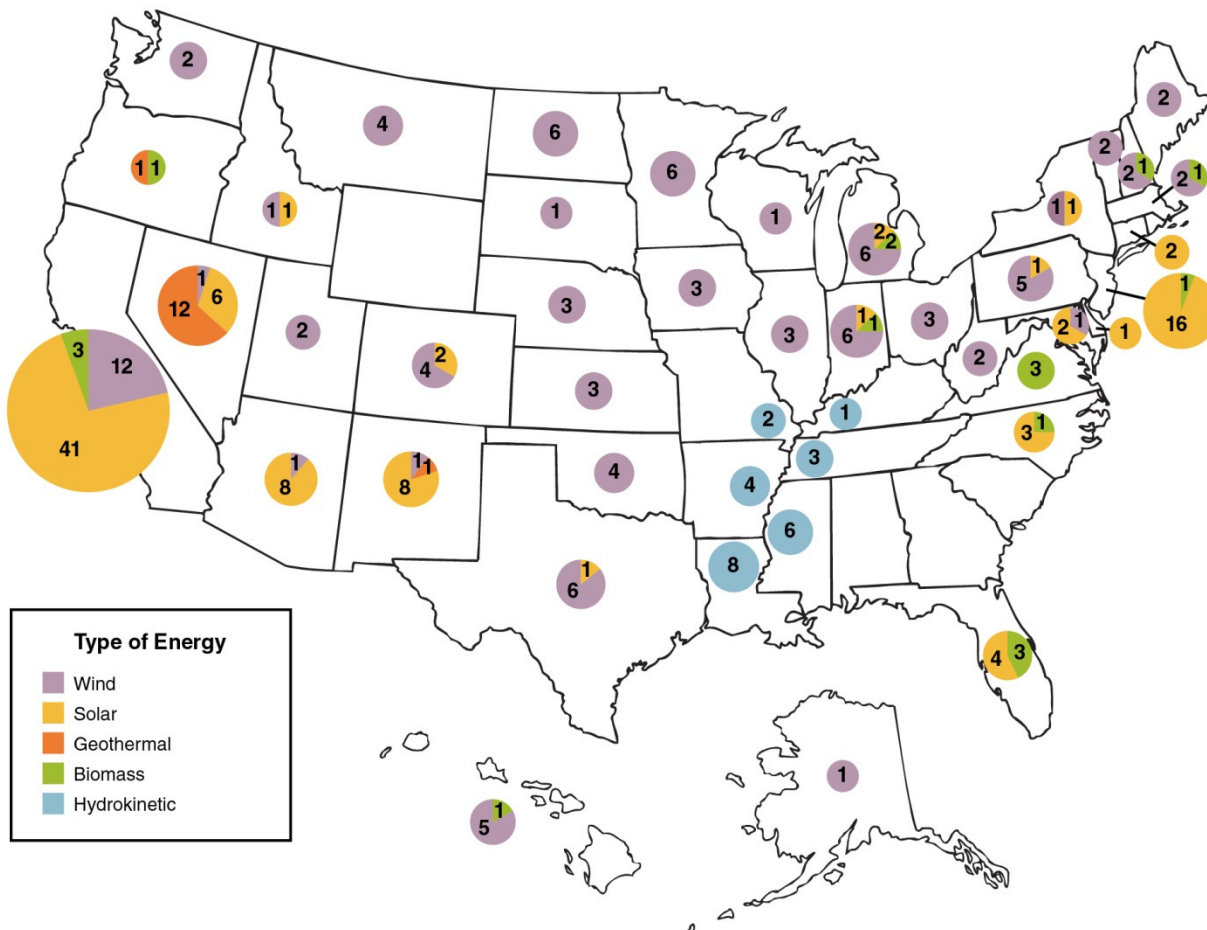
In 2011, many renewable projects, especially small solar generation, were driven by the expiration of the 1603 Federal Cash Grant Program (expired on December 31, 2011). The cash grant reimbursed 30 percent of the capital costs for eligible renewable projects and was easier for small developers to obtain than the investment tax credit, which isn't due to expire until the end of 2016. As shown in **Figure 7**, there were about 300 MW of new solar builds in 2011.

As with solar, many wind developers took advantage of the Federal Production Tax Credit, which is set to expire at the end of 2012. The EAD reported about 1.1 GW of new wind capacity in 2011, which is about 20 percent of the total new U.S. generating capacity reported in the EAD in 2011.⁹

In 2011, there were numerous announcements or proposals for renewable power generation plants. **Figure 8** illustrates the geographic distribution of proposed and new renewable projects by type. Most proposed projects were either wind or solar, but some biomass and geothermal projects were also announced or brought on-line in 2011.

⁹ The value of 1.1 GW is based on stories picked up by the EAD. For comparison, the American Wind Energy Association reported 6.8 GW of installed wind in 2011 (http://www.awea.org/learnabout/industry_stats/index.cfm). While wind capacity numbers are relatively large compared to total capacity additions, the amount of electricity generated with wind is significantly smaller. For example, in 2011 2.9 percent of the electricity generated in the United States was produced from wind (<http://205.254.135.24/electricity/monthly/pdf/epm.pdf>).

Figure 8. Number of New and Proposed Renewable Energy Projects, 2011



Predictably, renewable energy projects are closely linked to the energy resource quality. Solar projects are more common in geographic locations with a high solar incidence, such as the Western United States; wind projects are most prevalent in the Midwest; and hydrokinetic projects are concentrated along the Mississippi River. State-level policies are also an important driver in renewable development. For example, California and New Jersey have renewable portfolio standards with strong solar incentives, and as a result, these two States accounted for the bulk of announced solar projects in 2011.

3.1.4 Nuclear Power Plants

The nuclear meltdown at the Fukushima Dai'ichi plant in March 2011 brought renewed attention to the nuclear sector in the United States. While there were no major physical changes to the U.S. nuclear infrastructure in 2011, there has been increased scrutiny on nuclear power plants in the last year, with some States calling for closures. Highlighted below are a few recent developments that stemmed from both the Japanese disaster and other opposition to nuclear power:

- Within days of the earthquake, New York Governor Andrew Cuomo renewed his opposition to the Indian Point nuclear facility in Westchester County, recommending the shutdown of the plant when the operating licenses for the plant's two reactors expire in 2013 and 2015. Owner and operator Entergy expressed interest in new Federal licenses to keep the plant running another 20 years. New York's power grid operator has said that the shutdown of Indian Point, which provides about 25 percent of the power in New York City and Westchester, could lead to electric reliability problems.
- NRG Energy canceled the development of a new unit at its South Texas nuclear site following the Fukushima disaster. Tokyo Electric Power Company, which had about a 20 percent ownership stake in the South Texas project, withdrew financing to cope with problems related to the Fukushima disaster.
- A dispute regarding the relicensing of the Vermont Yankee plant began in 2010 when the State of Vermont denied its relicensing. (The plant's operating license was set to expire in March 2012.) The State is being challenged by the plant's owner, Entergy. Despite the controversy and reported leaks, in March 2011 the U.S. Nuclear Regulatory Commission (NRC) issued the plant a 20-year license extension. The case is ongoing in Federal courts.

Despite these setbacks, several companies proceeded with planned or proposed nuclear units at new and existing sites. The majority of these developments are occurring in the South and Gulf Coast regions, including Georgia, Alabama, Tennessee, Florida, and Texas. Elsewhere, utilities in Utah and Idaho are seeking nuclear permits. Newsworthy events from 2011 include:

- Southern Company's continued construction preparation at the site of two new Vogtle units near Augusta, Georgia. In February 2012, the NRC approved the construction license for Vogtle, the first granted in the United States since the Three Mile Island incident in 1979.
- In April, the NRC issued its final environmental impact statement in support of South Carolina Electric and Gas' plans to construct two new nuclear reactors at the existing Summer nuclear power plant in South Carolina.
- The NRC and U.S. Army Corps of Engineers (USACE) completed the final environmental impact statement for the proposed Comanche Peak units 3 and 4. The two new units would add 3.4 GW of capacity to the 2.3 GW already generated at the site. According to the NRC and USACE, no environmental concerns preclude granting a license to Luminant for the two units. Luminant plans to bring the units on-line in 2022 if funding can be secured.
- The Tennessee Valley Authority (TVA) aims to finish building the second 1,150 MW nuclear power reactor at its Watts Bar facility in Tennessee by 2013. The construction permit for units 1 and 2 was granted in 1973, but after the completion of unit 1, unit 2 was delayed until recently.
- TVA resurrected plans in June to complete the 1,260 MW Bellefonte Nuclear unit 1 in Hollywood, Alabama by 2018–2020. Previous work on the reactor stopped in the 1980s.

- TVA plans to submit an application to the NRC to install one or more small modular reactors at the Clinch River Site in Roane, Tennessee. These small modular reactors are a new innovative design that could reduce installation barriers and costs.
- Alternate Energy Holdings received rezoning approval to build the 2,800 MW Idaho Energy Complex nuclear plant in Payette County, Idaho. The company hopes to begin commercial operations at the plant in 2018.
- In October, Progress Energy’s Florida utility received approval from the Florida Public Service Commission (FPSC) to recover the costs for building two new 2,200 MW reactors in Levy County, Florida. The utility initially planned to operate the reactors by 2016–17, but it has delayed that timeline until 2020.
- Florida Power & Light received approval in October from the FPSC to recover the costs needed to build two new 2,200 MW reactors, which will be units 6 and 7, at its Turkey Point plant, with commercial operation planned for 2022–2023.
- Blue Castle Holdings discussed a proposed 3,000 MW nuclear power plant near Green River, Utah with the NRC as part of the early site permitting process in October.

3.1.5 Transmission Expansion and Smart Grid Implementation

The EAD reported 65 proposed new transmission project announcements in 2011. These announcements covered many project types, including low voltage substation connections, local transmission upgrades for larger power plants at existing sites, and high voltage direct current lines traversing large distances. A large number of announced projects were designed to bring renewable energy sources from remote regions to load centers. Of the 65 announced projects, 28 named connecting renewable power sources to the grid as their primary objective. Many more did not cite renewable power specifically, but did connect areas with high wind or solar potential to areas with high demand.

The move to adopt smart grid technologies accelerated in 2011 on the heels of American Recovery and Reinvestment Act funding. A few noteworthy smart grid investments by utilities and market operators include:

- PEPCO: \$500 million
- Midwest Independent System Operator (ISO): \$17.3 million
- San Diego Gas & Electric: \$3.5–3.6 billion by 2020
- New York ISO: \$74 million

Several other organizations announced smart grid integration plans, including Pacific Gas & Electric (PG&E), Bonneville Power Administration, and Duke Energy. A report by Pike Research estimates that annual revenue in the smart grid managed services market will increase from \$470 million in 2010 to \$4.3 billion by 2015.¹⁰

¹⁰ <http://www.telecompetitor.com/report-smart-grid-managed-services-worth-a-look-by-telecom/>

3.2 Natural Gas Projects

The boom in U.S. shale gas continued in 2011 with new proposals to build production, processing, and pipeline infrastructure to develop the resource and bring it to market. According to the U.S. Energy Information Administration (EIA), U.S. natural gas production increased to more than 63 billion cubic feet per day (Bcf/d) in 2011, up 19 percent from 52.8 Bcf/d in 2007.¹¹ Between 2010 and 2011 alone, U.S. gas production increased by 8 percent. The boom in U.S. shale gas production has been complemented by infrastructure projects to process the resource and bring it to market. In 2011 the glut in gas production, coupled with very mild weather during the 2011–12 heating season, pushed natural gas prices lower. Expectations of continued low prices led to the announcement of several proposals to liquefy and export U.S. shale gas.

3.2.1 Natural Gas Processing Plants

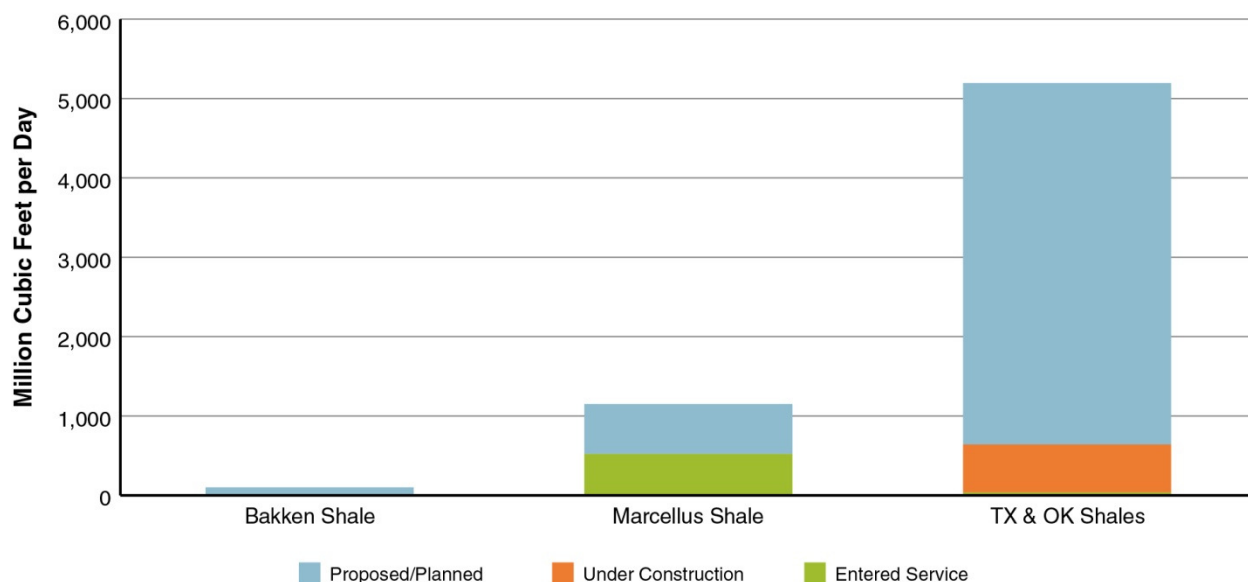
In 2011, the EAD reported 41 projects to construct new natural gas processing plants or expand processing capacity at existing plants, primarily to serve growing shale gas production in the United States. **Figure 9** shows the capacity of these projects by shale play and project status. As indicated, for 2011, the EAD reported total project capacity of 5.2 Bcf/d in the Texas and Oklahoma Shale plays;¹² 1.2 Bcf/d in the Marcellus Shale play in Pennsylvania and Ohio; and 100 million cubic feet per day (MMcf/d) in the Bakken Shale play in North Dakota. The total for the “proposed/planned,” “under construction,” and “entered service” plants in these three shale plays is nearly 6.5 Bcf/d. Of the 6.5 Bcf/d total, about 0.5 Bcf/d entered service in 2011, all in the Marcellus Shale. If all the projects reported in 2011 come on-line, their combined capacity would represent an increase of more than 8 percent over total U.S. natural gas processing capacity, which stood at 77 Bcf/d at the end of 2009 (most recent data available).¹³

¹¹ U.S. Dry Natural Gas Production, Energy Information Administration, http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_a.htm (Released February 29, 2012)

¹² A resource play is an area in which hydrocarbon accumulations or prospects of a given type occur.

¹³ “Natural Gas Processing Plants in the United States: 2010 Update,” Energy Information Administration, http://www.eia.gov/pub/oil_gas/natural_gas/feature_articles/2010/ngpps2009/ (Released June 17, 2011)

Figure 9. Capacity of New Natural Gas Processing Plant Projects by Shale Play



The EAD reported three new natural gas processing plants entered service or were expected to enter service in the Marcellus Shale play in 2011, with a combined gas processing capacity of 520 MMcf/d. These three facilities, all located in West Virginia, were constructed by Caiman Energy. The EAD also reported that 35 MMcf/d of new capacity came on-line as a result of a plant expansion in West Texas. The EAD reported four new gas processing plants with a combined capacity of 605 MMcf/d that were under construction (but not completed) in Texas and Oklahoma as of December 31, 2011.

3.2.2 Natural Gas Pipelines

In 2011, the EAD reported on several pipeline projects that entered service in 2011, which collectively added 8.8 Bcf/d of natural gas transportation capacity. Major pipeline projects that entered service in 2011 include:

- **Bison** – placed into service in January, this 407 MMcf/d pipeline runs from Wyoming, through Montana, to an interconnection with the Northern Border pipeline in North Dakota.
- **FGT Phase VIII Expansion** – placed into service in April, this 483-mile pipeline can deliver up to 800 MMcf/d from Alabama, through the Florida Panhandle, to central Florida.
- **Transco Southeast Expansions** – two expansions to Transco’s southeast system were placed in to service in May, totaling 600 MMcf/d of capacity: 380 MMcf/d in Alabama and 220 MMcf/d in North Carolina.
- **Ruby** – placed into service in July, this 680-mile pipeline can deliver up to 1.5 Bcf/d from the Opal Hub in Wyoming, through Utah and Nevada, to Malin, Oregon.

- **Rich Eagle Ford Mainline** – placed into service in October, this 160-mile pipeline delivers up to 400 MMcf/d of liquids-rich natural gas from the Eagle Ford Shale play in South Texas to natural gas processing facilities. The line could be expanded to transport up to 800 MMcf/d.
- **Acadian Haynesville Extension** – placed into service in November, this 270-mile pipeline added 1.8 Bcf/d of takeaway capacity to the Haynesville-Bossier Shale play in Louisiana.
- **300 Line** – placed into service in November, this 127-mile, 350 MMcf/d pipeline is the first of four new Northeast projects that Tennessee Gas Pipeline is developing to increase capacity on the system by 1.5 Bcf/d, primarily from the Marcellus Shale.
- **Lycoming** – the first section of this 850 MMcf/d pipeline was put into service in February, connecting Marcellus Shale producers to the Transco pipeline system.

3.2.3 LNG Export Terminals

The shale gas production boom and resulting relatively low natural gas prices in the United States have created an incentive to export U.S. natural gas. As of December 31, 2011, the EAD reported seven proposed liquefied natural gas (LNG) export projects in the contiguous United States (see **Table 2**). Five of these projects involve the installation of liquefaction trains and LNG carrier loading facilities at existing LNG import terminals that have been running at reduced rates due to ample domestic supplies. The other two projects are greenfield¹⁴ projects that have been proposed at sites that were initially proposed for LNG import terminals but were never constructed. The seven proposed export projects are summarized below, including information on the proposed site, export capacity, and target in-service date.

Table 2. Proposed LNG Export Terminal Projects (as of December 31, 2011)

Terminal	Site	Proposed Export Capacity (Bcf/d)	Target In-Service Date
Sabine Pass (LA)	Existing Import Terminal	2.6	2015
Lake Charles (LA)	Existing Import Terminal	2.0	2015
Freeport (TX)	Existing Import Terminal	1.8	2016
Cove Point (MD)	Existing Import Terminal	1.0	2016
Cameron (LA)	Existing Import Terminal	1.7	2017
Corpus Christi (TX)	Proposed Import Terminal	1.8	---
Coos Bay (OR)	Proposed Import Terminal	1.2	---

3.3 Petroleum Projects

Petroleum logistics and infrastructure in the United States have rapidly shifted over the past few years. The production boom in Canadian oil sands and shale rock formations in North America

¹⁴ A greenfield site is an area of agricultural or forest land, or some other undeveloped site, earmarked for commercial development or industrial projects.

have led to significant changes in supply, which are driving Mid-Continent crude prices significantly lower than prices on the East, West, and Gulf Coasts. These economic conditions have driven investments towards projects that enable movement of crude out of the Mid-Continent to other markets. Similar transformations are taking place in the refining sector.

3.3.1 Refineries

The U.S. refining industry is evolving with refinery expansions and upgrades in certain regions where new Canadian and domestic supply can be accessed. In October 2011, Motiva announced that its Port Arthur, Texas refinery expansion was 90 percent complete. The company plans to have the 325,000 barrels per day (b/d) expansion (boosting capacity to 600,000 b/d, making it the largest U.S. refinery) in operation by the first half of 2012. In January 2011, Marathon announced that its Garyville, Louisiana refinery's capacity was 464,000 b/d, up from 436,000 b/d. (This same refinery completed a 180,000 b/d expansion in 2010).¹⁵ In May, Total commissioned a 50,000 b/d coker at its 240,000 b/d Port Arthur refinery.

While there was some expansion in refining capacity in 2011, there was also significant activity related to capacity reductions. In areas such as the East Coast where refiners process expensive sweet crude in relatively old refineries, refineries are shutting down due to low margins (stemming from high crude prices, expensive upgrading options, and reduced gasoline demands). On the East Coast, three refineries announced potential closures in 2011:

- On September 6, Sunoco announced it would sell or shutter its 335,000 b/d Philadelphia, Pennsylvania refinery by July 2012. The refinery remains operational pending a final decision.
- Also on September 6, Sunoco announced the closure of its 178,000 b/d Marcus Hook, Pennsylvania refinery. The refinery is currently shut down.
- On September 27, ConocoPhillips announced it would immediately shut its 185,000 b/d Trainer, Pennsylvania refinery. The refinery is currently shut down.

In April 2011, Hovensa (Hess) shuttered 150,000 b/d of its 500,000 b/d St. Croix, U.S. Virgin Islands refinery.¹⁶ Hess planned to eliminate older, more costly operations to improve competitiveness of the refinery. However, margins did not support this plan, and on January 18, 2012, Hess announced it would shut the entire refinery due to poor economics. The refinery is currently closed.

3.3.2 Transportation

Petroleum is most efficiently transported via intra- and inter-state pipelines. These assets are extremely important to the reliable supply of crude oil and petroleum products in the United States. Given the extensive changes in crude oil supply from western Canada, the Bakken region in North Dakota, and the Eagle Ford Shale in Texas, an increasing supply of crude oil

¹⁵ <http://www.reuters.com/article/2010/03/25/refinery-operations-marathon-idUSN2522266320100325>

¹⁶ Hovensa is a joint venture between Hess and PDVSA, the Venezuelan State oil company. Hovensa exported gasoline, diesel, and jet fuel to U.S. East Coast markets and Puerto Rico.

(primarily light, sweet crude) has become available in the Mid-Continent region. In 2011, bottlenecks persisted in getting these surplus supplies to Gulf Coast refineries, and as a result, the price of crude oil in the Plains and Midwest remained well below prices for equivalent quality crude in other markets around the country.

This price differential has resulted in a number of projects to move low-priced crude oil from the Mid-Continent region to other markets. In 2011, the EAD reported 28 pipeline, railroad, and related infrastructure projects that were planned to address these constraints in 2011 and coming years.

Canadian Projects

Phase II of TransCanada's Keystone project went into service in February 2011 and connected Steele City, Nebraska with Cushing, Oklahoma.¹⁷ Phases III and IV comprise the Keystone XL project. Phase III would construct a new pipeline from Cushing to refining areas in Texas along the U.S. Gulf Coast. Phase IV would connect Hardisty, Alberta to Steele City, Nebraska. When completed, the Keystone XL project would increase the pipeline's capacity from 591,000 b/d to 1.3 million b/d of crude oil from western Canada to refineries in the Midwest and Gulf Coast.¹⁸ On January 18, 2012, the Keystone XL project was denied a Presidential Permit by the Obama Administration. TransCanada plans to submit a revised application for this project.¹⁹

In addition to the Keystone XL project, a number of other projects to deliver western Canadian crude oil to U.S. refineries or other markets were announced or underway during 2011.

Appendix D lists these projects.

Bakken and Cushing

Increased production in the Midwest from North Dakota's Bakken Shale and western Canada has exceeded the demand for crude in the Mid-Continent refineries, resulting in excess inventory at the Cushing, Oklahoma hub. To alleviate this situation, Enbridge and Enterprise are reversing the direction of their Seaway pipeline to move crude out of Cushing south to refineries on the Gulf Coast. The pipeline is scheduled to have initial capacity of 150,000 b/d in the second quarter 2012, ramping up to 400,000 b/d with the addition and modification of pump stations by 2013.

The Seaway reversal is one project that has been designed to help alleviate the growing demand for infrastructure to transport crude oil out of the Bakken Shale region in North Dakota to refining centers. Other proposed projects include building and expanding current pipelines and utilizing rail unit trains to move crude oil to refineries across the United States. Projects related to the Bakken Shale are summarized in **Appendix D**.

¹⁷ Phase I of TransCanada's Keystone pipeline project went into commercial service in June 2010. This phase of the project consisted of converting a natural gas pipeline to a crude oil pipeline and constructing a pipeline segment that delivers crude oil from Alberta, Canada to refining hubs in the U.S. Midwest.

¹⁸ http://www.transcanada.com/keystone_pipeline_map.html

¹⁹ http://www.cbsnews.com/8301-503544_162-57361324-503544/obama-denies-keystone-xl-pipeline-permit/

Eagle Ford

The Eagle Ford Shale is located in the Western Gulf Basin in southern Texas. In addition to the Bakken Shale, Eagle Ford is another domestic oil shale region with growing production. Its production spurred the announcement of a number of infrastructure projects in 2011 that are aimed at supplying refineries throughout the Gulf Coast with crude oil. Eagle Ford is also rich in natural gas liquids (NGL) content, which has triggered additional pipeline projects. These projects are identified in **Appendix D**.

3.4 Biofuels

The biofuels industry continued to announce plans for new biofuel production plants and infrastructure in 2011. In addition, a number of existing plants closed due to economic concerns, while others re-started. The industry is moving toward more efficient production at plants with lower carbon footprints, and at plants that process cellulosic and other feedstocks to produce ethanol and other biofuels that conform to the Renewable Fuel Standard 2 (RFS2) requirements.²⁰ Moreover, substantive distribution infrastructure changes were announced that will further improve economic ethanol penetration.

3.4.1 New Biofuel Plants

The EAD reported 48 stories in 2011 that delineated planned new biofuel producing facilities.

Advanced Ethanol: A total of 19 advanced ethanol plants with a combined capacity of more than 540 million gallons per year (MMGal/Yr) were announced in 2011, making it the largest category of biofuels plants proposed during the year. Cellulosic ethanol, the most common of the alternative, or “advanced,” ethanol technologies, is derived from a wide variety of sources of plant fiber, ranging from stalks and grain straw to switchgrass and quick-growing trees such as poplar and willow, and even municipal waste. Other advanced sources of ethanol proposed in 2011 included algae and sugar cane.

Corn-Based Ethanol: Florida and North Dakota were the only States with announced corn ethanol plants in 2011. The North Dakota plant is intended to be a hybrid, 50 MMGal/Yr corn ethanol plant to be combined with an 8 MMGal/Yr cellulosic ethanol plant.

“Unspecified” Ethanol: Some 12 additional ethanol plants, with a combined capacity of more than 700 MMGal/Yr, were announced across the country in 2011, but without details on their source fuels. These plants were located primarily in the Midwest.

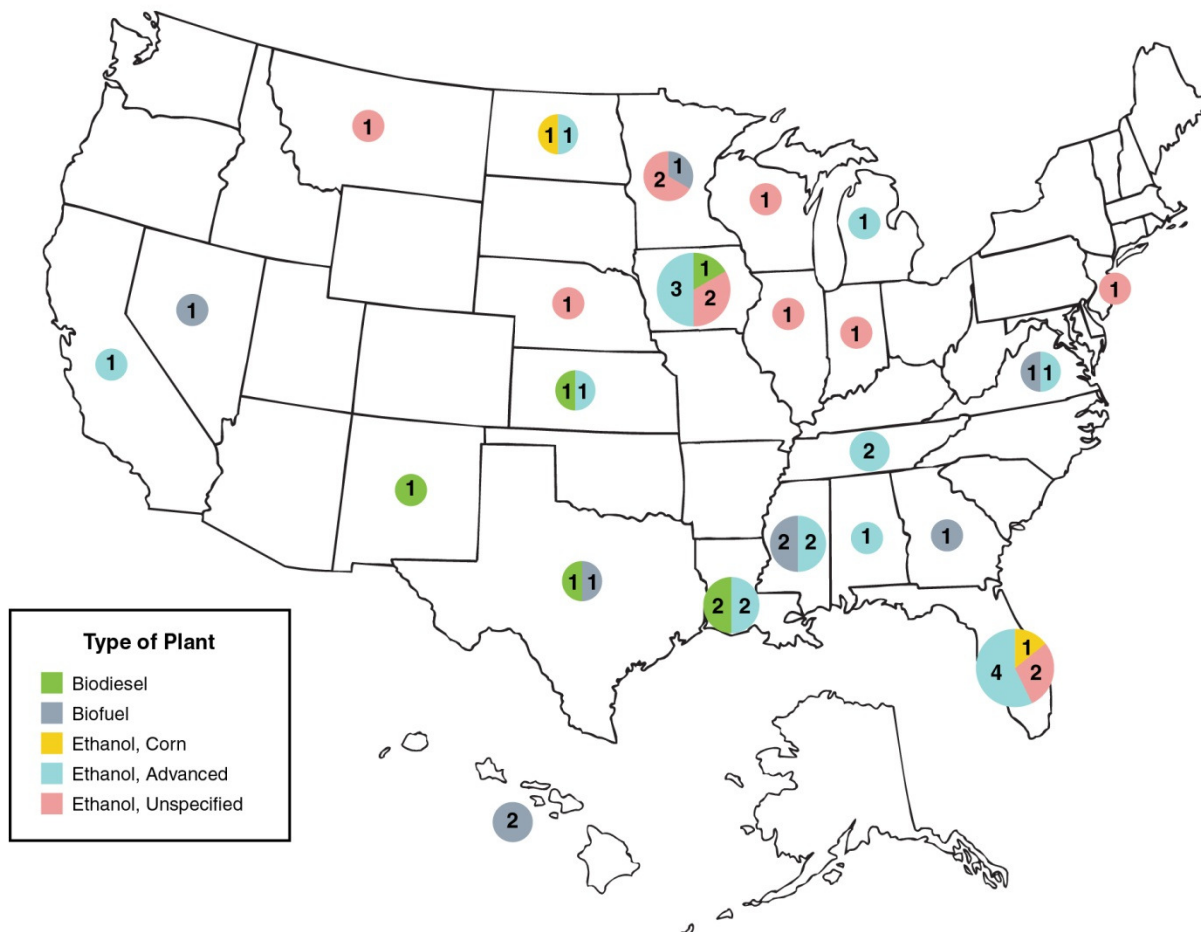
Biodiesel: Six biodiesel plants were proposed in 2011 with a total capacity of some 360 MMGal/Yr. These were located primarily in the Gulf Coast region.

²⁰ RFS2 became law in 2007 and requires obligated parties (refiners and importers) to use renewable fuel, or purchase renewable credits, for gasoline and diesel blending.

Biofuel: Nine EAD stories announced unspecified biofuel projects. Only three of these projects reported planned capacities.

Figure 10 shows a distribution of the projects by State and by biofuel type. Not surprisingly, the Midwest continues to be the focal point of biofuel production. The map also clearly shows a trend toward advanced ethanol projects and other biofuels in the Southeast.

Figure 10. Number of Proposed Biofuel Projects, 2011



3.4.2 Plants in Transition

In addition to the newly constructed or proposed biofuels infrastructure, eight previously shuttered plants were brought back on-line during 2011. These restored facilities brought 42 MMGal/Yr of biodiesel capacity, 25 MMGal/Yr of advanced (sorghum) ethanol capacity, and 332 MMGal/Yr of corn ethanol capacity back on-line across the nation.

In contrast, six biofuels plants were closed during 2011 for economic reasons. These plant closings combined to remove 170 MMGal/Yr of corn ethanol, 60 MMGal/Yr of advanced (sorghum) ethanol, and 40 MMGal/Yr of unspecified ethanol from U.S. capacity.

Plans for an additional four plants were scrapped during the year. Citing the likelihood of Congress ending the ethanol subsidy, plans for an ethanol plant in New York were cancelled. Also in New York, plans for a 110 MMGal/Yr ethanol plant were cancelled due to financing problems. A project to build a 100 MMGal/Yr cellulosic plant in Georgia was cancelled because of operational problems and because the plant was to produce cellulosic methanol, which is currently not eligible to meet Federal biofuel requirements. Hence, the project's funding was pulled, forcing its cancellation.

3.4.3 Distribution Infrastructure

The EAD reported a number of new projects to transport and store ethanol in 2011, and the cancellation of one project to build an ethanol pipeline:

Kinder Morgan Energy Partners – finished constructing its Deer Park Rail Terminal (DPRT) and related ethanol handling assets at its Pasadena Terminal along the Houston Ship Channel. The project included a new ethanol unit train facility capable of handling 14,000 b/d of ethanol, an offloading rail rack for unit trains of approximately 100 railcars, and an 80,000-barrel storage tank. The company also extended an existing ethanol pipeline by 2.4 miles to move product from the DPRT to the Pasadena Terminal.

Kinder Morgan Energy Partners, the Tampa Port Authority (TPA), and CSX Corporation – announced a joint project to bring ethanol to the Tampa market via the nation's first ethanol unit train-to-pipeline distribution system. The TPA plans to build new rail track and support infrastructure to handle 100-car unit train deliveries and develop an offloading yard at Hooker's Point, in the Port of Tampa. This rail infrastructure would enable CSX to transport ethanol from Midwest producers to central Florida in 100-car unit trains and offload within a 24-hour period into Kinder Morgan's Tampa Terminal, where the ethanol would be distributed to numerous blend terminals and to new markets via pipeline. The joint effort is expected to be operational by September 2012.

Motiva Enterprises LLC – announced plans to deliver ethanol from unit trains directly into existing storage tanks at the Port Everglades, Florida terminal.

Eco-Energy Holdings – announced plans to develop an ethanol unit train operation with 95,000 barrels of storage in Denton, North Carolina. The new facility could receive up to 96-car unit trains. Unit train operations are set to begin in the first quarter of 2012.

Atlas Oil Company – opened an ethanol trans-loading terminal in La Feria, Texas, with the capacity to offload over 150 cars (over 4 million gallons of ethanol) per month.

Magellan Pipeline Company – announced it was abandoning its plans to construct a 1,800-mile ethanol pipeline from the Midwest to the East Coast due to economics and its inability to secure Federal loan guarantees.

3.4.4 Policy Changes and Funding

Although the Federal subsidies for domestic ethanol production and tariffs on imported ethanol did expire at the end of 2011, other policies were initiated to support the use of ethanol. Of particular note is the EPA decision in January to allow up to 15 percent ethanol-blended gasoline (E15) for use in model year 2001 through 2006 passenger vehicles, including cars, sport utility vehicles, and light pickup trucks. Previously, EPA had approved the use of E15 for cars and light trucks manufactured since 2007. Now, E15 has been approved for all light-duty vehicles manufactured since 2001.

Government funding of new biofuel projects was prominent in 2011. In May, the U.S. Department of Energy (DOE) and the U.S. Department of Agriculture (USDA) announced a \$47M grant for eight biofuels and bioenergy research and development projects. In June, DOE announced a \$36M grant to fund six biofuels and bioproducts projects in California, Michigan, North Carolina, Texas, and Wisconsin. In August, USDA announced an additional \$45M in Federal funds to expand the availability of non-food crops for use in the manufacturing of liquid biofuels, setting aside acres in California, Kansas, Montana, Oklahoma, Oregon, and Washington for the production of renewable energy crops.

Later in August, President Obama announced a \$510M interagency biofuels plan through which DOE, USDA, and the U.S. Navy will each invest in partnership with the private sector to produce advanced drop-in²¹ aviation and marine biofuels. Shortly thereafter, DOE announced up to \$12M in additional investments to support development and production of drop-in biofuels projects in Illinois, Wisconsin, and North Carolina.

²¹ “Drop-in” refers to biofuels chemically similar to fossil fuels that can be “dropped into” tanks of petroleum fuels and shipped in pipelines with no risk of corrosion or quality issues.

4. International Events

While the Energy Assurance Daily (EAD) focuses on domestic and North American issues, it also reports significant international events that impact—or have the potential to impact—supply and markets in the United States. This section highlights international incidents that created disruptions in the energy supply in 2011, and summarizes global infrastructure changes that occurred or were announced in 2011.

4.1 Incidents and Disruptions

The most significant energy disruption in 2011 was the **Japanese earthquake that struck off the Pacific Coast of Japan on March 11**. The magnitude 9.0 earthquake triggered a tsunami that devastated the northern region of Japan and heavily damaged the Fukushima Dai'ichi nuclear power plant. The earthquake caused 11 nuclear plants and 6 refineries in Japan to shut down. The short-term impacts of the event moved global markets in petroleum and liquefied natural gas (LNG) supply as Japan and the International community responded to restore energy supply to Japan. Japanese officials said in December it could take as many as 40 years to clean up and fully decommission the three wrecked reactors and spent fuel rods at the Fukushima Dai'ichi nuclear plant.

Beyond the Fukushima disaster, major energy disruption incidents in 2011 are summarized in the paragraphs that follow.

- In late February, **unrest in Libya impacted oil production** and exports. Production outages increased through the summer to a peak of 1.6 million b/d. In June, the U.S. Department of Energy (DOE) and International Energy Agency (IEA) members released 60 million barrels of crude oil from emergency stockpiles to address disrupted oil supplies from Libya. After the Gaddafi regime was overthrown, oil production in Libya gradually was restored, and by year-end production was near normal levels.
- In February, **terrorists attacked the El-Arish gas pipeline** system that delivers natural gas from Egypt to Israel, Jordan, Syria, and Lebanon. The same pipeline was attacked in April, September, and November.
- Royal Dutch Shell's 500,000 barrels per day (b/d) **Singapore refinery had a massive fire** on September 29 that burned for nearly 30 hours. The fire forced the company to shut down the entire refinery and declare force majeure on its distillate deals. The refinery did not resume normal production levels until the end of the year.
- Several **attacks on Iraq's oil infrastructure** took place in 2011. In early June, militants blew up a storage tank at the Zubair 1 storage facility near the oil hub of Basra, and in October, two bombs hit pipeline networks transporting crude from the Rumaila oilfield, cutting output from 1.4 million b/d to 530,000 b/d. Officials reported on December 13 that three explosive charges blew up an oil pipeline that transports crude from southern Iraqi oilfields to the Zubair 1 storage facility.

- A series of floods struck **Queensland State, Australia** in December 2010 and January 2011, paralyzing coal-mining operations in a country that provides two-thirds of the world's coking coal production. At least six major coal mines declared force majeure in January, and most extended their declarations until April or May.
- Chevron had an off-shore **oil spill incident in Brazil**, which prompted Brazilian officials to require Chevron to suspend operations. Similarly, a leak at the ConocoPhillips production field in **China's Bohai Bay** caused China to shut-in production until the spill was controlled and restored.
- Ongoing **unrest continued to affect Nigerian oil production**, particularly along the Imo River in the Niger Delta region, with incidents increasing over the last half of 2011. Royal Dutch Shell reported numerous attacks on its Nigerian assets in July and August that forced it to temporarily shut-in production.
- **Piracy at sea** rose to an all-time high during the first quarter of 2011, with 142 attacks worldwide—mostly offshore **Somalia in the Gulf of Aden**. In February 2011 pirates attacked and held for nearly 2 months a 2 million-barrel cargo bound for U.S. markets.

4.2 Infrastructure Projects

Major international infrastructure events identified in the EAD mostly focused on petroleum in 2011, primarily in the Middle East, Canada, Brazil, and Russia. Power generation stories focused primarily on wind generation projects in Canada. International natural gas stories frequently focused on projects to transport LNG, further globalizing natural gas markets.

4.2.1 Petroleum

Middle East

- **Iraq** announced that its oil export capability would increase from 1.5 million b/d in 2011 to 5–6 million b/d by the end of 2013 due to construction of new pipelines and single-point moorings. BMG Company received preliminary approval to build a 150,000 b/d refinery in al-Ahdab oil field in Western Kut. **Syria and Iraq** struck a final deal to construct two oil pipelines and a gas pipeline through the two nations and were working to repair the long-shuttered, 300,000 b/d, Kirkuk, Iraq-to-Banias, Syria pipeline.
- **Saudi Aramco** announced it plans to raise domestic refining output capacity to 3.5 million b/d by 2016 following the construction of three new 400,000 b/d refineries. These refinery projects include a joint venture in Jubail with Total, planned for service in 2012; the Yanbu refinery in 2014; and the Jizan refinery in 2016.
- **Shell and Qatar Petroleum** started up the world's largest natural gas-to-liquids (GTL) project in Qatar in the fourth quarter of 2011. The "Pearl" project will process around 3 billion barrels of oil equivalent over its lifetime from Qatar's North Field. The 140,000 b/d Pearl GTL plant will produce oil products including diesel, kerosene, and naphtha.

- **Iran** announced it would boost production at the existing 55,000 b/d South Azadegan oilfield to 320,000 b/d over the next 4 years and eventually increase output to 600,000 b/d.
- The **United Arab Emirates** worked to restore its 480-km (288-mile) Abu Dhabi Crude Oil Pipeline to link the Habshan oilfields to the port of Fujairah on the Gulf of Oman, bypassing the Straits of Hormuz. The pipeline is reportedly planned to ship 2.5 million b/d of Murban crude.

Russia/Asia

- **Russia** launched the 270-mile Purpe-Samotlor crude oil pipeline that will supply 300,000 b/d to China and speed the development of new Arctic crude deposits, including Rosneft's largest new field, Vankor, which is expected to reach an output of 500,000 b/d in 2013. The Purpe-Samotlor pipeline will shorten the route to the East Siberia-Pacific Ocean pipeline.
- The **Russian** government approved financing for construction of the Zapolyarye-Purpe oil pipeline. Transneft will be both contractor and operator of the pipeline and plans to complete construction by 2016. The 300-mile pipeline will ship up to 900,000 b/d from fields in the Yamal-Nenets Autonomous District and northern Krasnoyarsk territory to the Eastern Siberia-Pacific Ocean pipeline.
- In **Kazakhstan**, construction began on a major expansion of the Caspian Pipeline Consortium system. The project will expand the line from its current capacity of 730,000 b/d to 1.4 million b/d in three phases from 2012 to 2015. The line carries crude oil from Kazakhstan to a dedicated terminal in the Black Sea.
- In **Indonesia**, ExxonMobil awarded initial engineering and construction contracts for the development of the 165,000 b/d Banyu Urip oil field in Indonesia.

Latin America

- Significant developments continued in the offshore areas of **Brazil**. Statoil began producing oil at the Peregrino field offshore Brazil. The field contains 300 to 600 million recoverable barrels of oil equivalent (boe). The company expects to gradually ramp up production to 100,000 boe per day (boe/d). Petrobras and partners announced a tender for two 150,000 b/d floating production, storage, and offloading (FPSO) units in Santos Basin for deployment by 2014. The BG Group announced plans to invest \$10 billion over 10 years to build 13 FPSOs, as well as a storage facility for crude oil. The Brazilian companies OSX and OGX announced plans to deploy a 100,000 b/d FPSO in mid-2013 at the Waimea Oilfield in the offshore region.
- In **Columbia**, Ecopetrol announced plans to study the feasibility of constructing a 559- to 746-mile pipeline linking heavy oilfields in the Llanos Region to the Pacific Ocean, improving deliveries to Asian markets. The U.S. export-import bank gave preliminary approval for \$2.84 billion in direct loans and guarantees for upgrades at Reficar's refinery in Cartagena. Reficar is planning a \$5.18 billion refinery upgrade project.

Canada

- A number of ports were proposed and engineered to expand Canada's access to U.S. markets for its increasing oil sands production (see **Section 4.3**). There are also projects being planned to export Canadian production to the Far East.
- China's Sinopec is investing in Enbridge's planned Northern Gateway oil pipeline. The proposed project consists of a 525,000 b/d oil export pipeline and a 193,000 b/d condensate import pipeline, both running about 731 miles from Alberta to British Columbia. Pending regulatory approval, Enbridge aims to complete the project in 2016.
- Kinder Morgan Energy Partners considered expanding its 300,000 b/d Trans Mountain Express oil pipeline by up to 400,000 b/d. Pending commercial support, the expansion could be in service by 2016–2018.

Other Markets

- In **Angola**, Total began production at the 220,000 b/d Pazflor oil field offshore Angola. The field contains estimated proved and probable reserves of 590 million barrels of oil. Total plans to ramp up production at the field to a full capacity of 220,000 b/d.
- In the **Bahamas**, Buckeye Partners' Bahamas Oil Refining Company (BORCO) announced plans to build 14 storage tanks with capacity of 3.5 million barrels, bringing total capacity to 14.5 million barrels. BORCO also launched a new inland dock capable of handling Panamax Tankers.
- In **Europe**, Royal Vopak NV announced plans in early 2011 to build an oil storage terminal in the Netherlands for European strategic petroleum reserves. The facility would have an initial capacity of 660,000 cubic meters (roughly 4 million barrels) and would be operational by the end of 2012.

4.2.2 Natural Gas

In Canada, Kitimat LNG partners were granted a 20-year export license by the Canadian National Energy Board to ship LNG from Canada to international markets. Also, FortisBC completed construction of the 1.5 Bcf Mount Hayes LNG Storage Tank on Vancouver Island, British Columbia. The facility should be in service by 2012.

In Africa, **Angola** Radio Nacional de Angola reported that the country's first LNG plant, with a design capacity to liquefy and export 1 billion cubic feet per day (Bcf/d) of natural gas, will begin operations during the first quarter of 2012.

4.2.3 Renewables

International renewable projects captured in the EAD in 2011 focused on wind projects. On a global basis, the American Wind Energy Association reported that China surpassed the United States with 41,800 megawatts (MW) of wind generation capacity, compared to 40,180 MW in the United States.

Canadian wind power will be bolstered by Patten Energy Group's 138 MW wind farm, now operational in Manitoba, and Finavera's proposed 77 MW Wildmare and 47 MW Tumbler Ridge wind energy projects in British Columbia, which have passed the screening stage of British Columbia's environmental assessment process. Also, the proposed 99 MW Knob Hill Wind Farm Phase 1 in British Columbia, now under new ownership, has been renamed Cape Scott Wind Farm and is now under construction.

In biomass, Biomass Secure Power plans to commission a 500,000 tonne/yr whitewood pellet plant in British Columbia in 2012.

Appendix A. Criteria for EAD Story Selection

Asset or Sector Activity (grouped by energy type)	Type of Event or Disruption	Criteria by Story Category ¹		
		Major Development	EAD Story	Energy Note
Electricity				
Electricity End-Use	Power Outage/ Restoration	>250,000 customers	25,000–250,000 customers	15,000–25,000 customers
Power Plant	Shut Down/ Restart/ New Capacity	Depends on impact; typically > 2,000 MW	99-2,000 MW	10- 99 MW
Transmission Line	Shut Down/ Restart/ New Capacity	Depends on impact; typically >500 kV	115-500 kV	< 115 kV
Substation	Break-in Damage/ Shutdown	---	Copper theft or severe impact	Minor or short-term impact
Petroleum				
Refinery	Shut Down, Restart, Flaring, New Capacity	Gulf Coast: >200,000 b/d Other U.S.: >100,000 b/d	Disruptions smaller than “Major” story that impact production	Flares and other events that do not impact production
Production or Transportation ²	Shut Down, Restart, Flaring, New Capacity	U.S./Canada: >200,000 b/d Foreign ³ : Depends on impact	U.S./Canada: 10,000 – 200,000 b/d Foreign ³ : >25,000 b/d	U.S./Canada: < 10,000 b/d Foreign ³ : < 25,000 b/d
Exploration	Oil Discovery	U.S./Canada: >10 billion barrels	US/Canada: 0.2 – 10 billion barrels Foreign: >2 billion barrels	US/Canada: 50 - 200 million barrels Foreign: >1 billion barrels
Natural Gas				
U.S./Canada Gas Production, Processing, or Transportation ²	Shutdown, Restart, New Capacity	Depends on impact; typically >500 MMcf/d or major explosion	100 – 500 MMcf/d	50 - 100 MMcf/d
Other				
Ethanol Plant, Biorefinery	Shutdown, Restart, New Capacity	Depends on impact; typically >500 MMGal/yr	10 – 500 MMGal/yr	< 10 MMGal/yr

¹ Criteria refer to number of customers affected, or the impact on energy infrastructure (measured in energy asset 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.

Appendix B. Major Developments, 2011

Date	Incident/ Weather Type	Incident	Impact
1/8/11	Fuel spill/leak	Alyeska shuts TAPS due to leak	The pipeline delivers crude oil from the Prudhoe Bay field to a port in Valdez, Alaska; it transported 642,261 b/d of oil, on average, in December 2010, according to Alyeska's website. The shutdown forced Prudhoe Bay producers to slash crude output to 5 percent of normal: from 630,000 b/d, on average, to approximately 31,500 b/d, multiple news and company sources reported. The shutdown did not disrupt shipments at the Valdez port. The pipeline restarted at reduced rates—about 400,000 b/d—January 11. Alyeska shut the line again on January 15 to install a bypass pipe around the site of a leak, and restarted it again on January 17.
1/26/11	Winter storm	Outages Eastern United States	Peak outages at 782,134 customers, across seven states and Washington, D.C.
1/31/11 – 2/2/11	Winter storm	ERCOT Initiates Rolling Blackouts	Cold weather—and a subsequent spike in electricity demand—forced offline 7,000 MW of power generation capacity (more than 50 generators) in Texas, and led the state's grid operator, the Electric Reliability Council of Texas (ERCOT), to ask all utilities in ERCOT to begin rolling outages on February 2, ERCOT and multiple news and company sources said. ERCOT canceled emergency procedures for the Texas grid on February 3.
		Outages Texas to U.S. East Coast	Peak outages at 2,426,390 customers, from Texas to U.S. East Coast.
		Explorer shuts pipeline due to weather	ERCOT asked Explorer to shut its 700,000 b/d, 28-inch line on February 2 due to cold weather, multiple power plant shutdowns, and rolling power outages. The affected line delivers up to 700,000 b/d of oil products from Louisiana to Illinois. The line resumed service February 3.
		Natural gas shut-ins due to weather	The cold weather forced offline at least 600 MMcf/d of natural gas output in Texas Basins, including 250 MMcf/d in the East Texas Basin, 220 MMcf/d in the Fort Worth Basin, and 215 MMcf/d in the Texas Gulf Coast basin, according to Bentek Energy data.
2/8/11	Explosions, fire	Explosions spark fire at Enterprise NGL facility	Explosions sparked a fire at Enterprise Products Partners' 305,000 b/d NGL fractionation facility in Mont Belvieu, Texas. Because the facility did not appear to connect "directly to natural gas supply pipelines," the incident was not expected to impact deliveries along regional pipelines, according to a reporter with the <i>Houston Chronicle</i> .
2/18/11 – 2/21/11	Winter storm	Outages in California	Storms cut power to some 744,000 Pacific Gas and Electric Company (PG&E) customers over the weekend.
2/18/11 – 2/19/11	Wind storm	Outages U.S. Northeast	Peak outages at 316,336 customers, across eight Northeastern states.
2/21/11 – 2/23/11	Winter storm	Outages U.S. Midwest	Peak outages at 413,400 customers, across several Midwestern states. (Our estimate here includes only states where more than 10,000 outages were reported.)

Date	Incident/ Weather Type	Incident	Impact
2/24/11 – 2/25/11	Thunderstorm/ Other storm	Outages U.S. Southeast and U.S. Mid-Atlantic	Peak outages at 397,085 customers, across U.S. Southeast and U.S. Mid-Atlantic.
3/20/11	Thunderstorm/ Other storm	Outages in California	Peak outages at 248,000 customers, in California.
3/30/11 – 3/31/11	Thunderstorm/ Other storm	Outages in Florida	Peak outages at 416,746 customers, in Florida.
4/4/11 – 4/5/11	Thunderstorm/ Other storm	Outages U.S. South	Peak outages at 1,205,038 customers, across the Southern states. (Our estimate here includes only states where more than 10,000 outages were reported.)
4/16/11	Tornado	Tornado shuts Surry nuclear plant in Virginia	An apparent tornado touched down on the switchyard supporting the plant and its access road on April 16, cutting off electrical feed from the grid to the station and forcing offline both of the facility's units, Dominion Virginia Power said in a press release.
4/15/11 – 4/18/11	Tornados/ Other Storm	Outages U.S. Central, Southeast, and East Coast	Peak outages at 753,012 customers, across Central and Southeastern states. (Our estimate here includes only states where more than 10,000 outages were reported.)
4/19/11 – 4/20/11	Thunderstorm/ Other storm	Outages Central United States	Peak outages at 497,987 customers, across multiple states. (Our estimate here includes only states where more than 10,000 outages were reported.)
4/25/11 – 4/28/11	Tornados/ Thunderstorm/ Other storm	Outages Southern, Midwestern, Eastern United States	Peak outages at 2,191,398 customers, across multiple states. Violent storms and tornadoes beginning April 25 swept across much of the U.S. South and moved into the Midwest and Northeast over several days. (Our estimate here includes only states where more than 10,000 outages were reported.) For details on the impact of this storm on customer outages, energy infrastructure issues, and restoration efforts see ISER Situation Reports—2011 Spring Storm.
		Winds cut power to Browns Ferry nuclear plant in Alabama	Storms and winds knocked out power at TVA's 3,391 MW Browns Ferry nuclear plant in Alabama on April 27, shutting all three units. Operators reported April 28 that repairs to the transmission lines would take at least several days and could take weeks. Unit 1 restarted by May 19, and Unit 2 restarted by May 24. [Unit 3 appears to have remained shut longer for maintenance.]
		Severe weather seriously damages TVA transmission system	Severe weather in the area served by the Tennessee Valley Authority (TVA) caused serious damage to the utility's transmission system April 27, with power outages and high voltage lines down in Alabama, Tennessee, Kentucky, and Mississippi. Storms and tornadoes from April 25–28 cut power to millions, including hundreds of thousands of TVA customers. The TVA, which sells electricity to 155 utilities and cooperatives, said it had restarted 14 high-voltage transmission lines by April 29; it said previously that the storms had damaged more than 90 power lines.

Date	Incident/ Weather Type	Incident	Impact
		Tornado damage shuts coal mine in Alabama	A tornado severely damaged above-ground facilities at Cliffs Natural Resources' Oak Grove coal mine near Birmingham, Alabama on April 28, forcing the company to shut production. The mine produces 900,000–1.4 million tons per year of coal.
4/25/11 – 4/26/11	Power failure	Power outages disrupt operations at three Texas City refineries	Power outages led BP to shut all units at its 475,000 b/d Texas City, Texas refinery and forced offline units at Valero's 214,000 b/d and Marathon's 76,000 b/d refineries in Texas City on April 25–26. The disruption led Enterprise Product Partners and Genesis Energy to divert flows along their jointly-owned, 400,000 b/d, 390-mile Cameron Highway Oil Pipeline away from Texas City. BP worked to restart multiple units April 26–May 5, but struggled with continued power issues. Valero was restarting units April 26–29 and restarted all units by May 2. Marathon Oil resumed normal rates late that week.
5/23/11 – 5/24/11	Thunderstorm/ Other storm	Outages U.S. Midwest and Tennessee	Peak outages at 366,960 customers, in Ohio, Indiana, Michigan, and Tennessee.
5/26/11 – 5/27/11	Thunderstorm/ Other storm	Outages U.S. South, East	Peak outages at 602,193 customers, across the entire U.S. eastern seaboard.
6/4/11 – 6/6/11	Thunderstorm/ Other storm	Outages U.S. South	Peak outages at 378,174 customers, across U.S. South.
6/8/11 – 6/10/11	Thunderstorm/ Other storm	Outages U.S. Midwest and Northeast	Peak outages at 429,465 customers, across U.S. Midwest and Northeast.
6/15/11 – 6/16/11	Thunderstorm/ Other storm	Outages U.S. South	Peak outages at 360,526 customers, in Georgia, the Carolinas, and Florida.
6/18/11 – 6/20/11	Thunderstorm/ Other storm	Outages U.S. Midwest and South	Peak outages at 372,296 customers, across U.S. Midwest and South.
6/21/11 – 6/22/11	Thunderstorm/ Other storm	Outages U.S. Midwest and Tennessee	Peak outages at 671,000 customers, across U.S. Midwest and Tennessee.
7/10/11 - 7/12/11	Thunderstorm/ Other storm	Outages U.S. Midwest	Peak outages at 1,462,026 customers, across U.S. Midwest, including 868,000 Commonwealth Edison (ComEd) customers in Metropolitan Chicago, Illinois. ComEd reportedly said that if smart grid capabilities had been available during the storm, 175,000 customers would not have lost power at all, and many other customers likely would have lost power for only a few minutes, not several days.
7/28/11 - 7/30/11	Tropical Storm Don	Tropical Storm Don shuts oil and natural gas production in the U.S. Gulf of Mexico	BOEMRE began reporting shut-ins July 28. Peak shut-ins appear by July 29, when BOEMRE estimated Tropical Storm Don shut-in 11.9 percent of U.S. Gulf of Mexico oil production and 6.2 percent of natural gas production. According to BOEMRE, companies evacuated personnel from 56 production platforms and four rigs, and they shut-in 166,554 b/d of oil production and 327 MMcf/d of natural gas production in the Gulf. However, news reports indicated much higher figures of production shut in—618,000 b/d of oil and 1.35 Bcf/d of natural gas. By July 31–August 1, companies were restoring production and no rigs or platforms remained evacuated.

Date	Incident/ Weather Type	Incident	Impact
8/23/11	Earthquake	An earthquake August 23 had its epicenter 11 miles from Dominion's North Anna nuclear plant in Virginia	Dominion's 1,806 MW North Anna nuclear plant shut after an earthquake on August 23 had its epicenter near Mineral, Virginia, which is about 11 miles from the North Anna plant. An NRC official said that because the earthquake shook the reactors more strongly than the plant's design anticipated, Dominion had to prove to the agency that the quake caused no functional damage to the reactors' safety systems. On November 11, the NRC approved both nuclear reactors for restart.
8/22/11 – 9/4/11	Hurricane Irene	Hurricane Irene causes major power outages in Puerto Rico and the U.S. Virgin Islands	Hurricane Irene made landfall on Puerto Rico as a Category 1 hurricane on Monday, August 22. Puerto Rico Electric Power Authority (PREPA) reported peak outages of 950,000 customers. Nearly 11,000 PREPA customers were still without power in Puerto Rico as of August 29. No exact outage numbers were available from the U.S. Virgin Islands, but reports indicated at least half of St. Croix was without power on August 22.
		Energy impacts in advance of the storm's landfall along the U.S. East Coast and in the Bahamas	Companies suspended operations at petroleum terminals along the East Coast and in the Bahamas. Nuclear power plants shut in advance of the storm, and refinery operations were affected throughout the Mid-Atlantic region.
		Hurricane Irene causes major power outages and energy infrastructure issues along U.S. East Coast	Hurricane Irene made landfall near Cape Lookout, North Carolina as a Category 1 hurricane at 8:00 AM EDT on Saturday, August 27. Peak U.S. outages at 8,382,482 customers, from North Carolina to Maine. For details on the impact of Hurricane Irene on customer outages, energy infrastructure issues, and restoration efforts see ISER Hurricane Irene Situation Reports. In addition to restoring power to customers, operators worked to restore operations at power plants, refineries, petroleum terminals, fuel storage facilities, and other energy infrastructure facilities over several days after the hurricane made landfall.
9/1/11 – 9/8/11	Tropical Storm	Tropical Storm Lee (initially classified as Tropical Depression 13) shuts-in oil and gas production in U.S. Gulf of Mexico	BP on September 1 declared force majeure for its 1.2 Bcf/d Destin natural gas pipeline. BOEMRE reported that by September 2, 169 platforms and 16 rigs were evacuated, and LOOP shut all tanker offloading. The storm came ashore September 3, knocking out power to at least 285,000 customers in Alabama, Georgia, and Louisiana, and others in Florida. The greatest oil and gas capacity shut-ins occurred by September 6, when 846,670 b/d of oil production (60.5 percent) and 2.2 Bcf/d of natural gas production (41.6 percent) were shut-in.

Date	Incident/ Weather Type	Incident	Impact
9/8/11	Accident/ Equipment failure	Worker error at Arizona substation trips 500 kV transmission line, cutting power to millions in U.S. Southwest	Peak outages at 1.6 million customers in Arizona and Southern California and 1.2 million customers in Mexico. ²² A single Arizona Power Service (APS) employee carrying out a procedure in the North Gila substation made a mistake and caused the North Gila-Hassayampa 500 kV transmission line near Yuma, Arizona to trip, according to reports. This error led to a massive power outage that swept across Arizona, Southern California, and Mexico around 7:00 PM EDT. Electricity was restored to most customers by the next morning. The grid disturbance caused Southern California Edison's 1,070 MW San Onofre nuclear Unit 2 and 1,080 MW nuclear Unit 3 to go off line. Full power was restored to Unit 2 by September 12 and Unit 3 by September 13.
10/13/11	Supply/Demand	TransCanada shuts Keystone crude oil pipeline due to supply backlog	TransCanada Corp. shut its 591,000 b/d Keystone pipeline October 13 because of a supply backlog caused by a lack of storage at an Enbridge storage terminal in Superior, Wisconsin. TransCanada restarted the line October 14.
10/29/11 – 11/7/11	Winter storm	Outages in U.S. Northeast and Mid-Atlantic	An early snow storm brought heavy, wet snow that broke tree limbs and brought down power lines, knocking out power to more than 4.3 million customers in the U.S. Northeast and Mid-Atlantic. Connecticut Light & Power (CL&P) was hit the hardest, reporting nearly 831,000 customers were without power at the peak of the storm. Utilities struggled to restore power. Six days after the storm began, on November 4, more than 427,000 customers from the Mid-Atlantic to New England were still without power. Nearly 61,000 CL&P customers and 1,900 PPL Electric customers remained without power November 7. For details on the impact of this winter storm on customer outages, energy infrastructure issues, and restoration efforts see ISER Situation Reports—U.S. Midcontinent to East Coast Major Winter Storm.
11/9/11 – 11/10/11	Equipment failure	TransCanada shuts Keystone crude oil pipeline due to mechanical issues	TransCanada shut its 591,000 b/d Keystone crude oil pipeline November 9 due to mechanical issues caused by a power outage. Operators restarted the pipeline the next morning, and company officials were investigating what might have caused the outage and mechanical problems.

²² Outage figures revised from those initially reported in the EAD to represent more accurate information reported by utilities after publication. "Pacific Southwest Outage." SDG&E. Presentation at Disaster Assistance and Recovery Forum. March 6, 2011. <http://bcl.uschamber.com/sites/default/files/SD%20Regional%20Forum%20-%20Earthquake%20Power%20Outage%20Challenges.pdf>

Date	Incident/ Weather Type	Incident	Impact
11/16/11	Explosion	Explosion shuts 25-inch gas pipeline in Ohio	A segment of the 25-inch, high-pressure Tennessee Gas Pipeline ruptured and exploded the morning of November 16 in Athens County, Ohio, destroying at least two buildings and starting a number of fires. The Tennessee Gas Pipeline stretches from the Mexican border to Canada and has multiple supply and delivery points along the way. According to data from the Energy Information Administration, the Tennessee Gas Pipeline has a capacity of 1,777 MMcf/d at the Kentucky-Ohio border.
11/30/11 – 12/1/11	Wind storm	Outages in Southern California	Santa Ana winds up to 100 mph tore through Southern California overnight November 30–December 1, downing power lines, trees, and buildings and knocking out power to 444,173 customers (peak figure). Much of South Pasadena remained without water the morning of December 1 because an electrical pump from the city's reservoirs failed due to the outage, reports said. LADWP reported that a power outage in northeast Los Angeles had affected pumping infrastructure supplying water to several communities and caused low water pressure in those communities. Southern California Edison reported the following Monday morning (four days later) that 25,089 of its customers still had no power.

Appendix C. Hours-of-Service Exemptions Citations

State waiver information was provided by the National Propane Gas Association.

Connecticut

Declaration of Civil Preparedness Emergency. Issued by Dannel P. Malloy, Governor of Connecticut. October 29, 2011.

Declaration of Emergency Notice. Issued by Melody A. Currey, Deputy Commissioner, State of Connecticut Department of Motor Vehicles. January 13, 2011.

Declaration of Emergency Notice. Issued by Melody A. Currey, Deputy Commissioner, State of Connecticut Department of Motor Vehicles. January 21, 2011.

Declaration of Emergency Notice. Issued by Melody A. Currey, Deputy Commissioner, State of Connecticut Department of Motor Vehicles. January 31, 2011.

Declaration of Emergency Notice. Issued by William Ramirez, Deputy Commissioner, State of Connecticut Department of Motor Vehicles. January 5, 2011.

Delaware

Emergency Waiver of Commercial Motor Vehicle Hours. Issued by the Delaware Emergency Management Agency. January 11, 2011.

Georgia

Waiver issued by Nathan Deal, Governor of Georgia. January 13, 2011.

Waiver issued by Sonny Perdue, Governor of Georgia. December 13, 2010.

Illinois

Declaration of Emergency. Issued by Michael R. Stout, Director of Illinois Department of Transportation Division of Traffic Safety. December 27, 2010.

Declaration of Emergency. Issued by Michael R. Stout, Director of Illinois Department of Transportation Division of Traffic Safety. January 24, 2011.

Iowa

Proclamation of Disaster Emergency. Issued by Terry E. Branstad, Governor of Iowa. August 26, 2011.

Kansas

State of Disaster Emergency Proclamation. Issued by Sam Brownback, Governor of Kansas. February 1, 2011.

Maine

State of Maine Proclamation. Issued by Paul R. LePage, Governor of Maine. January 20, 2011.

State of Maine Proclamation. Issued by Paul R. LePage, Governor of Maine. January 30, 2011.

State of Maine Proclamation. Issued by Paul R. LePage, Governor of Maine. February 6, 2011.

Maryland

Declaration of Transportation of Utility Emergency and an Exemption from Hours-of-Service Limitations. Issued by Mid-Atlantic Petroleum Distributors Association. December 28, 2010.

Declaration of Transportation of Utility Emergency and an Exemption from Hours-of-Service Limitations. Issued by Mid-Atlantic Petroleum Distributors Association. January 24, 2011.

Emergency Hurricane Efforts – Vehicle Size and Weight Limits. Executive Order: 01.01.2011.15. Issued by Martin O'Malley, Governor of Maryland. August 26, 2011.

Massachusetts

Declaration of Emergency Notice (Title 49 CFR Part 390.23). Issued by Deval L. Patrick, Governor of Massachusetts. January 28, 2011.

Declaration of Emergency Notice (Title 49 CFR Part 390.23). Issued by Deval L. Patrick, Governor of Massachusetts. February 1, 2011.

Missouri

Emergency Declaration 11-01. Issued by John M. Britt, Director of Missouri Department of Public Safety. January 31, 2011.

Emergency Declaration 11-01. Issued by John M. Britt, Director of Missouri Department of Public Safety. January 31, 2011.

New Hampshire

Waiver issued by Earl M. Sweeney, Assistant Commissioner of New Hampshire Department of Safety. February 4, 2011.

Waiver issued by John J. Barthelmes, Commissioner of New Hampshire Department of Safety. January 19, 2011.

Waiver issued by John J. Barthelmes, Commissioner of New Hampshire Department of Safety. January 28, 2011.

New Jersey

Waiver issued by Chris Christie, Governor of New Jersey. January 3, 2011.

Waiver issued by Chris Christie, Governor of New Jersey. January 14, 2011.

Waiver issued by Chris Christie, Governor of New Jersey. January 26, 2011.

New Mexico

Executive Order 2011-006. Issued by Susana Martinez, Governor of New Mexico. January 19, 2011.

New York

Waiver issued by Clifford Thomas, Acting Director of New York Office of Modal Safety and Security. December 30, 2010.

Waiver issued by Clifford Thomas, Acting Director of New York Office of Modal Safety and Security. January 21, 2011.

North Carolina

Executive Order No. 72: Temporary Suspension of Motor Vehicle Regulation to Ensure Adequate Fuel Supplies throughout the State. Issued by Beverly Eaves Perdue, Governor of North Carolina. December 17, 2010.

Executive Order No. 78: Proclamation of a State of Emergency by the Governor of the State of North Carolina. Issued by Beverly Eaves Perdue, Governor of North Carolina. January 10, 2011.

Executive Order No. 104: Temporary Suspension of Motor Vehicle Regulations to Ensure Restoration of Utility Services, Transporting Essential and Removing Debris throughout the State. Issued by Beverly Eaves Perdue, Governor of North Carolina. August 25, 2011.

Executive Order No. 109: Extending Executive Order No. 103, 104, 105 and 107. Issued by Beverly Eaves Perdue, Governor of North Carolina. November 1, 2011.

North Dakota

Executive Order 2011-26.3. Issued by Jack Dalrymple, Governor of North Dakota. October 31, 2011.

Ohio

Regulatory Relief for the Intrastate Transportation of Propane. Issued by Robert E. Marvin, Director of Ohio Public Utilities Commission Transportation Department. February 4, 2011.

Oklahoma

Executive Order 2011-04. Issued by Mary Fallin, Governor of Oklahoma. January 31, 2011.

Pennsylvania

Exemption 2011-01. Issued by R. Scott Christie, P.E. Acting Secretary of Pennsylvania Department of Transportation. January 21, 2011.

Proclamation of Disaster Emergency. Issued by Edward G. Rendell, Governor of Pennsylvania. December 29, 2010.

Rhode Island

State of Rhode Island and Providence Plantations Gubernatorial Proclamation. Issued by Lincoln D. Chafee, Governor of Rhode Island. January 21, 2011.

State of Rhode Island and Providence Plantations Gubernatorial Proclamation. Issued by Lincoln D. Chafee, Governor of Rhode Island. February 1, 2011.

South Carolina

Executive Order No. 2010-18. Issued by Mark Sanford, Governor of South Carolina. December 14, 2010.

Executive Order No. 2011-02. Issued by Nikki Haley, Governor of South Carolina. January 14, 2010.

South Dakota

Executive Order 2011-18. Issued by Dennis Daugaard, Governor of South Dakota. September 26, 2011.

Executive Order 2011-24. Issued by Dennis Daugaard, Governor of South Dakota. October 24, 2011.

Virginia

Limited Exemption of Hours Worked for Carriers Transporting Essential Emergency Relief Supplies. Issued by Michael M. Cline, State Coordinator of Virginia. August 25, 2011.

Limited Exemption of Hours Worked for Carriers Transporting Home Heating Fuels. Issued by Michael M. Cline, State Coordinator of Virginia. December 15, 2010.

Limited Exemption of Hours Worked for Carriers Transporting Home Heating Fuels. Issued by Michael M. Cline, State Coordinator of Virginia. January 13, 2011.

Appendix D. Petroleum Infrastructure Projects

Canadian Projects

Project	Company	Crude Destination	Capacity (TBD) ¹	Operational Date
Keystone XL Phases III & IV	TransCanada Corporation	Midwest and Gulf Coast refineries	700	Uncertain
Athabasca Pipeline Twin Line	Enbridge	Hardisty, AB	Initial: 450 Eventual: 800	2015–2016
Trans Mountain Pipeline Expansion	Kinder Morgan	Burnaby, BC	400	2016–2018
Corridor Pipeline Expansion Project	Inter Pipeline Fund	Edmonton, AB	165	In Operation
CN Rail Expansion	Canadian National Railway	Winnipeg, MB	N/A	N/A
G Seven Generations Rail Project	G Seven Generations	Valdez, AK	N/A	N/A

Notes: 1) TBD -- thousand barrels per day.

Eagle Ford Shale Projects¹

Project	Company	Crude Destination	Capacity (TBD) ²	Operational Date
Ho-Ho Pipeline Reversal	Shell Pipeline	St. James, LA	300	Q1 2013
Eagle Ford Pipeline Project	Plains All American	Corpus Christi, TX	300	Q1 2013
Sand Hills Pipeline (NGL)	DCP Midstream	Gulf Coast	Initial: 200 Eventual: 350	Initial: Q3 2012 Eventual: Q2 2013
Longhorn Pipeline Reversal	Magellan Midstream	Houston, TX	Initial: 135 Potential: 225	Initial: Q1 2013 Potential: N/A
Harvest Pipeline Project – Corpus Christi	Harvest Pipeline	Corpus Christi, TX	Initial: 100 Eventual: 150–200	Initial: Q1 2012 Eventual: N/A
Double Eagle Pipeline Project (NGL)	Copano Energy and Magellan Midstream	Corpus Christi, TX	100	Q1 2013
Liberty Pipeline Project (NGL)	Copano and Energy Transfer	Southeast Texas	75	In Operation
Harvest Pipeline – Three Rivers	Valero and Harvest Pipeline	Three Rivers, TX	Initial: 50 Eventual: 70	Q4 2011
Koch Pipeline Project	Koch Pipeline	Corpus Christi, TX	N/A	Q3 2012
South Texas Pipeline Expansion/Reversal	NuStar Energy	Three Rivers, TX and Corpus Christi, TX	N/A	In Operation (expansion Q2 2012)

Notes: 1) The Eagle Ford Shale play is in Texas. See EIA map for reference (http://www.eia.gov/oil_gas/rpd/shale_gas.pdf).

2) TBD -- thousand barrels per day.

Bakken Shale Projects¹

Project	Company	Crude Destination	Capacity (TBD) ²	Operational Date
Seaway Pipeline Reversal	Enbridge and Enterprise	Freeport, TX	Batched: 275–375 Full: 400	Batched: Q2 2012 Full: 2013
Bakken Pipeline Expansion	Enbridge	U.S. Mid-Continent and Central Canada refineries	145	Q4 2012
Bakken Oil Express Rail Hub – Burlington Northern Santa Fe	Bakken Oil Express	St. James, LA	Initial: 100 Eventual: 250	Initial: In Operation
BakkenLink Pipeline	BakkenLink LLC	Original: Baker, MT New: Fryburg, ND	100	Uncertain
COLT Crude Oil Hub – Rail	Rangeland Energy	West Coast - Tesoro refineries	80	Q1 2012
Dore Rail Terminal	Musket Corporation	Gulf Coast, West Coast, and Mid-Continent	70	Q1 2012
Bakken Marketlink Pipeline Project	TransCanada Corporation	Cushing, OK	65	Q1 2013
Line 5 Expansion	Enbridge	Michigan, Ohio, and Ontario refineries	50	Q4 2012
Rail Unloading Facility	Tesoro	Anacortes, WA	30	Q3 2012
Berthold Rail Project	Enbridge	N/A	Initial: 10 Eventual: 80	Initial: Q3 2012 Eventual: Q1 2013
St. James Rail Terminal	U.S. Development Group LLC	St. James, LA	65	Q4 2011
Trenton Railport – Burlington Northern Santa Fe	Savage Companies	Port Arthur, TX	N/A	Q2 2012

Notes: 1) The Bakken Shale play is in North Dakota and Montana. See EIA map for reference

(http://www.eia.gov/oil_gas/rpd/shale_gas.pdf).

2) TBD -- thousand barrels per day.

Appendix E. Abbreviations

b/d	barrels per day
bbl	barrel
Bcf/d	billion cubic feet per day
boe	barrels of oil equivalent
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement
CSAPR	Cross-State Air Pollution Rule
DOE	U.S. Department of Energy
E15	15 percent ethanol-blended gasoline
EAD	Energy Assurance Daily
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
FPSO	floating production, storage, and offloading
GTL	gas to liquids
GW	gigawatts
HOS	hours of service
IEA	International Energy Agency
ISER	Infrastructure Security and Energy Restoration
ISO	Independent System Operator
kV	kilovolt
LNG	liquefied natural gas
MATS	Mercury and Air Toxics Standards
MMBtu	million British thermal units
MMcf/d	million cubic feet per day
MMGal/Yr	million gallons per year
MW	megawatt
NGL	natural gas liquids
NRC	U.S. Nuclear Regulatory Commission
OE	Office of Electricity Delivery and Energy Reliability
RFS2	Renewable Fuel Standard 2
TBD	thousand barrels per day
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
VLCC	very large crude carrier
WTI	West Texas Intermediate
YIR	Year-in-Review