

# **Comparing the Impacts of Northeast Hurricanes on Energy Infrastructure**

**Office of Electricity Delivery and Energy Reliability**

**U.S. Department of Energy**



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## **For Further Information**

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**Contents**

Executive Summary ..... iv

Storm Comparison ..... 1

    Irene ..... 1

    Sandy ..... 2

    Storm Surge and Tides ..... 4

Electricity Impacts ..... 7

    Power Outages ..... 7

    Power Restoration ..... 11

    Nuclear Power Plants ..... 13

Petroleum Impacts ..... 14

    Refineries ..... 14

    Transportation & Supply ..... 16

    Prices & Stocks ..... 19

    Retail Stations ..... 24

Natural Gas ..... 25

    Transmission Pipelines ..... 25

    Local Distribution Companies ..... 25

Federal Actions ..... 26

    Providing Situational Awareness ..... 26

    Facilitating Restoration ..... 27

    Releasing Fuel Reserves ..... 29

    Easing Regulations ..... 30

State & Local Actions ..... 34

    Major Disaster and Emergency Declarations ..... 34

    Easing Regulations ..... 36

    Enforcing Price Gouging Laws ..... 37

    Facilitating Restoration ..... 38

Appendices ..... 41

    Appendix 1. Peak Customer Power Outages by States ..... 41

    Appendix 2. U.S. Coast Guard Commands ..... 42

    Appendix 3. Jones Act Waiver Vessel Deliveries by Port and Product ..... 43

    Appendix 4. Major Disaster Declarations and Emergency Declarations by State and Storm.. 44

## Figures

Figure ES-1. Irene and Sandy Storm Paths and Landfall Dates .....	iv
Figure 1. Hurricane Irene Day before First U.S. Landfall (August 26, 2011) .....	3
Figure 2. Hurricane Sandy Day before First U.S. Landfall (October 28, 2012) .....	3
Figure 3. New York Harbor Areas Flooded by Irene and Sandy .....	6
Figure 4. Peak Power Outages by Select State and Storm .....	7
Figure 5. Comparison of Power Outage Restoration Percentages by Storm .....	11
Figure 6. Comparison of Power Outage Restoration Percentages by Storm .....	12
Figure 7. Weekly Gross Inputs* into East Coast (PADD 1) Refineries .....	16
Figure 8. Weekly Petroleum Imports to the East Coast (PADD 1) .....	19
Figure 9. Selected Daily Wholesale and Weekly Retail Petroleum Product Prices .....	20
Figure 10. New York Harbor Gasoline Stock Changes and Spot Price Differentials .....	21
Figure 11. New York Harbor Distillate Stock Changes and ULSD Spot Price Differentials .....	23
Figure 12. Availability of Gasoline in the New York City Metropolitan Area .....	24
Figure 13. EIA's Interactive Infrastructure Map for Hurricane Sandy .....	27
Figure 14. ESF-12 Responders Deployed by Storm.....	28

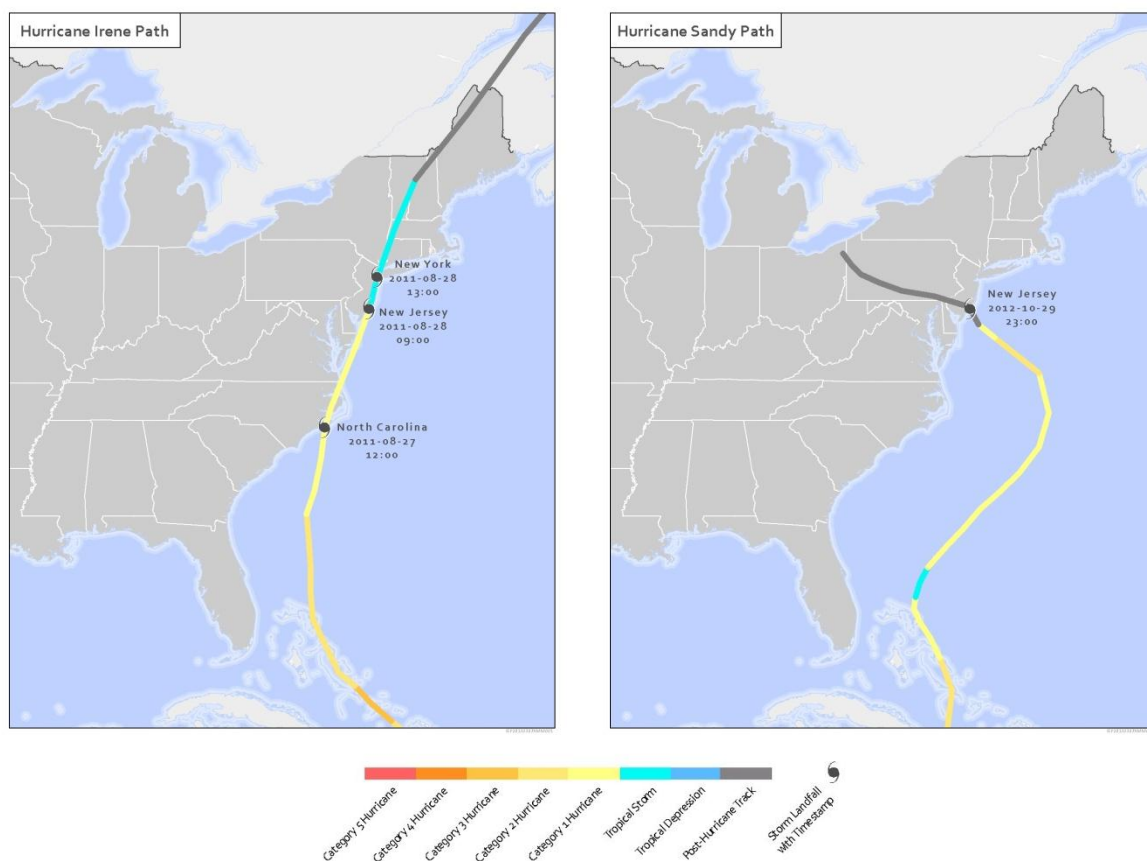
## Tables

Table ES-1. Energy Impacts of Hurricane Irene vs. Hurricane Sandy .....	v
Table 1. Irene vs. Sandy Storm Comparisons .....	1
Table 2. Maximum Recorded Storm Tides (Feet)* by Select Location and Storm .....	4
Table 3. Number of Energy Assets Located in Flooded Areas by Storm and State .....	5
Table 4. Electric Infrastructure Damage by Storm and Utility.....	9
Table 5. Nuclear Power Plants Units Affected by Hurricanes Irene and Sandy .....	13
Table 6. Refineries Affected by Hurricanes Irene and Sandy .....	15
Table 7. Petroleum Pipelines Affected by Hurricanes Irene and Sandy .....	17
Table 8. East Coast Port Sectors Affected by Hurricanes Irene and Sandy.....	18
Table 9. Hurricane Sandy Jones Act Waiver Vessel Deliveries by Port.....	31
Table 10. EPA Fuel Waivers Issued Following Hurricane Sandy.....	32
Table 11. Duration (Days) of Emergency and Major Disaster Declarations by State and Storm	35

## Executive Summary

Two major hurricanes have impacted the Northeastern United States over the past 2 years, devastating coastal communities and causing widespread impacts to the region's energy infrastructure, supply, and markets. In late August 2011, Hurricane Irene made landfall as a category 3 hurricane in North Carolina before moving up the East Coast, making successive landfalls in New Jersey and New York, and affecting communities in the United States as far north as Maine. In late October 2012, Hurricane Sandy made landfall as a post-tropical cyclone near Atlantic City, New Jersey before moving inland. Although Sandy was weaker than Irene at landfall, Sandy brought tropical storm conditions to a larger area of the East Coast, and blizzard conditions as far west as the Central and Southern Appalachians. Ultimately, Sandy had a larger and longer-lasting impact on the region's energy infrastructure and supply than Irene, and these impacts necessitated a greater response from Federal, State, and local governments. Figure ES-1 compares the paths of the two storms.

**Figure ES-1. Irene and Sandy Storm Paths and Landfall Dates**



Source: NOAA

Both Irene and Sandy caused extensive damage to electric transmission and distribution infrastructure in the Northeast and Mid-Atlantic. Irene disrupted power to 6.69 million customers from South Carolina to Maine. By comparison, Sandy (and the November 2012 Nor'easter that followed a week later) knocked out power to 8.66 million customers from North Carolina to

Maine and as far west as Illinois and Wisconsin. The devastation to electric infrastructure was greater during Sandy than during Irene, and the conditions in the aftermath of the storm were more challenging. Following Sandy, utilities had restored power to 95 percent of affected customers 10 days after outages peaked compared with 5 days following Irene.

Sandy’s impact on the region’s petroleum infrastructure was also more severe than Irene’s impact. Both storms caused flooding and power outages at refineries, pipelines, and petroleum terminals in the New York Harbor area, depressing petroleum product supply in the Northeast and leading to stock draw downs and temporary price increases. However, Sandy’s damage to petroleum infrastructure was more extensive, and restoration of petroleum supply systems following the storm took longer. Survey data from the Energy Information Administration (EIA) indicate that product deliveries (outflows) from petroleum product terminals in the New York Harbor had returned to only 61 percent of their pre-storm levels more than 9 days after Sandy made landfall. The supply issues at New York Harbor terminals, combined with power outages at retail fueling stations, led to widespread gasoline shortages in the New York City area in the weeks after Sandy made landfall. No widespread supply issues or gasoline shortages were reported following Hurricane Irene. Table ES-1 summarizes the major energy impacts of Hurricanes Irene and Sandy. Hurricanes Irene and Sandy did not have a major impact on natural gas infrastructure or supplies in the Northeast

**Table ES-1. Energy Impacts of Hurricane Irene vs. Hurricane Sandy**

<b>Impact</b>	<b>Irene</b>	<b>Sandy</b>
<b>Electric Customer Outages (millions)</b>	6.69	8.66
<b>Petroleum Refining Capacity Shut (barrels per day)</b>	238,000	308,000
<b>Petroleum Product Terminals Shut (number)</b>	25	57

Source: OE/ISER Situation Reports

Following both storms, various agencies within the Federal government worked together to provide situational awareness, facilitate restoration, and ease regulations. Following Sandy, the Department of Energy’s (DOE) Power Marketing Administrations from the Western United States—for the first time— assisted investor-owned utilities with power restoration under mutual aid agreements. The Federal government also—for the first time—released supplies from the Northeast Home Heating Oil Reserve. In addition, the Federal government issued waivers allowing foreign vessels to ship fuel from the Gulf Coast to the Northeast, permitting greater fuel-use flexibility for certain applications, and allowing utility and fuel truck drivers to work longer hours to expedite the restoration of energy systems and supply.

State and local governments also worked actively to address energy issues. Following Sandy, New Jersey and New York City implemented odd-even license plate fuel rationing programs. New York City also launched a program to expedite repairs to residential customers unable to receive power, gas, or heating oil due to damage within their homes.

## Storm Comparison

This report compares two major hurricanes that hit the Northeastern United States in 2011 and 2012 and their impacts on energy infrastructure. Hurricanes Irene and Sandy were large, powerful storms that caused extensive damage across much of the Mid-Atlantic and Northeast. The National Oceanic Atmospheric Administration (NOAA) ranks both storms among the costliest and deadliest weather events in U.S. history.<sup>1</sup> Although Sandy was weaker than Irene when it first made landfall in the United States, Sandy was much larger, with tropical storm-force winds reaching as far as 500 miles from the center of the storm. Table 1 compares aspects of each storm. Figure 1 and Figure 2 on page 3 present satellite photographs of Irene and Sandy as they approached the U.S. mainland.

**Table 1. Irene vs. Sandy Storm Comparisons**

	<b>Irene</b>	<b>Sandy</b>
<b>Landfall Date</b>	August 27, 2011	October 29, 2012
<b>Strength at First U.S. Landfall</b>	Category 1 Hurricane	Post-Tropical Cyclone
<b>Landfall Location (sustained winds)</b>	8/27 – Cape Lookout, NC (90 mph) 8/28 – Little Egg Inlet, NJ (80 mph) 8/28 – Coney Island, NY (75 mph)	10/29 – Atlantic City, NJ (80 mph)
<b>Distance of Tropical Storm-Force Winds from Center</b>	300 miles	500 miles
<b>Peak Flooding</b>	New York City* – 9.5 feet Philadelphia – 9.9 feet	New York City* – 14.1 feet Philadelphia – 10.6 feet
<b>Property Damage</b>	\$10 billion	Est. \$20+ billion
<b>Deaths</b>	45	131

\*The Battery

Sources: NOAA, EQUecat, Property Claim Services, press

## Irene

Irene made landfall as a category 1 hurricane in the Outer Banks region of North Carolina on the morning of August 27, 2011. In the days that followed, Irene tracked towards the Northeast, making its second U.S. landfall in New Jersey and its third and final U.S. landfall in Brooklyn, New York. Torrential rain and storm surges of 3–4 feet caused significant river flooding across eight States, including New York, Vermont, and New Jersey. The flood waters brought by Irene constituted one of the worst flood disasters ever recorded in the Northeast.<sup>2</sup> According to the National Weather Service, total water level peaked near 9.5 feet above the mean lower low water level at Battery Park in New York City, and at 9.9 feet along the Delaware River in Philadelphia.

Irene was unusually large, with tropical storm-force winds extending nearly 300 miles from its center. Irene was also a slow-moving storm, traveling at a top speed of 20 miles per hour (mph), compared to speeds of 30–40 mph for similarly sized storms. According to NOAA, Irene caused

<sup>1</sup> "Billion-Dollar Weather/Climate Disasters." NOAA. NCDC. <http://www.ncdc.noaa.gov/billions/events>

<sup>2</sup> State of the Climate Hurricanes & Tropical Storms August 2011. NOAA. NCDC. <http://www.ncdc.noaa.gov/sotc/tropical-cyclones/2011/8>.

45 deaths and \$10 billion in property damage, making it one of the deadliest and costliest storms in U.S. history. In late October 2011—2 months after Irene made landfall—a historic and unprecedented early season winter storm (known as a Nor'easter) deposited more than one foot of heavy wet snow on interior portions of northeastern New Jersey, the Lower Hudson Valley, and southern Connecticut.<sup>3</sup>

## Sandy

Sandy made landfall near Atlantic City, New Jersey on October 29, 2012 after transitioning from a tropical cyclone to a post-tropical cyclone. The storm had maximum sustained winds of 80 mph. Although weaker than Irene when it made landfall, Sandy was a larger storm, with tropical storm-force winds extending nearly 500 miles from the storm's center.<sup>4</sup> The storm's impact was recorded across 24 States, although not all of these States had measurable energy impacts. Sandy brought a large storm surge and high water levels to the coastal Northeast, where New Jersey, New York, and Connecticut experienced the greatest impact. Record water levels were observed at Battery Park in New York City (14.1 feet) and along the Delaware River in Philadelphia (10.6 feet). In addition to wind, rain, and storm surge impacts in coastal areas, Sandy also brought blizzard conditions to the Central and Southern Appalachians, where over a foot of snow fell in six States from North Carolina to Pennsylvania.

Sandy caused large-scale flooding and wind damage across the Mid-Atlantic and Northeast. Preliminary estimates indicate that Sandy led to at least 131 fatalities, and more than \$20 billion in property damage, making it another one of the deadliest and costliest weather events in U.S. history.

More than a week after Sandy made landfall, an early-season Nor'easter brought wind, snow, rain, and storm surge to parts of the Northeast still recovering from Sandy. Locations in New Jersey, New York, and Connecticut reported record November snowfall figures as a result of the storm.<sup>5</sup>

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<sup>3</sup> "October 29th Historic Early Season Snowstorm." National Weather Service New York, NY. <http://www.erh.noaa.gov/okx/StormEvents/10292011/index.html> and "Transmission and Facility Outages during the Northeast Snowstorm of October 29-30, 2011" Federal Energy Regulator Commission and North American Electric Reliability Corporation. <http://www.ferc.gov/legal/staff-reports/05-31-2012-ne-outage-report.pdf>

<sup>4</sup> "National Summary Information - October 2012." NOAA National Climatic Data Center. <http://www.ncdc.noaa.gov/sotc/summary-info/national/2012/10>

<sup>5</sup> "Significant Events from November and Autumn 2012." NOAA National Climatic Data Center. <http://www1.ncdc.noaa.gov/pub/data/cmb/images/us/2012/nov/monthlysigeventmap-112012.gif>



Figure 1. Hurricane Irene Day before First U.S. Landfall (August 26, 2011)



Figure 2. Hurricane Sandy Day before First U.S. Landfall (October 28, 2012)



Source: NOAA

## Storm Surge and Tides

Flooding resulting from storm surge and storm tides was a major problem affecting energy assets during Hurricanes Irene and Sandy. *Storm surge* is an abnormal rise in water levels generated by a storm, over and above the predicted astronomical tides. *Storm tides* are the abnormal rise in water levels due to a combination of storm surge and the astronomical tide. This rise in water level can cause extreme flooding in coastal areas, particularly when storm surge coincides with the normal high tide.<sup>6</sup> Table 2 shows storm tides as recorded at select locations along the East Coast following Irene and Sandy. In many cases, storm tides caused by the hurricanes exceeded previous maximum water level records.

**Table 2. Maximum Recorded Storm Tides (Feet)\* by Select Location and Storm**

Location	Irene	Sandy
Wilmington, NC	5.24	5.91
Washington, DC	3.87	6.11
Baltimore, MD	2.98	4.66
Philadelphia, PA	9.93	**10.62
Atlantic City, NJ	6.96	8.90
Bergen Point West Reach, NY	**10.22	**14.58
The Battery, NY	9.50	**14.06
New Haven, CT	**11.57	**12.25
Providence, RI	8.25	9.37
Boston, MA	11.95	12.92
Portland, ME	11.96	11.90

\*Referenced to Mean Lower Low Water (MLLW)

\*\* Maximum recorded water level value exceeded historical maximum value.

Source: NOAA Center for Operational Oceanographic Products and Services

The storm tide during Sandy was more severe and had a greater impact on energy assets than the storm tide during Irene. Table 3 provides an analysis of spatial inundation data provided by the Federal Emergency Management Agency (FEMA) following Hurricanes Irene and Sandy, geo-located against energy assets. FEMA inundation data for Irene was available for all the States listed in Table 3. Data for Sandy was available only for New Jersey, New York, Connecticut, and Rhode Island. Data for Pennsylvania was not available for either storm. Energy assets identified in Table 3 are located in areas that were fully or partially flooded but the assets may or may not have experienced water damage depending on the level of inundation, whether key equipment was protected or elevated, and other site-specific factors.

<sup>6</sup> "Storm Surge Overview" National Hurricane Center. National Weather Service. <http://www.nhc.noaa.gov/surge/>

**Table 3. Number of Energy Assets Located in Flooded Areas by Storm and State**

<b>Storm</b>	<b>Asset Type</b>	<b>CT</b>	<b>DE</b>	<b>MD</b>	<b>MA</b>	<b>NC</b>	<b>NH</b>	<b>NJ</b>	<b>NY</b>	<b>RI</b>	<b>VA</b>	<b>Total</b>
<b>Irene</b>	Electric Power Plant	7			1	5		19	12			<b>44</b>
	Electric Substations	9	1	3	1	8		21	12		9	<b>64</b>
	NG Compressors							1				<b>1</b>
	Oil Refineries											<b>0</b>
	Petroleum Terminals	4	2					9	7		5	<b>27</b>
	<b>Irene Total</b>		<b>20</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>13</b>	<b>0</b>	<b>50</b>	<b>31</b>	<b>0</b>	<b>14</b>
<b>Sandy</b>	Electric Power Plant	7	n/a	n/a	n/a	n/a	n/a	36	24	2	n/a	<b>69</b>
	Electric Substations	13	n/a	n/a	n/a	n/a	n/a	58	28	3	n/a	<b>102</b>
	NG Compressors		n/a	n/a	n/a	n/a	n/a	1			n/a	<b>1</b>
	Oil Refineries		n/a	n/a	n/a	n/a	n/a	1			n/a	<b>1</b>
	Petroleum Terminals	16	n/a	n/a	n/a	n/a	n/a	33	13		n/a	<b>62</b>
	<b>Sandy Total</b>		<b>36</b>	n/a	n/a	n/a	n/a	n/a	<b>129</b>	<b>65</b>	<b>5</b>	n/a

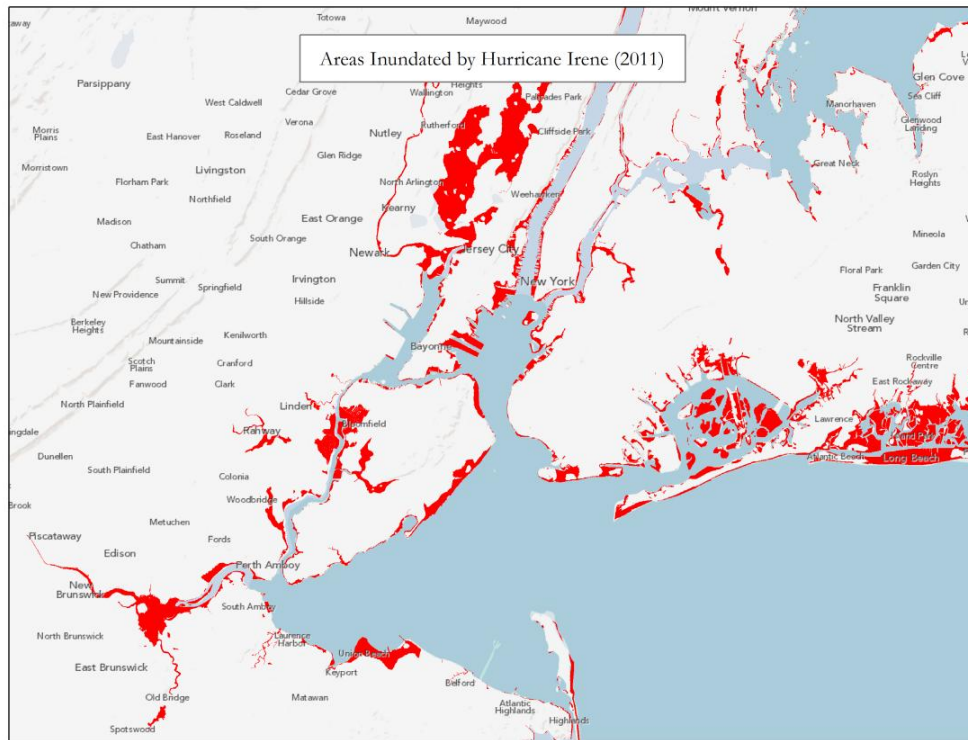
n/a = FEMA flood data are not available. PA flood data are not available for either storm.

Sources: FEMA, HSIP 2012, Ventyx, DOE

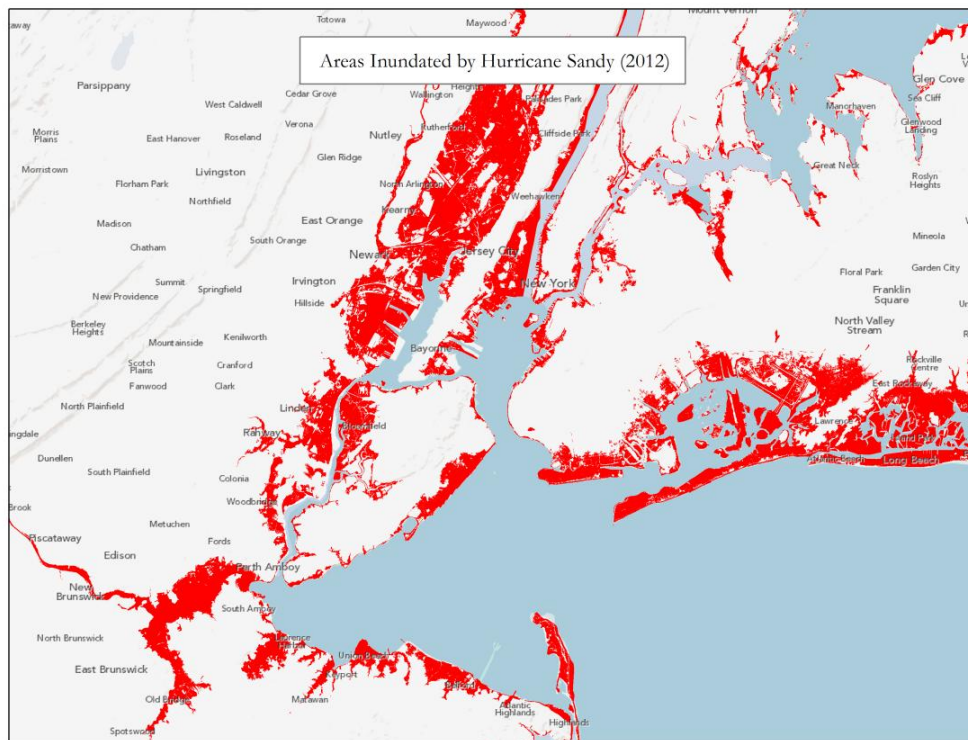
Table 3 indicates more energy assets were located in flooded areas during Sandy than during Irene, including power plants, substations, refineries, and petroleum terminals. The number of petroleum terminals in flooded areas during Sandy was more than double the number of terminals in flooded areas during Irene. During both storms, assets in New Jersey, New York, and Connecticut were the most severely affected, a factor that contributed to greater disruptions and longer restoration times for electric power service and petroleum supply chains in those States. These impacts are discussed in detail later in this report.

Flooding was a particular problem for petroleum assets located in the New York Harbor area during Irene and Sandy. Figure 3 shows a wider area of inundation in New York Harbor during Sandy than Irene, and NOAA's tidal gauge on Staten Island (See Bergen Point West Reach, NY in Table 2) measured a higher storm tide on the Kill Van Kull in New York Harbor during Sandy (14.58 feet) than during Irene (10.22 feet). Phillips 66's 238,000 barrel per day (b/d) Linden, New Jersey refinery reported that it sustained flooding in low-lying areas of its facility during Sandy. Petroleum terminals were also hit hard. Forty, or 76 percent, of the 53 petroleum terminals located in the New York Harbor were in flooded areas during Sandy, compared with 16 terminals, or 31 percent, during Irene.

Figure 3. New York Harbor Areas Flooded by Irene and Sandy



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ICF20130308MDD006

Source: FEMA

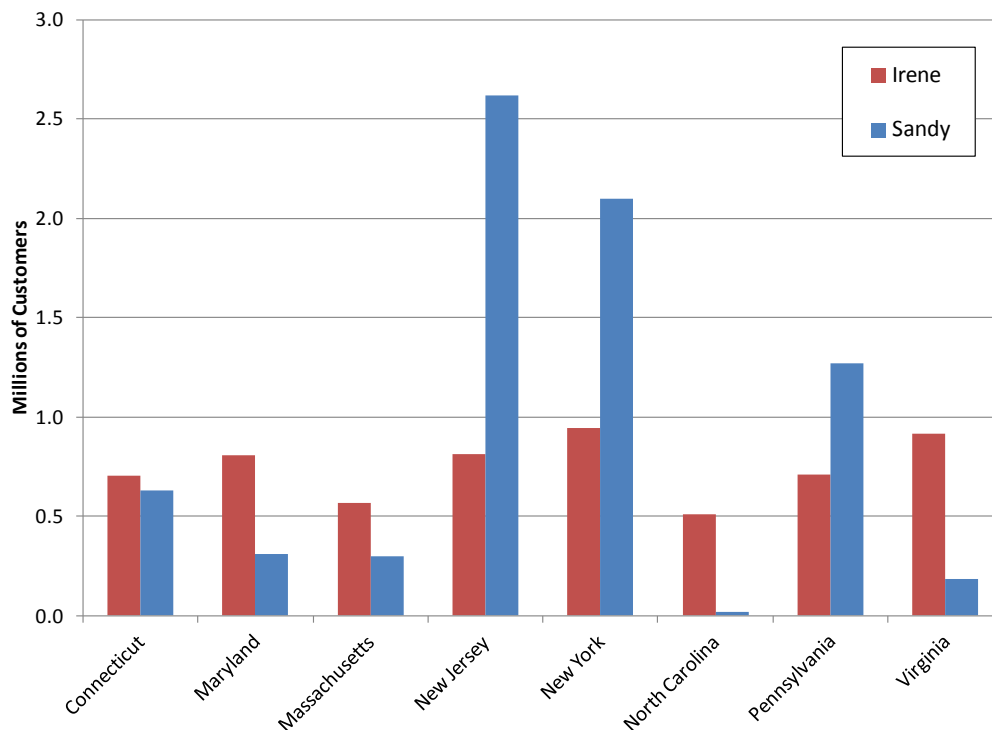
## Electricity Impacts

Both Hurricanes Irene and Sandy caused widespread damage to electric power transmission and distribution networks and left millions of customers without power across the Eastern Seaboard. Hurricane Sandy caused more overall customer power outages and affected more States than Irene. Power restoration following Sandy was complicated by the November 2012 Nor'easter, and it took utilities more than twice as long to reach full restoration following Sandy than it did following Irene.

## Power Outages

During Hurricane Irene, 6.69 million customer outages were reported across 14 States and the District of Columbia as the storm moved up the East Coast from South Carolina to Maine. By comparison, Hurricane Sandy and the November 2012 Nor'easter caused 8.66 million customer outages across 20 States and the District of Columbia from North Carolina to Maine and as far west as Illinois.<sup>7</sup> Figure 4 compares peak outages for States that experienced 500,000 or more peak customer outages during either storm. Figure 4 shows that Hurricane Irene caused more outages in Connecticut, Maryland, Massachusetts, North Carolina, and Virginia, while Hurricane Sandy caused more outages in New Jersey, New York, and Pennsylvania. For a full list of peak outages by State, see Appendix 1.

**Figure 4. Peak Power Outages by Select State and Storm**



Source: OE/ISER Emergency Situation Reports

<sup>7</sup> Outage totals for Irene and Sandy are the sum of peak outages reported for each State in Emergency Situation Reports published by DOE's Office of Electricity Delivery and Energy Reliability, Infrastructure Security and Energy Restoration division (OE/ISER). Outages for Sandy include 150,000 additional outages caused by the November 2012 Nor'easter. [http://www.oe.netl.doe.gov/emergency\\_sit\\_rpt.aspx](http://www.oe.netl.doe.gov/emergency_sit_rpt.aspx)

## Infrastructure Damage

Hurricanes Irene and Sandy brought devastating wind and flooding to the Northeast and Mid-Atlantic States, damaging electric power transmission and distribution infrastructure, including substations, power lines, and utility poles. Table 4 provides details of the damage, based primarily on information compiled from OE/ISER Emergency Situation Reports, company press releases, and utility filings with State public utility commissions. However, not all utilities in the affected areas provided detailed information on such impacts, and those that did report impacts did not often provide details in a uniform way. Consequently, it is not possible to directly compare the damage to power infrastructure between the two storms or even between utilities or States within the same storm. The data in the table is presented to provide perspective on the magnitude of damage caused by Hurricanes Irene and Sandy.

Although specific conclusions cannot be drawn from the available data, generally, utilities that experienced more customer outages experienced higher levels of infrastructure damage. In particular, available data indicates infrastructure damage was more severe for utilities serving customers in coastal New York and New Jersey during Sandy than Irene. The Long Island Power Authority's (LIPA) service territory, which serves customers on Long Island, New York, experienced high winds and flooding during both Irene and Sandy (See Figure 3). LIPA experienced damage to 50 substations, 2,100 transformers, and 4,500 utility poles following Sandy, as compared with damage to 22 substations, 1,000 transformers, and 900 utility poles following Irene.

**Table 4. Electric Infrastructure Damage by Storm and Utility**

State/Utility	Damage Locations		Substations		Transformers		Transmission Lines		Sections of Wire		Poles	
	Irene	Sandy	Irene	Sandy	Irene	Sandy	Irene	Sandy	Irene	Sandy	Irene	Sandy
<b>VIRGINIA</b>												
<b>Dominion Virginia Power</b>	35,000				27				57 mi		1,619	
<b>MARYLAND</b>												
<b>Baltimore Gas &amp; Electric</b>			0		247				4,861	2,500	348	
<b>Delmarva Power</b>			1		40				308		53	
<b>Pepco (MD)</b>			2		92		131		1,166		36	
<b>Potomac Edison</b>			0		7					95 mi	14	700
<b>SMECO</b>			0		195		1				313	
<b>PENNSYLVANIA</b>												
<b>Met Ed</b>	6,889	9,500			130	304	25	41	18 mi	53 mi	143	731
<b>PECO</b>		13,000			278	390			90 mi	141 mi	316	750
<b>Penelec</b>	1,483	1,800			10	88		42	3 mi	11 mi	30	80
<b>PPL</b>						601	18 mi			~100 mi	900	619
<b>UGI Utilities</b>	617	382							1,043		39	
<b>West Penn Power</b>		1,500				120		31		19 mi		65
<b>NEW JERSEY</b>												
<b>Atlantic City Electric</b>				7	107			20	1,070		59	
<b>Jersey Central Power &amp; Light</b>			7		465	400			47 mi	3,400	466	800
<b>Public Service Electric &amp; Gas</b>			8	31	383	1,000			1,384		599	2,500
<b>Rockland Electric</b>					58				974			27
<b>NEW YORK</b>												
<b>Central Hudson Gas &amp; Electric</b>		1,500		1	450		13	5	2,071	1,100	351	200
<b>Consolidated Edison</b>		30,000			163		4		2,598	900	91	
<b>Long Island Power Authority</b>	18,926		22	50	1,000	2,100	61		5,953	400 mi	900	4,500

State/Utility	Damage Locations		Substations		Transformers		Transmission Lines		Sections of Wire		Poles	
	Irene	Sandy	Irene	Sandy	Irene	Sandy	Irene	Sandy	Irene	Sandy	Irene	Sandy
<b>National Grid (NY)</b>					196		7		672		399	
<b>N.Y. State Electric &amp; Gas</b>				22	64		7	38	4,985	5,000	224	1,023
<b>Orange and Rockland</b>	5,400			17	336		2	27	3,612		151	500
<b>NEW ENGLAND</b>												
<b>Connecticut Light &amp; Power (CT)</b>	4,968				623	2,000		105 mi	3,404	2,400	941	2,700
<b>Central Maine Power (ME)</b>											259	95
<b>National Grid (RI)</b>				37			8				1,140	
<b>National Grid (MA)</b>					135		23		983		267	
<b>NSTAR (MA)</b>	10,000		6		194		4		2,000		194	
<b>United Illuminating Co. (CT)</b>	2								450		103	

Sources: OE/ISER Emergency Situation Reports, utility websites, State public utility commission filings (listed below)

State Public Utility Commission Filings:

Maryland: [http://webapp.psc.state.md.us/Intranet/casenum/CaseAction\\_new.cfm?CaseNumber=9279](http://webapp.psc.state.md.us/Intranet/casenum/CaseAction_new.cfm?CaseNumber=9279)

Massachusetts: <http://www.mass.gov/eea/grants-and-tech-assistance/guidance-technical-assistance/agencies-and-divisions/dpu/storm-orders.html>

New Jersey: <http://www.nj.gov/bpu/pdf/announcements/2012/stormreport2011.pdf>

New York: <http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=11-M-0481> and LIPA: <http://moreland.ny.gov/sites/default/files/DPS%20Irene%20Report%20-%20LIPA.pdf>

Pennsylvania: [http://www.puc.state.pa.us/consumer\\_info/electricity/reliability.aspx](http://www.puc.state.pa.us/consumer_info/electricity/reliability.aspx)

Rhode Island: [http://www.ripuc.org/eventsactions/docket/D\\_11\\_94\\_Booth.pdf](http://www.ripuc.org/eventsactions/docket/D_11_94_Booth.pdf)

Virginia: [http://www.scc.virginia.gov/comm/reports/irene\\_pue.pdf](http://www.scc.virginia.gov/comm/reports/irene_pue.pdf)

Connecticut: <http://www.ct.gov/pura/lib/pura/pressreleases/2012/110909finaldecision.pdf>

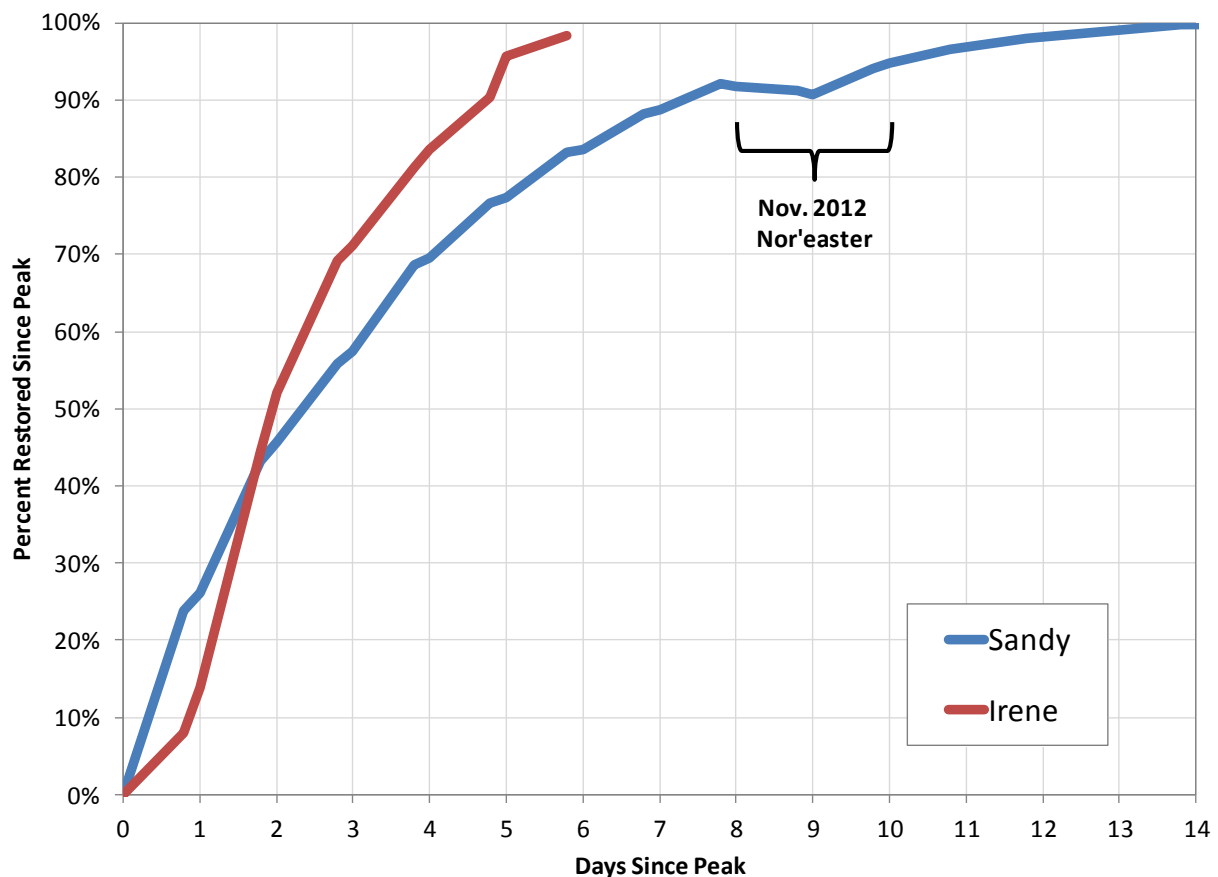


## Power Restoration

Full power restoration took more than twice as long following Hurricane Sandy than it did following Hurricane Irene. Outages from Irene peaked on August 28, 2011. Three days later utilities had restored power to 71 percent of the peak reported outages, and 5 days later power had been restored to 95 percent of the peak.

Outages from Hurricane Sandy peaked on October 30, 2012. Three days later utilities had restored power to 57 percent of the peak, and 6 days later power had been restored to 84 percent. Power restoration had reached more than 90 percent when the November 2012 Nor'easter slowed the progress of utility crews and added additional outages. Restoration of 95 percent was not achieved until 10 days after the peak. Figure 5 compares the progress of power outage restoration following Hurricanes Irene and Sandy.

**Figure 5. Comparison of Power Outage Restoration Percentages by Storm**

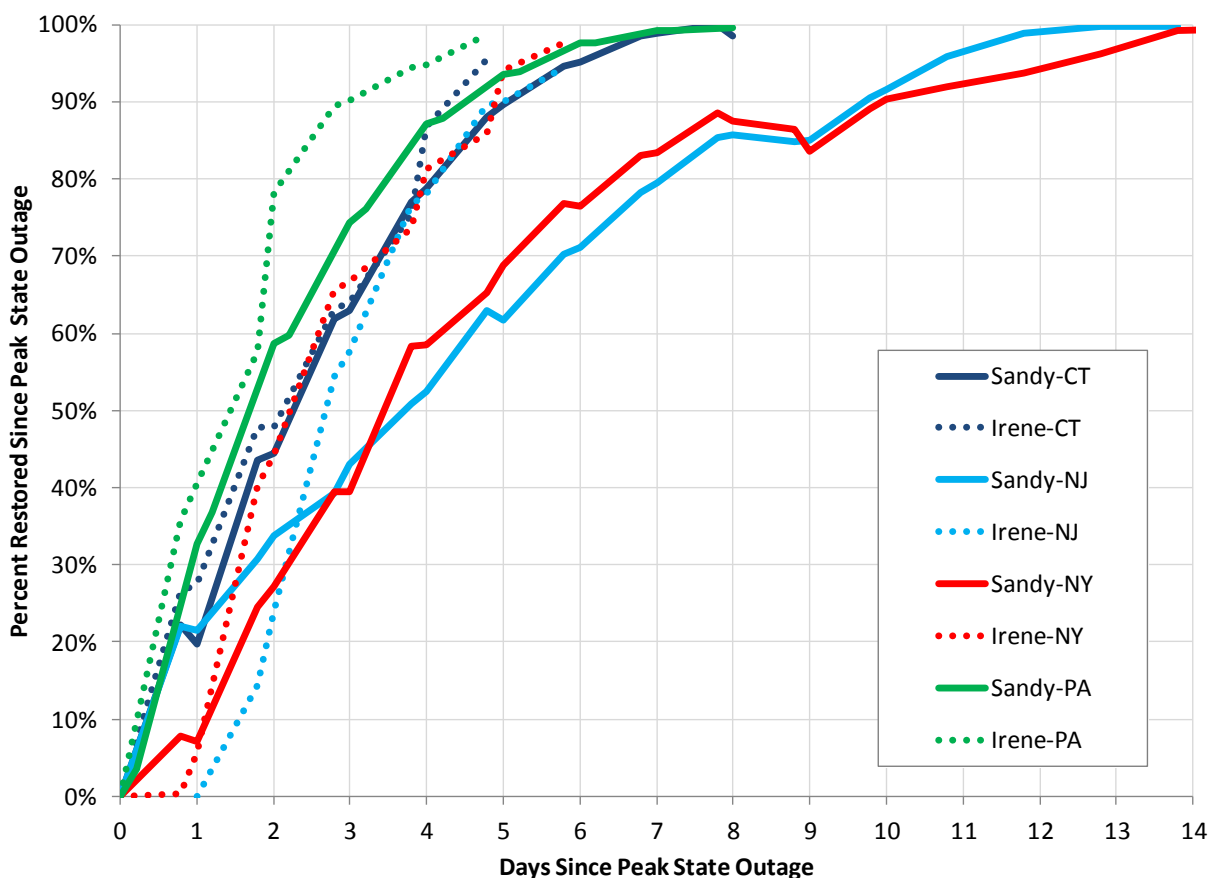


Source: OE/ISER Emergency Situation Reports

Power restoration took longer for individual States following Sandy than after Irene. Figure 6 compares power outage restoration by storm for the four States that experienced 500,000 or more customer outages during both Sandy and Irene: Connecticut, New Jersey, New York, and Pennsylvania. Figure 6 shows that full restoration came 8 days or more after peak outages for

each State following Hurricane Sandy, whereas outages were fully restored or nearly restored within 7 days for each State following Irene. Note that Hurricane Sandy caused more outages than Irene in three of the four States observed (See Figure 4). In New York and New Jersey, Hurricane Sandy caused more than twice the number of outages incurred during Irene.

**Figure 6. Comparison of Power Outage Restoration Percentages by Storm**



Source: OE/ISER Emergency Situation Reports

### Utility Personnel

Utilities deployed internal and external resources to restore power outages caused by Hurricanes Irene and Sandy. During major outage events, utilities often turn to the power industry’s mutual assistance network—a voluntary partnership of electric utilities from across the country. These mutual assistance partnerships utilize resources, skills, personnel, and equipment to help restore power during an emergency situation. According to the Edison Electric Institute<sup>8</sup>, 50,000 mutual assistance workers were involved in the clean-up and power

<sup>8</sup> The Edison Electric Institute represents shareholder-owned electric companies in the United States.

restoration effort following Hurricane Irene.<sup>9</sup> By comparison, 67,000 mutual assistance workers were involved in the restoration effort following Hurricane Sandy.<sup>10</sup>

## Nuclear Power Plants

Reactors at nuclear power plants in the Northeast were affected by Hurricanes Irene and Sandy. Some reactors were shut as a precaution to protect equipment from the storm; others were forced to shut down or reduce power output due to damage to plant facilities or transmission infrastructure serving the plant; and still others were forced to reduce power output due to reduced power demand caused by widespread utility customer outages. According to data from the Nuclear Regulatory Commission, two nuclear reactors (totaling 1,470 MWs of capacity) were shut and six others were operated at reduced capacity due to Hurricane Irene. Due to Sandy, three nuclear reactors (totaling 2,845 MWs of capacity) were shut and five were operated at reduced rates.

Table 5 lists the nuclear power reactors affected by Irene and Sandy. Of the nuclear reactors on the East Coast, three were affected by both storms: Dominion's Millstone Unit 3 in Connecticut and Exelon's Limerick Units 1 and 2 in Pennsylvania, which operated at reduced capacity during both Irene and Sandy.

**Table 5. Nuclear Power Plants Units Affected by Hurricanes Irene and Sandy**

Storm	Unit	State	Company	Capacity (MW)	Impact	Impact Start Date	Restoration Date
<b>Irene</b>	Calvert Cliffs 2	MD	Constellation	855	Shut	8/27/11	9/3/11
	Oyster Creek	NJ	Exelon	615	Shut	8/27/11	8/31/11
	Millstone 2	CT	Dominion	869	Reduced	8/28/11	8/30/11
	Millstone 3	CT	Dominion	1,233	Reduced	8/28/11	8/31/11
	Brunswick 1	NC	Progress Energy	938	Reduced	8/27/11	8/29/11
	Brunswick 2	NC	Progress Energy	920	Reduced	8/27/11	8/30/11
	Limerick 1	PA	Exelon	1,130	Reduced	8/28/11	8/30/11
	Limerick 2	PA	Exelon	1,134	Reduced	8/28/11	8/30/11
<b>Sandy</b>	Salem 1	NJ	PSEG	1,175	Shut	10/30/12	11/5/12
	Indian Point 3	NY	Entergy	1,040	Shut	10/30/12	11/3/12
	Nine Mile 1	NY	Constellation	630	Shut	10/29/12	11/10/12
	Millstone 3	CT	Dominion	1,233	Reduced	10/29/12	11/2/12
	Limerick 1	PA	Exelon	1,130	Reduced	10/30/12	10/31/12
	Limerick 2	PA	Exelon	1,134	Reduced	10/30/12	11/2/12
	Susquehanna 2	PA	PPL	1,190	Reduced	10/30/12	11/5/12
	Vermont Yankee	VT	Entergy	620	Reduced	10/30/12	10/31/12

Source: Nuclear Regulatory Commission

<sup>9</sup> "Understanding the Electric Power Industry's Mutual Assistance Network." Edison Electric Institute.

<sup>10</sup> "Multimedia Gallery Of Restoration Efforts - Superstorm Sandy." Edison Electric Institute.

<http://www.eei.org/ourissues/ElectricityTransmission/Reliability/Pages/MultimediaGallery-Sandy.aspx>

## Petroleum Impacts

Hurricanes Irene and Sandy disrupted petroleum supply networks in the Northeast due to direct effects from the storms (flooding, wind, etc.) as well as power interruptions caused by the storms. In particular, the hurricanes disrupted activity in the New York Harbor area—a major distribution hub for petroleum delivery to consumer markets in New York, New Jersey, Pennsylvania, and New England. The terminals in the New York Harbor area, which have a combined storage capacity of about 70 million barrels, receive product via pipeline from refineries on the U.S. Gulf Coast, the Philadelphia area, and the two refineries located in northern New Jersey – Phillips 66 Bayway (238,000 barrels per day) and Hess Port Reading (70,000 barrels per day). The terminals also receive product via tanker and barge, much of it imported from outside the United States. In addition, products from the terminals are redistributed by barge mainly to distribution terminals throughout the New York Harbor area, up the Hudson River as far as Albany, and into New England. Product moves via the Buckeye pipeline to Brooklyn/Queens terminals, all regional airports, and upstate New York and Pennsylvania. These distribution terminals supply gasoline, heating oil, and diesel fuel to trucks for delivery to retail outlets and local distributors.<sup>11</sup>

## Refineries

Several Northeast refineries were affected by flooding, wind, and other impacts brought by Hurricanes Irene and Sandy. Area refineries were also affected by power outages and logistical issues caused by the closure of crude oil and petroleum product transportation and distribution systems in the wake of the storms. Hurricane Irene shut one refinery and caused reductions at five others in the Northeast, while Hurricane Sandy shut two refineries and caused reductions at four others. The Phillips 66 Bayway refinery in Linden, New Jersey, which is the second largest refinery in the Northeast, was shut as a precaution prior to both storms. Following Hurricane Sandy, the Bayway refinery lost power, sustained flooding in low-lying areas of the plant, and remained offline for several weeks as operators conducted repairs and maintenance.<sup>12</sup> Table 6 lists the refineries impacted by Hurricanes Irene and Sandy.

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<sup>11</sup> “New York/New Jersey Intra Harbor Petroleum Supplies Following Hurricane Sandy: Summary of Impacts Through November 13, 2012.” November 2012. Energy Information Administration.

[http://www.eia.gov/special/disruptions/hurricane/sandy/pdf/petroleum\\_terminal\\_survey.pdf](http://www.eia.gov/special/disruptions/hurricane/sandy/pdf/petroleum_terminal_survey.pdf)

<sup>12</sup> Hurricane Sandy Situation Report # 5. October 30, 2012 (3:00 PM EDT). DOE/OE ISER. [http://energy.gov/sites/prod/files/2012\\_SitRep5\\_Sandy\\_10302012\\_300PM.pdf](http://energy.gov/sites/prod/files/2012_SitRep5_Sandy_10302012_300PM.pdf)

**Table 6. Refineries Affected by Hurricanes Irene and Sandy**

Storm	Refinery	State	Company	Capacity (b/d) <sup>A</sup>	Impact	Impact Start Date	Restoration Date
<b>Irene</b>	Linden	NJ	ConocoPhillips <sup>B</sup>	238,000	Reduced Shut	8/27/11 8/28/11	9/1/11
	Paulsboro	NJ	PBF	160,000	Reduced	8/27/11	8/29/11
	Trainer	PA	ConocoPhillips <sup>C</sup>	185,000	Reduced	8/27/11	8/31/11
	Philadelphia	PA	Sunoco <sup>D</sup>	335,000	Reduced	8/29/11	9/2/11
	Marcus Hook <sup>E</sup>	PA	Sunoco	178,000	Reduced	8/29/11	8/29/11
	Delaware City	DE	PBF	182,000	Reduced	8/29/11	8/29/11
<b>Sandy</b>	Linden	NJ	Phillips 66	238,000	Shut	10/29/12	11/27/12
	Port Reading	NJ	Hess	70,000	Shut	10/29/12	11/21/12
	Paulsboro	NJ	PBF	160,000	Reduced	10/29/12	11/1/12
	Trainer	PA	Monroe Energy	185,000	Reduced	10/29/12	10/31/12
	Philadelphia	PA	Philadelphia Energy Solutions	335,000	Reduced	10/29/12	11/7/12
	Delaware City	DE	PBF	182,000	Reduced	10/29/12	11/1/12

<sup>A</sup> Barrels per day – <sup>B</sup> Now Phillips 66 – <sup>C</sup> Now Monroe Energy – <sup>D</sup> Now Philadelphia Energy Solutions – <sup>E</sup> Idled December 2011  
Sources: OE/ISER Emergency Situation Reports, Energy Assurance Daily

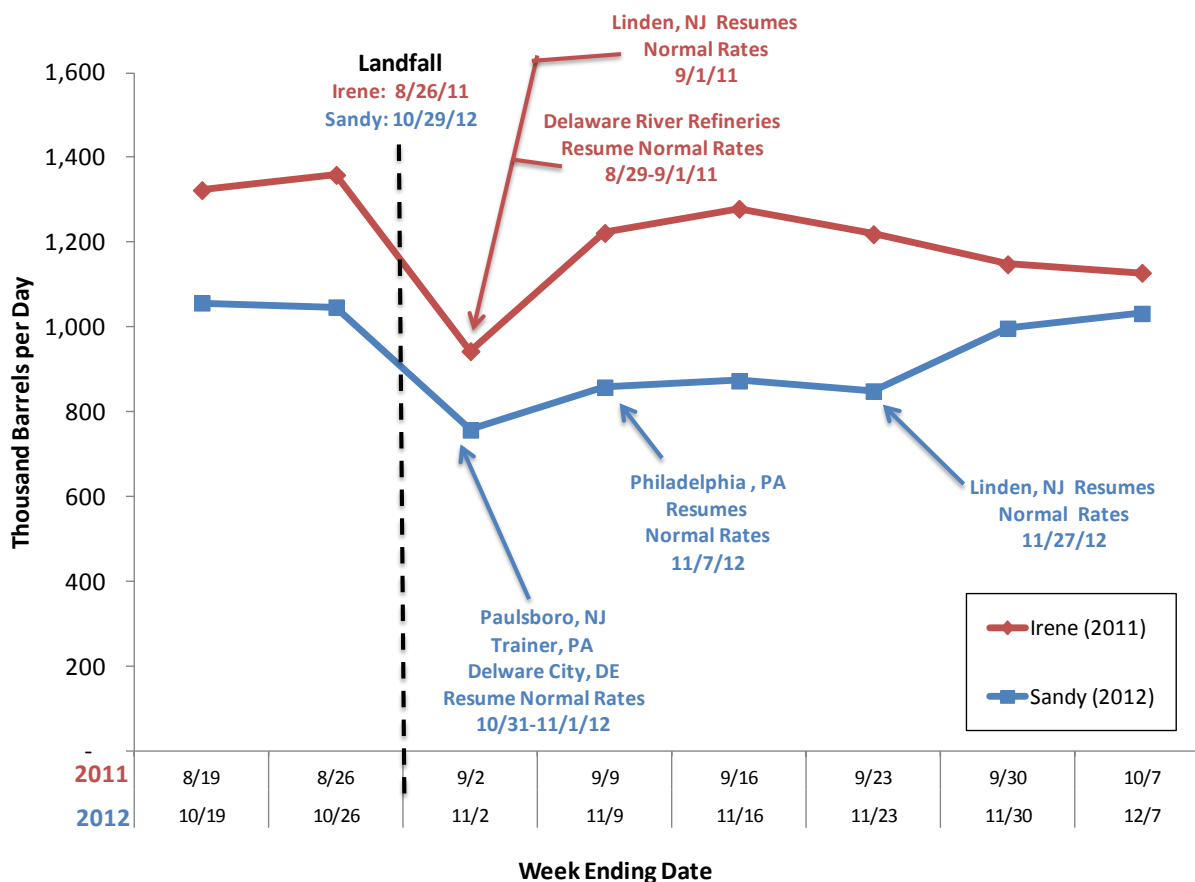
Refining activity is tracked by EIA at the regional level. Figure 7 compares weekly gross inputs of crude oil, unfinished oils, and natural gas plant liquids into atmospheric crude distillation units at East Coast refineries (in Petroleum Administration for Defense District 1, or PADD 1) in the weeks leading up to and following Hurricanes Irene and Sandy.<sup>13</sup> In the week after Hurricane Irene made landfall, gross inputs into East Coast refineries fell by 416,000 b/d, or 31 percent, from the week prior to landfall. In the second and third weeks after landfall, refining activity largely recovered, although not to pre-storm levels.

Hurricane Sandy disrupted East Coast refining activity for a longer period of time than Irene. In the week after Hurricane Sandy made landfall, gross inputs into East Coast refineries fell 290,000 b/d, or 28 percent, from the week prior to the storm.<sup>14</sup> Refineries that had reduced rates due to Sandy ramped inputs back up to normal rates in the following weeks but refining activity on the East Coast remained depressed due to the extended outage at Phillips 66's 238,000 b/d refinery in Linden, New Jersey. Refining activity did not return to pre-storm levels until a month after Sandy's landfall, when the Phillips refinery restarted and returned to normal rates.

<sup>13</sup> The gross inputs presented in Figure 7 do not include inputs into Hess's 70,000 b/d Port Reading, NJ refinery as this facility does not have a crude distillation unit.

<sup>14</sup> The overall lower crude runs in 2012 versus 2011 during this period is largely the result of the closure of the Sunoco refinery in Marcus Hook, PA and pre-storm reduced rates at Monroe Energy's refinery in Trainer, PA, which started up in September 2012. These closures were somewhat offset by the restart of the PBF Delaware City, DE refinery following PBF's purchase from Valero.

**Figure 7. Weekly Gross Inputs\* into East Coast (PADD 1) Refineries**



\*Gross Inputs: The crude oil, unfinished oils, and natural gas plant liquids put into atmospheric crude oil distillation units. (This does not include inputs into Hess’s Port Reading, NJ refinery.)  
 Sources: EIA, OE/ISER Emergency Situation Reports

### Transportation & Supply

In addition to affecting refinery production, Hurricanes Irene and Sandy also disrupted petroleum transportation and distribution assets—terminals, pipelines, and ports—that serve the Northeast.

#### Terminals

Hurricanes Irene and Sandy impacted many East Coast petroleum terminals. No comprehensive survey tracks the operational status of petroleum terminals and many companies do not publically report operations. Information compiled from company statements, trade press, and other media sources and published by OE/ISER in Emergency Situation Reports indicate that at least 25 terminals were partially or completely closed following Hurricane Irene, as compared with at least 57 terminals that partially or completely closed following Hurricane Sandy.

A survey of New York Harbor terminal operators conducted by EIA in the aftermath of Hurricane Sandy found that petroleum product flows remained significantly disrupted more than 9 days after the storm made landfall. The survey found that product receipts (inflows) of petroleum

products (gasoline, diesel, jet fuel, and ethanol) at petroleum terminals had been reduced to 65 percent of pre-storm levels during the week of November 7–13, 2012. The survey found that product deliveries (outflows) from petroleum terminals had been reduced to 61 percent of pre-storm levels over the same time period. By product type, outflows of gasoline had recovered the most, with deliveries returning to 72 percent of pre-storm levels; diesel deliveries had recovered to 55 percent; and other (jet fuel, ethanol) deliveries had recovered to just 20 percent.<sup>15</sup> No comparable data were collected in the aftermath of Hurricane Irene.

## Pipelines

Power outages and flooding at pipeline facilities and petroleum product terminals along the East Coast—particularly in the New York Harbor area—forced pipelines supplying the Northeast to shut segments or operate at reduced capacity in the wake of Hurricanes Irene and Sandy. Table 7 lists the pipelines affected by each storm. Irene shut segments of three petroleum product pipelines and one crude oil pipeline.

Sandy shut segments of three product pipelines. Both storms affected portions of the Buckeye Pipeline—a major interstate product pipeline that originates in New York Harbor and is the major supplier of fuel products to both the New York City metropolitan area as well as upstate New York and portions of Pennsylvania. Colonial Pipeline—a major interstate pipeline that supplies the East Coast with petroleum products from refineries on the U.S. Gulf Coast—experienced flooding and the loss of power at its facility in Linden, New Jersey during Hurricane Sandy. The Linden facility is the terminus of the Colonial Pipeline and the outage of this facility caused Colonial to shut down the segment of its mainline system serving markets in Philadelphia, New Jersey, and the New York Harbor.<sup>16</sup> Colonial Pipeline brought in portable generators to power the Linden facility and restored normal flows on the line following an outage of roughly 5 days.

**Table 7. Petroleum Pipelines Affected by Hurricanes Irene and Sandy**

Storm	Pipeline	Type	Capacity (b/d) <sup>A</sup>	Impact	Impact Start Date	Restoration Date
Irene	Buckeye	Product	900,000	Segments Shut	8/26/11	8/30/11
	Plantation	Product	600,000	Segments Shut	8/27/11	8/29/11
	Portland	Crude	410,000	Segments Shut	8/28/11	9/1/11
	TEPPCO (Enterprise)	Product	330,000	Segments Shut	8/27/11	8/30/11
Sandy	Buckeye	Product	900,000	Segments Shut	10/29/12	11/3/12
	Colonial	Product	2,400,000	Segments Shut	10/29/12	11/2/12
	Plantation	Product	600,000	Segments Shut	10/30/12	10/31/12

<sup>A</sup> Barrels per day, total system capacity

Source: OE/ISER Emergency Situation Reports

<sup>15</sup> “New York/New Jersey Intra Harbor Petroleum Supplies Following Hurricane Sandy: Summary of Impacts Through November 13, 2012.” November 2012. Energy Information Administration.

[http://www.eia.gov/special/disruptions/hurricane/sandy/pdf/petroleum\\_terminal\\_survey.pdf](http://www.eia.gov/special/disruptions/hurricane/sandy/pdf/petroleum_terminal_survey.pdf)

<sup>16</sup> Hurricane Sandy Emergency Situation Report #4. October 30, 2012 (10:00 AM EDT). DOE/OE ISER.

[http://www.oe.netl.doe.gov/docs/2012\\_SitRep4\\_Sandy\\_10302012\\_1000AM.pdf](http://www.oe.netl.doe.gov/docs/2012_SitRep4_Sandy_10302012_1000AM.pdf)

## Ports

The U.S. Coast Guard shut ports along the Eastern Seaboard from the Mid-Atlantic to New England in advance of both Hurricanes Irene and Sandy. Most of these ports re-opened 1 to 3 days later, after inspections and clean-up operations had been conducted. Following Sandy, a diesel spill from a damaged tank at a Motiva Enterprises' terminal in Sewaren, New Jersey, along with substantial storm debris in the waterway, kept the vessel traffic closed or heavily restricted on the Arthur Kill and surrounding waterways in New York Harbor for more than a week after the storm had passed. This closure affected barge and vessel traffic at several petroleum terminals in New Jersey and New York.

Table 8 lists the East Coast port sectors from North Carolina to Maine, the approximate petroleum imports registered at ports in each sector in 2011, and the shut-down and re-start dates for each sector in 2011 and 2012.<sup>17</sup> For a map of U.S. Coast Guard port sectors, see Appendix 2.

**Table 8. East Coast Port Sectors Affected by Hurricanes Irene and Sandy**

Port Sector	2011 Imports (b/d)*			Irene		Sandy	
	Crude Oil	Products	Total	Shut	Opened	Shut	Opened
North Carolina	-	19,973	19,973	8/26/11	8/29/11	N/A	N/A
Hampton Roads	-	17,008	17,008	8/26/11	8/29/11	10/29/12	10/30/12
Baltimore	-	19,425	19,425	8/27/11	8/29/11	10/29/12	10/30/12
Delaware Bay	737,534	81,715	819,249	8/27/11	8/29/11	10/29/12	10/31/12
New York	248,233	505,145	753,378	8/27/11	8/28/11	10/29/12	11/1/12**
Long Island Sound	-	47,707	47,707	8/27/11	8/31/11	10/29/12	10/31/12
S.E. New England	-	57,082	57,082	8/27/11	8/31/11	10/29/12	10/31/12
Boston	-	154,216	154,216	8/27/11	8/31/11	10/29/12	10/30/12
N. New England	-	119,764	119,764	N/A	N/A	N/A	N/A
<b>Grand Total</b>	<b>985,767</b>	<b>1,022,035</b>	<b>2,007,802</b>				

\*Barrels per day. The volumes include only international imports.

\*\*On November 1, 2012 the Port of New York reopened to all vessels. Due to an oil spill, traffic on the Arthur Kill and Kill Van Kull remained closed or restricted until November 7.

Sources: OE/ISER Emergency Situation Reports, EIA

## Imports

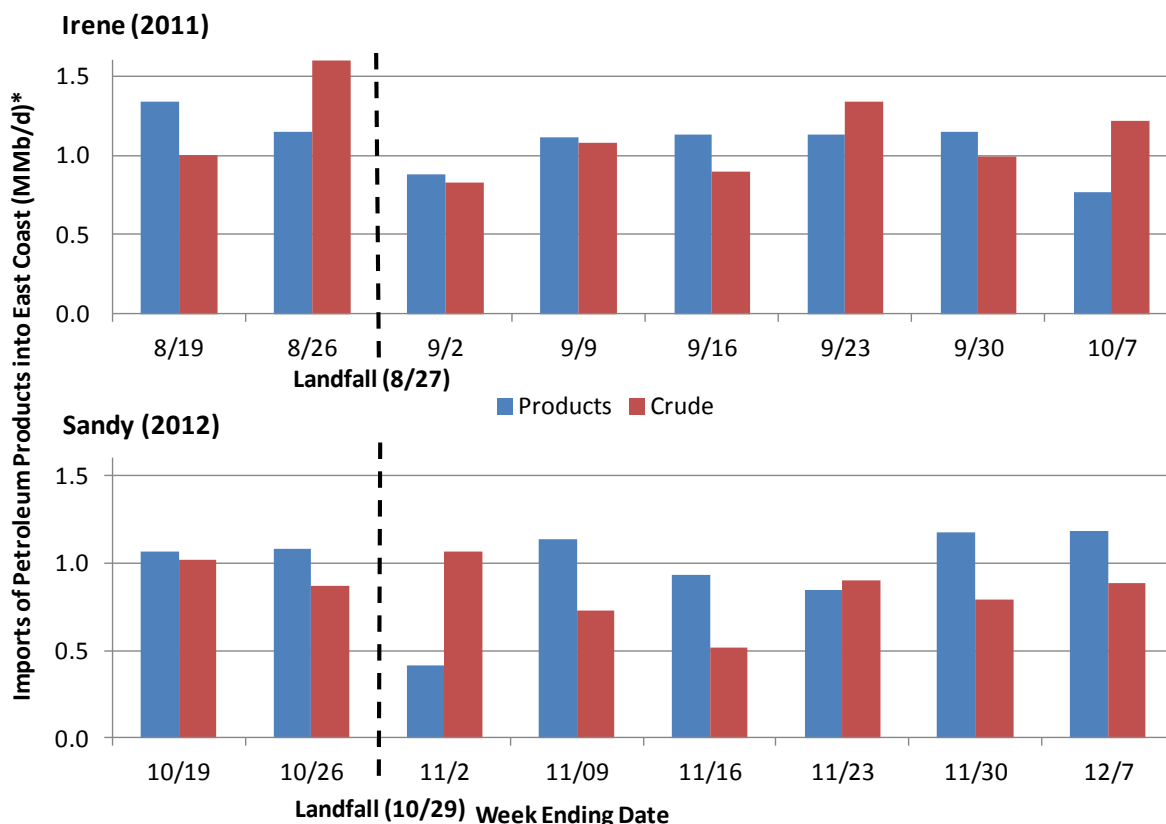
Hurricanes Irene and Sandy disrupted imports of petroleum products and crude oil into the Northeast due to the closure of port infrastructure was forced shut by from water and wind impacts, the inability of many terminals to receive cargoes, and outages and reductions at crude oil refineries. Figure 8 shows petroleum product and crude oil imports into the East Coast (PADD 1) in the weeks before and after Hurricanes Irene and Sandy made landfall. The data in Figure 8 show product imports into the East Coast following Irene fell by 264,000 b/d, or 23 percent, from the week before the storm. Following Sandy, East Coast product imports fell by roughly 668,000 b/d, or 62 percent, from the prior week. Figure 8 indicates that petroleum

<sup>17</sup> Drawn from the latest annual data available from EIA at the time of this report.



product imports began to return to pre-storm levels in the second week after the storms made landfall.<sup>18</sup>

**Figure 8. Weekly Petroleum Imports to the East Coast (PADD 1)**



\*MMb/d = million barrels per day  
Source: EIA

Crude imports were also affected in weeks following Irene and Sandy. In the week Irene made landfall, crude oil imports into the East Coast fell by 769,000 b/d, or 48 percent, from the previous week. By contrast, crude oil imports increased by 198,000 b/d, or 19 percent, in the week that Sandy made landfall. This increase may have been due to shipments that were en route to the East Coast in the week prior to landfall having to wait to come into port until Sandy had passed. In the next 2 weeks after Sandy's landfall, imports fell to as low as 500,000 b/d, or about half of their pre-storm levels, in part due to the extended shutdown of the Phillips 66 refinery in Linden, New Jersey.

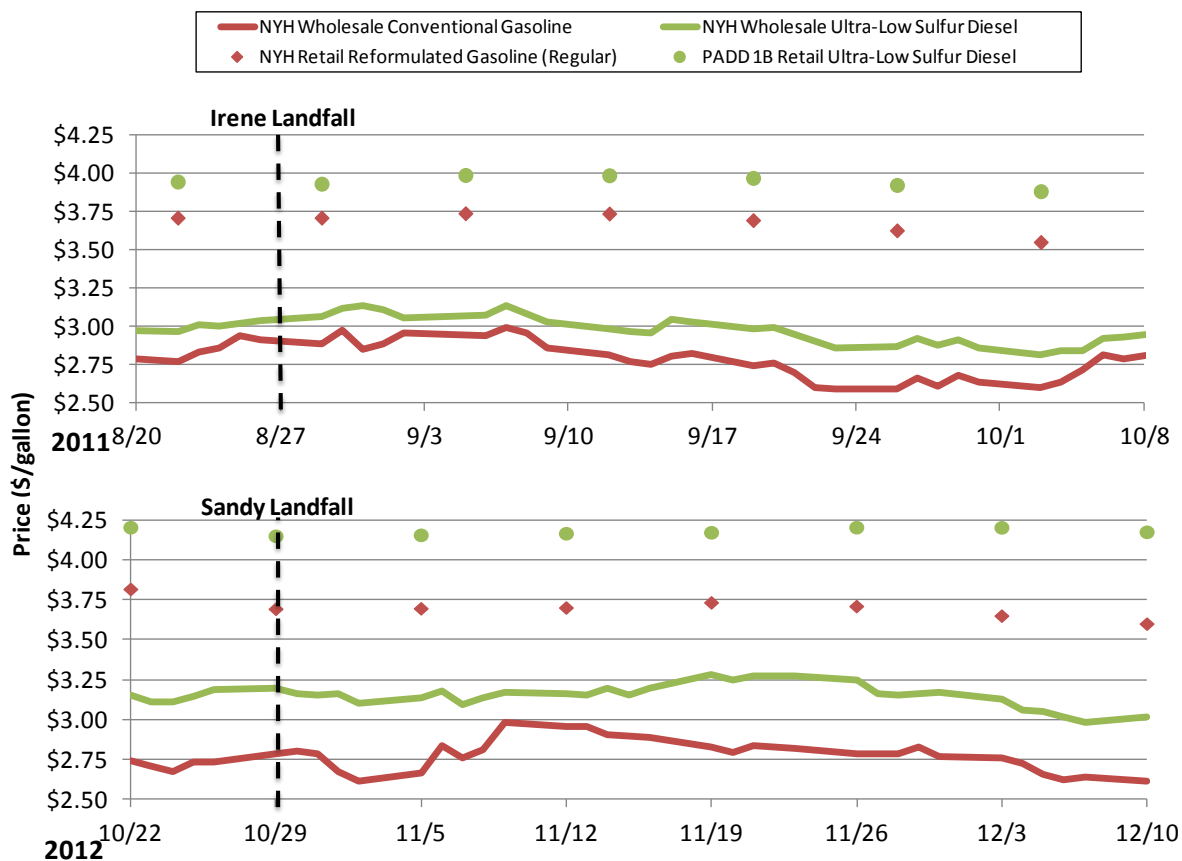
## Prices & Stocks

Hurricanes Irene and Sandy disrupted the petroleum supply chain, impacting petroleum product stocks and prices in the Northeast. Figure 9 summarizes the daily spot prices for conventional gasoline and ultra-low sulfur diesel (ULSD) traded in New York Harbor (NYH), as well as weekly

<sup>18</sup> The weekly data presented in Figure 8 are aggregated at the regional level and may mask port-specific impacts. For instance, product shipments into New York Harbor remained reduced 1 week after Sandy's landfall, but increased shipments to other East Coast ports may have offset this in the regional data.

retail prices for reformulated gasoline in New York Harbor and ULSD in the Mid-Atlantic region (PADD 1B), in the weeks leading up to and following the two storms. West Texas Intermediate and Brent crude spot prices were not affected by Irene and Sandy and therefore are not shown in Figure 9. A detailed analysis of gasoline and distillate stocks and prices appears later in this report.

**Figure 9. Selected Daily Wholesale and Weekly Retail Petroleum Product Prices**



Source: EIA

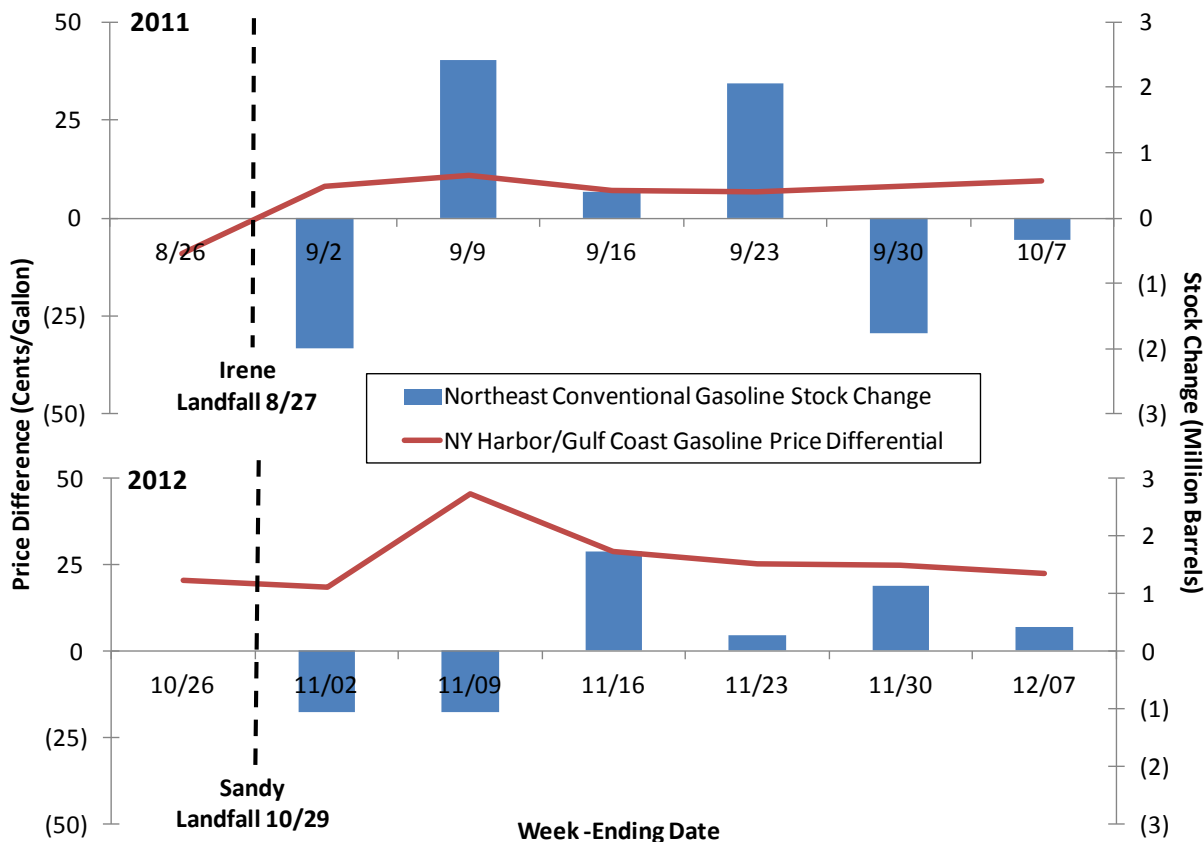
### Gasoline

Disruptions to refineries and petroleum transportation infrastructure caused by Hurricanes Irene and Sandy forced regional gasoline distributors to draw down gasoline stocks and led to temporary increases in spot gasoline price differentials. Figure 10 plots the change in week-ending (Friday) stocks of conventional gasoline in the Northeast—a combination of the New England (PADD 1A) and Mid-Atlantic (PADD 1B) regions—against the difference between the week-ending (Friday) spot gasoline price in New York Harbor and the week-ending spot gasoline price in the Gulf Coast for the weeks leading up to and following Hurricanes Irene and Sandy.

The New York Harbor/U.S. Gulf Coast (NYH/USGC) gasoline price differential measures the difference in the price of gasoline in the two regions. Because the Northeast receives gasoline

shipments by pipeline from the Gulf Coast, the price of gasoline in New York Harbor is typically higher than the price of gasoline in the Gulf Coast due to the added transportation costs. An increase in the NYH/USGC differential may indicate that regional factors—such as storm-related supply disruptions—could have increased the New York Harbor gasoline price relative to the price in the Gulf Coast.

**Figure 10. New York Harbor Gasoline Stock Changes and Spot Price Differentials**



Source: EIA

Figure 10 indicates that Northeast gasoline stocks experienced a large 1-week draw down following Hurricane Irene. The day before Irene made landfall, gasoline stocks in the Northeast stood at 29.9 million barrels. By September 2, 2011—6 days after the storm made landfall—the region’s gasoline stocks had fallen by 2 million barrels, or roughly 7 percent, from pre-storm levels. The draw down following Irene was short-lived; by September 9—13 days after landfall—Northeast gasoline stocks had recovered to surpass pre-storm levels.

Regional gasoline prices also experienced a temporary increase in the weeks following Irene’s landfall. By September 2, the NYH/USGC conventional gasoline price differential had increased by 17 cents from a week earlier—from negative 9 cents per gallon (indicating a surplus gasoline situation in New York Harbor) to positive 8 cents per gallon (indicating a shift to much tighter supply in New York Harbor). In the following weeks, New York Harbor gasoline remained at a premium to the Gulf Coast despite the recovery in the Northeast gasoline stocks. However, as

previously noted, New York Harbor gasoline prices typically exhibit a small premium to Gulf Coast gasoline prices under normal market conditions.

The impact to Northeast gasoline stocks and prices from Hurricane Sandy was slower to develop but larger and longer-lasting than the impact from Irene. On October 26, 2012—3 days before Sandy made landfall—Northeast gasoline stocks stood at 26.8 million barrels, or roughly 10 percent below where they stood prior to Irene. Over the next 2 weeks, Northeast stocks fell by 2.2 million barrels, or roughly 8 percent, from pre-storm levels. Stocks began to build again in the third week after landfall but did not return to pre-storm levels until November 30, the fifth week after landfall.

Although slower to develop, the temporary increase in the NYH/USGC gasoline price differential was larger following Hurricane Sandy than Hurricane Irene. By November 2—4 days after Sandy made landfall—the differential fell 2 cents from the previous week. This may have been due to lower demand as drivers stayed off the road while recovery efforts continued, and as many stores and business remained closed. A week later, drivers had returned to the roads but the petroleum supply chain remained disrupted. As a result, the New York Harbor premium more than doubled from 18 cents per gallon on November 2, to 46 cents per gallon on November 9, an increase of 28 cents. In the following weeks, the New York Harbor premium fell from its peak but remained higher than before the storm.

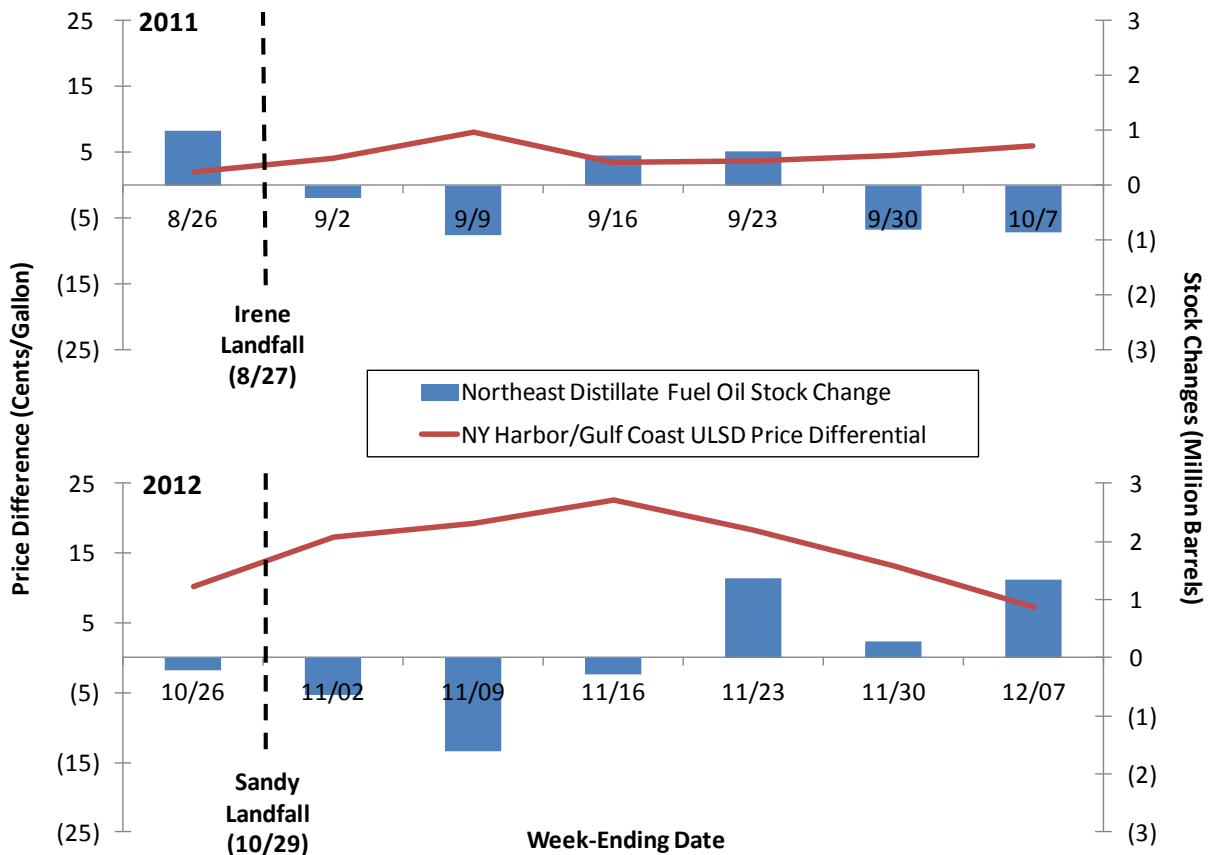
### Distillate

Disruptions to petroleum supply infrastructure by Hurricanes Irene and Sandy also affected the distillate fuel oil market. Figure 11 plots the weekly change in stocks of distillate fuel oil in the Northeast against the difference between the spot ULSD price in New York Harbor and the spot ULSD price in the U.S. Gulf Coast (the NYH/USGC differential) for the weeks leading up to and following Hurricane Irene and Sandy. Note that ULSD, the fuel used for the price analysis, represents only a portion of total distillate stocks in the Northeast, although ULSD prices and other distillate fuel oil prices typically closely follow one another.<sup>19</sup>

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<sup>19</sup> ULSD represented 28 percent of total Northeast distillate fuel oil stocks in the week prior to Irene and 35 percent prior to Sandy.

**Figure 11. New York Harbor Distillate Stock Changes and ULSD Spot Price Differentials**



Source: EIA

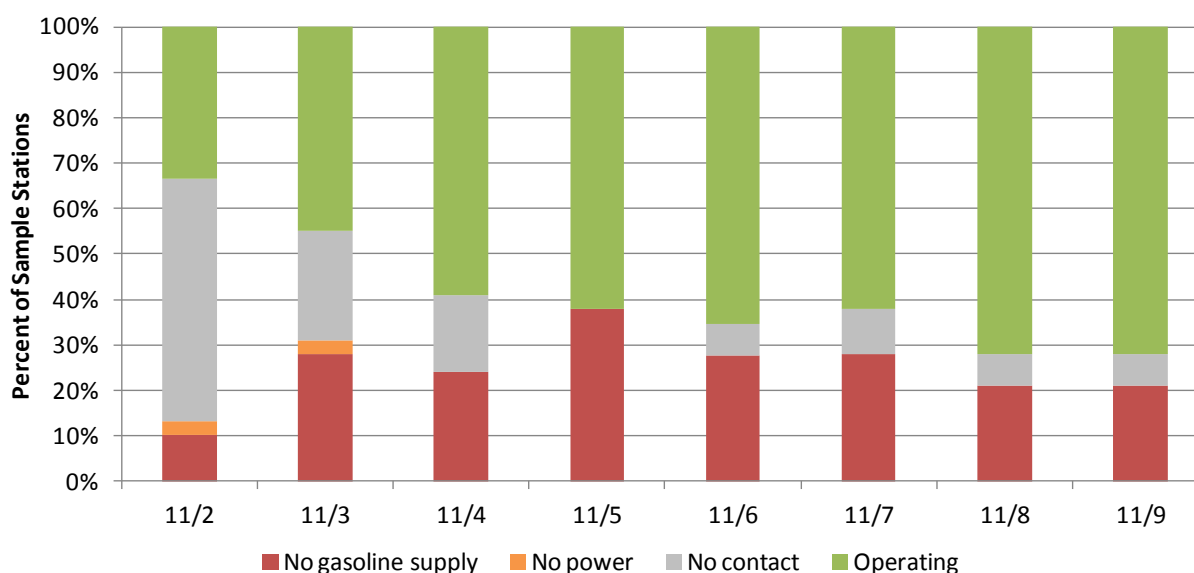
Hurricane Irene had a modest impact on Northeast distillate markets. Prior to Irene, Northeast distillate fuel oil stocks stood at 48.4 million barrels. In the weeks after Irene made landfall, stocks fell by 1.1 million barrels, or about 4 percent, leading to a 6-cent increase in the week-ending NYH/USGC ULSD spot price differential, from 2 cents per gallon on August 26, 2011 to 8 cents per gallon on September 9.

Hurricane Sandy (and the Nor'easter that followed), on the other hand, had a larger impact on Northeast distillate markets than Irene. Prior to Sandy, Northeast distillate fuel oil stocks stood at 28.6 million barrels, more than 40 percent below where they stood prior to Irene. In the weeks following Sandy, distillate stocks fell by a total of 2.8 million barrels, or 10 percent, from pre-storm levels. This large draw down in stocks was likely due to both supply disruptions caused by Hurricane Sandy as well high demand for heating oil due to cold weather in the Northeast, including the effects of the Nor'easter in early-to-mid November. In the weeks after Sandy made landfall, the week-ending NYH/USGC price differential more than doubled from 10 cents per gallon on October 26, 2012 to 23 cents per gallon on November 16.

## Retail Stations

Petroleum supply chain disruptions and power outages caused by Hurricane Sandy led to widespread fuel outages at retail fueling stations in the New York City metropolitan area, which includes parts of southeastern New York, Long Island, northern New Jersey, and western Connecticut. In response to the problems caused by Sandy, EIA conducted an emergency survey to monitor the vehicle fuel supply conditions in the New York City metropolitan area from November 2 to November 9, 2012 (See Figure 12) The survey found that a large portion of the retail fueling stations could not operate—due to a lack of fuel or a lack of power—over the survey timeframe. On November 2, only one-third of gas stations sampled by EIA were operational (assuming that the stations that could not be contacted were not operational). A week later, on November 9, the share of gas stations operating had risen to 72 percent. No widespread shortages were reported at retail fuel stations in the aftermath of Hurricane Irene.

**Figure 12. Availability of Gasoline in the New York City Metropolitan Area**



Source: New York City Metropolitan Area Retail Motor Gasoline Supply Report, EIA

## Retail Prices

Retail prices of gasoline and ULSD were not significantly affected by Hurricanes Irene or Sandy. Retail prices experienced modest increases in response to increases in spot prices but remained relatively stable in the aftermath of each storm (See Figure 9 for weekly retail prices, taken on Monday).

## Natural Gas

Hurricanes Irene and Sandy did not have a major impact on natural gas infrastructure and supplies in the Northeast. Flooding and power outages were a concern at compressor stations along some interstate pipelines following both storms, but natural gas flows were not interrupted. Natural gas utilities in areas affected by flooding shut off service as a precaution until home inspections could be completed.

## Transmission Pipelines

Following Hurricane Irene, three interstate natural gas transmission pipelines—Transcontinental Gas Pipeline, Tennessee Gas Pipeline, and Iroquois Gas Transmission—reported that they continued to operate during the storm but monitored low-lying areas of their systems for flooding. Transcontinental reported that some of its pumping stations lost power and/or had minor flooding. Iroquois reported that it used backup generators at some of its facilities.

Following Hurricane Sandy, Spectra Energy reported that power and communications were out at the majority of its facilities in New Jersey. The company also reported that two compressor stations on its Texas Eastern Transmission pipeline in northern New Jersey went down due to the loss of commercial power and the failure of backup generation to operate as intended. Tennessee Gas Pipeline, Columbia Gas Transmission, and the Interstate Natural Gas Association of America reported no impact to operations.<sup>20</sup>

## Local Distribution Companies

Following Hurricane Irene, two local distribution companies—Orange & Rockland (O&R) in New York and PECO in southeastern Pennsylvania—reported natural gas shut-offs to customers due to flooding. O&R reported that 500 of its gas customers were shut off as a precautionary measure due to extensive flooding, and PECO reported that it shut off 1,204 of its gas customers at various locations due to flooding.

Following Hurricane Sandy, New Jersey Natural Gas (NJNG) shut down part of its natural gas infrastructure serving Ocean and Monmouth counties including Long Beach Island and the barrier islands from Bay Head to Seaside Park. As part of the shutdown, NJNG vented gas from its distribution pipelines, allowing water to infiltrate the pipes. The damage caused by the water was severe enough that some portions of the distribution system needed to be completely rebuilt. The shut-downs affected approximately 32,000 of NJNG's customers.<sup>21</sup> As of early January 2013, more than 8,000 NJNG customers remained without service.<sup>22</sup>

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<sup>20</sup> "US Northeast gas pipelines weather storm despite power outages." Platts. October 30, 2012.

<http://www.platts.com/RSSFeedDetailedNews/RSSFeed/NaturalGas/7205010>

<sup>21</sup> "Important Update on Damage from Hurricane Sandy." New Jersey Natural Gas. November 8, 2012.

<http://www.njresources.com/news/releases/2012/njng/Thursday11812Statement.asp>

<sup>22</sup> "NJNG Provides Weekly Update on Service Restoration Efforts." New Jersey Natural Gas. January 1, 2013.

<http://www.njresources.com/news/releases/2013/njng/Friday010413.asp>

## Federal Actions

Numerous Federal agencies coordinated their response to the energy emergencies following Hurricanes Irene and Sandy to provide situational awareness, facilitate power restoration, release fuel reserves, and ease regulations. Federal agencies involved in these efforts included the Department of Energy (DOE), the Department of Homeland Security (DHS), the Federal Emergency Management Agency (FEMA), the Department of Transportation (DOT), the Environmental Protection Agency (EPA), the Federal Energy Regulatory Commission (FERC), the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard (USCG), and the Department of Defense (DOD).

## Providing Situational Awareness

DOE is the lead agency for Emergency Support Function #12 (ESF-12), which is intended to facilitate the restoration of damaged energy systems and components when activated by FEMA for incidents requiring a coordinated Federal response. ESF-12 is an integral part of the larger DOE responsibility of maintaining continuous and reliable energy supplies for the United States through preventive measures and restoration and recovery actions. ESF-12 collects, evaluates, and shares information on energy system damages and estimates the impact of energy system outages within affected areas. Additionally, ESF-12 responders provide information concerning the energy restoration process, such as projected schedules, percent restored, and the geographic progression of restoration.

In the aftermath of Hurricanes Irene and Sandy, DOE produced and publicly disseminated Emergency Situation Reports that provided a detailed summary of the impacts to the energy sector—power outages, and the status of petroleum refineries, pipelines, storage terminals, natural gas pipelines, and nuclear power plants—and the status of restoration activities to the impacted systems and facilities. During the most active days of restoration, DOE released Situation Reports twice daily. Between August 26 and September 4, 2011, DOE released 16 Situation Reports covering energy impacts from Hurricane Irene. Between October 28 and December 3, 2012, DOE released 33 Situation Reports—20 reports covering impacts from Hurricane Sandy and 13 reports covering the combined impact of Hurricane Sandy and the November 2012 Nor'easter.<sup>23</sup>

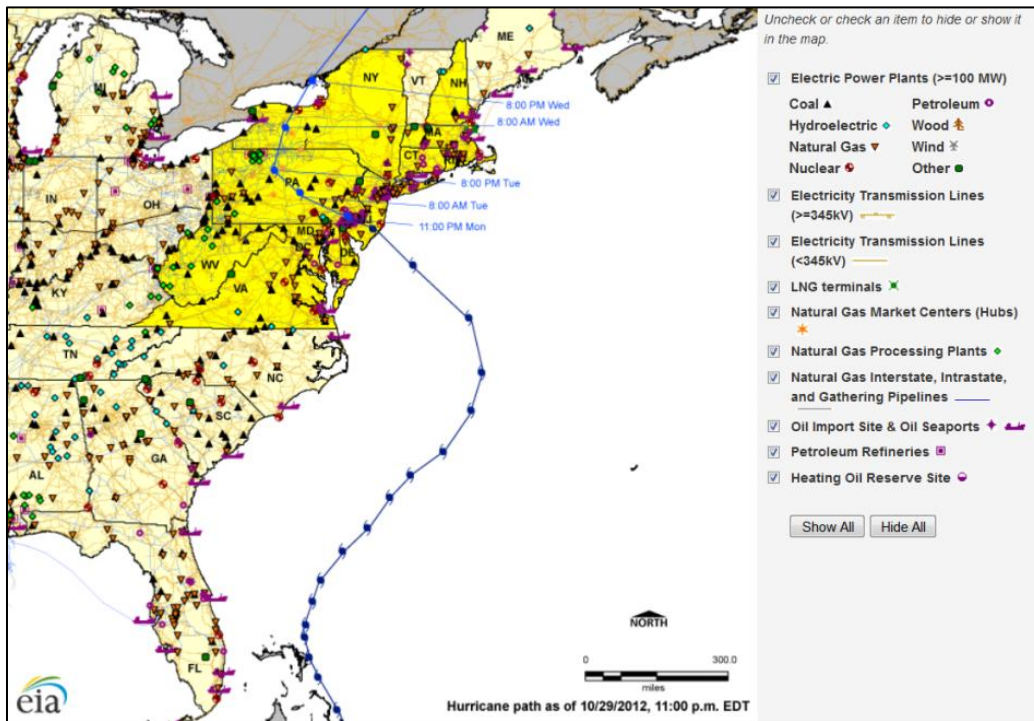
EIA provided informational resources on its website prior to Hurricanes Irene and Sandy and conducted emergency fuel surveys in the aftermath of Sandy. Prior to both storms, EIA posted an interactive mapping tool on its website that allowed users see the projected path of the storms relative to major energy infrastructure—power plants, storage terminals, pipelines, petroleum refineries, liquefied natural gas terminals, natural gas processing facilities, and electricity transmission lines—on the East Coast of the United States (See Figure 13).

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<sup>23</sup> The emergency situation reports are posted on OE/ISER's public website: [http://www.oe.netl.doe.gov/emergency\\_sit\\_rpt.aspx](http://www.oe.netl.doe.gov/emergency_sit_rpt.aspx)



Figure 13. EIA's Interactive Infrastructure Map for Hurricane Sandy



Source: EIA

In response to the widespread fuel supply issues following Hurricane Sandy, EIA conducted two emergency surveys. EIA's New York City Metropolitan Area Retail Motor Gasoline Supply Report monitored vehicle fuel supply conditions in the New York City metropolitan area on a temporary basis from November 2 to November 9, 2012 (See results of the survey in Figure 12). EIA's Petroleum Terminal Survey, conducted with the help of the National Petroleum Council and with the voluntary participation of the industry, evaluated petroleum product flows in the New York Harbor area both prior to Hurricane Sandy and as of Tuesday, November 13, 2012.

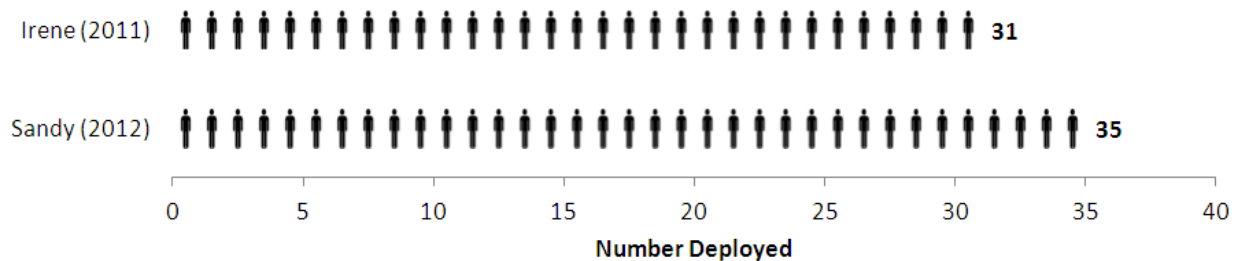
DOE also partnered with Google Crisis Maps to provide real-time information to users in need. Google Crisis Map showed power outage information, shelter and recovery centers, local emergency Twitter feeds, FEMA's disaster-declared areas and more. It also gave users the ability to find open gas stations and food stores in New Jersey and New York City.

### Facilitating Restoration

DOE provides 24/7 coverage of the ESF-12 desk at FEMA response centers when they are activated during an emergency. During Hurricanes Irene and Sandy, DOE staff deployed to various FEMA sites to support Federal response efforts, working closely with other Federal partners, State and local government entities, and representatives from the energy sector. During the Irene response, 31 DOE staff deployed to the National Response Coordination Center (NRCC) in Washington, DC; the Region I Regional Response Coordination Center (RRCC) in Boston, Massachusetts, the Region II RRCC in New York, New York, the Region III RRCC in Philadelphia, Pennsylvania, and the Region IV RRCC in Atlanta, Georgia; and the

Virginia Emergency Operations Center (EOC). To respond to Sandy, 35 DOE staff members deployed to the NRCC, the RRCCs for Region I, Region II (in Colt's Neck, New Jersey), and Region III; and the New York State EOC in Albany, New York. Figure 14 compares the number ESF-12 responders deployed for each storm.

**Figure 14. ESF-12 Responders Deployed by Storm**



Source: OE/ISER

Following Hurricane Irene, DOE sent senior officials to Connecticut and Rhode Island to meet with executives from utilities, governors, and elected representatives to discuss issues impeding restoration.

Following Hurricane Sandy, due to the extent of the damage to energy facilities, the Federal response was more involved than that following Irene. To facilitate restoration in the wake of Hurricane Sandy, an assessment team of experts from DOE performed damage assessments of some of the hardest-hit areas and met with local officials and utility representatives to discuss their needs. Secretary of Energy Steven Chu also toured the devastated region where he consulted with utility crews, State and local leaders, and industry officials to discuss ongoing response and recovery efforts. The Secretary participated in daily conference calls with DOE senior staff and with CEOs and other executives from the impacted utilities to ensure the Department was doing everything possible to aid the restoration process.

In addition, the President approved a 100 percent cost share under the Stafford Act to conduct emergency power restoration and emergency public transportation assistance, including direct federal assistance, within counties designated for public assistance in New Jersey, New York, and Connecticut. The 100 percent cost share was in place from October 30 until November 9, 2012. The cost share provided flexibility in post-disaster power restoration as States and municipalities did not have to bear any of the costs associated with eligible work for the duration of the program.

Also following Hurricane Sandy, DOE led an interagency Energy Restoration Task Force, based out of FEMA's NRCC. This Task Force was established to more efficiently coordinate and deploy the resources of the Federal Government and eliminate impediments to the restoration process in the energy sector. The Task Force focused on eliminating bureaucratic roadblocks or red tape that could delay utility teams in their efforts to restore power; identifying specific steps and additional resources that could help to get power back up as quickly as possible; facilitating the movement of utility workers, including by working with DOT to issue the appropriate permits

for utility trucks crossing State lines; developing new communications systems and an internal clearinghouse to help local and State law enforcement officials track the routes for utility teams coming into their States; identifying which electric and petroleum facilities could best utilize generators and water pumps supplied by the USACE; and coordinating with the USCG in their assessments of the petroleum terminals' marine facilities.

The Task Force engaged three of DOE's Power Marketing Administrations (PMAs)—Bonneville Power Administration, Southwestern Power Administration (SWPA), and Western Area Power Administration (WAPA)—which sent 235 staff and 200 pieces of equipment to help repair downed power lines and damaged substations in storm-impacted areas. The PMA crews were initially brought in using funding from the Stafford Act but were later retained by Jersey Central Power & Light under a mutual assistance agreement. This was the first time WAPA or SWPA engaged in mutual aid with an investor-owned utility.

The Task Force also engaged DOD resources to airlift personnel and equipment to New Jersey, and Federal resources through the DOT and other partner agencies worked with State and local authorities to ensure utility crews were able to reach the places where they were most needed. This included plowing snow or clearing fallen trees or other debris from the roads ahead of utility teams. In addition, utility trucks were—for the first time—classified as emergency response vehicles, allowing them to access fuel lines/delivery locations intended only for emergency responders.

DOE also worked to address the fuel supply chain disruptions caused by Hurricane Sandy. DOE worked with utility and fuel companies to assess their needs and to ensure that they were prioritizing repairs and power restoration to critical fuel infrastructure like terminals and refineries. DOE worked to identify gas stations that could use generators and coordinated with the USACE and the National Guard to deliver generators to those stations, so they could resume pumping gasoline prior to the restoration of commercial power. Additionally, the U.S. Coast Guard worked to ensure that ports and harbors were ready to receive shipments of oil and fuels.

DOE and its Federal partners remain engaged in ongoing efforts, including the Hurricane Sandy Rebuilding Task Force, a White House-sponsored Federal task force to support State and local governments as they work to rebuild stronger, safer, and more resilient communities.

## Releasing Fuel Reserves

To ease fuel supply issues in the wake of Hurricane Sandy, the President directed DOE on November 2, 2012 to loan ultra low sulfur diesel (ULSD) fuel from the Northeast Home Heating Oil Reserve to the DOD's Defense Logistics Agency (DLA). DLA distributed the ULSD to State, local, and Federal responders in New York and New Jersey, to fuel their emergency equipment, such as generators and water pumps, and to fuel responder vehicles. This was the first time that a release from the reserve had been authorized since its founding in 2000. Two additional requests for ULSD were received on November 7 after the Nor'easter compounded the fuel challenges in the Northeast. Those requests were promptly approved and loading from the reserve was accomplished on November 12 and 25, 2012. In total, over 120,000 barrels (more

than 5 million gallons) of fuel were provided to support emergency relief efforts.<sup>24</sup> No releases from the reserve were authorized following Hurricane Irene.

## Easing Regulations

To address fuel issues caused by Sandy, DHS, in coordination with DOD, DOE, and the Maritime Administration (MARAD), waived the Merchant Marine Act of 1920 (known as the Jones Act), allowing foreign vessels to ship fuel supplies from the U.S. Gulf Coast to the Northeast. Federal environmental regulations were also waived, allowing the use of a wider variety of fuel products in areas experiencing fuel shortages. In addition, Federal transportation regulations were waived, allowing more drivers, including utility and fuel truck drivers, to work longer hours to deliver goods to storm-affected areas.

## Jones Act Waiver

In response to fuel supply disruptions caused by Hurricane Sandy, DHS, in coordination with DOE, MARAD, and DOD, waived the Jones Act on November 2, 2012, allowing foreign vessels to ship petroleum products from the U.S. Gulf Coast to Northeastern ports. The Jones Act prohibits foreign-built, foreign-owned, or foreign-flagged vessels from carrying goods between U.S. ports. The waiver was modified on November 3 to additionally allow the transportation of other feedstock, blending components, and additives used to produce fuels.<sup>25</sup>

The Jones Act waiver allowed 11 vessels to deliver more than 2.7 million barrels (about 115 million gallons) of fuel from the Gulf Coast to ports in the Northeast in the wake of Hurricane Sandy. The majority of this fuel (1.9 million barrels) was gasoline, gasoline blendstock, or gasoline blending components. Diesel, kerosene, and ethanol made up the remainder of the shipments. New York Harbor (including Stapleton, New York) was the most popular destination for deliveries, receiving 1.3 million barrels, or nearly half of all Jones Act volumes. Table 9 summarizes volumes of petroleum products delivered under the Jones Act waiver by port of receipt. Appendix 3 shows Jones Act waiver deliveries by port and product. Following Irene, DHS issued no waivers of the Jones Act.

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<sup>24</sup> "Emergency Loans after Hurricane Sandy." U.S. Department of Energy.  
<http://www.fossil.energy.gov/programs/reserves/heatingoil/index.html>

<sup>25</sup> "Maritime Administration Reporting Requirements for the Special Purpose Jones Act Waiver Issued In Connection With Hurricane Sandy Recovery." U.S. Maritime Administration.  
[http://www.marad.dot.gov/ships\\_shipping\\_landing\\_page/domestic\\_shipping/hurricane\\_sandy\\_special\\_waiver/hurricane\\_sandy\\_special\\_waiver.htm](http://www.marad.dot.gov/ships_shipping_landing_page/domestic_shipping/hurricane_sandy_special_waiver/hurricane_sandy_special_waiver.htm)

**Table 9. Hurricane Sandy Jones Act Waiver Vessel Deliveries by Port**

<b>Port</b>	<b>Deliveries (barrels)</b>
<b>Curtis Bay, MD</b>	286,600
<b>Paulsboro, NJ</b>	95,745
<b>New York Harbor*</b>	1,289,853
<b>Albany, NY</b>	86,018
<b>New Haven, CT</b>	288,653
<b>Everett, MA</b>	270,000
<b>Newington, NH</b>	90,000
<b>Portsmouth, NH</b>	65,000
<b>Portland, ME</b>	200,350
<b>Searsport, ME</b>	60,000
<b>Total</b>	<b>2,732,219</b>

\*Includes Stapleton, NY  
Source: MARAD

### **EPA Fuel Waivers**

Following Hurricane Sandy, EPA waived certain fuel requirements under the Clean Air Act in order to facilitate supply logistics and increase import flexibility in affected States. DOE worked closely with EPA to provide due diligence in considering whether to waive requirements related to the sale, distribution, and use of Reformulated Gasoline (RFG) and ULSD. No waivers were deemed necessary following Hurricane Irene.

EPA's Multi-State Fuel Waiver, issued October 31, 2012, waived requirements for the use of RFG in Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, and the District of Columbia following Sandy. It also waived additional requirements prohibiting the blending of certain types of gasoline in the previously listed States, as well as in Mississippi, Alabama, Georgia, Tennessee, South Carolina, and North Carolina, to facilitate the distribution of fuel to areas affected by Sandy.<sup>26</sup>

EPA also waived requirements for the use of ULSD (thus allowing the use of home heating oil) in certain generators and pumps used for emergency purposes in New Jersey, beginning October 31, 2012, and in emergency response vehicles in New Jersey, beginning November 1, 2012. EPA waived ULSD requirements for emergency response vehicles and equipment in Pennsylvania; the five boroughs of New York City; and Nassau, Suffolk, Rockland, and Westchester counties in New York, beginning November 2, 2012.<sup>27</sup>

<sup>26</sup> "2012 Fuels Waivers." U.S. Environmental Protection Agency. <http://www.epa.gov/enforcement/air/fuel-waivers.html#2012>

<sup>27</sup> Ibid.

The EPA waivers relating to RFG and ULSD expired on November 20, 2012. Due to continued fuel-related impacts, the waivers for New York and New Jersey were later extended through December 7, 2012.<sup>28</sup>

EPA also issued a No Action Assurance (NAA), beginning November 2, 2012, which allowed fuel loading and unloading without the use of vapor recovery or vapor combustion devices at bulk gasoline and marine loading terminals and associated truck racks in New York and New Jersey. On November 5, EPA extended the NAA to Maryland and Massachusetts.<sup>29</sup> The NAA allowed operations to resume at terminals where vapor recovery/combustion devices were disabled due to damage or loss of power, and it also allowed operations to resume at fuel loading/unloading facilities that were not equipped with such devices. The NAA for all States terminated on November 17, 2012. Table 10 summarizes the fuel waivers issued by the EPA following Hurricane Sandy.

**Table 10. EPA Fuel Waivers Issued Following Hurricane Sandy**

Waiver	Applies to	States	From	To
<b>Reformulated Gasoline</b>	All Vehicles	CT, DC, DE, MD, MA, NH, PA, RI, VA	10/31/2012	11/20/2012
		NJ, NY	10/31/2012	12/7/2012
<b>Ultra-Low Sulfur Diesel</b>	Emergency Generators	NJ	10/31/2012	11/20/2012
<b>Ultra-Low Sulfur Diesel</b>	Emergency Response Vehicles	NJ	11/1/2012	12/7/2012
		NY	11/2/2012	12/7/2012
		PA	11/2/2012	11/20/2012
<b>NAA for the Use of Vapor Recovery Systems</b>	Terminals, Pipelines	NJ, NY	11/2/2012	11/17/2012
		MA, MD	11/5/2012	11/17/2012

Source: EPA

### Transportation Waivers

Hours-of-Service (HOS) regulations restrict the amount of time drivers are allowed to operate commercial vehicles and mandate time-off requirements between shifts to ensure on-road safety. For interstate commerce—the transportation of goods across State boundaries—the DOT’s Federal Motor Carrier Safety Administration (FMCSA) sets HOS regulations. For intrastate commerce—the transportation of goods within a State boundary—State-level HOS regulations may apply (See the State & Local Actions section of this report). During emergency situations, FMCSA may waive interstate regulations and State governments may waive intrastate regulations for vehicles assisting in emergency response. These waivers are often applied to utility trucks and fuel carriers.

Following Hurricane Sandy, FMCSA issued a regional emergency declaration and waived Federal regulations applying to motor vehicles engaged in interstate commerce, including driver

<sup>28</sup> “October and November 2012 Fuel Waivers Related to Hurricane Sandy.” U.S. Environmental Protection Agency. November 16, 2012. <http://www.epa.gov/enforcement/air/documents/fuelwaivers/nynj-fuelwaiver111612.pdf>

<sup>29</sup> “No Action Assurance for the Use of Vapor Recovery Systems Related to Hurricane Sandy.” U.S. Environmental Protection Agency. November 5, 2012. <http://www.epa.gov/enforcement/air/documents/policies/mobile/naa-vaporrecoverymamd110512.pdf>

qualification requirements, HOS requirements, and maintenance requirements. The waiver applied to commercial vehicles transporting emergency materials, including utility trucks and fuel carriers, in the Eastern Region: Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia. The waiver was effective from October 29 to November 27, 2012.<sup>30</sup> The DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) also issued a waiver allowing non-DOT specification cargo tank motor vehicles to transport gasoline to the Hurricane Sandy disaster relief area.<sup>31</sup> FMCSA did not waive interstate HOS regulations following Irene.

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<sup>30</sup> "Declaration of Regional Emergency in Response to Hurricane Sandy." Federal Motor Carrier Safety Administration. U.S. Department of Transportation. <http://www.fmcsa.dot.gov/about/alerts/hurricane-sandy-2012-response.aspx>

<sup>31</sup> Emergency Special Permit. Pipeline and Hazardous Materials Safety Administration. U.S. Department of Transportation. [http://phmsa.dot.gov/staticfiles/PHMSA/SPA\\_App/OfferDocuments/SP15752\\_2012110433.pdf](http://phmsa.dot.gov/staticfiles/PHMSA/SPA_App/OfferDocuments/SP15752_2012110433.pdf)

## State & Local Actions

State and local governments took measures to ration fuel, ease State regulations, enforce price gouging laws and facilitate power restoration in the aftermath of Hurricane Sandy.

## Major Disaster and Emergency Declarations

The first response to a disaster is the job of a local government's emergency response services, with help from nearby municipalities, the State, and volunteer agencies. In a catastrophic disaster, a State's governor can request Federal resources mobilized through FEMA, which can provide search and rescue assistance, help in restoring electrical power, as well as food, water, shelter, and supplies needed to meet other basic human needs. Following Hurricanes Irene and Sandy, numerous State governors requested Federal assistance through Major Disaster Declarations and Emergency Declarations.

A major disaster can result from hurricanes, earthquakes, tornados, or any other natural catastrophe, or regardless of cause, any major fire, flood, or explosion. The President must first determine whether State and local governments will require supplemental Federal aid in responding to the disaster. The event must clearly present more of a challenge than State or local governments can handle alone. If a Major Disaster Declaration is issued, funding comes from the President's Disaster Relief Fund, which is managed by FEMA and the disaster aid programs of other participating Federal agencies.

An Emergency Declaration is more limited in scope and doesn't result in the long-term Federal recovery programs that follow a Major Disaster Declaration. Generally, Federal assistance and funding are provided to meet a specific emergency need, or to help prevent a major disaster from occurring.

Table 11 shows the duration in days of Emergency Declarations and Major Disaster Declarations for States and territories affected by Hurricanes Irene and Sandy. Following Hurricane Irene, the President issued Major Disaster Declarations for 13 States, the District of Columbia, and Puerto Rico. The average duration of each declaration was 6 days. Maryland's declaration lasted the longest, at 12 days. Following Sandy, Major Disaster Declarations were issued for 12 States and the District of Columbia. The average duration of each declaration was 10 days, and the longest declarations (13 days) were issued for New Hampshire, New Jersey, Pennsylvania, and Virginia. Appendix 4 lists more details on incident dates and the durations of Emergency and Major Disaster Declarations following Irene and Sandy.



**Table 11. Duration (Days) of Emergency and Major Disaster Declarations by State and Storm**

State	Irene		Sandy	
	Emergency	Major Disaster	Emergency	Major Disaster
Connecticut	6	5	12	12
Delaware	n/a	6	12	12
District of Columbia	6	6	3	5
Maine		2		
Maryland	10	12	13	9
Massachusetts	10	2	12	12
New Hampshire	n/a	10	5	13
New Jersey	10	9	13	13
New York	11	7	12	12
North Carolina	7	7		
Ohio				1
Pennsylvania	19	4	13	13
Puerto Rico	3	3		
Rhode Island	3	2	13	5
Vermont	7	6		
Virginia	9	2	6	13
West Virginia			10	10

n/a – Duration not available  
Source: FEMA

## Rationing Fuel

Due to fuel shortages caused by Hurricane Sandy and the subsequent Nor'easter, the State of New Jersey, New York City, and two New York counties established fuel rationing programs in order to alleviate long lines at fueling stations.

On November 3, 2012, New Jersey established an odd-even license plate system for gasoline and diesel purchases in 12 New Jersey counties.<sup>32</sup> Under the program, which remained in effect until November 13, motorists were allowed to purchase fuel only every other day; motorists with license plates ending with an odd number were allowed to purchase fuel only on odd-numbered days, and motorists with even-numbered plates, on even-numbered days.<sup>33</sup> In addition to its fuel rationing program, New Jersey also established a telephone hotline for gas

<sup>32</sup> "Governor Christie Takes Action to Ease Gas Station Waits with Move to Odd-Even Rationing for Gasoline Purchases in 12 New Jersey Counties." Press Release. November 2, 2012. <http://nj.gov/governor/news/news/552012/approved/20121102n.html>

<sup>33</sup> "Christie Administration Announces Reinstatement of Pre-Sandy Fueling Practices at 6:00 A.M. Tuesday." Press Release. November 12, 2012. <http://nj.gov/governor/news/news/552012/approved/20121112c.html>

station owners to report problems at their station, which helped officials respond more effectively to their issues.<sup>34</sup>

On November 8, New York City, Nassau County, and Suffolk County established similar odd-even license plate fuel rationing systems after a power outage led to the partial failure of a terminal served by the Buckeye Pipeline, which pumps approximately 4.5 million gallons of gasoline per day to New York City and Long Island.<sup>35</sup> New York City's fuel rationing system was extended on November 18, at which time an estimated 30 percent of the City's gas stations were still not operating.<sup>36</sup> The system was lifted on November 23.

## Easing Regulations

The State of New Jersey and New York State, along with the New York City government, issued temporary waivers on certain State and local fuel regulations in order to alleviate fuel shortages in the aftermath of Hurricane Sandy. On October 31, 2012, The State of New Jersey waived its low sulfur diesel requirement for emergency generators operating in the public interest for two weeks.<sup>37</sup> On November 3, New York State temporarily eased restrictions on vapor pressure requirements for gasoline and waived the ultra-low sulfur diesel requirement for home heating oil.<sup>38</sup> On November 8, New York City temporarily suspended the City's low sulfur and biodiesel requirements for heating oil.<sup>39</sup> On November 8, New Jersey temporarily authorized the use of dyed diesel (intended for off-road use) to be used in on-road vehicles.<sup>40</sup>

The State of New Jersey and New York State governments also issued waivers relating to licensing and contracting regulations for fuel distributors in order to expand their access of fuel supplies. Both New Jersey and New York waived licensing requirements, which temporarily allowed all merchants to buy fuel from out of State for their in-State customers. Under normal conditions, merchants not licensed to import fuel can't legally buy and import gasoline and

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<sup>34</sup> "Christie Administration Launches Hotline for Gas Stations to Report Service Delivery Problems." Press Release. November 3, 2012. <http://nj.gov/governor/news/news/552012/approved/20121103g.html>

<sup>35</sup> "Mayor Bloomberg Signs Emergency Order to Establish Odd-Even License Plate System for Gasoline Purchases to Reduce Wait Times." Press Release. November 8, 2012. [http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr406-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr406-12.html&cc=unused1978&rc=1194&ndi=1) and "Statement by Governor Cuomo on Nassau and Suffolk Counties, New York City Implementing Temporary Gasoline Management Plan." Press Release. November 8, 2012. <http://www.governor.ny.gov/press/11082012-temp-gas-mgmtplan>

<sup>36</sup> "Mayor Bloomberg Extends Emergency Order for Odd-Even License Plate System for Gasoline Purchases." Press Release." November 18, 2012. [http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr429-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr429-12.html&cc=unused1978&rc=1194&ndi=1)

<sup>37</sup> "Christie Administration Eases Fuel Requirements for Certain Emergency Generators in Storm Aftermath." Press Release. October 31, 2012. <http://nj.gov/governor/news/news/552012/approved/20121031i.html>

<sup>38</sup> "Governor Cuomo Updates New Yorkers on Progress to Address Gas Shortage." Press Release. November 3, 2012. <http://www.governor.ny.gov/press/11032012gasshortageupdate>

<sup>39</sup> "Mayor Bloomberg Announces New Temporary Guidelines to Speed Heating Oil Deliveries and Boiler Repairs to Ensure New Yorkers Can Heat Homes and Businesses." Press Release. November 8, 2012. [http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr404-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr404-12.html&cc=unused1978&rc=1194&ndi=1)

<sup>40</sup> "Governor Christie Takes Further Actions to Bolster New Jersey's Supply of Gasoline and Diesel Fuel." Press Release. November 8, 2012. <http://nj.gov/governor/news/news/552012/approved/20121108b.html>

diesel from out of State.<sup>41</sup> New Jersey also suspended restrictions in New Jersey State law that placed limitations on the source of fuel that branded fuel retailers are allowed to sell, thus broadening the supply network for wholesale and retail gasoline sellers.<sup>42</sup>

Following Hurricane Irene, at least seven States issued intrastate HOS waivers, including Maryland, New Jersey, New York, North Carolina, Pennsylvania, Vermont, and Virginia.<sup>43</sup> Following Hurricane Sandy, State regulations were waived in 15 States and the District of Columbia, including Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia.<sup>44</sup>

## Enforcing Price Gouging Laws

New Jersey, New York, and Connecticut monitored price gouging in the aftermath of Hurricanes Irene and Sandy. New Jersey defines price gouging as a price increase of more than 10 percent above the price of the good during the normal course of business, prior to the state of emergency. The law does allow merchants to raise prices when they face additional costs imposed by suppliers or legitimate logistical concerns. A price increase is considered excessive if it is more than 10 percent above the amount of markup from cost, compared with the markup normally applied. New York and Connecticut have similar price gouging laws prohibiting “unconscionably excessive” prices on essential consumer goods after a major disaster. Following Irene, New Jersey investigated roughly 50 complaints of price gouging, including complaints against fuel retailers.<sup>45</sup> In September 2012, New Jersey reached a settlement with a northwestern New Jersey gas station accused of price gouging in the days after Irene.<sup>46</sup>

Prior to Hurricane Sandy, and in the storm’s aftermath, New Jersey, New York, and Connecticut issued forceful reminders to merchants, including retail gas stations and hardware stores selling generators during and after the State of Emergency. Following Sandy’s passage, New Jersey deployed teams of investigators to investigate claims of price gouging and by November 2, the State had brought subpoenas against 65 businesses across the State. Complaints were lodged primarily in northern New Jersey, with the highest number of complaints against gasoline merchants, who allegedly increased prices by \$1 or more per gallon at some retail stations. Merchants selling generators, batteries, and non-gasoline fuels, such as propane were also

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<sup>41</sup> “Governor Christie Acts to Boost Gasoline, Diesel Supplies.” Press Release. October 31, 2012. <http://nj.gov/governor/news/news/552012/approved/20121031o.html> and “Christie Administration Activates Temporary Hotlines to Report Price Gouging during Declared State of Emergency.” Press Release. October 30, 2012. <http://nj.gov/governor/news/news/552012/approved/20121030i.html>

<sup>42</sup> “Governor Chris Christie Continues Action to Broaden Access to Fuel for New Jerseyans.” Press Release. November 4, 2012. <http://nj.gov/governor/news/news/552012/approved/20121104g.html> and “Governor Cuomo Signs Executive Order to Suspend Restrictions for Gas Distributors after Hurricane Sandy.” Press Release. November 2, 2012. <http://www.governor.ny.gov/press/11022012-executive-order-gas-distribution>

<sup>43</sup> “HOS Rules Waived for Relief Trucks in 10 Storm-Struck States.” Truckaccidents.com. <http://blog.truckaccidents.com/2011/09/12/hos-rules-waived-for-relief-trucks-in-10-storm-struck-states/>

<sup>44</sup> See Footnote 30.

<sup>45</sup> “NJ Officials Investigating Claims of Price Gouging in Wake of Irene.” CBS New York. August 31, 2011. <http://newyork.cbslocal.com/2011/08/31/nj-officials-investigating-claims-of-price-gouging-in-wake-of-irene/>

<sup>46</sup> “NJ settles Irene-related gas price gouging claim.” Yahoo Finance. September 26, 2012. <http://finance.yahoo.com/news/nj-settles-irene-related-gas-161040403.html>

highly cited. Generator prices at some stores allegedly doubled from pre-storm prices.<sup>47</sup> In New York, the State brought price gouging charges against merchants at 25 gas stations in New York, Long Island, and Westchester County.<sup>48</sup> In Connecticut, 30 complaints of price gouging were filed, mostly against fuel providers.<sup>49</sup> In January 2013 retailers serving a gas station in Norwalk, Connecticut settled a price gouging case with the State.<sup>50</sup>

## Facilitating Restoration

The New York State government deployed 680 New York National Guard troops to Westchester County, Rockland County, and Long Island to work with electric utility repair crews. The National Guard troops were trained to identify downed power lines and properly mark them so that members of the public were not endangered as the repair process moved forward. Allocating the National Guard to this mission freed up utility employees to focus on the technical work of repairing lines and restoring power.<sup>51</sup>

The New York City government, in partnership with FEMA, launched the “NYC Rapid Repairs” program to send teams of contractors and City inspectors into neighborhoods impacted by Hurricane Sandy to make emergency repairs, including permanent or temporary restoration of heat, power, and hot water, and other limited repairs to protect a home from further significant damage. The program helped expedite repairs at homes where utilities were unable to restore power or gas service due to damage within the customer’s homes—to electrical equipment, the gas line, a boiler, and other equipment. At the time the program was launched, 90,000 customers remained without power in New York City, and the majority could not be restored due to damage within their homes.<sup>52</sup> By November 21, the City reported that more than 6,000 homeowners had enrolled in NYC Rapid Repairs, and teams had visited nearly 1,700 homes.<sup>53</sup> On November 26, New York City’s Mayor Michael Bloomberg ordered landlords of storm-damaged buildings to make repairs to restore heat and power or to sign up for the Rapid

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<sup>47</sup> “Christie Administration Subpoenas 65 Businesses in Investigations Into Post-Hurricane Price Gouging.” Press Release. November 2, 2012. <http://nj.gov/governor/news/news/552012/approved/20121102h.html>

<sup>48</sup> “A.G. Schneiderman Announces 12 More Enforcement Actions Against Gas Retailers in Post-sandy Price Gouging Investigation.” Press Release. New York State Office of the Attorney General. November 29, 2012. <http://www.ag.ny.gov/press-release/ag-schneiderman-announces-12-more-enforcement-actions-against-gas-retailers-post-sandy>

<sup>49</sup> “Price Gouging Complaints Rise after Sandy.” NBC Connecticut. November 5, 2012.

<http://www.nbcconnecticut.com/investigations/Price-Gouging-Complaints-Rise-After-Sandy-177345271.html>

<sup>50</sup> “Norwalk Gas Station Settles Allegations of Storm Sandy-Related Price Gouging.” Press Release. New Jersey Department of Consumer Protection. January 17, 2013. <http://www.ct.gov/dcp/cwp/view.asp?A=4187&Q=517192>

<sup>51</sup> “Governor Cuomo Deploys 600 Additional Troops to Help in Power Restoration in Westchester and Rockland Counties.” Press Release. November 2, 2012.

<http://www.governor.ny.gov/press/11022012additionaltroopdeployment>

<sup>52</sup> “Mayor Bloomberg Announces New Program to Repair Damaged Homes and Updates New Yorkers on City Response to Hurricane Sandy.” Press Release. November 9, 2012.

[http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr412-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr412-12.html&cc=unused1978&rc=1194&ndi=1)

<sup>53</sup> “Mayor Bloomberg Announces \$500 Million for NYC Rapid Repairs Program to Restore Power, Heat and Hot Water to Homes Damaged by Hurricane Sandy.” Press Release. November 21, 2012.

[http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr437-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr437-12.html&cc=unused1978&rc=1194&ndi=1)

Repairs program.<sup>54</sup> In addition to the Rapid Repairs program, the New York City government streamlined emergency work permits for boiler repairs and replacements to reduce the application timeline by as much as 2 weeks.<sup>55</sup>

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<sup>54</sup> “Mayor Bloomberg Announces Landlords of Storm-Damaged Buildings Must Immediately Take Action to Restore Heat and Electricity.” Press Release. November 26, 2012.  
[http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr444-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr444-12.html&cc=unused1978&rc=1194&ndi=1)

<sup>55</sup> “Mayor Bloomberg Announces New Temporary Guidelines to Speed Heating Oil Deliveries and Boiler Repairs to Ensure New Yorkers Can Heat Homes and Businesses.” Press Release. November 8, 2012.  
[http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor\\_press\\_release&catID=1194&doc\\_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr404-12.html&cc=unused1978&rc=1194&ndi=1](http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012b%2Fpr404-12.html&cc=unused1978&rc=1194&ndi=1)

## Conclusion

Hurricanes Irene and Sandy caused extensive damage to energy infrastructure in the Northeast and Mid-Atlantic, knocking out power to millions of customers and disrupting key pieces of the petroleum supply chain. Although Sandy was a weaker storm at landfall, it brought tropical storm-force winds (as well as blizzard conditions) to a larger area and ultimately had a greater impact on the region's energy infrastructure and supply. Customer power outages from Sandy (and the November 2012 Nor'easter) totaled 8.66 million, compared with total outages of 6.69 million from Irene. Ninety-five percent restoration following Sandy took 10 days—twice as long as following Irene.

Sandy also had a greater impact on the region's petroleum infrastructure and supply. In particular, extensive storm damage, flooding, and power outages at refineries and pipeline and marine receipt terminals in the New York Harbor area depressed petroleum product supply in the region for several weeks after the storm's landfall. These supply chain problems, combined with power outages at retail filling stations, led to a widespread shortage of fuel in the New York City metropolitan area.

Overall, the energy impacts following Sandy were more severe than those following Irene, and they necessitated a greater response from Federal, State, and local governments. Following both storms, the Federal Government worked to provide situational awareness, facilitate restoration, and ease regulations. Following Sandy, for the first time, DOE's Power Marketing Administrations worked alongside investor-owned utility workers under mutual aid agreements to restore power, utility trucks were classified as emergency response vehicles, and fuel from DOE's Home Heating Oil Reserve was released. The Federal Government also issued a greater number of waivers after Sandy, to help move fuel from the Gulf Coast to Northeast, and to provide greater fuel-use flexibility for certain emergency response applications. State and local governments also initiated several programs to address energy issues following Sandy, including implementing fuel rationing programs to reduce lines at retail filling stations.

Hurricanes Irene and Sandy caused widespread damage to energy infrastructure in the Northeast, including systems supplying power, petroleum products, and natural gas. Faced with these challenges, Federal, State, and local governments worked with industry to restore energy systems and supplies as quickly as possible.

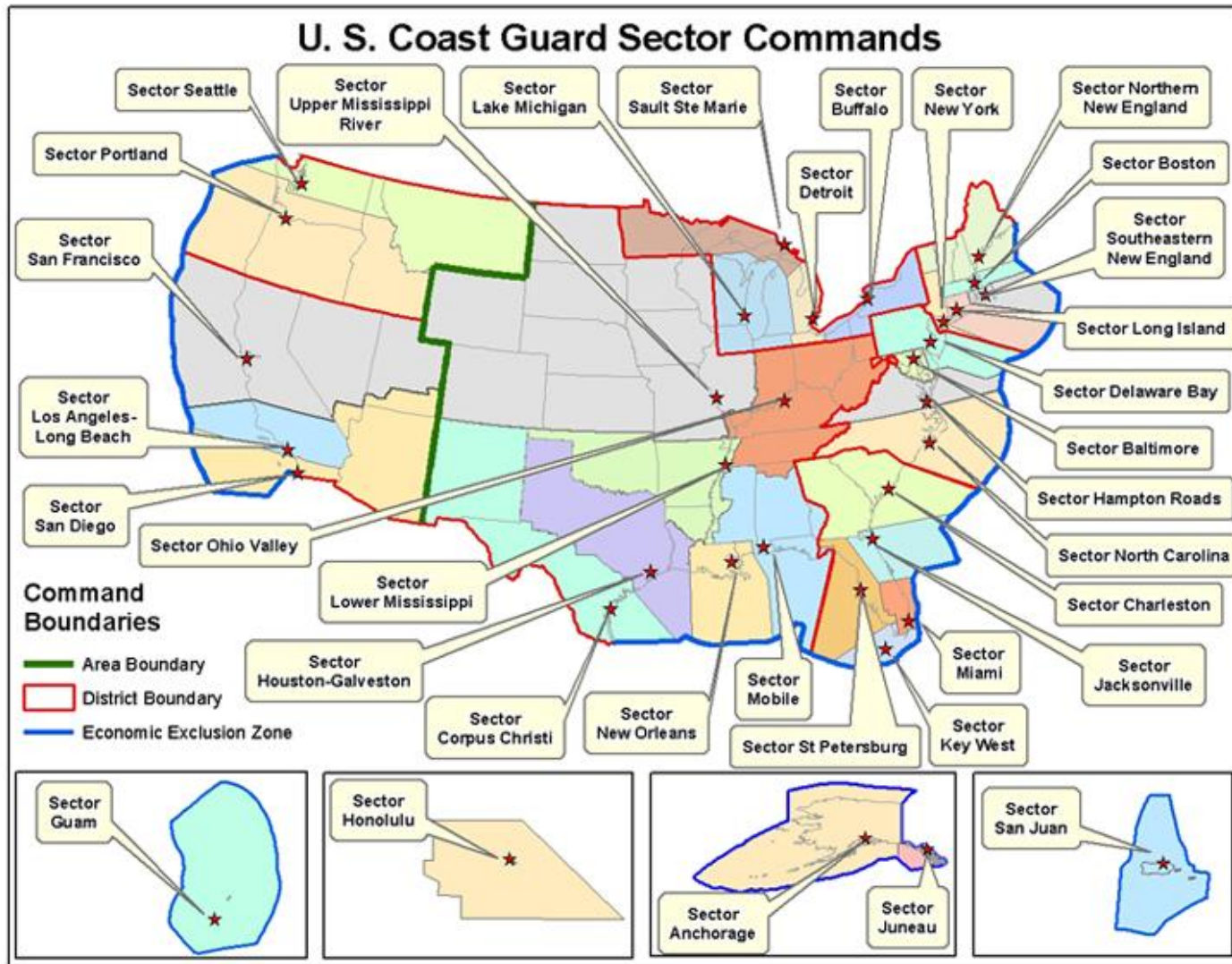
## Appendices

### Appendix 1. Peak Customer Power Outages by States

State	Peak Outages		Total Customers	Share of Total	
	Irene	Sandy		Irene	Sandy
Connecticut	702,154	626,559	2,047,240	34%	31%
Delaware	56,901	45,137	459,831	12%	10%
District of Columbia	29,447	3,583	269,815	11%	1%
Illinois		1,149	5,742,146	0%	0%
Indiana		9,224	3,103,313	0%	0%
Kentucky		8,379	2,234,984	0%	0%
Maine	201,663	90,727	1,568,419	13%	6%
Maryland	807,445	311,020	2,691,403	30%	12%
Massachusetts	567,000	298,072	3,451,306	16%	9%
Michigan		120,637	4,785,627	0%	3%
New Hampshire	116,766	141,992	715,797	16%	20%
New Jersey	810,847	2,615,291	4,031,813	20%	65%
New York	941,914	2,097,933	9,303,419	10%	23%
North Carolina	507,063	15,466	4,841,173	10%	0%
Ohio		267,323	6,759,784	0%	4%
Pennsylvania	707,155	1,267,512	6,491,718	11%	20%
Rhode Island	282,280	116,592	498,551	57%	23%
South Carolina	3,940		2,434,144	0%	0%
Tennessee		2,120	3,166,486	0%	0%
Vermont	47,557	17,959	358,678	13%	5%
Virginia	912,715	182,811	3,684,290	25%	5%
West Virginia		271,765	1,017,506	0%	27%
<b>Hurricane Subtotal</b>	<b>6,694,847</b>	<b>8,511,251</b>			
<b>2012 Nor'easter Outages</b>		<b>150,276</b>			
<b>Total</b>	<b>6,694,847</b>	<b>8,661,527</b>			

Source: OE/ISER Emergency Situation Reports

## Appendix 2. U.S. Coast Guard Commands



v6.0

Source: U.S. Coast Guard



### Appendix 3. Jones Act Waiver Vessel Deliveries by Port and Product

Port	CBOB	Ethanol	Gasoline	Natural Gasoline	RFG Blendstock	ULSD	ULS Kerosene	Total
Searsport, ME							60,000	<b>60,000</b>
Albany, NY			86,018					<b>86,018</b>
Curtis Bay, MD	103,600		183,000					<b>286,600</b>
Everett, MA					270,000			<b>270,000</b>
New Haven, CT			288,653					<b>288,653</b>
New York Harbor*	100,100		520,894	176,331		371,520	121,008	<b>1,289,853</b>
Newington, NH							90,000	<b>90,000</b>
Paulsboro, NJ		95,745						<b>95,745</b>
Portland, ME	00,350							<b>200,350</b>
Portsmouth, NH							65,000	<b>65,000</b>
<b>Grand Total</b>	<b>404,050</b>	<b>95,745</b>	<b>1,078,565</b>	<b>176,331</b>	<b>270,000</b>	<b>371,520</b>	<b>336,008</b>	<b>2,732,219</b>

\*Including Stapleton, NY

Source: MARAD

## Appendix 4. Major Disaster Declarations and Emergency Declarations by State and Storm

State	Major Disaster Declarations						Emergency Declarations					
	Irene			Sandy			Irene			Sandy		
	From	To	Days	From	To	Days	From	To	Days	From	To	Days
Connecticut	8/27/2011	9/1/2011	5	10/27/2012	11/8/2012	12	8/26/2011	9/1/2011	6	10/27/2012	11/8/2012	12
Delaware	8/25/2011	8/31/2011	6	10/27/2012	11/8/2012	12	8/26/2011	n/a	n/a	10/27/2012	11/8/2012	12
District of Columbia	8/26/2011	9/1/2011	6	10/26/2012	10/31/2012	5	8/26/2011	9/1/2011	6	10/28/2012	10/31/2012	3
Maine	8/27/2011	8/29/2011	2									
Maryland	8/24/2011	9/5/2011	12	10/26/2012	11/4/2012	9	8/26/2011	9/5/2011	10	10/26/2012	11/8/2012	13
Massachusetts	8/27/2011	8/29/2011	2	10/27/2012	11/8/2012	12	8/26/2011	9/5/2011	10	10/27/2012	11/8/2012	12
New Hampshire	8/27/2011	9/6/2011	10	10/26/2012	11/8/2012	13	8/26/2011	n/a	n/a	10/26/2012	10/31/2012	5
New Jersey	8/27/2011	9/5/2011	9	10/26/2012	11/8/2012	13	8/26/2011	9/5/2011	10	10/26/2012	11/8/2012	13
New York	8/26/2011	9/2/2011	7	10/27/2012	11/8/2012	12	8/25/2011	9/5/2011	11	10/27/2012	11/8/2012	12
North Carolina	8/25/2011	9/1/2011	7				8/25/2011	9/1/2011	7			
Ohio				10/29/2012	10/30/2012	1						
Pennsylvania	8/26/2011	8/30/2011	4	10/26/2012	11/8/2012	13	8/26/2011	9/14/2011	19	10/26/2012	11/8/2012	13
Puerto Rico	8/21/2011	8/24/2011	3			0	8/21/2011	8/24/2011	3			
Rhode Island	8/27/2011	8/29/2011	2	10/26/2012	10/31/2012	5	8/26/2011	8/29/2011	3	10/26/2012	11/8/2012	13
Vermont	8/27/2011	9/2/2011	6				8/26/2011	9/2/2011	7			
Virginia	8/26/2011	8/28/2011	2	10/26/2012	11/8/2012	13	8/26/2011	9/4/2011	9	10/26/2012	11/1/2012	6
West Virginia				10/29/2012	11/8/2012	10				10/29/2012	11/8/2012	10

Source: FEMA