4. Generating Resources

“Existing”, “planned-committed”, and “potential” are the three general types of generating units modeled in EPA Base Case v.5.13. Units that are currently operational in the electric industry are termed as “existing” units. Units that are not currently operating but are firmly anticipated to be operational in the future, and have either broken ground (initiated construction) or secured financing are termed “planned-committed”. “Potential” units refer to new generating options used in IPM for capacity expansion projections of the electric industry. Existing and planned-committed units are entered as exogenous inputs to the model, whereas potential units are endogenous to the model in the sense that the model determines the location and size of all the potential units that end up in the final solution for a specific model run.

This chapter is organized into the following five sections:

(1) Section 4.1 provides background information on the National Electric Energy Data System (NEEDS), the database which serves as the repository for information on existing and planned-committed units which are modeled in the EPA Base Case v.5.13,

(2) Section 4.2 provides detailed information on existing non-nuclear generating units modeled in EPA Base Case v.5.13,

(3) Section 0 provides detailed information pertaining to planned-committed units which are assumed in EPA Base Case v.5.13,

(4) Section 4.4 provides detailed information pertaining to the EPA Base Case assumptions for potential plants, and

(5) Section 4.5 describes the handling of existing and potential nuclear units in EPA Base Case v.5.13

4.1 National Electric Energy Data System (NEEDS)

EPA Base Case v.5.13 uses the NEEDS database as its source for data on all existing and planned-committed units. Table 4-1 below summarizes the resources used in developing data on existing units in NEEDS v.5.13. The data sources for planned-committed units in NEEDS are discussed below in Section 0. The population of existing units in NEEDS v.5.13 represents generating units that were in operation through the end of 2010. The population of planned-committed includes any units online or scheduled to come online from 2011 to the end of 2015 (with five exceptions listed in the note under Table 4-2 below).

4.2 Existing Units

EPA Base Case v.5.13 models existing units based on information contained in NEEDS. The sections below describe the procedures followed in determining the population of units in NEEDS, as well as each unit’s capacity, location, and configuration. Details are also given on the model plant aggregation scheme and the cost and performance characteristics associated with the existing non-nuclear units represented in EPA Base Case v.5.13.

4.2.1 Population of Existing Units

The population of existing units was taken primarily from EIA 860 (2010). A number of rules were used to screen the various data sources. These rules helped to ensure data consistency, but also made the population data adaptable for use in EPA Base Case v.5.13. Table 4-2 below summarizes the rules used in populating the NEEDS v.5.13 database. Excerpt from Table 4-35 lists all units that were not included in the NEEDS v.5.13 database based on these criteria.

Table 4-1 Data Sources for NEEDS v.5.13 for EPA Base Case v.5.13

Data Source[a]	Data Source Documentation
DOE's Form EIA-860	DOE's Form EIA-860 is an annual survey of utility and non-utility power plants at the generator level. It contains data such as summer, winter and nameplate capacity, location (state and county), operating status, prime mover, energy sources and in-service date of existing and proposed generators. NEEDS v.5.13 uses EIA Form 860 (2010, 2011) data as one of the primary generator data inputs. DOE's Form EIA-860 also collects data of steam boilers such as energy sources, boiler identification, location, operating status and design information; and associated environmental equipment such as NO_x combustion and post-combustion control, FGD scrubber, mercury control and particulate collector device information. Note that boilers in plants with less than 10 MW do not report all data elements. The association between boilers and generators is also provided. Note that boilers and generators are not necessarily in a one-to-one correspondence. NEEDS v.5.13 uses EIA Form 860 (2010, 2011) data as one of the primary boiler data inputs.
NERC Electricity Supply and Demand (ES&D) database	The NERC ES&D is released annually. It contains generator-level information such as summer, winter and nameplate capacity, state, NERC region and sub-region, status, primary fuel and on-line year. NEEDS v.5.13 uses NERC ES&D (2011) data as one of the data inputs.
DOE's Annual Energy Outlook (AEO)	The Energy Information Administration (EIA) Annual Energy Outlook presents annually updated forecasts of energy supply, demand and prices covering a 20-25 year time horizon. The projections are based on results from EIA's National Energy Modeling System (NEMS). Information from AEO 2012 such as heat rates, planned committed units were used in NEEDS v.5.13. Nuclear unit capacities and uprates are from AEO 2013.
Ventyx's New Entrants database	Ventyx's New Entrants database has information on new power plant builds, rerates and retirements. NEEDS v.5.13 uses the dataset downloaded on April 13, 2012 and April 23, 2013, as one of the sources of development of committed generating units.
EPA's Emission Tracking System	The Emission Tracking System (ETS) database is updated quarterly. It contains boiler-level information such as primary fuel, heat input, SO_2 and NO_x controls, and SO_2 and NO_x emissions. NEEDS v.5.13 uses annual and seasonal ETS (2011) data as one of the primary data inputs for NO_x rate development and environmental equipment assignment.
Utility and Regional EPA Office Comments	Comments from utilities and regional EPA offices regarding the population in NEEDS (retirements, new units) as well as unit characteristics were incorporated in NEEDS v.5.13.

Note:

[a] Shown in Table 4-1 are the primary issue dates of the indicated data sources that were used. Other vintages of these data sources were also used in instances where data were not available for the indicated issued date or where there were methodological reasons for using other vintages of the data.

Table 4-2 Rules Used in Populating NEEDS v.5.13 for EPA Base Case v.5.13

Scope	Rule
Capacity	Excluded units with reported summer capacity, winter capacity and nameplate capacity of zero or blank.
Status	Excluded units that were out of service for two or three consecutive years (i.e., generators with status codes "OS" in the latest three reporting years and boilers with status codes "OS" in the latest two reporting years) and units that were no longer in service and not expected to be returned to service (i.e., generators or boilers with status codes of "RE"). Status of boiler(s) and associated generator(s) were taken into account for determining operation status
Planned or Committed Units	Included planned units that had broken ground or secured financing and were expected to be online by the end of 2015; one geothermal unit and four nuclear units that are scheduled to come online after 2015 were also included[a]

Scope	Rule
Firm/Non-firm Electric Sales	Excluded non-utility onsite generators that do not produce electricity for sale to the grid on a net basis Excluded all mobile and distributed generators

Note:
[a] The geothermal unit is Bonnett, unit ST2; the four nuclear units are Vogtle, units 3&4, and V C Summer, units 2&3

As with previous versions of the database, NEEDS v.5.13 includes steam units at the boiler level and non-steam units at the generator level (nuclear units are also at the generator level). A unit in NEEDS v.5.13, therefore, refers to a boiler in the case of a steam unit and a generator in the case of a non-steam unit. Table 4-3 provides a summary of the population and capacity of the existing units included in NEEDS v.5.13 through 2010. EIA Form 860 (2010) is the starting point and largest component of the existing unit population in NEEDS v.5.13 but the final population of existing units is supplemented based on information from other sources, including comments from utilities, submissions to EPA's Emission Tracking System, Annual Energy Outlook, and reported capacity in Ventyx's New Entrants database.

EPA removed capacity from the NEEDS inventory based on public announcements of future closures. Removal of such capacity from the NEEDS inventory pre-empts the model itself from making any decisions regarding that capacity's future status or configuration; such capacity is simply no longer available for the model to consider in optimizing electricity supply to meet demand. The list of units considered for removal from NEEDS is built from several data sources including:

1. Edison Electric Institute (EEI), "Coal Fleet Retirement Announcements", July 29, 2011
2. PJM, "Future Deactivation Requests", "PJM Generator Deactivations", 2012 (updated frequently)
3. EIA, "Retired U.S. Electric Generating Units by Operating Company, Plant and Month, 2012
4. Research by EPA and ICF staff

EPA only removed units from the NEEDS inventory if a high degree of certainty could be assigned to future implementation of the announced action. The available retirement-related information was reviewed for each unit individually, and a determination was made regarding the removal of the unit from NEEDS v.5.13. This assessment is based on the rules below, applied in the following order:

1. All units that are listed as retired in the 2010, 2011, 2012 and February 2013 versions of EIA Electric Power Monthly are flagged for removal from NEEDS.
2. All units with a status flag of "RE" or with a planned retirement year prior to 2016 in 2011 EIA 860 are flagged for removal from NEEDS.
3. All units that have been cleared by a regional transmission operator (RTO) or independent system operator (ISO) to retire before 2016, or whose RTO/ISO clearance to retire is contingent on actions that can be completed before 2016, are flagged for removal from NEEDS.
4. All units that have committed specifically to retire before 2016 under federal or state enforcement actions or regulatory requirements are flagged for removal from NEEDS.
5. Finally, if a retirement announcement for a given unit can be corroborated by other available information then the unit is flagged for removal from NEEDS.

Note that units which are required to retire pursuant to enforcement actions or state rules in 2016 or later are retained in the NEEDS database. Such 2016-and-later retirements are captured as constraints on those units in IPM modeling, and the capacity is retired in future year projections per the terms of the related requirements.

Table 4-36 lists all units that were removed from EPA's inventory based on announcements that were reviewed using the rules outlined above.

Table 4-3 Summary Population (through 2010) of Existing Units in NEEDS v.5.13

Plant Type	Number of Units	Capacity (MW)
Biomass	161	3,140
Coal Steam	949	275,568
Combined Cycle	1659	203,181
Combustion Turbine	5419	135,353
Fossil Waste	58	372
Fuel Cell	15	3
Geothermal	201	2,304
Hydro	3749	77,946
IGCC	6	539
Landfill Gas	1315	1,437
Municipal Solid Waste	174	2,142
Non-Fossil Waste	100	1,328
Nuclear	99	98,173
O/G Steam	529	92,909
Pumped Storage	151	22,310
Solar PV	151	390
Solar Thermal	15	548
Tires	2	46
Wind	665	39,150
US Total	**15,418**	**956,837**

4.2.2 Capacity

The NEEDS unit capacity values implemented in EPA Base Case v.5.13 reflect net summer dependable capacity[18], to the extent possible. Table 4-4 summarizes the hierarchy of primary data sources used in compiling capacity data for NEEDS v.5.13; in other words, data sources are evaluated in this order, and capacity values are taken from a particular source only if the sources listed above it do not provide adequate data for the unit in question.[19]

Table 4-4 Hierarchy of Data Sources for Capacity in NEEDS v.5.13

Sources Presented in Hierarchy
Summer Net Dependable Capacity from Comments
2010 EIA 860 Summer Capacity
2011 EIA 860 Summer Capacity
2010 EIA 860 Winter Capacity
2011 EIA 860 Winter Capacity
2010 EIA 860 Nameplate Capacity
2011 EIA 860 Nameplate Capacity

Notes:
Presented in hierarchical order that applies.
If capacity is zero, unit is not included.

As noted earlier, NEEDS v.5.13 includes boiler level data for steam units, and generator level data for non-steam units. Capacity data in EIA are generator-specific and not boiler specific. Therefore, it was necessary to develop an algorithm for parsing generator-level capacity to the boiler level for steam producing units.

[18] As used here, net summer dependable capacity is the net capability of a generating unit in megawatts (MW) for daily planning and operation purposes during the summer peak season, after accounting for station or auxiliary services.

[19] EIA 860 2010 was reviewed before 2011 because 2010 was the most recent data year available at the time NEEDS development began.

The capacity-parsing algorithm used for steam units in NEEDS v.5.13 took into account boiler-generator mapping. Fossil steam electric units have boilers attached to generators that produce electricity. There are generally four types of links between boilers and generators: one boiler to one generator, one boiler to many generators, many boilers to one generator and many boilers to many generators.

The capacity-parsing algorithm used for steam units in NEEDS utilized steam flow data with the boiler-generator mapping. Under EIA 860, steam units report the maximum steam flow from the boiler to the generator. There is, however, no further data on the steam flow of each boiler-generator link. Instead, EIA 860 contains only the maximum steam flow for each boiler. Table 4-5 summarizes the algorithm used for parsing capacity with data on maximum steam flow and boiler-generator mapping. In Table 4-5, MFB_i refers to the maximum steam flow of boiler i and MW_{Gj} refers to the capacity of generator j. The algorithm uses the available data to derive the capacity of a boiler, referred to as MW_{Bj} in Table 4-5.

Table 4-5 Capacity-Parsing Algorithm for Steam Units in NEEDS v.5.13

Type of Boiler-Generator Links				
	One-to-One	One-to-Many	Many-to-One	Many-to-Many
For Boiler B_1 to B_N linked to Generators G_1 to G_N	$MW_{Bi} = MW_{Gj}$	$MW_{Bi} = \Sigma_j MW_{Gj}$	$MW_{Bi} = (MF_{Bi} / \Sigma_i MF_{Bi}) * MW_{Gj}$	$MW_{Bi} = (MF_{Bi} / \Sigma_i MF_{Bi}) * \Sigma_j MW_{Gj}$

Notes:
MF_{Bi} = maximum steam flow of boiler i
MW_{Gj} = electric generation capacity of generator j

Since EPA Base Case v.5.13 uses net energy for load as demand, NEEDS v.5.13 only includes generators that sell the majority of their power to the electric grid; this approach is intended to be broadly consistent with the generating capacity used in the AEO projections used as the source where demand is net energy for load. The generators that should be in NEEDS v.5.13 by this qualification are determined from the 2010 EIA Form 923 non-utility source and disposition data set.

4.2.3 Plant Location

NEEDS v.5.13 uses state, county and model region data to represent the physical location of each plant.

State and County

NEEDS v.5.13 used the state and county data in EIA 860 (2010, 2011).

Model Region

- For each unit the associated model region was derived based on NERC assessment regions reported in NERC ES&D 2011 for that unit. For units with no NERC assessment region data, state and county were used to derive associated model regions. Using these shares of each NEMS region net energy for load that falls in each IPM region, calculate the total net energy for load for each IPM region from the NEMS regional load in AEO 2013.

Table 3-1 in Chapter 3 provides a summary of the mapping between NERC assessment regions and EPA Base Case v.5.13 model regions.

4.2.4 Online Year

The EPA Base Case v.5.13 uses online year to capture when the unit entered service. NEEDS includes online years for all units in the database. In NEEDS v.5.13, online years for boilers, utility and non-utility generators were primarily derived from reported in-service dates in EIA Form 860 (2010, 2011).

EPA Base Case v.5.13 includes constraints to set the retirement year for generating units that are firmly committed to retire after 2015 based on state or federal regulations and enforcement actions. In addition, existing nuclear units must retire when they reach age 60. (See section 0 for a discussion of the nuclear lifetime assumption.) EPA Base Case v.5.13 also provides economic retirement options to coal, oil and gas steam, combined cycle, combustion turbines and nuclear units. This means that the model may elect to retire these units if it is economical to do so. In IPM, a retired plant ceases to incur FOM and VOM costs. However, retired units do continue to service debt on any previously incurred capital cost for model-installed retrofits if the model projected a retrofit on the unit prior to retirement.

4.2.5 Unit Configuration

Unit configuration refers to the physical specification of a unit's design. Unit configuration in EPA Base Case v.5.13 drives model plant aggregation, modeling of pollution control options and mercury emission modification factors. NEEDS v.5.13 contains information on the firing and bottom type of coal steam boilers in the database. Great effort was taken to ensure that the inventory of existing and committed controls represented in EPA Base Case v.5.13 was comprehensive and as up-to-date as possible. The hierarchy of data sources used is shown in Table 4-6.

Table 4-6 Data Sources for Unit Configuration in NEEDS v.5.13 for EPA Base Case v.5.13

Unit Component	Primary Data Source	Secondary Data Source	Tertiary Data Source	Other Sources	Default
Firing Type	2010 EIA 860	EPA's Emission Tracking System (ETS) – 2011	--	--	--
Bottom Type	2010 EIA 860	EPA's Emission Tracking System (ETS) – 2011	--	--	Dry
SO_2 Pollution Control	NSR Settlement or Comments	EPA's Emission Tracking System (ETS) - 2011	2010 EIA 860	See Note	No Control
NO_x Pollution Control	NSR Settlement or Comments	EPA's Emission Tracking System (ETS) - 2011	2010 EIA 860	See Note	No Control
Mercury Control	NSR Settlement or Comments	2010 EIA 860	--	--	No Control
Particulate Matter Control	NSR Settlement or Comments	EPA's Emission Tracking System (ETS) - 2011	2010 EIA 860	--	No Control
HCl Control	NSR Settlement or Comments	--	--	See Note	No Control

Note:
In addition to the primary, secondary and tertiary data sources listed here, the following sources were consulted and emission controls were updated when corroborating information could be found: Reports filed with the Securities and Exchange Commission; websites of generating unit owners and operators; GenerationHub; state public utility service commissions; state permitting agencies; architecture and engineering firm announcements (eg.: Shaw, URS, Stanley, Black &Veatch, Peter Kewit, etc.); equipment supplier announcements (Alstom, B&W, Babcock Power); Power-Eng.com; McILVAINE Utility Upgrade Database; ICAC (Institute of Clean Air Companies).

4.2.6 Model Plant Aggregation

While EPA Base Case using IPM is comprehensive in representing all the units contained in NEEDS, an aggregation scheme is used to combine existing units with similar characteristics into "model plants". The aggregation scheme serves to reduce the size of the model and makes the model manageable while capturing the essential characteristics of the generating units. The EPA Base Case v.5.13 aggregation scheme is designed so that each model plant only represents generating units from a single state. This design makes it possible to obtain state-level results directly from IPM outputs. In addition, the aggregation scheme supports modeling plant-level emission limits on fossil generation.

The "model plant" aggregation scheme encompasses a variety of different classification categories including location, size, technology, heat rate, fuel choices, unit configuration, SO_2 emission rates and environmental regulations among others. Units are aggregated together only if they match on all the different categories specified for the aggregation. The 11 major categories used for the aggregation scheme in EPA Base Case v.5.13 are the following:

(1) Model Region

(2) Unit Technology Type

(3) Fuel Demand Region

(4) Applicable Environmental Regulations

(5) State

(6) Facility (ORIS) for fossil units

(7) Unit Configuration

(8) Emission Rates

(9) Heat Rates

(10) Fuel

(11) Size

Table 4-7 shows the number of actual units by generation technology type and the related number of aggregated "model plants" used in the EPA Base Case v.5.13. For each plant type, the table shows the number of real plants and the number of model plants representing these real plants in EPA Base Case v.5.13.[20]

Table 4-7 Aggregation Profile of Model Plants as Provided at Set Up of EPA Base Case v.5.13

Existing and Planned/Committed Units		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
Biomass	194	119
Coal Steam	1,003	759
Combined Cycle	1,727	702
Combustion Turbine	5,552	2,200
Fossil_Other	60	18
Fuel Cell	25	12

[20] (1) The "Number of IPM Model Plants" shown for many of the "Plant Types" in the "Retrofits" block in Table 4-7 exceeds the "Number of IPM Model Plants" shown for "Plant Type" "Coal Steam" in the block labeled "Existing and Planned/Committed Units", because a particular retrofit "Plant Type" can include multiple technology options and multiple timing options (e.g., Technology A in Stage 1 + Technology B in Stage 2 + Technology C in Stage 3, the reverse timing, or multiple technologies simultaneously in Stage 1). (3) Since only a subset of coal plants is eligible for certain retrofits, many of the "Plant Types" in the "Retrofits" block that represent only a single retrofit technology (e.g., "Retrofit Coal with Selective Non-catalytic Reduction (SNCR)") have a "Number of IPM Model Plants" that is a smaller than the "Number of IPM Model Plants" shown for "Plant Type" "Coal Steam". (4) The total number of model plants representing different types of new units often exceeds the 64 US model regions and varies from technology to technology for several reasons. First, some technologies have multiple vintages (i.e., different cost and/or performance parameters depending on which run-year in which the unit is created), which must be represented by separate model plants in each IPM region. Second, some technologies are not available in particular regions (e.g., geothermal is geographically restricted to certain regions).

Existing and Planned/Committed Units		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
Geothermal	219	28
Hydro	3,807	160
Import	1	1
Integrated Gas Combined Cycle	10	5
Landfill Gas	1,414	225
Non Fossil_Other[a]	308	135
Nuclear[b]	105	105
Oil/Gas Steam	532	347
Pumped Storage	152	24
Solar PV	370	47
Solar Thermal	27	10
Wind	824	74
Total	**16,330**	**4,971**

New Units		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
New Advanced Coal with CCS	--	51
New Biomass	--	123
New Combined Cycle	--	61
New Combined Cycle with Carbon Capture	--	61
New Combustion Turbine	--	61
New Fuel Cell	--	122
New Future Technology	--	305
New Geothermal		64
New IGCC		56
New Landfill Gas	--	369
New Nuclear	--	122
New Offshore Wind	--	714
New Onshore Wind	--	1480
New Solar PV	--	228
New Solar Thermal		91
New SPC-WetFGD_SCR	--	51
Total	--	**3,959**

Retrofits		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
Retrofit Coal with ACI	--	414
Retrofit Coal with ACI + CCS	--	164
Retrofit Coal with ACI + CCS + HRI	--	158
Retrofit Coal with ACI + CCS + HRI + SCR	--	78
Retrofit Coal with ACI + CCS + HRI + SCR + Scrubber	--	138
Retrofit Coal with ACI + CCS + HRI + Scrubber	--	152
Retrofit Coal with ACI + CCS + SCR	--	78
Retrofit Coal with ACI + CCS + SCR + Scrubber	--	138
Retrofit Coal with ACI + CCS + Scrubber	--	152
Retrofit Coal with ACI + DSI	--	389
Retrofit Coal with ACI + DSI + HRI	--	385

Retrofits		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
Retrofit Coal with ACI + DSI + HRI + SCR	--	525
Retrofit Coal with ACI + DSI + HRI + SCR + Scrubber	--	354
Retrofit Coal with ACI + DSI + HRI + Scrubber	--	362
Retrofit Coal with ACI + DSI + HRI + SNCR	--	151
Retrofit Coal with ACI + DSI + HRI + SNCR + Scrubber	--	74
Retrofit Coal with ACI + DSI + SCR	--	528
Retrofit Coal with ACI + DSI + SCR + Scrubber	--	356
Retrofit Coal with ACI + DSI + Scrubber	--	364
Retrofit Coal with ACI + DSI + Scrubber + SNCR	--	76
Retrofit Coal with ACI + DSI + SNCR	--	173
Retrofit Coal with ACI + HRI	--	406
Retrofit Coal with ACI + HRI + SCR	--	570
Retrofit Coal with ACI + HRI + SCR + Scrubber	--	883
Retrofit Coal with ACI + HRI + Scrubber	--	737
Retrofit Coal with ACI + HRI + SNCR	--	162
Retrofit Coal with ACI + HRI + SNCR + Scrubber	--	302
Retrofit Coal with ACI + SCR	--	576
Retrofit Coal with ACI + SCR + Scrubber	--	886
Retrofit Coal with ACI + Scrubber	--	742
Retrofit Coal with ACI + Scrubber + SNCR	--	307
Retrofit Coal with ACI + SNCR	--	166
Retrofit Coal with C2G	--	621
Retrofit Coal with C2G + SCR	--	621
Retrofit Coal with CCS	--	410
Retrofit Coal with CCS + HRI	--	352
Retrofit Coal with CCS + HRI + SCR	--	124
Retrofit Coal with CCS + HRI + SCR + Scrubber	--	168
Retrofit Coal with CCS + HRI + Scrubber	--	200
Retrofit Coal with CCS + SCR	--	122
Retrofit Coal with CCS + SCR + Scrubber	--	168
Retrofit Coal with CCS + Scrubber	--	200
Retrofit Coal with DSI	--	239
Retrofit Coal with DSI + HRI	--	473
Retrofit Coal with DSI + HRI + SCR	--	658
Retrofit Coal with DSI + HRI + SCR + Scrubber	--	383
Retrofit Coal with DSI + HRI + Scrubber	--	333
Retrofit Coal with DSI + HRI + SNCR	--	129
Retrofit Coal with DSI + SCR	--	661
Retrofit Coal with DSI + SCR + Scrubber	--	385
Retrofit Coal with DSI + Scrubber	--	334
Retrofit Coal with DSI + SNCR	--	200
Retrofit Coal with HRI	--	646
Retrofit Coal with HRI + SCR	--	782
Retrofit Coal with HRI + SCR + Scrubber	--	1,347
Retrofit Coal with HRI + Scrubber	--	1,034
Retrofit Coal with HRI + Scrubber + SNCR	--	440
Retrofit Coal with HRI + SNCR	--	209
Retrofit Coal with SCR	--	399
Retrofit Coal with SCR + Scrubber	--	1,353
Retrofit Coal with Scrubber	--	524

Retrofits		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
Retrofit Coal with Scrubber + SNCR	--	452
Retrofit Coal with SNCR	--	106
Retrofit Combined Cycle with CCS	--	424
Retrofit Oil/Gas steam with SCR	--	227
Total	--	**25,670**

Retirements		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
CC Retirement	--	702
Coal Retirement	--	5,372
CT Retirement	--	2,200
IGCC Retirement	--	5
Non-Fossil Retirement	--	680
Nuke Retirement	--	105
O/G Retirement	--	1,195
Total	--	**10,259**
Grand Total (Existing and Planned/Committed + New + Retrofits + Retirements): 44,859		

Notes:

[a] Non Fossil_Other includes units whose fuel is municipal solid waste, tires, and other non-fossil waste.

[b] The 105 nuclear units include 99 currently operating units, 1 unit scheduled to retire in 2014 (Vermont Yankee), plus Watts Bar Nuclear Plant (Unit 2), Vogtle (Units 3&4), and V C Summer (Units 2&3), which are scheduled to come online during 2015 - 2018. All except Vermont Yankee Nuclear unit are listed in Table 4-34

4.2.7 Cost and Performance Characteristics of Existing Units

In EPA Base Case v.5.13 heat rates, emission rates, variable operation and maintenance cost (VOM) and fixed operation and maintenance costs (FOM) are used to characterize the cost and performance of all existing units in NEEDS v.5.13. For existing units, only the cost of maintaining (FOM) and running (VOM) the unit are modeled. Embedded costs, such as carrying capital charges, are not modeled; however, because such historically invested capital costs are sunk costs, they are economically irrelevant for projecting least-cost investment and operational decisions for electricity supply going forward. The section below contains a discussion of the cost and performance assumptions for existing units used in the EPA Base Case v.5.13.

Variable Operating and Maintenance Cost (VOM)

VOM represents the non-fuel variable cost associated with producing electricity. If the generating unit contains pollution control equipment, VOM includes the cost of operating the control equipment. Table 4-8 below summarizes VOM assumptions used in EPA Base Case v.5.13. The values shown in this table were obtained using a procedure developed jointly by EPA's power sector engineering staff and ICF.

Table 4-8 VOM Assumptions in EPA Base Case v.5.13

Capacity Type	SO_2 Control	NO_x Control	Hg Control	Variable O&M (2011$/mills/kWh)
Biomass	--	--	--	2.41
Coal Steam	No SO_2 Control	No NO_x Control	No Hg Control	0.84
			ACI	2.28
		SCR	No Hg Control	1.29
			ACI	2.73
		SNCR	No Hg Control	1.85
			ACI	3.29

Capacity Type	SO_2 Control	NO_x Control	Hg Control	Variable O&M (2011$/mills/kWh)
	Dry FGD	No NO_x Control	No Hg Control	4.29
			ACI	5.73
		SCR	No Hg Control	4.74
			ACI	6.18
		SNCR	No Hg Control	5.30
			ACI	6.74
	Wet FGD	No NO_x Control	No Hg Control	4.77
			ACI	6.21
		SCR	No Hg Control	5.22
			ACI	6.66
		SNCR	No Hg Control	5.78
			ACI	7.22
	DSI	No NO_x Control	No Hg Control	10.07
			ACI	11.51
		SCR	No Hg Control	10.52
			ACI	11.96
		SNCR	No Hg Control	11.08
			ACI	12.52
Combined Cycle	No SO_2 Control	No NO_x Control	No Hg Control	2.82 - 5.96
		SCR		2.95 - 6.09
		SNCR		3.41 - 6.55
Combustion Turbine	No SO_2 Control	No NO_x Control	No Hg Control	3.35 - 22.44
		SCR		3.48 - 22.57
		SNCR		3.94 - 23.03
Fuel Cell	--	--	--	0.00
Geothermal	--	--	--	2.86
Hydro	--	--	--	1.70
IGCC	--	--	--	3.24-6.38
Landfill Gas / Municipal Solid Waste	--	--	--	2.44
O/G Steam	No SO_2 Control	No NO_x Control	No Hg Control	0.76
		SCR		0.89
		SNCR		1.35
	Wet FGD	No NO_x Control		0.76
		SCR		0.89
		SNCR		1.35
Pumped Storage	--	--	--	9.43
Solar PV	--	--	--	0.00
Solar Thermal	--	--	--	3.51
Wind	--	--	--	2.20

Fixed Operation and Maintenance Cost (FOM)

FOM represents the annual fixed cost of maintaining a unit. FOM costs are incurred independent of generation levels and signify the fixed cost of operating and maintaining the unit's availability to provide generation.

Table 4-9 summarizes the FOM assumptions used in EPA Base Case v.5.13. Note that FOM varies by the age of the unit, and the total FOM cost incurred by a unit depends on its capacity size. The values appearing in this table include the cost of maintaining any associated pollution control equipment. The values in

Table 4-9 are based on FERC (Federal Energy Regulatory Commission) Form 1 data maintained by Ventyx and ICF research.

Table 4-9 FOM Assumptions Used in EPA Base Case v.5.13

Plant Type	SO_2 Control	NO_x Control	Hg Control	Age of Unit	FOM (2011$ /kW-Yr)
Biomass	--	--	--	All Years	35.28
Coal Steam	No SO_2 Control	No NO_x Control	No Hg Control	0 to 30 Years	36.49
				30 to 40 Years	38.61
				40 to 50 Years	49.13
				Greater than 50 Years	50.83
			ACI	0 to 30 Years	36.58
				30 to 40 Years	38.70
				40 to 50 Years	49.22
				Greater than 50 Years	50.92
		SCR	No Hg Control	0 to 30 Years	37.13
				30 to 40 Years	39.26
				40 to 50 Years	49.78
				Greater than 50 Years	51.48
			ACI	0 to 30 Years	37.22
				30 to 40 Years	39.35
				40 to 50 Years	49.86
				Greater than 50 Years	51.57
		SNCR	No Hg Control	0 to 30 Years	37.11
				30 to 40 Years	39.23
				40 to 50 Years	49.75
				Greater than 50 Years	51.45
			ACI	0 to 30 Years	37.20
				30 to 40 Years	39.32
				40 to 50 Years	49.84
				Greater than 50 Years	51.54
	Dry FGD	No NO_x Control	No Hg Control	0 to 30 Years	46.51
				30 to 40 Years	48.63
				40 to 50 Years	59.15
				Greater than 50 Years	60.85
			ACI	0 to 30 Years	46.60
				30 to 40 Years	48.72
				40 to 50 Years	59.24
				Greater than 50 Years	60.94
		SCR	No Hg Control	0 to 30 Years	47.15
				30 to 40 Years	49.28
				40 to 50 Years	59.80
				Greater than 50 Years	61.50
			ACI	0 to 30 Years	47.24
				30 to 40 Years	49.37

Plant Type	SO_2 Control	NO_x Control	Hg Control	Age of Unit	FOM (2011$ /kW-Yr)
				40 to 50 Years	59.88
				Greater than 50 Years	61.59
		SNCR	No Hg Control	0 to 30 Years	47.13
				30 to 40 Years	49.25
				40 to 50 Years	59.77
				Greater than 50 Years	61.47
			ACI	0 to 30 Years	47.22
				30 to 40 Years	49.34
				40 to 50 Years	59.86
				Greater than 50 Years	61.56
	Wet FGD	No NO_x Control	No Hg Control	0 to 30 Years	45.90
				30 to 40 Years	48.02
				40 to 50 Years	58.54
				Greater than 50 Years	60.24
			ACI	0 to 30 Years	45.99
				30 to 40 Years	48.11
				40 to 50 Years	58.63
				Greater than 50 Years	60.33
		SCR	No Hg Control	0 to 30 Years	46.54
				30 to 40 Years	48.67
				40 to 50 Years	59.19
				Greater than 50 Years	60.89
			ACI	0 to 30 Years	46.63
				30 to 40 Years	48.76
				40 to 50 Years	59.27
				Greater than 50 Years	60.98
		SNCR	No Hg Control	0 to 30 Years	46.52
				30 to 40 Years	48.64
				40 to 50 Years	59.16
				Greater than 50 Years	60.86
			ACI	0 to 30 Years	46.61
				30 to 40 Years	48.73
				40 to 50 Years	59.25
				Greater than 50 Years	60.95
	DSI	No NO_x Control	No Hg Control	0 to 30 Years	37.99
				30 to 40 Years	40.11
				40 to 50 Years	50.63
				Greater than 50 Years	52.33
			ACI	0 to 30 Years	38.08
				30 to 40 Years	40.20

Plant Type	SO_2 Control	NO_x Control	Hg Control	Age of Unit	FOM (2011$ /kW-Yr)
				40 to 50 Years	50.72
				Greater than 50 Years	52.42
		SCR	No Hg Control	0 to 30 Years	38.63
				30 to 40 Years	40.76
				40 to 50 Years	51.28
				Greater than 50 Years	52.98
			ACI	0 to 30 Years	38.72
				30 to 40 Years	40.85
				40 to 50 Years	51.36
				Greater than 50 Years	53.07
		SNCR	No Hg Control	0 to 30 Years	38.61
				30 to 40 Years	40.73
				40 to 50 Years	51.25
				Greater than 50 Years	52.95
			ACI	0 to 30 Years	38.70
				30 to 40 Years	40.82
				40 to 50 Years	51.34
				Greater than 50 Years	53.04
Combined Cycle	No SO_2 Control	No NO_x Control	No Hg Control	-	24.29
		SCR	No Hg Control	-	25.56
		SNCR	No Hg Control	-	24.42
Combustion Turbine	No SO_2 Control	No NO_x Control	No Hg Control	-	16.47
		SCR	No Hg Control	-	18.41
		SNCR	No Hg Control	-	16.91
Fuel Cell	--	--	--	All Years	370.36
Geothermal	--	--	--	All Years	40.07
Hydro	--	--	--	All Years	19.28
IGCC	No SO_2 Control	No NO_x Control	--	All Years	36.89
Landfill Gas / Municipal Solid Waste	--	--	--	All Years	46.10
O/G Steam	No SO_2 Control	No NO_x Control	No Hg Control	0 to 30 Years	20.31
				30 to 40 Years	21.22
				40 to 50 Years	23.68
				Greater than 50 Years	23.68
		SCR	No Hg Control	0 to 30 Years	21.34
				30 to 40 Years	22.25
				40 to 50 Years	24.71

Plant Type	SO_2 Control	NO_x Control	Hg Control	Age of Unit	FOM (2011$ /kW-Yr)
				Greater than 50 Years	24.71
		SNCR	No Hg Control	0 to 30 Years	20.47
				30 to 40 Years	21.39
				40 to 50 Years	23.84
				Greater than 50 Years	23.84
	Wet FGD	No NO_x Control	No Hg Control	0 to 30 Years	20.31
				30 to 40 Years	21.22
				40 to 50 Years	23.68
				Greater than 50 Years	23.68
		SCR	No Hg Control	0 to 30 Years	21.34
				30 to 40 Years	22.25
				40 to 50 Years	24.71
				Greater than 50 Years	24.71
		SNCR	No Hg Control	0 to 30 Years	20.47
				30 to 40 Years	21.39
				40 to 50 Years	23.84
				Greater than 50 Years	23.84
Pumped Storage	--	--	--	All Years	7.37
Solar PV	--	--	--	All Years	20.53
Solar Thermal	--	--	--	All Years	31.94
Wind	--	--	--	All Years	19.54

Heat Rates

Heat Rates describe the efficiency of the unit expressed as BTUs per kWh. The treatment of heat rates in EPA Base Case v.5.13 is discussed in Section 3.8.

Lifetimes

Unit lifetime assumptions in EPA Base Case v.5.13 are detailed in Sections 0 and 4.2.8.

SO_2 Rates

Section 3.9.1 contains a detailed discussion of SO_2 rates for existing units.

NO_x Rates

Section 3.9.2 contains a detailed discussion of NO_x rates for existing units.

Mercury Emission Modification Factors (EMF)

Mercury EMF refers to the ratio of mercury emissions (mercury outlet) to the mercury content of the fuel (mercury inlet). Section 5.4.2 contains a detailed discussion of the EMF assumptions in EPA Base Case v.5.13.

4.2.8 Life Extension Costs for Existing Units

The modeling time horizon in EPA Base Case 5.13 extends to 2050 and covers a period of almost 40 years. This time horizon requires consideration in EPA Base Case v.5.13 of investments, beyond routine maintenance, necessary to extend the life of existing units. The life extension costs for units with retirement options are summarized in Table 4-10 below. These costs were based on a review of FERC Form 1 data regarding reported annual capital expenditures made by older units.

Table 4-10 Life Extension Cost Assumptions Used in EPA Base Case v.5.13

Plant Type	Lifespan without Life Extension Expenditures	Life Extension Cost as Proportion of New Unit Capital Cost (%)	Capital Cost of New Unit (2011$/kW)	Life Extension Cost (2011$/kW)
Biomass - Fluidized Bed	40	6.6%	4,429	291
Coal Steam	40	7.0%	3,160	221
Combined Cycle	30	9.3%	1,047	98
Combustion Turbine & IC Engine	30	4.2%	691	29
Oil/Gas Steam	40	3.4%	2,923	98
IGCC	40	7.4%	3,254	241
Nuclear	40	9.0%	6,168	555
Landfill Gas	20	9.1%	9,023	823

Notes:
Life extension expenditures double the lifespan of the unit.

4.3 Planned-Committed Units

EPA Base Case v.5.13 includes all planned-committed units that are likely to come online because ground has been broken, financing obtained, or other demonstrable factors indicate a high probability that the unit will be built before 2016.

4.3.1 Population and Model Plant Aggregation

Like existing units, planned-committed units are contained in NEEDS. A comprehensive update of planned-committed units contained in NEEDS was performed for EPA Base Case v.5.13 using the information sources listed in Table 4-1. Table 4-11 summarizes the extent of inventory of planned-committed units in EPA Base Case v.5.13 indicating its generating capacity by unit types.

Table 4-11 Summary of Planned-Committed Units in NEEDS v.5.13 for EPA Base Case v.5.13

Type	Capacity (MW)	Year Range Described
Renewables/Non-conventional		
Biomass	901	2011 - 2015
Fuel Cell	33	2011 - 2015
Geothermal	332	2011 - 2016
Hydro	689	2011 - 2015
Landfill Gas	576	2011 - 2015
Municipal Solid Waste	119	2011 - 2015
Non-Fossil Waste	254	2011 - 2015
Pumped Storage	40	2015 - 2015
Solar PV	5,262	2011 - 2015
Solar Thermal	1,777	2012 - 2015
Wind	18,951	2011 - 2015
Subtotal	28,933	

Type	Capacity (MW)	Year Range Described
Fossil/Conventional		
Coal Steam	9,498	2011 - 2015
Combined Cycle	18,597	2011 - 2015
Combustion Turbine	8,899	2011 - 2015
Fossil Waste	40	2015 - 2015
IGCC	1,168	2012 - 2014
Nuclear	5,522	2015 - 2018
O/G Steam	4	2015 - 2015
Subtotal	44,528	
Grand Total	72,661	

Due to data confidentiality restrictions, NEEDS v.5.13 does not list the planned-committed units on a unit-by-unit basis. Rather, all units having similar technologies and located within the same model region are aggregated together as one record. Table 4-12 gives a breakdown of planned-committed units by IPM region, unit type, number of units, and capacity included in EPA Base Case v.5.13.

Table 4-12 Planned-Committed Units by Model Region in NEEDS v.5.13 for EPA Base Case v.5.13

IPM Region	Plant Type	Capacity (MW)
ERC_REST	Biomass	144
	Coal Steam	2,869
	Combined Cycle	620
	Combustion Turbine	166
	Hydro	0.19
	Landfill Gas	15
	Non-Fossil Waste	4
	Solar PV	78
	Wind	311
ERC_WEST	Wind	585
FRCC	Biomass	110
	Combined Cycle	2,388
	Combustion Turbine	465
	Landfill Gas	10
	Non-Fossil Waste	15
	Solar PV	74
MAP_WAUE	Combustion Turbine	60
	Wind	102
MIS_IA	Combustion Turbine	5
	Wind	460
MIS_IL	Biomass	15
	Coal Steam	1,600
	Combustion Turbine	20
	Wind	415
MIS_INKY	Hydro	162
	IGCC	586
	Landfill Gas	6
	Non-Fossil Waste	4
	Solar PV	17
MIS_LMI	Landfill Gas	26
	Non-Fossil Waste	4
	Solar PV	1
	Wind	391

IPM Region	Plant Type	Capacity (MW)
MIS_MAPP	Coal Steam	99
	Geothermal	23
	Non-Fossil Waste	6
	Solar PV	0
	Wind	431
MIS_MIDA	Wind	956
MIS_MNWI	Combined Cycle	300
	Combustion Turbine	5
	Hydro	10
	Landfill Gas	2
	Non-Fossil Waste	6
	Wind	807
MIS_MO	Combustion Turbine	6
	Landfill Gas	15
	Non-Fossil Waste	3
MIS_WUMS	Biomass	57
	Coal Steam	615
	Combustion Turbine	58
	Landfill Gas	23
	Wind	162
NENG_CT	Combined Cycle	628
	Combustion Turbine	763
NENG_ME	Combined Cycle	25
	Hydro	2
	Landfill Gas	3
	Wind	131
NENGREST	Biomass	77
	Combustion Turbine	40
	Hydro	2
	Landfill Gas	42
	Non-Fossil Waste	1
	Solar PV	54
	Wind	288
NY_Z_A&B	Biomass	15
	Landfill Gas	5
	Wind	141
NY_Z_C&E	Combustion Turbine	2
	Landfill Gas	13
	Wind	129
NY_Z_D	Wind	21
NY_Z_F	Hydro	2
	Non-Fossil Waste	20
NY_Z_G-I	Landfill Gas	2
NY_Z_J	Combined Cycle	540
	Combustion Turbine	466
	Fuel Cell	5
NY_Z_K	Combustion Turbine	0.23
	Solar PV	75
PJM_AP	Coal Steam	700
	Combined Cycle	570
	Hydro	0.01
	Landfill Gas	10
	Solar PV	20
	Wind	253

IPM Region	Plant Type	Capacity (MW)
PJM_ATSI	Combined Cycle	666
	Fossil Waste	23
	Landfill Gas	21
	Non-Fossil Waste	135
	Solar PV	19
	Wind	5
PJM_COMD	Biomass	55
	Landfill Gas	7
	Solar PV	23
	Wind	996
PJM_Dom	Biomass	50
	Combined Cycle	589
	Combustion Turbine	52
	Landfill Gas	42
	Solar PV	31
PJM_EMAC	Biomass	30
	Combined Cycle	545
	Combustion Turbine	990
	Hydro	137
	Landfill Gas	32
	Non-Fossil Waste	1
	Solar PV	431
	Wind	5
PJM_PENE	Biomass	1
	Combustion Turbine	2
	Landfill Gas	7
	O/G Steam	4
	Wind	511
PJM_SMAC	Biomass	4
	Combustion Turbine	5
	Landfill Gas	5
	Solar PV	7
PJM_West	Coal Steam	585
	Combined Cycle	539
	Hydro	47
	Landfill Gas	14
	Non-Fossil Waste	3
	Solar PV	3
	Wind	806
PJM_WMAC	Biomass	30
	Combined Cycle	100
	Combustion Turbine	10
	Landfill Gas	16
	Solar PV	27
	Wind	69
S_C_KY	Coal Steam	732
	Hydro	105
	Landfill Gas	2
S_C_TVA	Biomass	13
	Combined Cycle	878
	Hydro	66
	IGCC	582
	Landfill Gas	8
	Nuclear	1,122
	Solar PV	23

IPM Region	Plant Type	Capacity (MW)
S_D_AMSO	Municipal Solid Waste	115
S_D_N_AR	Combined Cycle	495
S_D_WOTA	Hydro	24
S_SOU	Biomass	122
	Combined Cycle	2,552
	Landfill Gas	18
	Non-Fossil Waste	2
	Nuclear	2,200
	Solar PV	3
S_VACA	Biomass	58
	Coal Steam	800
	Combined Cycle	4,203
	Combustion Turbine	727
	Hydro	33
	Landfill Gas	73
	Municipal Solid Waste	2
	Non-Fossil Waste	2
	Nuclear	2,200
	Solar PV	124
SPP_N	Coal Steam	279
	Hydro	5
	Landfill Gas	3
	Municipal Solid Waste	2
	Solar PV	0.09
	Wind	1,274
SPP_NEBR	Coal Steam	220
	Wind	244
SPP_SE	Combustion Turbine	33
	Non-Fossil Waste	21
SPP_SPS	Combustion Turbine	507
	Solar PV	55
	Wind	458
SPP_WEST	Coal Steam	609
	Combustion Turbine	20
	Hydro	20
	Wind	1,673
WEC_CALN	Biomass	21
	Combined Cycle	1,240
	Combustion Turbine	1,252
	Fuel Cell	3
	Hydro	8
	Landfill Gas	3
	Non-Fossil Waste	9
	Solar PV	1,057
	Solar Thermal	30
	Wind	468
WEC_LADW	Combined Cycle	560
	Combustion Turbine	1,133
	Fuel Cell	1
	Solar PV	178
WEC_SDGE	Biomass	2
	Combustion Turbine	38
	Fuel Cell	6
	Pumped Storage	40
	Solar PV	35

IPM Region	Plant Type	Capacity (MW)
WECC_AZ	Combustion Turbine	516
	Landfill Gas	6
	Non-Fossil Waste	0.15
	Solar PV	1,153
	Solar Thermal	250
	Wind	109
WECC_CO	Combined Cycle	200
	Combustion Turbine	200
	Hydro	8
	Landfill Gas	8
	Solar PV	89
	Solar Thermal	1
	Wind	546
WECC_ID	Combined Cycle	299
	Hydro	4
	Non-Fossil Waste	10
	Solar PV	10
	Wind	593
WECC_IID	Combined Cycle	94
	Geothermal	92
	Solar PV	249
WECC_MT	Biomass	12
	Combustion Turbine	172
	Hydro	13
	Landfill Gas	2
	Wind	221
WECC_NM	Combined Cycle	142
	Fossil Waste	17
	Geothermal	10
	Hydro	3
	Solar PV	75
	Solar Thermal	1
	Wind	50
WECC_NNV	Combustion Turbine	1
	Geothermal	138
	Landfill Gas	6
	Solar PV	3
	Solar Thermal	110
	Wind	150
WECC_PNW	Biomass	86
	Geothermal	30
	Hydro	39
	Landfill Gas	83
	Non-Fossil Waste	10
	Solar PV	10
	Wind	3,057
WECC_SCE	Combustion Turbine	1,158
	Fuel Cell	5
	Landfill Gas	37
	Solar PV	1,185
	Solar Thermal	1,385
	Wind	2,027
WECC_SF	Fuel Cell	13

IPM Region	Plant Type	Capacity (MW)
WECC_SNV	Combined Cycle Landfill Gas Solar PV	424 11 155
WECC_UT	Combustion Turbine Geothermal Wind	28 40 104
WECC_WY	Coal Steam Wind	390 2

Note:
Any unit in NEEDS v.5.13 that has an online year of 2011 or later was considered a Planned and Committed Unit

4.3.2 Capacity

The capacity of planned-committed units in NEEDS v.5.13 was obtained from the information sources reported above in Table 4-1.

4.3.3 State and Model Region

State location data for the planned-committed units in NEEDS v.5.13 came from the information sources noted in Section 4.3.1. The state information was then used to assign planned-committed units to their respective model regions.

4.3.4 Online and Retirement Year

As noted above, planned-committed units included in NEEDS v.5.13 are only those units which are likely to come on-line before 2016. All planned-committed units were given a default online year of 2015 since 2016 is the first analysis year in EPA Base Case v.5.13.

4.3.5 Unit Configuration, Cost and Performance

All planned-committed units in NEEDS v.5.13 assume the cost, performance, and unit configuration characteristics of potential units that are available in 2015. A detailed description of potential unit assumptions is provided below in Section 4.4.

4.4 Potential Units

The EPA Base Case v.5.13 includes options for developing a variety of potential units that may be “built” at a future date in response to electricity demand and the constraints represented in the model. Defined by region, technology, and the year available, potential units with an initial capacity of 0 MW are inputs into IPM. When the model is run, the capacity of certain potential units is raised from zero to meet demand and other system and operating constraints. This results in the model’s projection of new capacity.

In Table 4-7 the block labeled “New Units” gives a breakdown of the type and number of potential units provided in EPA Base Case v.5.13. The following sections describe the cost and performance assumptions for the potential units represented in the EPA Base Case v.5.13.

4.4.1 Methodology Used to Derive the Cost and Performance Characteristics of Conventional Potential Units

The cost and performance characteristics of conventional potential units in EPA Base Case v.5.13 are derived primarily from assumptions used in the Annual Energy Outlook (AEO) 2013 published by the U.S. Department of Energy's Energy Information Administration. The capital costs for IGCC and IGCC+CCS technologies in Table 4-13 are derived from a recently updated study[21] by DOE's National Energy Technology Laboratory (NETL).

4.4.2 Cost and Performance for Potential Conventional Units

EPA's assumed cost and performance characteristics for potential conventional units are shown in Table 4-13. The cost and performance assumptions are based on the size (i.e., net electrical generating capacity in MW) indicated in the table. However, the total new capacity that is added in a given model run for these technologies is not restricted to these capacity levels.

This table includes several components of cost. The total installed cost of developing and building a new plant is captured through the capital cost. It includes expenditures on pollution control equipment that new units are assumed to install to satisfy air regulatory requirements. The capital costs shown in Table 4-13 are typically referred to as "overnight" capital costs. They include engineering, procurement, construction, startup, and owner's costs (for such items as land, cooling infrastructure, administration and associated buildings, site works, switchyards, project management, licenses, etc). The capital costs in Table 4-13 do not include interest during construction (IDC). IDC is added to the capital costs shown in Table 4-13 during the set-up of an IPM run. Calculation of IDC is based on the construction profile and the discount rate. Details on the discount rates used in the EPA Base Case v.5.13 are discussed in Chapter 8 under financial assumptions.

Table 4-13 also shows fixed operating and maintenance (FOM) and variable operating and maintenance (VOM) components of cost. FOM is the annual cost of maintaining a generating unit. It represents expenses incurred regardless of the extent that the unit is run. It is expressed in units of $ per kW per year. VOM represents the non-fuel costs incurred in running an electric generating unit. It is proportional to the electrical energy produced and is expressed in units of $ per MWh.

In addition to the three components of cost, Table 4-13 indicates the first run year available, lead time, vintage periods, heat rate, and availability for each type of unit. Lead time represents the construction time needed for a unit to come online. Vintage periods are used to capture the cost and performance improvements resulting from technological advancement and learning-by-doing. Mature technologies and technologies whose first year available is not at the start of the modeling time horizon may have only one vintage period, whereas newer technologies may have several vintage periods. Heat rate indicates the efficiency of the unit and is expressed in units of energy consumed (Btus) per unit of electricity generated (kWh). Availability indicates the percentage of time that a generating unit is available to provide electricity to the grid once it has come on line. Availability takes into account estimates of the time consumed by planned maintenance and forced outages. The emission characteristics of the potential units are not presented in Table 4-13, but can be found in Table 3-12.

4.4.3 Short-Term Capital Cost Adder

In addition to the capital costs shown in Table 4-13 and

[21] http://www.netl.doe.gov/energy-analyses/pubs/BaselineCostUpdate.pdf.

Table 4-16 EPA Base Case v.5.13 includes a short-term capital cost adder that kicks in if the new capacity deployed in a specific model run year exceeds certain upper bounds. This adder is meant to reflect the added cost incurred due to short-term competition for scarce labor and materials. Table 4-14 shows the cost adders for each type of potential unit for model run years through 2030. The adder is not imposed after 2030 on the premise that by that time market adjustments in anticipation of such longer-term deployment patterns will have eliminated the short term scarcity experienced in earlier years.

The column labeled "Step 1" in Table 4-14 indicates the total amount of capacity of a particular plant type that can be built in a given model run year without incurring a cost adder. However, if the Step 1 upper bound is exceeded, then either the Step 2 or Step 3 cost adder is incurred. Above the Step 1 upper bound, the Step 2 cost adder applies until the cumulative capacity exceeds the Step 1 + Step 2 upper bound. Beyond that point, the Step 3 capital cost adder applies. For example, the Step 1 upper bound in 2016 for coal steam potential units is 6,913 MW. If no more than this total new coal steam capacity is built in 2016, only the capital cost shown in Table 4-13 is incurred. Between 6,913 and 11,522 MW (the sum of the Step 1 and Step 2 upper bounds, i.e., 6,913 MW + 4,609 MW = 11,522 MW), the Step 2 cost adder of $916/kW applies. For all the new coal capacity built in that model run year (not just the increment of new capacity above the Step 1 upper bound of 6,913 MW), this extra cost is added to the capital cost shown in Table 4-13. If the total new coal steam capacity exceeds the Step 1 + Step 2 upper bound of 11,522 MW, then the Step 3 capacity adder of $2,370/kW is incurred.

The short-term capital cost adders shown in Table 4-14 were derived from AEO assumptions.

4.4.4 Regional Cost Adjustment

The capital costs reported in Table 4-14 are generic. Before EPA implements these capital cost values values they are converted to region-specific costs. This is done through the application of regional cost cost adjustment factors which capture regional differences in labor, material, and construction costs and and ambient conditions. The regional adjustment factors used in EPA Base Case v.5.13 are shown in in Table 4-15. They were developed from AEO 2013 by multiplying the regional and ambient multipliers and are applied to both conventional technologies shown in Table 4-13 and renewable and non-conventional technologies shown in

- Table 4-16 below.

Table 4-13 Performance and Unit Cost Assumptions for Potential (New) Capacity from Conventional Technologies in EPA Base Case v.5.13

	Advanced Combined Cycle	Advanced Combustion Turbine	Nuclear	Integrated Gasification Combined Cycle	Integrated Gasification Combined Cycle with Carbon Sequestration	Supercritical Pulverized Coal
Size (MW)	400	210	2236	600	520	1300
First Run Year Available	2016	2016	2020	2018	2020	2018
Lead Time (Years)	3	2	6	4	4	4
Availability	87%	92%	90%	85%	85%	85%
Vintage #1 (2016-2054)						
Heat Rate (Btu/kWh)	6,430	9,750	10,452	8,700	10,700	8,800
Capital (2011$/kW)	1,006	664	5,429	2,969	4,086	2,883
Fixed O&M (2011$/kW/yr)	15.1	6.9	91.7	62.3	70.6	30.6
Variable O&M (2011$/MWh)	3.2	10.2	2.1	7.2	8.2	4.4

Notes:
[a] Capital cost represents overnight capital cost.

Table 4-14 Short-Term Capital Cost Adders for New Power Plants in EPA Base Case v.5.13 (2011$)

ID #	Plant Type		2016			2018			2020			2025			2030		
			Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
1	Biomass	Upper Bound (MW)	600	400	-	1,200	800	-	1,200	800	-	3,000	2,000	-	3,000	2,000	-
		Adder ($/kW)	-	1,285	3,322	-	1,285	3,322	-	1,285	3,322	-	1,285	3,322	-	1,285	3,322
2	Coal Steam	Upper Bound (MW)	6,913	4,609	-	13,826	9,218	-	13,826	9,218	-	34,566	23,044	-	34,566	23,044	-
		Adder ($/kW)	-	916	2,370	-	916	2,370	-	916	2,370	-	916	2,370	-	916	2,370
3	Combined Cycle	Upper Bound (MW)	46,157	30,771	-	92,314	61,542	-	92,314	61,542	-	230,784	153,856	-	230,784	153,856	-
		Adder ($/kW)	-	313	809	-	313	809	-	313	809	-	313	809	-	313	809
4	Combustion Turbine	Upper Bound (MW)	23,668	15,778	-	47,335	31,557	-	47,335	31,557	-	118,338	78,892	-	118,338	78,892	-
		Adder ($/kW)	-	200	518	-	200	518	-	200	518	-	200	518	-	200	518
5	Fuel Cell	Upper Bound (MW)	600	400	-	1,200	800	-	1,200	800	-	3,000	2,000	-	3,000	2,000	-
		Adder ($/kW)	-	2,215	5,727	-	2,215	5,727	-	2,215	5,727	-	2,215	5,727	-	2,215	5,727
6	Geothermal	Upper Bound (MW)	205	137	-	410	274	-	410	274	-	1,026	684	-	1,026	684	-
		Adder ($/kW)	-	2,268	5,865	-	2,268	5,865	-	2,268	5,865	-	2,268	5,865	-	2,268	5,865

ID #	Plant Type		2016			2018			2020			2025			2030		
			Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
7	IGCC and Advanced Coal with Carbon Capture	Upper Bound (MW)	2,400	1,600	-	4,800	3,200	-	4,800	3,200	-	12,000	8,000	-	12,000	8,000	-
		Adder ($/kW)	-	944	2,441	-	944	2,441	-	944	2,441	-	944	2,441	-	944	2,441
8	Landfill Gas	Upper Bound (MW)	600	400	-	1,200	800	-	1,200	800	-	3,000	2,000	-	3,000	2,000	-
		Adder ($/kW)	-	2,669	6,904	-	2,669	6,904	-	2,669	6,904	-	2,669	6,904	-	2,669	6,904
9	Nuclear	Upper Bound (MW)	11,244	7,496	-	22,488	14,992	-	22,488	14,992	-	56,220	37,480	-	56,220	37,480	-
		Adder ($/kW)	-	1,789	4,626	-	1,789	4,626	-	1,789	4,626	-	1,789	4,626	-	1,789	4,626
10	Solar Thermal	Upper Bound (MW)	90	60	-	180	120	-	180	120	-	450	300	-	450	300	-
		Adder ($/kW)	-	1,439	3,722	-	1,439	3,722	-	1,439	3,722	-	1,439	3,722	-	1,439	3,722
11	Solar PV	Upper Bound (MW)	286	190	-	571	381	-	571	381	-	1,428	952	-	1,428	952	-
		Adder ($/kW)	-	1,025	2,651	-	1,025	2,651	-	1,025	2,651	-	1,025	2,651	-	1,025	2,651
12	Onshore Wind	Upper Bound (MW)	11,618	7,746	-	23,237	15,491	-	23,237	15,491	-	58,092	38,728	-	58,092	38,728	-
		Adder ($/kW)	-	694	1,794	-	694	1,794	-	694	1,794	-	694	1,794	-	694	1,794
13	Offshore Wind	Upper Bound (MW)	600	400	-	1,200	800	-	1,200	800	-	3,000	2,000	-	3,000	2,000	-
		Adder ($/kW)	-	2,256	5,833	-	2,256	5,833	-	2,256	5,833	-	2,256	5,833	-	2,256	5,833

Table 4-15 Regional Cost Adjustment Factors for Conventional and Renewable Generating Technologies in EPA Base Case v.5.13

Model Region	Pulverized Coal	Integrated Gasification Combined Cycle	Integrated Gasification Combined Cycle with Carbon Capture	Advanced Combustion Turbine	Advanced Combined Cycle	Fuel Cell	Advanced Nuclear	Biomass	Geothermal	Landfill Gas	Onshore Wind	Offshore Wind	Solar Thermal	Solar Photovoltaic
ERC_REST	0.905	0.943	0.959	0.985	0.954	0.963	0.960	0.925	1.000	0.927	0.952	0.918	0.858	0.871
ERC_WEST	0.905	0.943	0.959	0.985	0.954	0.963	0.960	0.925	1.000	0.927	0.952	0.918	0.858	0.871
FRCC	0.921	0.961	0.981	0.977	0.959	0.972	0.966	0.940	1.000	0.944	0.963	1.000	0.891	0.901
MIS_MAPP	0.952	0.956	0.956	0.994	0.971	0.981	0.980	0.961	1.000	0.964	1.032	1.008	0.953	0.954
MAP_WAUE	0.952	0.956	0.956	0.994	0.971	0.981	0.980	0.961	1.000	0.964	1.032	1.008	0.953	0.954
MIS_IL	1.072	1.067	1.052	1.057	1.059	1.017	1.028	1.029	1.000	1.030	1.036	1.000	1.057	1.051
MIS_INKY	1.049	1.056	1.042	1.078	1.061	1.001	1.029	1.017	1.000	1.000	1.019	1.011	1.000	0.999
MIS_IA	0.952	0.956	0.956	0.994	0.971	0.981	0.980	0.961	1.000	0.964	1.032	1.008	0.953	0.954
MIS_MIDA	0.952	0.956	0.956	0.994	0.971	0.981	0.980	0.961	1.000	0.964	1.032	1.008	0.953	0.954

Model Region	Pulverized Coal	Integrated Gasification Combined Cycle	Integrated Gasification Combined Cycle with Carbon Capture	Advanced Combustion Turbine	Advanced Combined Cycle	Fuel Cell	Advanced Nuclear	Biomass	Geothermal	Landfill Gas	Onshore Wind	Offshore Wind	Solar Thermal	Solar Photovoltaic
MIS_LMI	0.980	0.968	0.959	0.992	0.978	0.994	0.992	0.982	1.000	0.985	0.998	0.981	0.965	0.968
MIS_MO	1.072	1.067	1.052	1.057	1.059	1.017	1.028	1.029	1.000	1.030	1.036	1.000	1.057	1.051
MIS_WUMS	1.049	1.042	1.021	1.057	1.040	1.001	1.029	1.017	1.000	1.000	1.019	1.011	1.000	0.999
MIS_MNWI	0.952	0.956	0.956	0.994	0.971	0.981	0.980	0.961	1.000	0.964	1.032	1.008	0.953	0.954
NENG_CT	1.096	1.056	1.008	1.147	1.105	1.009	1.054	1.038	1.000	1.016	1.058	1.031	1.035	1.028
NENGREST	1.096	1.056	1.008	1.147	1.105	1.009	1.054	1.038	1.000	1.016	1.058	1.031	1.035	1.028
NENG_ME	1.096	1.056	1.008	1.147	1.105	1.009	1.054	1.038	1.000	1.016	1.058	1.031	1.035	1.028
NY_Z_C&E	1.107	1.071	1.012	1.180	1.119	0.996	1.067	1.034	1.000	0.996	1.008	0.988	0.976	0.977
NY_Z_F	1.107	1.071	1.012	1.180	1.119	0.996	1.067	1.034	1.000	0.996	1.008	0.988	0.976	0.977
NY_Z_G-I	1.107	1.071	1.012	1.180	1.119	0.996	1.067	1.034	1.000	0.996	1.008	0.988	0.976	0.977
NY_Z_J	1.326	1.267	1.243	1.651	1.631	1.141	1.136	1.246	1.000	1.263	1.246	1.294	1.501	1.449
NY_Z_K	1.326	1.267	1.243	1.651	1.631	1.141	1.136	1.246	1.000	1.263	1.246	1.294	1.501	1.449
NY_Z_A&B	1.107	1.071	1.012	1.180	1.119	0.996	1.067	1.034	1.000	0.996	1.008	0.988	0.976	0.977
NY_Z_D	1.107	1.071	1.012	1.180	1.119	0.996	1.067	1.034	1.000	0.996	1.008	0.988	0.976	0.977
PJM_WMAC	1.152	1.123	1.068	1.232	1.184	1.018	1.085	1.070	1.000	1.034	1.048	1.026	1.055	1.048
PJM_EMAC	1.152	1.123	1.068	1.232	1.184	1.018	1.085	1.070	1.000	1.034	1.048	1.026	1.055	1.048
PJM_SMAC	1.152	1.123	1.068	1.232	1.184	1.018	1.085	1.070	1.000	1.034	1.048	1.026	1.055	1.048
PJM_West	1.049	1.042	1.021	1.057	1.040	1.001	1.029	1.017	1.000	1.000	1.019	1.011	1.000	0.999
PJM_AP	1.049	1.042	1.021	1.057	1.040	1.001	1.029	1.017	1.000	1.000	1.019	1.011	1.000	0.999
PJM_COMD	1.049	1.042	1.021	1.057	1.040	1.001	1.029	1.017	1.000	1.000	1.019	1.011	1.000	0.999
PJM_ATSI	1.049	1.042	1.021	1.057	1.040	1.001	1.029	1.017	1.000	1.000	1.019	1.011	1.000	0.999
PJM_Dom	0.885	0.925	0.932	0.959	0.918	0.956	0.954	0.906	1.000	0.911	0.947	0.921	0.824	0.841
PJM_PENE	1.152	1.123	1.068	1.232	1.184	1.018	1.085	1.070	1.000	1.034	1.048	1.026	1.055	1.048
S_VACA	0.885	0.925	0.932	0.959	0.918	0.956	0.954	0.906	1.000	0.911	0.947	0.921	0.824	0.841
S_C_KY	0.927	0.948	0.954	0.970	0.944	0.970	0.968	0.938	1.000	0.940	0.963	1.000	0.883	0.894
S_C_TVA	0.927	0.948	0.954	0.970	0.944	0.970	0.968	0.938	1.000	0.940	0.963	1.000	0.883	0.894
S_SOU	0.919	0.957	0.973	1.011	0.979	0.969	0.964	0.933	1.000	0.937	0.961	0.930	0.877	0.888
S_D_WOTA	0.917	0.950	0.962	0.993	0.964	0.969	0.965	0.933	1.000	0.941	0.962	1.000	0.879	0.890

Model Region	Pulverized Coal	Integrated Gasification Combined Cycle	Integrated Gasification Combined Cycle with Carbon Capture	Advanced Combustion Turbine	Advanced Combined Cycle	Fuel Cell	Advanced Nuclear	Biomass	Geothermal	Landfill Gas	Onshore Wind	Offshore Wind	Solar Thermal	Solar Photovoltaic
S_D_AMSO	0.917	0.950	0.962	0.993	0.964	0.969	0.965	0.933	1.000	0.941	0.962	1.000	0.879	0.890
S_D_N_AR	0.917	0.950	0.962	0.993	0.964	0.969	0.965	0.933	1.000	0.941	0.962	1.000	0.879	0.890
S_D_REST	0.917	0.950	0.962	0.993	0.964	0.969	0.965	0.933	1.000	0.941	0.962	1.000	0.879	0.890
SPP_NEBR	0.952	0.956	0.956	0.994	0.971	0.981	0.980	0.961	1.000	0.964	1.032	1.008	0.953	0.954
SPP_N	1.072	1.082	1.073	1.078	1.080	1.017	1.028	1.029	1.000	1.030	1.036	1.000	1.057	1.051
SPP_SE	0.980	1.002	1.007	1.032	1.016	0.991	0.992	0.979	1.000	0.982	1.018	1.000	0.974	0.974
SPP_WEST	0.980	1.007	1.014	1.039	1.024	0.991	0.992	0.979	1.000	0.982	1.018	1.000	0.974	0.974
SPP_SPS	0.980	1.002	1.007	1.032	1.016	0.991	0.992	0.979	1.000	0.982	1.018	1.000	0.974	0.974
WECC_ID	1.015	1.044	1.045	1.079	1.059	0.994	1.007	1.004	1.000	0.984	1.047	1.017	0.990	0.987
WECC_NNV	1.015	1.044	1.045	1.079	1.059	0.994	1.007	1.004	1.000	0.984	1.047	1.017	0.990	0.987
WECC_UT	1.015	1.044	1.045	1.079	1.059	0.994	1.007	1.004	1.000	0.984	1.047	1.017	0.990	0.987
WECC_SF	1.193	1.186	1.139	1.311	1.267	1.030	1.093	1.083	1.000	1.057	1.119	1.049	1.129	1.111
WEC_CALN	1.193	1.186	1.139	1.311	1.267	1.030	1.093	1.083	1.000	1.057	1.119	1.049	1.129	1.111
WECC_IID	1.000	1.092	1.135	1.188	1.166	0.995	1.001	1.000	1.000	0.988	1.035	1.000	0.993	0.991
WEC_LADW	1.193	1.186	1.139	1.311	1.267	1.030	1.093	1.083	1.000	1.057	1.119	1.049	1.129	1.111
WEC_SDGE	1.193	1.186	1.139	1.311	1.267	1.030	1.093	1.083	1.000	1.057	1.119	1.049	1.129	1.111
WECC_SCE	1.193	1.186	1.139	1.311	1.267	1.030	1.093	1.083	1.000	1.057	1.119	1.049	1.129	1.111
WECC_MT	1.015	1.044	1.045	1.079	1.059	0.994	1.007	1.004	1.000	0.984	1.047	1.017	0.990	0.987
WECC_PNW	1.015	1.044	1.045	1.079	1.059	0.994	1.007	1.004	1.000	0.984	1.047	1.017	0.990	0.987
WECC_CO	0.989	1.103	1.142	1.239	1.185	0.976	1.005	0.973	1.000	0.954	1.033	1.000	0.929	0.931
WECC_WY	1.015	1.126	1.174	1.239	1.190	0.994	1.007	1.004	1.000	0.984	1.047	1.017	0.990	0.987
WECC_AZ	1.000	1.092	1.135	1.188	1.166	0.995	1.001	1.000	1.000	0.988	1.035	1.000	0.993	0.991
WECC_NM	1.000	1.092	1.135	1.188	1.166	0.995	1.001	1.000	1.000	0.988	1.035	1.000	0.993	0.991
WECC_SNV	1.000	1.092	1.135	1.188	1.166	0.995	1.001	1.000	1.000	0.988	1.035	1.000	0.993	0.991

Table 4-16 Performance and Unit Cost Assumptions for Potential (New) Renewable and Non-Conventional Technology Capacity in EPA Base Case v.5.13

	Biomass-Bubbling Fluidized Bed (BFB)	Geothermal	Landfill Gas			Fuel Cells	Solar Photovoltaic	Solar Thermal	Onshore Wind	Offshore Wind
			LGHI	LGLo	LGVLo					
Size (MW)	50	50	50			10	150	100	100	400
First Run Year Available	2018	2018	2016			2016	2016	2016	2016	2018
Lead Time (Years)	4	4	3			3	2	3	3	4
Availability	83%	87%	90%			87%	90%	90%	95%	95%
Generation Capability	Economic Dispatch	Economic Dispatch	Economic Dispatch			Economic Dispatch	Generation Profile	Generation Profile	Generation Profile	Generation Profile
	Vintage #1 (2016-2054)					**Vintage #1 (2016)**				
Heat Rate (Btu/kWh)	13,500	30,000	13,648	13,648	13,648	9,246	9,756	9,756	9,756	9,756
Capital (2011$/kW)	4,041	1,187 - 15,752	8,408	10,594	16,312	7,117	3,364	4,690	2,258	6,298
Fixed O&M (2011$/kW/yr)	103.79	50 - 541	381.74	381.74	381.74	357.47	21.37	66.09	38.86	72.71
Variable O&M (2011$/MWh)	5.17	0.00	8.51	8.51	8.51	0.0	0.0	0.0	0.0	0.0
						Vintage #2 (2018)				
Heat Rate (Btu/kWh)						8,738	9,756	9,756	9,756	9,756
Capital (2011$/kW)						6995	3,281	4,636	2,250	6233
Fixed O&M (2011$/kW/yr)						357.5	21.4	66.1	38.9	72.7
Variable O&M (2011$/MWh)						0.0	0.0	0.0	0.0	0.0
						Vintage #3 (2020)				
Heat Rate (Btu/kWh)						8,230	9,756	9,756	9,756	9,756
Capital (2011$/kW)						6806	3,217	4,594	2,220	6108
Fixed O&M (2011$/kW/yr)						357.5	21.4	66.1	38.9	72.7
Variable O&M (2011$/MWh)						0.0	0.0	0.0	0.0	0.0
						Vintage #4 (2025)				
Heat Rate (Btu/kWh)						6,960	9,756	9,756	9,756	9,756
Capital (2011$/kW)						6276	3,027	4,470	2,123	5739
Fixed O&M (2011$/kW/yr)						357.5	21.4	66.1	38.9	72.7
Variable O&M (2011$/MWh)						0.0	0.0	0.0	0.0	0.0
						Vintage #5 (2030)				
Heat Rate (Btu/kWh)						6,960	9,756	9,756	9,756	9,756
Capital (2011$/kW)						5,799	2,859	4,360	2,039	5411
Fixed O&M (2011$/kW/yr)						357.5	21.4	66.1	38.9	72.7
Variable O&M (2011$/MWh)						0.0	0.0	0.0	0.0	0.0
						Vintage #6 (2040)				

	Biomass-Bubbling Fluidized Bed (BFB)	Geothermal	Landfill Gas			Fuel Cells	Solar Photovoltaic	Solar Thermal	Onshore Wind	Offshore Wind
			LGHI	LGLo	LGVLo					
Heat Rate (Btu/kWh)						6,960	9,756	9,756	9,756	9,756
Capital (2011$/kW)						4,872	2,533	4,147	1,864	4,759
Fixed O&M (2011$/kW/yr)						357.5	21.4	66.1	38.9	72.7
Variable O&M (2011$/MWh)						0.0	0.0	0.0	0.0	0.0
						Vintage #7 (2050)				
Heat Rate (Btu/kWh)						6,960	9,756	9,756	9,756	9,756
Capital (2011$/kW)						4872	2,533	4,147	1,864	4759
Fixed O&M (2011$/kW/yr)						357.5	21.4	66.1	38.9	72.7
Variable O&M (2011$/MWh)						0.0	0.0	0.0	0.0	0.0

Notes:
[a] Assumptions for Biomass Co-firing for Coal Plants can be found in Table 5-9

4.4.5 Cost and Performance for Potential Renewable Generating and Non-Conventional Technologies

Table 4-16 summarizes the cost and performance assumptions in EPA Base Case v.5.13 for potential renewable and non-conventional technology generating units. The parameters shown in

Table 4-16 are based on AEO 2013. The size (MW) presented in

Table 4-16 represents the capacity on which unit cost estimates were developed and does not indicate the total potential capacity that the model can build of a given technology. Due to the distinctive nature of generation from renewable resources, some of the values shown in

Table 4-16 are averages or ranges that are discussed in further detail in the following subsections. Also discussed below are additional types of data from sources other than AEO 2013 that play a role in the representation of these types of generation in EPA Base Case v.5.13

It should be noted that the short term capital cost adder in Table 4-14 and the regional cost adjustment factors in Table 4-15 apply to the renewable and non-conventional generation technologies as they do to the conventional generation technologies

Wind Generation

EPA Base Case v.5.13 includes onshore wind, offshore-shallow and offshore-deep wind generation. The following sections describe four key aspects of the representation of wind generation: wind quality and resource potential, generation profiles, reserve margin contribution, and capital cost calculation.

Wind Quality and Resource Potential: EPA worked with the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL), to conduct a complete update of the wind resource assumptions for use in EPA Base Case v.5.13. The result is a complete representation of the potential onshore, offshore (shallow and deep) wind generating capacity (in MW) broken into five wind quality classes (described in greater detail below) in each IPM model region.Table 4-17, Table 4-18, and Table 4-19 present the onshore, offshore shallow and offshore deep wind resource assumptions that are used in EPA Base Case v.5.13. Wind resources in EPA Base Case v.5.13 are aggregated into five wind classes, ranging from class 3 (designated to be the least productive for wind generation) to class 7 (designated to be the most productive for wind generation).

Table 4-17 Onshore Regional Potential Wind Capacity (MW) by Wind and Cost Class in EPA Base Case v.5.13

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 3	Cost Class 5
ERC_REST	TX	3	3,091	12,363	1,236	601,483
		4	309	1,237	124	60,176
		5	52	208	21	10,112
		6	7	27	3	1,318
		7	0.061	0.244	0.024	12
ERC_WEST	TX	3	1,910	7,642	764	371,768
		4	1,215	4,860	486	236,421
		5	611	2,445	244	118,943
		6	222	890	89	43,298
		7	63	250	25	12,181
FRCC	FL	3	0.202	0.398	0.204	0.396
MAP_WAUE	MN	3	45	190	63	8,728
		4	12	52	17	2,398
	MT	3	45	190	63	8,731
		4	79	330	110	15,191
		5	25	106	35	4,869
		6	4	16	5	757
		7	0.411	2	1	79
	ND	3	19	80	27	3,662
		4	49	205	68	9,441
		5	52	220	73	10,144
		6	26	110	37	5,078
		7	1	2	1	112
	SD	3	42	175	58	8,078

IPM Region	State	Wind Class	Cost Class 1	2	3	5
		4	337	1,416	472	65,220
		5	125	526	175	24,219
		6	35	147	49	6,746
		7	14	58	19	2,658
MIS_IA	IA	3	834	3,503	1,168	161,316
		4	399	1,676	559	77,184
		5	141	593	198	27,319
		6	40	167	56	7,676
		7	1	3	1	131
	MN	3	7	31	10	1,411
		4	24	101	34	4,660
		5	37	155	52	7,149
		6	30	128	43	5,891
		7	8	35	12	1,628
MIS_IL	IL	3	10,275	25,688	14,128	78,349
		4	39	98	54	298
MIS_INKY	IN	3	8,570	19,045	17,141	50,470
		4	420	934	840	2,475
	KY	3	0.054	0.120	0.108	0.318
MIS_LMI	MI	3	1,620	10,798	10,798	30,774
		4	10	67	67	190
		5	1	3	3	10
		6	0.201	1	1	4
		7	0.102	1	1	2
MIS_MAPP	MT	3	739	3,103	1,034	142,878
		4	633	2,660	887	122,473
		5	391	1,644	548	75,689
		6	148	621	207	28,585
		7	30	126	42	5,795
	ND	3	462	1,940	647	89,326
		4	1,468	6,167	2,056	283,981
		5	1,112	4,669	1,556	215,001
		6	556	2,336	779	107,578
		7	105	440	147	20,282
	SD	3	412	1,731	577	79,691
		4	1,141	4,792	1,597	220,646
		5	1,171	4,920	1,640	226,544
		6	625	2,623	874	120,798
		7	125	525	175	24,168
MIS_MIDA	IA	3	509	2,138	713	98,454
		4	419	1,759	586	81,018
		5	333	1,398	466	64,366
		6	165	692	231	31,867
		7	5	21	7	990
	IL	3	57	241	80	11,089
		4	0.215	1	0.301	42
MIS_MNWI	MI	3	1	4	1	170
	MN	3	1,652	6,939	2,313	319,537

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 3	Cost Class 5
		4	311	1,304	435	60,052
		5	136	571	190	26,285
		6	154	648	216	29,818
		7	36	153	51	7,046
	SD	3	0.137	1	0.192	26
		4	11	45	15	2,078
		5	39	164	55	7,564
		6	35	146	49	6,702
		7	6	23	8	1,081
	WI	3	109	456	152	20,991
MIS_MO	IA	3	140	351	193	1,070
	MO	3	12,356	30,891	16,990	94,218
		4	326	814	448	2,483
		5	5	13	7	40
MIS_WUMS	MI	3	25	42	4	4,142
		4	0.214	0.356	0.036	35
		5	0.029	0.049	0.005	5
		6	0.006	0.010	0.001	1
	WI	3	494	824	82	80,959
		4	2	4	0.403	396
		5	0.259	0.432	0.043	42
		6	0.055	0.092	0.009	9
NENG_CT	CT	3	2	4	4	11
NENG_ME	ME	3	1,093	2,186	2,186	5,464
		4	60	120	120	300
		5	23	46	46	115
		6	15	30	30	75
		7	19	39	39	96
NENGREST	MA	3	75	150	150	374
		4	26	52	52	130
		5	14	27	27	68
		6	6	12	12	29
		7	5	10	10	26
	NH	3	177	354	354	886
		4	19	38	38	94
		5	9	17	17	44
		6	5	10	10	24
		7	5	10	10	24
	RI	3	4	7	7	18
		4	1	1	1	3
		5	3	5	5	13
	VT	3	248	496	496	1,239
		4	24	49	49	122
		5	10	21	21	52
		6	6	12	12	30
		7	6	12	12	31
NY_Z_A&B	NY	3	2,095	2,095	2,095	4,189
		4	4	4	4	8

IPM Region	State	Wind Class	Cost Class 1	2	3	5
NY_Z_C&E	NY	3	1,847	1,847	1,847	3,694
		4	19	19	19	38
		5	4	4	4	8
		6	2	2	2	4
		7	3	3	3	5
NY_Z_D	NY	3	570	570	570	1,139
		4	28	28	28	55
		5	8	8	8	17
		6	4	4	4	7
		7	4	4	4	7
NY_Z_F	NY	3	472	472	472	944
		4	17	17	17	34
		5	5	5	5	10
		6	3	3	3	6
		7	4	4	4	9
NY_Z_G-I	NY	3	66	66	66	132
		4	1	1	1	3
		5	1	1	1	1
		6	0.400	0.400	0.400	1
		7	0.240	0.240	0.240	0.480
NY_Z_K	NY	3	55	55	55	110
		4	12	12	12	23
		5	2	2	2	5
PJM_AP	MD	3	45	101	91	267
		4	1	1	1	4
	PA	3	52	116	105	308
		4	1	3	3	8
		5	1	1	1	3
		6	0.018	0.040	0.036	0.106
	VA	3	17	39	35	103
		4	3	7	7	19
		5	2	4	3	10
		6	0.360	1	1	2
		7	0.162	0.360	0.324	1
	WV	3	142	316	284	837
		4	14	31	28	82
		5	3	7	6	18
		6	1	2	2	6
		7	1	2	2	6
PJM_ATSI	OH	3	2,019	4,486	4,037	11,887
		4	1	2	2	7
PJM_COMD	IL	3	9,743	21,651	19,486	57,375
		4	99	220	198	583
PJM_Dom	NC	3	34	34	34	68
	VA	3	71	71	71	141
		4	5	5	5	10
		5	2	2	2	4
		6	1	1	1	1

IPM Region	State	Wind Class	Cost Class 1	2	3	5
		7	0.120	0.120	0.120	0.240
PJM_EMAC	DE	3	2	2	2	4
	MD	3	313	313	313	626
	NJ	3	51	51	51	101
	VA	3	362	362	362	724
		4	2	2	2	3
PJM_PENE	PA	3	415	415	415	831
		4	16	16	16	31
		5	2	2	2	5
		6	0.020	0.020	0.020	0.040
PJM_SMAC	MD	3	1	1	1	2
PJM_West	IN	3	4,353	9,674	8,707	25,637
	KY	3	1	3	2	7
	MI	3	202	449	404	1,191
	OH	3	2,931	6,513	5,862	17,260
	TN	3	2	4	4	11
		4	0.288	1	1	2
		5	0.108	0.240	0.216	1
	VA	3	36	80	72	212
		4	3	7	6	19
		5	1	3	3	9
		6	0.297	1	1	2
	WV	3	4	10	9	26
		4	0.387	1	1	2
		5	1	1	1	3
		6	0.414	1	1	2
		7	0.261	1	1	2
PJM_WMAC	PA	3	107	107	107	213
		4	2	2	2	3
S_C_KY	KY	3	10	10	10	19
S_C_TVA	AL	3	10	10	10	20
	GA	3	7	7	7	15
		4	0.160	0.160	0.160	0.320
	KY	3	0.200	0.200	0.200	0.400
	NC	3	31	31	31	62
		4	6	6	6	11
		5	3	3	3	5
		6	2	2	2	4
		7	1	1	1	2
	TN	3	55	55	55	110
		4	1	1	1	2
		5	1	1	1	1
		6	0.040	0.040	0.040	0.080
		7	1	1	1	1
	VA	3	0.080	0.080	0.080	0.160
S_D_AMSO	LA	3	48	192	192	529
S_D_N_AR	AR	3	38	152	152	417
		4	0.495	2	2	5

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 3	Cost Class 5
		5	0.050	0.200	0.200	1
	MO	3	49	196	196	539
S_D_REST	AR	3	0.220	1	1	2
S_D_WOTA	LA	3	10	40	40	109
	TX	3	98	392	392	1,079
S_SOU	AL	3	13	13	13	26
	GA	3	18	18	18	35
		4	1	1	1	2
S_VACA	NC	3	122	122	122	244
		4	3	3	3	5
		5	1	1	1	1
		6	1	1	1	2
		7	0.340	0.340	0.340	1
	SC	3	48	48	48	97
		4	0.040	0.040	0.040	0.080
SPP_N	KS	3	1,949	8,230	3,899	202,509
		4	2,297	9,697	4,594	238,608
		5	2,687	11,346	5,374	279,175
		6	1,426	6,021	2,852	148,161
		7	211	889	421	21,880
	MO	3	1,021	4,312	2,043	106,102
		4	6	25	12	619
SPP_NEBR	NE	3	811	3,404	1,135	156,753
		4	1,436	6,031	2,010	277,691
		5	1,412	5,930	1,977	273,063
		6	738	3,100	1,033	142,746
		7	133	559	186	25,741
SPP_SE	LA	3	0.406	2	1	55
SPP_SPS	NM	3	1,128	5,318	1,612	153,108
		4	253	1,192	361	34,322
		5	45	210	64	6,045
		6	20	95	29	2,724
		7	3	15	5	433
	OK	3	25	117	35	3,372
		4	123	580	176	16,699
		5	225	1,060	321	30,520
		6	85	398	121	11,470
		7	32	149	45	4,296
	TX	3	696	3,282	995	94,481
		4	582	2,744	831	78,989
		5	462	2,176	659	62,645
		6	663	3,126	947	90,002
		7	256	1,206	365	34,718
SPP_WEST	AR	3	58	273	83	7,859
		4	1	5	2	148
		5	0.129	1	0.184	17
		6	0.032	0.149	0.045	4
		7	0.022	0.102	0.031	3

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 3	Cost Class 5
	MO	3	0.042	0.198	0.060	6
	OK	3	2,002	9,437	2,860	271,662
		4	816	3,846	1,165	110,705
		5	240	1,131	343	32,558
		6	70	331	100	9,515
		7	6	30	9	864
	TX	3	0.099	0.465	0.141	13
WEC_CALN	CA	3	187	623	218	2,088
		4	5	18	6	59
		5	1	5	2	16
		6	1	2	1	7
		7	0.360	1	0.420	4
WEC_LADW	CA	3	111	369	129	1,235
		4	41	137	48	460
		5	7	22	8	75
		6	5	18	6	59
		7	3	12	4	39
WEC_SDGE	CA	3	55	183	64	613
		4	14	47	17	159
		5	4	13	5	44
		6	1	2	1	7
		7	0.384	1	0.448	4
WECC_AZ	AZ	3	98	392	218	10,170
		4	0.233	1	1	24
		5	0.014	0.058	0.032	1
WECC_CO	CO	3	1,071	4,284	2,678	259,744
		4	314	1,257	786	76,222
		5	145	578	361	35,052
		6	18	72	45	4,388
		7	1	5	3	307
WECC_ID	ID	3	50	451	669	15,547
		4	1	11	16	382
		5	0.323	3	4	100
		6	0.104	1	1	32
		7	0.038	0.346	1	12
WECC_IID	CA	3	26	103	57	2,674
		4	0.325	1	1	34
		5	0.015	0.061	0.034	2
WECC_MT	MT	3	1,260	11,340	16,800	390,608
		4	229	2,065	3,059	71,112
		5	60	542	803	18,673
		6	17	157	232	5,396
		7	8	76	113	2,629
WECC_NM	NM	3	1,464	5,855	3,253	152,057
		4	567	2,269	1,260	58,928
		5	365	1,460	811	37,926
		6	142	569	316	14,774
		7	27	108	60	2,802

IPM Region	State	Wind Class	Cost Class 1	2	3	5
	TX	3	219	875	486	22,725
		4	9	38	21	982
		5	2	6	4	168
		6	1	2	1	58
		7	0.326	1	1	34
WECC_NNV	NV	3	21	188	278	6,471
		4	0.456	4	6	141
		5	0.068	1	1	21
		6	0.013	0.119	0.176	4
WECC_PNW	CA	3	1	5	7	173
		4	0.036	0.324	0.480	11
		5	0.007	0.065	0.096	2
		6	0.001	0.011	0.016	0.372
	ID	3	2	15	23	527
		4	0.252	2	3	78
		5	0.123	1	2	38
		6	0.105	1	1	33
		7	0.088	1	1	27
	OR	3	76	681	1,008	23,440
		4	4	34	50	1,158
		5	1	10	15	355
		6	1	5	7	168
		7	0.355	3	5	110
	WA	3	51	462	685	15,930
		4	3	25	37	861
		5	1	7	10	238
		6	0.368	3	5	114
		7	0.241	2	3	75
WECC_SCE	CA	3	989	3,295	1,153	11,039
		4	69	229	80	768
		5	34	112	39	375
		6	15	50	18	169
		7	28	93	33	313
WECC_SF	CA	3	237	790	277	2,648
		4	28	92	32	309
		5	26	87	30	290
		6	4	12	4	39
WECC_SNV	NV	3	1	5	3	138
		4	0.004	0.014	0.008	0.374
WECC_UT	UT	3	39	350	519	12,062
		4	0.279	3	4	86
		5	0.039	0.351	1	12
		6	0.006	0.054	0.080	2
		7	0.003	0.027	0.040	1
WECC_WY	NE	4	2	22	32	745
		5	15	138	204	4,748
		6	16	146	216	5,026
		7	0.471	4	6	146

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 3	Cost Class 5
	SD	3	125	1,124	1,665	38,719
		4	38	344	510	11,863
		5	11	95	141	3,286
		6	1	13	19	447
		7	0.018	0.162	0.240	6
	WY	3	918	8,261	12,238	284,541
		4	338	3,046	4,513	104,927
		5	188	1,694	2,509	58,337
		6	114	1,027	1,521	35,370
		7	98	878	1,301	30,238

Table 4-18 Offshore Shallow Regional Potential Wind Capacity (MW) by Wind and Cost Class in EPA Base Case v.5.13

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 4
ERC_REST	TX	3	850	1,700	1,700
		4	6,423	12,846	12,846
		5	1,079	2,158	2,158
		6	2,625	5,251	5,251
FRCC	FL	3	57,921	115,842	115,842
		4	7	13	13
MIS_INKY	IN	3	63	125	125
		4	259	517	517
		5	85	169	169
MIS_LMI	MI	3	1,739	3,478	3,478
		4	3,784	7,567	7,567
		5	1,899	3,799	3,799
		6	416	831	831
MIS_MNWI	MI	3	118	236	236
		4	14	29	29
	MN	3	134	269	269
	WI	3	911	1,822	1,822
		4	141	282	282
MIS_WUMS	MI	3	2,275	4,550	4,550
		4	3,095	6,189	6,189
		5	477	953	953
		6	59	117	117
		7	92	185	185
	WI	3	525	1,049	1,049
		4	1,472	2,944	2,944
		5	737	1,473	1,473
		6	84	167	167
NENG_CT	CT	3	287	574	574
		4	162	323	323
NENG_ME	ME	3	619	1,238	1,238
		4	419	837	837
		5	166	331	331

IPM Region	State	Wind Class	Cost Class 1	2	4
		6	234	469	469
		7	16	33	33
NENGREST	MA	3	181	363	363
		4	579	1,158	1,158
		5	661	1,321	1,321
		6	2,307	4,615	4,615
		7	3,112	6,224	6,224
	NH	3	24	48	48
		4	52	103	103
		5	31	62	62
	RI	3	43	87	87
		4	89	177	177
		5	85	170	170
		6	225	449	449
NY_Z_A&B	NY	3	205	410	410
		4	1,092	2,184	2,184
		5	2	4	4
NY_Z_C&E	NY	3	249	499	499
		4	524	1,048	1,048
		5	2	5	5
NY_Z_G-I	NY	3	1	1	1
NY_Z_J	NY	3	46	93	93
		4	118	237	237
		5	4	8	8
NY_Z_K	NY	3	258	517	517
		4	881	1,763	1,763
		5	787	1,573	1,573
		6	1,533	3,067	3,067
PJM_ATSI	OH	3	173	347	347
		4	2,628	5,256	5,256
		5	1,261	2,523	2,523
PJM_COMD	IL	3	100	200	200
		4	267	534	534
		5	418	836	836
		6	2	4	4
PJM_Dom	NC	3	706	1,413	1,413
		4	2,776	5,551	5,551
		5	3,843	7,687	7,687
		6	553	1,107	1,107
	VA	3	809	1,619	1,619
		4	979	1,958	1,958
		5	1,313	2,626	2,626
		6	1	1	1
PJM_EMAC	DE	3	214	428	428
		4	1,079	2,159	2,159
		5	170	340	340
	MD	3	1,303	2,607	2,607
		4	1,696	3,392	3,392

IPM Region	State	Wind Class	Cost Class		
			1	2	4
		5	366	732	732
	NJ	3	365	729	729
		4	1,626	3,253	3,253
		5	2,981	5,962	5,962
		6	1,953	3,907	3,907
	VA	3	365	730	730
		4	3,555	7,110	7,110
		5	1,525	3,050	3,050
PJM_PENE	PA	3	23	45	45
		4	649	1,297	1,297
		5	427	853	853
PJM_SMAC	MD	3	567	1,134	1,134
		4	0.040	0.080	0.080
PJM_West	MI	3	62	123	123
		4	440	880	880
S_D_AMSO	LA	3	8,846	17,693	17,693
S_D_WOTA	LA	3	3,590	7,181	7,181
		4	586	1,172	1,172
S_SOU	TX	3	639	1,278	1,278
		4	1,145	2,290	2,290
	AL	3	1,939	3,877	3,877
	FL	3	4,827	9,654	9,654
	GA	3	5,135	10,270	10,270
		4	4,146	8,292	8,292
	MS	3	1,056	2,113	2,113
S_VACA	NC	3	1,437	2,874	2,874
		4	8,366	16,733	16,733
		5	6,468	12,935	12,935
		6	94	188	188
	SC	3	381	762	762
		4	9,932	19,864	19,864
		5	2,993	5,986	5,986
SPP_SE	LA	3	1,828	3,656	3,656
WEC_CALN	CA	3	196	391	391
		4	37	73	73
		5	11	23	23
		6	4	9	9
WEC_LADW	CA	3	10	21	21
WECC_PNW	CA	3	122	243	243
		4	43	86	86
		5	24	48	48
		6	2	4	4
	OR	3	876	1,753	1,753
		4	150	300	300
		5	46	92	92
		6	64	128	128
		7	9	18	18
	WA	3	610	1,220	1,220

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 4
		4	404	808	808
		5	1	1	1
WECC_SCE	CA	3	170	339	339
		4	55	109	109
		5	7	15	15
		6	0.080	0.160	0.160
WECC_SF	CA	3	326	652	652
		4	1	3	3

Table 4-19 Offshore Deep Regional Potential Wind Capacity (MW) by Wind and Cost Class in EPA Base Case v.5.13

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 4
ERC_REST	TX	3	10,991	21,982	21,982
		4	7,963	15,926	15,926
		5	97	194	194
FRCC	FL	3	61,964	123,927	123,927
MIS_INKY	IN	3	298	596	596
MIS_LMI	MI	3	5,068	10,136	10,136
		4	16,868	33,736	33,736
		5	259	518	518
MIS_MNWI	MI	3	464	928	928
	MN	3	4,795	9,590	9,590
	WI	3	3,608	7,216	7,216
MIS_WUMS	MI	3	9,225	18,450	18,450
		4	7,779	15,558	15,558
		5	8,557	17,114	17,114
		6	5,572	11,145	11,145
	WI	3	1,427	2,854	2,854
		4	8,953	17,906	17,906
		5	300	599	599
NENG_CT	CT	3	19	38	38
NENG_ME	ME	3	499	999	999
		4	962	1,924	1,924
		5	1,789	3,579	3,579
		6	7,377	14,755	14,755
		7	7,582	15,165	15,165
NENGREST	MA	3	279	558	558
		4	817	1,633	1,633
		5	8,923	17,845	17,845
		6	15,734	31,467	31,467
	NH	3	70	140	140
		4	369	737	737
		5	359	717	717
		6	660	1,319	1,319
	RI	3	205	411	411
		4	300	600	600

IPM Region	State	Wind Class	Cost Class 1	Cost Class 2	Cost Class 4
		5	2,624	5,248	5,248
NY_Z_A&B	NY	3	4,384	8,767	8,767
		4	37	74	74
NY_Z_C&E	NY	3	1,377	2,754	2,754
		4	0.160	0.320	0.320
NY_Z_J	NY	3	1	2	2
		4	0.240	0.480	0.480
NY_Z_K	NY	3	432	865	865
		4	981	1,963	1,963
		5	10,948	21,896	21,896
		6	69	137	137
PJM_ATSI	OH	3	4	7	7
PJM_COMD	IL	3	491	981	981
		4	1,269	2,538	2,538
PJM_Dom	NC	3	938	1,875	1,875
		4	11,658	23,316	23,316
		5	588	1,177	1,177
	VA	3	142	284	284
		4	713	1,426	1,426
PJM_EMAC	DE	3	469	938	938
		4	10	19	19
	MD	3	3,802	7,603	7,603
		4	29	58	58
	NJ	3	1,281	2,562	2,562
		4	5,085	10,171	10,171
		5	3,280	6,560	6,560
	VA	3	3,637	7,274	7,274
		4	568	1,135	1,135
PJM_PENE	PA	3	230	461	461
PJM_SMAC	MD	3	6	13	13
PJM_West	MI	3	1,462	2,925	2,925
		4	355	710	710
S_D_AMSO	LA	3	10,146	20,293	20,293
S_D_WOTA	LA	3	222	444	444
S_SOU	AL	3	3,564	7,129	7,129
	FL	3	14,264	28,527	28,527
	GA	3	2,379	4,757	4,757
	MS	3	5	10	10
S_VACA	NC	3	4,338	8,677	8,677
		4	9,454	18,909	18,909
	SC	3	7,383	14,766	14,766
		4	91	182	182
SPP_SE	LA	3	125	249	249
WEC_CALN	CA	3	12,809	25,617	25,617
		4	5,277	10,555	10,555
		5	6,043	12,087	12,087
		6	12,939	25,878	25,878
		7	3,678	7,356	7,356

IPM Region	State	Wind Class	Cost Class		
			1	2	4
WEC_LADW	CA	3	6,527	13,054	13,054
WECC_PNW	CA	3	299	598	598
		4	322	644	644
		5	469	938	938
		6	1,103	2,206	2,206
		7	1,538	3,076	3,076
	OR	3	6,530	13,061	13,061
		4	12,517	25,035	25,035
		5	3,759	7,518	7,518
		6	4,667	9,334	9,334
		7	4,598	9,197	9,197
	WA	3	6,716	13,431	13,431
		4	6,304	12,607	12,607
WECC_SCE	CA	3	17,439	34,877	34,877
		4	10,699	21,398	21,398
		5	5,028	10,056	10,056
WECC_SF	CA	3	3,883	7,766	7,766
		4	3,907	7,814	7,814
		5	4,064	8,127	8,127
		6	49	98	98

Generation Profiles: Unlike other renewable generation technologies, which dispatch on an economic basis subject to their availability constraint, wind and solar technologies can only be dispatched when the wind blows and the sun shines. To represent intermittent renewable generating sources like wind and solar, EPA Base Case v.5.13 uses generation profiles which specify hourly generation patterns for a representative day in winter and summer. Each eligible model region is provided with a distinct set of winter and summer generation profiles for wind, solar thermal and solar photovoltaic plants.

For Hour 1 through Hour 24 the generation profile indicates the amount of generation (kWh) per MW of available capacity. The wind generation profiles were prepared with data from NREL. This provided the separate winter and summer generation profiles for wind classes 3-7 for onshore and offshore (shallow and deep) generation in each IPM region. As an illustrative example, Excerpt of Table 4-20 shows the generation profile for onshore wind in model region WECC_CO. In IPM the seasonal average "kWh of generation per MW" (shown in the last row of the Excerpt of Table 4-20) is used to derive the generation from a particular wind class in a specific model region.

Excerpt of Table 4-20 Representative Wind Generation Profiles in EPA Base Case v.5.13

Illustrative Hourly Wind Generation Profile (kWh of Generation per MW of Electricity)
The complete data set in spreadsheet format can be downloaded via the link found at
www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev513.html

Winter Hour	Wind Class				
	1	2	3	4	5
01	410	483	504	521	539
02	404	478	499	517	536
03	400	474	497	514	533
04	388	462	486	504	526
05	366	439	465	485	511
06	351	423	449	471	499

Summer Hour	Wind Class				
	1	2	3	4	5
01	273	326	385	407	431
02	263	314	373	396	422
03	252	303	362	386	412
04	234	285	343	366	394
05	208	257	312	335	364
06	187	234	286	308	339

07	348	419	443	467	495
08	355	427	448	471	500
09	346	420	440	463	493
10	331	406	426	452	483
11	319	394	415	443	475
12	317	391	412	441	474
13	317	388	409	440	473
14	319	389	410	441	475
15	322	389	411	441	475
16	319	384	405	436	471
17	308	373	390	423	459
18	309	374	389	422	458
19	332	399	412	444	478
20	369	438	450	478	506
21	395	467	480	503	525
22	410	483	497	517	536
23	415	488	504	522	540
24	413	486	505	522	540
Winter Average	**357**	**428**	**448**	**472**	**500**

07	170	213	263	284	315
08	166	206	254	276	306
09	159	198	243	265	294
10	162	204	244	267	298
11	175	220	254	280	312
12	191	238	267	293	326
13	202	248	273	298	332
14	210	255	276	300	334
15	216	260	279	303	336
16	218	261	279	303	336
17	215	257	275	299	330
18	220	262	280	304	333
19	241	284	306	330	357
20	268	313	342	367	391
21	284	332	370	394	417
22	289	341	386	408	430
23	286	340	392	413	435
24	281	335	391	412	435
Summer Average	**224**	**270**	**310**	**333**	**362**

Notes:
Based on Onshore Wind in Model Region WECC_CO.
This is an example of the wind data used in EPA Base Case v.5.13

To obtain the seasonal generation for the units in a particular wind class in a specific region, one must multiply the installed capacity by the capacity factor (which represents the ratio of actual productivity in a time period to the theoretical maximum in the period). Capacity factor is the average "kWh of generation per MW" from the applicable generation profile multiplied by the number of days in the time period (i.e., summer or winter) to obtain the level of generation. The capacity factors for wind generation that are used in EPA Base Case v.5.13 were obtained from NREL and are shown in Table 4-21, Table 4-22, and.Table 4-23.

Reserve Margin Contribution (also referred to as capacity credit): EPA Base Case v.5.13 uses reserve margins, discussed in detail in Section 3.6, to model reliability. Each region has a reserve margin requirement which is used to determine the total capacity needed to reliably meet peak demand. The ability of a unit to assist a region in meeting its reliability requirements is modeled through the unit's contribution to reserve margin. If the unit has 100 percent contribution towards reserve margin, then the entire capacity of the unit is counted towards meeting the region's reserve margin requirement. However, if any unit has less than a 100 percent contribution towards reserve margin, then only the designated share of the unit's capacity counts towards the reserve margin requirement.

All units except those that depend on intermittent resources have 100% contributions toward reserve margin. This means that wind and solar have limited (less than 100 percent) contributions toward reserve margins in the EPA Base Case v.5.13.

Table 4-21, Table 4-22, and Table 4-23 present the reserve margin contributions apportioned to new wind plants in the EPA Base Case v.5.13 as derived from AEO 2012 and NREL. NREL is the source for capacity factors; AEO 2012 Reference Case outputs are used to develop a ratio of capacity factors to reserve contribution. The tables show the onshore and offshore (shallow and deep) reserve margins for each wind class.

Table 4-21 Onshore Reserve Margin Contribution an Average Capacity Factor by Wind Class

	Wind Class				
	1	**2**	**3**	**4**	**5**

Capacity Factor	30%	36%	39%	41%	44%
Reserve Margin Contribution[a]	20%	24%	26%	27%	29%

Note:
[a] Reserve Margin Contribution for ERC_REST and ERC_WEST is 8.7%.

Table 4-22 Offshore Shallow Reserve Margin Contribution an Average Capacity Factor by Wind Class

	Wind Class				
	1	**2**	**3**	**4**	**5**
Capacity Factor	31%	40%	43%	46%	50%
Reserve Margin Contribution[a]	20%	26%	28%	30%	33%

Note:
[a] Reserve Margin Contribution for ERC_REST and ERC_WEST is 8.7%.

Table 4-23 Offshore Deep Reserve Margin Contribution an Average Capacity Factor by Wind Class

	Wind Class				
	1	**2**	**3**	**4**	**5**
Capacity Factor	36%	45%	49%	51%	53%
Reserve Margin Contribution[a]	24%	30%	32%	34%	35%

Note:
[a] Reserve Margin Contribution for ERC_REST and ERC_WEST is 8.7%.

Capital cost calculation: EPA Base Case v.5.13 uses multipliers similar to the LT (long term) multipliers from the Energy Information Administration's NEMS model[22] to capture differences in the capital cost of new wind capacity caused by such factors as distance from existing transmission, terrain variability, slope and other causes of resource degradation, site accessibility challenges, population proximity, competing land uses, aesthetics, and environmental factors. Five cost classes are used in EPA Base Case v.5.13 with class 1 having the lowest cost adjustment factor (1) and class 5 having the highest adjustment factor (ranging from 2.00 to 2.50 depending on whether the wind resource is onshore, offshore shallow or offshore deep), as shown in Table 4-24. To obtain the capital cost for a particular new wind model plant, the base capital costs shown in

[22] Revising the Long Term Multipliers in NEMS: Quantifying the Incremental Transmission Costs Due to Wind Power, Report to EIA from Princeton Energy Resources International, LLC. May 2007.

Table 4-16 are multiplied by the cost adjustment factor for the wind cost class applicable to the new plant.

Table 4-24 Capital Cost Adjustment Factors for New Wind Plants in Base Case v.5.13

	Cost Class				
	1	**2**	**3**	**4**	**5**
Onshore	1	1.1	1.25	--	2.00
Offshore Deep Water	1	1.35	--	2.5	--
Offshore Shallow Water	1	1.35	--	2.5	--

Many factors figure in whether the model determines that adding wind capacity yields the greatest incremental improvement in the system-wide (least cost) solution available to the model at a particular point in the solution process. These factors include trade-offs between such items as the cost, capacity factor, reserve margin contribution, and dispatch capabilities and constraints on the new wind capacity relative to other choices. However, to perform its trade-off computations, the model requires the values described above.

As an illustrative example, Table 4-25 shows the calculations that would be performed to derive the potential electric generation, reserve margin contribution, and cost of new (potential) onshore capacity in wind class 3, cost class 2 in the WECC_CO model region in run year 2020.

Table 4-25 Example Calculations of Wind Generation Potential, Reserve Margin Contribution, and Capital Cost for Onshore Wind in WECC_CO at Wind Class 3, Cost Class 2

Required Data

Table 4-17	Potential wind capacity (C) =	578 MW
Table 4-20	Winter average generation (G_W) per available MW =	448 kWh/MW
Table 4-20	Summer average generation (G_S) per available MW =	310 kWh/MW
	Hours in Winter (H_W) season (October – April) =	5,088 hours
	Hours in Summer (H_S)season (May – September) =	3,672 hours
Table 4-21	Reserve Margin Contribution (RM) WECC_CO, Wind Class 3 =	26 percent
Table 4-16	Capital Cost (Cap_{2020}) in vintage range for year 2020 =	$2,220/kW
Table 4-24	Capital Cost Adjustment Factor ($CAF_{ON,C2}$) for onshore cost class 2 =	1.1
Table 4-15	Regional Factor (RF)	1.033

Calculations

$$\begin{aligned}
Generation\ Potential &= C \times G_W \times H_w + C \times G_S \times H_s \\
&= 578\,MW \times 448\,kWh/MW \times 5088\,hours\ + \\
&\quad 578\,MW \times 310\,kWh/MW \times 3672\,hours \\
&= 1{,}975\,GWh
\end{aligned}$$

$$\begin{aligned}
Reserve Margin Contribution &= RM \times C \\
&= 26\% \times 578\,MW \\
&= 149\,MW
\end{aligned}$$

$$\begin{aligned}
Capital\ Cost &= \mathrm{Cap}_{2020} \times \mathrm{CAF}_{ON,C2} \times RF \times C \\
&= \$2{,}220/\mathrm{kW} \times 1.1 \times 1.033 \times 578\,MW \\
&= \$1{,}458{,}055
\end{aligned}$$

Solar Generation

EPA Base Case v.5.13 includes solar PV and solar thermal generation technologies. The following sections describe four key aspects of the representation of solar generation: solar resource potential, generation profiles, reserve margin contribution, and capital cost calculation.

Solar Resource Potential: The resource potential estimates for solar PV and solar thermal technologies were developed by NREL by model region and state. These are summarized in Table 4-26 and

Table 4-27.

Table 4-26 Solar PV Regional Potential Capacity (MW) in EPA Base Case v.5.13

Model Region	State	Class					
		1	2	3	4	5	6
FRCC	FL	--	466,717	2,016,007	2	--	--
ERC_REST	TX	--	5,330,140	6,734,722	17,494	--	--
ERC_WEST	TX	--	--	4,352,761	1,172,478	1,508,010	960,326
MAP_WAUE	MN	13,256	97,901	--	--	--	--
	MT	--	177,744	--	--	--	--
	ND	--	248,206	--	--	--	--
	SD	--	991,602	--	--	--	--
MIS_IA	IA	846	2,792,414	--	--	--	--
	MN	--	205,901	--	--	--	--
MIS_IL	IL	--	3,840,608	--	--	--	--
MIS_INKY	IN	11,692	2,660,403	--	--	--	--
	KY	--	454,286	--	--	--	--
MIS_LMI	MI	1,187,823	1,910,779	--	--	--	--
MIS_MAPP	MT	--	2,526,463	--	--	--	--
	ND	575,717	5,813,548	--	--	--	--
	SD	--	5,361,555	--	--	--	--
MIS_MIDA	IA	--	2,636,683	--	--	--	--
	IL	--	151,384	--	--	--	--
MIS_MNWI	MI	38,128	32,825	--	--	--	--
	MN	1,628,979	5,292,787	--	--	--	--
	SD	--	167,192	--	--	--	--
	WI	215,333	1,174,605	--	--	--	--
MIS_MO	IA	--	52,502	--	--	--	--
	MO	--	2,718,802	--	--	--	--
MIS_WUMS	MI	437,954	465,821	--	--	--	--
	WI	541,446	2,293,924	--	--	--	--
NENG_CT	CT	6,300	74,375	--	--	--	--
NENG_ME	ME	1,174,023	305,524	--	--	--	--
NENGREST	MA	30,548	118,009	--	--	--	--
	NH	34,503	101,436	--	--	--	--
	RI	49	34,073	--	--	--	--
	VT	88,147	11,168	--	--	--	--
NY_Z_A&B	NY	321,929	152,829	--	--	--	--
NY_Z_C&E	NY	482,549	176,823	--	--	--	--
NY_Z_D	NY	223,636	75,990	--	--	--	--
NY_Z_F	NY	82,765	64,662	--	--	--	--
NY_Z_G-I	NY	5,299	58,250	--	--	--	--
NY_Z_J	NY	--	676	--	--	--	--
NY_Z_K	NY	--	25,646	--	--	--	--
PJM_AP	MD	2,017	59,871	--	--	--	--
	PA	76,636	78,377	--	--	--	--
	VA	--	122,956	--	--	--	--
	WV	7,588	76,925	--	--	--	--

Model Region	State	Class					
		1	2	3	4	5	6
PJM_ATSI	OH	474,342	869,085	--	--	--	--
	PA	151,543	2,456	--	--	--	--
PJM_COMD	IL	546	1,576,218	--	--	--	--
PJM_Dom	NC	--	441,910	--	--	--	--
	VA	--	1,742,725	--	--	--	--
PJM_EMAC	DE	--	175,165	--	--	--	--
	MD	--	329,397	--	--	--	--
	NJ	183	316,902	--	--	--	--
	PA	--	146,075	--	--	--	--
	VA	--	53,494	--	--	--	--
PJM_PENE	PA	276,816	30,194	--	--	--	--
PJM_SMAC	DC	--	35	--	--	--	--
	MD	--	180,702	--	--	--	--
PJM_West	IN	11,570	745,754	--	--	--	--
	KY	--	18,542	--	--	--	--
	MI	52,303	87,422	--	--	--	--
	OH	88,741	1,452,563	--	--	--	--
	TN	--	684	--	--	--	--
	VA	--	155,747	--	--	--	--
	WV	272	28,898	--	--	--	--
PJM_WMAC	PA	72,963	208,057	--	--	--	--
S_C_KY	KY	--	816,227	--	--	--	--
	OH	--	10,749	--	--	--	--
	VA	--	3	--	--	--	--
S_C_TVA	AL	--	591,879	--	--	--	--
	GA	--	71,479	--	--	--	--
	KY	--	736,215	--	--	--	--
	MS	--	1,174,913	--	--	--	--
	NC	--	7,785	--	--	--	--
	TN	--	2,239,778	--	--	--	--
	VA	--	5,167	--	--	--	--
S_D_AMSO	LA	--	271,634	8,334	--	--	--
S_D_N_AR	AR	--	1,619,623	--	--	--	--
	MO	--	807,954	--	--	--	--
S_D_REST	AR	--	716,350	--	--	--	--
	LA	--	1,131,420	--	--	--	--
	MS	--	1,951,363	--	--	--	--
S_D_WOTA	LA	--	214,557	252	--	--	--
	TX	--	627,283	--	--	--	--
S_SOU	AL	--	3,052,382	60,455	--	--	--
	FL	--	493,841	86,080	--	--	--
	GA	--	3,322,002	986,103	--	--	--
	MS	--	948,473	2,612	--	--	--
S_VACA	GA	--	23,380	--	--	--	--
	NC	--	2,773,996	--	--	--	--
	SC	--	2,110,013	123,622	--	--	--
SPP_N	KS	--	3,558,781	5,141,266	280	--	--

Model Region	State	Class					
		1	2	3	4	5	6
	MO	--	1,721,823	--	--	--	--
SPP_NEBR	NE	--	4,965,449	1,966,681	--	--	--
SPP_SE	LA	--	1,122,714	731	--	--	--
SPP_SPS	NM	--	--	--	109,326	1,514,976	698,712
	OK	--	--	452,416	198,521	4,648	--
	TX	--	--	1,263,287	1,705,702	653,658	--
SPP_WEST	AR	--	1,206,494	--	--	--	--
	LA	--	123,494	--	--	--	--
	MO	--	3,278	--	--	--	--
	OK	--	2,497,664	3,662,342	--	--	--
WEC_CALN	CA	5	17,827	1,686,553	252,117	76,837	15,751
WEC_LADW	CA	--	190	1,721	2,111	11,541	125,266
WEC_SDGE	CA	--	--	3,150	4,613	2,169	48,580
WECC_AZ	AZ	--	--	--	4,413	173,124	6,915,162
WECC_CO	CO	--	71,601	4,752,161	608,847	210,420	171,178
WECC_ID	ID	--	531,421	2,050,967	--	--	--
WECC_IID	CA	--	--	--	1,822	294	351,868
WECC_MT	MT	1,211	4,618,469	--	--	--	--
WECC_NM	NM	--	--	25,168	432,099	1,882,143	4,735,551
	TX	--	--	--	--	7,033	521,127
WECC_NNV	NV	--	343	2,079,313	896,221	587,765	1,587,307
WECC_PNW	CA	--	3,935	413,255	--	--	--
	ID	--	137,335	--	--	--	--
	OR	90,067	700,240	2,032,709	--	--	--
	WA	310,047	1,361,856	3,472	--	--	--
WECC_SCE	CA	--	1,638	191,598	276,918	61,789	1,474,690
WECC_SF	CA	--	2,481	114,703	999	--	--
WECC_SNV	NV	--	--	--	--	--	201,386
WECC_UT	UT	--	3,040	1,896,010	751,291	521,256	275,303
WECC_WY	NE	--	--	110,382	--	--	--
	SD	--	437,434	47,535	--	--	--
	WY	--	1,828,509	3,173,479	--	--	--

Table 4-27 Solar Thermal Regional Potential Capacity (MW) in EPA Base Case v.5.13

Model Region	State	Class				
		1	2	3	4	5
FRCC	FL	95,433	--	--	--	--
ERC_REST	TX	2,115,870	740	--	--	--
ERC_WEST	TX	2,659,629	1,949,748	4,854	--	--
MIS_MAPP	MT	298,407	--	--	--	--
	ND	23,728	--	--	--	--
	SD	834,490	--	--	--	--
S_SOU	AL	41	--	--	--	--
	FL	1,740	--	--	--	--
S_VACA	SC	322	--	--	--	--
SPP_N	KS	3,918,845	74,124	--	--	--
SPP_NEBR	NE	2,195,753	--	--	--	--
SPP_SPS	NM	--	1,448,536	957	--	--
	OK	187,119	215,536	--	--	--
	TX	411,642	1,842,654	--	--	--
SPP_WEST	OK	2,119,578	--	--	--	--
WEC_CALN	CA	1,040,697	223,718	24	--	--
WEC_LADW	CA	566	8,894	9,262	12,719	48,426
WEC_SDGE	CA	1,755	5,221	4,542	10,439	1,001
WECC_AZ	AZ	--	43,388	420,953	1,953,964	1,203,911
WECC_CO	CO	1,634,219	1,546,981	110,412	99,734	2,319
WECC_ID	ID	1,351,218	73,561	--	--	--
WECC_IID	CA	1,292	24,647	42,366	121,604	34,391
WECC_MT	MT	544,703	--	--	--	--
WECC_NM	NM	26,098	991,156	1,051,211	1,072,218	325,541
	TX	--	64,109	225,279	3,306	--
WECC_NNV	NV	213,922	1,493,428	209,881	208,912	448,126
WECC_PNW	CA	89,511	135,681	--	--	--
	ID	262	--	--	--	--
	OR	1,097,342	46,192	--	--	--
	WA	436,316	--	--	--	--
WECC_SCE	CA	307,385	74,751	65,694	130,995	512,927
WECC_SF	CA	80,914	450	--	--	--
WECC_SNV	NV	--	7,080	4,996	25,427	49,166
WECC_UT	UT	571,368	1,056,308	114,414	64,245	1,491
WECC_WY	NE	68,643	--	--	--	--
	SD	191,888	--	--	--	--
	WY	1,976,069	102,883	--	--	--

Generation profiles: Like wind, solar is an intermittent renewal technology. Since it can only be dispatched when the sun shines, not on a strictly economic basis, it is represented in EPA Base Case v.5.13 with generation profiles which specify hourly generation patterns for typical winter and summer days in each eligible region. The generation profiles were prepared with data from NREL which provided separate winter and summer generation profiles for solar thermal and photovoltaic in each eligible IPM region. As an illustrative example, Excerpt of Table 4-28 shows the solar thermal and solar photovoltaic winter and summer generation profiles in model region WECC_AZ.

Excerpt of Table 4-28 Representative Solar Generation Profiles in EPA Base v.5.13

Illustrative Hourly Solar Generation Profile (kWh of Generation per MW of Electricity)
The complete data set in spreadsheet format can be downloaded via the link found at
www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev513.html

Winter Hour	Solar Thermal	Solar Photovoltaic
01	0	0
02	0	0
03	0	0
04	0	0
05	0	0
06	0	446
07	70	446
08	481	446
09	869	446
10	937	446
11	856	446
12	819	446
13	832	552
14	909	552
15	987	552
16	761	552
17	245	64
18	2	64
19	0	64
20	0	64
21	0	64
22	0	0
23	0	0
24	0	0
Winter Average	**324**	**236**

Summer Hour	Solar Thermal	Solar Photovoltaic
01	0	3
02	0	3
03	0	3
04	0	3
05	0	3
06	4	574
07	702	574
08	1348	574
09	1446	574
10	1468	574
11	1418	574
12	1383	574
13	1317	600
14	1295	600
15	1261	600
16	1212	600
17	962	155
18	273	155
19	0	155
20	0	155
21	0	155
22	0	3
23	0	3
24	0	3
Summer Average	**587**	**301**

Note:
Based on model region WECC_AZ.
This is an example of the solar data used in EPA Base Case v.5.13

Reserve margin contribution:

Table 4-29 presents the annual average capacity factors (CFs) and reserve margin contributions by model region for new solar thermal and photovoltaic units in EPA Base Case v.5.13. The state specific capacity factors included in this table are from NREL and the associated reserve margin contribution estimates are based on AEO 2012 projections. NREL is the source for capacity factors; AEO 2012 Reference Case outputs are used to develop a ratio of capacity factors to reserve contribution.

Table 4-29 Solar Photovoltaic Reserve Margin Contribution and Average Capacity Factor by State and Solar Thermal Reserve Margin Contribution and Average Capacity Factor by Class

	Solar Photovoltaic	
State	Average Capacity Factor	Reserve Margin Contribution
Alabama	20%	23%
Alaska	11%	12%
Arizona	26%	30%
Arkansas	21%	24%
California	25%	29%
Colorado	26%	30%
Connecticut	18%	21%
Delaware	19%	21%
Florida	21%	24%
Georgia	20%	23%
Hawaii	21%	24%
Idaho	22%	25%
Illinois	19%	21%
Indiana	18%	21%
Iowa	20%	23%
Kansas	24%	27%
Kentucky	19%	21%
Louisiana	20%	22%
Maine	19%	22%
Maryland	18%	20%
Massachusetts	18%	21%
Michigan	17%	20%
Minnesota	19%	22%
Mississippi	20%	22%
Missouri	19%	22%
Montana	21%	24%
Nebraska	22%	25%
Nevada	26%	30%
New Hampshire	18%	21%
New Jersey	20%	23%
New Mexico	26%	30%
New York	18%	21%
North Carolina	21%	23%
North Dakota	20%	23%
Ohio	17%	20%
Oklahoma	22%	25%
Oregon	23%	26%
Pennsylvania	18%	20%
Rhode Island	18%	20%
South Carolina	20%	23%
South Dakota	21%	24%
Tennessee	20%	23%
Texas	22%	25%
Utah	25%	28%
Vermont	18%	20%
Virginia	20%	23%
Washington	20%	23%
West Virginia	17%	20%
Wisconsin	18%	21%
Wyoming	23%	26%

	Solar Thermal	
Solar Class	Average Capacity Factor	Reserve Margin Contribution
1	32%	39%
2	39%	49%
3	43%	53%
4	43%	54%
5	45%	56%

Geothermal Generation

Geothermal Resource Potential: Ten model regions in EPA Base Case v.5.13 have geothermal potential. The potential capacity in each of these regions is shown in Table 4-30. The values are based on AEO 2013 data.

Table 4-30 Regional Assumptions on Potential Geothermal Electric Capacity

IPM Model Region	Capacity (MW)
WEC_CALN	191
WEC_LADW	83
WECC_AZ	70
WECC_IID	5,058
WECC_NM	292
WECC_NNV	820
WECC_PNW	1,069
WECC_SCE	621
WECC_SF	579
WECC_UT	127
Total	**8,910**

Notes:
This data is a summary of the geothermal data used in EPA Base Case v.5.13.

Cost Calculation: EPA Base Case v.5.13 does not contain a single capital cost, but multiple geographically-dependent capital costs for geothermal generation. The assumptions for geothermal were developed using AEO 2013 cost and performance estimates for 100 known sites. Both dual flash and binary cycle technologies[23] were represented. In EPA Base Case v.5.13 the 100 sites were aggregated into 62 different options based on geographic location and cost and performance characteristics of geothermal sites in each of the ten eligible IPM regions where geothermal generation opportunities exist. Table 4-31 shows the potential geothermal capacity and cost characteristics for applicable model regions.

Table 4-31 Potential Geothermal Capacity and Cost Characteristics by Model Region

IPM Region	Capacity (MW)	Capital Cost (2011$)	FO&M (2011$/kW-yr)
WEC_CALN	5	24,731	822
	6	20,629	920
	6	29,144	791
	9	20,017	572
	11	14,841	493
	13	17,615	487
	16	5,051	221
	16	10,073	352
	19	11,692	348
	29	4,495	161
	29	7,613	315
	32	9,122	282
WEC_LADW	10	10,361	324
	73	7,200	196

[23] In dual flash systems, high temperature water (above 400°F) is sprayed into a tank held at a much lower pressure than the fluid. This causes some of the fluid to “flash,” i.e., rapidly vaporize to steam. The steam is used to drive a turbine, which, in turn, drives a generator. In the binary cycle technology, moderate temperature water (less than 400°F) vaporizes a secondary, working fluid which drives a turbine and generator. Due to its use of more plentiful, lower temperature geothermal fluids, these systems tend to be most cost effective and are expected to be the most prevalent future geothermal technology.

IPM Region	Capacity (MW)	Capital Cost (2011$)	FO&M (2011$/kW-yr)
WECC_AZ	26	29,114	1,001
	44	27,769	652
WECC_IID	10	14,320	434
	19	9,217	351
	38	11,395	360
	72	4,999	203
	84	8,041	230
	88	6,930	244
	128	8,349	234
	135	4,082	139
	347	3,533	116
	359	2,735	96
	1,866	7,447	118
	1,912	6,581	104
WECC_NM	9	23,780	756
	11	28,310	714
	24	18,793	481
	62	6,998	197
	186	4,016	103
WECC_NNV	66	3,366	142
	78	2,602	119
	93	4,080	139
	152	4,387	194
	431	5,247	187
WECC_PNW	9	24,402	986
	18	24,198	653
	19	17,474	535
	36	15,350	490
	38	20,609	620
	81	9,215	252
	101	7,760	237
	113	3,481	119
	124	2,654	110
	264	4,408	126
	266	4,074	93
WECC_SCE	7	19,885	705
	8	23,338	643
	11	16,931	553
	32	19,802	586
	274	3,091	119
	289	2,196	113
WECC_SF	14	24,018	775
	17	28,523	737
	35	12,225	417
	240	4,495	136
	273	2,713	115
WECC_UT	52	2,684	132
	75	4,049	147

Landfill Gas Electricity Generation

Landfill Gas Resource Potential: Estimates of potential electric capacity from landfill gas are based on the AEO 2012 inventory. EPA Base Case v.5.13 represents three categories of potential landfill gas units; "high", "low", and "very low". The categories refer to the amount and rate of methane production from the existing landfill site. Table 4-32 summarizes potential electric capacity from landfill gas used in EPA Base Case v.5.13.

There are several things to note about Table 4-32. The AEO 2012 NEMS region level estimates of the potential electric capacity from new landfill gas units are disaggregated to IPM regions based on electricity demand. The limits listed in Table 4-32 apply to the IPM regions indicated in column 1. In EPA Base Case v.5.13 the new landfill gas electric capacity in the corresponding IPM regions shown in column 1 cannot exceed the limits shown in columns 3-5. As noted earlier, the capacity limits for three categories of potential landfill gas units are distinguished in this table based on the rate of methane production at three categories of landfill sites: LGHI = high rate of landfill gas production, LGLo = low rate of landfill gas production, and LGLVo = very low rate of landfill gas production. The values shown in Table 4-32 represent an upper bound on the amount of new landfill capacity that can be added in each of the indicated model regions and states for each of the three landfill categories.

The cost and performance assumptions for adding new capacity in each of the three landfill categories are presented in

Table 4-16.

Table 4-32 Regional Assumptions on Potential Electric Capacity from New Landfill Gas Units (MW)

IPM Region	State	Class LGHI	Class LGLo	Class LGLVo
ERC_REST	TX	12	19	296
ERC_WEST	TX	1	1	23
FRCC	FL	16	24	159
MAP_WAUE	MN	0	0	3
	MT	0	0	0
	ND	0	1	5
	SD	0	2	9
MIS_IA	IA	0	3	16
	MN	0	0	0
MIS_IL	IL	12	18	99
MIS_INKY	IN	9	14	103
	KY	0	1	7
MIS_LMI	MI	7	11	97
MIS_MAPP	MT	0	0	0
	ND	0	0	4
	SD	0	0	2
MIS_MIDA	IL	0	0	0
	IA	0	5	23
MIS_MNWI	MI	0	0	0
	MN	1	13	59
	SD	0	0	2
	WI	0	2	9
MIS_MO	IA	0	0	0
	MO	10	15	83
MIS_WUMS	MI	0	1	6
	WI	10	17	99
NENG_CT	CT	6	9	14
NENG_ME	ME	2	3	4
NENGREST	MA	11	17	25
	NH	2	3	5
	RI	1	2	4
	VT	1	1	2
NY_Z_A&B	NY	5	8	19
NY_Z_C&E	NY	5	8	17
NY_Z_D	NY	1	2	4
NY_Z_F	NY	2	3	8
NY_Z_G-I	NY	4	6	14
NY_Z_J	NY	13	20	43
NY_Z_K	NY	5	8	17
PJM_AP	MD	0	1	7
	PA	3	4	33
	VA	0	0	4
	WV	1	1	12
PJM_ATSI	OH	7	11	77

IPM Region	State	Class		
		LGHI	LGLo	LGLVo
	PA	0	0	6
PJM_COMD	IL	11	17	122
PJM_Dom	NC	0	0	2
	VA	3	5	46
PJM_EMAC	DE	1	1	9
	MD	0	1	7
	NJ	12	18	92
	PA	6	10	52
	VA	0	0	0
PJM_PENE	PA	2	3	19
PJM_SMAC	MD	8	12	65
	DC	1	1	8
PJM_West	IN	3	5	37
	KY	1	2	14
	MI	0	0	6
	OH	12	18	133
	TN	0	0	0
	VA	2	3	26
	WV	2	3	23
PJM_WMAC	PA	8	12	64
S_C_KY	KY	2	3	27
	OH	0	0	0
	VA	0	0	0
S_C_TVA	AL	1	1	13
	GA	0	0	4
	KY	0	0	8
	MS	0	1	10
	NC	0	0	2
	TN	6	8	77
	VA	0	0	0
S_D_AMSO	LA	0	1	12
S_D_N_AR	AR	0	1	11
	MO	0	0	4
S_D_REST	AR	0	0	1
	LA	0	1	9
	MS	0	1	9
S_D_WOTA	LA	0	0	2
	TX	0	1	9
S_SOU	AL	2	3	30
	FL	0	0	8
	GA	6	8	77
	MS	0	0	7
S_VACA	GA	0	0	1
	NC	5	8	73
	SC	2	4	37
SPP_N	KS	0	0	36
	MO	0	0	28
SPP_NEBR	NE	0	6	26

IPM Region	State	Class		
		LGHI	LGLo	LGLVo
SPP_SE	LA	0	0	11
SPP_SPS	NM	0	0	5
	OK	0	0	0
	TX	0	0	17
SPP_WEST	AR	0	0	24
	LA	0	0	4
	MO	0	0	0
	OK	1	1	59
	TX	0	0	5
WEC_CALN	CA	64	97	306
WEC_LADW	CA	14	22	70
WEC_SDGE	CA	11	17	55
WECC_AZ	AZ	0	0	40
WECC_CO	CO	0	0	27
WECC_ID	ID	2	3	15
WECC_IID	CA	0	0	0
WECC_MT	MT	1	1	7
WECC_NM	NM	0	0	6
	TX	0	0	2
WECC_NNV	NV	1	1	8
WECC_PNW	CA	0	0	0
	ID	0	0	3
	OR	5	8	41
	WA	10	15	73
WECC_SCE	CA	61	92	291
WECC_SF	CA	3	4	15
WECC_SNV	NV	0	0	9
WECC_UT	UT	3	5	26
WECC_WY	NE	0	0	0
	SD	0	0	1
	WY	0	0	5

4.5 Nuclear Units

4.5.1 Existing Nuclear Units

Population, Plant Location, and Unit Configuration: To provide maximum granularity in forecasting the behavior of existing nuclear units, all 104 nuclear units in EPA Base Case v.5.13 are represented by separate model plants. As noted in Table 4-7 the 104 nuclear units include 100 currently operating units plus Watts Bar Nuclear Plant (Unit 2), Vogtle (Units 3&4), and V C Summer (Units 2&3), which are scheduled to come online during 2015 – 2018. All are listed in Table 4-34. The population characteristics, plant location, and unit configuration data in NEEDS v.5.13 were obtained primarily from EIA Form 860 and AEO 2013.

Capacity: Nuclear units are baseload power plants with high fixed (capital and fixed O&M) costs and low variable (fuel and variable O&M) costs. Due to their low VOM and fuel costs, nuclear units are run to the maximum extent possible, i.e., up to their availability. Consequently, a nuclear unit's capacity factor is equivalent to its availability. Thus, EPA Base Case v.5.13 uses capacity factor assumptions to define the upper bound on generation from nuclear units. Nuclear capacity factor assumptions in EPA Base Case v.5.13 are based on an Annual Energy Outlook projection algorithm. The nuclear capacity factor projection algorithm is described below:

- For each reactor, the capacity factor over time is dependent on the age of the reactor.
- Capacity factors increase initially due to learning, and decrease in the later years due to aging.
- For individual reactors, vintage classifications (older and newer) are used.
- For the older vintage (start before 1982) nuclear power plants, the performance peaks at 25 years:
  - Before 25 years: Performance increases by 0.5 percentage point per year;
  - 25-60 years: Performance remains flat; and
- For the newer vintage (start in or after 1982) nuclear power plants, the performance peaks at 30 years:
  - Before 30 years: Performance increases by 0.7 percentage points per year;
  - 30-60 years: Performance remains flat; and
- The maximum capacity factor is assumed to be 90 percent. That is, any given reactor is not allowed to grow to a capacity factor higher than 90 percent. However, if a unit began with a capacity factor above 90 percent, it is allowed to retain that capacity factor. Given that some units' historical capacity factors are above 90 percent, the projected capacity factors range from 60 percent to 96 percent.

Cost and Performance: Unlike non-nuclear existing conventional units discussed in section 4.2.7, emission rates are not needed for nuclear units, since there are no SO_2, NO_x, CO_2, or mercury emissions from nuclear units.

As with other generating resources, EPA Base Case v.5.13 uses variable operation and maintenance (VOM) costs and fixed operation and maintenance (FOM) costs to characterize the cost of operating nuclear units. The heat rate, FOM, and VOM values from AEO 2013, which were used to characterize the cost and performance of existing nuclear units in EPA Base Case v.5.13 are shown in Table 4-34.

EPA Base Case v.5.13 also incorporates the planned nuclear capacity uprates sourced from AEO 2013 and EPA research. These are shown in Table 4-33**.**

Table 4-33 Nuclear Upratings (MW) as Incorporated in EPA Base Case v.5.13

Name	Plant ID	Unit ID	Year	Change in MWs
Fort Calhoun	2289	1	2017	75
McGuire	6038	1	2013	18.7
McGuire	6038	2	2013	18.7

4.5.2 Potential Nuclear Units

The cost and performance assumptions for nuclear potential units that the model has the option to build in EPA Base Case v.5.13 are shown in Table 4-13 above. The cost assumptions are from AEO 2013.

Table 4-34 Characteristics of Existing Nuclear Units

Region	State	Plant Name	Unique ID	On-Line Year	Capacity (MW)	Heat Rate (Btu/kWh)	FOM (2011$ /kW-yr)	VOM (2011 mills/kWh)
ERC_REST	Texas	Comanche Peak	6145_1	1990	1,205	10,460	182.1	0.18
		Comanche Peak	6145_2	1993	1,195	10,460	182.1	0.18
		South Texas Project	6251_1	1988	1,280	10,460	199.2	0.18
		South Texas Project	6251_2	1989	1,280	10,460	199.2	0.18

Region	State	Plant Name	Unique ID	On-Line Year	Capacity (MW)	Heat Rate (Btu/kWh)	FOM (2011$ /kW-yr)	VOM (2011 mills/kWh)
FRCC	Florida	St Lucie	6045_1	1976	961	10,460	160.8	0.15
		St Lucie	6045_2	1983	949	10,460	160.8	0.15
		Turkey Point	621_3	1972	802	10,460	227.2	0.21
		Turkey Point	621_4	1973	802	10,460	227.2	0.21
MIS_IA	Iowa	Duane Arnold Energy Center	1060_1	1975	601	10,460	187.5	0.18
MIS_IL	Illinois	Clinton Power Station	204_1	1987	1,065	10,460	199.2	0.18
MIS_LMI	Michigan	Fermi	1729_2	1988	1,085	10,460	178.8	0.18
		Palisades	1715_1	1972	803	10,460	200.3	0.18
MIS_MNWI	Minnesota	Monticello	1922_1	1971	633	10,460	251.6	0.25
		Prairie Island	1925_1	1974	594	10,427	173.8	0.88
		Prairie Island	1925_2	1974	592	10,427	173.8	0.89
MIS_MO	Missouri	Callaway	6153_1	1984	1,190	10,460	124.4	0.12
MIS_WUMS	Wisconsin	Point Beach Nuclear Plant	4046_1	1970	591	10,460	203.6	0.18
		Point Beach Nuclear Plant	4046_2	1972	593	10,460	203.6	0.18
NENG_CT	Connecticut	Millstone	566_2	1975	869	10,460	194.4	0.19
		Millstone	566_3	1986	1,233	10,460	180.2	0.19
NENGREST	Massachusetts	Pilgrim Nuclear Power Station	1590_1	1972	685	10,460	225.7	0.18
	New Hampshire	Seabrook	6115_1	1990	1,246	10,460	199.2	0.19
NY_Z_A&B	New York	R E Ginna Nuclear Power Plant	6122_1	1970	581	10,460	216.8	0.18
NY_Z_C&E	New York	James A Fitzpatrick	6110_1	1976	828	10,460	216.1	0.18
		Nine Mile Point Nuclear Station	2589_1	1969	630	10,460	204.2	0.18
		Nine Mile Point Nuclear Station	2589_2	1987	1,143	10,460	199.2	0.18
NY_Z_G-I	New York	Indian Point 2	2497_2	1973	1,006	10,460	207.2	0.18
		Indian Point 3	8907_3	1976	1,031	10,460	194.9	0.18
PJM_ATSI	Ohio	Davis Besse	6149_1	1977	894	10,460	180.2	0.20
		Perry	6020_1	1987	1,256	10,460	186.6	0.63
PJM_COMD	Illinois	Braidwood Generation Station	6022_1	1988	1,178	10,460	194.1	0.18
		Braidwood Generation Station	6022_2	1988	1,152	10,460	194.1	0.18
		Byron Generating Station	6023_1	1985	1,164	10,460	194.3	0.17
		Byron Generating Station	6023_2	1987	1,136	10,460	194.3	0.17
		Dresden Generating Station	869_2	1970	867	10,460	212.4	0.17
		Dresden Generating Station	869_3	1971	867	10,460	212.4	0.18
		LaSalle Generating Station	6026_1	1984	1,118	10,427	169.1	0.80
		LaSalle Generating Station	6026_2	1984	1,120	10,427	169.1	0.82
		Quad Cities Generating Station	880_1	1972	908	10,460	197.0	0.17
		Quad Cities Generating Station	880_2	1972	911	10,460	197.0	0.18
PJM_Dom	Virginia	North Anna	6168_1	1978	943	10,460	114.1	0.10
		North Anna	6168_2	1980	943	10,460	114.1	0.11
		Surry	3806_1	1972	838	10,427	129.2	0.62
		Surry	3806_2	1973	838	10,427	129.2	0.61
PJM_EMAC	New Jersey	Oyster Creek	2388_1	1969	614	10,460	225.4	0.19
		PSEG Hope Creek Generating Station	6118_1	1986	1,173	10,460	180.2	0.18
		PSEG Salem Generating Station	2410_1	1977	1,166	10,460	199.2	0.18
		PSEG Salem Generating Station	2410_2	1981	1,160	10,460	199.2	0.18
	Pennsylvania	Limerick	6105_1	1986	1,146	10,460	199.9	0.17
		Limerick	6105_2	1990	1,150	10,460	199.9	0.17
		Peach Bottom	3166_2	1974	1,122	10,460	198.7	0.18
		Peach Bottom	3166_3	1974	1,122	10,460	198.7	0.17
PJM_SMAC	Maryland	Calvert Cliffs Nuclear Power Plant	6011_1	1975	855	10,460	199.2	0.18
		Calvert Cliffs Nuclear Power Plant	6011_2	1977	850	10,460	199.2	0.17
PJM_West	Michigan	Donald C Cook	6000_1	1975	1,009	10,460	150.6	0.24
		Donald C Cook	6000_2	1978	1,060	10,460	150.6	0.14
	Pennsylvania	Beaver Valley	6040_1	1976	921	10,460	229.6	0.56
		Beaver Valley	6040_2	1987	914	10,460	229.6	0.57
PJM_WMAC	Pennsylvania	PPL Susquehanna	6103_1	1983	1,260	10,460	186.3	0.20

Region	State	Plant Name	Unique ID	On-Line Year	Capacity (MW)	Heat Rate (Btu/kWh)	FOM (2011$ /kW-yr)	VOM (2011 mills/kWh)
		PPL Susquehanna	6103_2	1985	1,260	10,460	186.3	0.18
		Three Mile Island	8011_1	1974	805	10,460	194.3	0.18
S_C_TVA	Alabama	Browns Ferry	46_1	1974	1,101	10,460	199.2	0.19
		Browns Ferry	46_2	1975	1,104	10,460	199.2	0.19
		Browns Ferry	46_3	1977	1,105	10,460	199.2	0.20
	Tennessee	Sequoyah	6152_1	1981	1,152	10,460	210.3	0.18
		Sequoyah	6152_2	1982	1,126	10,460	210.3	0.18
		Watts Bar Nuclear Plant	7722_1	1996	1,123	10,460	198.0	0.18
		Watts Bar Nuclear Plant	7722_2	2015	1,122	10,460	137.0	2.16
S_D_AMSO	Louisiana	Waterford 3	4270_3	1985	1,159	10,460	180.1	0.13
S_D_N_AR	Arkansas	Arkansas Nuclear One	8055_1	1974	834	10,460	161.7	0.13
		Arkansas Nuclear One	8055_2	1980	989	10,460	161.7	0.12
S_D_REST	Louisiana	River Bend	6462_1	1986	974	10,460	163.2	0.17
	Mississippi	Grand Gulf	6072_1	1985	1,368	10,460	158.2	0.13
S_SOU	Alabama	Joseph M Farley	6001_1	1977	874	10,460	149.5	0.14
		Joseph M Farley	6001_2	1981	860	10,460	149.5	0.14
	Georgia	Edwin I Hatch	6051_1	1975	876	10,460	133.2	0.14
		Edwin I Hatch	6051_2	1979	883	10,460	133.2	0.14
		Vogtle	649_1	1987	1,150	10,460	111.3	0.09
		Vogtle	649_2	1989	1,152	10,460	111.3	0.09
		Vogtle	649_3	2017	1,100	10,400	112.9	2.16
		Vogtle	649_4	2018	1,100	10,400	112.9	2.16
S_VACA	North Carolina	Brunswick	6014_1	1977	938	10,460	155.7	0.14
		Brunswick	6014_2	1975	932	10,460	155.7	0.14
		Harris	6015_1	1987	900	10,460	186.9	0.16
		McGuire	6038_1	1981	1,100	10,460	137.5	0.11
		McGuire	6038_2	1984	1,100	10,460	137.5	0.11
	South Carolina	Catawba	6036_1	1985	1,129	10,460	137.7	0.13
		Catawba	6036_2	1986	1,129	10,460	137.7	0.12
		H B Robinson	3251_2	1971	724	10,460	142.2	0.16
		Oconee	3265_1	1973	846	10,460	137.0	0.13
		Oconee	3265_2	1974	846	10,460	137.0	0.12
		Oconee	3265_3	1974	846	10,460	137.0	0.12
		V C Summer	6127_1	1984	966	10,460	170.6	0.17
		V C Summer	6127_2	2017	1,100	10,400	112.9	2.16
		V C Summer	6127_3	2018	1,100	10,400	112.9	2.16
SPP_N	Kansas	Wolf Creek Generating Station	210_1	1985	1,175	10,460	159.6	0.16
SPP_NEBR	Nebraska	Cooper	8036_1	1974	766	10,460	199.2	0.18
		Fort Calhoun	2289_1	1973	479	10,460	187.2	0.18
WEC_CALN	California	Diablo Canyon	6099_1	1985	1,122	10,460	169.8	0.18
		Diablo Canyon	6099_2	1986	1,118	10,460	169.8	0.18
WECC_AZ	Arizona	Palo Verde	6008_1	1986	1,311	10,460	236.2	0.23
		Palo Verde	6008_2	1986	1,314	10,460	236.2	0.23
		Palo Verde	6008_3	1988	1,312	10,460	236.2	0.23
WECC_PNW	Washington	Columbia Generating Station	371_2	1984	1,097	10,460	202.3	0.19

Excerpt from Table 4-35 Capacity Not Included Based on EIA Form 860 - Existing Units

This is a small excerpt of the data in Excerpt from Table 4-35. The complete data set in spreadsheet format can be downloaded via the link found at http://www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev513.html.

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Notes
Hospira Inc	55788	GEN1	Combustion Turbine	New York	1.1	Dropped - Onsite Unit

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Notes
Hospira Inc	55788	GEN2	Combustion Turbine	New York	1.1	Dropped - Onsite Unit
AG Processing Inc	10223	E.C.	Coal Steam	Iowa	8.5	Dropped - Onsite Unit
Oxford Cogeneration Facility	52093	GEN1	Combustion Turbine	California	2.4	Dropped - PLANNED_RETIREMENT_YEAR <=2015
Oxford Cogeneration Facility	52093	GEN2	Combustion Turbine	California	2.4	Dropped - PLANNED_RETIREMENT_YEAR <=2015
South Belridge Cogeneration Facility	50752	GEN1	Combustion Turbine	California	19	Dropped - Onsite Unit
South Belridge Cogeneration Facility	50752	GEN2	Combustion Turbine	California	19	Dropped - Onsite Unit
South Belridge Cogeneration Facility	50752	GEN3	Combustion Turbine	California	19	Dropped - Onsite Unit
Lost Hills Cogeneration Plant	52077	GEN4	Combustion Turbine	California	2.7	Dropped - Onsite Unit
Lost Hills Cogeneration Plant	52077	GEN5	Combustion Turbine	California	2.7	Dropped - Onsite Unit
Lost Hills Cogeneration Plant	52077	GEN6	Combustion Turbine	California	2.7	Dropped - Onsite Unit
AES Hawaii	10673	GEN1	Coal Steam	Hawaii	180	Dropped - in Alaska or in Hawaii
Agrium Kenai Nitrogen Operations	54452	744A	Combustion Turbine	Alaska	2.5	Dropped - Onsite Unit
Agrium Kenai Nitrogen Operations	54452	744B	Combustion Turbine	Alaska	2.5	Dropped - Onsite Unit
Agrium Kenai Nitrogen Operations	54452	744C	Combustion Turbine	Alaska	2.5	Dropped - Onsite Unit
Agrium Kenai Nitrogen Operations	54452	744D	Combustion Turbine	Alaska	2.5	Dropped - Onsite Unit
Agrium Kenai Nitrogen Operations	54452	744E	Combustion Turbine	Alaska	2.5	Dropped - Onsite Unit
Southside Water Reclamation Plant	10339	GEN1	Non-Fossil Waste	New Mexico	2.1	Dropped - Onsite Unit
Southside Water Reclamation Plant	10339	GEN2	Non-Fossil Waste	New Mexico	2.1	Dropped - Onsite Unit
Southside Water Reclamation Plant	10339	GEN3	Non-Fossil Waste	New Mexico	1.1	Dropped - Onsite Unit
Southside Water Reclamation Plant	10339	GEN4	Non-Fossil Waste	New Mexico	1.1	Dropped - Onsite Unit
Martin Dam	16	1	Hydro	Alabama	46.5	Dropped - PLANNED_RETIREMENT_YEAR <=2015
Martin Dam	16	2	Hydro	Alabama	46.5	Dropped - PLANNED_RETIREMENT_YEAR <=2015

Table 4-36 Capacity Not Included Due to Recent Announcements

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
5 in 1 Dam Hydroelectric	10171	GEN1	Hydro	Iowa	0.7	2015
5 in 1 Dam Hydroelectric	10171	GEN2	Hydro	Iowa	0.7	2015
5 in 1 Dam Hydroelectric	10171	GEN3	Hydro	Iowa	0.7	2015
Abilene Energy Center Combustion Turbine	1251	GT1	Combustion Turbine	Kansas	64	2012
ACE Cogeneration Facility	10002	CFB	Coal Steam	California	101	2015
AES Greenidge LLC	2527	6	Coal Steam	New York	108	2012
AES Thames	10675	A	Coal Steam	Connecticut	90	2012
AES Thames	10675	B	Coal Steam	Connecticut	90	2012
AES Westover	2526	13	Coal Steam	New York	84	2012
Albany	2113	3	Combustion Turbine	Missouri	0.6	2015
Alliant SBD 9801 Aegon Martha's Way	56072	01	Combustion Turbine	Iowa	1	2012
Alloy Steam Station	50012	BLR4	Coal Steam	West Virginia	38	2007
Alma	4140	B1	Coal Steam	Wisconsin	17.4	2013
Alma	4140	B2	Coal Steam	Wisconsin	17.4	2013
Alma	4140	B3	Coal Steam	Wisconsin	20.9	2013
Alma	4140	B4	Coal Steam	Wisconsin	48	2015
Alma	4140	B5	Coal Steam	Wisconsin	72	2015
Alvarado Hydro Facility	54242	AHF	Hydro	California	1.4	2015
Animas	2465	4	O/G Steam	New Mexico	16	2015
Arapahoe	465	4	Coal Steam	Colorado	109	2013
Astoria Generating Station	8906	20	O/G Steam	New York	181	2012
B C Cobb	1695	1	O/G Steam	Michigan	62	2015
B C Cobb	1695	2	O/G Steam	Michigan	62	2015
B C Cobb	1695	3	O/G Steam	Michigan	62	2015
B C Cobb	1695	4	Coal Steam	Michigan	156	2015
B C Cobb	1695	5	Coal Steam	Michigan	156	2015
B L England	2378	1	Coal Steam	New Jersey	113	2013
B L England	2378	2	Coal Steam	New Jersey	155	2015
B L England	2378	IC1	Combustion Turbine	New Jersey	2	2015
B L England	2378	IC2	Combustion Turbine	New Jersey	2	2015
B L England	2378	IC3	Combustion Turbine	New Jersey	2	2015
B L England	2378	IC4	Combustion Turbine	New Jersey	2	2015
Balefill LFG Project	55159	UNT1	Landfill Gas	New Jersey	0.1	2010
Balefill LFG Project	55159	UNT2	Landfill Gas	New Jersey	0.1	2010

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
Ben French	3325	1	Coal Steam	South Dakota	21.6	2014
Berlin	6565	3A	Combustion Turbine	Maryland	1.8	2015
Berlin Gorham	54639	GOR1	Hydro	New Hampshire	1.2	2015
Big Sandy	1353	BSU2	Coal Steam	Kentucky	800	2014
Binghamton Cogen	55600	1	Combustion Turbine	New York	42	2012
Biodyne Lyons	55060	001	Landfill Gas	Illinois	0.9	2015
Biodyne Lyons	55060	002	Landfill Gas	Illinois	0.9	2015
Biodyne Lyons	55060	004	Landfill Gas	Illinois	0.9	2015
Biodyne Peoria	55057	001	Landfill Gas	Illinois	0.8	2015
Biodyne Peoria	55057	002	Landfill Gas	Illinois	0.8	2015
Biodyne Peoria	55057	004	Landfill Gas	Illinois	0.8	2015
Biodyne Peoria	55057	005	Landfill Gas	Illinois	0.8	2015
Biodyne Pontiac	55054	1	Landfill Gas	Illinois	4.2	2015
Biodyne Pontiac	55054	3	Landfill Gas	Illinois	4.2	2015
Biodyne Pontiac	55054	GEN2	Landfill Gas	Illinois	4.2	2015
Biron	3971	6	Hydro	Wisconsin	0.4	2015
Bluebonnet	55552	UNT2	Landfill Gas	Texas	1	2015
Bountiful City	3665	2	Combustion Turbine	Utah	1.2	2015
Bountiful City	3665	6	Combustion Turbine	Utah	2.5	2015
Brunot Island	3096	1B	Combustion Turbine	Pennsylvania	15	2011
Brunot Island	3096	1C	Combustion Turbine	Pennsylvania	15	2011
Bryan	3561	3	O/G Steam	Texas	12	2015
Bryan	3561	4	O/G Steam	Texas	22	2015
Bryan	3561	5	O/G Steam	Texas	25	2015
Bryan	3561	6	O/G Steam	Texas	50	2015
Canadys Steam	3280	CAN1	Coal Steam	South Carolina	105	2012
Canadys Steam	3280	CAN2	Coal Steam	South Carolina	115	2013
Canadys Steam	3280	CAN3	Coal Steam	South Carolina	180	2013
Cane Run	1363	4	Coal Steam	Kentucky	155	2015
Cane Run	1363	5	Coal Steam	Kentucky	168	2015
Cane Run	1363	6	Coal Steam	Kentucky	240	2015
Cape Canaveral	609	PCC1	O/G Steam	Florida	396	2010
Cape Canaveral	609	PCC2	O/G Steam	Florida	396	2010
Cape Fear	2708	5	Coal Steam	North Carolina	144	2012
Cape Fear	2708	6	Coal Steam	North Carolina	172	2012
Cape Fear	2708	1B	Combined Cycle	North Carolina	11	2012
Carbon	3644	1	Coal Steam	Utah	67	2015
Carbon	3644	2	Coal Steam	Utah	105	2015
Cedar Station	2380	CED1	Combustion Turbine	New Jersey	44	2015
Cedar Station	2380	CED2	Combustion Turbine	New Jersey	22.3	2015
CES Placerita Power Plant	10677	UNT2	Combined Cycle	California	46	2015
CES Placerita Power Plant	10677	UNT3	Combined Cycle	California	23	2015
Chamois	2169	1	Coal Steam	Missouri	16	2013
Chamois	2169	2	Coal Steam	Missouri	47	2013
Cherokee	469	3	Coal Steam	Colorado	152	2014
Chesapeake	3803	1	Coal Steam	Virginia	111	2014
Chesapeake	3803	2	Coal Steam	Virginia	111	2014
Chesapeake	3803	3	Coal Steam	Virginia	156	2014
Chesapeake	3803	4	Coal Steam	Virginia	217	2014
Chesapeake	3803	7	Combustion Turbine	Virginia	16	2011
Chesapeake	3803	8	Combustion Turbine	Virginia	16	2011
Chesapeake	3803	9	Combustion Turbine	Virginia	16	2011
Chesapeake	3803	10	Combustion Turbine	Virginia	16	2011
Clinch River	3775	3	Coal Steam	Virginia	230	2015
Coal Canyon	226	1	Hydro	California	0.9	2015
Conesville	2840	3	Coal Steam	Ohio	165	2012
Conners Creek	1726	15	O/G Steam	Michigan	58	2011
Conners Creek	1726	16	O/G Steam	Michigan	58	2011
Conners Creek	1726	17	O/G Steam	Michigan	58	2011
Conners Creek	1726	18	O/G Steam	Michigan	58	2011
Crawford	867	7	Coal Steam	Illinois	213	2012

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
Crawford	867	8	Coal Steam	Illinois	319	2012
Crosscut	143	1	O/G Steam	Arizona	7.5	2015
Crosscut	143	2	O/G Steam	Arizona	7.5	2015
Crosscut	143	3	O/G Steam	Arizona	7.5	2015
Crosscut	143	4	O/G Steam	Arizona	2.5	2015
Crosscut	143	5	O/G Steam	Arizona	2.5	2015
Crosscut	143	6	O/G Steam	Arizona	2.5	2015
Crystal River	628	3	Nuclear	Florida	1028	2013
CTV Power Purchase Contract Trust	54300	SX1S	Wind	California	0.1	2015
Cutler	610	PCU5	O/G Steam	Florida	68	2012
Cutler	610	PCU6	O/G Steam	Florida	137	2012
Cytec 1, 2 & 3	56257	CY 1	Combustion Turbine	Connecticut	2	2011
Cytec 1, 2 & 3	56257	CY 2	Combustion Turbine	Connecticut	2	2011
Cytec 1, 2 & 3	56257	CY 3	Combustion Turbine	Connecticut	2	2011
Danskammer Generating Station	2480	1	O/G Steam	New York	66	2013
Danskammer Generating Station	2480	2	O/G Steam	New York	62	2013
Danskammer Generating Station	2480	3	Coal Steam	New York	138	2013
Danskammer Generating Station	2480	4	Coal Steam	New York	237	2013
Danskammer Generating Station	2480	5	Combustion Turbine	New York	2.5	2013
Danskammer Generating Station	2480	6	Combustion Turbine	New York	2.5	2013
DeCordova Power Company LLC	8063	1	O/G Steam	Texas	818	2011
Deepwater	2384	1	O/G Steam	New Jersey	78	2015
Deepwater	2384	8	Coal Steam	New Jersey	81	2015
Dolphus M Grainger	3317	1	Coal Steam	South Carolina	83	2013
Dolphus M Grainger	3317	2	Coal Steam	South Carolina	83	2013
Dunbarton Energy Partners LP	55779	MA1	Landfill Gas	New Hampshire	0.6	2012
Dunbarton Energy Partners LP	55779	MA2	Landfill Gas	New Hampshire	0.6	2012
E F Barrett	2511	7	Combustion Turbine	New York	16.6	2011
Eagle Mountain	3489	1	O/G Steam	Texas	115	2015
Eagle Mountain	3489	2	O/G Steam	Texas	175	2015
Eagle Mountain	3489	3	O/G Steam	Texas	375	2015
Eagle Valley	991	3	Coal Steam	Indiana	40	2015
Eagle Valley	991	4	Coal Steam	Indiana	56	2015
Eagle Valley	991	5	Coal Steam	Indiana	62	2015
East Third Street Power Plant	10367	CB1302	Coal Steam	California	18.7	2012
Edgewater	4050	3	Coal Steam	Wisconsin	70	2015
El Segundo Power	330	3	O/G Steam	California	325	2013
Elrama Power Plant	3098	1	Coal Steam	Pennsylvania	93	2012
Elrama Power Plant	3098	2	Coal Steam	Pennsylvania	93	2012
Elrama Power Plant	3098	3	Coal Steam	Pennsylvania	103	2012
Elrama Power Plant	3098	4	Coal Steam	Pennsylvania	171	2012
FirstEnergy Albright	3942	1	Coal Steam	West Virginia	73	2012
FirstEnergy Albright	3942	2	Coal Steam	West Virginia	73	2012
FirstEnergy Albright	3942	3	Coal Steam	West Virginia	137	2012
FirstEnergy Armstrong Power Station	3178	1	Coal Steam	Pennsylvania	172	2012
FirstEnergy Armstrong Power Station	3178	2	Coal Steam	Pennsylvania	172	2012
FirstEnergy Ashtabula	2835	7	Coal Steam	Ohio	244	2015
FirstEnergy Bay Shore	2878	2	Coal Steam	Ohio	138	2012
FirstEnergy Bay Shore	2878	3	Coal Steam	Ohio	142	2012
FirstEnergy Bay Shore	2878	4	Coal Steam	Ohio	215	2012
FirstEnergy Eastlake	2837	1	Coal Steam	Ohio	132	2015
FirstEnergy Eastlake	2837	2	Coal Steam	Ohio	132	2015
FirstEnergy Eastlake	2837	3	Coal Steam	Ohio	132	2015
FirstEnergy Eastlake	2837	4	Coal Steam	Ohio	240	2012
FirstEnergy Eastlake	2837	5	Coal Steam	Ohio	597	2012
FirstEnergy Lake Shore	2838	18	Coal Steam	Ohio	245	2015
FirstEnergy Mitchell Power Station	3181	1	O/G Steam	Pennsylvania	27	2013
FirstEnergy Mitchell Power Station	3181	2	O/G Steam	Pennsylvania	27	2013
FirstEnergy Mitchell Power Station	3181	3	O/G Steam	Pennsylvania	27	2013
FirstEnergy Mitchell Power Station	3181	33	Coal Steam	Pennsylvania	278	2013
FirstEnergy R E Burger	2864	5	Coal Steam	Ohio	47	2011

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
FirstEnergy R E Burger	2864	6	Coal Steam	Ohio	47	2011
FirstEnergy R Paul Smith Power Station	1570	9	Coal Steam	Maryland	28	2012
FirstEnergy R Paul Smith Power Station	1570	11	Coal Steam	Maryland	87	2012
FirstEnergy Rivesville	3945	7	Coal Steam	West Virginia	37	2012
FirstEnergy Rivesville	3945	8	Coal Steam	West Virginia	88	2012
FirstEnergy Willow Island	3946	1	Coal Steam	West Virginia	54	2012
FirstEnergy Willow Island	3946	2	Coal Steam	West Virginia	181	2012
Fisk Street	886	19	Coal Steam	Illinois	326	2012
Frank E Ratts	1043	1SG1	Coal Steam	Indiana	120	2015
Frank E Ratts	1043	2SG1	Coal Steam	Indiana	121	2015
G W Ivey	665	18	Combustion Turbine	Florida	8	2015
Gaylord	1706	5	Combustion Turbine	Michigan	14	2015
George Neal North	1091	1	Coal Steam	Iowa	137	2015
George Neal North	1091	2	Coal Steam	Iowa	301	2015
Geysers Unit 5-20	286	U10	Geothermal	California	30	2015
Geysers Unit 5-20	286	U9	Geothermal	California	30	2015
Gilbert	2393	8	Combined Cycle	New Jersey	90	2015
Gilbert	2393	C1	Combustion Turbine	New Jersey	23	2015
Gilbert	2393	C2	Combustion Turbine	New Jersey	25	2015
Gilbert	2393	C3	Combustion Turbine	New Jersey	25	2015
Gilbert	2393	C4	Combustion Turbine	New Jersey	25	2015
Glen Gardner	8227	1	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	2	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	3	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	4	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	5	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	6	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	7	Combustion Turbine	New Jersey	20	2015
Glen Gardner	8227	8	Combustion Turbine	New Jersey	20	2015
Glen Lyn	3776	6	Coal Steam	Virginia	235	2015
Glen Lyn	3776	51	Coal Steam	Virginia	45	2015
Glen Lyn	3776	52	Coal Steam	Virginia	45	2015
Green River	1357	4	Coal Steam	Kentucky	68	2015
Green River	1357	5	Coal Steam	Kentucky	95	2015
Greenport	2681	2	Combustion Turbine	New York	1.5	2015
Greenport	2681	7	Combustion Turbine	New York	1.6	2015
Groveton Paper Board	56140	TUR1	Combustion Turbine	New Hampshire	4	2015
Groveton Paper Board	56140	TUR2	Combustion Turbine	New Hampshire	4	2015
H B Robinson	3251	1	Coal Steam	South Carolina	177	2012
Hanford	10373	CB1302	Coal Steam	California	25	2012
Hansel	672	21	Combined Cycle	Florida	30	2012
Hansel	672	22	Combined Cycle	Florida	8	2012
Hansel	672	23	Combined Cycle	Florida	8	2012
Harbor Beach	1731	1	Coal Steam	Michigan	95	2015
Harllee Branch	709	3	Coal Steam	Georgia	509	2015
Harllee Branch	709	4	Coal Steam	Georgia	507	2015
Harvey Couch	169	1	O/G Steam	Arkansas	12	2015
Hatfields Ferry Power Station	3179	1	Coal Steam	Pennsylvania	506	2013
Hatfields Ferry Power Station	3179	2	Coal Steam	Pennsylvania	506	2013
Hatfields Ferry Power Station	3179	3	Coal Steam	Pennsylvania	506	2013
Herington	1283	1	Combustion Turbine	Kansas	1.6	2012
Herington	1283	2	Combustion Turbine	Kansas	1	2012
Herington	1283	3	Combustion Turbine	Kansas	3.1	2012
Herington	1283	5	Combustion Turbine	Kansas	0.9	2012
Herkimer	52057	01	Hydro	New York	0.1	2015
Herkimer	52057	02	Hydro	New York	0.1	2015
Herkimer	52057	03	Hydro	New York	0.1	2015
Herkimer	52057	04	Hydro	New York	0.1	2015
High Street Station	1670	3	Combustion Turbine	Massachusetts	0.7	2015
HMDC Kingsland Landfill	55604	UNT1	Landfill Gas	New Jersey	0.1	2010
HMDC Kingsland Landfill	55604	UNT2	Landfill Gas	New Jersey	0.1	2010

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
HMDC Kingsland Landfill	55604	UNT3	Landfill Gas	New Jersey	0.1	2010
Holcomb Rock	56314	HG2	Hydro	Virginia	0.2	2015
Howard Down	2434	10	O/G Steam	New Jersey	23	2010
Hutsonville	863	05	Coal Steam	Illinois	75	2011
Hutsonville	863	06	Coal Steam	Illinois	76	2011
Indian River Generating Station	594	1	Coal Steam	Delaware	89	2011
Indian River Generating Station	594	2	Coal Steam	Delaware	89	2010
Ivy River Hydro	50890	GEN1	Hydro	North Carolina	0.2	2015
Ivy River Hydro	50890	GEN2	Hydro	North Carolina	0.2	2015
Ivy River Hydro	50890	GEN3	Hydro	North Carolina	0.2	2015
Ivy River Hydro	50890	GEN4	Hydro	North Carolina	0.2	2015
Ivy River Hydro	50890	GEN5	Hydro	North Carolina	0.2	2015
Ivy River Hydro	50890	GEN6	Hydro	North Carolina	0.2	2015
J C Weadock	1720	7	Coal Steam	Michigan	155	2015
J C Weadock	1720	8	Coal Steam	Michigan	151	2015
J R Whiting	1723	1	Coal Steam	Michigan	97	2015
J R Whiting	1723	2	Coal Steam	Michigan	101	2015
J R Whiting	1723	3	Coal Steam	Michigan	124	2015
Jefferies	3319	3	Coal Steam	South Carolina	152	2012
Jefferies	3319	4	Coal Steam	South Carolina	150	2012
John Sevier	3405	3	Coal Steam	Tennessee	176	2015
John Sevier	3405	4	Coal Steam	Tennessee	176	2015
Johnsonville	3406	1	Coal Steam	Tennessee	107	2015
Johnsonville	3406	2	Coal Steam	Tennessee	107	2015
Johnsonville	3406	3	Coal Steam	Tennessee	107	2015
Johnsonville	3406	4	Coal Steam	Tennessee	107	2015
Kammer	3947	1	Coal Steam	West Virginia	200	2015
Kammer	3947	2	Coal Steam	West Virginia	200	2015
Kammer	3947	3	Coal Steam	West Virginia	200	2015
Kanawha River	3936	1	Coal Steam	West Virginia	200	2015
Kanawha River	3936	2	Coal Steam	West Virginia	200	2015
Kaw	1294	1	O/G Steam	Kansas	42	2013
Kaw	1294	2	O/G Steam	Kansas	42	2013
Kaw	1294	3	O/G Steam	Kansas	56	2013
Kewaunee	8024	1	Nuclear	Wisconsin	566	2013
Kitty Hawk	2757	GT1	Combustion Turbine	North Carolina	16	2011
Kitty Hawk	2757	GT2	Combustion Turbine	North Carolina	15	2011
Kraft	733	3	Coal Steam	Georgia	101	2015
L V Sutton	2713	1	Coal Steam	North Carolina	97	2013
L V Sutton	2713	2	Coal Steam	North Carolina	104	2013
L V Sutton	2713	3	Coal Steam	North Carolina	389	2013
Lake Creek	3502	D1	Combustion Turbine	Texas	2	2009
Lake Creek	3502	D2	Combustion Turbine	Texas	2	2009
Lansing	1047	2	Coal Steam	Iowa	8.4	2012
Lansing	1047	3	Coal Steam	Iowa	21	2014
Lee	2709	GT1	Combustion Turbine	North Carolina	12	2012
Lee	2709	GT2	Combustion Turbine	North Carolina	21	2012
Lee	2709	GT3	Combustion Turbine	North Carolina	21	2012
Lee	2709	GT4	Combustion Turbine	North Carolina	21	2012
Lilliwaup Falls Generating	50700	4735	Hydro	Washington	0.2	2015
Lilliwaup Falls Generating	50700	4736	Hydro	Washington	0.2	2015
Lilliwaup Falls Generating	50700	4737	Hydro	Washington	0.2	2015
Lilliwaup Falls Generating	50700	4738	Hydro	Washington	0.2	2015
Lilliwaup Falls Generating	50700	4739	Hydro	Washington	0.2	2015
Lilliwaup Falls Generating	50700	4740	Hydro	Washington	0.2	2015
Lilliwaup Falls Generating	50700	4741	Hydro	Washington	0.2	2015
Loveridge Road Power Plant	10368	CB1302	Coal Steam	California	18	2012
Maine Energy Recovery	10338	ABLR	Municipal Solid Waste	Maine	9	2012
Maine Energy Recovery	10338	BBLR	Municipal Solid Waste	Maine	9	2012
Marysville	1732	9	Coal Steam	Michigan	42	2011
Marysville	1732	10	Coal Steam	Michigan	42	2011

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
Marysville	1732	11	Coal Steam	Michigan	42	2011
Marysville	1732	12	Coal Steam	Michigan	42	2011
McIntosh	6124	1	Coal Steam	Georgia	156	2015
Meredosia	864	01	Coal Steam	Illinois	26	2011
Meredosia	864	02	Coal Steam	Illinois	26	2011
Meredosia	864	03	Coal Steam	Illinois	26	2011
Meredosia	864	04	Coal Steam	Illinois	26	2011
Meredosia	864	05	Coal Steam	Illinois	203	2011
Meredosia	864	06	O/G Steam	Illinois	166	2011
Miami Fort	2832	6	Coal Steam	Ohio	163	2015
Middle Station	2382	MID1	Combustion Turbine	New Jersey	19.1	2015
Middle Station	2382	MID2	Combustion Turbine	New Jersey	19.5	2015
Middle Station	2382	MID3	Combustion Turbine	New Jersey	36	2015
Missouri Avenue	2383	MISB	Combustion Turbine	New Jersey	20.5	2015
Missouri Avenue	2383	MISC	Combustion Turbine	New Jersey	20.5	2015
Missouri Avenue	2383	MISD	Combustion Turbine	New Jersey	20.6	2015
Montgomery	8025	1	Combustion Turbine	Minnesota	20.6	2012
Morgan City	1449	1	O/G Steam	Louisiana	5.8	2015
Morgan City	1449	2	O/G Steam	Louisiana	5.8	2015
Morgan Creek	3492	5	O/G Steam	Texas	175	2015
Morgan Creek	3492	6	O/G Steam	Texas	511	2015
Morris Sheppard	3557	1	Hydro	Texas	12	2015
Morris Sheppard	3557	2	Hydro	Texas	12	2015
Muskingum River	2872	1	Coal Steam	Ohio	190	2015
Muskingum River	2872	2	Coal Steam	Ohio	190	2015
Muskingum River	2872	3	Coal Steam	Ohio	205	2015
Muskingum River	2872	4	Coal Steam	Ohio	205	2015
Muskingum River	2872	5	Coal Steam	Ohio	585	2014
Neil Simpson	4150	5	Coal Steam	Wyoming	14.6	2014
Nelson Dewey	4054	1	Coal Steam	Wisconsin	115	2015
Nelson Dewey	4054	2	Coal Steam	Wisconsin	111	2015
Neosho	1243	7	O/G Steam	Kansas	67	2012
New Albany Energy Facility	55080	1	Combustion Turbine	Mississippi	60	2015
New Albany Energy Facility	55080	2	Combustion Turbine	Mississippi	60	2015
New Albany Energy Facility	55080	3	Combustion Turbine	Mississippi	60	2015
New Albany Energy Facility	55080	4	Combustion Turbine	Mississippi	60	2015
New Albany Energy Facility	55080	5	Combustion Turbine	Mississippi	60	2015
New Albany Energy Facility	55080	6	Combustion Turbine	Mississippi	60	2015
Nichols Road Power Plant	10371	CB1302	Coal Steam	California	17.8	2012
Niles	2861	1	Coal Steam	Ohio	108	2012
Niles	2861	2	Coal Steam	Ohio	108	2012
Nine Mile	3869	1	Hydro	Washington	8.9	2015
North Branch	7537	A	Coal Steam	West Virginia	37	2014
North Branch	7537	B	Coal Steam	West Virginia	37	2014
Norton	1310	1	Combustion Turbine	Kansas	0.9	2011
Norton	1310	2	Combustion Turbine	Kansas	1.3	2011
Norton	1310	3	Combustion Turbine	Kansas	2.4	2011
Norton	1310	4	Combustion Turbine	Kansas	3.1	2011
Norton	1310	5	Combustion Turbine	Kansas	2.2	2011
O H Hutchings	2848	H-1	Coal Steam	Ohio	58	2015
O H Hutchings	2848	H-2	Coal Steam	Ohio	55	2015
O H Hutchings	2848	H-3	Coal Steam	Ohio	63	2015
O H Hutchings	2848	H-4	Coal Steam	Ohio	63	2013
O H Hutchings	2848	H-5	Coal Steam	Ohio	63	2015
O H Hutchings	2848	H-6	Coal Steam	Ohio	63	2015
Oakely	1311	1	Combustion Turbine	Kansas	1.2	2012
Oakely	1311	2	Combustion Turbine	Kansas	0.3	2012
Oakely	1311	4	Combustion Turbine	Kansas	0.8	2012
Oakely	1311	6	Combustion Turbine	Kansas	3.2	2012
Oakland Dam Hydroelectric	10433	1	Hydro	Pennsylvania	0.5	2015
Oakland Dam Hydroelectric	10433	2	Hydro	Pennsylvania	0.5	2015

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
Osage	4151	1	Coal Steam	Wyoming	10.1	2010
Osage	4151	2	Coal Steam	Wyoming	10.1	2010
Osage	4151	3	Coal Steam	Wyoming	10.1	2010
Pearl Station	6238	1A	Coal Steam	Illinois	22.2	2012
Pella	1175	6	Coal Steam	Iowa	11.5	2012
Pella	1175	7	Coal Steam	Iowa	11.5	2012
Pella	1175	8	Coal Steam	Iowa	11.5	2012
Permian Basin	3494	5	O/G Steam	Texas	115	2011
Philip Sporn	3938	11	Coal Steam	West Virginia	145	2015
Philip Sporn	3938	21	Coal Steam	West Virginia	145	2015
Philip Sporn	3938	31	Coal Steam	West Virginia	145	2015
Philip Sporn	3938	41	Coal Steam	West Virginia	145	2015
Philip Sporn	3938	51	Coal Steam	West Virginia	440	2012
Picway	2843	9	Coal Steam	Ohio	95	2015
Port Everglades	617	PPE1	O/G Steam	Florida	213	2013
Port Everglades	617	PPE2	O/G Steam	Florida	213	2013
Port Everglades	617	PPE3	O/G Steam	Florida	387	2013
Port Everglades	617	PPE4	O/G Steam	Florida	392	2013
Porterdale Hydro	50242	TB-1	Hydro	Georgia	0.7	2015
Porterdale Hydro	50242	TB-2	Hydro	Georgia	0.7	2015
Portland	3113	1	Coal Steam	Pennsylvania	158	2015
Portland	3113	2	Coal Steam	Pennsylvania	243	2015
Powerdale	3031	1	Hydro	Oregon	6	2015
Prairie Creek	1073	2	Coal Steam	Iowa	2.1	2010
Prairie River	378	1	Hydro	Minnesota	0.3	2015
Prairie River	378	2	Hydro	Minnesota	0.3	2015
PSEG Burlington Generating Station	2399	91	Combustion Turbine	New Jersey	46	2014
PSEG Burlington Generating Station	2399	92	Combustion Turbine	New Jersey	46	2014
PSEG Burlington Generating Station	2399	93	Combustion Turbine	New Jersey	46	2014
PSEG Burlington Generating Station	2399	94	Combustion Turbine	New Jersey	46	2014
PSEG Burlington Generating Station	2399	111	Combustion Turbine	New Jersey	46	2015
PSEG Burlington Generating Station	2399	112	Combustion Turbine	New Jersey	46	2015
PSEG Burlington Generating Station	2399	113	Combustion Turbine	New Jersey	46	2015
PSEG Burlington Generating Station	2399	114	Combustion Turbine	New Jersey	46	2015
PSEG Edison Generating Station	2400	11	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	12	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	13	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	14	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	21	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	22	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	23	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	24	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	31	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	32	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	33	Combustion Turbine	New Jersey	42	2015
PSEG Edison Generating Station	2400	34	Combustion Turbine	New Jersey	42	2015
PSEG Essex Generating Station	2401	101	Combustion Turbine	New Jersey	42	2015
PSEG Essex Generating Station	2401	102	Combustion Turbine	New Jersey	42	2015
PSEG Essex Generating Station	2401	103	Combustion Turbine	New Jersey	42	2015
PSEG Essex Generating Station	2401	104	Combustion Turbine	New Jersey	42	2015
PSEG Essex Generating Station	2401	111	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	112	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	113	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	114	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	121	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	122	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	123	Combustion Turbine	New Jersey	46	2015
PSEG Essex Generating Station	2401	124	Combustion Turbine	New Jersey	46	2015
PSEG Sewaren Generating Station	2411	1	O/G Steam	New Jersey	104	2015
PSEG Sewaren Generating Station	2411	2	O/G Steam	New Jersey	118	2015
PSEG Sewaren Generating Station	2411	3	O/G Steam	New Jersey	107	2015

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
PSEG Sewaren Generating Station	2411	4	O/G Steam	New Jersey	124	2015
Pulliam	4072	5	Coal Steam	Wisconsin	52	2015
Pulliam	4072	6	Coal Steam	Wisconsin	71	2015
R Gallagher	1008	1	Coal Steam	Indiana	140	2012
R Gallagher	1008	3	Coal Steam	Indiana	140	2012
Ravenswood	2500	GT8	Combustion Turbine	New York	20	2015
Reid Gardner	2324	1	Coal Steam	Nevada	100	2014
Reid Gardner	2324	2	Coal Steam	Nevada	100	2014
Reid Gardner	2324	3	Coal Steam	Nevada	98	2014
Riverside	1559	GT6	Combustion Turbine	Maryland	115	2014
Riverton	1239	39	Coal Steam	Kansas	38	2015
Riverton	1239	40	Coal Steam	Kansas	54	2015
Riviera	619	PRV3	O/G Steam	Florida	277	2011
Riviera	619	PRV4	O/G Steam	Florida	288	2011
Rochester 5	2641	2	Hydro	New York	12.9	2015
Rochester 5	2641	HY1	Hydro	New York	12.9	2015
Rochester 5	2641	HY3	Hydro	New York	18	2015
Sabetha Power Plant	1320	4	Combustion Turbine	Kansas	0.7	2012
Sabetha Power Plant	1320	8	Combustion Turbine	Kansas	2.1	2012
San Francisquito 2	6480	1	Hydro	California	14.5	2015
San Onofre Nuclear Generating Station	360	2	Nuclear	California	1094	2013
San Onofre Nuclear Generating Station	360	3	Nuclear	California	1080	2013
Schuylkill Generating Station	3169	1	O/G Steam	Pennsylvania	166	2013
Schuylkill Generating Station	3169	IC1	Combustion Turbine	Pennsylvania	2.7	2013
Shawville	3131	1	Coal Steam	Pennsylvania	122	2015
Shawville	3131	2	Coal Steam	Pennsylvania	125	2015
Shawville	3131	3	Coal Steam	Pennsylvania	175	2015
Shawville	3131	4	Coal Steam	Pennsylvania	175	2015
Shelby Municipal Light Plant	2943	1	Coal Steam	Ohio	12	2012
Shelby Municipal Light Plant	2943	2	Coal Steam	Ohio	12	2012
Small Hydro of Texas	55000	01	Hydro	Texas	0.4	2015
Small Hydro of Texas	55000	02	Hydro	Texas	0.4	2015
Small Hydro of Texas	55000	03	Hydro	Texas	0.4	2015
Smart Papers LLC	50247	B010	Coal Steam	Ohio	26	2012
Smart Papers LLC	50247	B020	Coal Steam	Ohio	15.1	2012
Smart Papers LLC	50247	B022	Coal Steam	Ohio	4.5	2012
Somerset Station	1613	6	Coal Steam	Massachusetts	109	2011
Steamboat 1	50763	OE11	Geothermal	Nevada	0.9	2015
Steamboat 1	50763	OE12	Geothermal	Nevada	0.9	2015
Steamboat 1	50763	OE13	Geothermal	Nevada	0.9	2015
Steamboat 1	50763	OE14	Geothermal	Nevada	0.9	2015
Steamboat 1	50763	OE21	Geothermal	Nevada	0.9	2015
Steamboat 1	50763	OE22	Geothermal	Nevada	0.9	2015
Steamboat 1	50763	OE23	Geothermal	Nevada	0.9	2015
Steamboat 1A Power Plant	52138	DE32	Geothermal	Nevada	0.9	2015
Swift 2	6265	21	Hydro	Washington	34	2015
Taconite Harbor Energy Center	10075	3	Coal Steam	Minnesota	76	2015
Tangier	6390	3	Combustion Turbine	Virginia	0.6	2015
Tangier	6390	4	Combustion Turbine	Virginia	0.8	2015
Tanners Creek	988	U1	Coal Steam	Indiana	145	2015
Tanners Creek	988	U2	Coal Steam	Indiana	145	2015
Tanners Creek	988	U3	Coal Steam	Indiana	200	2015
Tanners Creek	988	U4	Coal Steam	Indiana	500	2014
Teche	1400	2	O/G Steam	Louisiana	33	2011
Tecumseh Energy Center	1252	1	Combustion Turbine	Kansas	18	2012
Tecumseh Energy Center	1252	2	Combustion Turbine	Kansas	19	2012
Thomas C Ferguson	4937	1	O/G Steam	Texas	420	2013
Thousand Springs	820	1	Hydro	Idaho	0.8	2015
Thousand Springs	820	2	Hydro	Idaho	0.8	2015
Tillotson Rubber	50095	IC1	Combustion Turbine	New Hampshire	0.4	2012
Tillotson Rubber	50095	IC2	Combustion Turbine	New Hampshire	0.6	2012

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Tillotson Rubber	50095	TG2	Biomass	New Hampshire	0.6	2012
Tillotson Rubber	50095	TGI	Biomass	New Hampshire	0.7	2012
Titus	3115	1	Coal Steam	Pennsylvania	81	2015
Titus	3115	2	Coal Steam	Pennsylvania	81	2015
Titus	3115	3	Coal Steam	Pennsylvania	81	2015
Tradinghouse Power Company LLC	3506	2	O/G Steam	Texas	818	2011
Trigen Syracuse Energy	50651	2	Coal Steam	New York	24.6	2013
Trigen Syracuse Energy	50651	3	Coal Steam	New York	24.6	2013
Trigen Syracuse Energy	50651	4	Coal Steam	New York	12.3	2013
Trigen Syracuse Energy	50651	5	Coal Steam	New York	12.3	2013
Tulsa	2965	1403	O/G Steam	Oklahoma	65	2015
Turkey Point	621	PTP2	O/G Steam	Florida	392	2013
TXU Sweetwater Generating Plant	50615	GT01	Combined Cycle	Texas	41	2009
TXU Sweetwater Generating Plant	50615	GT02	Combined Cycle	Texas	86	2009
TXU Sweetwater Generating Plant	50615	GT03	Combined Cycle	Texas	86	2009
Tyrone	1361	5	Coal Steam	Kentucky	71	2013
Union Carbide Seadrift Cogen	50150	IGT	Combined Cycle	Texas	12	2015
Upper Androscoggin	54202	2	Hydro	Maine	0.5	2015
Venice	913	GT1	Combustion Turbine	Illinois	26	2015
Vermilion	897	1	Coal Steam	Illinois	62	2011
Vermilion	897	2	Coal Steam	Illinois	99	2011
Vermilion	897	3	Combustion Turbine	Illinois	10	2011
Vermont Yankee	3751	1	Nuclear	Vermont	620.3	2014
Viking Energy of Northumberland	50771	B1	Biomass	Pennsylvania	16.2	2012
W N Clark	462	55	Coal Steam	Colorado	17.6	2013
W N Clark	462	59	Coal Steam	Colorado	24.9	2013
W S Lee	3264	1	Coal Steam	South Carolina	100	2015
W S Lee	3264	2	Coal Steam	South Carolina	100	2015
W S Lee	3264	3	Coal Steam	South Carolina	170	2015
Wabash River	1010	2	Coal Steam	Indiana	85	2014
Wabash River	1010	3	Coal Steam	Indiana	85	2014
Wabash River	1010	4	Coal Steam	Indiana	85	2014
Wabash River	1010	5	Coal Steam	Indiana	95	2014
Walter C Beckjord	2830	1	Coal Steam	Ohio	94	2012
Walter C Beckjord	2830	2	Coal Steam	Ohio	94	2015
Walter C Beckjord	2830	3	Coal Steam	Ohio	128	2015
Walter C Beckjord	2830	4	Coal Steam	Ohio	150	2015
Walter C Beckjord	2830	5	Coal Steam	Ohio	238	2015
Walter C Beckjord	2830	6	Coal Steam	Ohio	414	2015
Walter Scott Jr Energy Center	1082	1	Coal Steam	Iowa	43	2015
Walter Scott Jr Energy Center	1082	2	Coal Steam	Iowa	88	2015
Wanapum	3888	2	Hydro	Washington	97	2012
Washington Parish Energy Center	55486	CTG1	Combined Cycle	Louisiana	172	2015
Washington Parish Energy Center	55486	CTG2	Combined Cycle	Louisiana	172	2015
Washington Parish Energy Center	55486	ST1	Combined Cycle	Louisiana	215	2015
Watts Bar Fossil	3419	A	Coal Steam	Tennessee	56	2011
Watts Bar Fossil	3419	B	Coal Steam	Tennessee	56	2011
Watts Bar Fossil	3419	C	Coal Steam	Tennessee	56	2011
Watts Bar Fossil	3419	D	Coal Steam	Tennessee	56	2011
Webbers Falls	2987	3	Hydro	Oklahoma	23	2015
Welsh	6139	2	Coal Steam	Texas	528	2014
Werner	2385	GT1	Combustion Turbine	New Jersey	53	2015
Werner	2385	GT2	Combustion Turbine	New Jersey	53	2015
Werner	2385	GT3	Combustion Turbine	New Jersey	53	2015
Werner	2385	GT4	Combustion Turbine	New Jersey	53	2015
Western Renewable Energy	56358	1	Biomass	Arizona	2.5	2015
Weston	4078	1	Coal Steam	Wisconsin	58	2015
Weston	4078	2	Coal Steam	Wisconsin	81	2015
Wilbur East Power Plant	10370	CB1302	Coal Steam	California	18.1	2012
Wilbur West Power Plant	10369	CB1302	Coal Steam	California	18.2	2012
Williston	2791	2	Combustion Turbine	North Dakota	4.7	2012

Plant Name	ORIS Plant Code	Unit ID	Plant Type	State Name	Capacity (MW)	Retirement Year
Wisconsin Rapids	3974	6	Hydro	Wisconsin	0.3	2015
Wisconsin Rapids	3974	8	Hydro	Wisconsin	0.3	2015
Wiscoy 170	2646	1	Hydro	New York	0.6	2015
Wiscoy 170	2646	2	Hydro	New York	0.4	2015
Worcester Energy	10165	1	Biomass	Maine	5.7	2015
Worcester Energy	10165	2	Biomass	Maine	5.7	2015
Worcester Energy	10165	3	Biomass	Maine	5.7	2015
Wythe Park Power Petersburg Plant	54045	1	Fossil Waste	Virginia	3	2013
Yorktown	3809	1	Coal Steam	Virginia	159	2014
Yuma	524	3	Combustion Turbine	Colorado	0.2	2015