Updates in January 2020 Reference Case

1. Introduction

This document describes the updates in the January 2020 Reference Case that are incremental to the EPA's Power Sector Modeling Platform v6 using IPM November 2018 Reference Case. These updates are detailed below.

Table 1-1 lists updates included in January 2020 Reference Case incremental to EPA's Power Sector Modeling Platform v6 using IPM November 2018 Reference Case (for which full-fledged documentation is available) and also differentiates the updates that were already included in May 2019 Reference Case. Updates that are highlighted in gray were new in the January 2020 Reference Case.

Table 1-1 Updates in the January 2020 Reference Case incremental to November 2018 Reference Case

Description	For More Information
Power System Operation	
Updated SO_2 Floor Rates and Removal Efficiencies	Section 3.9.1
Updated Renewable Portfolio Standards and Solar Carve-Outs	Table 3-19
Updated BART NO_x limits	Table 3-28
Added Offshore Wind Mandates	Table 3-29
Added Clean Energy Standards	Table 3-30
Added 45Q – Credit for Carbon Dioxide Sequestration	Table 3-31
Added Affordable Clean Energy (ACE) Rule	Table 3-32
Generating Resources	
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Updated Summary Population (through 2018) of Existing Units in NEEDS v6	Table 4-3
Updated Aggregation Profile of Model Plants as Provided at Set up of EPA Platform v6	Table 4-7
Updated Summary of Planned-Committed Units in NEEDS v6 for EPA Platform v6	Table 4-11
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Updated Short-Term Capital Cost Adders for New Power Plants in EPA Platform v6 (2016$)	Table 4-14
Updated Performance and Unit Cost Assumptions for Potential (New) Renewable and Non-Conventional Technology Capacity in EPA Platform v6	Table 4-16
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Updated Solar Thermal Capacity Factor by Resource Class and Season	Table 4-47

Description	For More Information
Added New Jersey ZEC Bill	Section 4.5.1

Section 3.9.1

SO_2 Floor Rates and Removal Efficiencies

The SO_2 removal efficiencies for existing coal units with FGD's were updated based on those reported in 2017 EIA Form 860. The FGD removal efficiencies in South Carolina are based on efficiencies realized during the 2015-2018 period. In addition, the SO_2 rate floor values for existing coal units with FGD's are calculated as follows.

- Dry FGD - minimum (0.08, minimum reported ETS SO_2 rate for the 2014-2018 period)
- Wet FGD - minimum (0.06, minimum reported ETS SO_2 rate for the 2014-2018 period)

Section 3.9.3

BART NO_x Limits

Table 3-28 lists the BART NO_x and SO_2 limits applied to specific EGUs in the January 2020 Reference Case. In the January 2020 Reference Case, the BART NO_x limits for Hunter 1-2 and Huntington 1-2 were updated from 0.07 lbs/MMBtu to 0.26 lbs/MMBtu and a new BART NO_x limit of 0.34 lbs/MMBtu was added to Hunter 3.

Table 3-28 BART Regulations included in EPA Platform v6

BART Affected Plants	UniqueID	BART Status/ CSAPR/ Shutdown/ Coal-to-Gas	NO_x BART Limit	SO_2 BART Limit	NO_x Compliance Date	SO_2 Compliance Date	State
Comanche	470_B_1	BART NO_x & BART SO_2	0.20 lb/MMBtu	0.12 lb/MMBtu 0.10 lb/MMBtu combined on annual average	2018	2018	Colorado
Comanche	470_B_2	BART NO_x & BART SO_2	0.20 lb/MMBtu	0.12 lb/MMBtu 0.10 lb/MMBtu combined on annual average	2018	2018	Colorado
Craig	6021_B_C1	BART SO_2		0.11 lb/MMBtu	2021	2012	Colorado
Craig	6021_B_C2	BART NO_x & BART SO_2	0.08 lb/MMBtu	0.11 lb/MMBtu	2018	2012	Colorado
Four Corners	2442_B_4	BART NO_x & BART SO_2	0.098 lb/MMBtu	Actual emissions	2018	2018	New Mexico
Four Corners	2442_B_5	BART NO_x & BART SO_2	0.098 lb/MMBtu	Actual emissions	2018	2018	New Mexico
Gerald Gentleman	6077_B_1	BART NO_x	0.23 lb/MMBtu	CSAPR	2018	2018	Nebraska
Gerald Gentleman	6077_B_2	BART NO_x	0.23 lb/MMBtu	CSAPR	2018	2018	Nebraska
Hayden	525_B_H1	BART NO_x & BART SO_2	0.08 lb/MMBtu	0.13 lb/MMBtu	2018	2018	Colorado
Hayden	525_B_H2	BART NO_x & BART SO_2	0.07 lb/MMBtu	0.13 lb/MMBtu	2018	2018	Colorado
Martin Drake	492_B_6	BART NO_x & BART SO_2	0.32 lb/MMBtu	0.13 lb/MMBtu	2018	2018	Colorado
Martin Drake	492_B_7	BART NO_x & BART SO_2	0.32 lb/MMBtu	0.13 lb/MMBtu	2018	2018	Colorado
Nebraska City	6096_B_1	BART NO_x & BART SO_2	0.23 lb/MMBtu	1.2 lb/MMBtu	2018	2018	Nebraska
San Juan	2451_B_1	BART NO_x & BART SO_2	0.23 lb/MMBtu	Actual emissions	2018	2018	New Mexico
San Juan	2451_B_4	BART NO_x & BART SO_2	0.23 lb/MMBtu	Actual emissions	2018	2018	New Mexico
Apache Station	160_B_2	BART NO_x & BART SO_2	0.085 lb/MMBtu	0.00064 lb/MMBtu	12/5/2017	12/5/2017	Arizona
Apache Station	160_B_3	BART NO_x & BART SO_2	0.23 lb/MMBtu	0.15 lb/MMBtu	12/5/2017	12/5/2017	Arizona
Cherokee	469_B_4	BART NO_x & BART SO_2	0.12 lb/MMBtu	7.81 tpy (12 month rolling)	2018	2018	Colorado
Cholla	113_B_3	BART NO_x & BART SO_2	0.22 lb/MMBtu	0.15 lb/MMBtu	12/1/2017 - April 30, 2025	2016 - April 30, 2025	Arizona
Cholla	113_B_3	BART NO_x & BART SO_2	0.08 lb/MMBtu	0.0006 lb/MMBtu	after April 30, 2025	after April 30, 2025	Arizona
Cholla	113_B_4	BART NO_x & BART SO_2	0.22 lb/MMBtu	0.15 lb/MMBtu	12/1/2017 - April 30, 2025	2016 - April 30, 2025	Arizona
Cholla	113_B_4	BART NO_x & BART SO_2	0.08 lb/MMBtu	0.0006 lb/MMBtu	after April 30, 2025	after April 30, 2025	Arizona

BART Affected Plants	UniqueID	BART Status/ CSAPR/ Shutdown/ Coal-to-Gas	NO_x BART Limit	SO_2 BART Limit	NO_x Compliance Date	SO_2 Compliance Date	State
Coal Creek	6030_B_1	BART SO_2		0.15 lb/MMBtu or 95% efficiency	2018	2018	North Dakota
Coal Creek	6030_B_2	BART SO_2		0.15 lb/MMBtu or 95% efficiency	2018	2018	North Dakota
Coronado	6177_B_U1B	BART NO_x & BART SO_2	0.065 lb/MMBtu	0.08 lb/MMBtu	12/5/2017	2016	Arizona
Coronado	6177_B_U2B	BART NO_x & BART SO_2	0.080 lb/MMBtu	0.08 lb/MMBtu	12/5/2017	2016	Arizona
Jeffrey Energy Center	6068_B_1	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.15 lb/MMBtu	2018	2018	Kansas
Jeffrey Energy Center	6068_B_2	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.15 lb/MMBtu	2018	2018	Kansas
La Cygne	1241_B_1	BART NO_x & BART SO_2	0.13 lb/MMBtu (combined both units)	0.15 lb/MMBtu	6/1/2015	2016	Kansas
La Cygne	1241_B_2	BART NO_x & BART SO_2	0.13 lb/MMBtu (combined both units)	0.15 lb/MMBtu	6/1/2015	2018	Kansas
Leland Olds	2817_B_1	BART NO_x & BART SO_2	0.19 lb/MMBtu	0.15 lb/MMBtu or 95% efficiency	2018	2018	North Dakota
Leland Olds	2817_B_2	BART NO_x & BART SO_2	0.35 lb/MMBtu	0.15 lb/MMBtu or 95% efficiency	2018	2018	North Dakota
Merrimack	2364_B_2	BART NO_x & BART SO_2	0.30 lb/MMBtu	90 % control	2018	2018	New Hampshire
Milton R Young	2823_B_B1	BART NO_x & BART SO_2	0.36 lb/MMBtu	0.15 lb/MMBtu or 95% efficiency	2018	2018	North Dakota
Milton R Young	2823_B_B2	BART NO_x & BART SO_2	0.35 lb/MMBtu	0.15 lb/MMBtu or 95% efficiency	2018	2018	North Dakota
Muskogee	2952_B_4	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.06 lbs/MMBtu	2018	2018	Oklahoma
Muskogee	2952_B_5	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.06 lbs/MMBtu	2018	2018	Oklahoma
Pawnee	6248_B_1	BART NO_x & BART SO_2	0.07 lb/MMBtu	0.12 lb/MMBtu	2018	2018	Colorado
Ray D Nixon	8219_B_1	BART NO_x & BART SO_2	0.21 lb/MMBtu	0.11 lb/MMBtu	2018	2018	Colorado
Sooner	6095_B_1	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.06 lbs/MMBtu	2018	2018	Oklahoma
Sooner	6095_B_2	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.06 lbs/MMBtu	2018	2018	Oklahoma
Northeastern	2963_B_3313	BART NO_x & BART SO_2	0.23 lb/MMBtu	0.40 lb/MMBtu	2018	2016 to 2026	Oklahoma
Seminole	136_B_1	BART SO_2		0.25 lb/MMBtu	2018	2018	Florida
Seminole	136_B_2	BART SO_2		0.25 lb/MMBtu	2018	2018	Florida
Northside Generating Station	667_B_1	BART SO_2		3600 tpy across 3 units	2018	2018	Florida

BART Affected Plants	UniqueID	BART Status/ CSAPR/ Shutdown/ Coal-to-Gas	NO_x BART Limit	SO_2 BART Limit	NO_x Compliance Date	SO_2 Compliance Date	State
Northside Generating Station	667_B_2	BART SO_2		3600 tpy across 3 units	2018	2018	Florida
Deerhaven Generating Station	663_B_B2	BART SO_2		5500 tpy	2018	2018	Florida
Big Cajun 2	6055_B_2B1	BART NO_x	0.15 lb/MMBtu		2014		Louisiana
Big Stone	6098_B_1	BART NO_x & BART SO_2	0.1 lb/MMBtu	0.09 lb/MMBtu	2018	2018	South Dakota
J H Campbell	1710_B_1	BART SO_2		0.29 lb/MMBtu		2017	Michigan
J H Campbell	1710_B_2	BART NO_x & BART SO_2	0.08 lb/MMBtu	0.32 lb/MMBtu	2015	2017	Michigan
J H Campbell	1710_B_3	BART NO_x & BART SO_2	0.08 lb/MMBtu	0.07 lb/MMBtu	2015	2018	Michigan
Dave Johnston	4158_B_BW44	BART NO_x	0.15 lb/MMBtu		2019		Wyoming
Jim Bridger	8066_B_BW71	BART NO_x	0.26 lb/MMBtu 0.07 lb/MMBtu after 2022		2018		Wyoming
Jim Bridger	8066_B_BW72	BART NO_x	0.26 lb/MMBtu 0.07 lb/MMBtu after 2022		2018		Wyoming
Jim Bridger	8066_B_BW73	BART NO_x	0.07 lb/MMBtu		2018		Wyoming
Jim Bridger	8066_B_BW74	BART NO_x	0.07 lb/MMBtu		2018		Wyoming
Laramie River Station	6204_B_1	BART NO_x & BART SO_2	0.06 lb/MMBtu	0.12 lb/MMBtu	2019		Wyoming
Laramie River Station	6204_B_2	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.12 lb/MMBtu	2019		Wyoming
Naughton	4162_B_1	BART NO_x	0.26 lb/MMBtu		2019		Wyoming
Naughton	4162_B_2	BART NO_x	0.26 lb/MMBtu		2019		Wyoming
Naughton	4162_B_3	BART NO_x	0.07 lb/MMBtu		2019		Wyoming
Transalta Centralia Generation	3845_B_BW22	BART NO_x & BART SO_2	0.21 lb/MMBtu (both units averaged together)	10000 tpy	2013	2002	Washington
Sherburne County	6090_B_1	BART SO_2		0.05 lb/MMBtu		9/30/2015	Minnesota
Sherburne County	6090_B_2	BART SO_2		0.05 lb/MMBtu		9/30/2015	Minnesota
Hunter	6165_B_1	BART NO_x	0.26 lb/MMBtu		2022		Utah
Hunter	6165_B_2	BART NO_x	0.26 lb/MMBtu		2022		Utah
Hunter	6165_B_3	BART NO_x	0.34 lb/MMBtu		2022		Utah
Huntington	8069_B_1	BART NO_x	0.26 lb/MMBtu		2022		Utah

BART Affected Plants	UniqueID	BART Status/ CSAPR/ Shutdown/ Coal-to-Gas	NO_x BART Limit	SO_2 BART Limit	NO_x Compliance Date	SO_2 Compliance Date	State
Huntington	8069_B_2	BART NO_x	0.26 lb/MMBtu		2022		Utah
Lawrence Energy Center	1250_B_4	BART NO_x & BART SO_2	0.18 lb/MMBtu	0.15 lb/MMBtu	2014	2014	Kansas
Lawrence Energy Center	1250_B_5	BART NO_x & BART SO_2	0.15 lb/MMBtu	0.15 lb/MMBtu	2014	2014	Kansas
Tecumseh Energy Center	1252_B_9	BART NO_x	0.18 lb/MMBtu		2018		Kansas
B L England 2	2378_B_2	BART NO_x & BART SO_2	0.1 lb/MMBTU	0.15 lb/MMBTU	2012	2011	New Jersey
Danskammer Generating Station	2480_B_4	BART NO_x & BART SO_2	0.12 lb/MMBTU	0.09 lb/MMBTU	2014	2014	New York
Arthur Kill Generating Station	2490_B_30	BART NO_x & BART SO_2	0.15 lb/MMBTU	0.15 lb/MMBTU	2014	2014	New York
Ravenswood	2500_B_10	BART NO_x	0.15 lb/MMBTU		2014		New York
Ravenswood	2500_B_20	BART NO_x	0.15 lb/MMBTU		2014		New York
Ravenswood	2500_B_30	BART NO_x	0.15 lb/MMBTU		2014		New York
E F Barrett	2511_B_20	BART NO_x	0.1 lb/MMBTU		2014		New York
Northport	2516_B_1	BART NO_x	0.1 lb/MMBTU		2014		New York
Northport	2516_B_2	BART NO_x	0.1 lb/MMBTU		2014		New York
Northport	2516_B_3	BART NO_x	0.1 lb/MMBTU		2014		New York
Northport	2516_B_4	BART NO_x	0.1 lb/MMBTU		2014		New York
Oswego Harbor Power	2594_B_5	BART NO_x & BART SO_2	383 tpy	0.8 lb/MMBTU	2014	2014	New York
Oswego Harbor Power	2594_B_6	BART NO_x & BART SO_2	665 tpy	0.8 lb/MMBTU	2014	2014	New York
Bowline Point	2625_B_1	BART NO_x	0.15 lb/MMBTU		2014		New York
Bowline Point	2625_B_2	BART NO_x	0.15 lb/MMBTU		2014		New York
Sherburne County	6090_B_3	BART SO_2		0.29 lb/MMBTU		2017	Minnesota
Laramie River Station	6204_B_3	BART NO_x	0.15 lb/MMBtu		2018		Wyoming
Antelope Valley	6469_B_B1	BART NO_x	0.17 lb/MMBTU		2018		North Dakota
Antelope Valley	6469_B_B2	BART NO_x	0.17 lb/MMBTU		2018		North Dakota
Roseton Generating Station	8006_B_1	BART SO_2		0.55 lb/MMBTU		2014	New York

BART Affected Plants	UniqueID	BART Status/ CSAPR/ Shutdown/ Coal-to-Gas	NO_x BART Limit	SO_2 BART Limit	NO_x Compliance Date	SO_2 Compliance Date	State
Roseton Generating Station	8006_B_2	BART SO_2		0.55 lb/MMBTU		2014	New York
Cholla	113_B_1	C2G by 2025					Arizona
Cholla	113_B_3	C2G by 2025					Arizona
Cholla	113_B_4	C2G by 2025					Arizona

Note: Above table does not reflect all BART units, only those that have unit-specific requirements.
BART units where CSAPR, a state program, or litigation suggests no current unit-specific requirement are not reflected.

Section 3.9.9

Renewable Portfolio Standard

Renewable Portfolio Standards (RPS) generally refers to various state-level policies that require the addition of renewable generation to meet a specified share of statewide electricity sales. In EPA Platform v6, the state RPS requirements are represented at a state level based on requirements. Table 3-19 incorporates updated state level RPS requirements and solar carve-out requirements in CA, DC, MD, ME, NM, NV, NY, OH and WA included in the January 2020 Reference Case.

Table 3-19 Renewable Portfolio Standards in EPA Platform v6

State Renewable Portfolio Standards								
State	**2021**	**2023**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Arizona	6.3%	7.4%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%
California	33.0%	38.7%	44.3%	57.5%	60.0%	60.0%	60.0%	60.0%
Colorado	21.2%	21.2%	21.2%	21.2%	21.2%	21.2%	21.2%	21.2%
Connecticut	26.5%	30.0%	34.0%	44.0%	44.0%	44.0%	44.0%	44.0%
District of Columbia	26.3%	38.8%	52.0%	87.0%	100.0%	100.0%	100.0%	100.0%
Delaware	15.2%	16.6%	18.1%	18.1%	18.1%	18.1%	18.1%	18.1%
Iowa	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
Illinois	9.8%	11.5%	13.1%	14.0%	14.0%	14.0%	14.0%	14.0%
Massachusetts	21.5%	23.5%	25.5%	30.5%	35.5%	40.5%	45.5%	50.5%
Maryland	30.5%	34.7%	40.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Maine	45.0%	51.0%	59.0%	80.0%	85.0%	90.0%	95.0%	100.0%
Michigan	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Minnesota	25.7%	25.7%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%
Missouri	10.6%	10.6%	10.6%	10.6%	10.6%	10.6%	10.6%	10.6%
Montana	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%
North Carolina	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
New Hampshire	19.8%	21.2%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%
New Jersey	23.5%	30.5%	37.5%	52.5%	52.5%	52.5%	52.5%	52.5%
New Mexico	20.0%	28.1%	36.1%	45.2%	57.2%	69.2%	70.7%	72.3%
Nevada	18.9%	22.9%	29.8%	43.8%	43.8%	43.8%	43.8%	43.8%
New York	30.5%	39.3%	48.1%	70.0%	70.0%	70.0%	70.0%	70.0%
Ohio	5.3%	6.2%	7.1%	7.6%	7.6%	7.6%	7.6%	7.6%
Oregon	14.1%	14.1%	21.0%	27.6%	36.1%	41.1%	42.6%	42.6%
Pennsylvania	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Rhode Island	17.5%	20.5%	23.5%	31.0%	38.5%	38.5%	38.5%	38.5%
Texas	4.2%	4.1%	4.1%	3.9%	3.7%	3.6%	3.4%	3.3%
Vermont	62.4%	67.6%	68.8%	79.8%	85.0%	85.0%	85.0%	85.0%
Washington	11.8%	11.8%	11.8%	11.8%	11.8%	11.8%	11.8%	11.8%
Wisconsin	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.65%
State RPS Solar Carve-outs								
State	**2021**	**2023**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
District of Columbia	2.5%	2.9%	3.5%	5.0%	7.0%	9.5%	10.0%	10.0%
Delaware	1.8%	2.2%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Illinois	1.05%	1.23%	1.41%	1.50%	1.50%	1.50%	1.50%	1.50%
Massachusetts	0.17%	0.18%	0.20%	0.24%	0.28%	0.32%	0.36%	0.40%
Maryland	6.75%	8.75%	11.50%	14.50%	14.50%	14.50%	14.50%	14.50%
Minnesota	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%
Missouri	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%
North Carolina	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
New Hampshire	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%
New Jersey	5.10%	5.10%	4.80%	2.21%	1.10%	1.10%	1.10%	1.10%
New Mexico	0%	0%	0%	0%	0%	0%	0%	0%
Nevada	0%	0%	0%	0%	0%	0%	0%	0%
Ohio	0%	0%	0%	0%	0%	0%	0%	0%
Pennsylvania	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%

Note 1: The Renewable Portfolio Standard percentages are applied to modeled electricity sale projections.
Note 2: North Carolina standards are adjusted to account for swine waste and poultry waste set-asides.

Offshore Wind Requirement

Multiple U.S. states have recently adopted offshore wind energy policies that call for the deployment of 17,668 MW of offshore wind capacity by 2035. Table 3-29 summarizes the state-specific offshore wind mandates that are included in the January 2020 Reference Case.

Table 3-29 Offshore Wind Mandates

State	Bill/Act	Mandate Specifications	Implementation Year
Maryland	Senate Bill 516	400 MW, 800 MW, and 1,200 MW of offshore wind capacity by 2026, 2028 and 2030 respectively	2030
	Maryland Offshore Wind Energy Act of 2013	368 MW of offshore wind capacity (248 MW of US Wind, Inc. and 120 MW of Skipjack Offshore Energy, LLC projects)	2023
New Jersey	Executive Order No. 8	3,500 MW of offshore wind capacity by 2030	2030
Connecticut	House Bill 7156	2,000 MW of offshore wind capacity by 2030	2030
Massachusetts	Massachusetts Energy Diversity Act	1,600 MW of offshore wind capacity by 2027	2030
New York	Climate Leadership and Community Protection Act	9,000 MW of offshore wind capacity by 2035	2035
Maine	Final Report of the Ocean Energy Task Force, 2009	Goal of 5,000 MW of offshore wind capacity by 2030	Not implemented

Clean Energy Standard

A clean energy standard requires a certain percentage of electricity sales be met through zero carbon resources, such as renewables, nuclear energy and hydropower. Several states CA, NM, NV, NY and WA have recently implemented the clean energy standards and the updates are included in the January 2020 Reference Case. These requirements are summarized in Table 3-30.

Table 3-30 Clean Energy Standards in EPA Platform v6

State Clean Energy Standards								
State	**2021**	**2023**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
California	-	-	-	-	-	-	-	100%
New Mexico[1]	-	-	-	-	-	-	100%	100%
Nevada	-	-	-	-	-	-	-	100%
New York	-	-	-	-	-	100%	100%	100%
Washington[2]	-	-	-	100%	100%	100%	100%	100%

Notes:

[1]For 2045 the 100% target is applicable to public utilities and in 2050 it is applicable to both public utilities and rural electric cooperatives.

[2]For the compliance period beginning January 1, 2030, through December 31, 2044, an electric utility may satisfy up to twenty percent of its compliance obligation with an alternative compliance option.

45Q – Credit for Carbon Dioxide Sequestration

Bipartisan Budget Act of 2018, Section 45Q – which amended a Credit for Carbon Dioxide Sequestration originally passed in 2008 (hereafter referred to as the 45Q tax credit) were implemented in the January 2020 Reference Case.

The updated 45Q tax credit (2018) offers increased monetary incentives by way of a tax credit for the capture and geologic storage of CO_2 that would otherwise be emitted by electric power plants and other industrial sources in the United States. The basic features of the tax credit include the following:

- $12.83 per metric ton in 2016 for carbon dioxide (CO_2) captured and injected into existing oil wells for enhanced oil recovery (EOR). The credit increases to $35 per metric ton by 2026. The credit for intermediate years is determined by linear interpolation. The credit is adjusted for inflation post 2026.

- $22.66 per metric ton in 2016 for CO_2 captured and sequestrated in geologic formation (Non-EOR). The credit increases to $50 per metric ton by 2026. The credit for intermediate years is determined by linear interpolation. The credit is adjusted for inflation post 2026.

- The dollar amounts of credit are in 2017 nominal dollars. The difference in the amounts of credit between EOR and Non-EOR is by design to recognize the fact that the EOR captured CO_2 can be used to produce oil that may not otherwise be recovered, while the Non-EOR stored CO_2 does not bring additional revenue.

- The credit applies for 12 years beginning on the date equipment is placed in service.

The January 2020 Reference Case implements the 45Q tax credit by applying the value of the credit through an adjustment to the step prices in the CO_2 storage cost curves.[1] The process involves converting the dollar amounts of credit into 2016 real dollars, calculating weighted average tax credits by run year, and applying the weighted average tax credits to the individual step prices in the CO_2 storage cost curves. Annual inflation is assumed to be 1.83%.[2]

Although the 45Q tax credit expires in 2026, due to an assumed construction lead time of 4 years, a 2030 vintage plant is assumed to qualify for the tax credit.

Affordable Clean Energy (ACE) Rule

The January 2020 Reference Case includes a representation of the Affordable Clean Energy (ACE) rule. Consistent with the RIA for the Final rule, HRI is adopted at affected units based upon unit size and efficiency. The heat rates and sizes are specified below. Sources that are covered by the rule are divided into twelve groups based on three size categories and four efficiency categories, and a cost and performance assumption for HRI from the candidate technologies is assigned to each group (based upon analysis done to support the Final Rule[3]). The HRI cost and performance differs across the groups, as

[1] For more information on the CO_2 storage cost curves, see Chapter 6 – CO_2 Capture, Storage, and Transport in the Documentation for EPA's Power Sector Modeling Platform v6 Using Integrated Planning Model. The documentation is available online at https://www.epa.gov/airmarkets/documentation-ipm-platform-v6-all-chapters.

[2] For more information on the inflation and other financial assumptions, see Chapter 10 – Financial Assumptions in the Documentation for EPA's Power Sector Modeling Platform v6 Using Integrated Planning Model. The documentation is available online at https://www.epa.gov/airmarkets/documentation-ipm-platform-v6-all-chapters.

[3] the Regulatory Impact Analysis for the Repeal of the Clean Power Plan, and the Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units (2019). Available at https://www.epa.gov/stationary-sources-air-pollution/affordable-clean-energy-rule

summarized in table below. The representation assumes that all units that are projected to operate in each category adopt HRI measures as specified in the table below. In practice, states may choose to implement ACE differently. As states develop their plans to meet the requirements of ACE, adjustments will be made in EPA's modeling of ACE to best reflect each state's requirements. More information on the development of these illustrative scenario assumptions can be found in Chapter 1 of the Regulatory Impact Analysis for the Repeal of the Clean Power Plan, and the Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units.[4]

Table 3-32: HRI Cost and Performance Assumptions for Illustrative Policy Scenario, by Unit Capacity and Heat Rate

	Small (<25 MW to 200 MW)	**Medium** (200 MW to 500 MW)	**Large** (>500 MW)
Group 1 **(Most Efficient)** ≤ 9,773 Btu/kWh	N/A (<1%)	N/A (1%)	N/A (10%)
Group 2 9,774 –10,396 Btu/kWh	1.0% at $47/kW (1%)	0.8% at $32/kW (7%)	0.8% at $25/kW (36%)
Group 3 10,397 – 11,019 Btu/kWh	2.1% at $47/kW (4%)	1.9% at $32/kW (13%)	1.8% at $25/kW (15%)
Group 4 **(Least Efficient)** ≥ 11,020 Btu/kWh	3.2% at $47/kW (4%)	2.9% at $32/kW (7%)	2.8% at $25/kW (3%)

Note: Share of total capacity represented by each category in parentheses.

Section 4.1

National Electric Energy Data System (NEEDS)

January 2020 Reference Case uses January 2020 version of NEEDS. NEEDS was updated with the comments (retirement and non-retirement) from the NEEDS Comment Tracker. Unretired units have been included. To facilitate the use of the 2030 projections of emissions as a proxy for the 2028 year, the retirement years for NEEDS units with retirement years of 2029 and 2030 were pushed back to 2035 run year. Incremental units including committed units for all fossil and non-fossil units > 25 MW based on a comparison of February 2019 and October 2017 versions of EIA Form 860M were hardwired.

[4] Ibid.

Table 4-1 Data Sources for NEEDS v6 for EPA Platform v6

Data Source[1]	Data Source Documentation
EIA Form 860	EIA Form 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 v6 uses the annual 2015 EIA Form 860, annual 2016 Early Release EIA Form 860, 2017 Early Release EIA Form 860, May 2017 EIA Form 860M, October 2017 EIA Form 860M, July 2018 EIA Form 860M, February 2019 EIA Form 860M and the August 2019 EIA Form 860M as the primary generator data inputs. EIA Form 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 controls, 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 v6 uses 2015 EIA Form 860 and 2016 Early Release EIA Form 860 as the primary boiler data inputs.
EIA'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 30-year time horizon. The projections are based on results from EIA's National Energy Modeling System (NEMS). Information from AEO 2017 such as heat rates and planned-committed units were used in NEEDS v6.
EPA's Emission Tracking System	The Emission Tracking System (ETS) database is updated quarterly. It contains information including primary fuel, heat input, SO_2, NO_x, Mercury, and HCl controls, and SO_2 and NO_x emissions. NEEDS v6 uses annual and seasonal ETS (2017) 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, regional EPA offices and other stakeholders regarding the prior versions of NEEDS.

Note:

[1] Shown in Table 4-1 are the primary issue dates of the indicated data sources 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 4-3 Summary Population (through 2018) of Existing Units in NEEDS v6

Plant Type	Number of Units	Capacity (MW)
Biomass	176	3,617
Coal Steam	548	216,442
Combined Cycle	1,866	261,908
Combustion Turbine	5,613	145,228
Energy Storage	98	763
Fossil Waste	81	1,049
Fuel Cell	89	150
Geothermal	153	2,465
Hydro	3,785	79,287
IGCC	5	815
Landfill Gas	1,555	1,827
Municipal Solid Waste	159	2,082
Non-Fossil Waste	209	2,010
Nuclear	92	94,394
O/G Steam	446	72,671
Offshore Wind	1	29
Onshore Wind	1,249	95,456
Pumped Storage	148	22,196
Solar PV	2,788	28,597
Solar Thermal	16	1,754
Tires	2	52
US Total	19,079	1,032,790

Table 4-7 Aggregation Profile of Model Plants as Provided at Set up of EPA Platform v6

Existing and Planned/Committed Units		
Plant Type	**Number of Units**	**Number of IPM Model Plants**
Biomass	300	165
Coal Steam	678	527
Combined Cycle	2,032	891
Combustion Turbine	5,994	2,535
Energy Storage	85	41
Fossil Waste	86	25
Fuel Cell	72	35
Geothermal	174	31
Hydro	5,455	252
IGCC	5	2
IMPORT	1	1
Landfill Gas	1,643	307
Municipal Solid Waste	166	60
Non-Fossil Waste	268	140
Nuclear	115	115
O/G Steam	590	399
Offshore Wind	1	1
Onshore Wind	1,570	89

Pumped Storage	155	27
Solar PV	2,532	98
Solar Thermal	17	5
Tires	2	1
Total	**21,941**	**5,747**

New Units

Plant Type	Number of IPM Model Plants
New Battery Storage	168
New Biomass	134
New Combined Cycle	456
New Combined Cycle with Carbon Capture	228
New Combustion Turbine	456
New Fuel Cell	150
New Geothermal	93
New Hydro	153
New Landfill Gas	379
New Nuclear	132
New Offshore Wind	894
New Onshore Wind	5,358
New Solar PV	1,373
New Solar Thermal	261
New Ultrasupercritical Coal with 30% CCS	266
New Ultrasupercritical Coal with 90% CCS	266
New Ultrasupercritical Coal without CCS	138
Total	**10,905**

Retrofits

Plant Type	Number of IPM Model Plants
Retrofit Coal with ACI	74
Retrofit Coal with ACI + CCS	92
Retrofit Coal with ACI + CCS + HRI	92
Retrofit Coal with ACI + CCS + HRI + SCR	20
Retrofit Coal with ACI + CCS + HRI + SNCR	29
Retrofit Coal with ACI + CCS + SCR	20
Retrofit Coal with ACI + DSI	20
Retrofit Coal with ACI + DSI + HRI	20
Retrofit Coal with ACI + DSI + HRI + SCR	31
Retrofit Coal with ACI + DSI + HRI + SCR + Scrubber	22
Retrofit Coal with ACI + DSI + HRI + Scrubber	18
Retrofit Coal with ACI + DSI + HRI + Scrubber + SNCR	14
Retrofit Coal with ACI + DSI + HRI + SNCR	27
Retrofit Coal with ACI + DSI + SCR	31
Retrofit Coal with ACI + DSI + SCR + Scrubber	22
Retrofit Coal with ACI + DSI + Scrubber	18
Retrofit Coal with ACI + DSI + Scrubber + SNCR	14
Retrofit Coal with ACI + DSI + SNCR	31

Retrofit Coal with ACI + HRI	74
Retrofit Coal with ACI + HRI + SCR	62
Retrofit Coal with ACI + HRI + SCR + Scrubber	62
Retrofit Coal with ACI + HRI + Scrubber	53
Retrofit Coal with ACI + HRI + Scrubber + SNCR	74
Retrofit Coal with ACI + HRI + SNCR	61
Retrofit Coal with ACI + SCR	62
Retrofit Coal with ACI + SCR + Scrubber	62
Retrofit Coal with ACI + Scrubber	52
Retrofit Coal with ACI + Scrubber + SNCR	75
Retrofit Coal with ACI + SNCR	62
Retrofit Coal with C2G	454
Retrofit Coal with C2G + SCR	454
Retrofit Coal with CCS	791
Retrofit Coal with CCS + HRI	788
Retrofit Coal with CCS + HRI + SCR	252
Retrofit Coal with CCS + HRI + SCR + Scrubber	208
Retrofit Coal with CCS + HRI + Scrubber	232
Retrofit Coal with CCS + HRI + Scrubber + SNCR	152
Retrofit Coal with CCS + HRI + SNCR	180
Retrofit Coal with CCS + SCR	255
Retrofit Coal with CCS + SCR + Scrubber	212
Retrofit Coal with CCS + Scrubber	240
Retrofit Coal with CCS + Scrubber + SNCR	156
Retrofit Coal with CCS + SNCR	183
Retrofit Coal with DSI	21
Retrofit Coal with DSI + HRI	70
Retrofit Coal with DSI + HRI + SCR	75
Retrofit Coal with DSI + HRI + SCR + Scrubber	21
Retrofit Coal with DSI + HRI + Scrubber	26
Retrofit Coal with DSI + HRI + SNCR	69
Retrofit Coal with DSI + SCR	109
Retrofit Coal with DSI + SCR + Scrubber	33
Retrofit Coal with DSI + Scrubber	38
Retrofit Coal with DSI + SNCR	103
Retrofit Coal with HRI	482
Retrofit Coal with HRI + SCR	432
Retrofit Coal with HRI + SCR + Scrubber	450
Retrofit Coal with HRI + Scrubber	357
Retrofit Coal with HRI + Scrubber + SNCR	408
Retrofit Coal with HRI + SNCR	342
Retrofit Coal with SCR	242
Retrofit Coal with SCR + Scrubber	582
Retrofit Coal with Scrubber	224
Retrofit Coal with Scrubber + SNCR	544
Retrofit Coal with SNCR	203

Retrofit Combined Cycle with CCS	2787
Retrofit Oil/Gas steam with SCR	222
Total	**13,691**
Retirements	
Plant Type	**Number of IPM Model Plants**
Biomass Retirement	165
CC Retirement	891
Coal Retirement	5,394
CT Retirement	2,535
Geothermal Retirement	31
Hydro Retirement	252
IGCC Retirement	2
Landfill Gas Retirement	307
Nuke Retirement	115
Oil/Gas steam Retirement	1,075
Total	**10,767**
Grand Total (Existing and Planned/Committed + New + Retrofits + Retirements):41,110	

Table 4-11 Summary of Planned-Committed Units in NEEDS v6 for EPA Platform v6

Plant Type	Capacity (MW)	Year Range Described
Renewables/Non-conventional		
Biomass	200	2019 - 2019
Energy Storage	41	2019 - 2019
Fuel Cell	15	2019 - 2019
Hydro	147	2019 - 2020
Landfill Gas	3	2019 - 2021
Non-Fossil Waste	67	2019 - 2020
Onshore Wind	8,230	2019 - 2024
Solar PV	3,168	2019 - 2020
Subtotal	11,869	
Fossil/Conventional		
Combined Cycle	13,802	2019 - 2022
Combustion Turbine	1,747	2019 - 2021
Nuclear	2,200	2022 - 2023
Subtotal	17,749	
Grand Total	29,618	

Table 4-12 Planned-Committed Units by Model Region in NEEDS v6 for EPA Platform v6

IPM Region	Plant Type	Capacity (MW)
ERC_REST	Combined Cycle	232
	Onshore Wind	1,069
ERC_WEST	Energy Storage	10
	Onshore Wind	1,626
	Solar PV	590
FRCC	Biomass	12
	Combined Cycle	1,723
	Combustion Turbine	74
	Solar PV	524
MIS_AMSO	Combined Cycle	1,000
MIS_D_MS	Combustion Turbine	36
MIS_IA	Onshore Wind	172
MIS_IL	Combustion Turbine	3
	Onshore Wind	185
MIS_LA	Non-Fossil Waste	48
MIS_LMI	Combined Cycle	1,181
	Combustion Turbine	8
	Onshore Wind	307
MIS_MAPP	Combustion Turbine	218
	Onshore Wind	150
MIS_MIDA	Onshore Wind	369
MIS_MNWI	Combined Cycle	200
	Combustion Turbine	20
	Onshore Wind	100
MIS_WUMS	Combined Cycle	700
	Combustion Turbine	183
	Solar PV	2
NENG_CT	Combined Cycle	485
	Fuel Cell	7
NENGREST	Combustion Turbine	539
	Energy Storage	1
	Onshore Wind	33
NY_Z_G-I	Combined Cycle	1,313
	Non-Fossil Waste	19
NY_Z_J	Combustion Turbine	2
PJM_AP	Onshore Wind	146
PJM_ATSI	Combined Cycle	1,333
PJM_COMD	Onshore Wind	212
PJM_Dom	Solar PV	267
PJM_EMAC	Combined Cycle	14
PJM_PENE	Combined Cycle	1,858
	Combustion Turbine	9
PJM_West	Combined Cycle	0.01
	Combustion Turbine	11
PJM_WMAC	Combined Cycle	941
S_C_KY	Landfill Gas	1
S_C_TVA	Solar PV	0.4
S_SOU	Biomass	188
	Combustion Turbine	44
	Nuclear	2,200
	Solar PV	589
S_VACA	Combined Cycle	586
	Combustion Turbine	13
	Solar PV	75
SPP_N	Onshore Wind	970
SPP_NEBR	Onshore Wind	478

IPM Region	Plant Type	Capacity (MW)
SPP_SPS	Onshore Wind	999
SPP_WAUE	Onshore Wind	98
SPP_WEST	Onshore Wind	604
	Solar PV	3
WEC_CALN	Solar PV	200
WEC_LADW	Combined Cycle	603
	Solar PV	100
WEC_SDGE	Solar PV	80
WECC_AZ	Combustion Turbine	496
WECC_ID	Hydro	3
WECC_IID	Solar PV	30
WECC_MT	Hydro	3
	Onshore Wind	80
WECC_PNW	Hydro	140
WECC_SCE	Combined Cycle	632
	Combustion Turbine	93
	Energy Storage	30
	Fuel Cell	8
	Landfill Gas	2
	Onshore Wind	131
	Solar PV	350
WECC_SNV	Solar PV	300
WECC_UT	Solar PV	58
WECC_WY	Onshore Wind	500
MIS_S_WOTA	Combined Cycle	1,000

Note: Any unit in NEEDS v6 that has an online year of 2019 or later was considered a Planned/Committed Unit.

Section 4.4.5

Cost and Performance for Potential Renewable Generating Technologies

Cost assumptions for battery storage, solar PV, solar CSP and onshore wind technology were updated based on NREL ATB 2019 mid case. The offshore wind technology cost assumptions from NREL ATB 2019 mid case are approximately modeled by scaling the capital costs and FOM in EPA's November 2018 Reference Case.

Table 4-14 Short-Term Capital Cost Adders for New Power Plants in EPA Platform v6 (2016$)

Plant Type		2021			2023			2025			2030			2035		
		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
Biomass	Upper Bound (MW)	1,904	3,312	No limit	1,270	2,208	No limit	1,270	2,208	No limit	3,174	5,520	No limit	3,174	5,520	No limit
	Adder ($/kW)	-	1,726	5,483	-	1,697	5,391	-	1,658	5,268	-	1,555	4,939	-	1,477	4,692
Coal Steam - UPC	Upper Bound (MW)	18,361	31,932	No limit	12,241	21,288	No limit	12,241	21,288	No limit	30,602	53,220	No limit	30,602	53,220	No limit
	Adder ($/kW)	-	1,652	5,246	-	1,622	5,151	-	1,583	5,027	-	1,479	4,697	-	1,400	4,446
Coal Steam - UPC30	Upper Bound (MW)	18,361	31,932	No limit	12,241	21,288	No limit	12,241	21,288	No limit	30,602	53,220	No limit	30,602	53,220	No limit
	Adder ($/kW)	-	2,285	7,257	-	2,243	7,126	-	2,189	6,955	-	2,045	6,497	-	1,936	6,151
Coal Steam - UPC90	Upper Bound (MW)	18,361	31,932	No limit	12,241	21,288	No limit	12,241	21,288	No limit	30,602	53,220	No limit	30,602	53,220	No limit
	Adder ($/kW)	-	2,526	8,025	-	2,481	7,880	-	2,421	7,690	-	2,262	7,185	-	2,141	6,802
Combined Cycle	Upper Bound (MW)	132,125	229,782	No limit	88,083	153,188	No limit	88,083	153,188	No limit	220,208	382,970	No limit	220,208	382,970	No limit
	Adder ($/kW)	-	492	1,563	-	484	1,536	-	472	1,499	-	436	1,384	-	408	1,297
Combustion Turbine	Upper Bound (MW)	66,275	115,260	No limit	44,183	76,840	No limit	44,183	76,840	No limit	110,458	192,100	No limit	110,458	192,100	No limit
	Adder ($/kW)	-	298	947	-	292	926	-	282	895	-	255	811	-	236	749
Fuel Cell	Upper Bound (MW)	1,725	3,000	No limit	1,150	2,000	No limit	1,150	2,000	No limit	2,875	5,000	No limit	2,875	5,000	No limit
	Adder ($/kW)	-	3,118	9,904	-	3,023	9,603	-	2,912	9,249	-	2,629	8,350	-	2,399	7,619
Geothermal	Upper Bound (MW)	883	1,536	No limit	589	1,024	No limit	589	1,024	No limit	1,472	2,560	No limit	1,472	2,560	No limit
	Adder ($/kW)	-	3,785	12,023	-	3,777	11,996	-	3,759	11,939	-	3,718	11,809	-	3,656	11,613
Landfill Gas	Upper Bound (MW)	625	1,088	No limit	417	725	No limit	417	725	No limit	1,042	1,813	No limit	1,042	1,813	No limit
	Adder ($/kW)	-	3,993	12,685	-	3,930	12,484	-	3,837	12,189	-	3,593	11,413	-	3,396	10,789
Nuclear	Upper Bound (MW)	32,327	56,220	No limit	21,551	37,480	No limit	21,551	37,480	No limit	53,878	93,700	No limit	53,878	93,700	No limit
	Adder ($/kW)	-	2,688	8,538	-	2,524	8,018	-	2,459	7,812	-	2,288	7,267	-	2,156	6,848
Solar Thermal	Upper Bound (MW)	2,830	4,921	No limit	1,886	3,281	No limit	1,886	3,281	No limit	4,716	8,202	No limit	4,716	8,202	No limit
	Adder ($/kW)	-	2,160	6,861	-	2,420	7,688	-	2,224	7,064	-	1,853	5,886	-	1,655	5,258
Solar PV	Upper Bound (MW)	25,858	46,265	No limit	18,406	32,011	No limit	18,406	32,011	No limit	46,016	80,027	No limit	46,016	80,027	No limit
	Adder ($/kW)	-	399	1,269	-	428	1,359	-	404	1,285	-	348	1,105	-	318	1,011
Onshore Wind	Upper Bound (MW)	33,941	67,466	No limit	30,238	52,588	No limit	30,238	52,588	No limit	75,595	131,470	No limit	75,595	131,470	No limit
	Adder ($/kW)	-	715	2,271	-	683	2,171	-	651	2,068	-	572	1,818	-	526	1,671
Hydro	Upper Bound (MW)	10,360	18,018	No limit	6,907	12,012	No limit	6,907	12,012	No limit	17,267	30,030	No limit	17,267	30,030	No limit
	Adder ($/kW)	-	1,046	3,323	-	1,046	3,323	-	1,046	3,323	-	1,046	3,323	-	1,046	3,323

Table 4-16 Performance and Unit Cost Assumptions for Potential (New) Renewable and Non-Conventional Technology Capacity in EPA Platform v6

	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 Year Available	2021	2021	2021			2021	2021	2021	2021	2021
Lead Time (Years)	4	4	3			3	1	3	3	3
Availability	83%	90% - 95%	90%			87%	90%	90%	95%	95%
Generation Capability	Economic Dispatch	Economic Dispatch	Economic Dispatch			Economic Dispatch	Generation Profile	Economic Dispatch	Generation Profile	Generation Profile
	Vintage #1 (2021-2054)					**Vintage #1 (2021)**				
Heat Rate (Btu/kWh)	13,500	30,000	18,000	18,000	18,000	8,653	0	0	0	0
Capital (2016$/kW)	3,733	3,072 - 21,106	8,556	10,780	16,598	6,889	1,020	6,190	1,440	3,149
Fixed O&M (2016$/kW/yr)	110.34	105 - 542	410.32	410.32	410.32	0.00	12.24	64.76	41.35	85.45
Variable O&M (2016$/MWh)	5.49	0.00	9.14	9.14	9.14	44.9	0	4.0	0	0
						Vintage #2 (2023)				
Heat Rate (Btu/kWh)						7,807	0	0	0	0
Capital (2016$/kW)						6,680	979	5,755	1,387	2,909
Fixed O&M (2016$/kW/yr)						0.0	11.75	61.53	40.65	80.42
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0
						Vintage #3 (2025)				
Heat Rate (Btu/kWh)						6,960	0	0	0	0
Capital (2016$/kW)						6,434	938	5,350	1,334	2,686
Fixed O&M (2016$/kW/yr)						0.0	11.25	58.30	39.96	75.69
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0
						Vintage #4 (2030)				
Heat Rate (Btu/kWh)						6,960	0	0	0	0
Capital (2016$/kW)						5,809	834	4,603	1,202	2,203
Fixed O&M (2016$/kW/yr)						0	10.01	50.23	38.22	65.06
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0
						Vintage #5 (2035)				
Heat Rate (Btu/kWh)						6,960	0	0	0	0
Capital (2016$/kW)						5,300	788	4,161	1,137	1,807
Fixed O&M (2016$/kW/yr)						0	9.45	50.23	36.78	55.93

	Biomass-Bubbling Fluidized Bed (BFB)	Geothermal	Landfill Gas			Fuel Cells	Solar Photovoltaic	Solar Thermal	Onshore Wind	Offshore Wind
			LGHI	LGLo	LGVLo					
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0
						Vintage #6 (2040)				
Heat Rate (Btu/kWh)						6,960	0	0	0	0
Capital (2016$/kW)						4,841	742	3,930	1,071	1,484
Fixed O&M (2016$/kW/yr)						0	8.90	50.23	35.35	48.08
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0
						Vintage #7 (2045)				
Heat Rate (Btu/kWh)						6,960	0	0	0	0
Capital (2016$/kW)						4,402	701	3,814	1,005	1,219
Fixed O&M (2016$/kW/yr)						0	8.42	50.23	33.92	41.34
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0
						Vintage #8 (2050)				
Heat Rate (Btu/kWh)						6,960	0	0	0	0
Capital (2016$/kW)						3,968	661	3,722	939	1,001
Fixed O&M (2016$/kW/yr)						0	7.94	50.23	32.48	35.56
Variable O&M (2016$/MWh)						44.9	0	3.4	0	0

Table 4-20 Onshore Average Capacity Factor by Wind TRG

TRG	Capacity Factor		
	Vintage #1 (2021-2054)	Vintage #2 (2030-2054)	Vintage #3 (2040-2054)
1	51.60%	54.23%	54.49%
2	49.36%	52.06%	52.44%
3	48.16%	50.90%	51.38%
4	46.69%	49.48%	50.09%
5	43.78%	46.59%	47.30%
6	39.11%	41.87%	42.58%
7	32.84%	35.42%	36.09%
8	26.09%	28.43%	29.05%
9	19.32%	21.28%	21.83%
10	12.02%	13.40%	13.78%

Table 4-21 Onshore Reserve Margin Contribution by Wind TRG

TRG	Vintage #1 (2021-2054)	Vintage #2 (2030-2054)	Vintage #3 (2040-2054)
1	0% - 50%	0% - 53%	0% - 54%
2	0% - 84%	0% - 88%	0% - 90%
3	0% - 82%	0% - 87%	0% - 90%
4	0% - 81%	0% - 86%	0% - 90%
5	0% - 78%	0% - 83%	0% - 90%
6	0% - 74%	0% - 79%	0% - 90%
7	0% - 69%	0% - 75%	0% - 90%
8	0% - 67%	0% - 73%	0% - 82%
9	0%	0%	0% - 1%
10	0%	0%	0%

Table 4-23 Offshore Shallow Reserve Margin Contribution by Wind TRG

TRG	Vintage #1 (2021-2054)	Vintage #2 (2030-2054)	Vintage #3 (2040-2054)
1	0% - 88%	0% - 89%	0% - 90%
2	0% - 88%	0% - 89%	0% - 90%
3	0% - 88%	0% - 89%	0% - 90%

Table 4-25 Offshore Mid Depth Reserve Margin Contribution by Wind TRG

TRG	Vintage #1 (2021-2054)	Vintage #2 (2030-2054)	Vintage #3 (2040-2054)
5	0% - 88%	0% - 89%	0% - 90%
6	0% - 88%	0% - 89%	0% - 90%

Table 4-27 Offshore Deep Reserve Margin Contribution by Wind TRG

TRG	Vintage #1 (2021-2054)	Vintage #2 (2030-2054)	Vintage #3 (2040-2054)
8	0% - 87%	0% - 88%	0% - 70%

Table 4-32 Solar Photovoltaic Reserve Margin Contribution by Resource Class

	Resource Class						
	2	3	4	5	6	7	8
Reserve Margin Contribution	0% - 1%	0% - 61%	0% - 90%	0% - 90%	0% - 90%	0% - 74%	0% - 77%

Section 4.4.5

Energy Storage

Energy storage is the capture of energy produced at one time for use at a later time. Presently, the most common energy storage technologies are pumped storage and lithium-ion battery storage. EPA Platform v6 now includes battery storage by IPM region and state.

Table 4-35 summarizes the key cost and performance assumptions for new battery storage as implemented in the January 2020 Reference Case. These assumptions are based on NREL ATB 2019 mid case.

Table 4-35 Performance and Unit Cost Assumptions for Potential (New) Battery Storage

		Battery Storage
Size (MW)		30
First Year Available		2021
Lead Time (Years)		1
Availability (%)		96.4
Reserve Margin Contribution (%)		100
Generation Capability		Economic Dispatch
Storage System Efficiency (%)		85
Charge Capacity (Hours)		4
Variable O&M (2016$/MWh)		-
	Capital Cost without IDC (2016$/kW)	**Fixed O&M (2016$/kW/yr)**
2021	1,198	29.94
2023	1,074	26.84
2025	949	23.73
2030	795	19.88
2035	745	18.63
2040	696	17.39
2045	646	16.15
2050	596	14.91

Multiple U.S. states have instituted standalone targets and mandates for energy storage procurement. January 2020 Reference Case has incorporated updated storage mandates in California, Massachusetts, and New York. The mandates related to California Assembly Bill 2868 and Senate Bill 801 were removed as these mandates did not have a specific year for implementation. Table 4-36 summarizes the state-specific energy storage mandates that are included in the January 2020 Reference Case.

Table 4-36 Energy Storage Mandates in EPA Platform v6

State/Region	Bill	Mandate Type	Mandate Specifications	Implementation Status
California	Assembly Bill No. 2514	Target in MW	Energy storage target of 1,325 megawatts for Pacific Gas and Electric Company, Southern California Edison, and San Diego Gas & Electric by 2020, with installations required no later than the end of 2024.	2025
			LADWP adopted a resolution setting its 2021 energy storage target at 178 MW.	
New York	New York State Energy Storage Target	Target in MW	1,500 Megawatts by 2025 and up to 3,000 megawatts by 2030	2025
New Jersey	Assembly Bill No. 3723	Target in MW	600 megawatts of energy storage by 2021 and 2,000 megawatts of energy storage by 2030.	2021
Oregon	House Bill 2193	Target in MWh per electric company	An electric company shall procure one or more qualifying energy storage systems that have the capacity to store at least five megawatt hours of energy on or before January 1, 2020.	2020
Massachusetts	Chapter 188	Target in MWh	200 Megawatt hour (MWh) energy storage target for electric distribution companies to procure viable and cost-effective energy storage systems to be achieved by January 1, 2020.	2020
	House Bill 4857	Target in MWh	Goal of 1,000 MWh of energy storage by the end of 2025.	2025

Section 4.5.1

New Jersey ZEC Bill

New Jersey has established a ZEC program. Salem Harbor 1 & 2 and Hope Creek nuclear units are eligible to receive payments during the year of implementation plus the three following years and may be considered for additional three-year renewal periods thereafter. January 2020 Reference Case has modeled the New Jersey ZEC bill by disabling the retirement options for Salem Harbor 1 & 2 and Hope Creek nuclear power plants in 2021 run year.