

AEO2021 Electricity-Renewables Analysis Working Group: New Economic Context, Policy Assumptions, and Key Model Updates



For

EIA Electricity Working Group

August 6, 2020

By

Electricity Analysis Team

Office of Electricity, Coal, Nuclear, and Renewables Analysis

AEO2021 Electricity-Renewables Working Group: overview of first teleconference

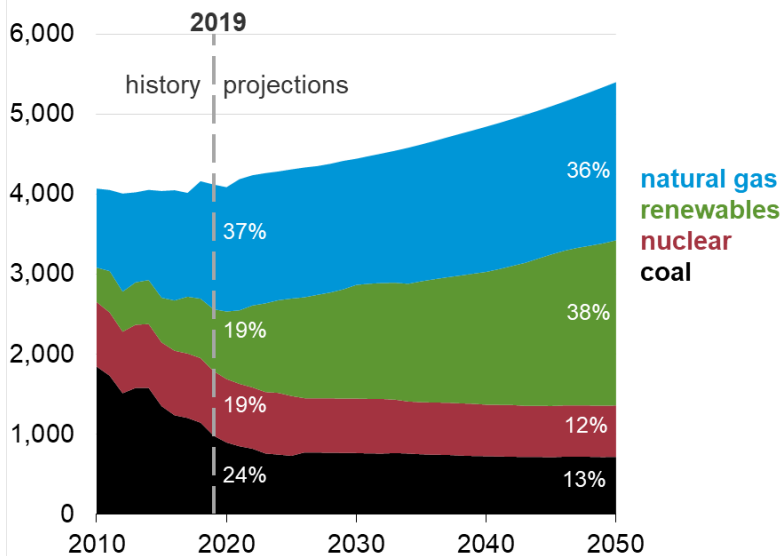
- Review of *Annual Energy Outlook 2020* (AEO2020) results
- Proposed modeling enhancements for AEO2021
- Changes to laws and regulations
- Considerations for future long term domestic modeling
- Global economic disruption as a result COVID-19 mitigation efforts

Review of AEO2020 results

Electricity generation from natural gas and renewables increases as a result of lower natural gas prices and declining costs of solar and wind renewable capacity

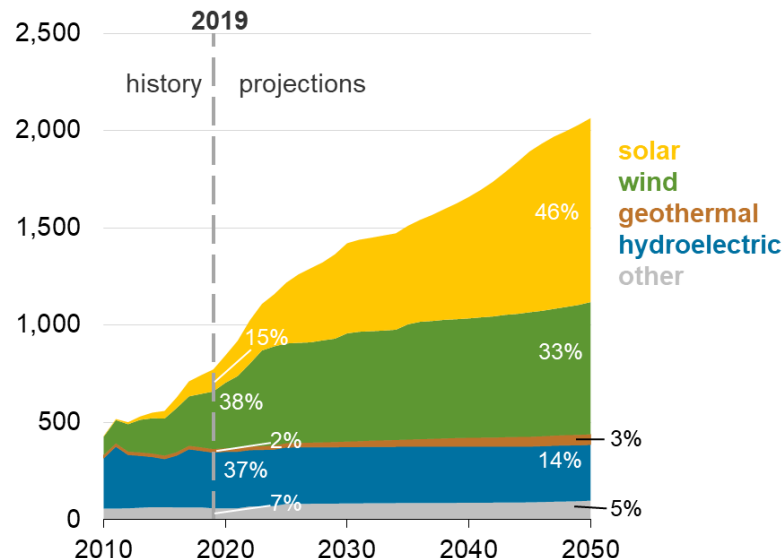
Electricity generation from selected fuels
(AEO2020 Reference case)

billion kilowatthours



Renewable electricity generation, including end use
(AEO2020 Reference case)

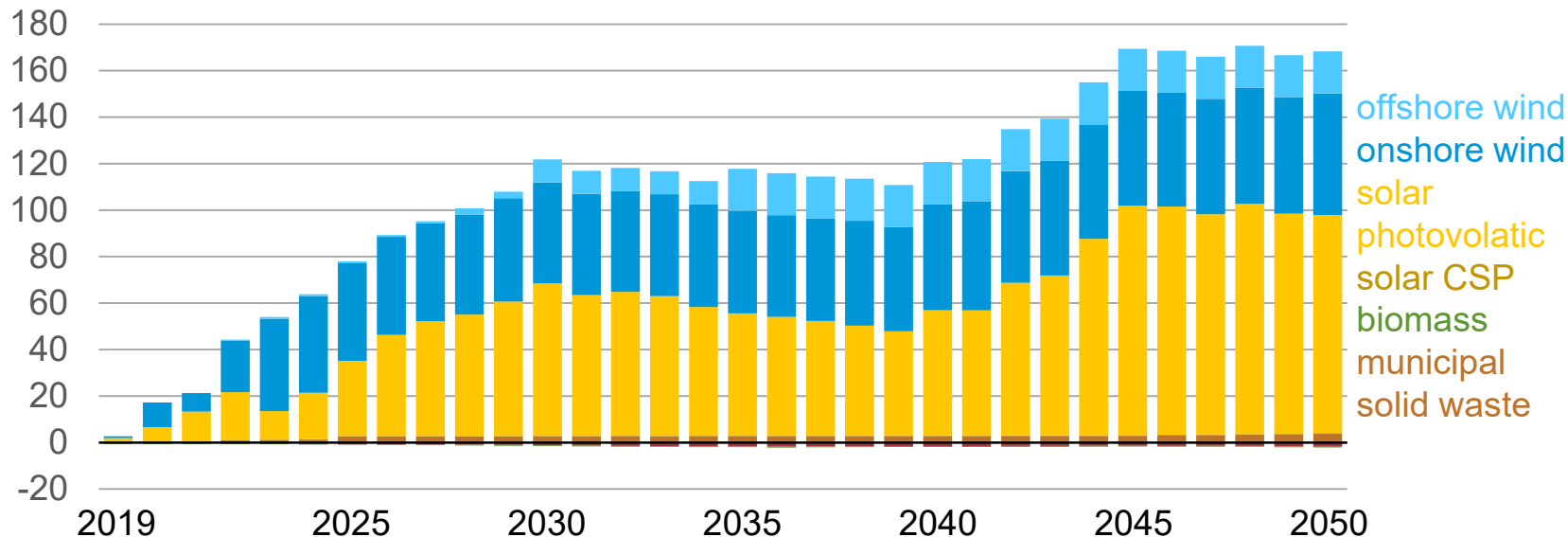
billion kilowatthours



Source: Source: ref2020.d112119a

Capital cost reduction in AEO2020 resulted in higher capacity additions for solar photovoltaic (PV) and onshore wind compared with AEO2019

Difference in annual renewable capacity additions by technology (AEO2019-AEO2020)
gigawatts



Source: ref2020.d112119a and ref2019.d111618a

High Renewables Cost and Low Renewables Cost cases introduced as additional core sensitivity analyses

Technology	Overnight capital cost (2019 \$/kW)				Fixed operation and maintenance cost (2019 \$/kW-year)			
	Reference (2019)	Reference (2050)	High	Low	Reference (2019)	Reference (2050)	High	Low
			Renewables Cost (2050)	Renewables Cost (2050)			Renewables Cost (2050)	Renewables Cost (2050)
Biomass	4,104	2,691	4,104	1,650	125.2	125.2	125.2	75.11
Municipal solid waste	1,557	1,085	1,557	664	20.02	20.02	20.02	12.01
Onshore wind	1,260	878	1,260	538	26.22	26.22	26.22	15.73
Offshore wind	5,446	2,369	5,446	1,411	109.5	109.5	109.5	55.54
Solar thermal	7,191	4,364	7,191	2,716	85.03	85.03	85.03	51.02
Solar photovoltaic, utility-scale	1,307	615	1,307	374	15.19	15.19	15.19	9.111
Solar photovoltaic, residential	2,019	1,382	2,019	829	18	12	18	7
Solar photovoltaic, commercial	1,539	993	1,539	596	16	10	16	6
Wind, residential	5,200	5,200	5,200	3,120	31	31	32	19
Wind, commercial	1,548	1,548	1,548	929	230	227	230	133

Note:

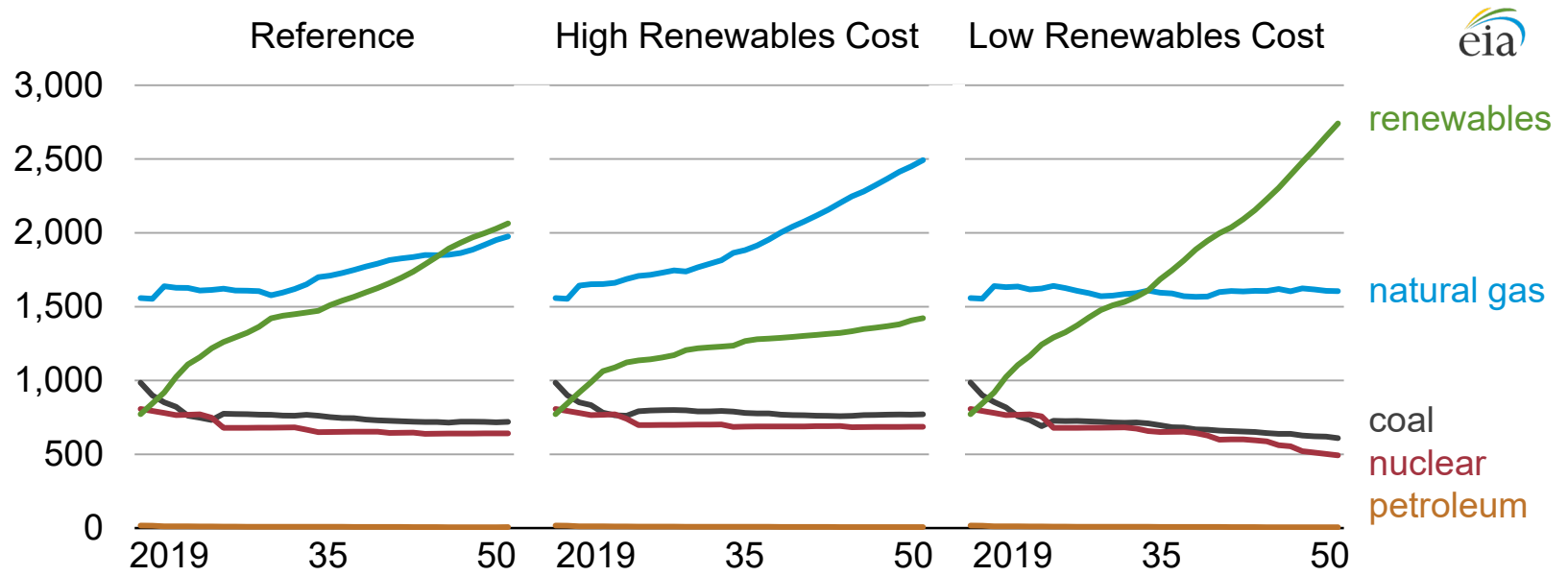
1. For hydropower and geothermal resources, costs are based on site-specific supply curves.
2. Solar photovoltaic costs are expressed in dollars per kilowatt of direct current (DC) instead of net alternating current (AC) power available to the grid.

Source: *Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies (2020)*, U.S. Energy Information Administration, *Annual Energy Outlook 2020*

Natural gas-fired generation and renewables are direct replacements for each other; coal and nuclear generation declines in Low Renewables Cost case

All-sector electricity generation from selected fuel by case, 2019–50

billion kilowatthours



Source: U.S. Energy Information Administration, Annual Energy Outlook 2020

Proposed modeling enhancements for AEO2021

AEO2021 modeling enhancements to the National Energy Modeling System's Electricity Market Module

- Planned model developments for generating technologies in AEO2021
- Move toward dynamic regional redefinition capability in the Electricity Market Module (EMM)
- Change in treatment of distributed generation

Planned model developments for renewable technologies in AEO2021

- PV/battery Hybrid - Include solar PV plus storage as an option for capacity expansion
- Capacity credit for storage – Determine an approach to decrement storage capacity credit at high penetrations (not likely to be implemented for AEO2021)
- Long-term resource multiplier for wind – Update to new regions
- Landfill Gas - Implementation of revised landfill gas submodule

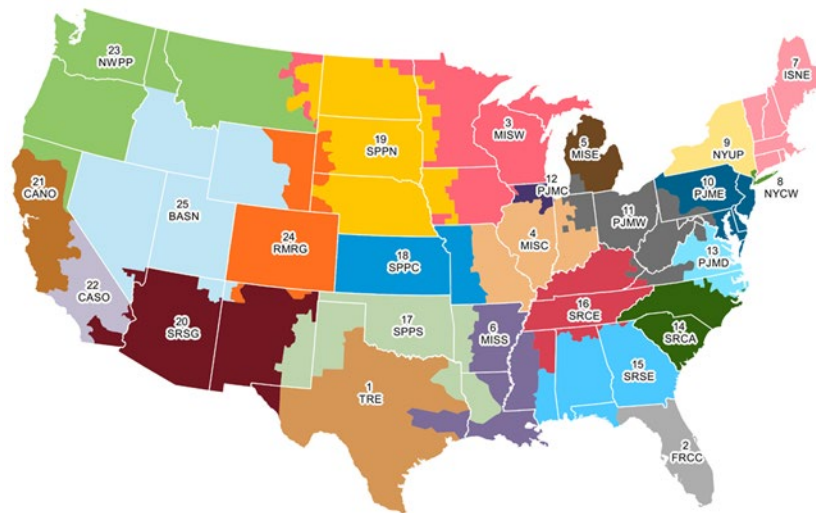
Planned model developments for other technologies in AEO 2021

- High-voltage direct current (HVDC) transmission – Update regional cost data
- Small modular reactors (SMR)
 - Under active consideration in utility capacity expansion plans
 - Sargent & Lundy overnight capital cost estimate \$6,191 per kilowatt

Moving toward dynamic regional redefinition capability

- New for AEO2021—regional inputs read from SQLite database generated by new Python tool
 - First step in being able to more easily change region definitions for specific analyses
- AEO2021 will remain at the same region configuration as AEO2020
 - Which alternative regional configurations should EIA consider as regional redefinition capability is developed?

Retain AEO2020 region mapping in AEO2021



Source:

Change in treatment of distributed generation (DG)

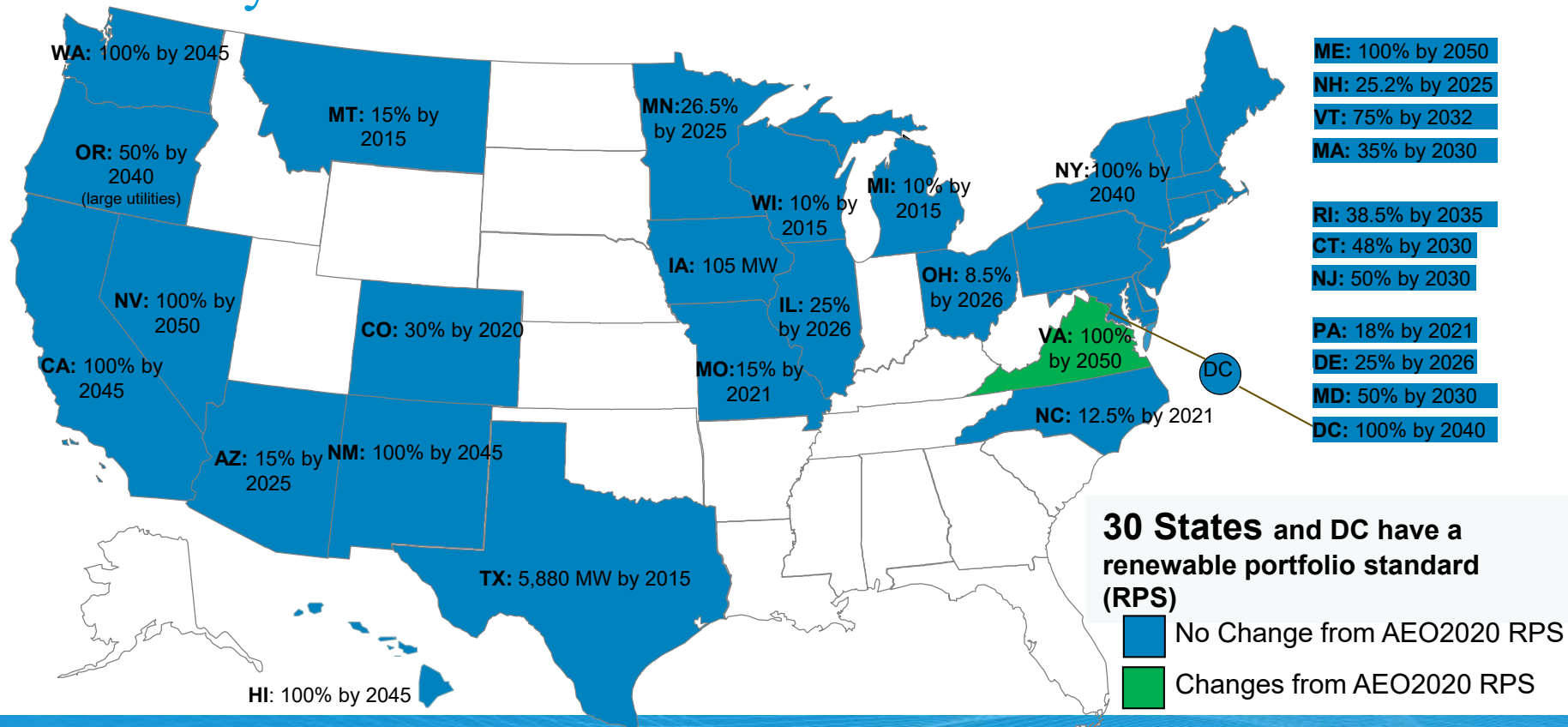
- Building sectors will no longer subtract own-use generation estimates from their end-use consumption values
- Previous treatment
 - Earlier AEOs had already incorporated dispatch of rooftop PV in EMM to better represent time-of-day availability and impacts on load shape to EMM, but the end-use reporting still reflected fixed assumptions that subtracted the PV generation from various end use consumption values
 - Non-PV end-use generation for own use was subtracted from specific end use consumption and EMM did not dispatch this capacity
- New treatment:
 - All buildings sector DG will be dispatched within EMM (at capacity factors determined by end use models)
 - EMM planning and dispatch models will see demand values that include the total DG generation
 - AEO electricity tables will still break out power sector versus end-use generation and report retail sales and direct use separately (no changes)

Changes to laws and regulations

Changes to legislation and regulations

- Extension of safe harboring year for projects that began construction in 2016 and 2017 (will not affect Renewable Fuels Module)
- Virginia renewable portfolio standard (RPS) update (100% carbon-free by 2050), tracking other possible updates
- Close monitor of any possible updates to the production tax credit/investment tax credit in response to the economic downturn
- Currently no additional state mandates for offshore wind have been announced since AEO2020, tracking possible updates
- Battery storage mandates: Virginia 3100 megawatts by 2050

State RPS policies will be finalized toward the end of the AEO cycle



Other state clean energy programs

- Viability of Zero Emission Credit (ZEC) programs
 - Monitor legislative activity to determine what, if any, consequences may occur in light of Ohio HB 6
 - Track federal response: Federal Energy Regulatory Commission (FERC) Minimum Offer Price Rule (MOPR) (next slides)

Expansion of Regional Greenhouse Gas Initiative (RGGI)

- New entrant: Virginia Clean Energy Economy Act (Senate Bill 851/House Bill 1526)
 - Virginia Clean Economy Act (Senate Bill 851/House Bill 1526)
 - 2021: carbon dioxide (CO₂) allowance of 27.16/metric ton (mt)
 - Allocation decreases each year by 0.84/mt CO₂
 - 2030 and beyond: CO₂ allowance of 19.6/mt CO₂
 - Dominion Energy and Appalachian Power required to retire CO₂-emitting electric generating units by December 31, 2045
- Potential entrant: Pennsylvania (legislative roadblock House Bill 2025)
 - Addition of PA generators to RGGI would represent a significant expansion of the RGGI program
 - PA would represent: (based on *Electric Power Monthly 2019* values)
 - 46% of RGGI coal capacity
 - 78% of RGGI coal generation

Federal response to state differential treatment— FERC MOPR

- To address the potential that state-subsidized units might under-bid in capacity auctions, FERC created Minimum Offer Price Rule (MOPR)
- PJM must establish resource-specific MOPRs for new and existing resources that receive (or are eligible for) state subsidies, including:
 - Existing resources: Renewable energy credits (RECs) (if they have not cleared the capacity market), and zero-emission credits (ZECs)
 - New resources: RECs, demand response, energy efficiency, storage
- Under the MOPR rule, PJM must establish an auction price floor for
 - New resources= Net cost of new entry (CONE)
 - Existing resources = Net avoidable cost rate (ACR)

Considering approaches to modeling the impact of MOPR

- EIA has no model for a capacity auction
- One alternative approach to modeling MOPR
 - Assume the impact of the MOPR is that additional affected plants will not clear the capacity market
 - Model MOPR impact by excluding those units from contributing to the reserve margin, by ignoring or overriding the capacity credit
 - Compare with case without these assumptions

Addressing voluntary commitments to decarbonization

- **No change in EIA precedent:** *current laws and regulations* will remain the basis for input assumptions to Reference case
- Common question in preceding working groups: how does EIA account for utility plans/commitments to de-carbonize?
 - EIA has seen Integrated Resource Plans (IRPs) as more aspirational and thus not appropriate to model
 - The increasing number and specificity of de-carbonization announcements may indicate a move toward implementation
- EIA considers different approaches to if/how to incorporate IRP statements into modeling

Considerations for future long term domestic modeling

Long term modeling enhancements

- Revised methodology: Transmission and distribution (T&D) spending projections
- Adding coastal wind as designated technology type (currently only represented by regional differences in capital cost)
- Enhance coal transportation rate escalation methodology
 - Replace existing econometric approach with an index-based approach adjusted for productivity to improve model transparency and address projected stagnant-to-declining trends in coal production

Global economic disruption as a result of COVID-19 mitigation efforts

The new context: Global economic disruption as a result of COVID-19 mitigation efforts

- Short term impacts of COVID-19 mitigation efforts have been reflected in *Short-Term Energy Outlook* (STEO) forecasts
- Long term impacts of COVID-19 mitigation efforts still under review
 - These effects will be largely reflected in inputs from Macroeconomic/End Use models
- AEO2021 Macro/Industrial Working Group meeting: Thursday, September 17, 2020
- EIA will host a series of workshops on the near and long term impacts on the energy market (detailed announcement forthcoming in the next few weeks)
- A complete schedule of working groups can be found [here](#)

AEO2021 Outlook Schedule

- Model development: June-October 2020
- 2nd Working Group Session: September 2020
- Expected AEO release: January 2021

Contact information: Electricity Analysis Team

- Thad Huetteman, Team Leader Thaddeus.Huetteman@eia.gov (202) 586-7238
- Lori Aniti Lori.Aniti@eia.gov (202) 586-2867
- Kenneth Dubin Kenneth.Dubin@eia.gov (202) 586-0477
- Tyler Hodge Tyler.Hodge@eia.gov (202) 586-0442
- Scott Jell Scott.Jell@eia.gov (202) 586-5196
- Augustine Kwon Augustine.Kwon@eia.gov (202) 586-3645
- Nilay Manzagol Nilay.Manzagol@eia.gov (202) 586-3704
- Laura Martin Laura.Martin@eia.gov (202) 586-1494

Contact information: Renewable Electricity Analysis Team

- Chris Namovicz, Team Leader Chris.Namovicz@eia.gov (202) 586-7120
- Richard Bowers Richard.Bowers@eia.gov (202) 586-8586
- Michelle Bowman Michelle.Bowman@eia.gov (202) 586-0526
- Vikram Linga Vikram.Linga@eia.gov (202) 586-9224
- Fred Mayes Fred.Mayes@eia.gov (202) 586-1508
- Manussawee Sukunta Manussawee.Sukunta@eia.gov (202) 586-0279
- Ed Thomas Edward.Thomas@eia.gov (202) 586-3704

Questions/Comments?

Capital costs revised downward for most renewable technologies in AEO2020 from prior years

Technology	AEO2020	AEO2019 (2019\$/kW)	Approx. % change	AEO2019 (2019\$/kW)	% change (AEO2019 base)
	(2019\$/kW)				
Onshore wind – large plant footprint: Great Plains region	\$1,260	\$1,652	-23.70%	\$1,954	-35.5%
Offshore wind (fixed-bottom)	\$5,446	\$6,656	-18.20%	\$6,658	-18.2%
Solar photovoltaic, single axis tracking	\$1,307	\$2,004	-34.80%	\$2,198	-40.5%
Solar thermal	\$7,191	\$4,365	64.70%	\$4,368	64.6%
Battery storage, 50 MW 200 MWh	\$1,383	\$1,603	-13.70%	\$1,985	-30.3%
Landfill gas	\$1,557	NA	NA	NA	NA
Biomass plant	\$4,104	\$3,967	3.50%	\$3,969	3.4%

Source: Cost and Performance Characteristics for [AEO2020](#) and [AEO2019](#)