Independent Statistics & Analysis
U.S. Energy Information Administration

Alternative Policies – Executive Summary

March 2020

Independent Statistics & Analysis
www.eia.gov

U.S. Department of Energy
Washington, DC 20585

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Overview

The U.S. Energy Information Administration (EIA) released its *Annual Energy Outlook 2020* (AEO2020) in January 2020. The AEO2020 Reference case generally assumes that existing laws and regulations remain as enacted throughout the projection period, including when the laws or policies are scheduled to sunset. However, in the area of policies that target emissions reduction, history has demonstrated that there is significant uncertainty in this assumption. For example, tax credits supporting wind and solar electric generation are often extended year to year, and vehicle emission standards, etc. are the subject of legislative debate and action. There are also examples, such as the Clean Power Plan, where rules are issued and later repealed. Therefore, it is important to consider the uncertainty associated with the assumption of current laws and legislation.

This *Issue in Focus* article presents a series of cases related to the uncertainty around a set of current policies including

- Accelerating carbon-free generation
- Carbon fee
- Reimbursement of residential solar photovoltaic (PV) generation at wholesale electricity prices
- Affordable Clean Energy rule

The alternative cases examined are intended to identify and quantify uncertainties in energy system model inputs associated with potential future changes in the legislative environment and to describe the effect these uncertainties could have on modeled U.S. energy markets, including total U.S. energy-related CO2 emissions.

This article discusses legislative uncertainty in the AEO2020 Reference case. It does not consider a full range of policy options available to policymakers. Furthermore, the assumptions used in the alternative cases should not be construed as EIA opinion regarding how laws or regulations should, or are likely to, be changed.

Executive summary

Each of the four sections in this paper discusses alternative cases. Unless otherwise specified, cases presented in this article start with the AEO2020 Reference case and change particular assumptions to address uncertainty about the future of selected existing laws and regulations. A summary table identifying the alternative cases and detailing their assumptions are found in Appendix 1.

50% Carbon-Free Generation case

The 50% Carbon-Free Generation case assumes that all Lower 48 states achieve at least 50% of electricity sales by 2050 from carbon-free electric generation sources. States are assumed to continue current programs, such as a Renewable Portfolio Standard (RPS) and clean energy standard (CES), and add new policies, as necessary, that achieve the 50% carbon-free generation by 2050 using a combination of generation technologies that emit little to no net CO2. These include

- Nuclear
- Existing large-scale and new hydropower
- Fossil-fuel generation with at least 90% carbon capture and sequestration
- Geothermal
- Biomass
- Solar PV (including large-scale and distributed generation)
- Solar thermal
- Onshore wind (including large-scale and distributed generation)
- Offshore wind

Wind and solar photovoltaic generation growth is similar to the AEO2020 Reference case until 2035 and 2045, respectively, when growth accelerates to reach 10% and 17% higher than the AEO2020 Reference case in 2050. Nuclear generation helps meet the carbon-free generation requirements, resulting in fewer nuclear plant retirements than in the AEO2020 Reference case and 19% higher nuclear generation by 2050. This case results in total U.S. energy-related CO2 emissions that are 3% lower in 2050 than in the AEO2020 Reference case and 7% lower in 2050 than in 2019.

Renewable Portfolio Standards Sunset case

The Renewable Portfolio Standards (RPS) Sunset case assumes that all states terminate existing RPS policies in 2020 and do not enact new RPS or carbon-free generation policies. This case illustrates the effects of current RPS policies. It shows that eliminating current state RPS requirements would reduce renewable generation by 4% by 2050 compared with the AEO2020 Reference case and that total U.S. energy-related CO2 emissions would be 1% higher in 2050 relative to the AEO2020 Reference case and 3% lower in 2050 when compared with 2019.

Carbon Fee cases

The carbon fee cases assume economy-wide implementation of a $15, $25 and $35 fee (2019 dollars per metric ton of carbon dioxide) starting in 2021. These fees increase by 5% (in real dollars) per year and reach $61.74, $102.90, and $144.06 (per metric ton of carbon dioxide), respectively, by 2050. Emissions revenues are distributed back to consumers via lump-sum payments, keeping the government deficit neutral.

The three carbon fee cases show that total energy-related CO2 emissions decline early in the projection period before leveling off in the late 2030s. The electric power sector is the most responsive to carbon fees, as coal loses market share to natural gas and renewables even faster than projected in the Reference case. The $35 carbon fee case shows total U.S. energy-related CO2 emissions would be 27% lower in 2050 than in the AEO2020 Reference case and 30% lower in 2050 when compared with 2019.

No Affordable Clean Energy Rule case

The AEO2020 Reference case includes the Affordable Clean Energy (ACE) Rule, which was issued by the U.S. Environmental Protection Agency in June 2019 to establish guidelines for states developing plans to limit carbon dioxide emissions at their coal-fired power plants. AEO2020 reflects this program in its projections by requiring that all coal plants with the potential to improve plant heat rates undertake these projects or retire by 2025. As a sensitivity case, the No ACE Rule case assumes that the existing ACE Rule is not implemented and that all coal-fired power plants continue to operate at their current efficiency levels if economical to do so.

In this case, fewer coal-fired power plants retire, and coal-fired electricity generation falls at a slower rate relative to the Reference case. By the 2040s, less-efficient coal-fired capacity is either dispatched at lower operational levels or remains in service to satisfy reserve requirements rather than to meet growing electricity demand. This case shows that total U.S. energy-related CO2 emissions would be 1% higher in 2050 than in the AEO2020 Reference case and 3% lower in 2050 when compared with 2019.

Utility Rate Structure cases

In the Reference case, residential end users who sell electricity to the grid are compensated at the retail electricity rate. The utility rate structure cases assume all distributed solar PV generation will be compensated at the wholesale or marginal price of electricity. The change in compensation increases payback periods and leads to fewer installations and less residential PV generation. With less onsite electricity generation, electricity sales from utility-scale power plants increase slightly relative to their AEO2020 case counterparts. This case shows that under Reference case assumptions total U.S. energy-related CO2 emissions would be similar in 2050 to the AEO2020 Reference case and 4% lower in 2050 when compared with 2019.

Appendix 1. Alternative policy scenario case descriptions

Section	Case name	Description
50% Carbon-Free Generation	50% Carbon-Free Generation case	States achieve a minimum 50% of electricity sales by 2050 using zero- or low-carbon generating technologies
	Renewable Portfolio Standard (RPS) Sunset case	States with existing RPS policies terminate their programs in 2020, and no new RPS or carbon-free generation policies are enacted
Carbon Fees	$15 Fee case	Imposes an economy-wide carbon fee starting at $15 per metric ton of carbon dioxide in 2021 and rises by 5% (real) per year
	$25 Fee case	Imposes an economy-wide carbon fee starting at $25 per metric ton of carbon dioxide in 2021 and rises by 5% (real) per year
	$35 Fee case	Imposes an economy-wide carbon fee starting at $35 per metric ton of carbon dioxide in 2021 and rises by 5% (real) per year
No Affordable Clean Energy (ACE) Rule	No ACE case	Removes the implementation of ACE
Utility Rate Structure	Reference with Wholesale Photovoltaic (PV) Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate
	High Economic Growth with Wholesale PV Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate with AEO2020 High Economic Growth case assumptions
	Low Economic Growth with Wholesale PV Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate with AEO2020 Low Economic Growth case assumptions
	High Oil and Gas Supply with Wholesale PV Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate with AEO2020 High Oil and Gas Supply case assumptions
	Low Oil and Gas Supply with Wholesale PV Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate with AEO2020 Low Oil and Gas Supply case assumptions
	High Renewables Cost with Wholesale PV Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate with AEO2020 High Renewables Cost case assumptions
	Low Renewables Cost with Wholesale PV Rate case	Compensates residential solar PV generation from 2020 onward at the wholesale PV rate with AEO2020 Low Renewables Cost case assumptions

Appendix 2. Renewable Portfolio Standard requirements in the Reference case and 50% Carbon-Free Generation case

State[1]	Reference case target	50% Carbon-Free Generation by 2050	Reference case qualifying technologies	50% Carbon-Free Generation qualifying technologies added
AZ	15% by 2025	50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
CA	60% electricity generation by 2030, 100% carbon-free by 2045	Maintains Reference case path	Geothermal electric, solar thermal electric, solar photovoltaics, wind biomass, municipal solid waste, landfill gas, hydroelectric Carbon-free includes nuclear, carbon capture and sequestration	No additional technologies
CO	30% by 2020 for investor-owned utilities, 20% by 2020 for large electric cooperatives, 10% by 2020 for other cooperatives and municipal utilities serving more than 40,000 customers	50% by 2050, for all utilities	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells	Nuclear, carbon capture and sequestration
CT	48% by 2030 (44% renewables, 4% efficiency and combined heat and power)	50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
DE	25% by 2026	50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
DC	100% by 2040	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies
IL	25% by 2026 (3,000 megawatts [MW] solar and 1,300 MW wind)	50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind	Nuclear, carbon capture and sequestration
IA	105 MW of eligible renewable resources	50% by 2050, starting in 2025	Solar thermal, solar PV, wind, biomass, hydroelectric, municipal solid waste, landfill gas, offshore wind	Nuclear, carbon capture and sequestration, geothermal
MA	35% by 2030 (and an additional 1% per year thereafter)	Maintains Reference case path. MA path ends at 50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies
MD	50% by 2030	Maintains reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies

State[1]	Reference case target	50% Carbon-Free Generation by 2050	Reference case qualifying technologies	50% Carbon-Free Generation qualifying technologies added
ME	100% by 2050	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies
MI	15% by 2021, with specific new capacity goals for utilities that serve more than one million customers	50% by 2050 for all utilities regardless of size	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind	Nuclear, carbon capture and sequestration
MN	31.5% by 2020 (Xcel), 26.5% by 2025 (other investor-owned utilities), or 25% by 2025 (other utilities)	50% by 2050 for all utilities	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind	Nuclear, carbon capture and sequestration
MO	15% by 2021	50% by 2050, starting in 2025	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
MT	15% by 2015	50% by 2050, starting in 2025	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
NC	12.5% by 2021 for investor-owned utilities, 10% by 2018 for municipal and cooperative utilities	50% by 2050, starting in 2025, applies to all utilities	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind	Nuclear, carbon capture and sequestration
NH	24.8% by 2025	50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
NJ	50% by 2030 with the solar carve-out reaching 5.1% in 2021 before gradually decreasing to 1.1% by 2033	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies
NM	80% renewable generation by 2040, 100% carbon-free by 2045	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind Carbon-free includes nuclear	No additional technologies
NV	50% renewable generation by 2030, 100% carbon-free by 2050	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind Carbon-free includes nuclear	No additional technologies
NY	70% renewable generation by 2030, 100% carbon-free by 2040.	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind Carbon-free includes nuclear	No additional technologies

State[1]	Reference case target	50% Carbon-Free Generation by 2050	Reference case qualifying technologies	50% Carbon-Free Generation qualifying technologies added
OH	8.5% renewable energy resources by 2026	50% by 2050	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
OR	50% by 2040	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind	No additional technologies
PA	18% by 2020	50% by 2050, starting in 2025	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
RI	38.5% by 2035	50% by 2050, starting in 2035	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
TX	5,880 MW by 2015	50% by 2050, starting in 2025	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind	Nuclear, carbon capture and sequestration
VT	75% by 2032	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies
WA	100% carbon-free by 2045	Maintains Reference case path	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	No additional technologies
WI	10% by 2015	50% by 2050, starting in 2025	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, fuel cells, offshore wind	Nuclear, carbon capture and sequestration
All other states[2]	Several states included here have current renewable portfolio goals, which are non-binding and therefore not modeled in the Reference case	50% by 2050, starting in 2025	NA	Geothermal electric, solar thermal, solar PV, wind, biomass, hydroelectric, landfill gas, offshore wind, nuclear, carbon capture and sequestration

[1] Although Hawaii has a 100% renewable generation by 2045 Renewable Portfolio Standard that is implicitly accounted for in previous work, the generation in Alaska and Hawaii are not included in this analysis as the generation mix from these states is determined outside of the NEMS model because of the unique electricity supply markets in these states.

[2] *All other states* includes AL, AR, FL, GA, ID, IN, KS, KY, LA, MS, ND, NE, OK, SC, SD, TN, UT, VA, WV, WY