



EPA's Clean Power Plan
Summary of Draft IPM Modeling Results:
Nevada

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Major Changes from Prior Model Runs

- **Natural Gas Prices:** Gas prices are lower than prior round of analysis (see appendix). The gas supply curve that we used is derived from the average of the AEO 2015 Reference Case and the AEO 2015 High Gas Resource Case (Henry Hub Gas Price). Basis differentials were derived from ICF's Integrated Gas Module.
- **ITC/PTC Extension:** On December 18, 2015, Congress passed extensions to the investment tax credit (ITC) and production tax credit (PTC) for renewable energy projects. With the addition of these extensions, total U.S. Wind capacity in the Reference Case increases by about 40 GW from 2015 to a total of 118.6 GW in 2020, vs. the prior Reference Case of 103.6 GW by 2020. Utility-scale solar capacity more than triples from 2015 levels to a total of 37.2 GW in the updated runs vs. 26.9 GW in the prior Reference Case.
- **Energy Efficiency Assumptions:** We continue to model a range of energy efficiency levels (current, modest, and significant), but we modified our approach to "modest" case for some states. In the revised "modest" approach, states that are already achieving annual savings levels greater than 1% (of prior-year sales) maintain their historic (2013) savings levels.
- **Trading:** We continue to assume that California does not trade compliance instruments with other states; rather we assume updated California Energy Commission (CEC)-projected AB 32 carbon prices in California.
- **New Builds:**
  - Solar cost forecasts from National Renewable Energy Laboratory (NREL) continue to decline
  - No economic hydro builds allowed in the U.S.
  - Renewable builds limited as discussed in appendix and additional firm builds added (NGCC and renewables)

Scenarios Evaluated: Integrated Planning Model (IPM®)

Mass-Based Scenarios

Code	Abbreviated Assumptions	Regulatory Approach	Level of Energy Efficiency	Trading Zones
MB01	E+N, State, CEE	Mass-Based (Existing + New)	Current EE	**State-by-state compliance** (except RGGI)
MB02	E+N, State, EE1	Mass-Based (Existing + New)	Modest EE (1%)	**State-by-state compliance** (except RGGI)
MB03	E+N, National, CEE	Mass-Based (Existing + New)	Current EE	**Nationwide trading** (except California; RGGI trades with other states)
MB04	E+N, National, EE1	Mass-Based (Existing + New)	Modest EE (1%)	**Nationwide trading** (except California; RGGI trades with other states)
MB05	E+N, National, EE2	Mass-Based (Existing + New)	Significant EE (2%)	**Nationwide trading** (except California; RGGI trades with other states)
MB06	E, State, CEE	Mass-Based (Existing Only)	Current EE	**State-by-state compliance** (except RGGI)
MB07	E, National, CEE	Mass-Based (Existing Only)	Current EE	**Nationwide trading** (except California; RGGI trades with other states)

Subcategory-Specific Dual Rate Scenario

Code	Abbreviated Assumptions	Regulatory Approach	Level of Energy Efficiency	Trading Zones
DR01	DR, EE1	Rate-Based (Dual Rate)	Modest EE (1%)	Nationwide trading of RE, EE, Nuclear, and GS-ERCs (except California and RGGI)

Note: In all cases, we assume CEC-projected carbon prices in California—not the CPP mass goals for the state—and the RGGI states are assumed to comply with a region-wide, mass-based target equal to the 2020 RGGI cap and RGGI states trade these allowances nationally.

Renewables Capital Costs and Build Assumptions

- Renewables cost assumptions are presented on the following slide.
- These model runs assume that renewable resources are limited to 20 percent of net energy for load by technology type and 30 percent of net energy for load in total at each of IPM's U.S. sub-regions, on the assumption that grid integration impacts are relatively minor below these levels. EPA considers this assumption to be a conservative approach that provides a high degree of assurance that the renewable capacity deployment pattern projected by the model would not incur significant grid integration costs. See Final Clean Power Plan Rule, page 64808.
- Short-term capital cost adders are also assumed for wind and solar consistent with EPA's Base Case v.5.15. Capital costs increase when capacity additions exceed specified thresholds.
- Also, 2018 solar builds are limited to a 7.5 GW per calendar year and 2018-2019 wind builds are limited to a 15 GW per calendar year.
- Virginia wind builds limited to 500 MW based on feedback from state dialogues.

Current Renewable Cost Assumptions

	RE Potential Build Cost and Performance - EPA v5.15					
Renewable Technologies	First Year	Vintage	Overnight Capital Costs in 2016-2054 (2012$/kW)	Heat Rate in 2016-2054 (Btu/kWh)	VOM (2012$/MWh)	FOM (2012/kW)
Biomass BFB	2018	2018-2040	4,111	13,500	5.2	103.8
Landfill Gas*	2016	2016-2040	8,554	13,648	8.5	381.7
Solar PV	2016	2016	2,182	-	-	7.4
		2018	1,880	-	-	7.4
		2020	1,579	-	-	7.4
		2025	1,448	-	-	7.4
		2030	1,053	-	-	7.4
		2040	1,053	-	-	7.4
Solar Thermal	2016	2016	5,015	-	-	42.2
		2018	4,935	-	-	42.2
		2020	4,857	-	-	42.2
		2025	4,660	-	-	42.2
		2030	4,463	-	-	42.2
		2040	4,059	-	-	42.2
Onshore Wind	2016	2016	1,724	-	-	46.5
		2018	1,717	-	-	46.5
		2020	1,711	-	-	46.5
		2025	1,701	-	-	46.5
		2030	1,697	-	-	46.5
		2040	1,696	-	-	46.5
Offshore Wind	2016	2016	5,243	-	-	101.4
		2018	4,970	-	-	101.4
		2020	4,697	-	-	101.4
		2025	4,141	-	-	101.4
		2030	4,032	-	-	101.4
		2040	3,929	-	-	101.4

For the purpose of this analysis, the Solar PV costs in 2030 were reduced to $1,053/kW based on updated data from the National Renewable Energy Laboratory (NREL).

Otherwise the renewable cost assumptions are consistent with EPA's Base Case version 5.15.

Note: Capital cost multipliers are used to adjust region specific capital cost assumptions.
*EPA's analysis includes three different landfill gas build options with varying capital costs (LGLo, LGvLO, LGHi). The costs shown above are for the mid range LGLo.

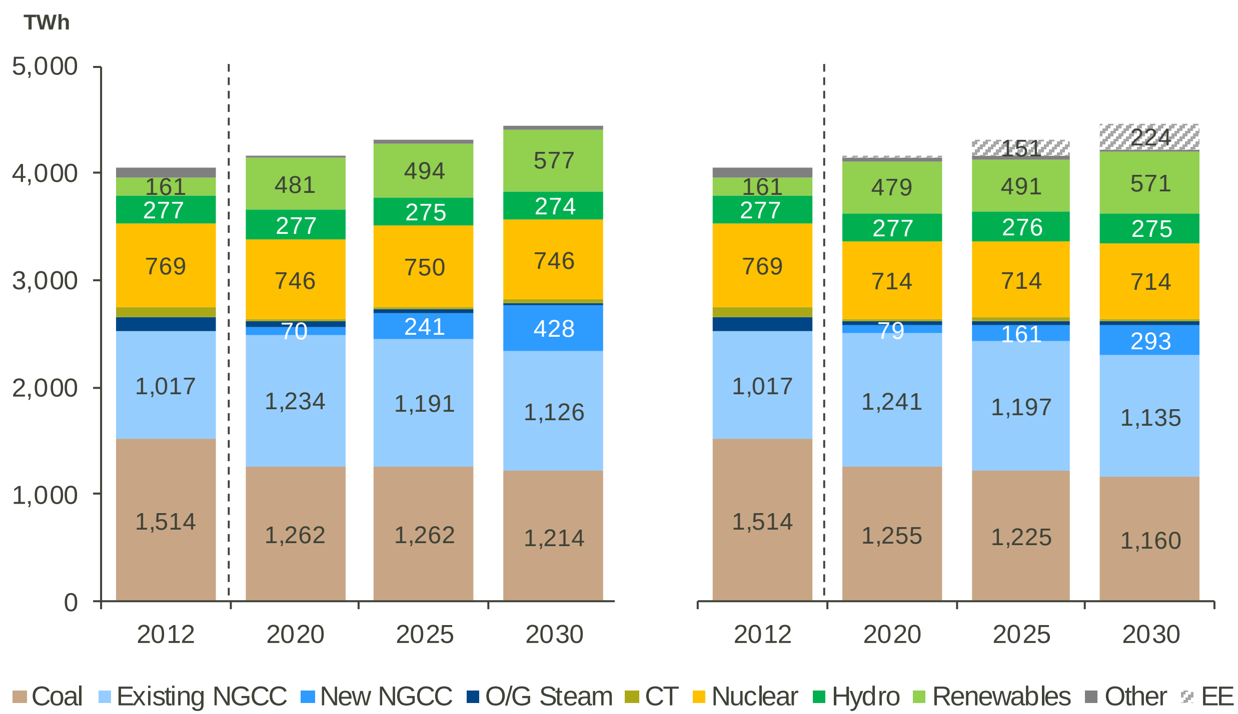
Total U.S.
Generation Fuel Mix: Reference Cases

Reference Case Highlights

- Assumes existing power sector regulations (MATS, CSAPR, 316(b), AB 32, RGGI, state RPS)
- No Clean Power Plan
- AEO 2015 demand growth
- National Henry Hub Gas price = $4.22 (2020) to $4.69 (2030) $/MMBtu. See appendix for more detail.
- ITC and PTC extension included
- 81 GW of coal retirements by 2030, including 17 GW of firm (announced) retirements after 2016.
- 10 GW of nuclear retirements by 2030, including 3 GW of firm (announced) retirements after 2016.

RCa, no incremental EE – **2012-2030**

RCb, Current EE – **2012-2030**



Note: RCb assumes additional energy efficiency savings beyond what is reflected in the AEO 2015 demand growth forecast. States are assumed to achieve their current (2013) annual savings rates between 2018 and 2030.

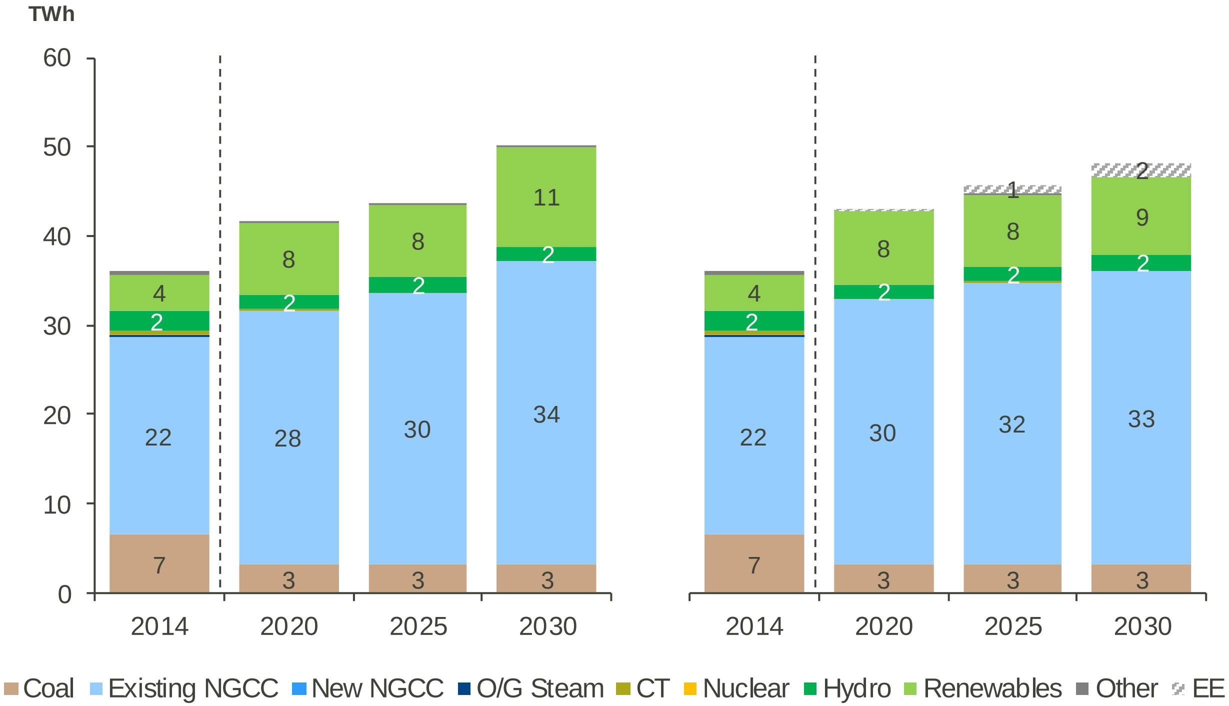
Nevada
Generation Fuel Mix: Reference Cases

Reference Case Highlights

- Assumes existing power sector regulations (MATS, CSAPR, 316(b), AB 32, RGGI, state RPS)
- No Clean Power Plan
- AEO 2015 demand growth
- National Henry Hub Gas price = $4.22 to $4.69 ($/MMBtu). See appendix for more detail.
- PTC and ITC extension included

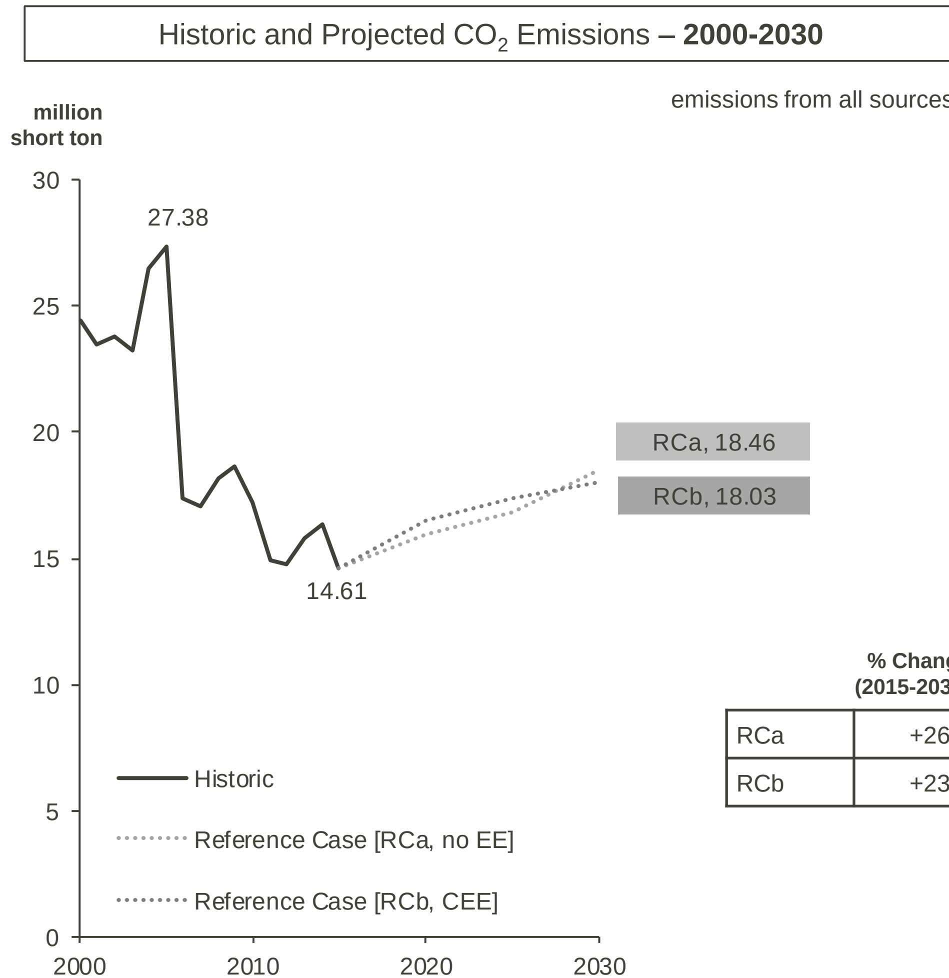
RCa, no EE Generation – **2012-2030**

RCb, Current EE Generation – **2012-2030**



Note: RCb assumes additional energy efficiency savings beyond what is reflected in the AEO 2015 demand growth forecast. States are assumed to achieve their current (2013) annual savings rates between 2018 and 2030.

Nevada
Projected Electric Sector CO_2 Emissions by 2030



% Change (2015-2030)

RCa	+26%
RCb	+23%

Results

The Clean Power Plan is projected to achieve a 16% to 18% reduction in Electric Sector CO_2 emissions by 2030 (from 2015) levels across a range of scenarios

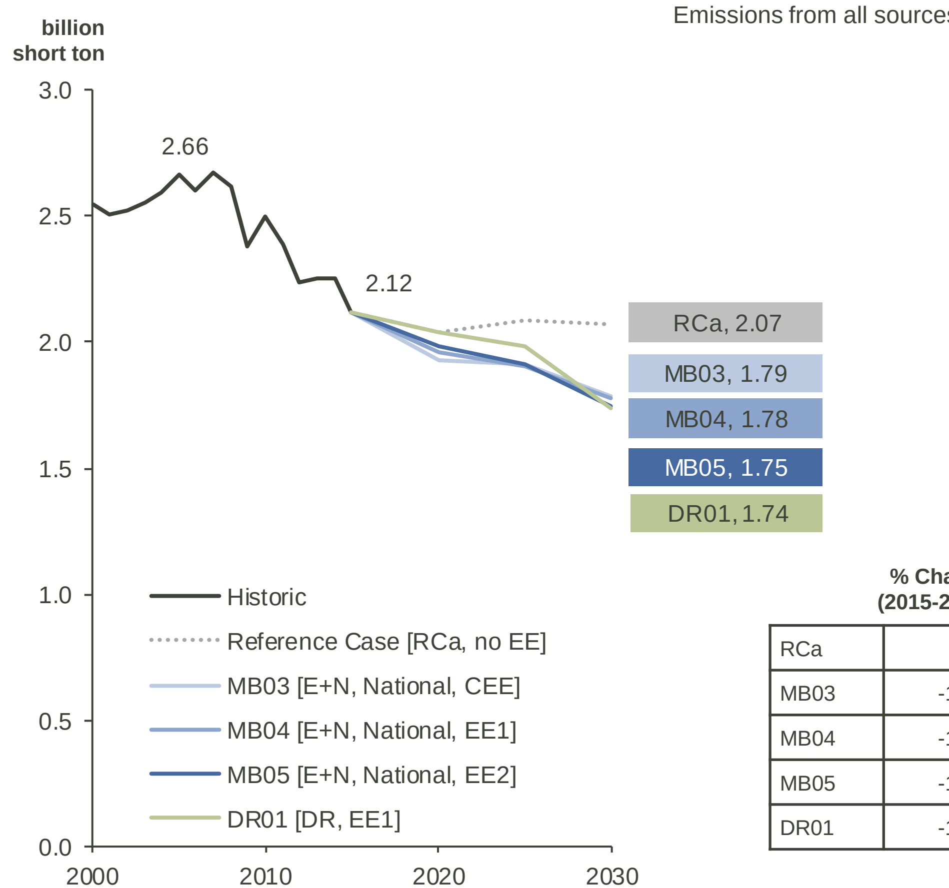
The Clean Power Plan is projected to achieve a significant reduction in electric sector CO_2 emissions across a range of different policy cases (i.e., mass-based and rate-based targets).

Across the "Existing + New" policy scenarios, emissions are projected to decline between 16% and 18% below 2015 levels. See chart.

The emission outcomes under the rate-based scenario, unlike the mass-based approach, are not fixed, and may vary if economic conditions (e.g. natural gas prices, renewable technology prices) differ from the assumptions used in this report.

Note: the electric sector reduced its CO_2 emissions by roughly 20% between 2005 and 2015. Across these model runs, emissions would be reduced between 33% and 34% from 2005 levels.

Historic and Projected CO_2 Emissions – **2000-2030**



% Change (2015-2030)

RCa	-3%
MB03	-16%
MB04	-16%
MB05	-18%
DR01	-18%

The mass-based policy runs with national trading project modest allowance prices throughout the program; increasing the level of EE moderates the prices even further.

Four model runs assumed mass-based, nationwide trading (except California), producing national allowance prices. The allowance prices are relatively modest across the scenarios, particularly in the early years of the program.

As the level of energy efficiency increases, the model forecasts a reduction in allowance prices (see cases MB03, MB04, and MB05 in the table below).

For MB07, the "Existing Only" case, allowance prices illustrate the overall fleet-wide reduction in stringency, which can be seen when compared to MB03 "Existing + New" case, as both scenarios assume the same level of current energy efficiency. However, MB07 does not assume any type of leakage mitigation and is therefore not presumed approvable, whereas the "Existing + New" cases would be approvable.

Allowance Prices **(2012$/ton)**

Code	Assumptions	2025	2030
MB03	Existing + New, National, Current EE	$0.00	$6.05
MB04	Existing + New, National, 1% EE	$0.00	$2.97
MB05	Existing + New, National, 2% EE	$0.00	$0.00
MB07	Existing Only, National, Current EE	$0.00	$4.14

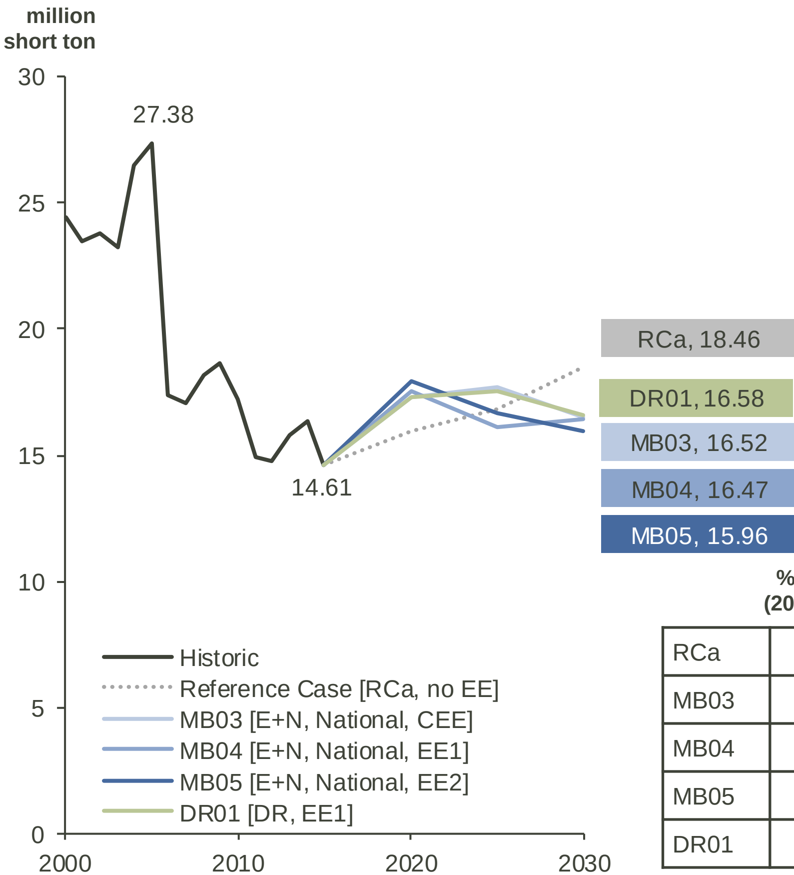
Current EE Scenarios

Note: This analysis does not assume banking of allowances and the CPP goals are assumed to remain constant post-2030.

Nevada

Projected Electric Sector CO_2 Emissions by 2030

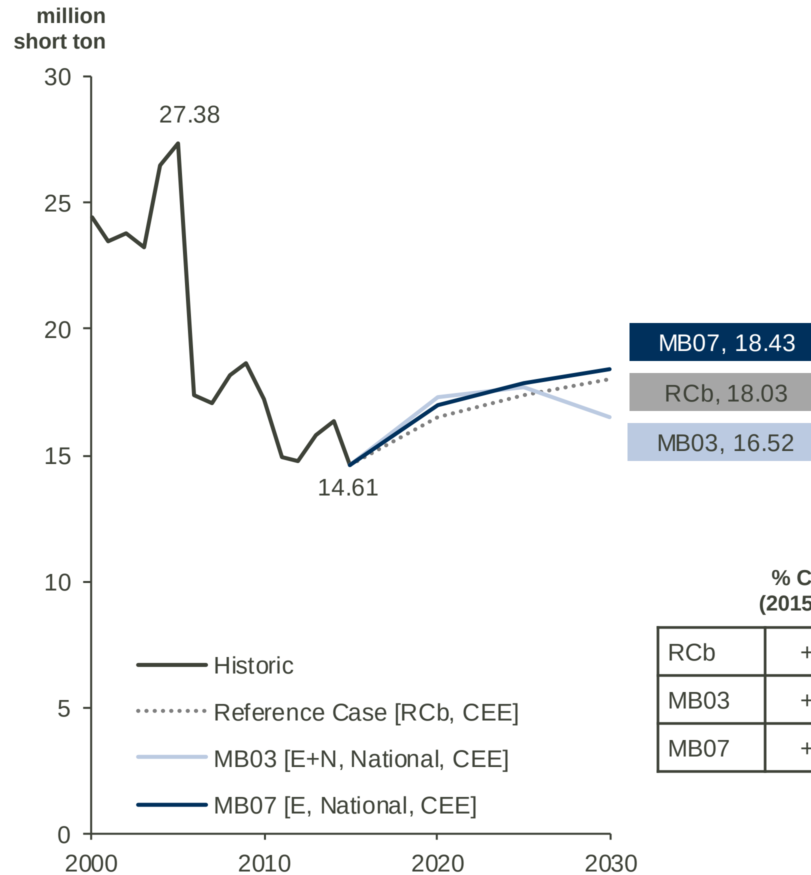
Historic and Projected CO_2 Emissions – **2000-2030**



% Change (2015-2030)

RCa	+26%
MB03	+13%
MB04	+13%
MB05	+9%
DR01	+14%

Emissions from all sources



% Change (2015-2030)

RCb	+23%
MB03	+13%
MB07	+26%

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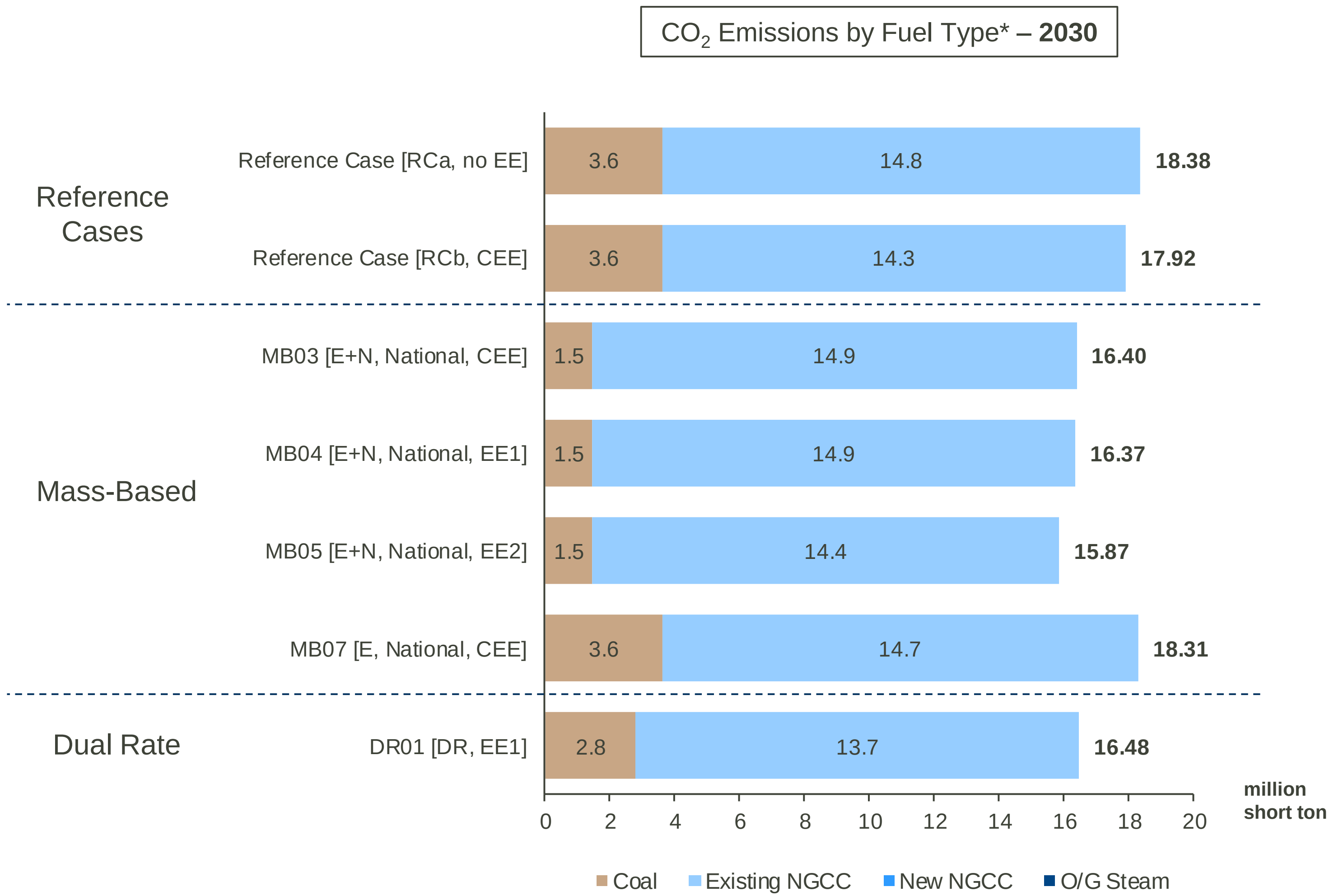
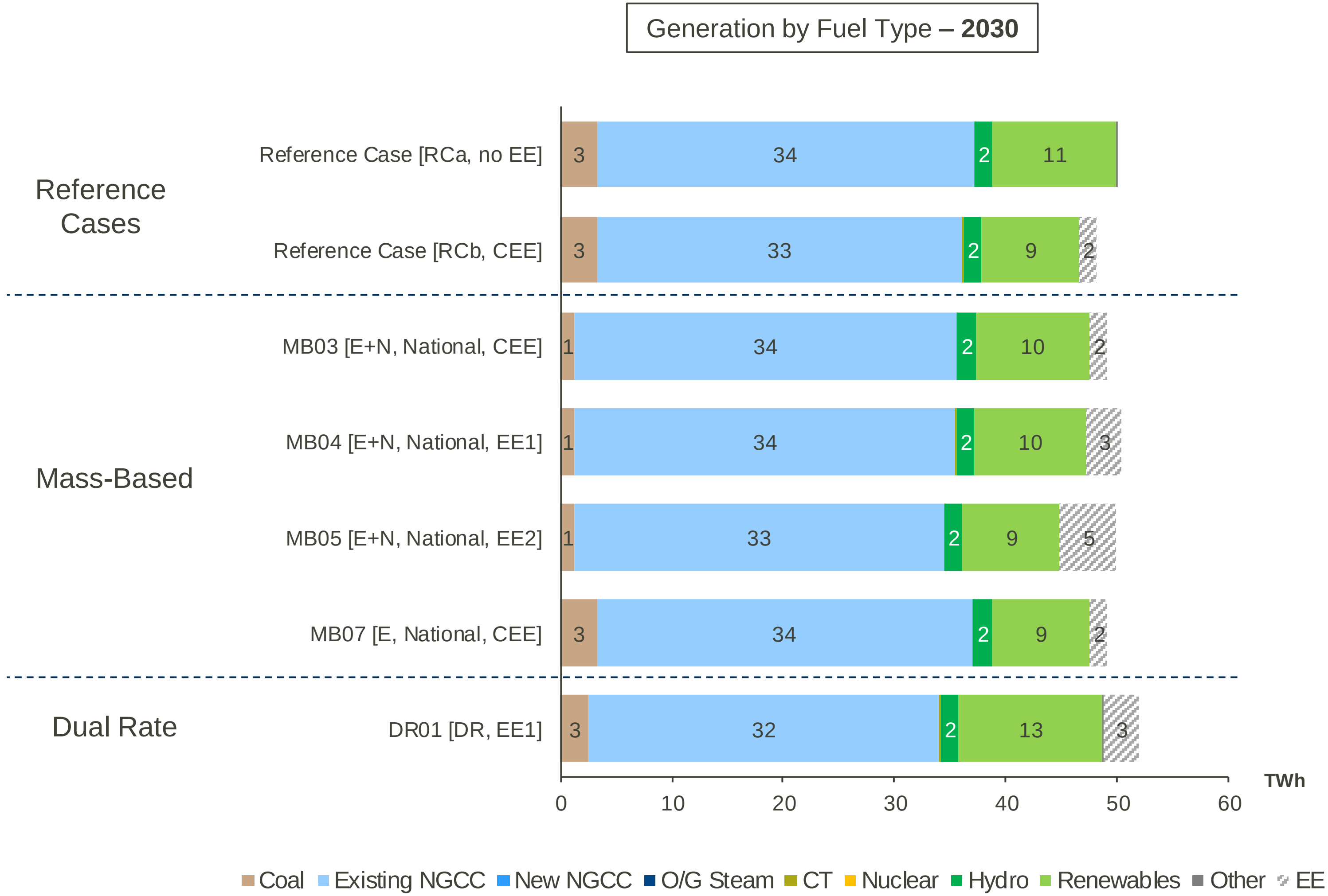
Electric Sector CO_2 Emissions

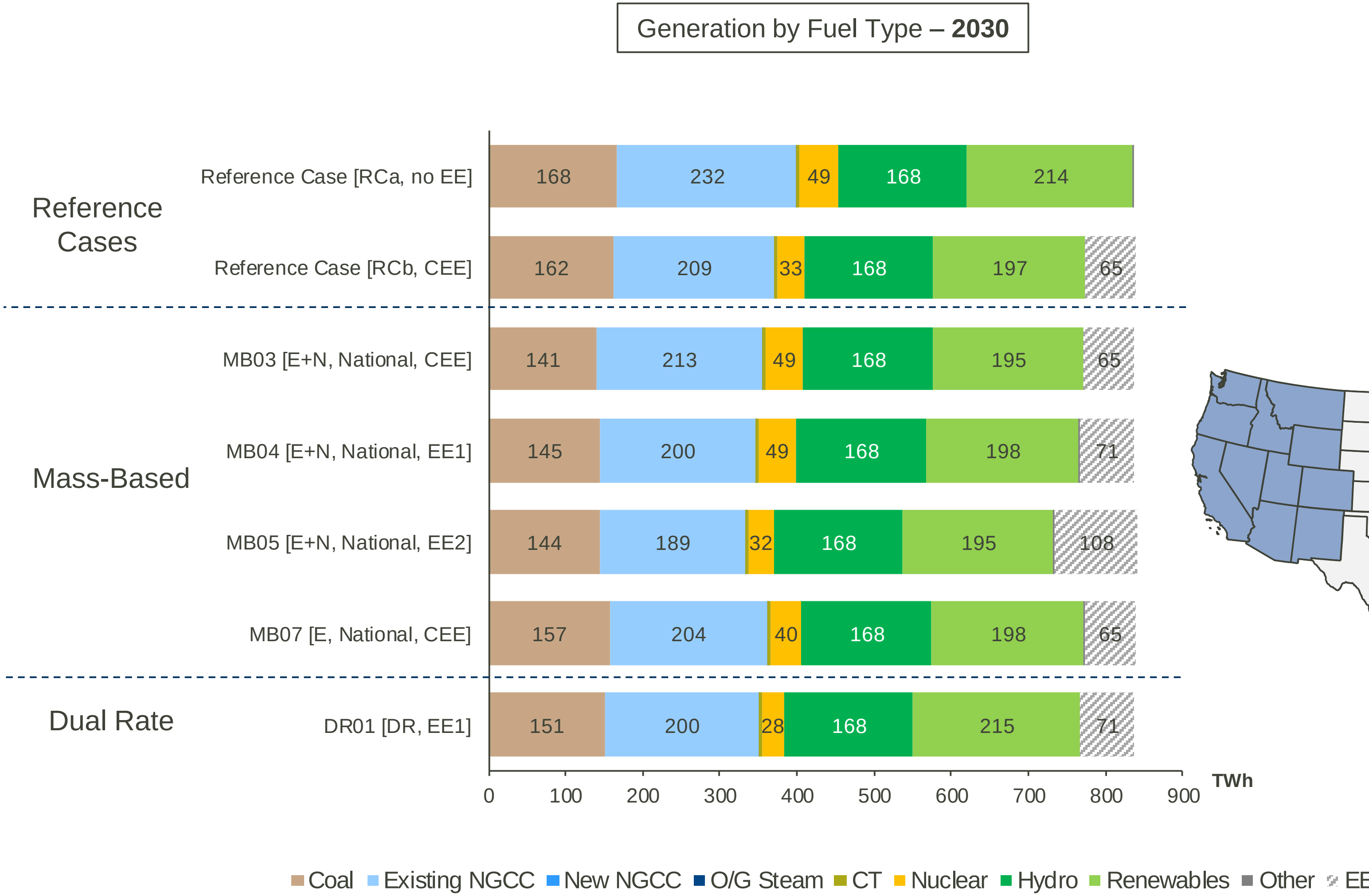


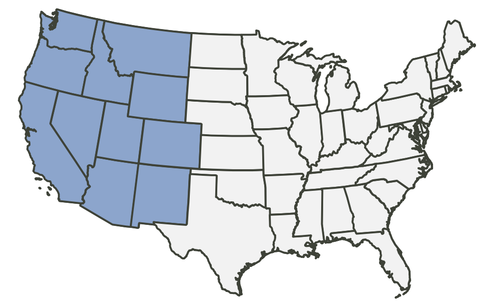
*Does not include emissions from CT and Other sources

Nevada
Generation Fuel Mix

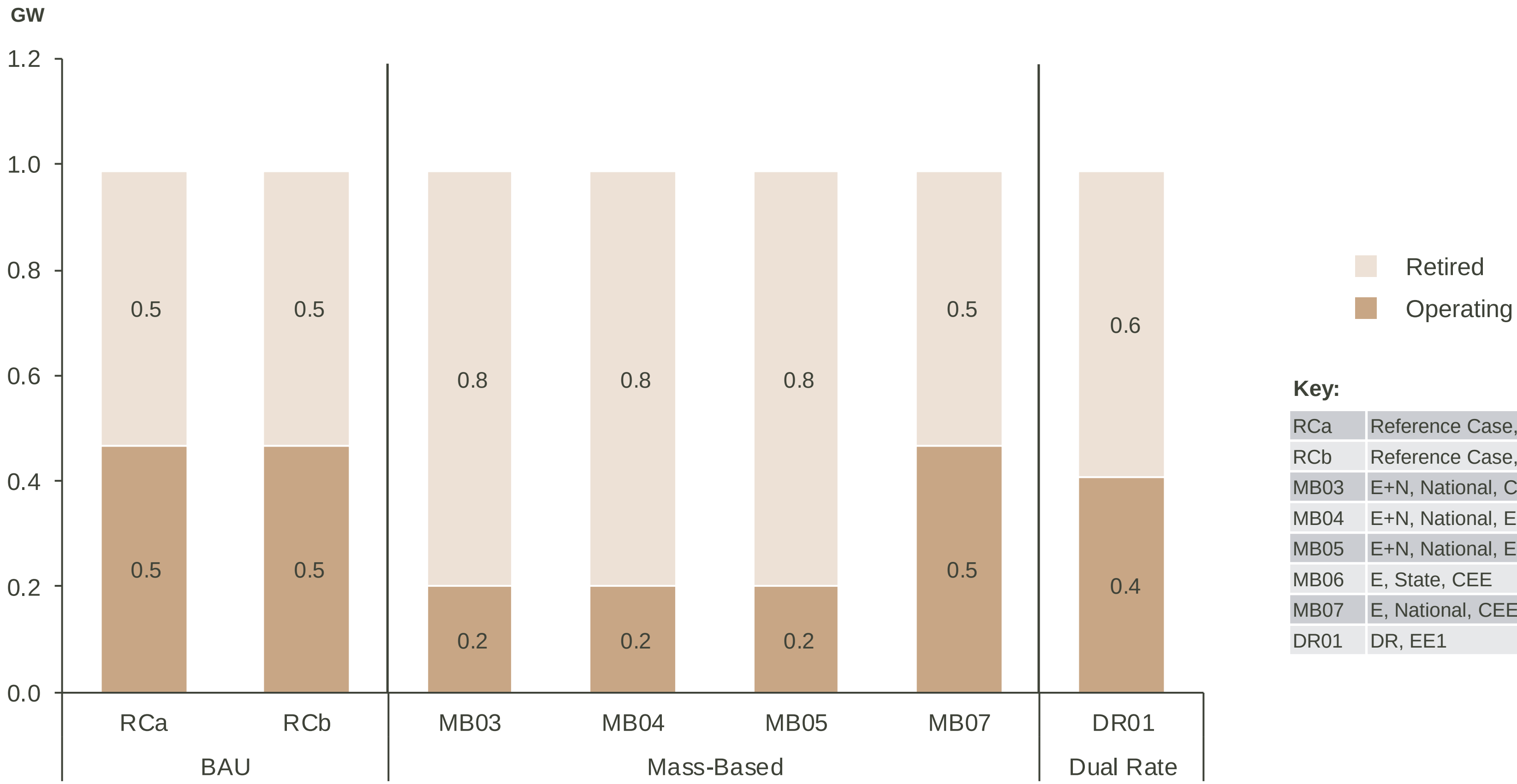


Western States
Generation Fuel Mix





Nevada
Coal Capacity by 2030

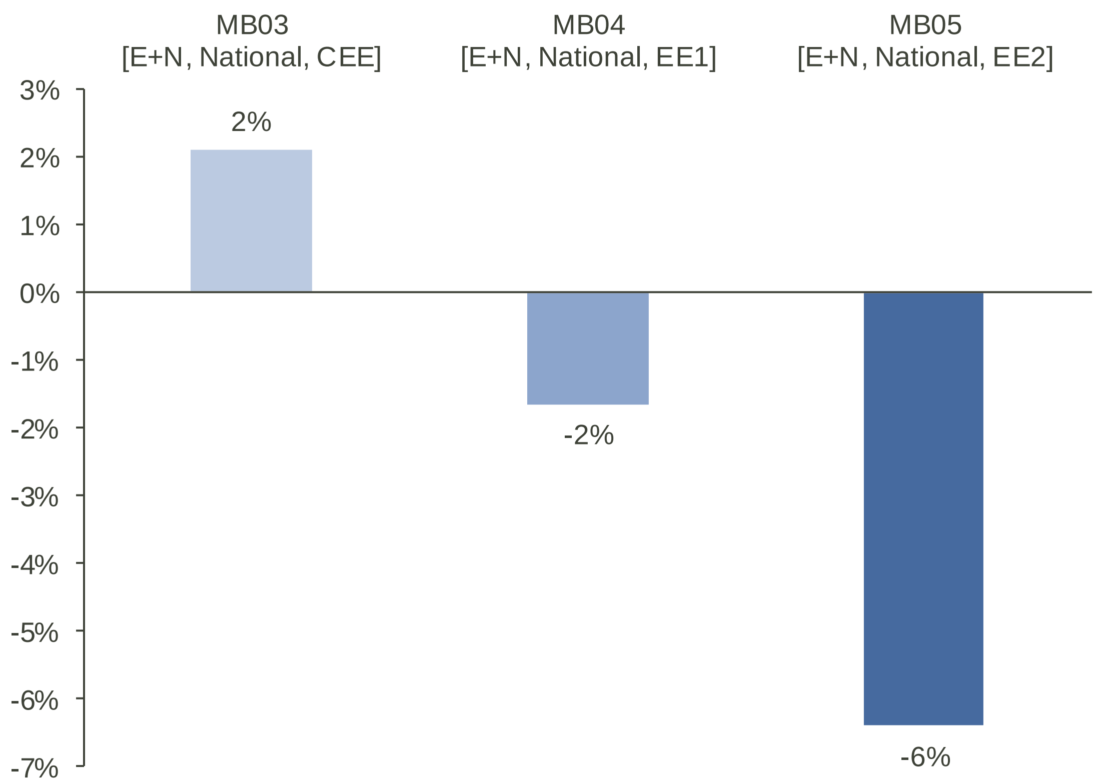


Key:

RCa	Reference Case, no EE
RCb	Reference Case, CEE
MB03	E+N, National, CEE
MB04	E+N, National, EE1
MB05	E+N, National, EE2
MB06	E, State, CEE
MB07	E, National, CEE
DR01	DR, EE1

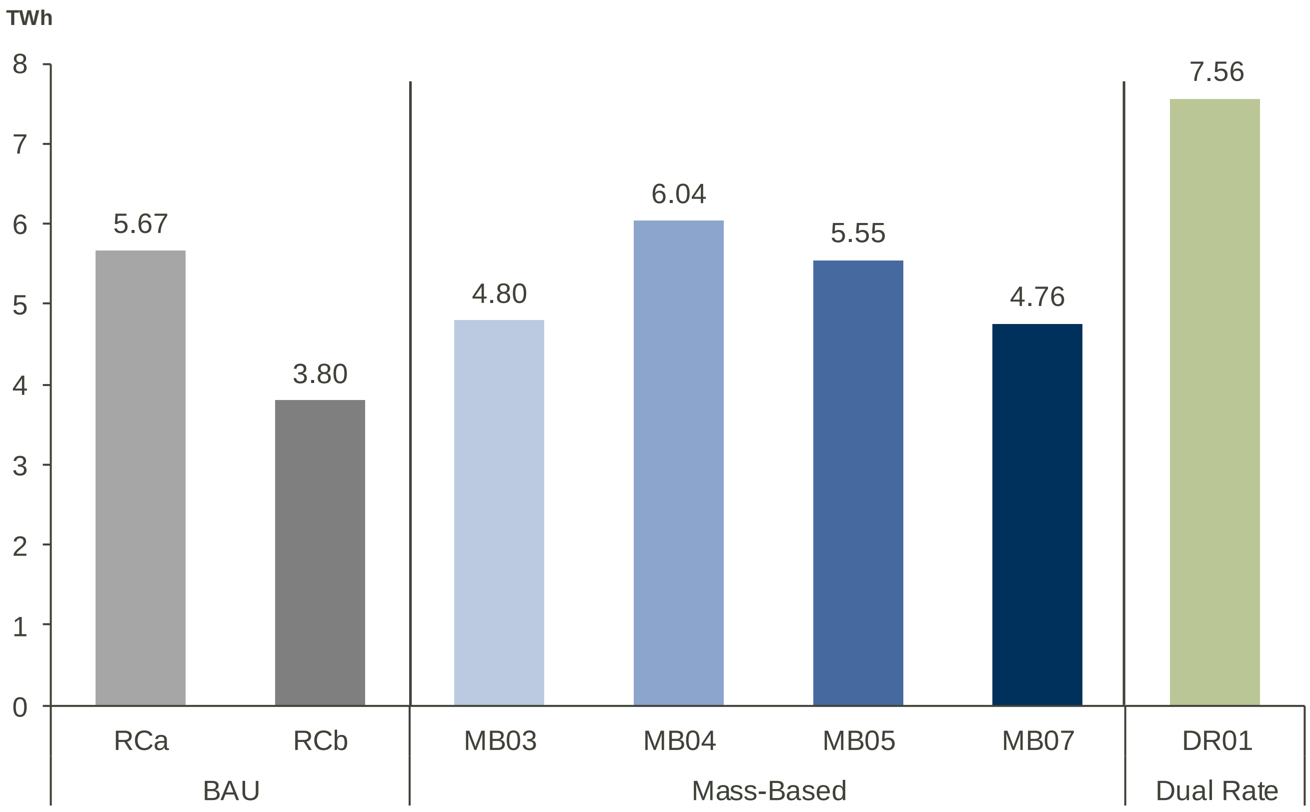
Nevada
Monthly Retail Bill ($/month)

Monthly Retail Bill Compared to RCb [Reference Case, Current EE] – **2030**



Note: See appendix for comparison to RCa [Reference Case, no EE].

Nevada
Net Exports: 2030



Key:

RCa	Reference Case, no EE
RCb	Reference Case, CEE
MB01	E+N, State, CEE
MB02	E+N, State, EE1
MB03	E+N, National, CEE
MB04	E+N, National, EE1
MB05	E+N, National, EE2
MB06	E, State, CEE
MB07	E, National, CEE
DR01	DR, EE1

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Run Year Structure

Model Year:	Representative of Average for Years:
2020	2019-2022
2025	2023-2027
2030	2028-2033

Note: throughout this summary report, when we refer to results in 2020, 2025, and 2030, we are referring to the model years above.

Demand-Side Energy Efficiency Assumptions

- Historic rates of energy efficiency savings differ for each state and were drawn from the data reported by utilities in Energy Information Administration (EIA) Form 861, 2013, available at http://www.eia.gov/electricity/data/eia861/.
- In the "Current EE" scenario, the available supply of EE is calculated based on an extension of each state's 2013 annual savings rate. The annual savings rate is held constant between 2020 and 2030 to derive incremental annual savings and cumulative savings estimates for each state.
- In the "Modest EE" scenario, the available supply of EE is calculated based on the methodology in EPA's Regulatory Impact Analysis (RIA) for the Clean Power Plan. Cumulative efficiency savings are projected for each state for each year by ramping up from historic savings levels to a target annual incremental demand reduction rate of 1.0 percent of electricity demand over a period of years starting in 2020, and maintaining that rate throughout the modeling horizon.
  - Consistent with EPA's approach, the pace of improvement from the state's historical incremental demand reduction rate is set at 0.2 percentage points per year, beginning in 2020, until the target rate of 1.0 percent is achieved.
  - States already at or above the 1.0 percent target rate are assumed to remain at their historic savings rate beginning in 2020 and sustain that rate thereafter.
- In the "Significant EE" scenario, the available supply of EE is calculated based on the same methodology as the "Modest EE" scenario, but each state ramps up to a target annual incremental demand reduction rate of 2.0 percent of electricity demand.
- In the "Modest EE" and "Significant EE" scenarios, adoption of efficiency was modeled endogenously using a supply curve of program costs. In this simplified supply curve approach, the highest amount of savings assumed to be available to states in the supply curve varies by scenario, as described in the methodology above. The costs are based on LBNL's comprehensive 2015 cost study, available at: https://emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf.
- Participant costs are accounted for in the calculation of total system costs.

Retail Bill Calculation

The projected monthly average electricity bills (residential) reflect the combined effects of changes to average retail rates and average household electricity demand under the various modeling scenarios, and by region. Monthly bill impacts would change if the allowance value under a mass-based trading system was returned to customers.

The Retail Price Model accounts for variations in regulated and deregulated markets by calculating cost-of-service and competitive retail prices for each region and then weighing and allocating both to individual IPM regions according to the market structure that best represents each region:

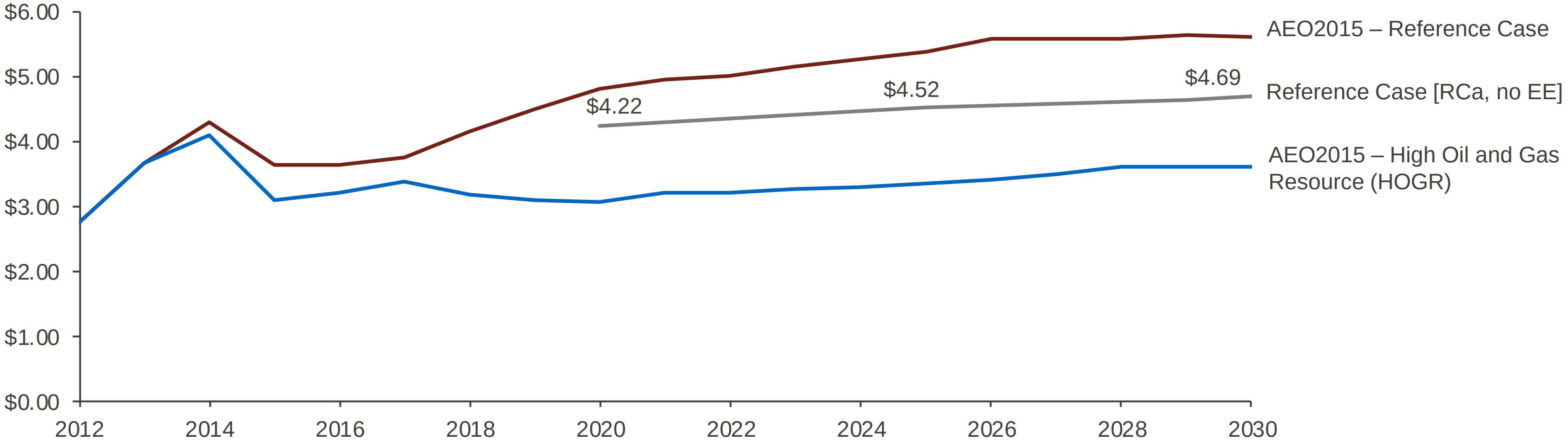
Regional Average Price (mills/kWh) = Competitive Retail Power Price * Deregulation Share (%) + Cost-Of-Service Retail Power Price * Cost-Of-Service Share (%)

Competitive retail power price is comprised of competitive generation cost and transmission and distribution charges. Cost-Of-Service retail power price includes the cost of generation and the recovery of costs associated with transmission and distribution facilities and services.

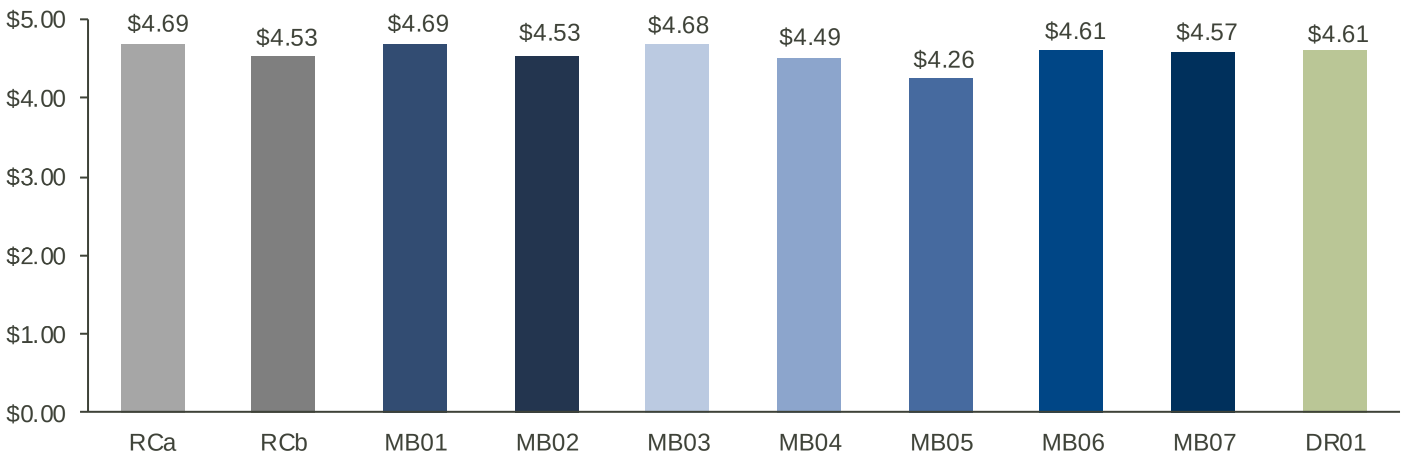
Average retail bills are calculated based on retail rates and household demand, after energy efficiency savings.

Natural Gas Prices (2012$/MMBtu): Total U.S.

Reference Case A Projected Henry Hub Natural Gas Price – **2012-2030**



All Scenario Projected Henry Hub Natural Gas Price – **2030**



Key:

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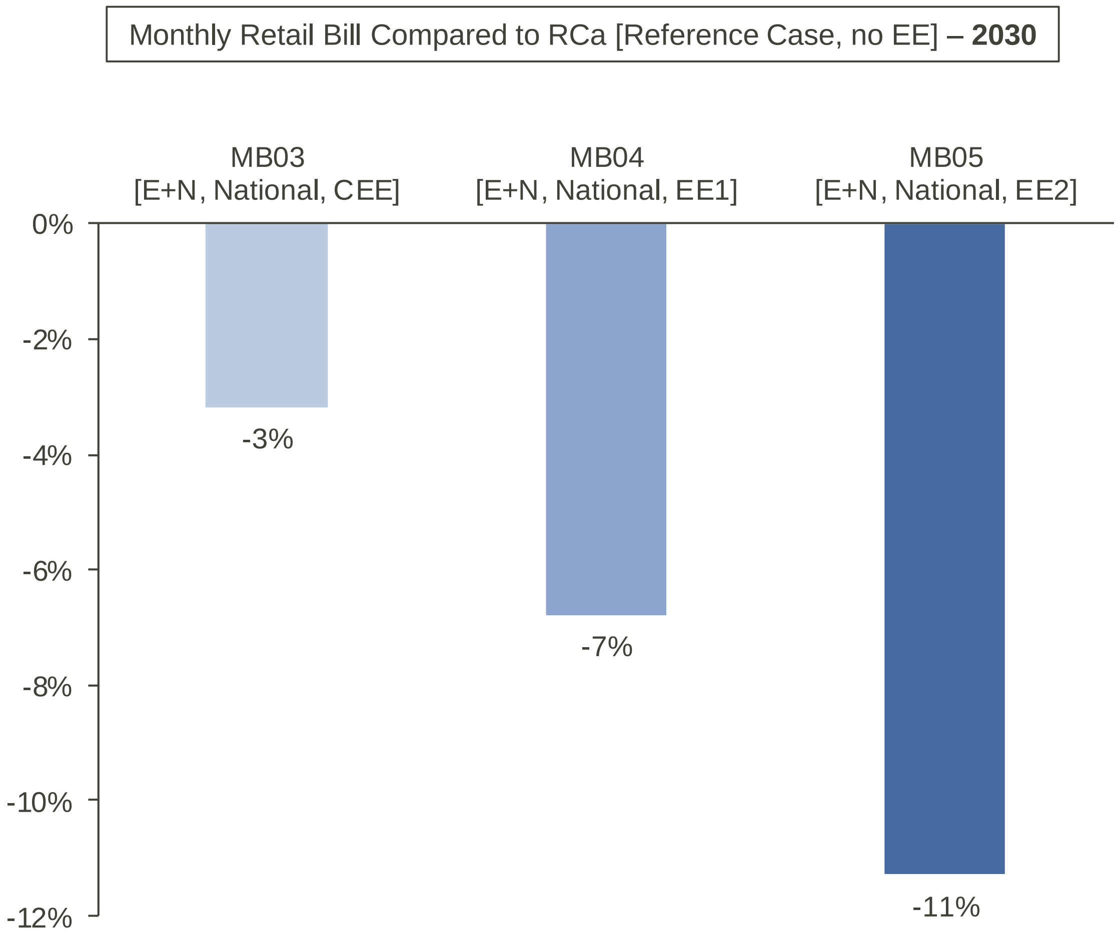
RCb	Reference Case, CEE
MB01	E+N, State, CEE
MB02	E+N, State, EE1
MB03	E+N, National, CEE
MB04	E+N, National, EE1
MB05	E+N, National, EE2
MB06	E, State, CEE
MB07	E, National, CEE
DR01	DR, EE1

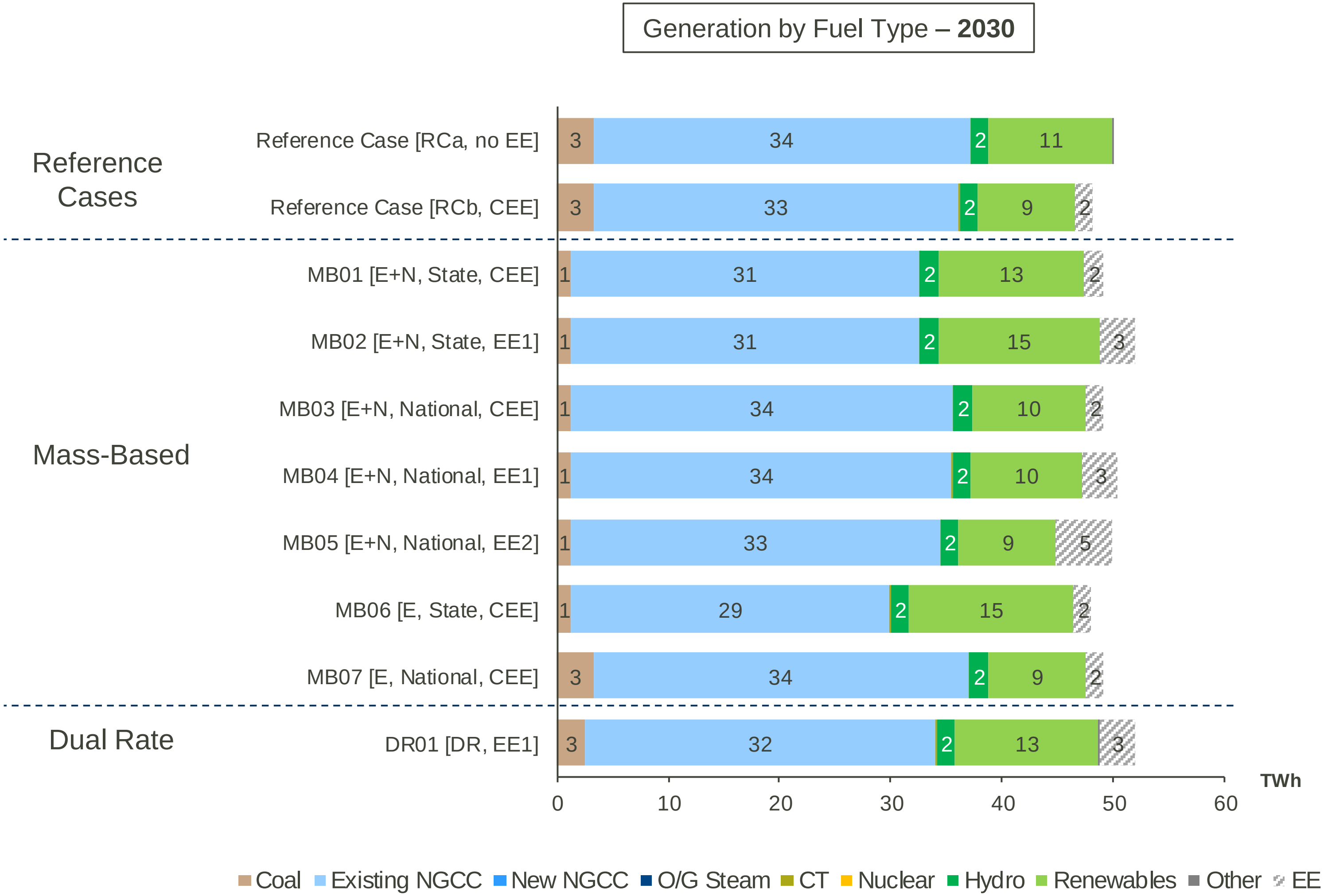
Henry Hub Gas (2012$/MMBtu): Total U.S.

Code	Assumptions	2020	2025	2030
RCa	Reference Case, no EE	$4.22	$4.52	$4.69
RCb	Reference Case, CEE	$4.27	$4.44	$4.53
MB01	E+N, State, CEE	$4.32	$4.52	$4.69
MB02	E+N, State, EE1	$4.33	$4.47	$4.53
MB03	E+N, National, CEE	$4.29	$4.45	$4.68
MB04	E+N, National, EE1	$4.32	$4.40	$4.49
MB05	E+N, National, EE2	$4.36	$4.37	$4.26
MB06	E, State, CEE	$4.25	$4.48	$4.61
MB07	E, National, CEE	$4.25	$4.41	$4.57
DR01	DR, EE1	$4.25	$4.37	$4.61

Nevada
Monthly Retail Bill ($/month)



Nevada
Generation Fuel Mix: All Scenarios



Levelized Cost of Energy (2016-2050): Total U.S.