EPA CLEAN POWER PLAN:

WESTERN STATE RESOURCE SCENARIOS

Prepared for the Western Interstate Energy Board and the State-Provincial Steering Committee

by Energy Strategies

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TABLE OF CONTENTS

INTRODUCTION

The EPA's Clean Power Plan proposes to limit carbon dioxide (CO_2) emission from existing electric generators by setting state-specific CO_2 reduction goals. The ruling will require intense coordination among state energy agencies, utility regulators, air regulators, utilities and generation asset owners, among other parties. Numerous industry forums have and will continue to form, allowing parties to contemplate nuances of the rule, potential implementation options, and the impacts of different strategies on electric system reliability and economics. To inform these discussions, the State-Provision Steering Committee (SPSC) organized the Western States Modeling Work Group (Work Group) in August, 2014. The SPSC is a committee of Governor's representatives, Premiers and utility commissioners that provide input to regional transmission planning and analysis in the Western Interconnection. The committee consists of appointees from each state and province in the Western Interconnection. The Work Group serves as a technical forum for Western States and works to provide input into modeling by the Western Electricity Coordinating Council (WECC) on possible future Clean Power Plan compliance scenarios in the Western Interconnection.

In early 2015, the Work Group initiated an effort to develop planning scenarios that would illustrate future state-level resource mixes that could result from strategies that states may employ to comply with the Clean Power Plan. The SPSC retained Energy Strategies to develop these scenarios. The goal of the project was to help the Western Interstate Energy Board (WIEB) and the SPSC understand how the proposed rule may potentially impact the resource-mix in the west. This information would enable the SPSC to provide WECC with state-level resource mix information that could be useful in analyzing the potential impacts the change in generation would have on reliability of the Western Interconnection.

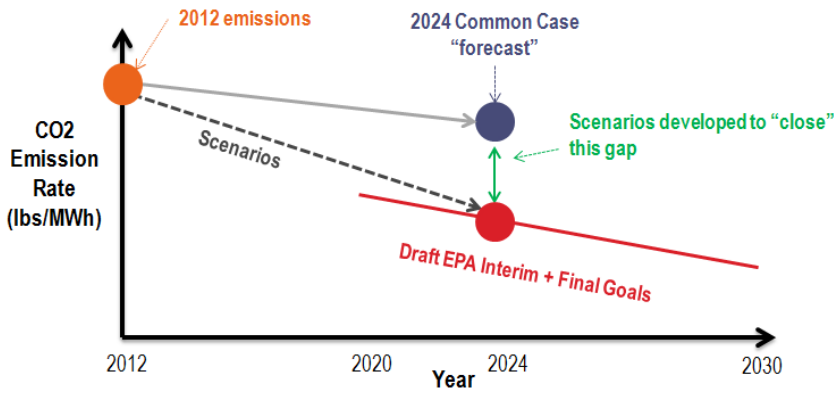
Assessing resource mixes that may result through implementation of the Clean Power Plan can help states understand the potential impact of different compliance strategies, while also creating plausible scenarios that could be subject to future electric system reliability analysis based on data from the WECC 2024 Common Case. This report summarizes scenarios, their themes, the assumptions used to develop the scenarios, as well as the resulting resource mixes for each Western State. This high-level analysis is based on EPA's proposed rule released in June 2014. The final rule will be released during the summer of 2015, and its interpretation and implementation by states could be substantially different than the proposed rule and the interpretation used to inform this analysis. The analysis supporting this report was based on the proposed rule and was conducted not to prescribe or recommend compliance outcomes, but rather to explore potential impacts and to provide information that could ultimately inform future discussions and decision making.

SCENARIO DEVELOPMENT APPROACH

Most technical grid analysis and system reliability studies are conducted with a forward looking study timeframe anywhere from 1 to 10-years. Based on this, resource scenarios for this project were created for the 2024 interim-compliance year. The scenario development exercise required two key pieces of information: (1) CO_2 emissions states might expect under a business-as-usual (BAU) reference scenario; and (2) the degree these CO_2 emissions must be reduced in order to achieve state-level compliance

with the EPA interim targets. The WECC 2024 Common Case[1] was used as the main source for future emissions data since the it represents simulated hourly operation of the western grid based on a security-constrained economic dispatch, taking into account statutory RPS requirements, expected levels of energy efficiency, and a realistic transmission build out made up of "high probability" projects expected to be in-service in the 10-year timeframe. The 2024 Common Case state emission rates, as calculated in our analysis, served as a "business-as-usual" emission forecast. The EPA interim targets served as the emission target for each state. Figure 1 visually depicts how scenarios were developed in order to close the emission rate gap between the 2024 Common Case emission rate (i.e., business-as-usual) and the EPA proposed interim goal.

FIGURE 1: SCENARIO DEVELOPMENT APPROACH



State-specific compliance scenarios to reduce emissions rates were developed were developed using the EPA's proposed "building blocks". Emission reduction measures reflected in the scenarios include:

- **Heat rate improvements** – Increasing the efficiency of coal plants would mean fewer emissions for the same amount of energy, thereby reducing the generator's total CO_2 emissions.
- **Redispatch estimates** – While none of the scenarios feature a simulated economic redispatch from high to low emission resources, the effect is emulated by retiring coal resources and replacing their generation with combined cycle gas generation and/or renewable resources. The effect of this is a redispatch away from coal to other low- or no-emission energy sources, thereby reducing state CO_2 emissions. Additionally, redispatch impacts caused by the addition of renewable resources and energy efficiency were captured by estimated the corresponding reductions in generation from marginal units, which were assumed to be combined cycle generators.
- **Additional energy efficiency or renewable energy** – Additional energy efficiency and renewable energy were added to state resource mixes to reduce a state's emission rate by (1) adding to the denominator used to calculate the emission rate; and (2) reducing the amount of net load that must be served by CO_2 emitting thermal resources. Additional renewable energy and/or energy efficiency reduce the need for energy from thermal resources[2][3]. These

[1] Link to WECC Common Case dataset: https://www.wecc.biz/TransmissionExpansionPlanning/Pages/Datasets.aspx
[2] States with significant over-generation issues might not experience this effect. If renewable energy is already being curtailed, adding further renewable energy will not result in a 1-to-1 carbon reduction. For the purposes of this study, California was not in need of further emission reductions (beyond those in the BAU scenario) so this issue was ignored as few western states have experienced over-generation to the same degree that California has.

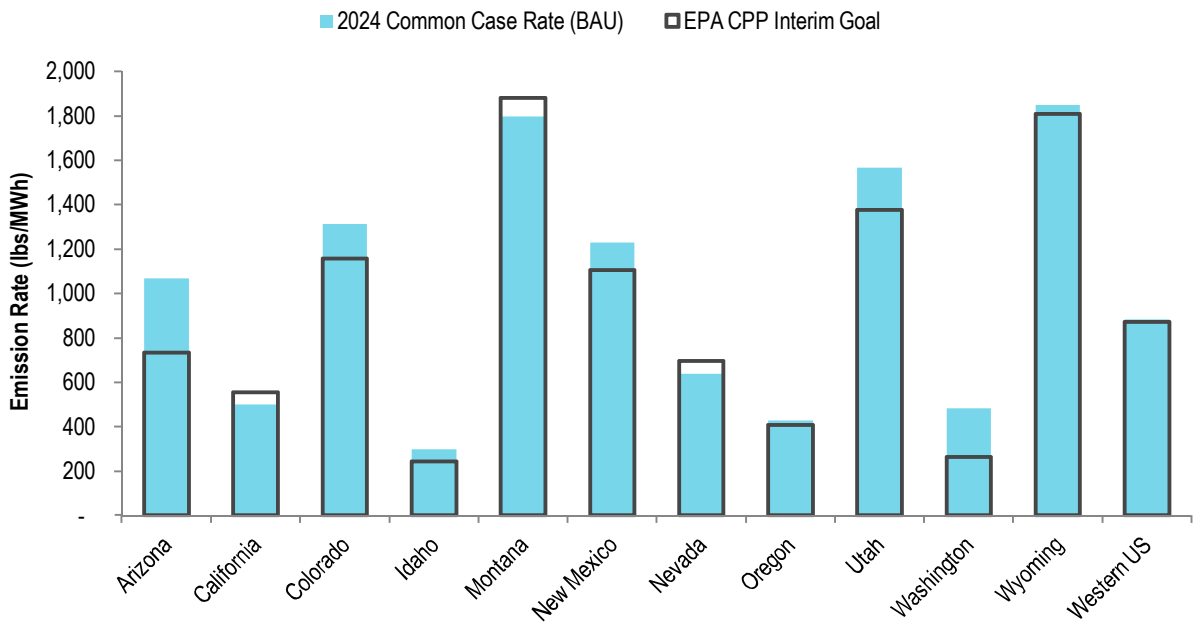
emission reductions were accounted for in the analysis. This redispatch assumption would need to be verified in an operational model, but it was suitable for this high-level scenario analysis. Note that the exact emission impacts of renewable energy and energy efficiency additions cannot be precisely derived from a spreadsheet model due to their complex, system-wide impacts on the dispatch of thermal plants, and the need to consider transmission constraints.

BUSINESS-AS-USUAL SCENARIO

As a first step in developing state specific compliance scenarios, the WECC 2024 Common Case data was used to calculate a "business-as-usual" estimate of state emission rates, consistent with the methods proposed by the EPA. These state specific emission rates were then compared to the interim EPA emission reduction target in order to identify states with "compliance gaps", or in other words, states with estimated 2024 business-as-usual emission rates higher than their EPA interim target goal. The results of this analysis are summarized in Figure 2. As shown, Arizona, Colorado, Idaho, New Mexico, Oregon, Utah, Washington, and Wyoming all have emission rate gaps, which in this scenario development exercise, would translate to the need for additional emission reduction measures. The analysis suggests that planned actions (as represented in the Common Case data) may enable a handful of states to comply with the EPA interim emission rate target. These states (California, Montana, and Nevada) were not subject to further compliance measures in the scenario design exercise.

[3] The reliability implications of this were not taken into account and should be the subject of continuing analysis as states develop their compliance plans.

FIGURE 2: STATE EMISSION RATES ASSUMING GEOGRAPHIC ASSIGNMENT OF RE[4]



RULE INTERPRETATION AND ASSUMPTIONS

In order to create scenarios where states meet their identified EPA interim goals, the Work Group identified compliance strategies of particular interest and then Energy Strategies developed state-level scenarios based on these strategies. The Work Group decided to test divergent compliance themes in order to better understand the infrastructure impact (in terms of MW capacity installed or retired) that these types of decisions could have on the interconnection as a whole, and for individual states. It is worth noting the significant amount of discussion the group had about what a realistic compliance approach might represent. Certain states had the perspective that the most realistic approach would be one that leveraged numerous, if not all, compliance options, while others saw value in studies that leveraged the building blocks individually. The Work Group ultimately decided to balance these two desires and create several scenarios – some using single building block measures and others more complex using multiple compliance measures.

Based on guidance from the Work Group, Energy Strategies developed four scenarios, each with a unique compliance theme intended to test strategies states could employ in their compliance approach. The scenarios and their key assumptions are summarized in Table 1.

[4] Note that the chart and supporting analysis assumes that renewable energy credits are assigned to the state where the renewable generator is physically located. This runs contrary to compliance approach proposed in the draft rule. This assumption was made based on an initial lack of data about renewable energy contracts, RECs, and ownership. This issue is discussed in detail later in a report, and sensitivity is reviewed.

TABLE 1: SCENARIO SUMMARY

Decision Variable	Reference (Common Case)	Scenario A	Scenario B	Scenario C	Scenario D
Compliance Theme:	**3 of 11 states meet interim goal**	**High coal retirements replaced with renewables**	**Regional coordination, single-state goals**	**Blended portfolio with high energy efficiency**	**High coal retirements replaced with combined cycle**
Goal Setting: State or multi-state	State	State	State	State	State
Goal Type: Mass or rate	Rate-based	Rate-based	Rate-based	Rate-based	Rate-based
Compliance Framework	State based	State based	Utility based	State based	State based
RE Designation and 111(b) resources: Geographic or Delivered; Included or excluded	Geographic 111(b) Included	Geographic 111(b) Included	Geographic 111(b) Included	Geographic 111(b) Included	Geographic 111(b) Included
Multi-state Coordination: Yes or No	No	No	Yes	No	No

Key assumptions used to develop the above scenarios include:

- **Goal Setting:** All scenarios assumed that states would develop compliance plans and take action to meet their individual state goal. Note that in Scenario B, states were allowed to coordinate across assumed and fictitious regions in order to share emission rate reduction credits in achieving individual state goals.
- **Goal Type:** All scenarios assumed rate-based goal setting and compliance. This approach was taken to simplify and expedite the analysis. Mass-based goals were of equal interest to the group, and are being considered for future analysis.
- **Compliance Framework:** This assumption references the footprint of the compliance mechanism. Three of the four scenarios assumed that a state would be responsible for the affected generating units within its borders, regardless if those units were owned by multi-state utilities, out-of-state utilities, or producing energy delivered to other states through long-term power purchase contracts. Scenario B allows for a more "utility centric" compliance approach where the accounting allows multi-state utilities (within the identified regions) to take credit for and accrue emission reductions across state borders.
- **RE Designation and 111(b) Resources:** The EPA's draft rule proposes that a state could take credit for all of the CO_2 emission reductions from renewable energy measures implemented by a state, whether they occur in the state or in other states. This issue remains a point of contention in the draft rule, and EPA has collected comments on the subject. Based on an initial lack of data availability regards to renewable energy contracts, credits, and ownership, the analysis assumes renewable energy would be credited to that state where the resources is geographically located. Based on interest from the Work Group, Energy Strategies and WIEB staff collected data on renewable energy contracts and RECs from states and performed a sensitivity assuming interstate renewable energy accounting. This information is summarized later in the report. New qualified resources (namely, new natural gas combined-cycle units), will be

regulated under EPA 111(b). The Clean Power Plan gives states deference on if they include 111(b) resources in their 111(d) compliance plans. Since states are not likely to have established a strategic direction on this subject, Energy Strategies assumed that all 111(b) resources would be included in state's compliance efforts. This allowed the project team to estimate the impact of potential system redispatch more accurately (outside of a production cost model).

- **Multi-state Coordination:** States are contemplating opportunities to cooperate in developing compliance modules that could be shared across state boarders. This would allow states to maintain autonomy in terms of their state goals and plans, while giving them the flexibility to exchange compliance credits between states when practical to comply with the EPA goal. Scenario C, which emulates regional sharing of compliance credits, attempts to depict such a future. In all other scenarios states are responsible for all aspects of their compliance

In the sections that follow, as short description of each scenario is provided, along with high level summary information depicting the future resource mix for the Western Interconnection. The Appendix contains additional tables and data describing each of the scenarios.

SCENARIO A – HIGH COAL RETIREMENT REPLACED WITH RENEWABLES

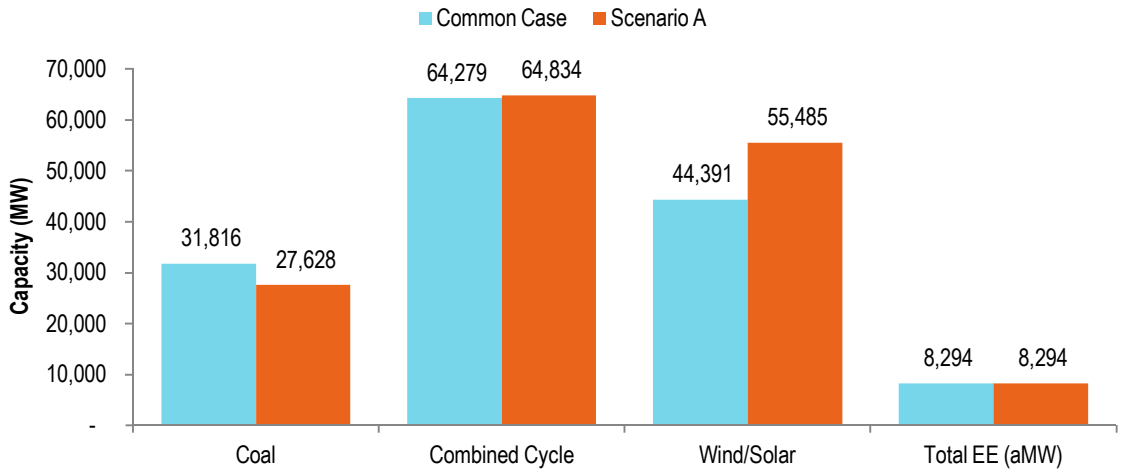
Scenario A achieves state-compliance with the EPA interim targets by retiring coal plants and replacing their generation with renewable generation (wind and solar). For each western state needing emission reductions, three measures were taken (in order), until the state met its interim goal. As a first step to compliance, it was assumed that affected coal plants could achieve a 2% heat rate improvement through the implementation of operation efficiencies and minor capital investments. Next, a series of coal plants were retired and their energy was replaced by a prevalent local renewable resource[5] (i.e. solar in Arizona and wind in Wyoming). Energy Strategies conducted a review of plant specific data in Western integrated resource plans and other publically available sources to identify an initial set of coal retirements and repowerings planned near 2025. These plants were retired first, and their energy was replaced through the addition of wind and solar resources. If the state's goal wasn't achieved though this action, the plants with retirement dates late in the compliance period (e.g., 2029, 2030) were identified, assigned an earlier retirement date in the analysis, and replaced with an energy equivalent amount of renewable energy. Finally, if states still did not reach the compliance target, then additional coal plants were identified based on (a) assumptions in recent utility studies; (b) existence of emission retrofits for regional haze and other environmental compliance, and/or (c) relative age and efficiency (represented by the plants emission rate) relative to the rest of the coal generation fleet. Any plants retired through this process were also replaced with wind and/or solar generation. Wind and solar capacity was added to meet the energy target (MWh) as determined by the coal plant retirements. High-level capacity factor estimates (based on a review of NREL wind profile data and WREZ estimates), were used to convert energy to renewable energy capacity (MW). Solar or wind was selected based on the prevalent resource in that state.

Several states did not have coal plants to retire, but still needed emission reductions to achieve compliance. For these states, renewable energy was added to push these states under the target emission rate.

[5] Capacity factor assumptions for renewable resources were based WREZ data: http://www.westgov.org/rtep/220-wrez-transmission-model-page

Scenario A resulted in the retirement of 12% of the western coal fleet, which represented 3% of the system overall energy. Colorado and Arizona were the two states most affected by retirements, combining for over half of the coal plant retirements. Key resource mix changes (in MW) from the Common Case (reference) scenario to Scenario A are provided in Figure 3.

FIGURE 3: SCENARIO A RESOURCE SUMMARY (2024)[6]

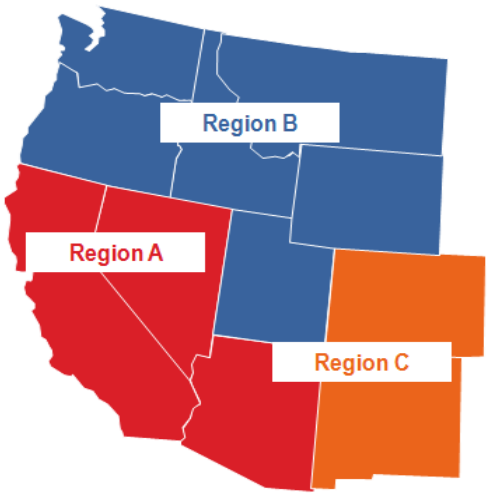


SCENARIO B – REGIONAL COORDINATION, SINGLE STATE GOALS

During the scenario development process, the Work Group expressed interest in Energy Strategies developing a simplified scenario that demonstrated cooperation among Western states in achieving individual state compliance targets. To emulate such a future, Energy Strategies identified three regions (Figure 4) that would be subject to emission reduction credit sharing. The regions were identified based on factors such as the presence of multi-state utilities, electrical connectivity, and relative position to their compliance targets. In the scenario, each state was still assumed to meet its individual interim compliance emission rate target, but could rely on emission reduction "credits" from other states in its region to do so.

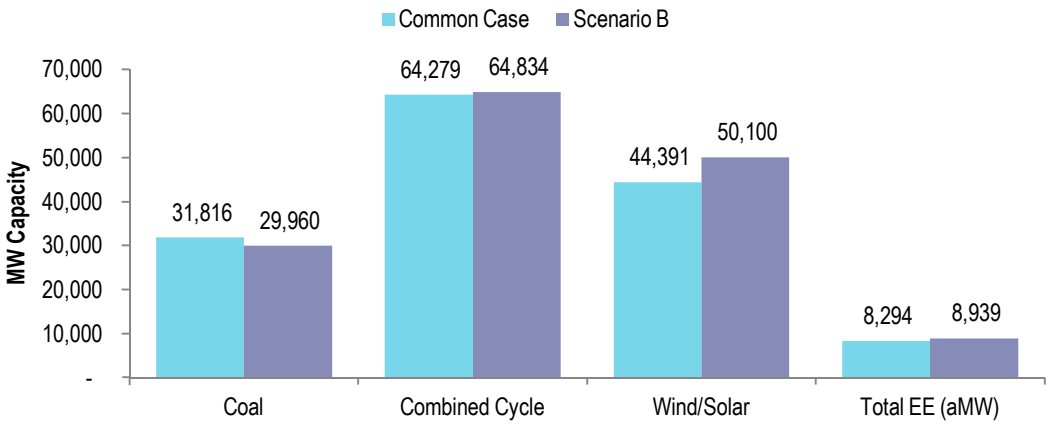
[6] 555 MW of coal to gas repowerings are included in Scenario A as category "combined cycle"

FIGURE 4: TEST REGIONS FOR CREDIT SHARING



As an initial compliance measure, affected coal plants were assumed to improve their heat rate 2%. At this point, states with surplus credits could share those credits with states in deficit (e.g.; states with BAU emission rates higher than their goal). This exchange was performed with zero transaction cost. If state-to-state coordination through credit sharing did not result in a region's states achieving their emission reduction goal, additional measures were taken – first in the form of likely coal retirements slated for the 2025 timeframe, followed by additional renewable energy and energy efficiency. The credits from these actions were again shared across state boarders. After taking these actions, and distributing the credits to those states in need (or further reducing the remaining need/deficit in those states where the action took place), all of the western states were at or below their interim goal. The resulting interconnection-wide resource mix is shown in Figure 5.

FIGURE 5: SCENARIO B RESOURCE SUMMARY (2024)



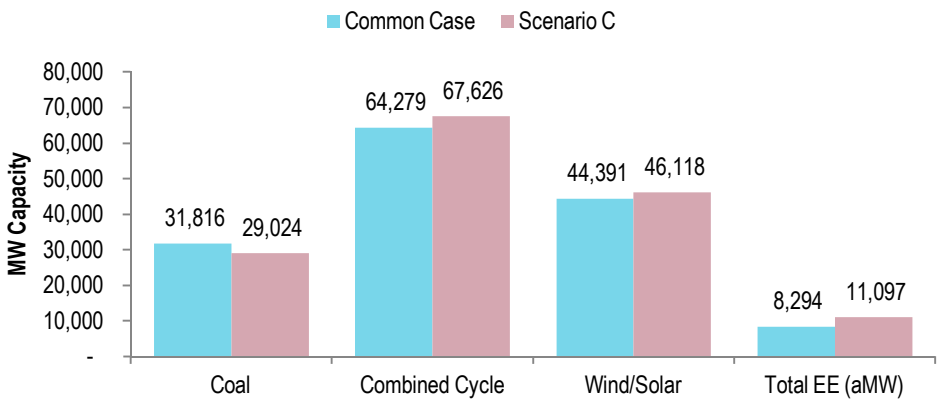
A true regional approach under the Clean Power Plan would be much more complicated than what was studied in this scenario. Transaction costs were ignored, regions were identified without the consideration of many factors, and a rudimentary emission reduction credit was used as a fully-transferable multi-state currency. With these assumptions in mind, it is worth noting that the scenario featured fewer coal retirements than the other scenarios.

SCENARIO C – BLENDED PORTFOLIO WITH HIGH ENERGY EFFICIENCY

The Work Group was also interested in a scenario that featured a more diverse and balanced approach to Clean Power Plan compliance. To some, this type of scenario is thought of as the most realist path to compliance, since it is unlikely that any state will rely on a single building block (e.g.; redispatch, additional renewable energy, coal retirements) to meet their target. Scenario C featured 2% heat rate improvements, like prior scenarios, and the retirement of a set of known and probably coal units in the 2025 time period. These units were replaced by natural gas facilities in this scenario. Additionally, higher levels of incremental rate-payer funded energy efficiency were assumed in the scenario, and the corresponding impacts on emissions as driven by load reductions were estimated. The energy efficiency assumptions were based on data obtained from Lawrence Berkeley National Lab (LBNL) reports[7].

In total, 25,000 GWh of new energy efficiency were assumed in the scenario (per LBNL data). This would result in about a 2.3% load reduction for the Western states. The resulting resource mix for Scenario C is summarized in Figure 6.

FIGURE 6: SCENARIO C RESOURCE SUMMARY (2024)



SCENARIO D – HIGH COAL RETIREMENT REPLACED WITH COMBINED CYCLE

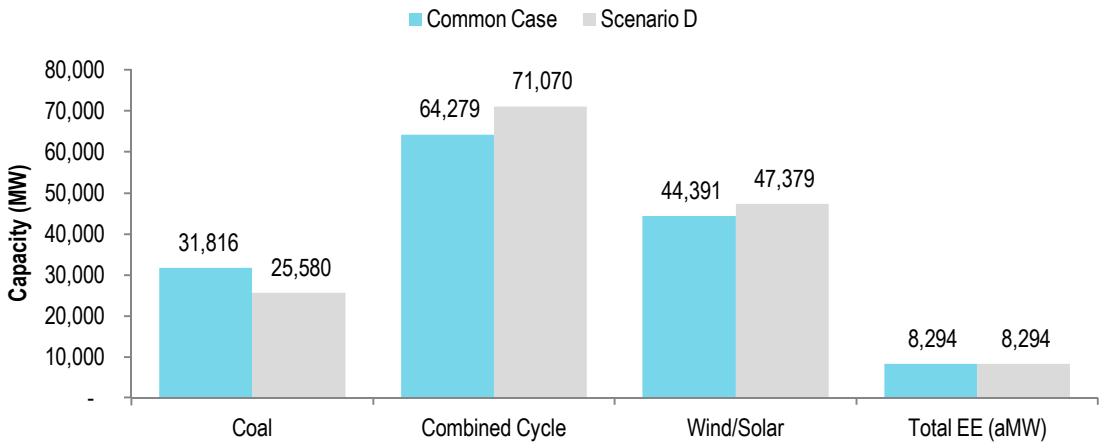
Scenario D was created to bookend potential approaches that may be taken with regards to replacing energy once provided by coal plants. Scenario A replaced retired coal resources with renewable generation, while Scenario D assumes the coal generation is replaced by new combined cycle gas generation. The scenario also includes 2% heat rate improvements on all affected coal units, and a small amount of added renewable energy in states that did not have coal to retire as a compliance mechanism.

By replacing coal with gas fired combined cycles in Scenario D, it was necessary to retire 50% more coal units than in Scenario A where the generation was replaced by renewable energy. The coal unit retirements in Scenario D represented 17% of the total west-wide coal fleet, and 4% of total generation (by energy). By replacing this generation with combined cycle gas units, energy

[7] http://emp.lbl.gov/sites/all/files/lbnl-5803e.pdf and http://emp.lbl.gov/sites/all/files/lbnl-6578e.pdf

from gas-fired generation would increase approximately 10% from the business-as-usual reference scenario. The resulting resource mix for Scenario D is summarized in Figure 7.

FIGURE 7: SCENARIO D RESOURCE MIX SUMMARY (2024)



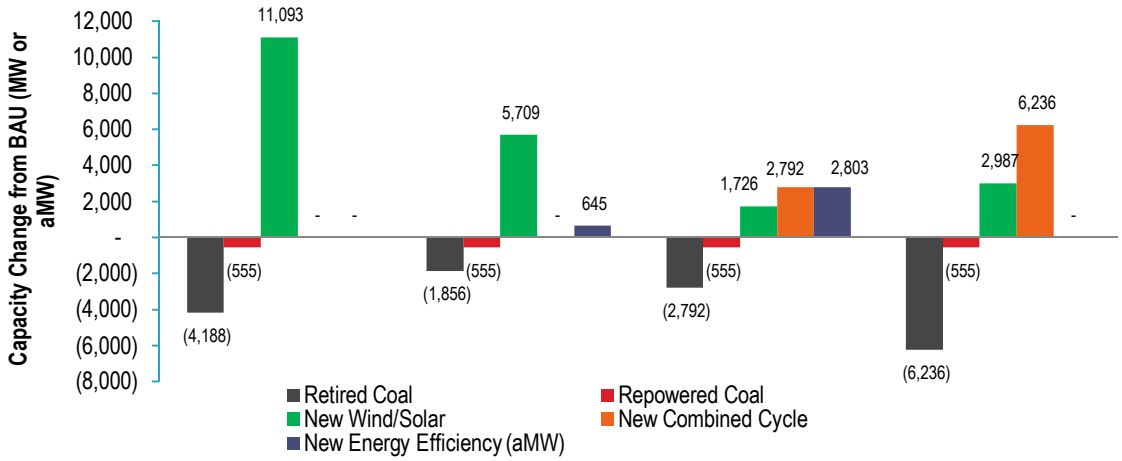
SUMMARY

All four scenarios are comparable in that they estimate 2024 west-wide and state-level resource mixes that produce calculated emission rates in line with EPA's proposed Clean Power Plan interim goals.

Figure 8 shows the change, in MW capacity (or aMW in the case of energy efficiency), from the Common Case or BAU resource portfolio to that of the four different scenarios.

FIGURE 8: RESOURCE MIX SUMMARY (2024)

Scenario	Scenario A	Scenario B	Scenario C	Scenario D
Compliance Theme:	**High coal retirements replaced with renewables**	**Regional coordination, single-state goals**	**Blended portfolio with high energy efficiency**	**High coal retirements replaced with combined cycle**

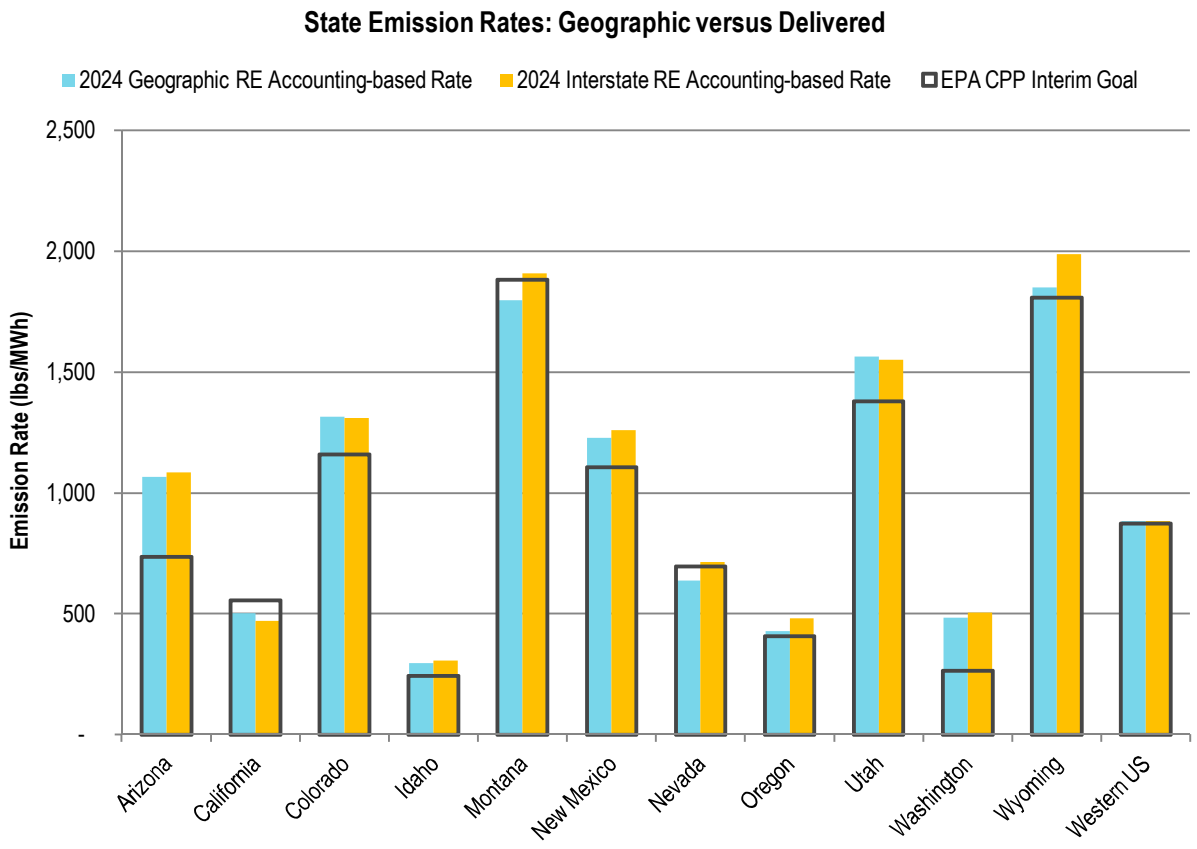


SENSITIVITY: INTERSTATE RENEWABLE ENERGY ACCOUNTING

One of the many complexities of the rule, in terms of both goal setting and compliance, is centered on the accounting of renewable energy. State goals were set based on the physical location of generation and the estimated potential for renewables within a state. However, with regards to compliance, the current draft version of the Clean Power Plan allows states to take credit for renewable energy generation outside of their borders through ownership, contracts, or renewable energy credits (RECs).

The four scenarios and references case described above used a geographic accounting of renewable energy, meaning that any renewable generation from a generator within a state was credited to the state where that generator physically resided. This assumption was made due to a lack of data about renewable energy generator ownership, RECs, and contracts. This was identified as a shortcoming early on in the project, and WIEB staff and state representatives from energy offices and utility commissions gathered data about ownership and contracts of renewable energy, and this information was provided to Energy Strategies to perform a sensitivity on the renewable energy accounting assumption. The results of this effort at shown in Figure 9, where the original emission rates ("2024 Geographic RE Accounting-based Rate") are compared with new emission rates calculated using the gathered data ("Interstate RE Accounting-based Rate"). It is worth noting that the underlying resource mix for each scenario is the same, only the accounting of renewable energy changed.

FIGURE 9: STATE EMISSION RATES ASSUMING INTERSTATE ACCOUNTING OF RE



The updated accounting of renewable energy caused some significant changes in state's emission rates, leaving certain states either further or closer to their compliance goal. The rates in Montana, New Mexico, Oregon, and Wyoming increased substantially (>5%), while the emission rates in California and Utah both decreased (6% and 1% respectively). Several other states had less substantial but still significant changes in their emission rate based on the more accurate accounting method.

TABLE 2: CHANGE IN 2024 EMISSION RATE GOING FROM GEOGRAPHIC TO INTERSTATE ACCOUNTING

State	% Change in Emission Rate
Arizona	2%
California	-6%
Colorado	0%
Idaho	3%
Montana	6%
New Mexico	3%
Nevada	12%
Oregon	12%

State	% Change in Emission Rate
Utah	-1%
Washington	4%
Wyoming	7%

The analysis identified 23,800 GWh of renewable energy in the 2024 Common Case as "interstate" generation. This represents about 18% of the West's total renewable energy – suggesting that the renewable energy accounting issue will be critical to many states in developing their compliance plans. California has the most at stake, in terms of total interstate renewable energy, as 66% of the 23,800 GWh is owned or contracted by California entities. States in the PacifiCorp footprint are also impacted by the allocation of renewable energy. PacifiCorp serves customer load in six western states and its renewable energy was allocated to each of its states base on its Multi-State Protocol (MSP) allocations (

Figure 10), which are used to assign PacifiCorp's costs to the states served by the utility. Because of this allocation, Nevada, Oregon, and Washington each "lose" between 3,000-4,000 GWh of energy to the remaining PacifiCorp states.

FIGURE 10: ASSUMED PAC MSP ALLOCATION[8]

State	MSP State Allocation (%)
California	1.57%
Idaho	5.58%
Oregon	26.02%
Utah	43.01%
Washington	7.86%
Wyoming	15.97%

OBSERVATIONS

The development of the reference business-as-usual emission rates, the four compliance scenarios, and the interstate renewable energy accounting sensitivity lead to the following observations:

- **Contrasting futures –** Based on the analysis, it is apparent that state compliance plans could have a significant impact on Western state resource mixes. Some strategies could result in significant investment through the retirement and replacement of generation, while others appear to introduce efficiencies and reduce the "net change" in the resource mix.
- **Reliability –** This study did not consider the reliability impacts of the scenarios. There was no capacity analysis, reserve estimations, powerflow studies, or production cost modeling performed. It would be prudent to perform these types of analyses (at local and regional levels) before drawing conclusions about the technical feasibility of these scenarios.
- **Coal retirements –** In order for certain states to reach their interim emission targets through coal retirements alone, they may have to retire most or in some cases nearly all of their coal generation, depending heavily on the type of resource being used for replacement energy.
- **Regional coordination –** State-to-state regional coordination is complex, even in the hypothetical future outlined in this report. However, the complexity might be worth tackling as it appears that this coordination could introduce significant compliance efficiencies.
- **Emission rate impacts –** Due to the mechanics of the EPA's rate-based framework, incremental energy efficiency and renewable energy could have a significant impact on state's emission rates. By reducing "net load" served by the thermal generator fleet, these compliance options reduce both the pounds of carbon dioxide produced from the existing affected units (i.e. lower loads requires decreased generation which results in reduced emissions), while also providing an addition "energy" (e.g. MWh) credit on the denominator of the rate equation.

[8] Based on a recent Wyoming rate case proceeding

APPENDIX – SCENARIO DATA

SCENARIO A – HIGH COAL RETIREMENT REPLACED WITH RENEWABLES SUMMARY

Heat Rate Improvement

Scenario assumes 2% heat-rate improvement for all affected coal generation in Western states.

Coal Retirements

Retirements							*Renewable Energy Replacement*			
Plant	**Units**	**State**	**MW**	**Date**	**Repower**	**Reference**	**Type**	**Energy (MWh)**	**Annual CF (%)**	**MW**
Cholla	4	AZ	380	2025	Yes	PAC 2015 IRP pref				
Centralia	2	WA	688	2025		WA State Law	Wind	3,956,435	40%	1,129
North Valmy	2	NV	268	2025		Ret. Date	Solar	1,687,563	30%	642
Intermountain PP	1	UT	900	2025		AB 132	Solar	6,581,467	30%	2,504
Apache	2	AZ	175	2017	Yes	Regional Haze				
Coronado	1	AZ	380	2024*		SWAT Study[9]	Solar	2,853,023	30%	1,086
Springerville	1	AZ	400	2024*		SWAT Study	Solar	2,569,673	30%	978
Cholla	1	AZ	116	2024*		Age, emissions	Solar	635,924	30%	242
Cholla	3	AZ	271	2024*		Assumed	Solar	1,972,517	30%	751
H Wilson	4	AZ	156	2024*		Age, region haze	Solar	1,236,565	30%	471
San Juan	1	NM	340	2024*		SWAT 5k Study[10]	Wind/Solar	2,359,072	30%	898
Hayden	1	CO	184	2024*		2029 retire	Wind	1,114,990	40%	318
Hayden	2	CO	262	2024*		2029 retire	Wind	1,895,096	40%	541
Martin Drake	5-6	CO	123	2024*		Age and emission rate	Wind	726,769	40%	207
Nucla	1-4	CO	100	2024*		Age and emission rate	Wind	523,208	40%	149

[9] http://www.azcc.gov/Divisions/Utilities/Electric/Biennial/2014%20BTA/Coal%20Plant%20Shutdown%20Status%20of%20SWAT%20Investigation.pdf

[10] http://www.azcc.gov/Divisions/Utilities/Electric/Biennial/2014%20BTA/Coal%20Plant%20Shutdown%20Status%20of%20SWAT%20Investigation.pdf

Additional Renewable Energy

State	Renewable Energy Added (MWh)	Renewable Energy Added (MW)	Type
Wyoming	2,297,639	583	Wind
Colorado	276,354	70	Wind
Idaho	500,099	143	Wind
Oregon	985,609	281	Wind
Washington	352,288	101	Wind

Incremental Energy Efficiency

There was no incremental EE beyond what was already included in the Common Case

SCENARIO B – REGIONAL COORDINATION, SINGLE STATE GOALS SUMMARY

Heat Rate Improvement

Scenario assumes 2% heat-rate improvement for all affected coal generation in Western states.

Coal Retirements

Retirements							*Renewable Energy Replacement*			
Plant	**Units**	**State**	**MW**	**Date**	**Repower**	**Reference**	**Type**	**Energy (MWh)**	**Annual CF (%)**	**MW**
Cholla	4	AZ	380	2025	Yes	PAC 2015 IRP pref				
Centralia	2	WA	688	2025		WA State Law	Wind	3,956,435	40%	1,129
North Valmy	2	NV	268	2025		Ret. Date	Solar	1,687,563	30%	642
Intermountain PP	1	UT	900	2025		AB 132	Solar	6,581,467	30%	2,504
Apache	2	AZ	175	2017	Yes	Regional Haze				

Additional Renewable Energy

State	Renewable Energy Added (MWh)	Renewable Energy Added (MW)	Type
Colorado	4,600,000	1167	Wind
New Mexico	1,050,000	266	Wind/Solar

Incremental Energy Efficiency

State	Energy Efficiency Added (MWh)
Colorado	4,600,000
New Mexico	1,050,000

Other Key Assumptions

Compliance regions were as follows:

Region A	Region B	Region C
AZ	ID	CO
CA	MT	NM
NV	OR	
	UT	
	WA	
	WY	

SCENARIO C – BLENDED PORTFOLIO WITH HIGH ENERGY EFFICIENCY SUMMARY

Heat Rate Improvement

Scenario assumes 2% heat-rate improvement for all affected coal generation in Western states.

Coal Retirements

Retirements							*Renewable Energy Replacement*		
Plant	**Units**	**State**	**MW**	**Date**	**Repower**	**Reference**	**Energy (MWh)**	**Annual CF (%)**	**MW**
Cholla	4	AZ	380	2025	Yes	PAC 2015 IRP pref			
Centralia	2	WA	688	2025		WA State Law	Replaced with equivalent MW combined cycle		
North Valmy	2	NV	268	2025		Ret. Date			
Intermountain PP	1	UT	900	2025		AB 132			
Apache	2	AZ	175	2017	Yes	Regional Haze			
Coronado	1	AZ	380	2024*		SWAT Study	Replaced with equivalent MW combined cycle		
Springerville	1	AZ	400	2024*		SWAT Study			
H Wilson	4	AZ	156	2024*		Age, region haze			

Additional Renewable Energy

State	Renewable Energy Added (MWh)	Renewable Energy Added (MW)	Type
Arizona	2,794,219	1,063	Solar
Colorado	2,613,391	663	Wind

Incremental Energy Efficiency

State	Energy Efficiency Added (MWh)
Arizona	2,794,219
Colorado	2,613,391

Other Key Assumptions

Additional generation from combined cycles were assume to have a carbon dioxide emission rate of 900 lbs/MWh, and natural gas repowerings were assigned a 1500 lbs/MWh emission rate

SCENARIO D SUMMARY – HIGH COAL RETIREMENT REPLACED WITH COMBINED CYCLE

Heat Rate Improvement

Scenario assumes 2% heat-rate improvement for all affected coal generation in Western states.

Coal Retirements

Retirements (replaced by Combined Cycle gas)						
Plant	**Units**	**State**	**MW**	**Date**	**Repower**	**Reference**
Dave Johnson	1-4	WY	762	2026		PAC 2015 IRP (RH)
Centralia	2	WA	688	2025		WA State Law
North Valmy	2	NV	268	2025		Ret. Date
Intermountain PP	1	UT	900	2025		AB 132
Cholla	4	AZ	380	2025	Yes	PAC 2015 IRP
Apache	2	AZ	175	2017	Yes	Regional Haze
Apache	3	AZ	175	2024*		Age
Coronado	1	AZ	380	2024*		SWAT Study
Coronado	2	AZ	385	2024*		Age
Springerville	1	AZ	400	2024*		SWAT Study
Springerville	2	AZ	401	2024*		Age
Cholla	1	AZ	116	2024*		Age, emissions
Cholla	3	AZ	271	2024*		Assumed
H Wilson	4	AZ	156	2024*		Age, region haze
San Juan	1	NM	340	2024*		SWAT 5k Study
Comanche	1	CO	325	2024*		Age
Hayden	1	CO	184	2024*		2029 retire
Hayden	2	CO	262	2024*		2029 retire
Martin Drake	5-6	CO	123	2024*		Age and emission rate
Nucla	1-4	CO	100	2024*		Age and emission rate

All retirements were replaced with combined cycle generation (same capacity) assuming a carbon dioxide emission rate of 900 lbs/MWh. Repowerings assumed a 1500 lbs/MWh rate.

Additional Renewable Energy

State	Renewable Energy Added (MWh)	Renewable Energy Added (MW)	Type
Arizona	2,511,017	955	Solar
Colorado	268,582	77	Wind
Idaho	500,099	143	Wind
Oregon	985,609	281	Wind
Utah	707,512	269	Solar
Washington	4,421,764	1,262	Wind

Incremental Energy Efficiency

There was no incremental EE beyond what was already included in the Common Case