Technical Support Document (TSD)

Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electricity Utility Generating Units

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Incorporating RE and Demand-Side EE Impacts into State Plan Demonstrations

U.S. Environmental Protection Agency

Office of Air and Radiation

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I. Introduction

This technical support document details certain demonstration requirements for Clean Power Plan (CPP) state plan submittals that must include a projection of carbon dioxide (CO_2) emission performance by affected electric generating units (EGUs), as identified in section VIII.D.2.a(3) of the preamble.[1] Development of a state's CO_2 emission performance projection begins with an electricity demand forecast, which, depending upon the type of analytical method or model used, the state may want to reflect the impacts of renewable energy (RE) and demand-side energy efficiency (EE) policies and programs. In order to develop this electricity demand forecast, first, the state would either select an existing base case electricity demand and supply forecast or develop its own. Section II below addresses how to choose or develop a base case demand and supply forecast as well as how to document any included RE or demand-side EE measures. Second, the state may adjust this base case demand forecast to reflect the impacts of RE and demand-side EE measures included in the state plan. Section III describes how to quantify the impacts of RE and demand-side EE policies and programs and then adjust the base case demand forecast to reflect these impacts.

II. Base Case Electricity Demand and Supply Forecasts

The CO_2 emission performance projection of affected EGUs requires information from an electricity demand and supply forecast as a basis for predicting generation and emissions during the interim and final plan performance periods. This section describes the steps a state should take to demonstrate that the base case demand forecast transparently represents future demand and supply:

Step 1: Choose or develop a base case electricity demand and supply forecast.

Step 2: Document RE and demand-side EE already included in the base case electricity demand and supply forecast.

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[1] This includes state measures type plans as well as some emission standards type plans.

<u>Step 1</u>: Choose or develop a base case electricity demand and supply forecast.

A state can develop its own base case electricity demand and supply forecast or use a forecast from the following information sources: [2]

- U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook (AEO),
- North American Electric Reliability Corporation (NERC),
- Regional transmission organizations (RTOs)/independent system operators (ISOs) (e.g., PJM Interconnection, ISO-New England, NYISO),
- Vertically integrated utilities (e.g., a large power company that operates the electricity system for a specific region), in combinations with another publically available source,
- State energy agencies (e.g., State Energy Office or Public Utility Commission (PUC)), and
- Regional councils that coordinate energy planning (e.g., Northwest Power and Conservation Council)

To develop its own state-specific base case electricity demand and supply forecast, a state would apply an annual average electricity demand growth rate derived from one of the above data sources to state or regional specific historical electricity sales data. States may also consider more comprehensive modeling approaches that calculate expected demand based on assumptions including: electricity prices, technology development, population, and economic forecasts. For the base case supply forecast, a state should inventory all generation resources available to meet state demand through the final plan performance periods, including in-state existing and anticipated capacity, and any expected imports.

<u>Step 2</u>: Document RE and demand-side EE measures included in the base case electricity demand and supply forecast.

Demand forecasts from different information sources reflect on-the-books RE and demand-side EE policies to varying degrees in demand and supply forecasts. The state must therefore research and document how on-the-books RE and demand-side EE programs included in the

[2] States can either adopt an existing forecast from one of these sources or use data from them to develop their own forecast. States may request to use a different source and EPA would review those requests on an individual basis. Any state-specific base case forecasts developed by states must be approved by EPA per the final emission guidelines.

demand or supply forecast used by the state are incorporated into that. This will clarify which programs are influencing the growth rate assumptions, and the EPA will use this information to assess whether the demand and supply forecast is reasonable. This also helps ensure that impacts captured in the base case forecast are not double-counted in the base case forecast or duplicated in the state plan performance projection. A state should work with the source of the forecast to understand whether and how RE and demand-side EE policies and programs, including but not limited to the list below, are included in the base case electricity demand and supply forecast:

- EE policies or programs funded by utility ratepayers,
- Existing federal appliance and lighting efficiency standards that are already in effect,
- Forthcoming federal appliance and lighting standards,
- State appliance or lighting efficiency standards (if applicable),
- State building energy codes,
- Renewable portfolio standards, and
- Codified local policies.

There are at least two ways that these programs are captured in an existing forecast:

1. Programs are explicitly identified, meaning the forecast shows a direct connection between the program and its impacts on energy demand or supply (MWhs),
2. Programs are indirectly, and either fully or partially, captured through econometric or other assumptions in the relevant economic model (e.g., as captured in National Energy Modeling System (NEMS)).[3]

[3] Demand-side EE programs explicitly included in a demand forecast are programs that the forecast's documentation specifically states directly impact future demand levels. Some demand-side EE programs, however, are indirectly represented in the assumption and not explicitly identified. For example, the U.S. Energy Information Agency's (EIA) Annual Energy Outlook (AEO) explicitly includes in the reference case for electricity demand and supply forecast existing federal appliance and equipment standards for residential and commercial sectors as well as state renewable portfolio standards. The AEO indirectly captures some impacts of state demand-side EE programs in the forecast and does not explicitly call out their impacts. Indirect impacts do not need to be quantified, but on a case-by case basis, a discount factor toward any incremental savings in the CPP performance projection may be required to adjust for potential double counting. For more information visit: http://www.epa.gov/statelocalclimate/state/statepolicies.html.

For all RE and demand-side EE programs included in the base case demand forecast, a state must document whether the program is captured explicitly or indirectly. In addition, a state must include the following information for on-the-books programs that are reflected in the base case forecast:

1. Policy or program name,
2. Whether the policy is codified in state or local rule,
3. Year enacted,
4. When the policy requirements sunset.

The above requirements apply regardless of whether an RE or demand-side EE program will be used to meet the emission guidelines (e.g., to generate ERCs or as state measures). For example, assume a state with an Energy Efficiency Resource Standard (EERS) in state law adopts a rate-based emission standards type state plan that requires a projection. The impacts of the on-the-books EERS may already be included in the base case demand forecast, and if so, should be documented. If the affected EGUs in the state do not need to use the energy savings (e.g., emission rate credits (ERCs) from demand-side EE) from the state's EERS to adjust their CO_2 emission rates, then the state's plan demonstration would include the four pieces of information noted above about its EERS to support the reasonableness of the electricity demand forecast.[4] If the state expects affected EGUs to use the demand-side EE impacts from the EERS to adjust their rates, then the state plan should document the eight pieces of information noted at the end of this section. Similarly, under a mass-based state measures approach where the state EERS is not included as a state measure, the state plan demonstration would include the four pieces of information noted above. If the on-the-books EERS is included as a state measure, then the plan should document the eight pieces of information noted below. This information will inform the EPA's evaluation of whether the emission standards in the state plan are achievable.

In addition to documenting for on-the-books RE or demand-side EE measures the four pieces of information noted above and whether they are directly or indirectly captured in the base case demand and supply forecast, the state plan must provide additional information on certain types

[4] For example, affected units in the state might be able to achieve the rate-based emission standards with other measures or actions outside of the EERS.

of on-the-books programs. There are at least two categories of on-the-books policies and programs that must be explicitly accounted for in the base case demand and/or supply forecast and in the following manner:

- Qualifying RE and demand-side EE programs that are implemented after 2012 and impact electricity generation in 2022 or later.[5]
  - Quantify the (annual incremental and cumulative savings or generation (MWhs)) x (effective useful life) to estimate the savings that impacts demand or generation in 2022 or later.

- Qualifying RE and demand-side EE programs that impact electricity generation in 2020 or 2021 and meet eligibility requirements in the final rule regarding the Clean Energy Incentive Program.[6]
  - Quantify the (annual incremental and cumulative savings or generation (MWhs)) x (effective useful life) to estimate the savings that impacts demand or generation in 2020 and 2021.

Because these on-the-books RE and demand-side EE measures or programs are explicitly accounted for in the base case demand forecast, the same impacts must not be represented again in the state plan performance projection. In other words, such impacts cannot be included in the CO_2 emission performance projection, because they are already captured in that base case forecast. For any RE and demand-side EE programs that are explicitly included in an EGU base case forecast and will be used to meet the CPP emission guidelines, the state must document the following information:

1. Policy or program name,
2. Whether the program is codified in state or local rule,
3. Year enacted,
4. When the program requirements sunset,
5. Program requirements (e.g., targets in megawatt hours (MWh) or percentage),

[5] Eligibility requirements related to the timing, geography and type of RE and demand-side EE measures that can be used to adjust a CO_2 performance rate of an affected EGU under the final rule are detailed in section VIII.K.1.
[6] For details refer to sections VIII.B.2 and VIII.K.1.a of the preamble**.**

6. Annual energy savings or generation in the base year (MWh),
7. Annual and cumulative energy savings or generation in the future interim and final periods (MWh), and
8. Estimated useful lives for programs.

III. Proper Characterization of Renewable Energy and Demand-Side Energy Efficiency in a State Plan Performance Projection

Section VIII.D.2.a.(3)(a) of the preamble explains which types of state plans require CO_2 emission performance projections for affected EGUs in order to show that the state plan will lead to achievement of the CO_2 emission performance rates, state goal, or other emission guideline requirements. State plans that require such a projection must include a base case electricity demand and supply forecast as well as supporting documentation, as explained in section II above. In addition, such plans must quantify the combined future impact of all the emission standards and state measures included in the state plan. This section explains the proper characterization of expected RE and demand-side EE impacts in a CO_2 emission performance projection.

States that plan to use RE and demand-side EE to meet the emission guidelines (e.g., to generate ERCs or as state measures) under applicable state plan types that require a performance projection will need to project the expected incremental direct generation impacts and electricity savings of RE and demand-side EE.[7] While RE and demand-side EE measures, programs and policies may impact the generation, construction, retirement and CO_2 emissions of both affected and non-affected EGUs, a projection must demonstrate how RE and demand-side EE will enable affected EGUs to meet the emission guidelines. There are different approaches to projecting electricity savings and renewable generation, depending upon the design of an RE and demand-side EE program. Regardless of the approach chosen, a state plan that includes RE and demand-

[7] Incremental direct effects refers to RE and demand-side EE beyond any impacts that are in the base case. If a new program is more stringent than an existing program already in the base case, it may not be appropriate to use the full magnitude of the new program.

side EE must document specific assumptions in their performance projections, as described below.

A. Approaches to Estimating Future RE Generation and EE Savings

Projections of expected annual electricity savings and/or renewable energy generation are necessary inputs when projecting EGU CO_2 emission performance. This is because increased RE generation will impact the generation of affected EGUs and resulting CO_2 emissions. Electricity savings estimates included in EE projections will lower electricity demand forecasts in the CO_2 emission performance projections. The EE projection can be used as an input, or modifier, to various models or other tools in order to demonstrate that the state plan will achieve emission guideline requirements.

A CO_2 emission performance projection must include the potential impacts of RE and demand-side EE, and the state must document how those RE and demand-side EE impacts are reflected in the projection. The state can incorporate RE and demand-side EE impacts at the individual project or program level, or it can aggregate RE and demand-side EE impacts across a portfolio of programs.[8] The EPA historically has accepted the estimation of RE and demand-side EE at an aggregated level as indicated in EPA's Bundled Measures Guidance.[9] The state must also verify that the assumptions about RE and demand-side EE availability are reasonable, such as based on an assessment of RE and demand-side EE potential.

As discussed above, a state plan CO_2 emission performance projection must not include RE and demand-side EE impacts captured in the base case electricity demand forecast. Consequently, RE and demand-side EE impacts included in the CO_2 emission performance projection must be incremental to and non-duplicative of impacts included in the base case

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[8] This can include state and local sponsored programs, and RE and demand-side EE projects, such as ones done under performance contracting, provided they meet the eligibility requirements specified in section VIII.K.1 of the preamble. Other types of programs and projects that may be eligible for inclusion are described in section VIII.K.1.a.

[9] Guidance on Incorporating Bundled Measures in a State Implementation Plan, www.epa.gov/ttn/oarpg/t1/memoranda/10885guideibminsip.pdf.

demand forecast. The performance projections, for example, could include impacts from RE and demand-side EE programs not reflected in the base case forecast or from the expansion of existing programs beyond levels reflected in the base case forecast. A state must use the following general equations to quantify the expected incremental impacts of RE and demand-side EE during the future interim and final performance periods.[10]

Energy Efficiency:

- (Incremental first-year annual plus cumulative savings of EE program[11]) x (effective useful life) for each interim period and final period. Determine persistent level of savings for final period and beyond.

Renewable Energy:

- (Incremental MW installed capacity) x (location-[12] and technology-specific capacity factors) x (8760 hours) for each interim period and final period. Determine persistent level of renewable energy generation for final period and beyond.

Several tools and methods are available to help states estimate the potential direct energy impacts of RE and demand-side EE that will be used to adjust a state's electricity demand and supply forecast. States can base their electricity savings projections on past evaluation, measurement and verification (EM&V) reports that document impacts of similar projects or programs and that have been submitted to public service commissions or evaluated by third parties. States also can conduct their own surveys or studies to estimate the direct energy impacts

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[10] The EPA recognizes that for unique situations, states may not be able to use these exact equations. In those unique circumstances, states can propose an alternative equation to EPA for approval on a case-by-case basis.

[11] Projections of demand-side EE impacts must reflect the annual impacts that occur due to new EE impacts in a given year plus the impacts of EE investments made in previous years that are still generating savings (i.e., have not exceed their measure life or otherwise ended).

[12] States can use location-specific capacity factors informed by historical data or weather-prediction models, such as the kind of data included in the National Renewable Energy Laboratory (NREL) Eastern Wind Integration and Transmission Study (EWITS) or in publicly available datasets from EIA and ISO/RTOs.

of EE policies and/or use sophisticated methods, such as building simulation tools, vintaging models, production costing, and cost-of-energy analysis models.[13] Any methodology used must be EPA-approved, and each state is encouraged to consult with the EPA early during the plan development process about the tools and methods it intends to employ.

Assessing the potential RE and demand-side EE impacts of measures, policies or programs can involve bottom-up economic and/or engineering-based estimation techniques that are based upon a representation of the fundamentals of the technology and economic behavior. These bottom-up approaches estimate potential energy savings at a very detailed level and roll these estimates up to the statewide level. Alternatively, the potential impacts of RE and demand-side EE can be quantified based upon the design and requirements of state-level policies and regulations specified over a future time frame. The next two sections describe how a state plan CO_2 performance projection would calculate the generation impacts of two common state policies: energy efficiency resource standards and renewable portfolio standards.

B. Projecting Energy Savings from Energy Efficiency Resource Standards

Many states have adopted an EERS, which is a policy that sets targets for energy savings over a specified time frame from demand-side EE programs operated by utilities or other program administrators. States typically specify annual first-year or cumulative targets as percentages of electricity sales or as absolute energy savings. States use different bases for specifying EERS goals. Some specify goals based on electricity sales (in MWhs) from investor-owned utilities, while others have mandated energy savings targets based on total MWh sales or a subset of total MWh sales.

A state can quantify energy savings for use in its CO_2 emission performance projection using formulas specific to the state's EERS, as described below.[14] For this approach a state would

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[13] For more information about available tools for estimating direct energy impacts, see Assessing the Multiple Benefits Guide: A Resource for States, Chapter 2. http://www.epa.gov/statelocalclimate/documents/pdf/epa_assessing_benefits_ch2.pdf#page=4.

[14] Savings from purely voluntary demand-side EE goals are not state enforceable measures and are not eligible for use in a CO_2 emission performance projection for a state measures type plan. Quantification of eligible demand-side EE savings must be done in accordance with the requirements specified in section VIII.K.3 of the preamble.

select the appropriate sales basis, and if the basis is not total sales, a state could use recent year utility-level sales data from EIA and growth rates from EIA, an RTO/ISO, NERC or other publicly available sources to develop base case forecasts of sales of the utilities required to comply with the EERS. The design of the EERS will affect whether a state, for purposes of its CO_2 emission performance projection, should assume energy savings at the EERS target level. For example, it may not be appropriate to assume full achievement of energy savings goals in an EERS that includes cost/rate caps or other design features that may not lead to incremental energy savings relative to the base case demand forecast (e.g., counting savings from building energy codes or historical EE programs).

The general formulas a state must use to quantify first-year and cumulative energy savings from an EERS policy for each year (t) are shown below, though a state may propose a different methodology if it better represents the state's EERS. Once these first-year and cumulative energy savings are quantified, the state can incorporate them into the demand forecast of its CO_2 emission performance projection.[15]

1. EERS with Annual First-Year EE Savings Targets Specified in Percent Terms

A(t) = r(t) Z(t-1)
C(t) = A(t) + A(t-1) + … + A(t-L+1)
I(t) = C(t) - E(t)
Z(t) = B(t) - I(t)

Where:
r is the annual first-year percent savings target,
A is the annual first-year energy savings,
L is the measure lifetime,
B is the base case sales of utilities affected by these specific policies,
C is the cumulative energy savings,
E is the cumulative savings embedded in the base case demand forecast,[16]
I is the cumulative savings incremental to the base case demand forecast, and
Z is the adjusted sales after application of cumulative incremental savings.

[15] These equations are the recommended calculation methods for inclusion in state plans.
[16] States using the AEO 2013 forecast should take note that it does not include state-level EERS policies but does embed EE savings of policies. These EE savings are not reported out by the AEO and need to be determined independently.

For example, a representative state has an EERS first-year target of 2% for each year 2016-2018. Forecasted baseline sales of utilities in 2015 are 50,000 GWh, growing by 1% each year of the forecast period. Embedded savings are 50 GWh per year, applied to years in which first-year energy savings are realized. The measure lifetime assumed for both first-year energy savings and embedded savings is four years. Table 1 applies this example to the above formula. This is the most common type of EERS structure, and states having adopted some version of it include Arizona, Illinois, Indiana, and Ohio.

Table 1: Example EERS with Annual First-Year EE Savings Targets Specified in Percent Terms

	2015	2016	2017	2018	2019	2020	2021	2022
Baseline sales of affected utilities (GWh) (B)	50,000.0	50,500.0	51,005.0	51,515.1	52,030.2	52,550.5	53,076.0	53,606.8
First-year percent savings target (%) (r)		2%	2%	2%				
First-year energy savings (GWh) (A)		1,000.0	991.0	982.3				
Cumulative energy savings (GWh) (C)		1,000.0	1,991.0	2,973.3	2,973.3	1,973.3	982.3	0.0
Cumulative savings embedded (GWh) (E)		50.0	100.0	150.0	150.0	100.0	50.0	0.0
Cumulative savings incremental (GWh) (I)		950.0	1,891.0	2,823.3	2,823.3	1,873.3	932.3	0.0
Adjusted sales after incremental savings (GWh) (Z)	50,000.0	49,550.0	49,114.0	48,691.8	49,206.9	50,677.2	52,143.7	53,606.8

2. EERS with Annual First-Year EE Savings Targets Specified in Absolute Terms

$C(t) = A(t) + A(t-1) + \ldots + A(t-L+1)$
$I(t) = C(t) - E(t)$
$Z(t) = B(t) - I(t)$

Where:
A is the annual first-year energy savings target,
L is the measure lifetime,
B is the base case sales of utilities affected by these specific policies,
C is the cumulative energy savings,
E is the cumulative savings embedded in the base case demand forecast,
I is the cumulative savings incremental to the base case demand forecast, and
Z is the adjusted sales after application of cumulative incremental savings.

For example, a representative state has an EERS first-year target of 1,000 GWh in 2016, increasing by about 2% per year for 2017-2018 to the absolute targets shown in the table below. Forecasted baseline sales of utilities in 2015 are 50,000 GWh, growing by 1% each year of the forecast period. Embedded savings are 50 GWh per year, applied to years in which first-year energy savings are realized. The measure lifetime assumed for both first-year energy savings and embedded savings is four years. Table 2 applies this example to the above formula. States that applied this structure during their EERS implementation include Florida, Iowa, and Oregon.

Table 2: Example EERS with Annual First-Year EE Savings Targets Specified in Absolute Terms

	2015	2016	2017	2018	2019	2020	2021	2022
Baseline sales of utilities (GWh) (B)	50,000.0	50,500.0	51,005.0	51,515.1	52,030.2	52,550.5	53,076.0	53,606.8
First-year energy savings (GWh) (A)		1,000.0	1,020.0	1,040.4				
Cumulative energy savings (GWh) (C)		1,000.0	2,020.0	3,060.4	3,060.4	2,060.4	1,040.4	0.0
Cumulative savings embedded (GWh) (E)		50.0	100.0	150.0	150.0	100.0	50.0	0.0
Cumulative savings incremental (GWh) (I)		950.0	1,920.0	2,910.4	2,910.4	1,960.4	990.4	0.0
Adjusted sales after incremental savings (GWh) (Z)	50,000.0	49,550.0	49,085.0	48,604.7	49,119.8	50,590.1	52,085.6	53,606.8

3. EERS with Cumulative EE Savings Targets Specified in Percent Terms

$A(t) = C(t) – C(t-1) + A(t-L)$

If r(t) available,
$C(t) = r(t) \times B(t)$
$I(t) = C(t) - E(t)$
$Z(t) = B(t) - I(t)$

If r(t) not available,
Z(t) calculated by interpolation
$I(t) = B(t) - Z(t)$
$C(t) = I(t) + E(t)$

Where:
r is the cumulative percent savings target,
A is the annual first-year energy savings,
L is the measure lifetime,
B is the base case sales of utilities affected by these specific policies,
C is the cumulative energy savings,
E is the cumulative savings embedded in the base case demand forecast,
I is the cumulative savings incremental to the base case demand forecast, and
Z is the adjusted sales after application of cumulative incremental savings.

For example, a representative state has an EERS cumulative target of 5% by 2018. Forecasted baseline sales of utilities in 2015 are 50,000 GWh, growing by 1% each year of the forecast period. Embedded savings are 50 GWh per year, applied to years in which first-year energy savings are realized. The measure lifetime assumed for both first-year energy savings and embedded savings is four years. Distribution of the cumulative energy savings in 2018 to the first-year savings for 2016-2018 applies the simple assumption of an equal share of savings being implemented in each year. Table 3 applies this example to the above formula. This approach is uncommon, and states that applied this structure in earlier years of their EERS policies include New York and Pennsylvania.

Table 3: Example EERS with Cumulative EE Savings Targets Specified in Percent Terms

	2015	2016	2017	2018	2019	2020	2021	2022
Baseline sales of utilities (GWh) (B)	50,000.0	50,500.0	51,005.0	51,515.1	52,030.2	52,550.5	53,076.0	53,606.8
Cumulative percent savings target (%) (r)				5%				
First-year energy savings (GWh) (A)		858.6	858.6	858.6				
Cumulative energy savings (GWh) (C)		858.6	1,717.2	2,575.8	2,575.8	1,717.2	858.6	0.0
Cumulative savings embedded (GWh) (E)		50.0	100.0	150.0	150.0	100.0	50.0	0.0
Cumulative savings incremental (GWh) (I)		808.6	1,617.2	2,425.8	2,425.8	1,617.2	808.6	0.0
Adjusted sales after incremental savings (GWh) (Z)	50,000.0	49,691.4	49,387.8	49,089.3	49,604.4	50,933.3	52,267.4	53,606.8

4. EERS with Cumulative EE Savings Targets Specified in Absolute Terms

$A(t) = C(t) - C(t-1) + A(t-L)$

If C(t) available,
$I(t) = C(t) - E(t)$
$Z(t) = B(t) - I(t)$

If C(t) not available,
Z(t) calculated by interpolation
$I(t) = B(t) - Z(t)$
$C(t) = I(t) + E(t)$

Where:
C is the cumulative energy savings target,
A is the annual first-year energy savings,

L is the measure lifetime,
B is the base case sales of utilities affected by these specific policies,
E is the cumulative savings embedded in the base case demand forecast,
I is the cumulative savings incremental to the base case demand forecast, and
Z is the adjusted sales after application of cumulative incremental savings.

For example, a representative state has an EERS cumulative target of 3,000 GWh by 2018. Forecasted baseline sales of utilities in 2015 are 50,000 GWh, growing by 1% each year of the forecast period. Embedded savings are 50 GWh per year, applied to years in which first-year energy savings are realized. The measure lifetime assumed for both first-year energy savings and embedded savings is four years. Distribution of the cumulative energy savings in 2018 to the first-year savings for 2016-2018 applies the simple assumption of an equal share of savings being implemented in each year. Table 4 applies this example to the above formula. States that utilized this structure during EERS implementation include California and Hawaii.

Table 4: Example EERS with Cumulative EE Savings Targets Specified in Absolute Terms

	2015	2016	2017	2018	2019	2020	2021	2022
Baseline sales of utilities (GWh) (B)	50,000.0	50,500.0	51,005.0	51,515.1	52,030.2	52,550.5	53,076.0	53,606.8
First-year energy savings (GWh) (A)		1,000.0	1,000.0	1,000.0				
Cumulative energy savings (GWh) (C)		1,000.0	2,000.0	3,000.0	3,000.0	2,000.0	1,000.0	0.0
Cumulative savings embedded (GWh) (E)		50.0	100.0	150.0	150.0	100.0	50.0	0.0
Cumulative savings incremental (GWh) (I)		950.0	1,900.0	2,850.0	2,850.0	1,900.0	950.0	0.0
Adjusted sales after incremental savings (GWh) (Z)	50,000.0	49,550.0	49,105.0	48,665.1	49,180.2	50,650.5	52,126.0	53,606.8

C. Projecting Generation Impacts from Renewable Portfolio Standards

Renewable portfolio standards (RPS) set RE targets across a specified period of time. Most often these state policies require that a specified percentage of the electricity sold by a utility comes from eligible renewable technologies (e.g., wind, solar, biomass).

A state must project annual RE generation using formulas specific to the state's RPS policy, as shown below, or an EPA-approved alternative method. Similar to the EERS approach described above, a state would select the appropriate sales basis, and if the basis is not total sales, a state could use a recent year of utility-level sales data from EIA and growth rates from EIA, an

RTO/ISO, NERC or other publicly available sources to develop base case forecasts of sales for the utilities required to comply with the RPS.

The design of the RPS will affect whether a state can assume full achievement of the RPS targets. Many RPSs include provisions for alternative compliance payments, which allow an entity to pay a fee in lieu of achieving the RPS. Additionally, RPS policies may include sources that are not eligible for CPP compliance purposes. In such cases, only generation impacts from eligible RE sources should be included in a state's CO_2 emission performance projection.[17]

The general formulas a state must use to quantify annual generation impacts of an RPS policy for each year (t) are shown below, though a state may propose a different methodology if it better represents the state's RPS.[18]

1. RPS with Annual Targets Specified in Percent of Retail Sales Terms

$$A(t) = r(t) \times Z(t) - MWh_{ineligible}(t)$$

Where:
A is the total MWh of CPP-qualifying renewable generation in a future year,
r is the annual RPS percent RE target,
Z is the forecasted electricity sales that fall under the RPS policy, and
$MWh_{ineligible}$ is the MWh of generation from technologies ineligible under CPP
(t) is the year

Note that each state should apply this general formula to its specific RPS design. For example, if a specified percentage of RE is required to be met by sales from investor-owned utilities and separate percentage from rural cooperatives, then the state should apply the formula individually

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[17] States must represent measures in their projection in accordance with the accounting and eligibility requirements specified in the guidelines, irrespective of the ways that RE is counted under a state requirement, such as an RPS, or for the purposes of renewable energy certificates. For example, some RPS apply an adjustment factor or allow credit different from the accounting method included in the final rule. RE generation from purely voluntary RE goals are not state enforceable measures and are not eligible for use in a performance projection for a state measures plan type. Similarly, alternate compliance payments, state-level bonuses for RE and RE resources permitted under an RPS that are not permitted under the final guidelines are not eligible to demonstrate performance in a projection. For more information about acceptable accounting methods for RE, see sections VIII.K.1 and VIII.K.2 of the preamble. For information about addressing interactions between renewable energy credits (RECs) and emission rate credits, see section VIII.K.2.
[18] The equations in this section are the recommended calculation methods for inclusion in state plans.

for each class and sum the MWh for each to calculate A(t). Additionally, each state plan should estimate the MWh of generation from any technologies that fall within the scope of its RPS but outside CPP. This estimate ($MWh_{ineligible}$) can be based on planned and/or expected new capacities for these technologies and best-available historical capacity factors.

For example, take a representative state with an RPS target of 10% in 2015, rising to 15% by 2020. Forecasted sales in 2015 are 75,000 gigawatthours (GWh), growing in subsequent years. In 2015, the renewable requirement is 7,500 GWh, but 500 GWh of the RPS is met by technologies ineligible under the final CPP. As a result, eligible renewable generation is 7,000 GWh in 2015. Assuming the same $MWh_{ineligible}$ in future years, the state would predict 11,500 GWh of CPP eligible renewables in 2020. The table below applies this example to the above formula. This is a common type of RPS policy. States with structures similar to this include Massachusetts, North Carolina, and Illinois.

Table 5: Example Qualifying Renewable Energy Calculation

	2015	**2016**	**2017**	**2018**	**2019**	**2020**
RPS Target (%)	10%	11%	12%	13%	14%	15%
Forecast Sales (GWh)	75,000	76,000	77,000	78,000	79,000	80,000
Required RE Gen (GWh)	7,500	8,360	9,240	10,140	11,060	12,000
CPP Ineligible RE Gen (GWh)	500	500	500	500	500	500
CPP Eligible RE Gen (GWh)	7,000	7,860	8,740	9,640	10,560	11,500

2. RPS with Annual Targets Specified in Absolute Capacity Terms (MW)

RPS policies often include technology "carve-outs" that specify required contributions of particular technology types. Even where these carve-outs are not specified, many different technologies can contribute to meet an RPS. The formula below illustrates three different technologies contributing to an RPS. The distinction between technology types is important in calculating RE generation from a capacity-based RPS due to the differences in the underlying operating characteristics of technologies (i.e., capacity factors). Each state should include the number of technology types that best applies to its own RPS design. In this example, each technology (1, 2, and 3) is an eligible RE resource per the final emission guidelines; a technology that is not an eligible RE resource should not be included in the formula.[19]

$$A(t) = [f_1(t) \times C_1(t) + f_2(t) \times C_2(t) + f_3(t) \times C_3(t)] \times H$$

Where:
A is the total MWh of eligible renewable generation in a future year,
f_1, f_2, and f_3 are annual effective capacity factors for eligible technologies 1, 2, and 3, respectively, and
C_1, C_2, and C_3 are the eligible renewable capacities for technologies 1, 2, and 3, respectively (in MW).
H is hours in the year (8760, except leap years)

For example, take a representative state with a target of 10,000MW of wind capacity in 2015, and 100MW of solar energy. The state average wind capacity factor is 28.4% and the state average solar capacity factor is 18.7%. Wind would be expected to produce 24,878,400 MWh of energy (10,000MW x 8760 hours x 28.4%), while solar would produce 163,812 MWh (100MW x 8760 hours x 18.7%). In total the state would estimate 25,042,212 MWh of renewable generation. Table 6 applies this example to the above formula. States with structures similar to this include Texas and Iowa. Some states have overall targets specified as a percentage of sales with a specific carve out for some amount (MWh) of wind or solar energy. In order to avoid double counting, the amount of the carve-out would not be added to the overall target, as it represents a subset of the overall generation (MWh) requirement.

Table 6: Example Qualifying Renewable Energy Calculation (Capacity Target)

	2015	2016	2017	2018	2019	2020
Wind Target (MW)	1,000	1,100	1,200	1,300	1,400	1,500
Wind Capacity Factor (%)	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%
Wind Energy (GWh)	2,488	2,737	2,985	3,234	3,483	3,732
Solar Target (MW)	150	175	200	225	250	275
Solar Capacity Factor (%)	18.2%	18.2%	18.2%	18.2%	18.2%	18.2%

[19] For more information about what renewable resources are eligible under the emissions guidelines, see section VIII.K.3.

Solar Energy (GWh)	239	279	319	359	399	438
Total Eligible Gen (GWh)	2,727	3,016	3,304	3,593	3,882	4,170

The above equations are sufficient to calculate the expected annual energy output from renewable energy associated with an RPS. As previously noted, annual capacity factor projections vary by technology and even within a technology category, depending on the location of the resource. As a result, if annual energy projections are based on aggregate capacity factors, a state should specify the location of all assumed RE generation and the source of capacity factor projections.

D. Documentation of Assumptions Related to RE and Demand-Side EE in a State Plan CO_2 Performance Projection

As explained above, states that plan to use RE and demand-side EE policies and programs under a state plan approach that requires a demonstration using projections (as described in section VIII.D.2.a.(3)(a) of the preamble) must quantify for each requirement and program the expected direct electricity savings and generation impacts on affected EGUs. Further, the state plan performance demonstration must document the underlying assumptions regarding the renewable electricity generation and electricity savings impacts on affected EGUs. Specific considerations and assumptions that should be described in the state plan, when relevant, include the following:

- *Energy efficiency and/or renewable energy requirement or program description:* What is the requirement/program? Who will administer it? Does it require new legislation or can a state implement it under existing authorities?
- *Requirements/program time period:* What year does each specific program start and end? What are the MWh targets for the interim and final performance periods, including interim steps and other applicable time periods? How will the program meet the permanent requirements in the CPP?
- *Relationship to complementary or existing requirement/program(s):* Will this program include any federally enforceable limits? Are state measures an expansion or extension of existing requirements or programs? If the plan includes an expansion of an existing

program that allows for ineligible resources or unaffected EGUs, how does the demonstration address these impacts?

- *Program focus:* What sector or consumer type is the focus of the measure?
- *Anticipated compliance or penetration rate:* Which affected EGUs will be subject to the RE and demand-side EE policy or program? Does the projection reflect characteristics of applicable RE technologies and demand-side EE programs and policies?
- *Technology performance:* What technologies and/or generating capacity will be implemented? For how many years will the measure achieve electricity savings (e.g., measure life) or generate renewable electricity? How will measure performance degrade or decay over time?
- *Transmission and distribution (T&D) loss:* Is there an expected increase or decrease in T&D losses that would require adjustment of the energy savings estimate?
- *Resource Costs:* What is the cost of saved and/or generated electricity for the RE and demand-side EE measures?
- *Program Costs and Funding:* What is the cost of the program, including administration costs? How it be funded?
- *Resource availability:* Are the projected electricity savings or renewable electricity generation levels realistic compared to the potential available?