

**Status Report: Evaluation of Environmental Impacts of  
the Renewable Electricity Standard**

**Introduction**

The California Environmental Quality Act (CEQA) and Air Resources Board (ARB/Board) policy require an analysis to determine the potential environmental impacts of proposed regulations. This document summarizes the status of ARB's efforts to evaluate the environmental and public health impacts of the proposed rulemaking for the 33 percent Renewable Electricity Standard (RES). As part of its analysis, staff will evaluate the impacts of the proposal on greenhouse gases (GHG), criteria pollutants, and toxic air contaminants. The analysis will also include an assessment of potential community impacts. In addition to assessing potential air quality impacts, the ARB has established a contract to assist with the development of a CEQA equivalent analysis for non-air environmental impacts including land, water, biology, cultural and visual impacts. The status of the non-air quality impact assessment is briefly discussed in this document as well.

For the analysis presented here, staff evaluated the impacts of a 33 percent RES compliance scenario that extends the requirements of the RPS to all load serving entities. In a future analysis, staff will evaluate the impacts of a 33 percent RES compliance scenario that allows California utilities to purchase the renewable energy "attributes" from renewable energy credits (RECs) where the electricity is produced and consumed in other jurisdictions within the Western Electricity Coordinating Council (WECC). These analyses will be done in cooperation with the California Energy Commission, the California Public Utilities Commission, and the California Independent System Operator. Both analyses focus on the quantification of air quality-related impacts that may result from implementation of the 33 percent RES.

In conducting the environmental impacts analysis, staff will concurrently address the criteria listed in section 38562 of the Global Warming Solutions Act of 2006 (AB 32 or Act)<sup>1</sup>. As proposed, the RES will allow the use of market-mechanisms, staff will also address the criteria listed in section 38570 of the Act<sup>2</sup>.

---

<sup>1</sup> Section 38562 states that, to the extent feasible, any adopted regulations shall: be equitable, ensure activities do not disproportionately impact low-income communities, complement and not interfere with federal and state ambient air quality or toxic air contaminant emission standards, and consider overall societal benefits.

<sup>2</sup> These criteria include, to the extent feasible, the following: (1) consider the potential for direct, indirect, and cumulative emission impacts from these mechanisms, including localized impacts in communities that are already adversely impacted by air pollution; (2) design any market-based compliance mechanism to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants; and (3) maximize additional environmental and economic benefits for California, as appropriate.

## Methodology

The air quality analysis evaluates the impacts of possible compliance scenarios on GHG emissions throughout the WECC. The analysis also evaluates the statewide, regional, and, to the extent practical, local air quality impacts resulting from changes in criteria pollutant and toxic air contaminant emissions that accompany implementing the RES. For the 20 percent RPS, the analysis evaluates the impacts of increasing the renewable energy resources from the 2008 level to 20 percent in 2020. For the 33 percent RES possible compliance scenario, the analysis evaluates the air quality impacts of increasing the renewable energy resources from 20 percent to 33 percent in 2020.

To evaluate the air quality impacts of the possible scenarios, staff used the current version of the RES Calculator developed by Energy and Environmental Economics, Inc. The estimates of GHG and criteria pollutant emissions for the 20 percent RPS and 33 percent RES scenarios are based on output data from the RES Calculator and ARB developed emission factors. The RES Calculator develops resource plans for meeting a renewable generation target in California by 2020. The model ranks and sorts individual resources within 52 competitive renewable energy zones. It then deploys new renewables in selected zones until the specified renewable generation is met for a given load forecast. The emission estimates are based on preliminary emission factors that may be updated as more information becomes available. In addition, we will provide emission estimates for toxic air contaminants when we prepare the final environmental impacts analysis.

California's total electricity retail sales in 2020 is estimated to be 251,000 gigawatt-hours (GWh) for the low load scenario and 289,000 GWh for the high load scenario. The high load and low load scenarios are from the 2009 Integrated Energy Policy Report load forecast to evaluate the additional renewable energy needed to meet the 33 percent target. The high load scenario uses historical data to draw assumptions and includes embedded values for combined heat and power (CHP) and solar distributed generation (DG), including rooftop and wholesale sources. However, the high load scenario does not include load reductions from several AB 32 Scoping Plan measures, primarily energy efficiency, CHP, and solar DG. The low load scenario reflects changes to the high load scenario by including modifications to incorporate AB 32 Scoping Plan measures. The result is a lower need for renewable energy as compared to the 2020 high load scenario.

Tables 1 and 2 show the actual and projected electricity retail sales in 2008 and 2020 for the low load and high load forecasts, respectively. Values in these tables for "New Renewables" are a direct output from the RES Calculator. The values for "Traditional Resources" and "Existing Renewables" come from sources that were operational as of 2008. Power production from nuclear and large hydro power is assumed to remain constant from 2008 to 2020. The power production from natural gas is assumed to decline with increasing production from new renewable resources.

**Table 1  
Electricity Retail Sales (Actual and Projected) in 2008 and 2020 Low Load Scenario (GWh)**

Resource	2008		2020			
	California generation	Out-of-state generation	20% RPS		33% RES Scenario	
			California generation	Out-of-state generation	California generation	Out-of-state generation
<b>Traditional Resources &amp; Existing Renewables</b>	179,000	83,200	159,000	72,700	136,000	60,400
<b>New Renewables</b>						
Wind			8,910	5,390	10,300	9,490
Solar thermal			261	0	12,400	1,300
Solar PV			438	0	6,470	0
Geothermal			913	436	9,680	445
Solid fuel biomass			1,580	598	1,690	610
Landfill/digester gas			223	0	2,080	0
Small hydro			95	64	111	66
<b>TOTAL</b>	<b>179,000</b>	<b>83,200</b>	<b>172,000</b>	<b>79,000</b>	<b>179,000</b>	<b>72,000</b>

**Table 2  
Electricity Retail sales (Actual and Projected) in 2008 and 2020 High Load Scenario (GWh)**

Resource	2008		2020			
	California generation	Out-of-state generation	20% RPS		33% RES Scenario	
			California generation	Out-of-state generation	California generation	Out-of-state generation
<b>Traditional Resources &amp; Existing Renewables</b>	179,000	83,200	179,000	83,200	155,000	70,400
<b>New Renewables</b>						
Wind			9,340	5,500	15,000	9,490
Solar thermal			261	0	14,400	1,300
Solar PV			718	0	6,890	0
Geothermal			7,380	445	11,000	445
Solid fuel biomass			1,660	610	2,320	610
Landfill/digester gas			223	0	2,080	0
Small hydro			95	66	111	66
<b>TOTAL</b>	<b>179,000</b>	<b>83,200</b>	<b>199,000</b>	<b>90,000</b>	<b>207,000</b>	<b>82,000</b>

The GHG emission estimates include all areas interconnected within the WECC. The GHG emission factors (EFs) for each type of renewable resource are based on ARB’s analysis entitled “Evaluation of Greenhouse Gas Benefits for Renewable Energy Technologies,” which was presented at the March 18, 2010, public workshop for the proposed RES rulemaking.

The criteria pollutant emission estimates include all emissions occurring in California. The emission factors for criteria pollutants are based on historical emission data and environmental impact reports. Wind, solar PV, and small hydro resources are assumed to have zero operating emissions. For solid-fuel biomass, the emissions exclude truck emissions from hauling feedstock to the facility. The associated truck emissions will be included as we update this analysis.

**Air Quality Discussion and Results**

GHG Emissions in the WECC

Table 3 summarizes the GHG emissions in the WECC in 2008 and 2020 under the 20 percent RPS scenario. The table shows the GHG emissions were about 103 million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>e) in 2008. In 2020, the GHG emissions are projected to decrease to 85 MMTCO<sub>2</sub>e under the low load scenario due to the fact that with low growth renewable generation displaces a sizeable amount of natural gas powered resources. This preliminary analysis indicates that GHG emissions under the high load scenario are similar to 2008 levels. However, this projection requires further analysis.

**Table 3  
WECC-Wide GHG Emissions from the 20 Percent RPS  
(MMTCO<sub>2</sub>e/yr)**

2008 Emissions	20% RPS in 2020	
	Low Load	High Load
103	85	104

Table 4 compares the GHG emissions in 2020 under the 20 percent RPS scenario to the GHG emissions under the 33 percent RES scenario. This table shows the GHG emissions in 2020 would be reduced by an additional 20 to 23 MMTCO<sub>2</sub>e under the 33 percent RES scenarios for low and high load growth, respectively.

**Table 4  
WECC-Wide GHG Emissions from 20 Percent RPS vs. 33 Percent RES  
(MMTCO<sub>2</sub>e/yr in 2020)**

	Low Load	High Load
<b>20% RPS Scenario</b>	85	104
<b>33% RES Scenario</b>	65	81
<b>Emission Reduction</b>	20	23

Statewide Criteria Pollutant Emissions

Table 5 shows statewide criteria pollutant emissions in 2008 from electricity generation in California. These emission levels serve as reference points for comparing to emissions in 2020 for the 20 percent RPS and 33 percent RES scenarios.

**Table 5**  
**Statewide Criteria Pollutant Emissions in 2008**

	CA Energy Production (GWh)	NO <sub>x</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	CO (tons/yr)	PM <sub>2.5</sub> (tons/yr)
<b>TOTAL</b>	179,000	15,200	1,980	22,200	2,970

Tables 6 and 7 show preliminary estimates of the statewide criteria pollutant emissions in 2020 for the low load forecast for the 20 percent RPS and 33 percent RES scenarios, respectively. For the 20 percent RPS scenario (Table 6), emission levels decrease from 2008 to 2020 for all pollutants. For the 33 percent RES scenario (Table 7), emission levels decrease from 2008 to 2020 for all pollutants.

**Table 6**  
**2020 Statewide Criteria Pollutant Emissions:**  
**20 Percent RPS, Low Load Scenario**

Resource	CA Energy Production (GWh)	NO <sub>x</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	CO (tons/yr)	PM <sub>2.5</sub> (tons/yr)
<b>Traditional Resources &amp; Existing Renewables</b>	159,000	13,500	1,760	19,700	2,640
<b>New Renewables</b>					
Wind	8,910	0	0	0	0
Solar thermal	261	1	0	1	2
Solar PV	438	0	0	0	0
Geothermal	913	4	15	3	16
Solid fuel biomass	1,580	316	79	166	287
Landfill/digester gas	223	56	0	212	7
Small hydro	95	0	0	0	0
<b>TOTAL</b>	<b>172,000</b>	<b>13,900</b>	<b>1,850</b>	<b>20,100</b>	<b>2,950</b>

**Table 7**  
**2020 Statewide Criteria Pollutant Emissions:**  
**33 Percent RES, Low Load Scenario**

Resource	CA Energy Production (GWh)	NO <sub>x</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	CO (tons/yr)	PM <sub>2.5</sub> (tons/yr)
<b>Traditional Resources &amp; Existing Renewables</b>	136,000	11,500	1,500	16,800	2,250
<b>New Renewables</b>					
Wind	10,300	0	0	0	0
Solar thermal	12,400	51	0	39	75
Solar PV	6,470	0	0	0	0
Geothermal	9,680	40	164	27	165
Solid fuel biomass	1,690	337	85	177	306
Landfill/digester gas	2,080	519	1	1,970	62
Small hydro	111	0	0	0	0
<b>TOTAL</b>	<b>179,000</b>	<b>12,500</b>	<b>1,750</b>	<b>19,100</b>	<b>2,860</b>

Tables 8 and 9 show the statewide criteria pollutant emissions in 2020 for the high load forecast for the 20 percent RPS and 33 percent RES scenarios, respectively. For the 20 percent RPS scenario (Table 8), emission levels are expected to increase slightly for all criteria pollutants. For the 33 percent RES scenario (Table 9), some emission levels decrease while others increase slightly.

**Table 8**  
**2020 Statewide Criteria Pollutant Emissions:**  
**20 Percent RPS, High Load Scenario**

Resource	CA Energy Production (GWh)	NO <sub>x</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	CO (tons/yr)	PM <sub>2.5</sub> (tons/yr)
<b>Traditional Resources &amp; Existing Renewables</b>	179,000	15,200	1,980	22,200	2,970
<b>New Renewables</b>					
Wind	9,340	0	0	0	0
Solar thermal	261	1	0	1	2
Solar PV	718	0	0	0	0
Geothermal	7,380	31	125	21	126
Solid fuel biomass	1,660	332	83	174	301
Landfill/digester gas	223	56	0	212	7
Small hydro	95	0	0	0	0
<b>TOTAL</b>	<b>199,000</b>	<b>15,600</b>	<b>2,190</b>	<b>22,600</b>	<b>3,400</b>

**Table 9**  
**2020 Statewide Criteria Pollutant Emissions:**  
**33 Percent RES, High Load Scenario**

Resource	CA Energy Production (GWh)	NO <sub>x</sub> (tons/yr)	SO <sub>x</sub> (tons/yr)	CO (tons/yr)	PM <sub>2.5</sub> (tons/yr)
<b>Traditional Resources &amp; Existing Renewables</b>	155,000	13,100	1,710	19,200	2,570
<b>New Renewables</b>					
Wind	15,000	0	0	0	0
Solar thermal	14,400	59	0	45	87
Solar PV	6,890	0	0	0	0
Geothermal	11,000	46	186	31	188
Solid fuel biomass	2,320	464	116	243	421
Landfill/digester gas	2,080	519	1	1,970	62
Small hydro	111	0	0	0	0
<b>TOTAL</b>	<b>207,000</b>	<b>14,200</b>	<b>2,010</b>	<b>21,500</b>	<b>3,320</b>

Table 10 compares statewide criteria pollutant emissions in 2020 for the 20 percent RPS to those for the 33 percent RES scenario, low load forecast. This table shows that criteria pollutant emissions for the 33 percent RES scenario are less than for the 20 percent RPS scenario. Table 11 makes the same comparison, but for the high load forecast. Again, criteria pollutant emissions are less for the 33 percent RES scenario.

**Table 10**  
**2020 Statewide Criteria Pollutant Emissions:**  
**20 Percent RPS vs. 33 Percent RES Scenarios, Low Load (tons/yr)**

	<b>NO<sub>x</sub></b>	<b>SO<sub>x</sub></b>	<b>CO</b>	<b>PM<sub>2.5</sub></b>
<b>20% RPS Scenario</b>	13,900	1,850	20,100	2,950
<b>33% RES Scenario</b>	12,500	1,750	19,100	2,860
<b>Emissions Reduction</b>	1,400	100	1,000	90
<b>Percent Reduction</b>	10.1	5.4	5.0	3.1

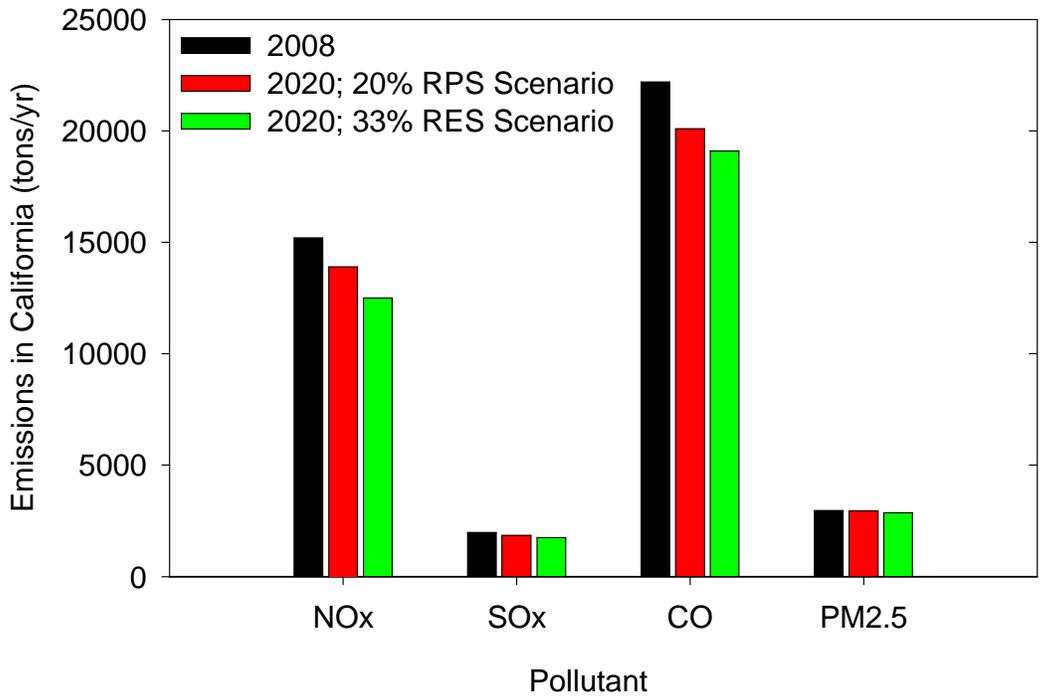
**Table 11**  
**2020 Statewide Criteria Pollutant Emissions:**  
**20 Percent RPS vs. 33 Percent RES Scenarios, High Load (tons/yr)**

	<b>NO<sub>x</sub></b>	<b>SO<sub>x</sub></b>	<b>CO</b>	<b>PM<sub>2.5</sub></b>
<b>20% RPS Scenario</b>	15,600	2,190	22,600	3,400
<b>33% RES Scenario</b>	14,200	2,010	21,500	3,320
<b>Emissions Reduction</b>	1,400	180	1,100	80
<b>Percent Reduction</b>	9.0	8.2	4.9	2.4

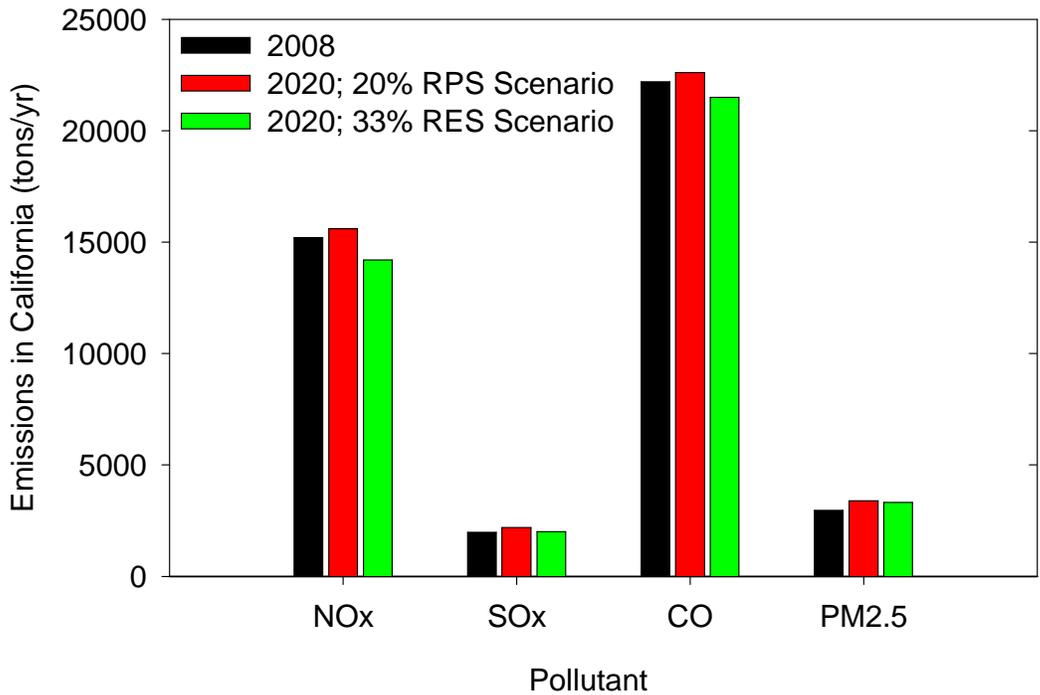
Figure 1 compares criteria pollutant emissions in 2008 to emissions in 2020 for the 20 percent RPS and 33 percent RES scenarios, low load forecast. The emissions in Figure 1 include all sources of electricity generation in California. This figure shows emissions are decreasing from 2008 to 2020 for the 20 percent RPS and the 33 percent RES scenarios.

Figure 2 compares 2008 emissions to 2020 emissions for the high load forecast. In this case, the emissions increase from the increasing electricity load is only partially reduced by the increase in renewable sources. However, as the figure indicates, the introduction of additional renewables through a 33 percent requirement is generally expected to reduce criteria pollutant emissions in 2020 relative to business-as-usual (i.e., 20 percent RPS scenario).

**Figure 1**  
**Statewide Emissions from Electricity Generation**  
**2020 Low Load**



**Figure 2**  
**Statewide Emissions from Electricity Generation**  
**2020 High Load**



Regional and Local Criteria Pollutant Emissions

Staff is working with the energy agencies to assess the impacts that the integration of renewable resources will have on criteria pollutant emissions regionally and at the community scale. These analyses will consider: 1) the locations of existing facilities and new renewable resources; 2) the need to provide supporting power to integrate intermittent renewable resources into the electricity system; 3) the transmission required to deliver electricity from renewable resources in remote locations to the grid; and 4) the impacts of programs such as the State Water Resources Control Board's once-through-cooling ruling, and AB 32 that are expected to result in the retirement or repowering of aging power plants and increases in power plant efficiency.

Summary of Air Quality Benefits

This preliminary analysis is conservative and may underestimate the air quality benefits from the 20 percent RPS and 33 percent RES compliance scenarios. This analysis will be refined to reflect new scenarios that consider the integration of renewable resources in state as well as out of state.

**Non-Air Environmental Impacts**

ARB, in consultation with a contractor, will evaluate the non-air environmental impacts associated with the RES. In addition to new renewable generation facilities, new transmission lines will be required to bring electricity from producing zones in remote areas to end users. Distribution lines may also need to be upgraded. In some locations, existing transmission lines connected to fossil fuel power plants may need to be upgraded to maintain system reliability while supporting power supplies from intermittent renewable resources such as wind and solar. The ARB contractor will consider the Renewable Energy Transmission Initiative and other reports to identify potential transmission lines, environmental impacts, and mitigation measures for the installation of new transmission lines in the State. The CEQA equivalent analysis for non-air environmental impacts will include land, water, biology, cultural, and visual impacts.