

# 2023 Proposed Preferred System Plan and 2024-25 Transmission Planning Portfolios Supplemental Criteria Pollutant Analysis

Energy Division Staff  
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California Public  
Utilities Commission

# Criteria pollutant analyses of the IRP PSP 25MMT Core and Least Cost cases for years 2026, 2030, and 2035

# Background – criteria pollutants analysis

- Statute directs the Commission's IRP process to ensure that LSEs "minimize localized air pollutants and other greenhouse gas emissions, with early priority on disadvantaged communities "(PU Code 454.52 (a)(1)(H))
- Reports from SERVIM studies were post-processed to produce criteria pollutant analyses for the CAISO area only as well as all of California. Analysis quantifies the quantity and breakdown of criteria pollutants within DACs (Disadvantaged Communities) and outside DACs.
- The following slides present these analyses for 2026, 2030, and 2035 with the 25 MMT Core and Least Cost cases paired with the 2022 IEPR electric demand forecast
  - Refer to 2023 Proposed Preferred System Plan (PSP) Reliability and Emissions Analysis slides for further background on these cases, available here: [PSP ruling-Reliability and emissions analysis-slides 2023-10-04-FINAL \(ca.gov\)](#)
- Analysis steps using SERVIM outputs
  - Methods to estimate start NOx emissions and normal operation NOx emissions
  - Data sources for estimating emission factors – Biomass emissions factors were updated this PSP cycle, given new information sourced from RPS contracts. The effect is to lower emissions from biomass, particularly NOx emissions.
  - Methods to summarize results by resource type, study year, and DAC status

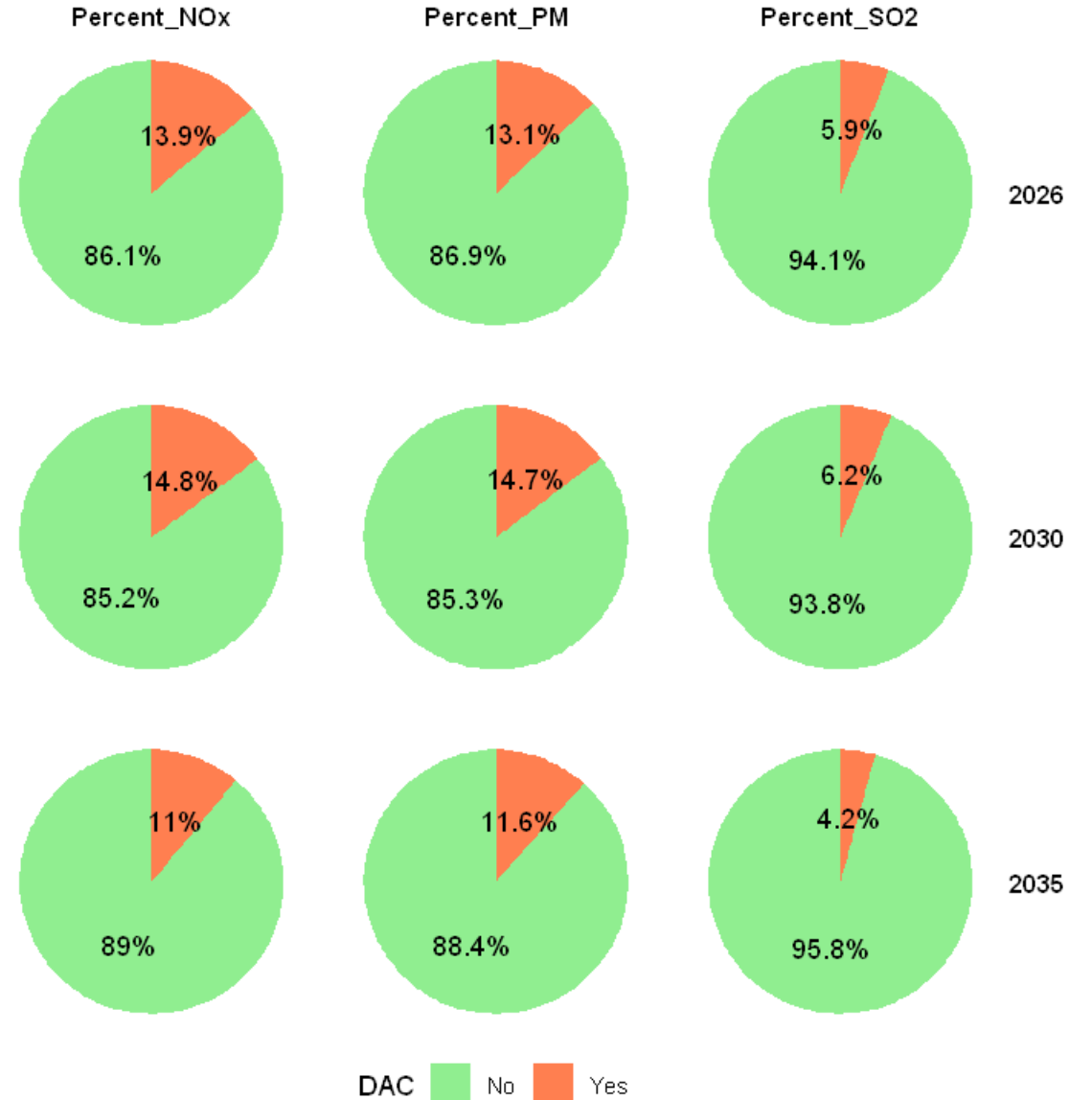
# California-wide electric sector criteria pollutants (metric tons) by DAC – Core Case

- In the Core case, in California, between 4% to 15% of criteria pollutants emissions are in Disadvantaged Communities (DAC) and between 85% and 96% outside DACs. PM2.5 and NOx emissions are most likely to be in DAC areas and SO2 least likely.

Emissions In DAC	2026	2030	2035
NOx	13.9%	14.8%	11%
PM	13.1%	14.7%	11.6%
SO2	5.9%	6.2%	4.2%

- DACs contain about 25% of California's population
- In DAC:** Emissions from generating units located in disadvantaged communities as defined by the California Environmental Protection Agency and in D.18-02-018 (even if the emissions may migrate beyond)
- Not in DAC:** Emissions from generating units not located in disadvantaged communities (even if emissions may migrate into such communities)

## CA Emissions by DAC

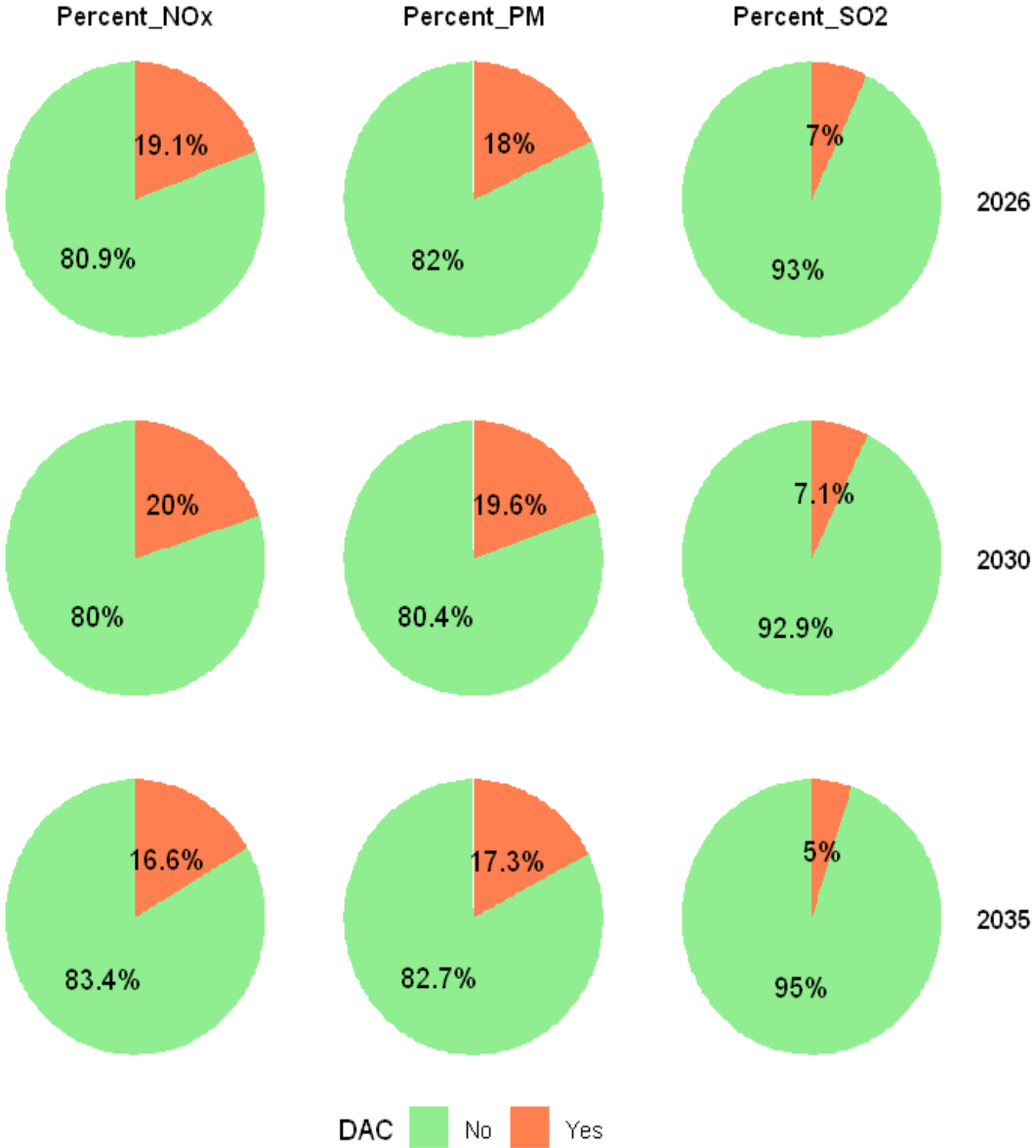


# CAISO electric sector criteria pollutants (metric tons) by DAC – Core Case

- In the Core case, in CAISO, between 5% to 20% of criteria pollutants emissions are in Disadvantaged Communities (DAC) and between 80% and 95% outside DACs. PM2.5 emissions are most likely to be in DAC areas and SO2 least likely.

Emissions In DAC	2026	2030	2035
NOx	19.1%	20%	16.6%
PM	18%	19.6%	17.3%
SO2	7%	7.1%	5%

CAISO Emissions by DAC



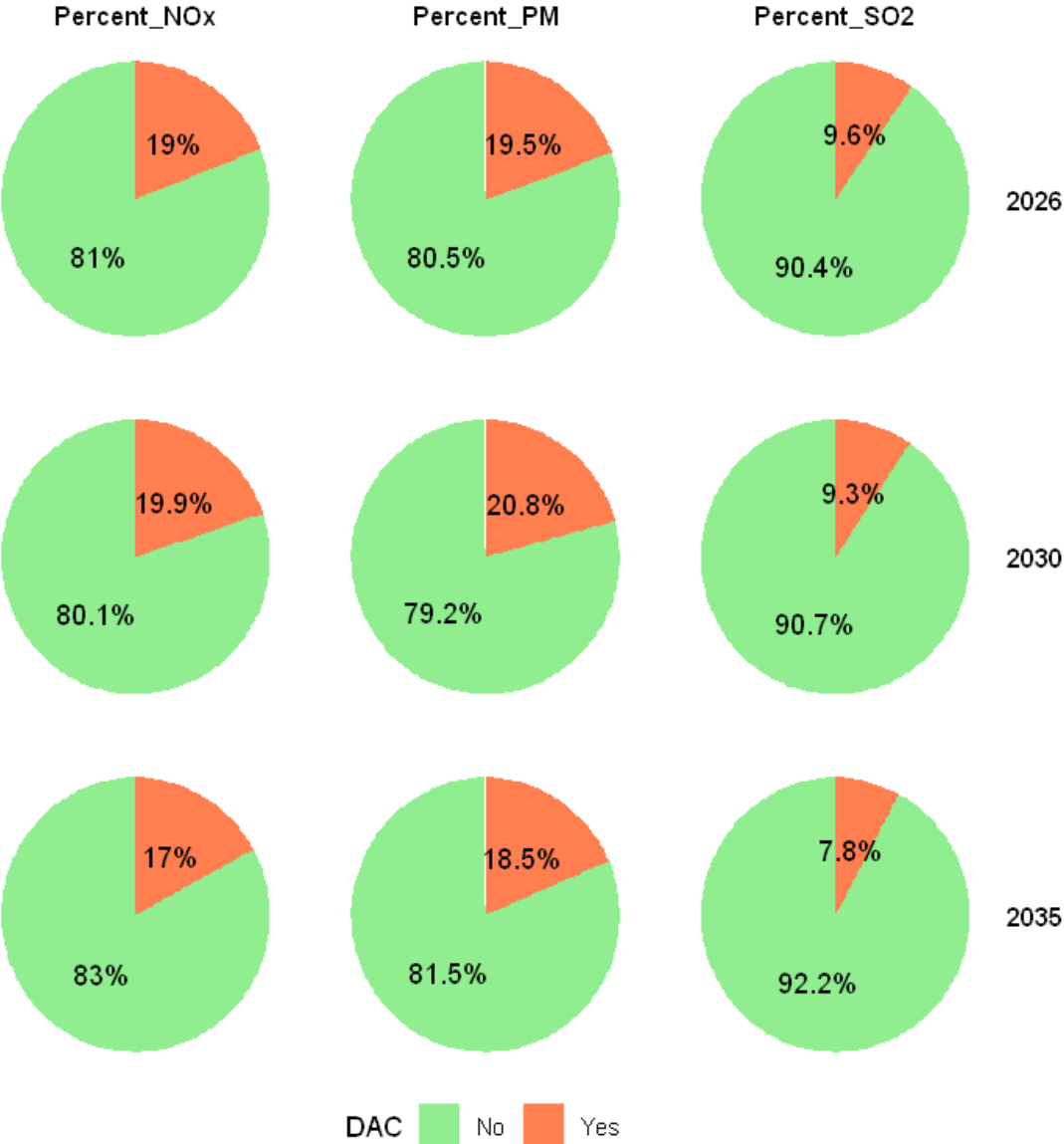
- DACs contain about 25% of California's population
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- Not in DAC:** Emissions from generating units not located in disadvantaged communities (even if emissions may migrate into such communities)

# California-wide electric sector criteria pollutants (metric tons) by DAC – Least Cost Case

- In the Least Cost case, in California, between 8% to 21% of criteria pollutants emissions are in Disadvantaged Communities (DAC) and between 79% and 92% outside DACs. In this portfolio, PM2.5 are most likely to be in DAC areas and SO2 least likely.

Emissions In DAC	2026	2030	2035
NOx	19%	19.9%	17%
PM	19.5%	20.8%	18.5%
SO2	9.6%	9.3%	7.8%

CA Emissions by DAC



- DACs contain about 25% of California's population
- In DAC:** Emissions from generating units located in disadvantaged communities as defined by the California Environmental Protection Agency and in D.18-02-018 (even if the emissions may migrate beyond)
- Not in DAC:** Emissions from generating units not located in disadvantaged communities (even if emissions may migrate into such communities)

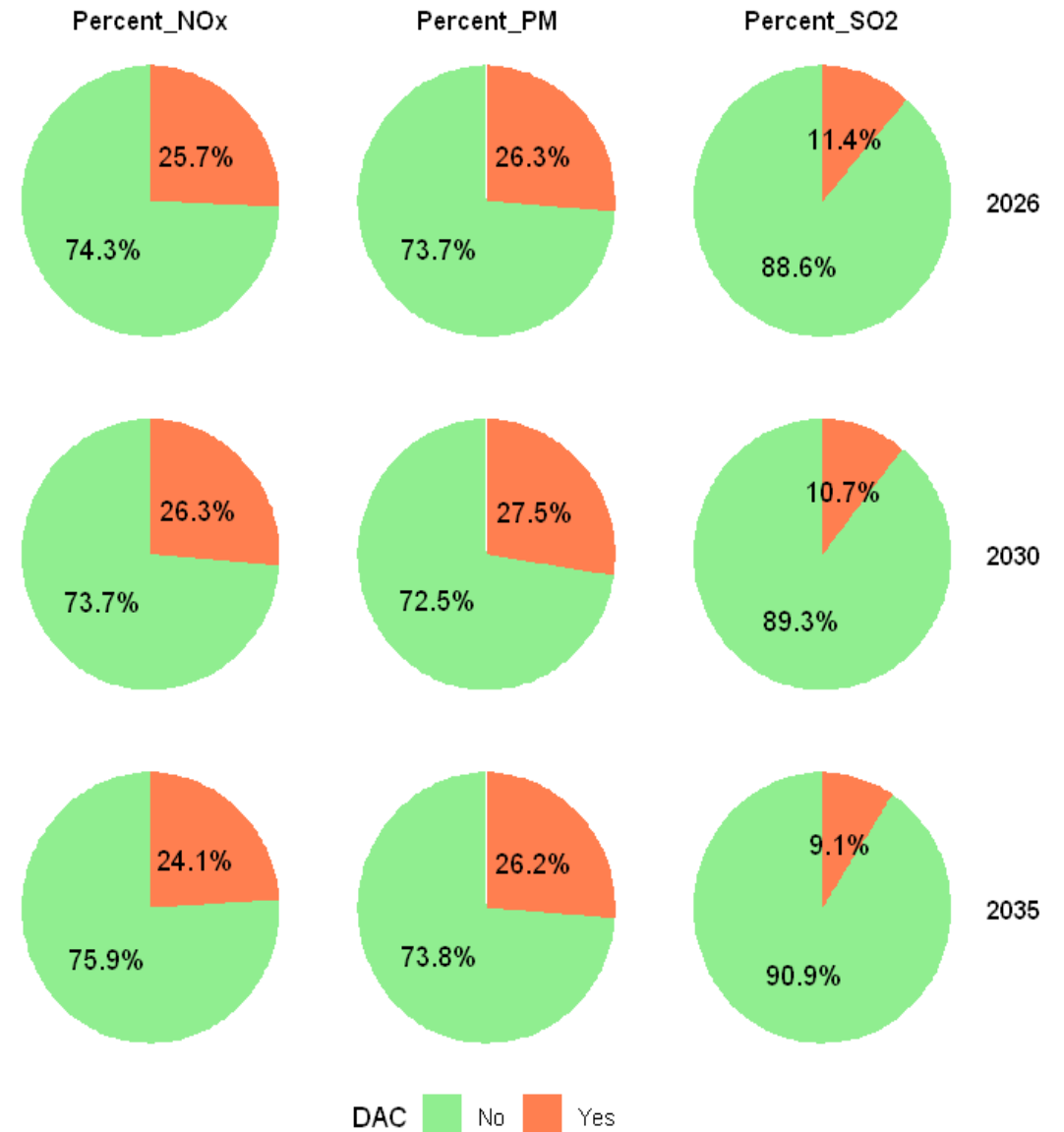
# CAISO electric sector criteria pollutants (metric tons) by DAC – Least Cost Case

- In the Least Cost case, in CAISO, between 9% to 28% of criteria pollutants emissions are in Disadvantaged Communities (DAC) and between 72% and 91% outside DACs. PM2.5 emissions are most likely to be in DAC areas and SO2 least likely.

Emissions In DAC	2026	2030	2035
NOx	25.7%	26.3%	24.1%
PM	26.3%	27.5%	26.2%
SO2	11.4%	10.7%	9.1%

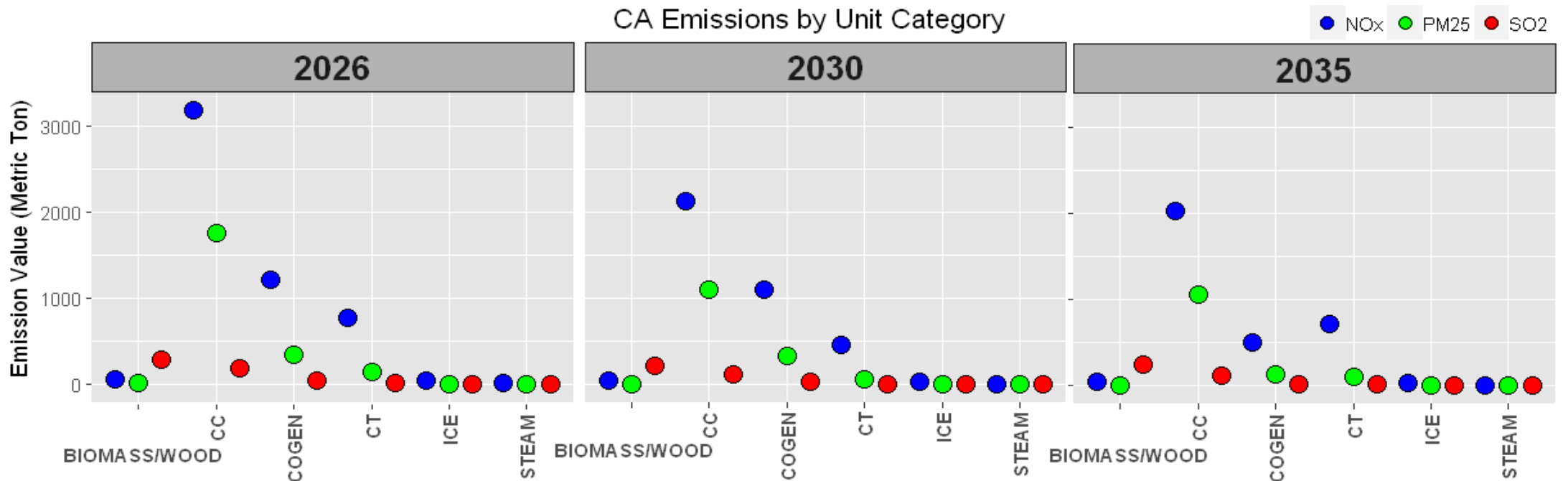
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## CAISO Emissions by DAC



# California Emissions by Unit Category – Core Case

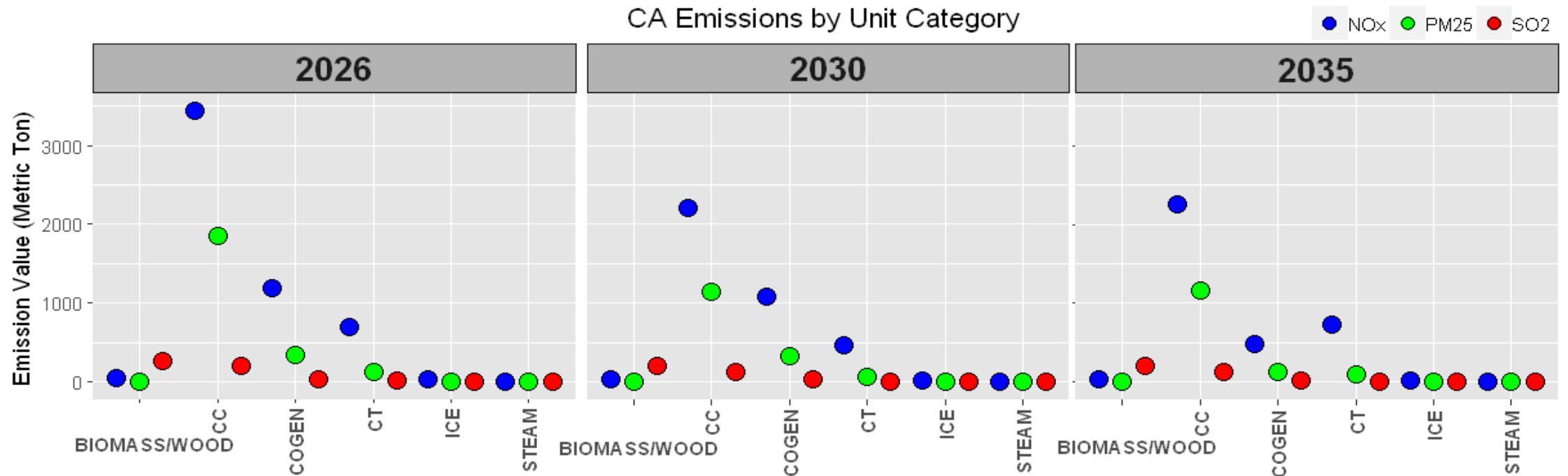
- California wide emissions shown for: biomass, CC (Combined Cycle), cogen (Cogeneration), CT (Combustion Turbine) and ICE (Internal Combustion Engine) for Core Studies
- NOx emissions are higher for CC, Cogen and CT units
- Biomass and CC units have higher SO2 emissions





# California Emissions by Unit Category – Least Cost Case

- California wide emissions shown for: biomass, CC (Combined Cycle), cogen (Cogeneration), CT (Combustion Turbine) and ICE (Internal Combustion Engine) for Least Cost Studies
- NOx emissions are higher for CC, Cogen and CT units
- Biomass units have higher SO2 emissions

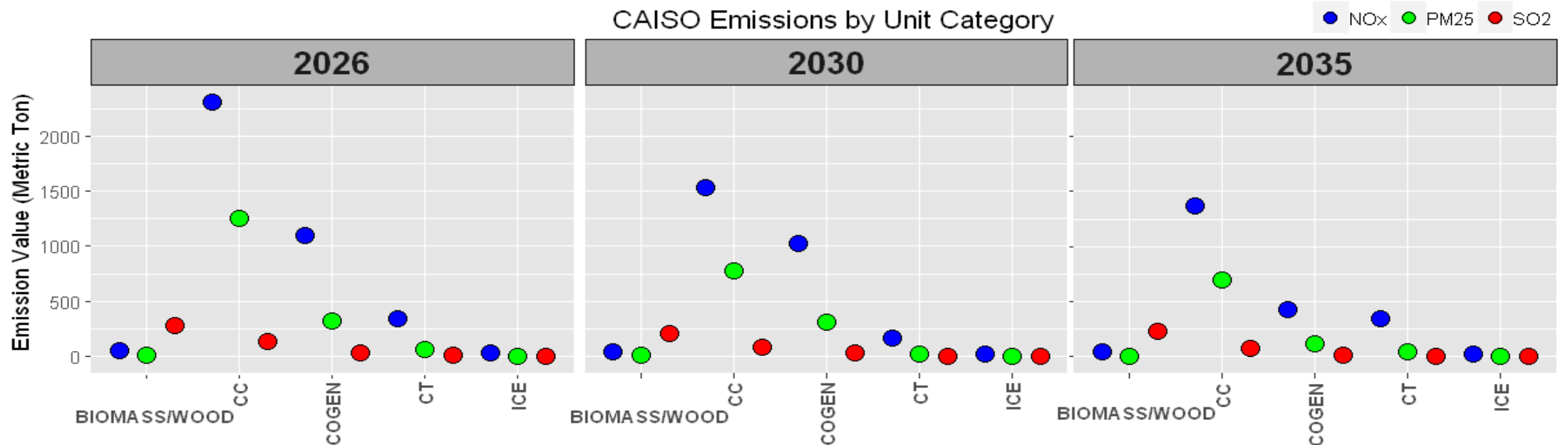


# CAISO Emissions by Unit Category – Core Case

- CAISO emissions shown for: biomass, CC, Cogen, CT and ICE for Core studies
- NOx emissions are higher for CC, Cogen and CT units
- Biomass units have higher SO2 emissions, although their total generation is much lower than Cogen and CCs

CAISO Thermal Generation - Core Case

	2026	2030	2035	
<b>Biomass</b>	1,862	1,456	1,380	GWh
<b>CC</b>	60,729	35,819	34,113	GWh
<b>Cogen</b>	10,008	9,379	3,930	GWh
<b>CT</b>	2,260	684	1,536	GWh
<b>ICE</b>	121	64	95	GWh
<b>Geothermal</b>	16,776	22,684	22,999	GWh



# CAISO Emissions by Unit Category – Least Cost Case

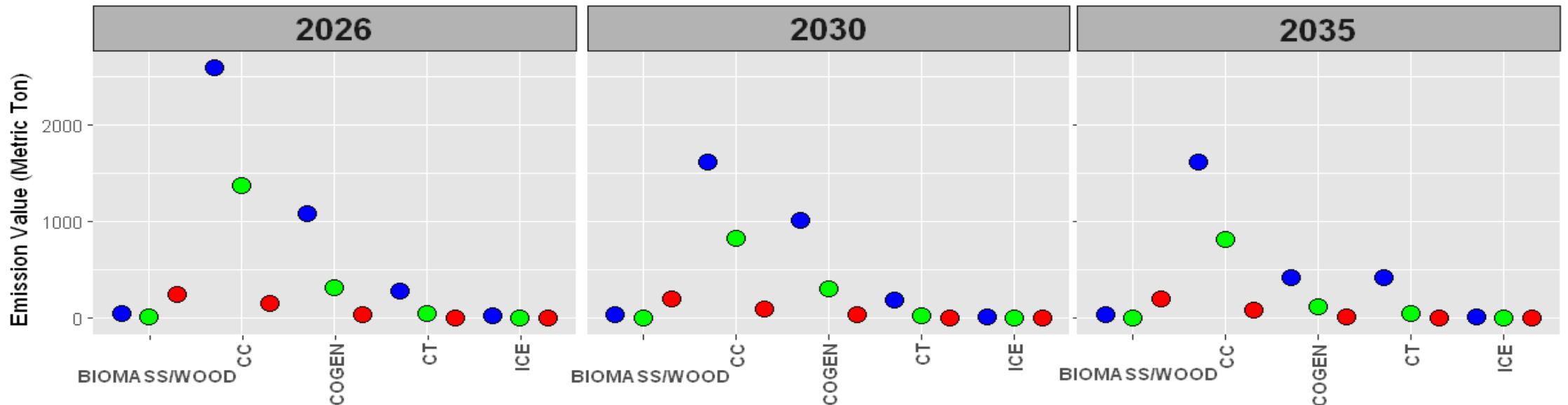
- CAISO emissions shown for: biomass, CC, Cogen, CT and ICE for Least Cost Studies
- NOx emissions are higher for CC, Cogen and CT units
- Biomass units have higher SO2 emissions, although their total generation is much lower than Cogen and CCs

CAISO Thermal Generation - LC Case

	2026	2030	2035	
<b>Biomass</b>	1,732	1,451	1,358	GWh
<b>CC</b>	66,212	39,906	39,687	GWh
<b>Cogen</b>	9,869	9,234	3,863	GWh
<b>CT</b>	1,680	687	1,612	GWh
<b>ICE</b>	90	48	63	GWh
<b>Geothermal</b>	11,685	22,802	33,050	GWh

CAISO Emissions by Unit Category

● NOx ● PM25 ● SO2



# California-wide capacity, energy, fuel burn, and criteria pollutants by unit category

# 2026 California-wide criteria pollutants by unit category - Core Case

2026 CA Core

Unit Category	Capacity (MW)	Generation (TWh)	Fuel_Burn (MMBTU)	NOx (Metric Tons)	PM2.5 (Metric Tons)	SO2 (Metric Tons)
BIOMASS /WOOD	563	0.71	3.98	55.28	8.51	292.02
CC	20,527	80.27	585.73	3,180.91	1,753.50	185.98
COGEN	2,141	11.10	114.69	1,213.69	343.34	36.41
CT	10,588	5.43	49.71	767.97	148.81	15.78
ICE	309	0.16	1.52	39.99	6.89	0.48
STEAM	186	0.11	1.17	7.64	3.99	0.37
<b>Total</b>	<b>34,313</b>	<b>97.77</b>	<b>756.79</b>	<b>5,265.49</b>	<b>2,265.03</b>	<b>531.05</b>

- Biomass listed above includes ONLY wood and biomass, excluding biogas for criteria pollutant calculations.
- Biomass units have high emission intensities, emitting a large share of total criteria pollutants despite producing relatively small amounts of electricity
- CC units have low emission intensity but still emit a significant share of total criteria pollutants since they produce large amounts of electricity

# 2030 California-wide criteria pollutants by unit category - Core Case

2030 CA Core

Unit Category	Capacity (MW)	Generation (TWh)	Fuel_Burn (MMBTU)	NOx (Metric Tons)	PM2.5 (Metric Tons)	SO2 (Metric Tons)
BIOMASS /WOOD	734	0.52	1.60	40.45	6.22	213.63
CC	21,485	50.58	366.91	2,119.63	1,098.41	116.50
COGEN	2,141	10.06	107.46	1,100.32	321.72	34.12
CT	10,588	2.11	19.45	457.85	58.21	6.17
ICE	309	0.09	0.76	22.29	3.47	0.24
STEAM	186	0.02	0.33	1.98	1.12	0.10
<b>Total</b>	<b>35,443</b>	<b>63.39</b>	<b>496.51</b>	<b>3,742.51</b>	<b>1,489.15</b>	<b>370.77</b>

# 2035 California-wide criteria pollutants by unit category - Core Case

## 2035 CA Core

Unit Category	Capacity (MW)	Generation (TWh)	Fuel_Burn (MMBTU)	NOx (Metric Tons)	PM2.5 (Metric Tons)	SO2 (Metric Tons)
BIOMASS /WOOD	733	0.59	3.57	45.93	7.07	242.62
CC	20,772	48.20	351.76	2,026.78	1,053.08	111.69
COGEN	1,064	4.51	44.21	495.76	132.34	14.04
CT	10,588	3.71	35.49	722.08	106.26	11.27
ICE	309	0.13	1.13	30.87	5.14	0.36
STEAM	186	0.04	0.56	3.48	1.90	0.18
<b>Total</b>	<b>33,651</b>	<b>57.18</b>	<b>436.72</b>	<b>3,324.90</b>	<b>1,305.78</b>	<b>380.15</b>

# 2030 California-wide criteria pollutants by unit category – 2021 PSP analysis for comparison

2030 CA (2021 PSP analysis)

Unit Category	Capacity (MW)	Generation (TWh)	Fuel_Burn (MMBTU)	NOx (Metric Tons)	PM2.5 (Metric Tons)	SO2 (Metric Tons)
Biomass /Wood	615	4.40	53.40	4,667.10	1,735.90	667.70
CC	20,483	54.40	400.00	1,437.10	1,196.00	112.70
Cogen	1,933	9.90	75.30	1,075.70	224.20	23.80
CT	10,450	7.60	78.00	454.30	231.50	22.00
ICE	305	0.20	1.60	15.70	7.10	0.50
Steam	272	0.10	1.10	5.20	3.70	0.40
<b>Total</b>	<b>34,057</b>	<b>76.60</b>	<b>609.40</b>	<b>7,655.10</b>	<b>3,398.40</b>	<b>827.10</b>

- Biomass followed by biogas units have highest emission intensities, emitting a large share of total criteria pollutants despite producing relatively small amounts of electricity
- CC units have low emission intensity but still emit a significant share of total criteria pollutants since they produce large amounts of electricity



# Comparison of 2030 study year from 2021 modeling and 2023 PSP modeling - Core Case

	Capacity (MW)	Generation (TWh)	Fuel_Burn (MMBTU)	NOx (Metric Tons)	PM2.5 (Metric Tons)	SO2 (Metric Tons)
2021 PSP	34,057	76.60	609.40	7,655.10	3,398.40	827.10
2023 PSP	35,443	63.39	496.51	3,742.51	1,489.15	370.77
Decrease from 2021 PSP		17.25%	18.52%	51.11%	56.18%	55.17%

- Slight increase in thermal capacity in California in proposed 2023 PSP due to corrections and updates to the Anchor Data Set, showing more generation retained in LADWP generation and SMUD areas.
- Overall decreases in criteria pollutants driven by 18% decrease in usage of thermal generators (10 TWh reduction in CC and CT generators and 4 TWh reduction in biomass).
- Part of the PM2.5 and SO2 emission decrease driven by decrease in emissions factors used for biomass in the proposed 2023 PSP, as well as decrease in overall biomass generation.

# Conclusions

- CAISO criteria pollutant emissions decrease significantly between 2026 and 2035, with the Least Cost case having lower emissions than the Core case (Slides 10 and 11).
- Revised emissions factors for biomass generators contributed to a large drop in per MWh emissions. Still, biomass is the largest emitter of SO<sub>2</sub> now that steam and coal are no longer present in California. More attention to SO<sub>2</sub> emissions from biomass generators appear to be warranted.
- CC generators are the largest emitters overall in California of PM<sub>2.5</sub> and NO<sub>x</sub>, though Cogen and CT generators also emit significant quantities relative to their overall generation.
- California-wide share of emissions which occur in DAC areas (ranging between 4% - 21%) are less than the proportion of the state's population in DACs (approximately 25%).