

# Analyzing the effects of market proliferation in the West on California gas dispatch

November 2023

GridLAB



ENERGY  
STRATEGIES



## Project team and Advisors

### Project team

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### We appreciate input from the following individuals and their organizations throughout the study

- Ari Eisenstadt and Alexis Sutterman, California Environmental Justice Alliance
- Shana Lazerow, Communities for a Better Environment
- Mark Specht, Union of Concerned Scientists
- Sarah Xu, Brightline Defense

**Disclaimer:** *The views contained in this report do not represent the views of any of the advisors or their organizations*

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- ② **Methodology & Assumptions**
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## Context and Purpose

- **Context**

Environmental Justice groups are concerned that California joining an expanded Western RTO could mean additional dispatch of gas plants in California, especially gas plants in disadvantaged communities.

- **Purpose**

The purpose of this study is to explore the potential impacts energy market regionalization may have on the dispatch and resulting emissions from California thermal units, with a focus on combined cycle and combustion turbine gas generators

- **Of particular interest** is the impact of market regionalization on emissions from generating units located in or near disadvantaged communities (DACs)

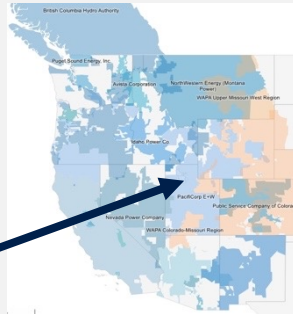


## Approach

- A series of nodal production cost simulation models that emulate system operations under varying market structures and footprints in the 2032 time-frame were conducted
- The models reflected forecasts for generation expansion, new transmission, and load growth across WECC, with special attention to such forecasts within California
- Changes to generation dispatch and emissions from thermal units in California under each market scenario were recorded and compared to existing market structures to inform the studies findings
- The study used the GridView™ security-constrained economic dispatch modeling tool, leveraging market models recently developed by Energy Strategies as a part of the State-led Market Study completed in 2021

Estimate change in generation & emissions for the California gas fleet, in aggregate and within DACs, assuming a range of West-wide market outcomes

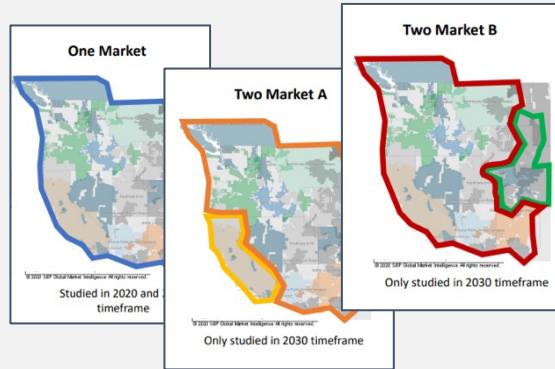
**BAU (Status Quo)**



No DA markets. Western EIM and SPP WEIS participation continues

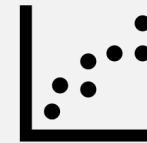
vs.

**Market Scenarios (six cases)**



=

**Change in Emissions**



Comparison of BAU versus scenarios used to calculate change in emissions for California gas fleet

- ✓ CO<sub>2</sub>
- ✓ SO<sub>x</sub>
- ✓ NO<sub>x</sub>

Modeling performed for a **2032 study year** using models, sourced from WECC, updated to reflect resource plans, transmission expansion, and public policy requirements for that horizon

## Key Findings

- **Modeling performed as a part of this study indicates that the proliferation of **day-ahead (DA) energy markets** in the West could result in *slight decreases* in aggregate California thermal generation**
- **When California is included as part of a **new, larger regional transmission organization (RTO) market footprint**, modeling results indicate a *significant decrease* in aggregate California thermal generation**
  - However, when California is assumed to operate a separate and stand-alone RTO, with the rest of the west operating in a parallel RTO market, reductions in generation within California were less significant
- **Similar trends were observed for gas units located in disadvantaged communities (DACs) in California:**
  - Day-ahead markets caused *slight* reductions in fleet dispatch within DACs
  - While we see total overall reductions in emissions and generation in the California gas fleet as a result of DA markets, some DACs experience increases in generation/emissions and other DACs experience decreases, so local impacts to the gas fleet tend to vary
  - This local variance is due to the prevailing cost of energy (LMPs), fuel prices, and transmission congestion that result from market changes
- With a few exceptions, RTOs caused *significant reductions* in fleet dispatch within DACs
  - Three DACs (in Modesto, Antioch, and Burbank) saw increases in generation and emissions under RTO market scenarios
  - RTOs cause generation & emissions to decline across DACs, in aggregate
- Roughly half of California thermal generators are located in DACs, suggesting that decisions regarding which market and market footprint to join can impact DACs significantly

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# Methodology & Assumptions





# Model Development

- Energy Strategies performed nodal market simulations using the GridView™ security-constrained economic dispatch modeling tool, leveraging market models recently developed by Energy Strategies as a part of the State-led Market Study completed in 2021.
  - The market scenarios and footprints analyzed in the State-led Market Study were leveraged in this analysis
  - Additional documentation regarding modeling approaches adopted for the State-led study are available on Energy Strategies' website [here](#)
- The following updates were made to the State-led Market Study models:
  - California load and resource mix were updated to reflect the high electrification assumptions from CAISO's 2022-23 Transmission Planning Process
  - Western coal plant retirement timelines were updated
  - Emission rates for thermal units in California were updated to values obtained from CPUC
  - LADWP's plans to convert select units to hydrogen or hydrogen blends by 2032



## GridView

is a powerful and user-friendly software tool for integrated engineering and economic analysis of the electric power grid.



S&P Capital IQ

**1-market grid operator in US West could save \$2B annually by 2030, study finds**

Friday, September 24, 2021 1:58 PM MT

# Market Constructs and Footprints Studied

Three market constructs were applied to four market footprints to develop market scenarios considered in this study.

## Energy Imbalance Market (EIM)

- Centrally optimized real-time dispatch; day-ahead unit commitment not optimized across market participants
- Individual transmission tariffs
- Limited transmission dedicated to real-time market
- Balancing Authority Area (BAA) boundaries and associated reliability obligations retained

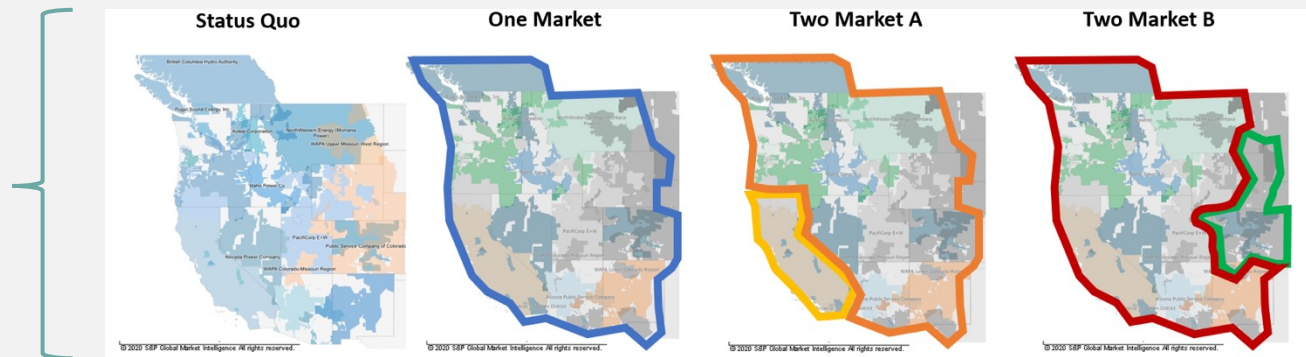
## Day Ahead Market (DA)

- Centrally optimized real-time and day-ahead energy market
- Individual transmission tariffs
- Limited transmission dedicated to market at assumed rate (other transactions must pay tariff rate for transmission)
- BAA boundaries and associated reliability obligations retained

## RTO

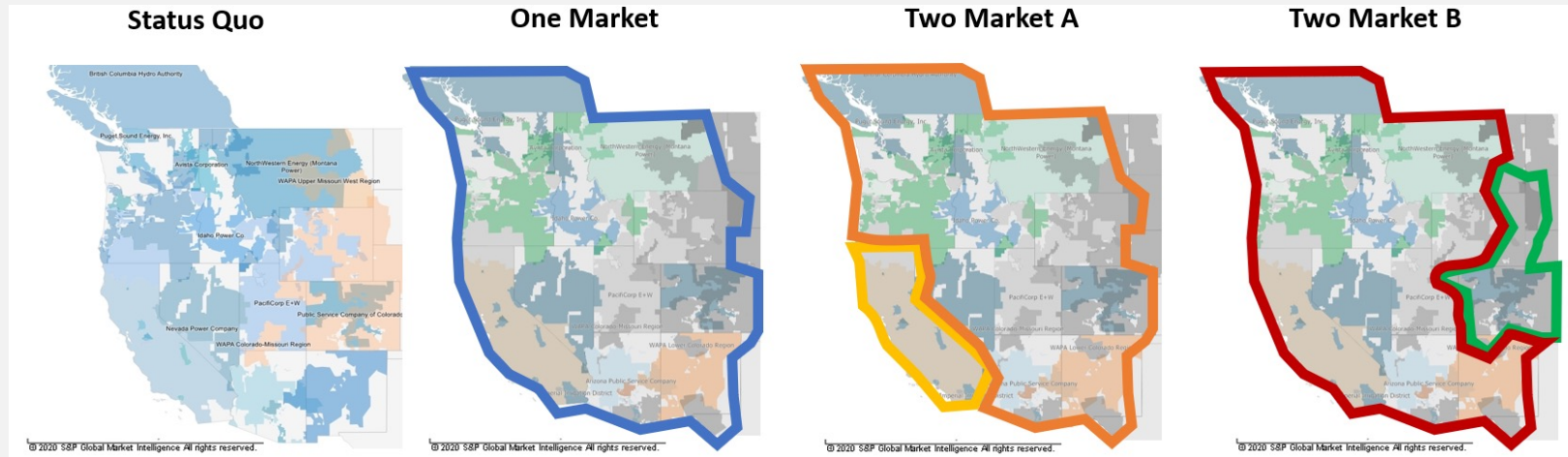
- Centrally optimized real-time and day-ahead energy market
- Joint transmission tariff for participants in a given footprint
- Transmission used up to reliability limit
- BAA boundaries and reliability obligations consolidated

Market footprints considered in the study reflect futures where market seams are created and futures where the West consolidates into a single market footprint



## A summary of the seven market scenarios considered in this analysis are summarized below:

- **Status Quo EIM:** Status Quo scenario in which real-time markets proceed with planned EIM expansions.
- **Status Quo DA:** Scenario with same footprint as the Status Quo EIM scenario, but the real-time market is replaced with a day-ahead market.
- **1Mkt DA:** Day-ahead market across the Western United States.
- **2Mkt A DA:** Two day-ahead markets operate in parallel in the “Two Market A” footprint shown on the previous slide.
- **1Mkt RTO:** RTO market across the Western United States.
- **2Mkt A RTO:** Two RTO markets operate in parallel in the “Two Market A” footprint.
- **2Mkt B RTO:** Two RTO markets operate in parallel in the “Two Market B” footprint.



# Summary of Market Modeling Assumptions

Assumption	Market Construct		
	EIM Markets	Day-ahead Markets	RTO Markets
<b>Real-time intra-market trading costs</b>	No cost for market transactions	\$3/MWh for market transactions above EIM-levels (which are \$0/MWh)	No cost for all transactions
<b>Day-ahead intra-market trading costs</b>	Tariff rate + \$4	\$3/MWh for market transactions	No cost for all transactions
<b>Real-time trading costs for market exports and out-of-market transactions</b>	Tariff rate + \$2	Tariff rate + \$2	Tariff rate + \$2 (exports only)
<b>Day-ahead trading costs for market exports and out-of-market transactions</b>	Tariff rate + \$4	Tariff rate + \$4	Tariff rate + \$4 (exports only)
<b>Transmission available for market transactions</b>	~15% of inter-area transfer capability for real-time transactions	~30% of inter-area transfer capability for day-ahead transactions, 15% for real-time	100% of inter-area transfer capability for day-ahead and real-time transactions
<b>CAISO export limit</b>	Real-time: 7000 MW Day-ahead: 2000 MW	Real-time: No limit Day-ahead: No limit, except for 2 Market A which has 7,000	Real-time: No limit Day-ahead: No limit, except for 2 Market A which has 7,000
<b>Operating reserves</b>	BA and reserve sharing group obligations retained		BAs consolidated and reserves held across market footprint
<b>Flexibility reserves</b>	BA-level constraint based on sub-hourly demand and wind/solar volatility and forecast error		BAs consolidated and reserves held across market footprint



# Updated SO<sub>2</sub>, NO<sub>x</sub> and PM<sub>2.5</sub> Emission Rates

## Energy Strategies updated emission rates for thermal units in California to align with assumptions sourced from the CPUC IRP planning process

- The SO<sub>2</sub> and NO<sub>x</sub> emission rates in the WECC Anchor Dataset are blended rates using emissions information from EIA, CEC, and other databases, and do not accurately reflect emissions from generators in CA, which have more advanced emission control technologies.
  - Emissions from units in CA are typically lower than those from units in other states; therefore, using blended rates result in higher-than-expected emission amounts.
- Emissions amounts were updated using emissions rates from the CPUC (2019-20 IRP: Proposed Reference System Portfolio Validation with SERVM Reliability and Production Cost Modeling).
  - Annual SO<sub>2</sub>, NO<sub>x</sub>, and PM 2.5 emissions from each thermal unit in CA were recalculated using CPUC emission rates, based on their fuel consumption.

Summary of Adopted Emission Rates for California Generators

Generator Type	Emission Rate (lb/MMBtu)		
	NO <sub>x</sub>	PM2.5	SO <sub>2</sub>
<b>Biomass</b>	0.1938	0.0717	0.0276
<b>CC</b>	0.0078	0.0066	0.0006
<b>Cogen</b>	0.0334	0.0066	0.0007
<b>Biogas</b>	0.1059	0.0291	0.0361
<b>CT</b>	0.0122	0.0066	0.0006
<b>Geothermal</b>	0.0058	0.0061	0.0000
<b>Steam</b>	0.0125	0.0073	0.0007
<b>ICE</b>	0.0220	0.0096	0.0014
<b>Solar Thermal</b>	0.0026	0.0000	0.0000

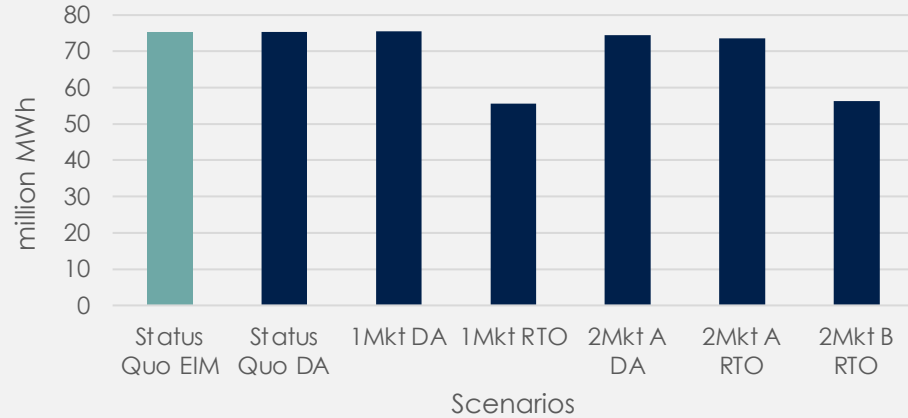
# Study Results

The following results explore how the regionalization of energy markets may impact California thermal generation dispatch, on aggregate and within Disadvantaged Communities (DACs)

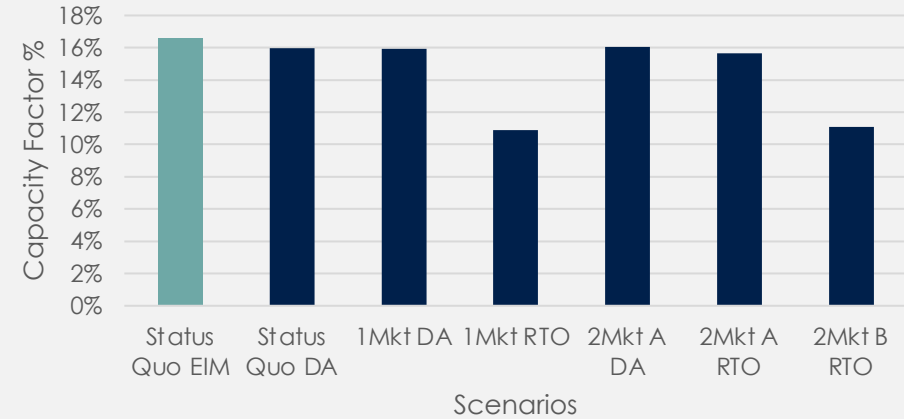


# Study Metrics for CA Aggregated Thermal Generation

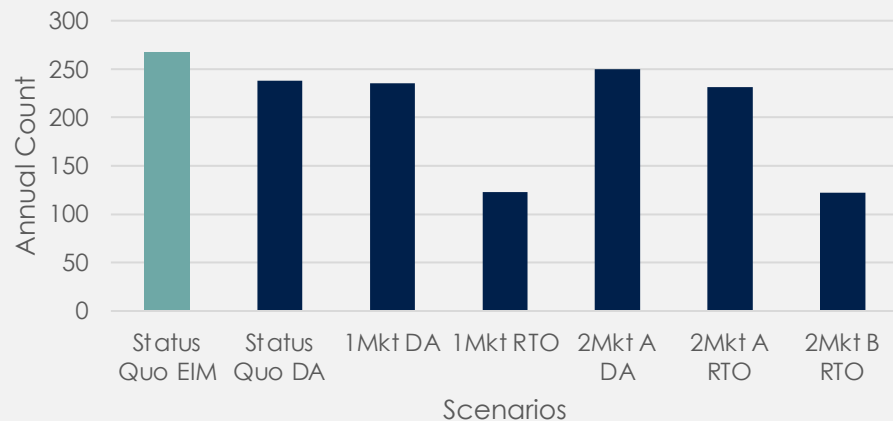
CA Annual Thermal Generation



Thermal Generator Capacity Factor



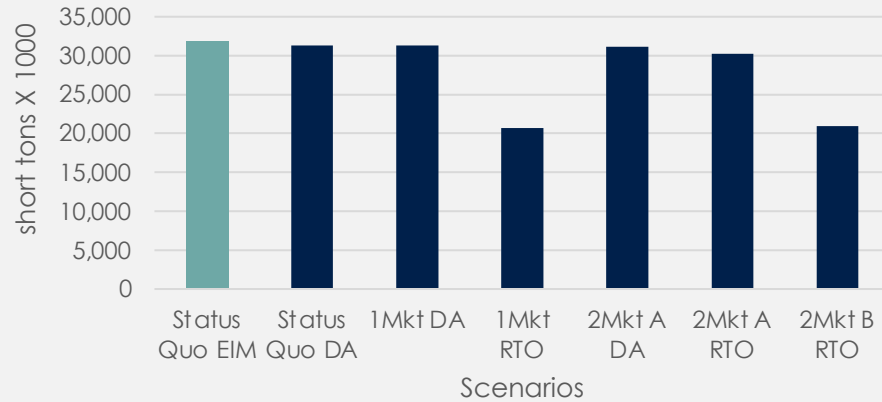
Average of Number of Starts



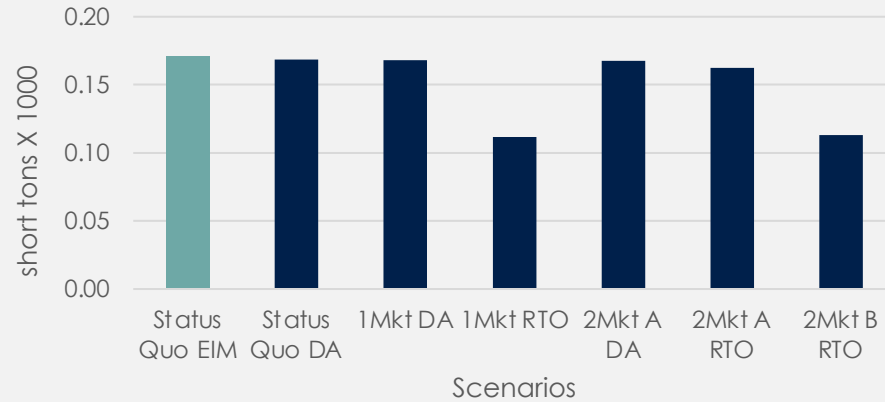
- The **Status Quo EIM** scenario assumes continued proliferation of EIM markets in the West and is the reference point for evaluating changes in dispatch
- With the DA Market scenarios, there was **no material change in thermal fleet dispatch** in California
  - However, a slight decrease in capacity factor was observed for all DA Market scenarios
- Under the 2 Market A RTO scenario (e.g., where California maintains a separate RTO), a **small reduction in dispatch** was observed
- 1 Market RTO and 2 Market B RTO scenarios caused thermal dispatch to **decrease by roughly 25%**

# Study Metrics for CA Aggregated Thermal Generation (cont.)

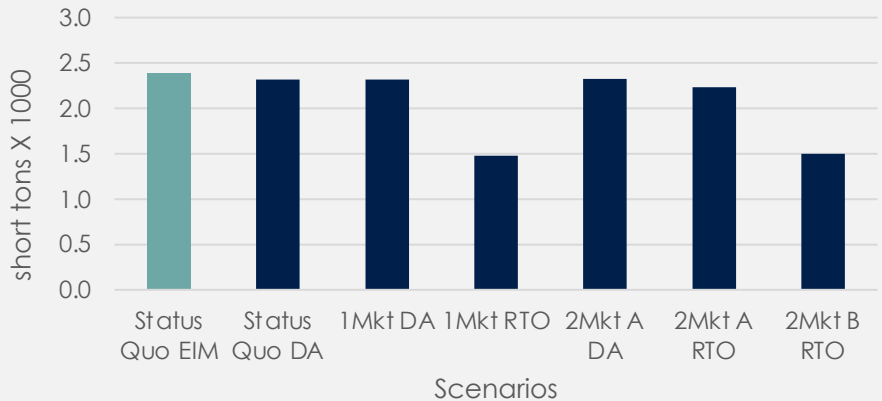
### CO<sub>2</sub> Emissions



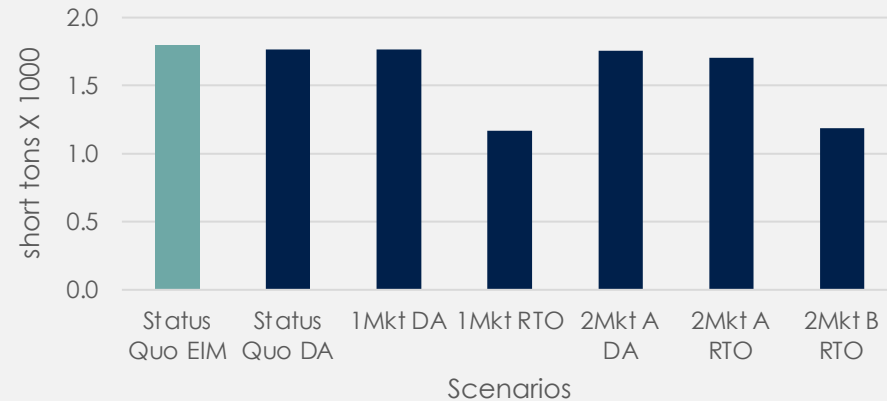
### SO<sub>2</sub> Emissions



### NO<sub>x</sub> Emissions



### PM 2.5 Emissions

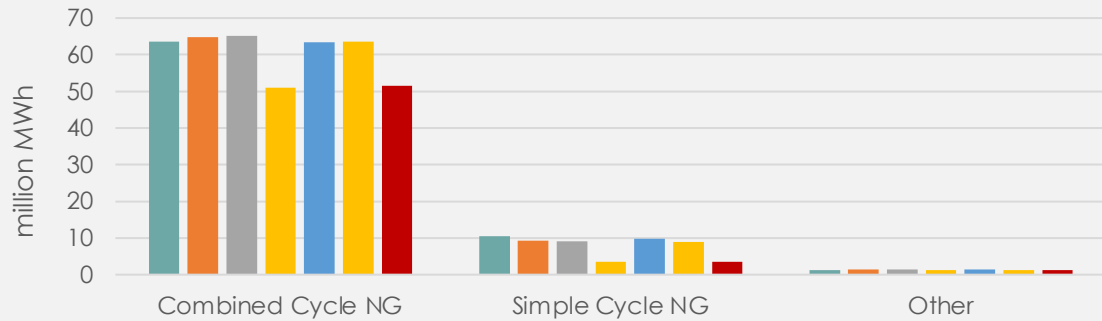


- CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub> and PM 2.5 **emissions fell by 30-35%** for the 1 Market RTO and 2 Market B RTO scenarios
- Emissions were not **materially impacted** in the DA markets and 2 Market A RTO scenarios



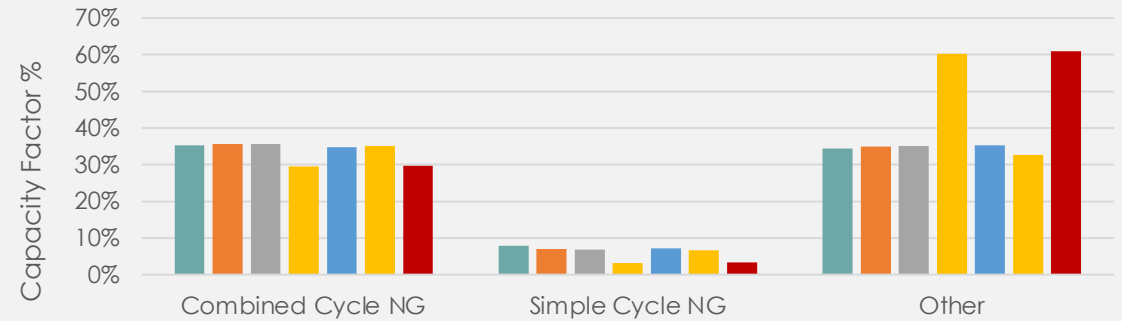
# Study Metrics by Thermal Generator Class

### Annual Generation



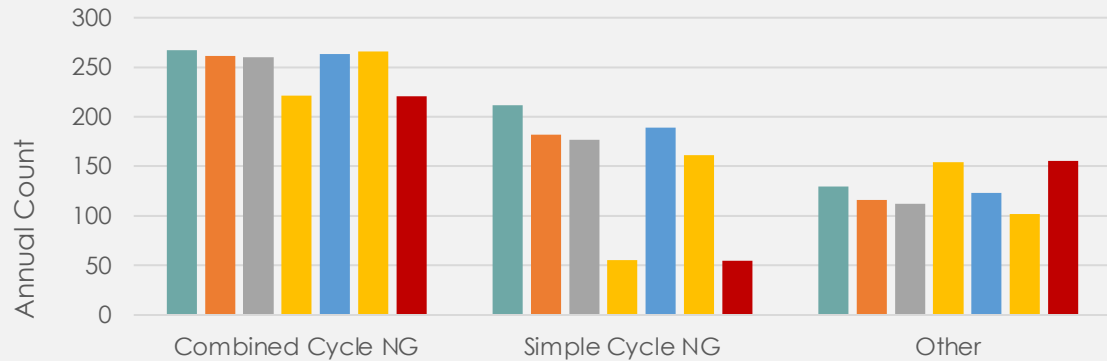
■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

### Capacity Factor



■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

### Average Number of Starts

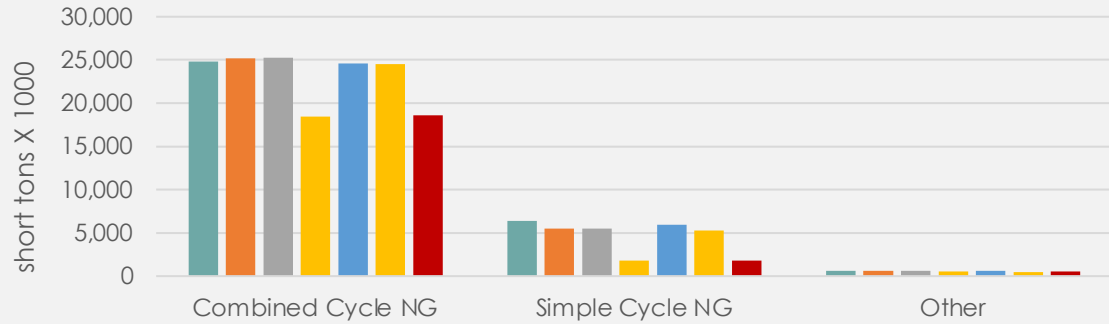


■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

- The Combined Cycle and Simple Cycle fleets experienced significant downward dispatch in both the **1 Market RTO** and **2 Market B RTO** scenarios

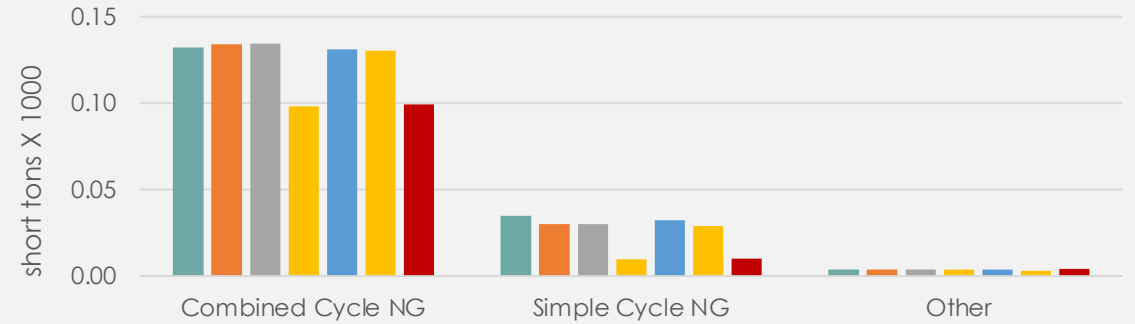
# Study Metrics by Thermal Generator Class (cont.)

### CO<sub>2</sub> Emissions



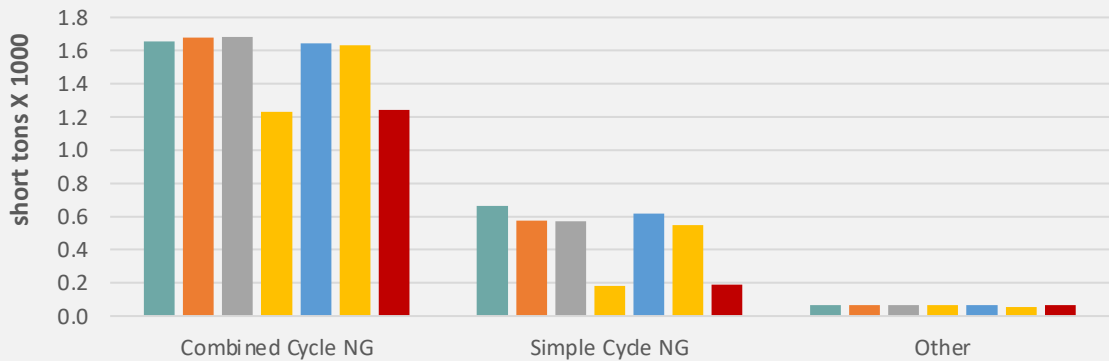
■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

### SO<sub>2</sub> Emissions



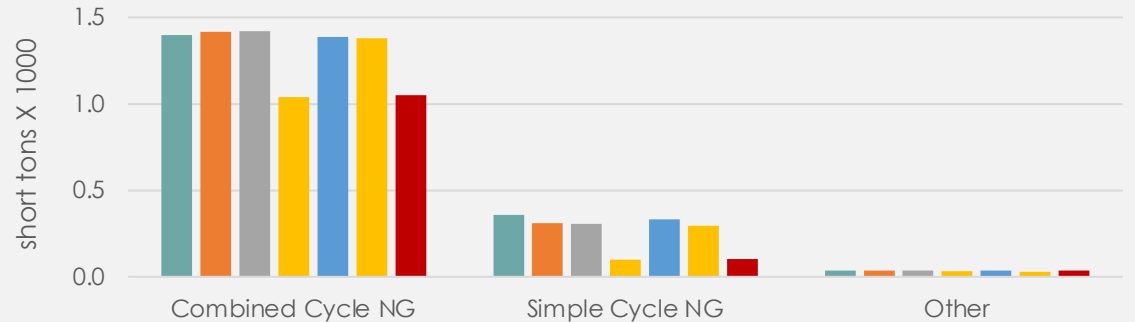
■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

### NO<sub>x</sub> Emissions



■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

### PM 2.5 Emissions



■ Status Quo EIM ■ Status Quo DA ■ 1Mkt DA ■ 1Mkt RTO ■ 2Mkt A DA ■ 2Mkt A RTO ■ 2Mkt B RTO

# Mapping Thermal Units to DACs

- Roughly 52% of thermal units in CA are located in DACs
- Most DACs contain five or fewer generators, with 2 DACs accounting for nearly 30% of the capacity within DACs

DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	Approximate Location
6029003304	21	2554	8044684	Unincorporated Kern County area
6037980007	11	2286	5072700	Long Beach
6013305000	3	840	2626561	Antioch
6037980030	6	724	2569527	El Segundo
6037121102	2	576	1759361	Los Angeles
6013309000	2	604	1707319	Pittsburg
6037408202	5	520	1230013	Industry
6095253500	4	460	1174463	Unincorporated Solano County area
6001437101	1	315	1110156	Hayward
6025011400	3	288	923122	El Centro
6037310800	2	352	912543	Burbank
6099003700	3	336	900861	Unincorporated Stanislaus County area
6037980002	1	400	756471	Carson
6013315000	1	127	735715	Unincorporated Contra Costa County area
6071009116	1	342	703639	Adelanto
6029005103	17	880	671974	Unincorporated Kern County area
6085504602	5	318	611537	San Jose
6037532400	2	134	445116	Vernon
6013358000	3	65	429134	Rodeo
6085512602	4	258	290852	Unincorporated Santa Clara County area
6037980014	1	107	271741	Los Angeles
6085505202	2	151	240191	Santa Clara
6059087805	3	175	224290	Stanton
6071007107	5	254	184908	Grand Terrace
6067004501	1	157	183869	Sacramento
6073016202	2	93	182588	El Cajon
6099000602	8	182	171137	Modesto
6067005205	2	115	170062	Sacramento
6019006100	1	48	164917	Unincorporated Fresno County area
6037294830	5	245	136895	Los Angeles

DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	Approximate Location
6019001500	2	97	130129	Unincorporated Fresno County area
6099003002	4	212	122017	Unincorporated Stanislaus County area
6071001906	2	80	116317	Ontario
6019003900	3	159	112298	Unincorporated Fresno County area
6037570202	1	50	108688	Long Beach
6019008302	7	598	87632	Unincorporated Fresno County area
6065030900	2	106	85434	Riverside
6031001601	2	100	65840	Unincorporated Kings County area
6031001200	2	98	65180	Unincorporated Kings County area
6071002207	2	82	63560	Rancho Cucamonga
6019000800	1	11	20755	Unincorporated Fresno County area
6029003303	3	75	20169	Unincorporated Kern County area
6037980033	1	47	19176	Long Beach
6067007301	1	74	16243	McClellan Park
6095252402	1	48	14398	Unincorporated Solano County area
6107004300	1	49	14234	Unincorporated Tulare County area
6037550300	1	47	12738	Norwalk
6065045707	4	80	10770	Coachella
6099002002	2	124	4898	Empire
6025010600	2	50	3775	Brawley
6029006500	2	57	3059	California City
6029001600	2	63	2889	Bakersfield
6029003700	2	7	2223	Unincorporated Kern County area
6111002905	1	49	1643	Unincorporated Ventura County area
6073005000	1	6	641	San Diego
6039000507	1	4	571	Unincorporated Madera County area
6077003900	1	5	410	Unincorporated San Joaquin County area
6073013307	1	35	101	Chula Vista
Not in DAC	168	16475	39732399	

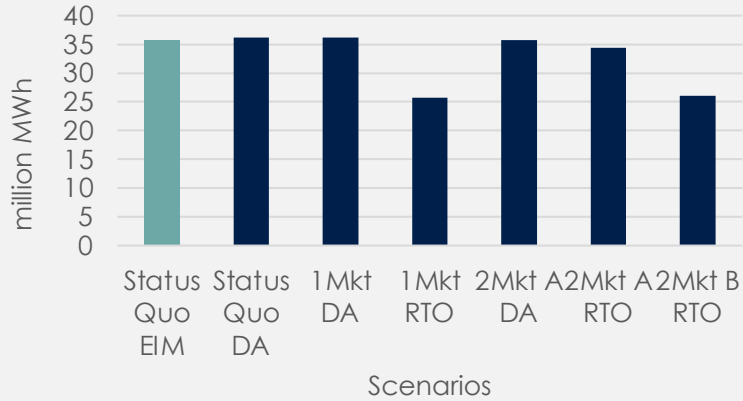
## Impacts of Regional Market Scenarios on Generation and Capacity Factors of Generator Located in DACs

- Results for thermal units in DACs are similar to those of the broader CA fleet
- A large RTO market which includes California results in significant *decreases* in generation and emissions in most DACs as compared to the Status Quo EIM case.
  - Under the **1 Market RTO** and **2 Market B RTO** scenarios, only 3 out of 58 DACs (in Modesto, Antioch, and Burbank) experienced generation *increases*; while generation *decreased* by more than 60% in 34 DAC regions.
- Under a DA scenario, many DACs saw *increases* in generations and emissions compared to the Status Quo EIM case
  - Generation increased in **15 DACs** in the **2 Market A DA** scenario and in **17 DACs in the 1 Market DA** scenario, with average increases of 9 - 11%. No DAC experienced decreases of greater than 60% in any DA market scenario.
- Maps of DACs in California's major metro areas (see subsequent slides) show that DA markets are likely to produce mixed impacts on thermal generation (with generation increasing in some areas and decreasing in others).
- **Takeaway:** RTOs that include California in a broader market footprint more consistently result in *decreases* in thermal generation and associated emissions. When California operates its own separate RTO, emissions reductions are lower.

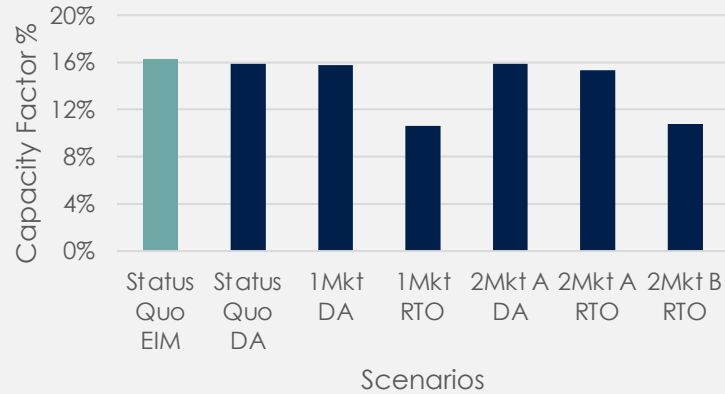


# Study Metrics for Generators in DACs

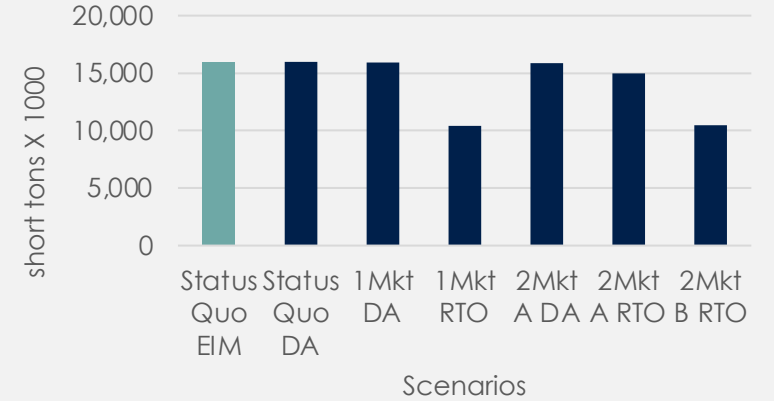
**Thermal Generation in DACs**



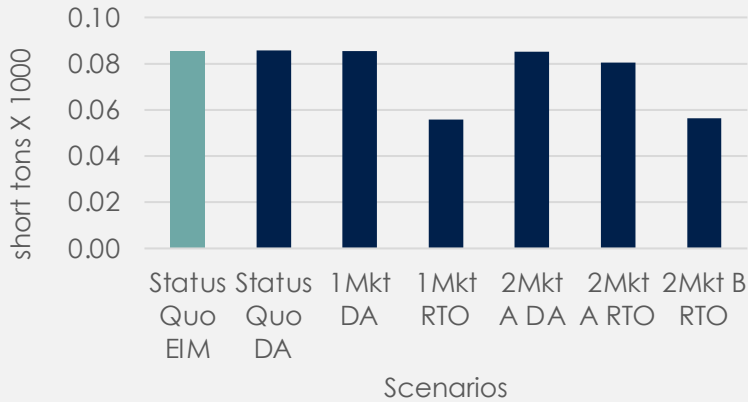
**Capacity Factor in DACs**



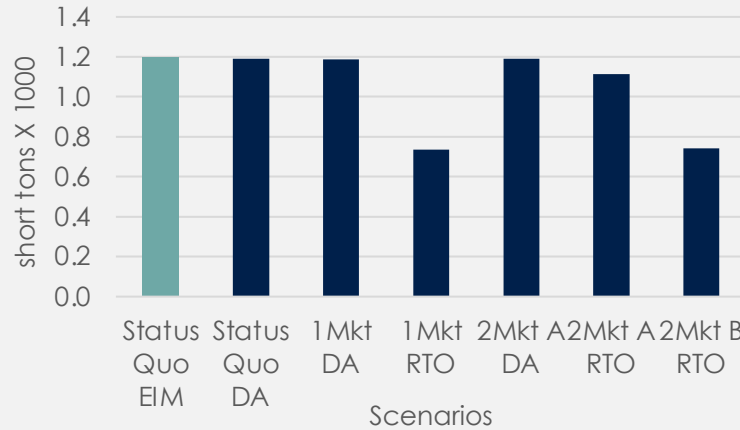
**CO<sub>2</sub> Emissions in DACs**



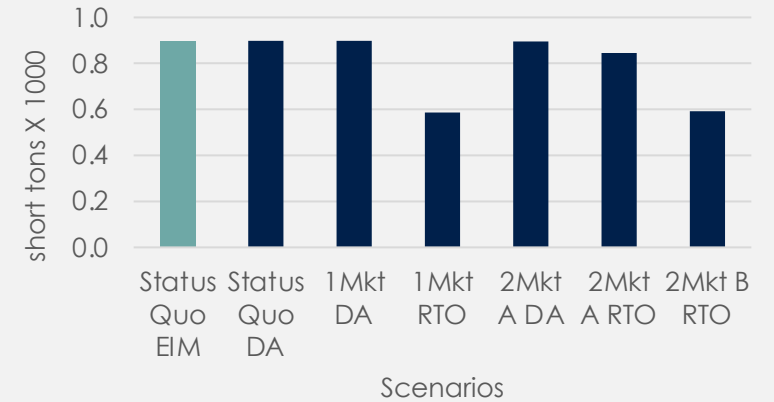
**SO<sub>2</sub> Emissions in DACs**



**NO<sub>x</sub> Emissions in DACs**



**PM 2.5 Emissions in DACs**



# Impacts of Regional Markets in DACs with Significant Generation Capacity

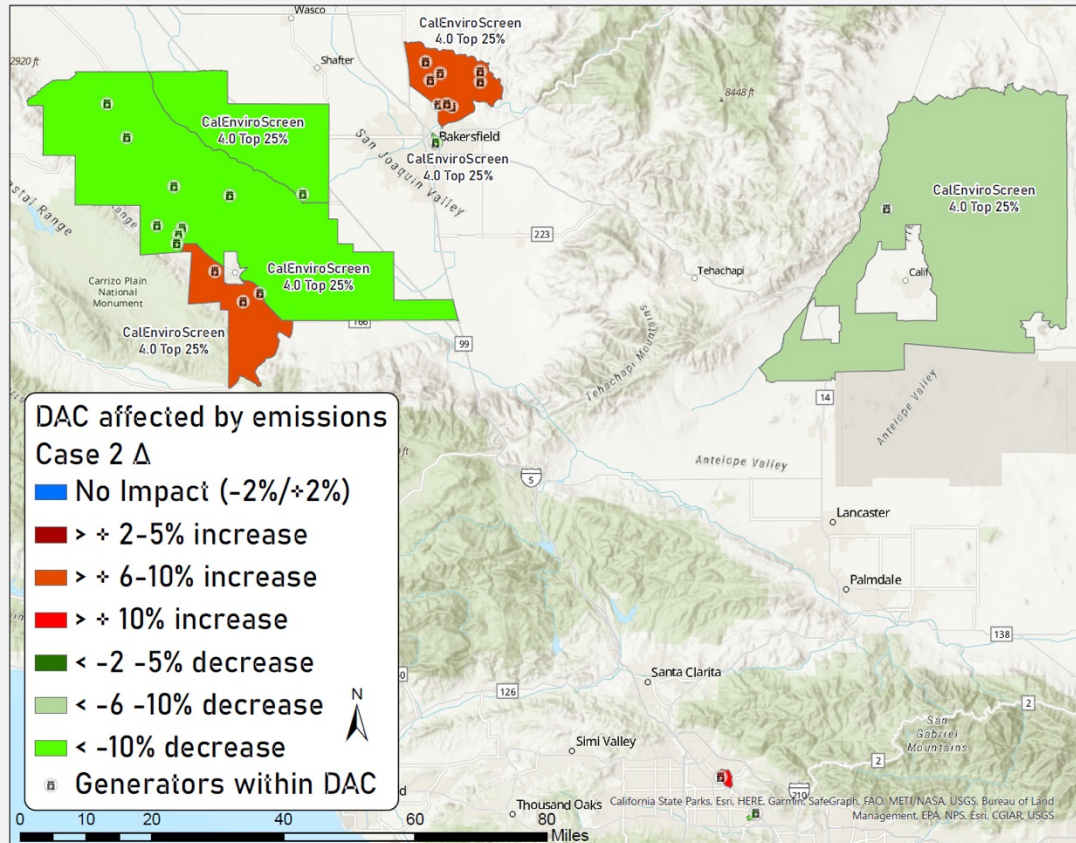
- In the DACs with the greatest amount of generation capacity, DA markets had minimal impacts on thermal generation
  - However, the **1 Market RTO** and **2 Market B RTO** scenarios resulted in a **23% decrease in generation and emissions**, on average

## Filtering for DACs with Greatest Thermal Generator Capacity

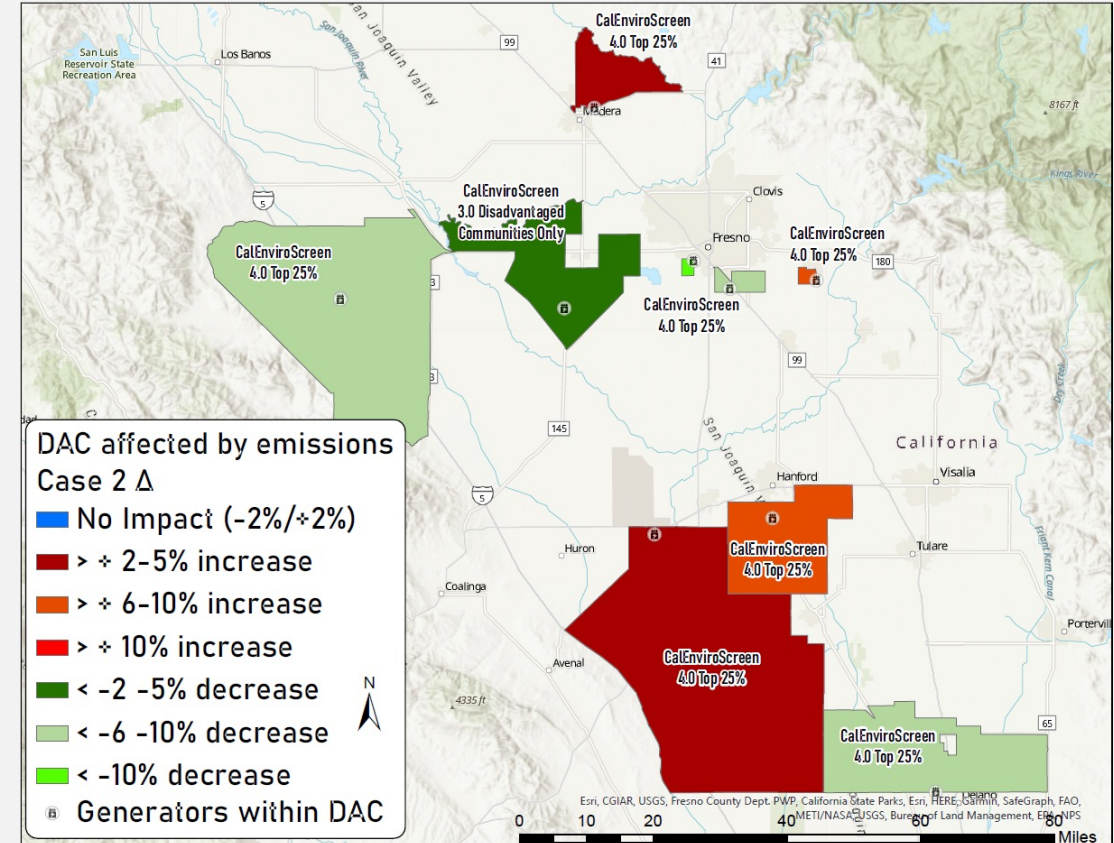
DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	% change from SQ EIM Scenario					Approximate Location	DAC Category	
				SQ RT DA	1Mkt DA	1Mkt RTO	2Mkt A DA	2Mkt A RTO			2Mkt B RTO
6029003304	21	2554	8044684	-1.50%	-0.97%	-11.92%	-2.03%	-1.80%	-10.74%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6037980007	11	2286	5072700	9.28%	10.09%	-33.75%	9.68%	-7.82%	-33.16%	Long Beach	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6029005103	17	880	671974	-28.17%	-29.35%	-52.74%	-15.66%	-26.36%	-50.56%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6013305000	3	840	2626561	12.46%	13.44%	19.49%	4.00%	13.02%	20.46%	Antioch	CalEnviroScreen 4.0 Top 25%
6037980030	6	724	2569527	-2.78%	-2.49%	-33.92%	-3.56%	-4.24%	-34.12%	El Segundo	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013309000	2	604	1707319	14.28%	14.75%	-26.19%	6.96%	16.81%	-26.18%	Pittsburg	CalEnviroScreen 4.0 Top 25%
6019008302	7	598	87632	-25.50%	-28.40%	-88.74%	-16.35%	-31.78%	-89.00%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%

# Changes in Generation Under a Status Quo DA Markets Scenario\*

## DACs in Bakersfield



## DACs in Fresno

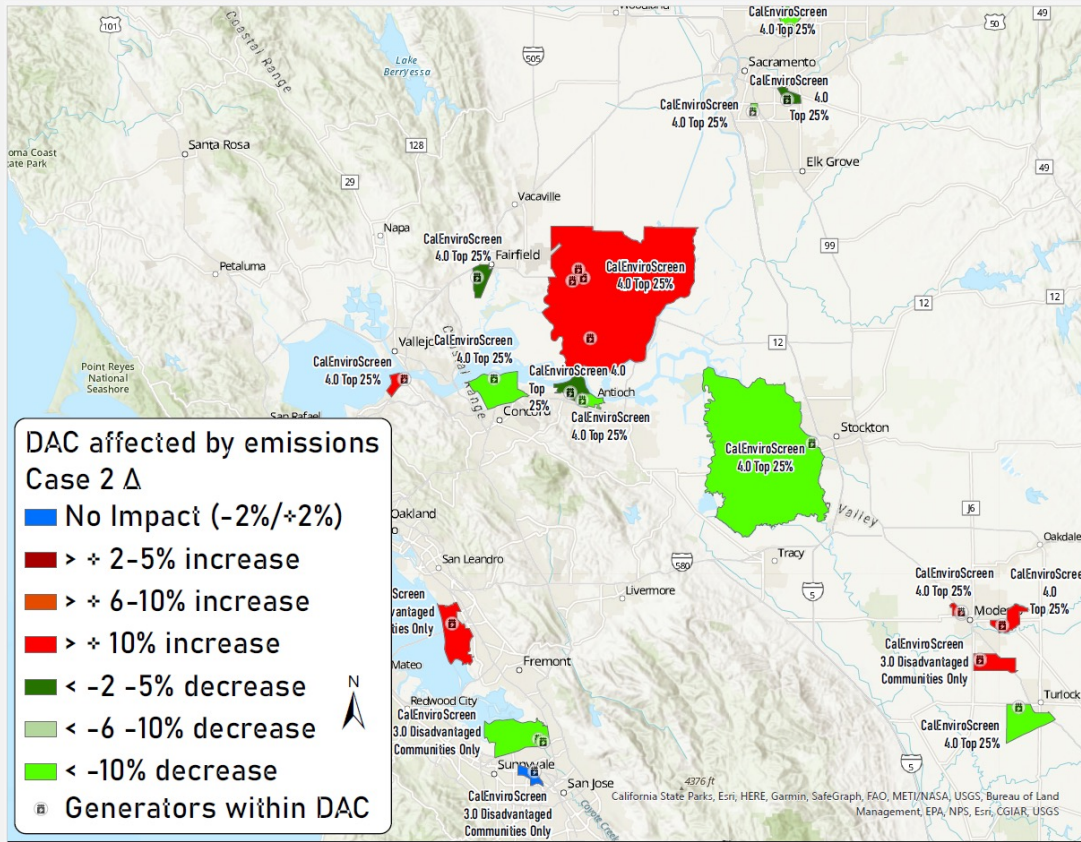


\*as compared to Status Quo EIM Markets scenario



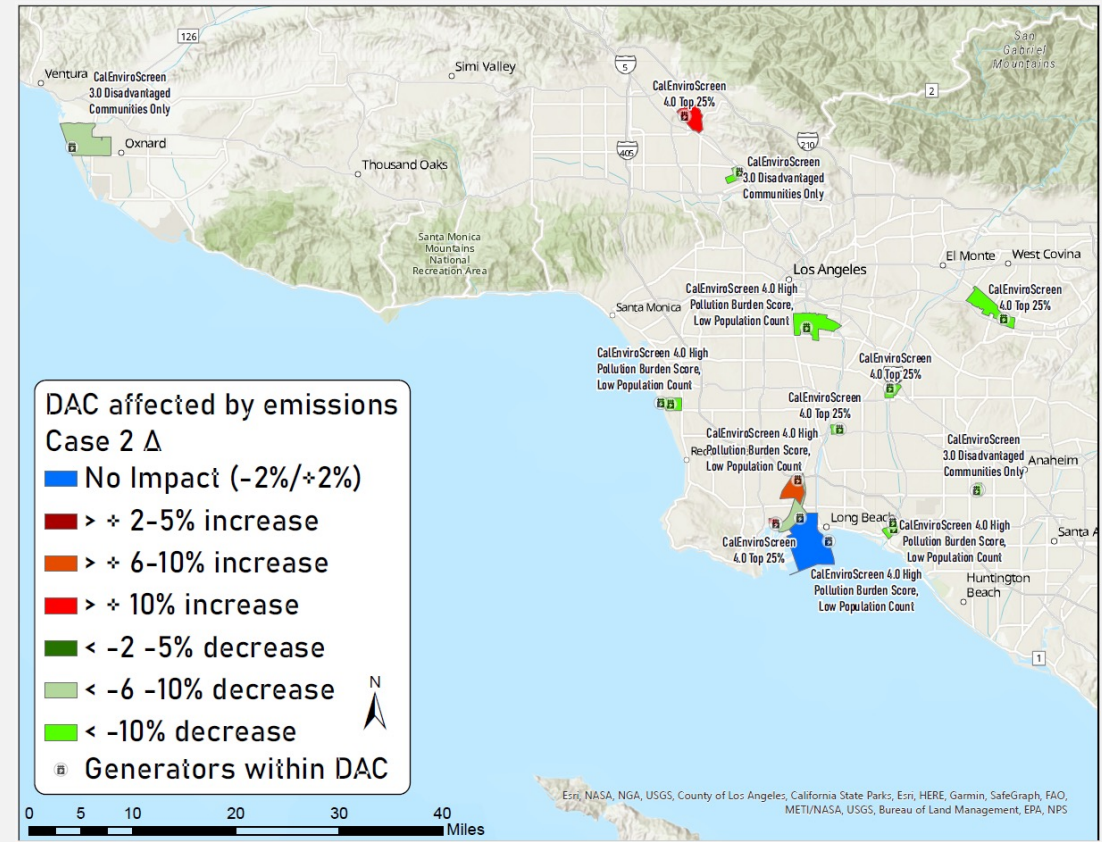
# Changes in Generation Under a Status Quo DA Markets Scenario\* (cont.)

## DACs in Bay Area and Central Valley



\*as compared to Status Quo EIM Markets scenario

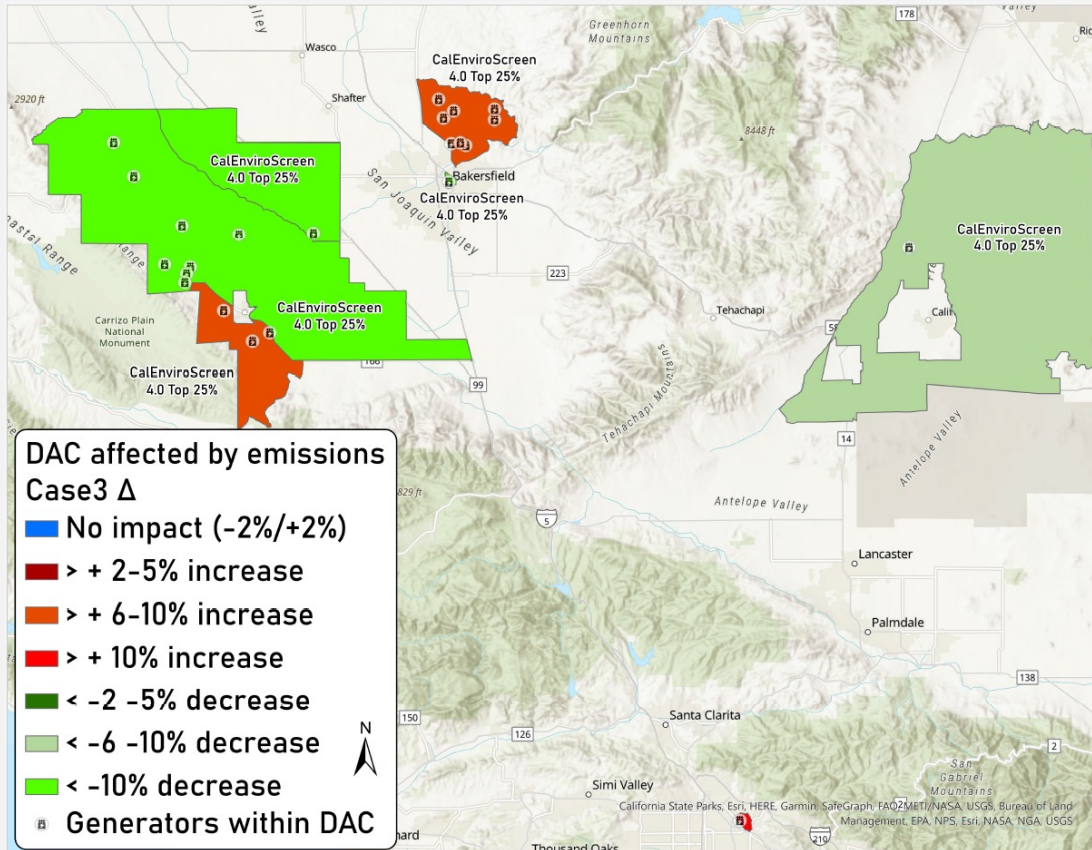
## DACs in Los Angeles and Ventura County



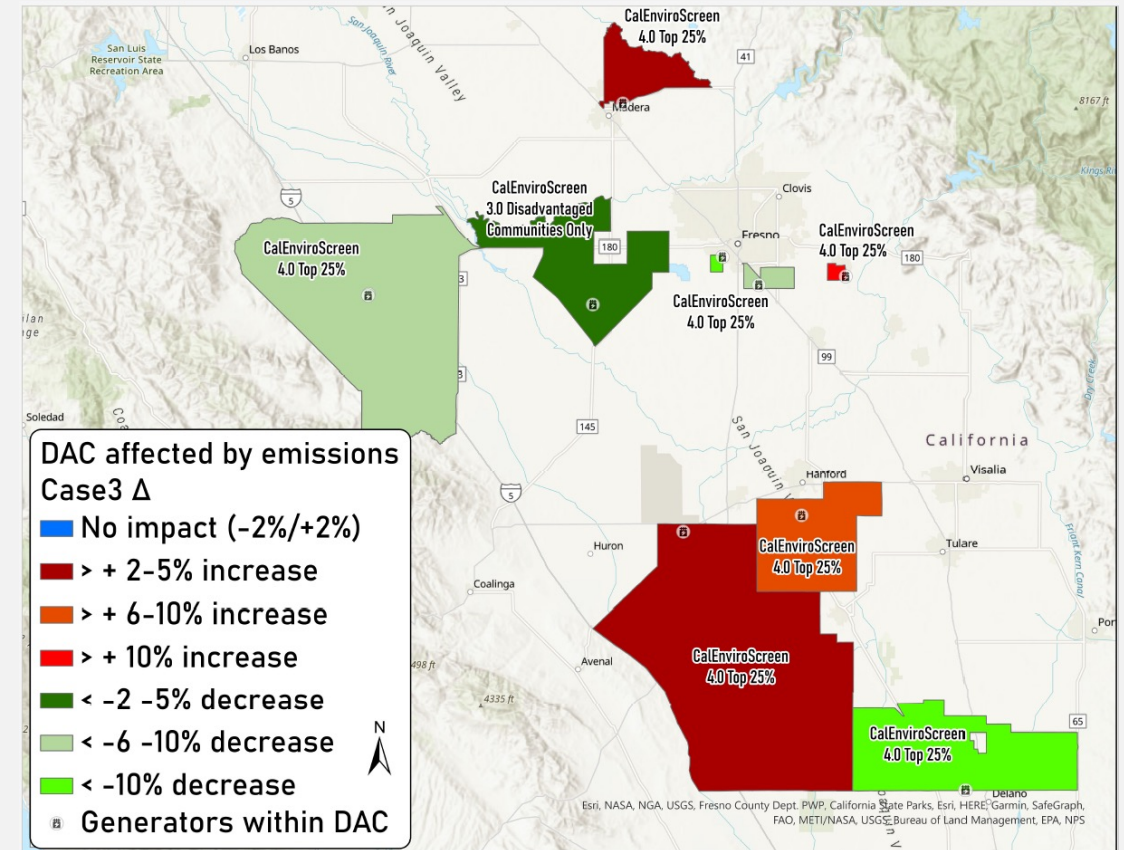


# Changes in Generation Under a 1 Market DA Scenario\*

## DACs in Bakersfield



## DACs in Fresno

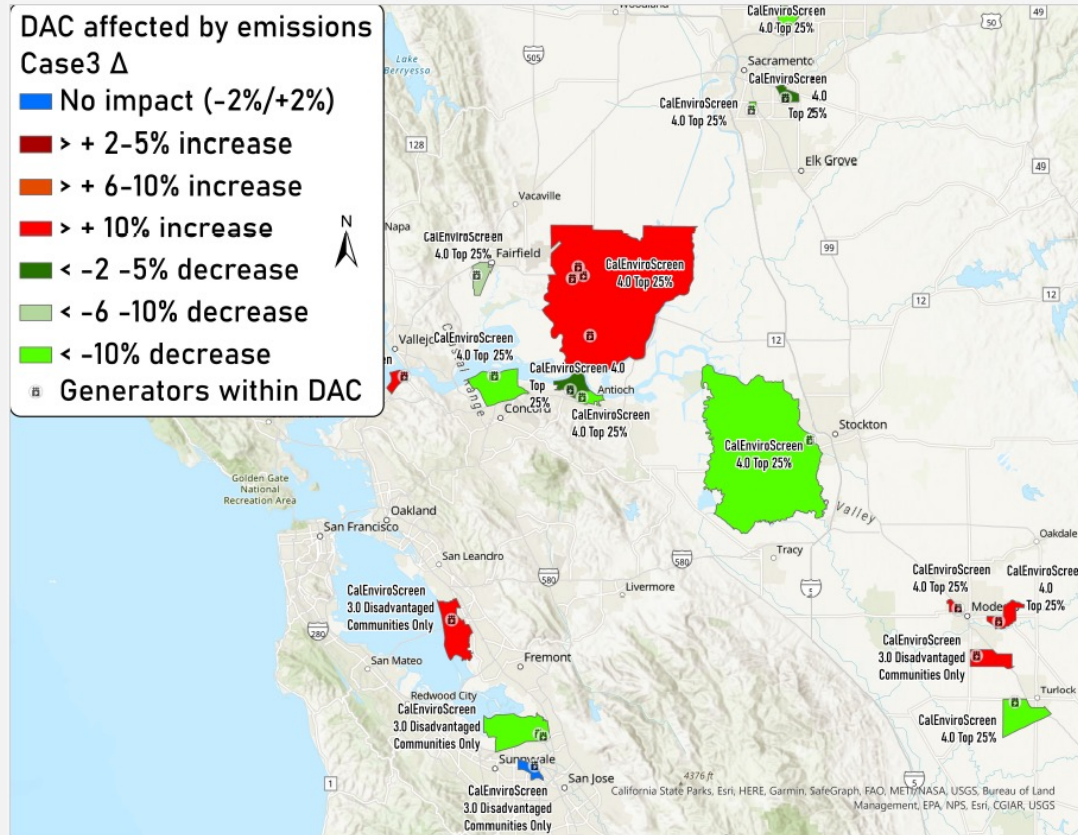


\*as compared to Status Quo EIM Markets scenario

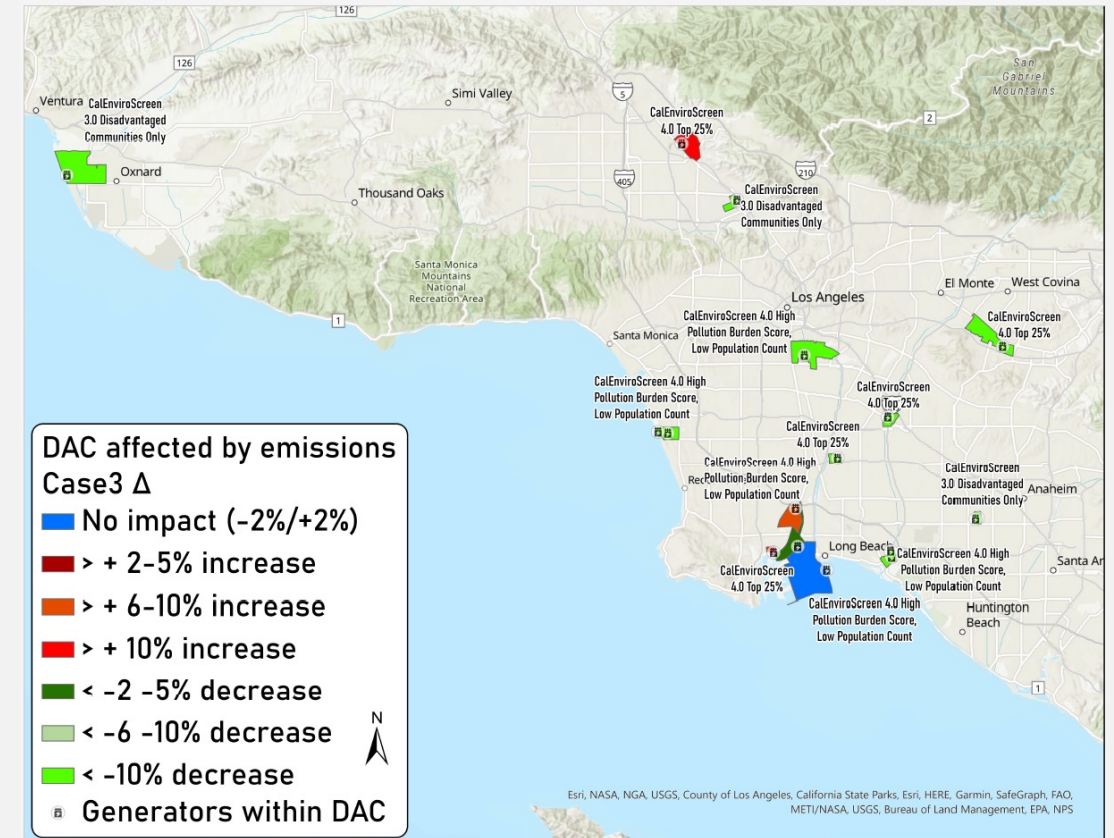


# Changes in Generation Under a 1 Market DA Scenario\* (cont.)

## DACs in Bay Area and Central Valley



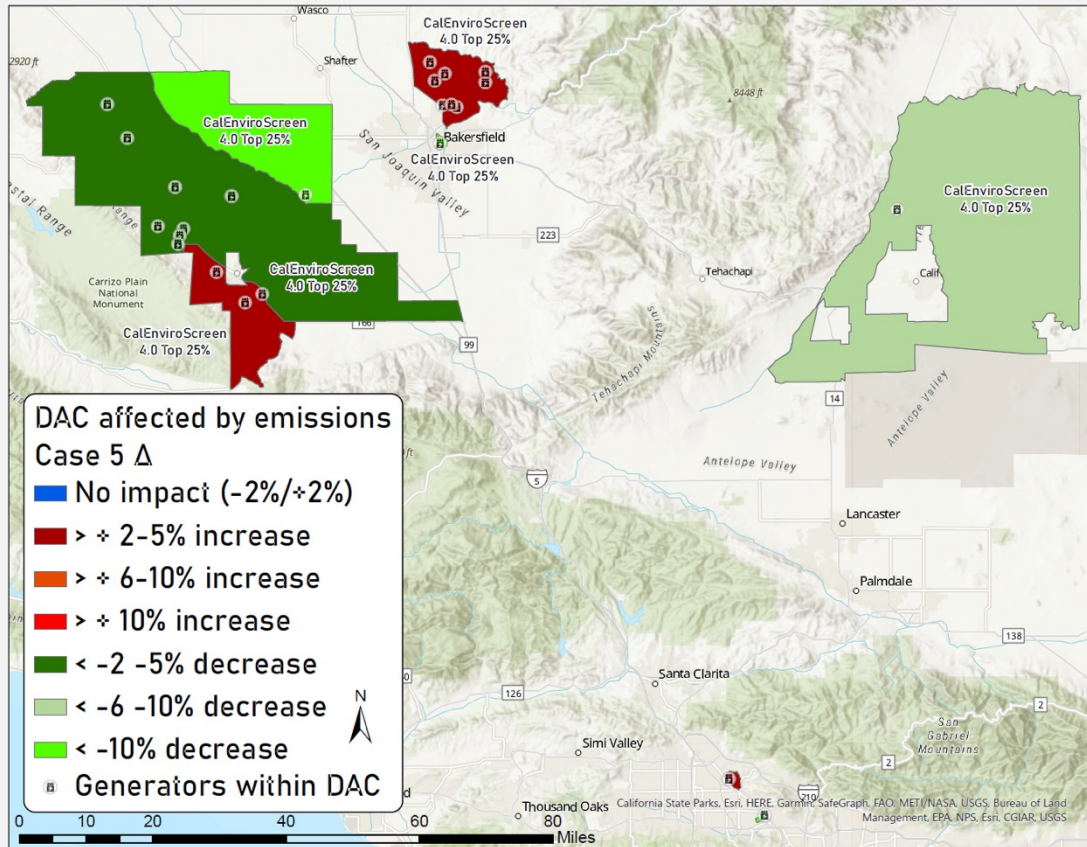
## DACs in Los Angeles and Ventura County



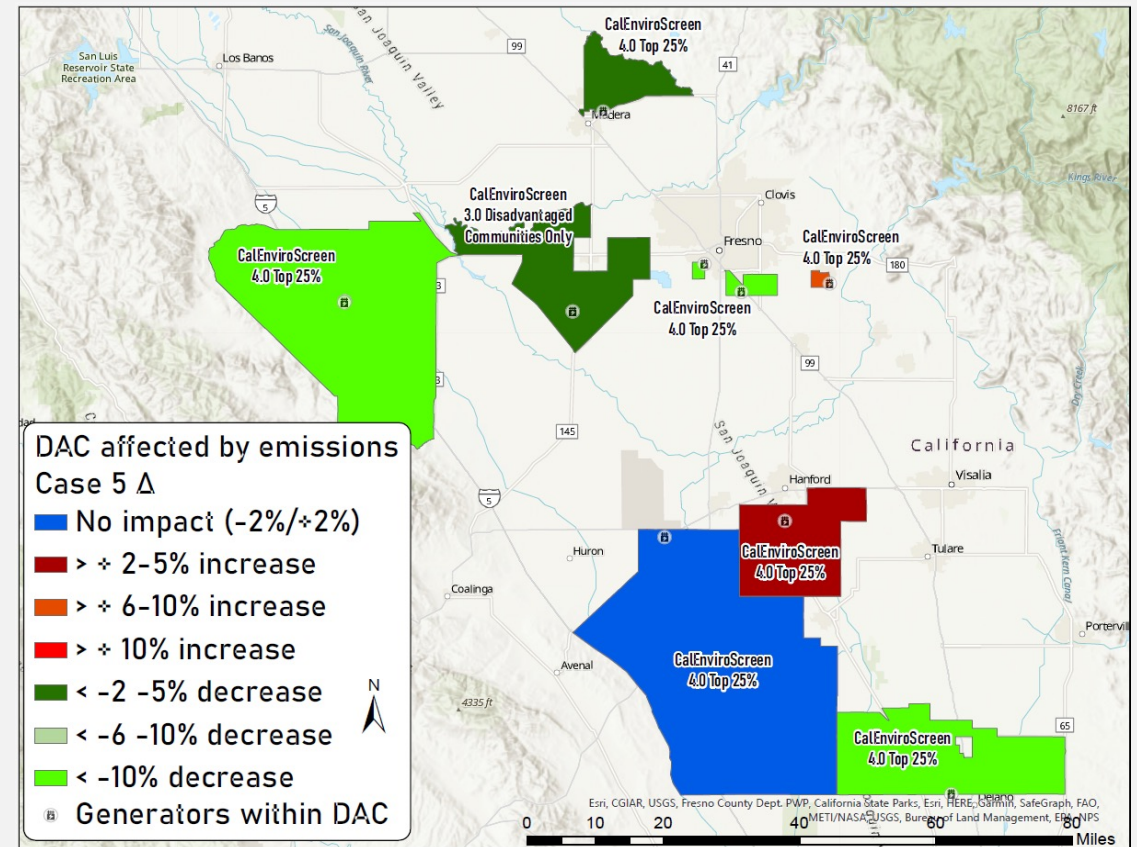
\*as compared to Status Quo EIM Markets scenario



## DACs in Bakersfield



## DACs in Fresno

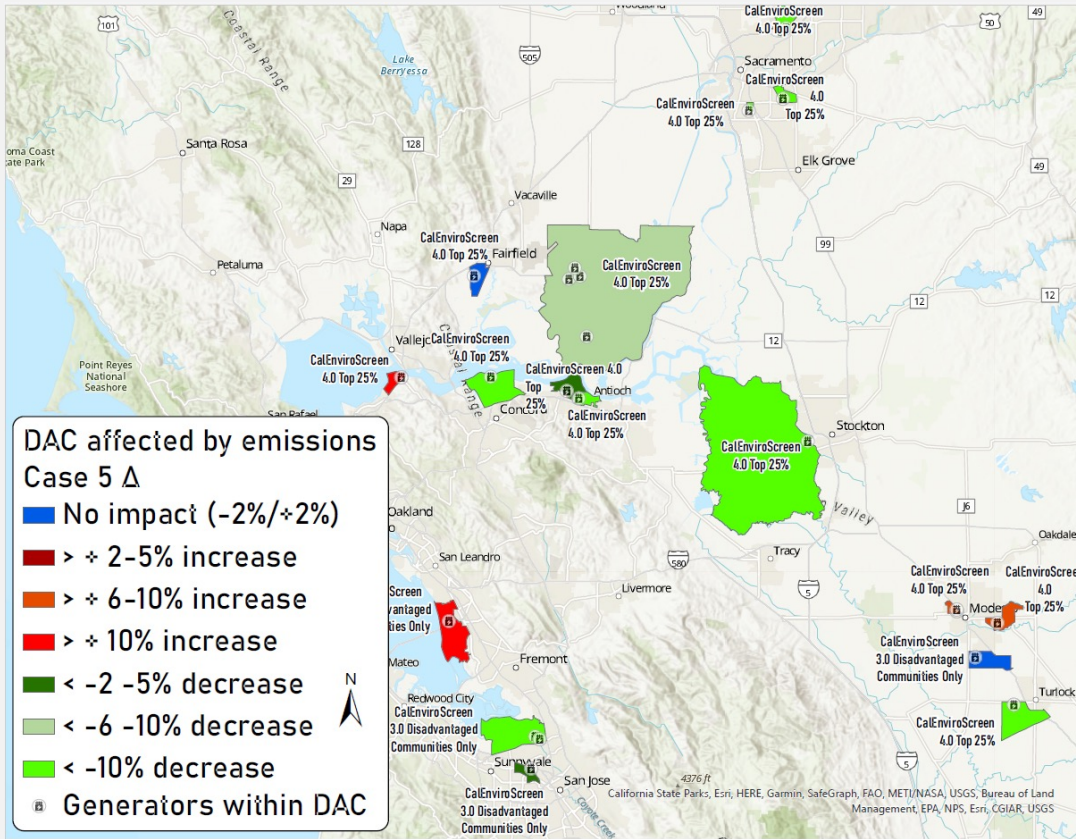


\*as compared to Status Quo EIM Markets scenario

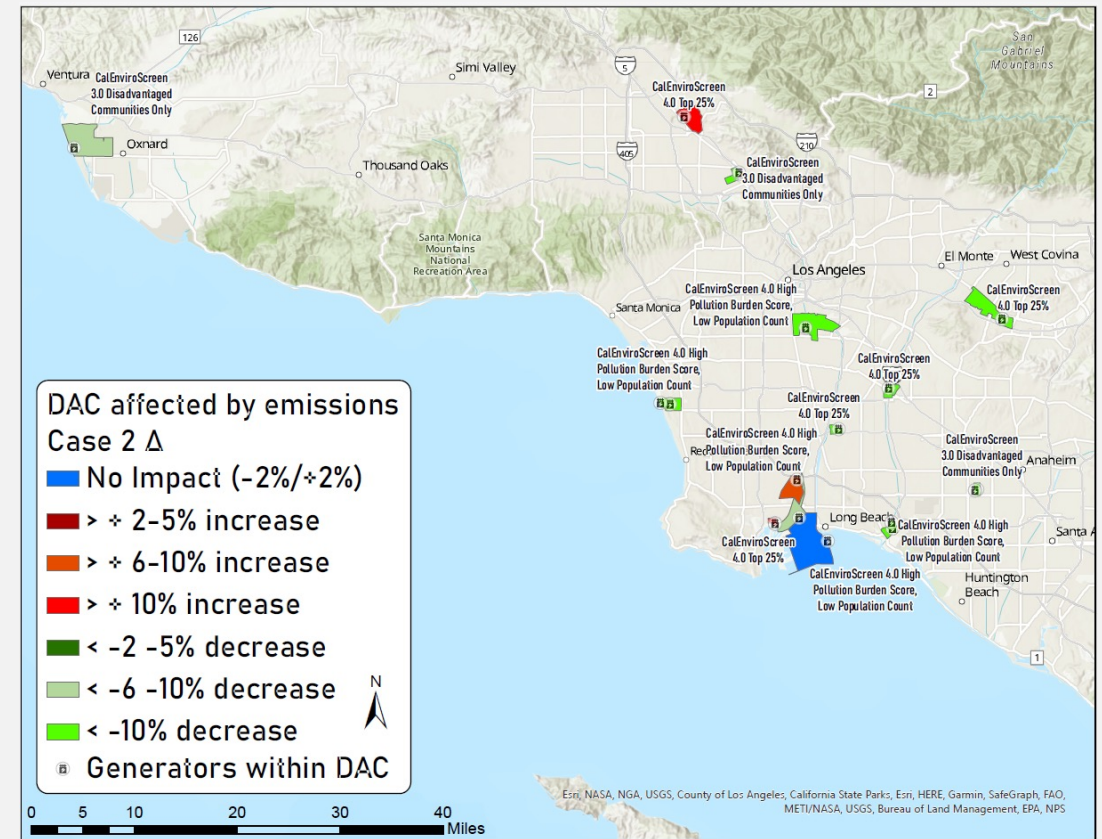


# Changes in Generation Under a 2 Market A DA Scenario\* (cont.)

## DACs in Bay Area and Central Valley



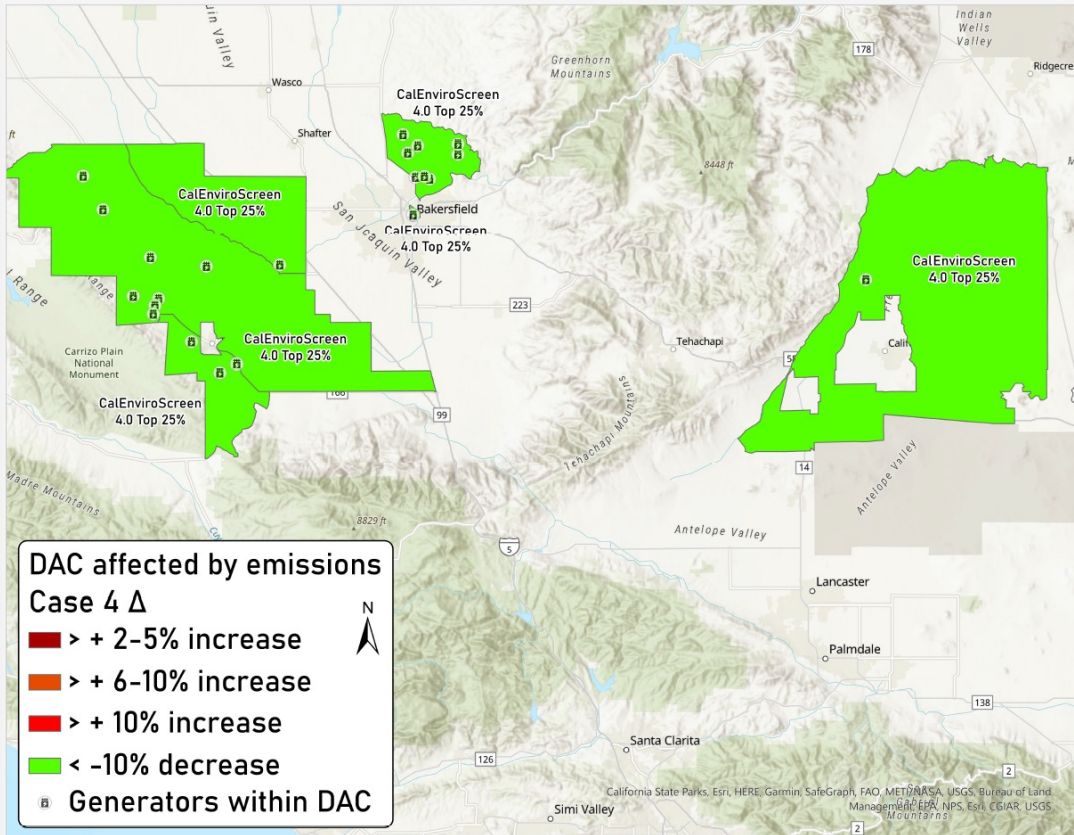
## DACs in Los Angeles and Ventura County



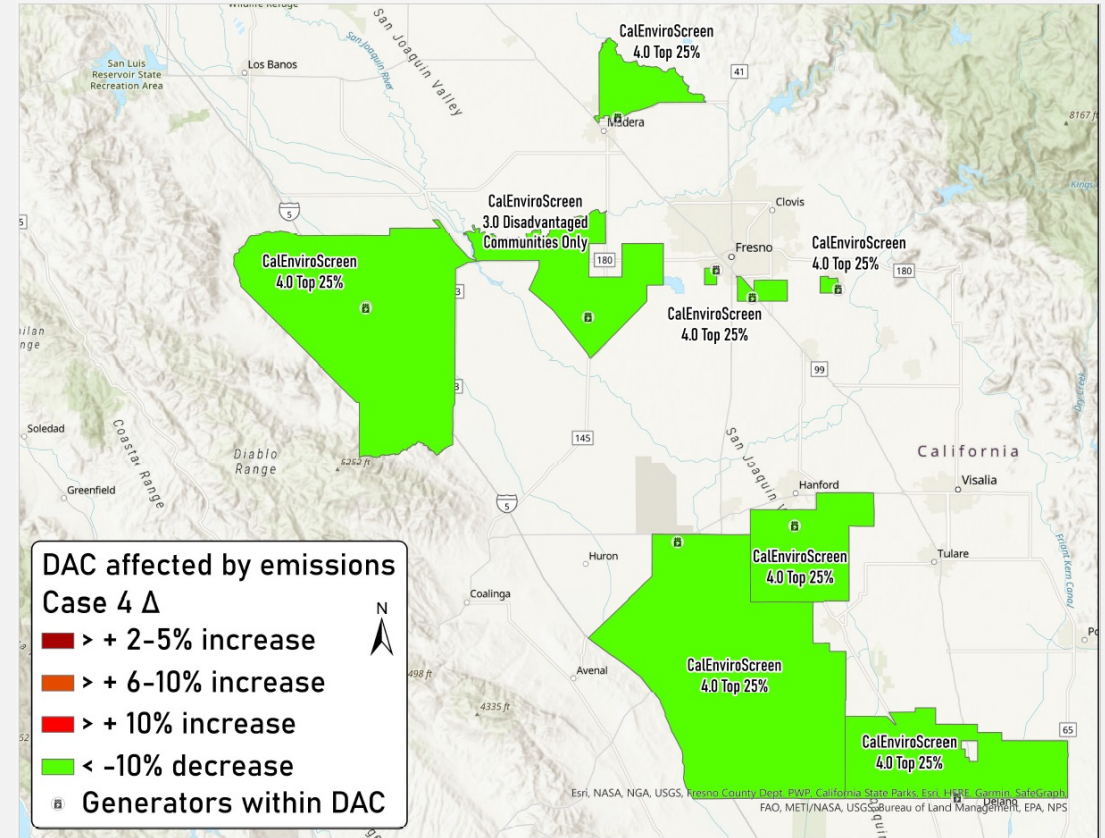
\*as compared to Status Quo EIM Markets scenario



## DACs in Bakersfield



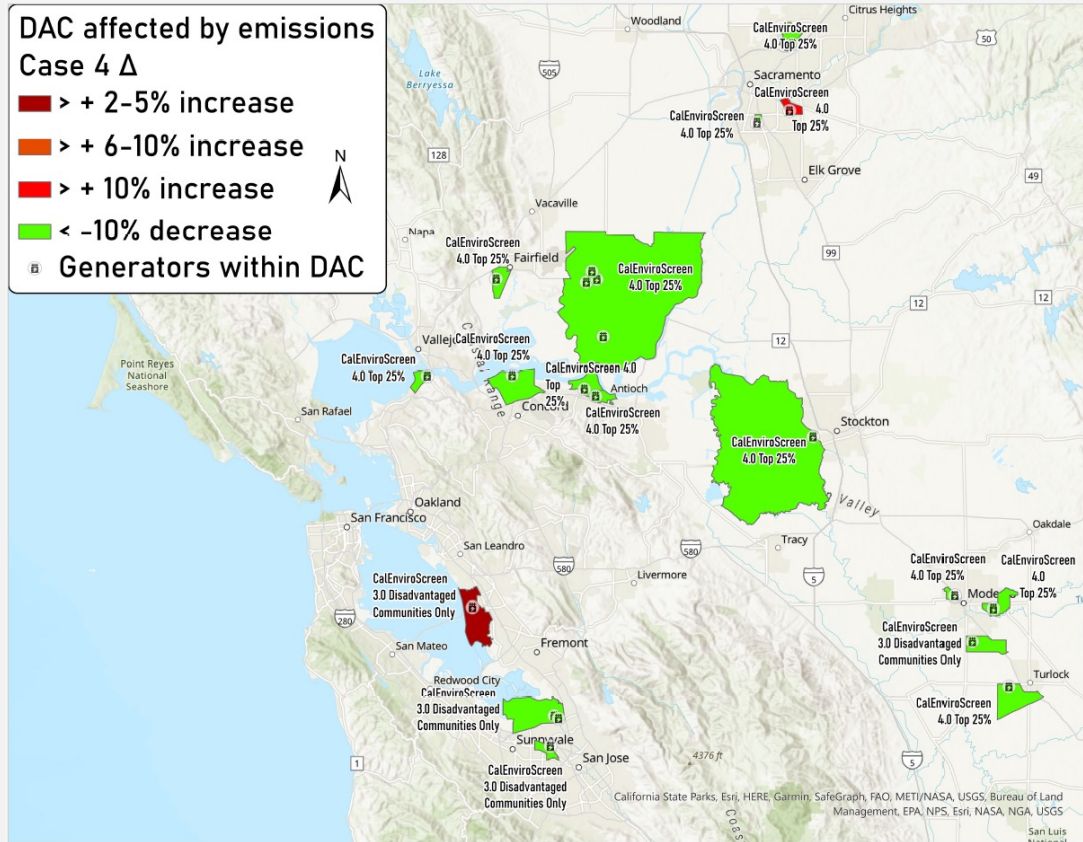
## DACs in Fresno



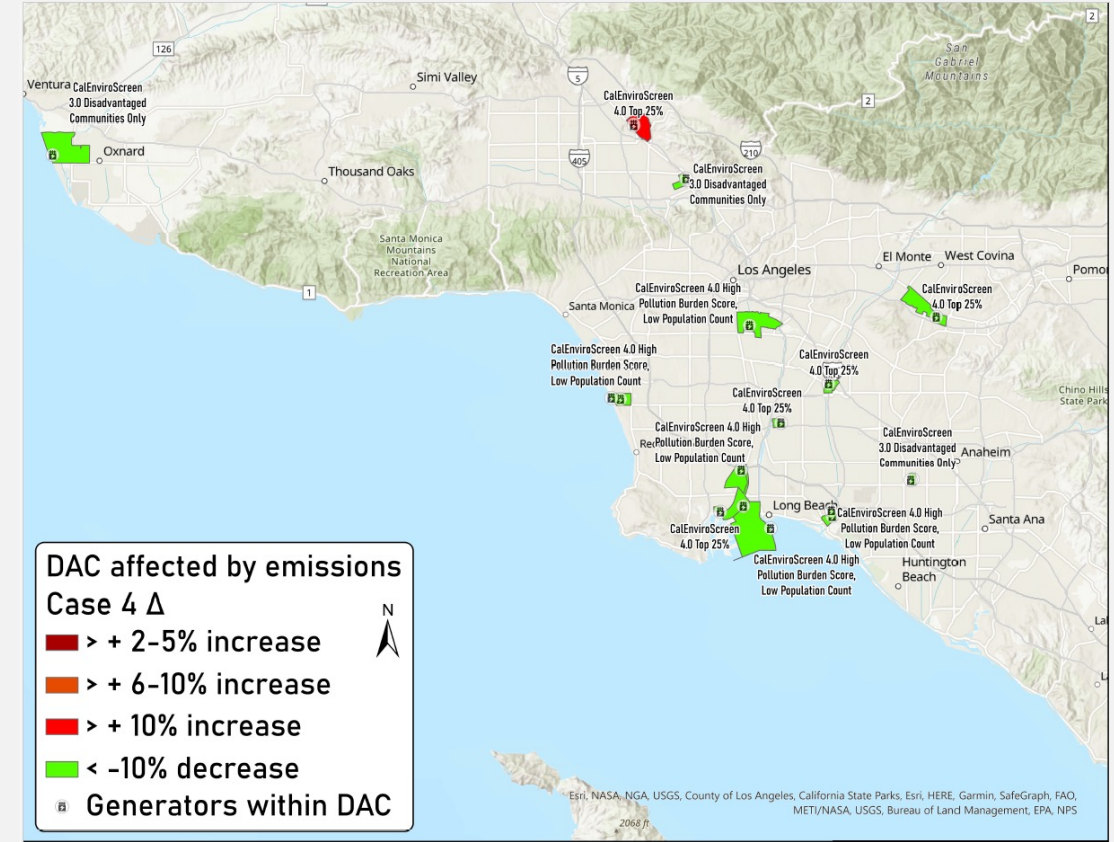
\*as compared to Status Quo EIM Markets scenario

# Changes in Generation Under a 1 Market RTO Scenario\* (cont.)

## DACs in Bay Area and Central Valley



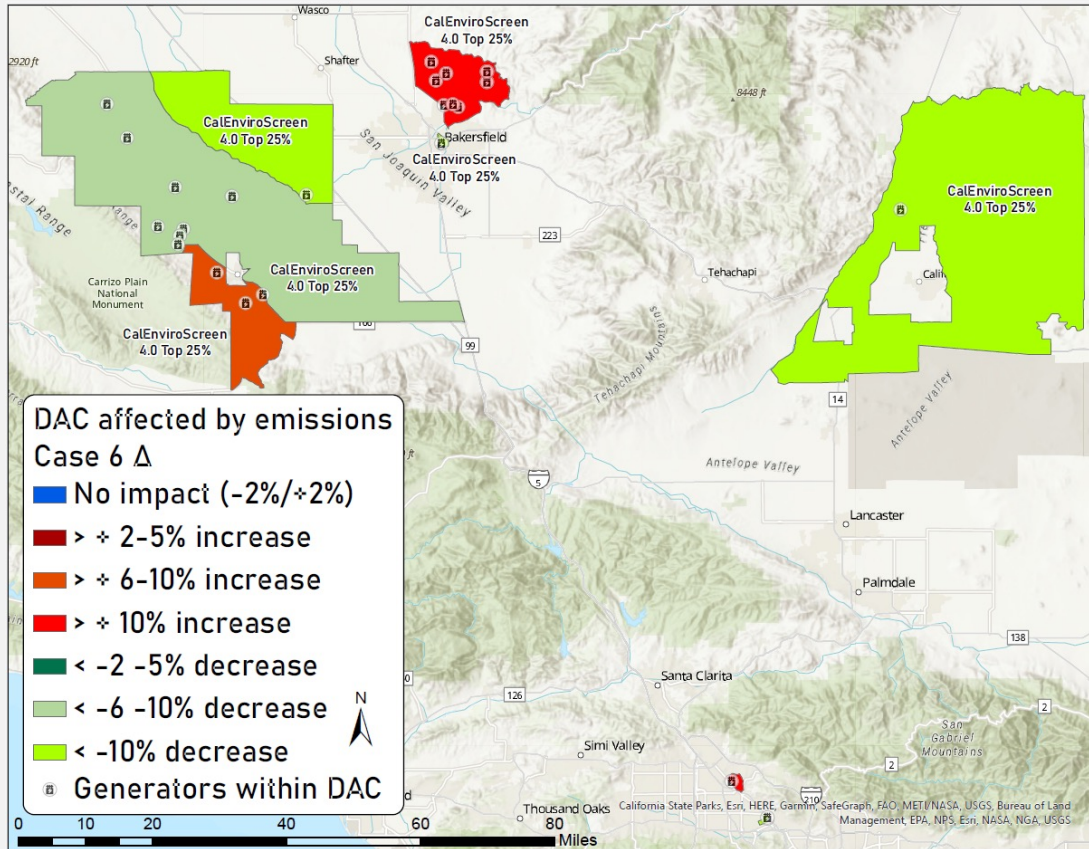
## DACs in Los Angeles and Ventura County



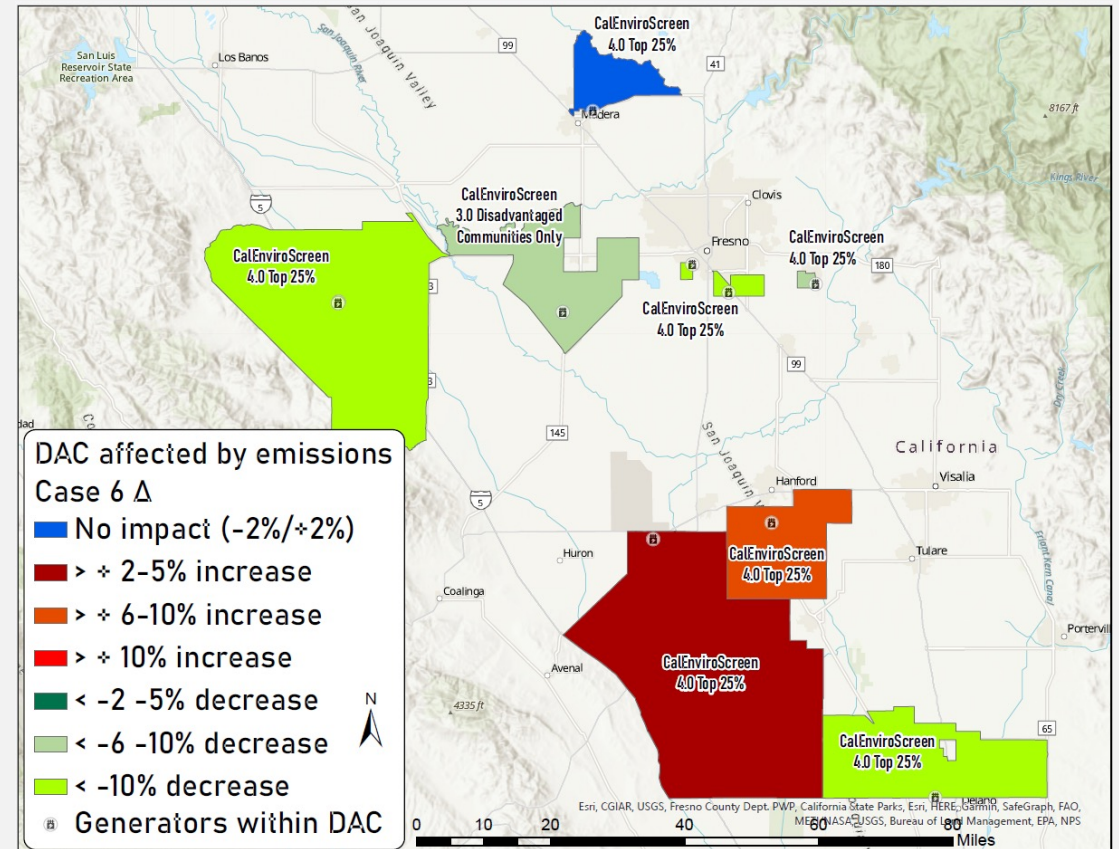
\*as compared to Status Quo EIM Markets scenario



## DACs in Bakersfield



## DACs in Fresno

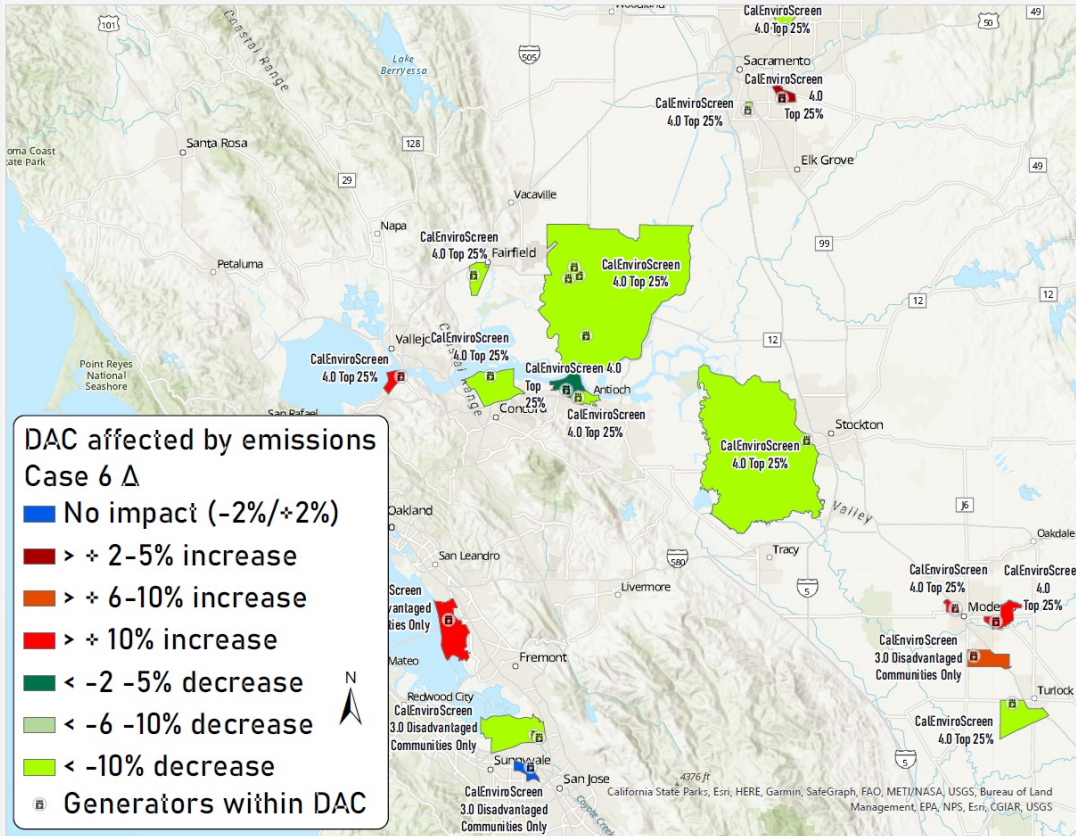


\*as compared to Status Quo EIM Markets scenario

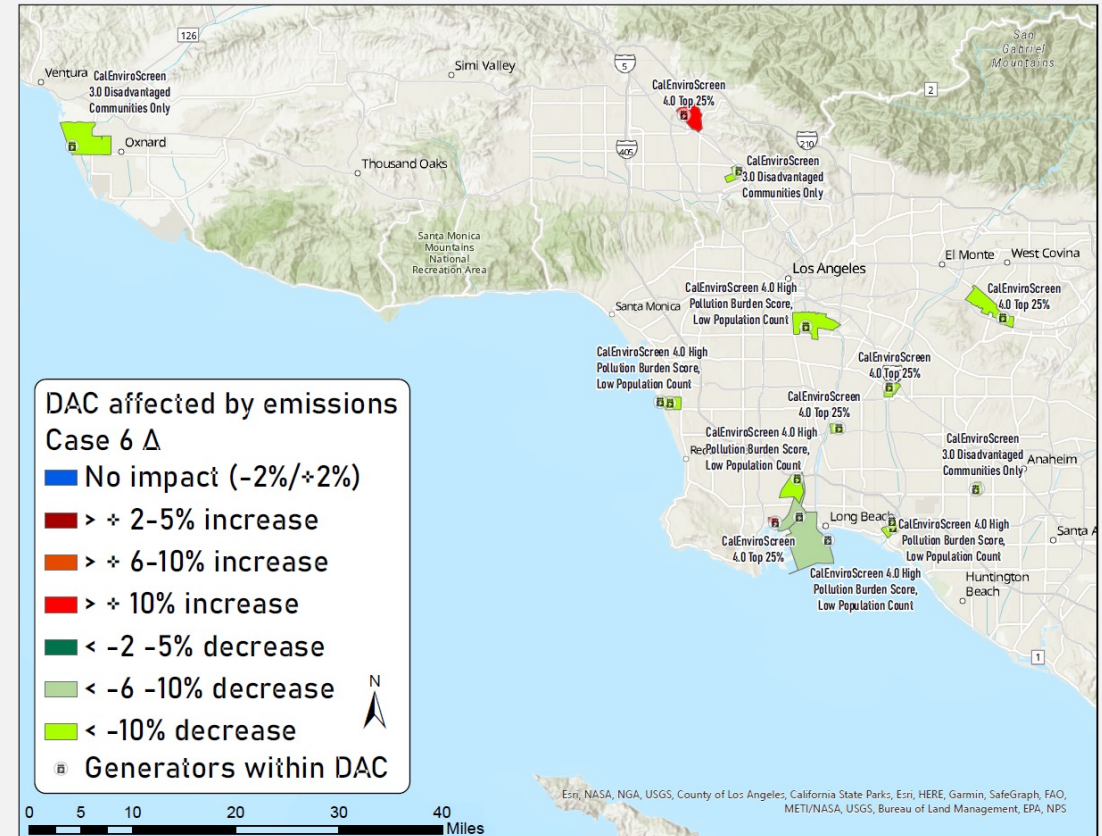


# Changes in Generation Under a 2 Market A RTO Scenario\* (cont.)

## DACs in Bay Area and Central Valley



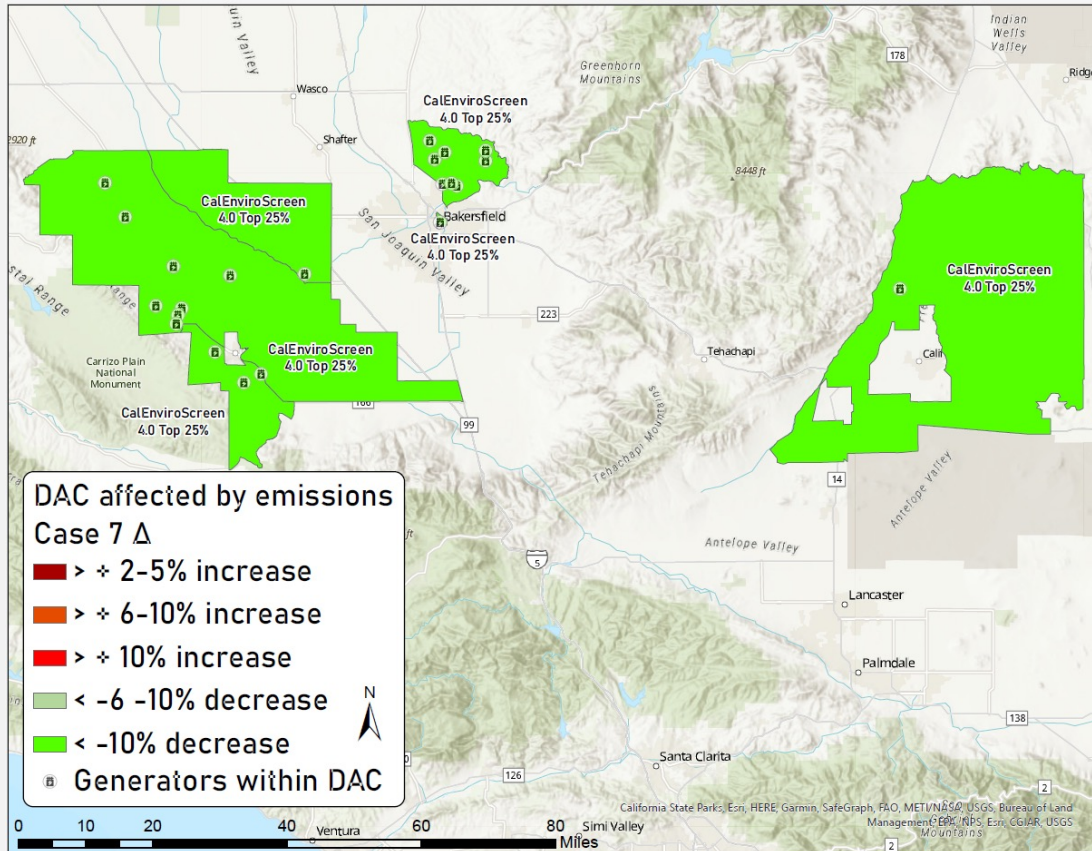
## DACs in Los Angeles and Ventura County



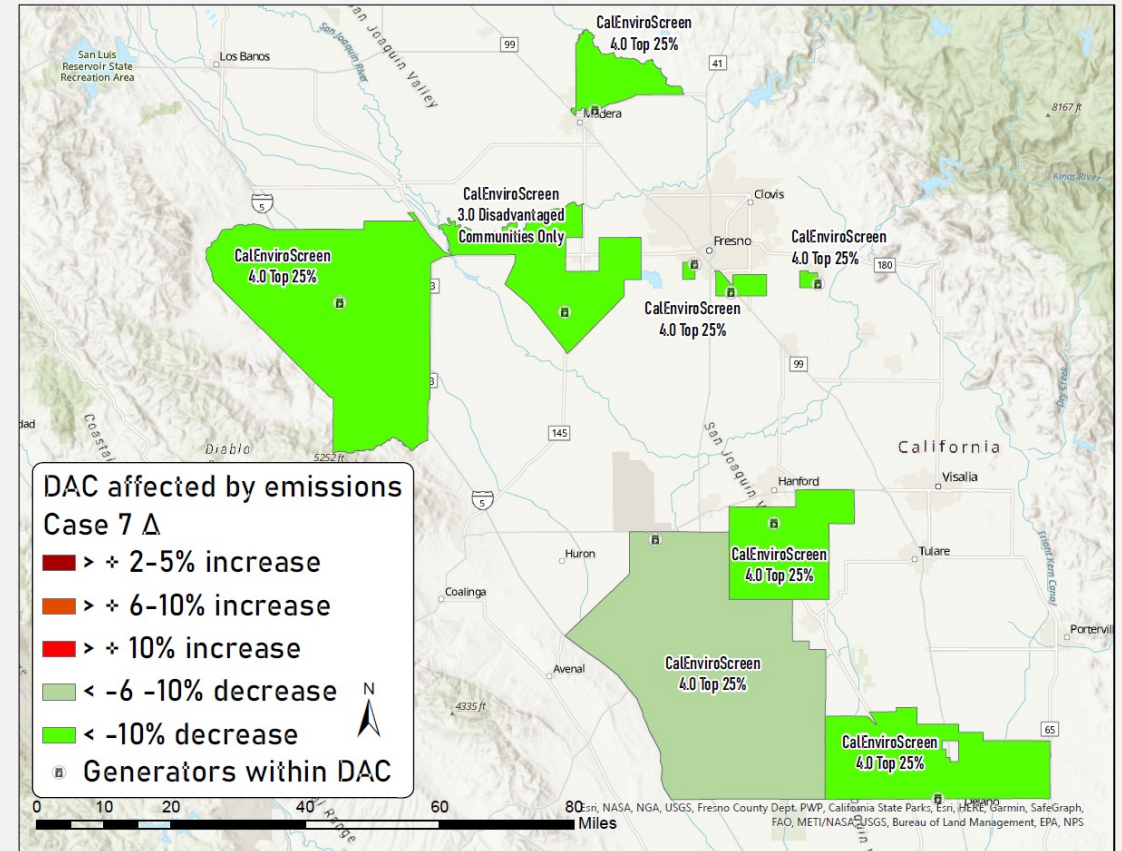
\*as compared to Status Quo EIM Markets scenario



## DACs in Bakersfield



## DACs in Fresno

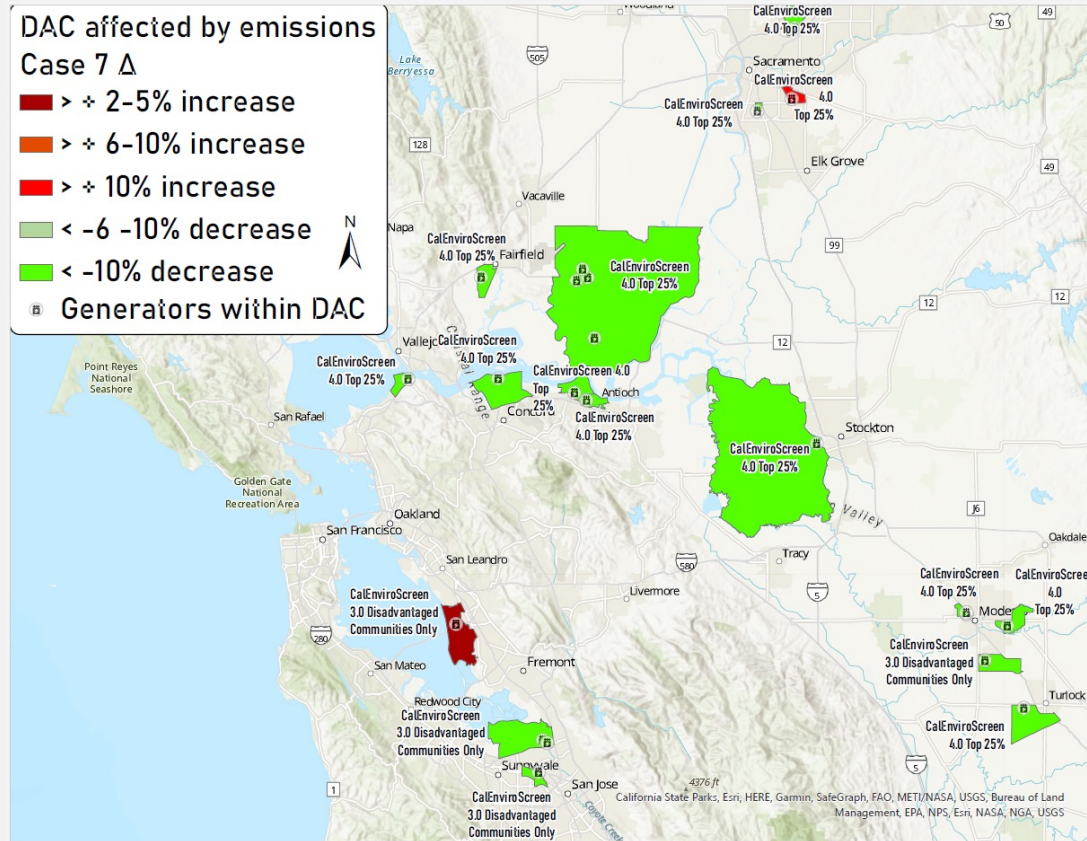


\*as compared to Status Quo EIM Markets scenario

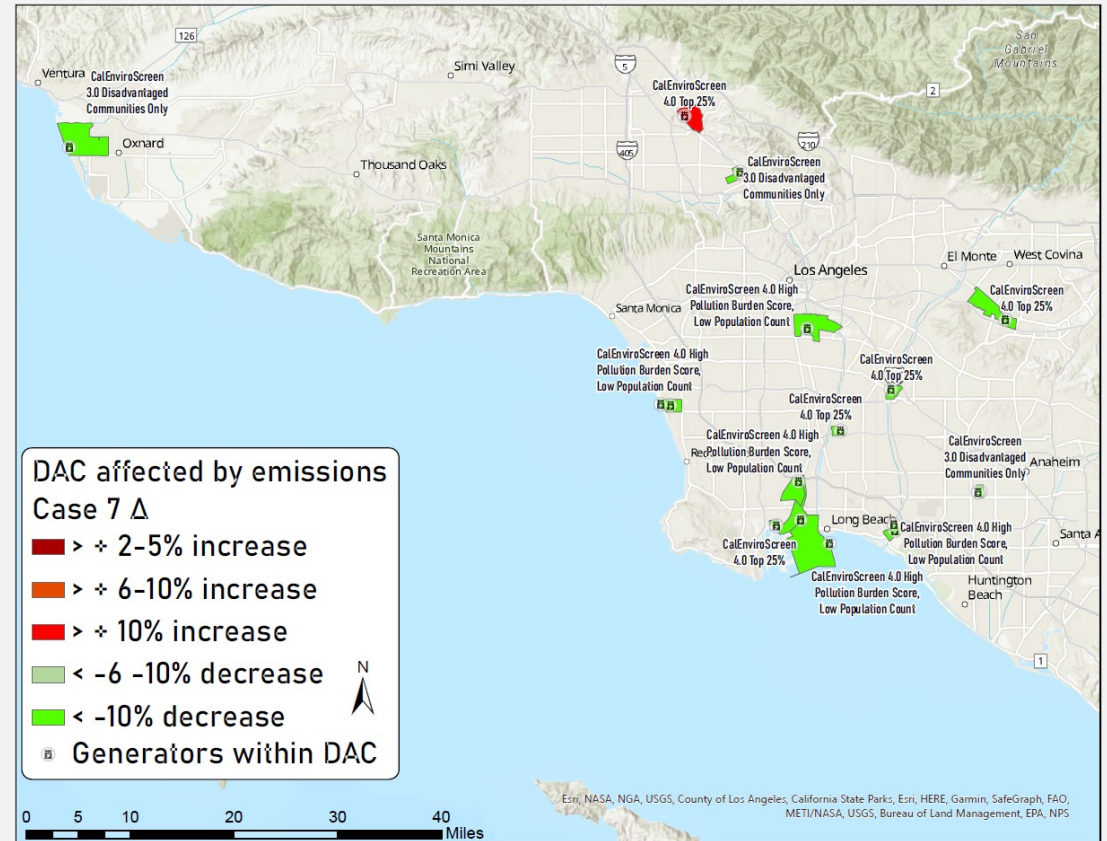


# Changes in Generation Under a 2 Market B RTO Scenario\* (cont.)

## DACs in Bay Area and Central Valley



## DACs in Los Angeles and Ventura County



\*as compared to Status Quo EIM Markets scenario

GridLAB



## Appendix

# Capacity Factor and Generation Changes for Each DAC by Market Scenarios





# Capacity Factor of DAC Generation in Different Scenarios

DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	Capacity Factor %							Approximate Location	DAC Category
				SQ RT EIM	SQ DA	1Mkt DA	1Mkt RTO	2Mkt A DA	2Mkt A RTO	2Mkt B RTO		
6029003304	21	2554	8044684	36%	35%	36%	32%	35%	35%	32%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6037980007	11	2286	5072700	25%	28%	28%	17%	28%	23%	17%	Long Beach	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013305000	3	840	2626561	36%	40%	40%	43%	37%	40%	43%	Antioch	CalEnviroScreen 4.0 Top 25%
6037980030	6	724	2569527	40%	39%	39%	27%	39%	39%	27%	El Segundo	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6037121102	2	576	1759361	35%	39%	40%	38%	39%	36%	38%	Los Angeles	CalEnviroScreen 4.0 Top 25%
6013309000	2	604	1707319	32%	37%	37%	24%	35%	38%	24%	Pittsburg	CalEnviroScreen 4.0 Top 25%
6037408202	5	520	1230013	27%	25%	25%	13%	24%	23%	13%	Industry	CalEnviroScreen 4.0 Top 25%
6095253500	4	460	1174463	29%	31%	31%	20%	30%	32%	20%	Unincorporated Solano County area	CalEnviroScreen 4.0 Top 25%
6001437101	1	315	1110156	40%	43%	43%	30%	42%	44%	30%	Hayward	CalEnviroScreen 3.0 Disadvantaged Communities Only
6025011400	3	288	923122	37%	33%	29%	23%	34%	23%	23%	El Centro	CalEnviroScreen 4.0 Top 25%
6037310800	2	352	912543	30%	35%	35%	31%	35%	33%	31%	Burbank	CalEnviroScreen 3.0 Disadvantaged Communities Only
6099003700	3	336	900861	31%	27%	27%	19%	25%	23%	19%	Unincorporated Stanislaus County area	CalEnviroScreen 4.0 Top 25%
6037980002	1	400	756471	22%	13%	13%	3%	15%	12%	3%	Carson	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013315000	1	127	735715	66%	70%	70%	40%	69%	73%	40%	Unincorporated Contra Costa County area	CalEnviroScreen 4.0 Top 25%
6071009116	1	342	703639	23%	25%	25%	2%	25%	16%	2%	Adelanto	CalEnviroScreen 4.0 Top 25%
6029005103	17	880	671974	9%	6%	6%	4%	7%	6%	4%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6085504602	5	318	611537	22%	26%	27%	11%	24%	27%	10%	San Jose	CalEnviroScreen 3.0 Disadvantaged Communities Only
6037532400	2	134	445116	38%	36%	36%	15%	36%	35%	14%	Vernon	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013358000	3	65	429134	76%	77%	78%	68%	77%	78%	68%	Rodeo	CalEnviroScreen 4.0 Top 25%
6085512602	4	258	290852	13%	14%	14%	5%	13%	14%	5%	Unincorporated Santa Clara County area	CalEnviroScreen 4.0 Top 25%
6037980014	1	107	271741	29%	25%	25%	6%	26%	23%	6%	Los Angeles	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6085505202	2	151	240191	18%	22%	22%	10%	20%	21%	10%	Santa Clara	CalEnviroScreen 3.0 Disadvantaged Communities Only
6059087805	3	175	224290	15%	11%	11%	4%	12%	11%	4%	Stanton	CalEnviroScreen 3.0 Disadvantaged Communities Only
6071007107	5	254	184908	8%	6%	6%	1%	6%	6%	1%	Grand Terrace	CalEnviroScreen 4.0 Top 25%
6067004501	1	157	183869	13%	13%	13%	8%	12%	13%	8%	Sacramento	CalEnviroScreen 4.0 Top 25%
6073016202	2	93	182588	22%	18%	18%	4%	19%	16%	5%	El Cajon	CalEnviroScreen 4.0 Top 25%
6099000602	8	182	171137	11%	10%	10%	19%	9%	11%	19%	Modesto	CalEnviroScreen 4.0 Top 25%
6067005205	2	115	170062	17%	17%	17%	11%	16%	16%	10%	Sacramento	CalEnviroScreen 4.0 Top 25%
6019006100	1	48	164917	39%	38%	38%	34%	39%	36%	34%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%
6037294830	5	245	136895	6%	7%	7%	0%	9%	8%	0%	Los Angeles	CalEnviroScreen 4.0 Top 25%

# Capacity Factor of DAC Generation in Different Scenarios (cont.)

DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	Capacity Factor %								Approximate Location	DAC Category
				SQ RT EIM	SQ DA	1Mkt DA	1Mkt RTO	2Mkt A DA	2Mkt A RTO	2Mkt B RTO			
6019001500	2	97	130129	15%	13%	13%	5%	15%	14%	5%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%	
6099003002	4	212	122017	7%	5%	5%	0%	5%	6%	0%	Unincorporated Stanislaus County area	CalEnviroScreen 3.0 Disadvantaged Communities Only	
6071001906	2	80	116317	17%	9%	9%	1%	11%	9%	1%	Ontario	CalEnviroScreen 4.0 Top 25%	
6019003900	3	159	112298	8%	8%	8%	2%	7%	8%	2%	Unincorporated Fresno County area	CalEnviroScreen 3.0 Disadvantaged Communities Only	
6037570202	1	50	108688	25%	23%	22%	7%	22%	21%	7%	Long Beach	CalEnviroScreen 4.0 Top 25%	
6019008302	7	598	87632	2%	1%	1%	0%	1%	1%	0%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%	
6065030900	2	106	85434	9%	7%	7%	1%	8%	7%	1%	Riverside	CalEnviroScreen 3.0 Disadvantaged Communities Only	
6031001601	2	100	65840	8%	5%	5%	1%	6%	6%	1%	Unincorporated Kings County area	CalEnviroScreen 4.0 Top 25%	
6031001200	2	98	65180	8%	7%	7%	0%	7%	7%	1%	Unincorporated Kings County area	CalEnviroScreen 4.0 Top 25%	
6071002207	2	82	63560	9%	5%	6%	1%	7%	6%	1%	Rancho Cucamonga	CalEnviroScreen 3.0 Disadvantaged Communities Only	
6019000800	1	11	20755	21%	22%	22%	15%	20%	21%	16%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%	
6029003303	3	75	20169	3%	2%	2%	1%	3%	2%	1%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%	
6037980033	1	47	19176	5%	2%	2%	1%	3%	2%	0%	Long Beach	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count	
6067007301	1	74	16243	3%	1%	1%	1%	1%	1%	0%	McClellan Park	CalEnviroScreen 4.0 Top 25%	
6095252402	1	48	14398	3%	3%	3%	1%	3%	3%	1%	Unincorporated Solano County area	CalEnviroScreen 4.0 Top 25%	
6107004300	1	49	14234	3%	2%	2%	0%	3%	2%	0%	Unincorporated Tulare County area	CalEnviroScreen 4.0 Top 25%	
6037550300	1	47	12738	3%	2%	2%	1%	2%	2%	0%	Norwalk	CalEnviroScreen 4.0 Top 25%	
6065045707	4	80	10770	2%	1%	1%	0%	1%	0%	0%	Coachella	CalEnviroScreen 3.0 Disadvantaged Communities Only	
6099002002	2	124	4898	0%	0%	0%	0%	0%	0%	0%	Empire	CalEnviroScreen 4.0 Top 25%	
6025010600	2	50	3775	1%	1%	1%	0%	1%	0%	0%	Brawley	CalEnviroScreen 4.0 Top 25%	
6029006500	2	57	3059	1%	1%	1%	0%	1%	0%	0%	California City	CalEnviroScreen 4.0 Top 25%	
6029001600	2	63	2889	1%	1%	1%	0%	0%	0%	0%	Bakersfield	CalEnviroScreen 4.0 Top 25%	
6029003700	2	7	2223	4%	2%	2%	2%	3%	3%	1%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%	
6111002905	1	49	1643	0%	0%	0%	0%	0%	0%	0%	Unincorporated Ventura County area	CalEnviroScreen 3.0 Disadvantaged Communities Only	
6073005000	1	6	641	1%	1%	1%	0%	1%	1%	0%	San Diego	CalEnviroScreen 4.0 Top 25%	
6039000507	1	4	571	2%	2%	2%	0%	2%	2%	0%	Unincorporated Madera County area	CalEnviroScreen 4.0 Top 25%	
6077003900	1	5	410	1%	1%	1%	0%	1%	0%	0%	Unincorporated San Joaquin County area	CalEnviroScreen 4.0 Top 25%	
6073013307	1	35	101	0%	0%	0%	0%	0%	0%	0%	Chula Vista	CalEnviroScreen 4.0 Top 25%	
Not in DAC	168	16475	39732399	28%	27%	27%	21%	27%	27%	21%			

# Change in DAC generation from Status Quo EIM Scenario

DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	% Change in Generation from Status Quo EIM Scenario						Approximate Location	DAC Category
				Status Quo DA	1Mkt DA	1Mkt RTO	2Mkt A DA	2Mkt A RTO	2Mkt B RTO		
6029003304	21	2554	8044684	-2%	-1%	-12%	-2%	-2%	-11%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6037980007	11	2286	5072700	9%	10%	-34%	10%	-8%	-33%	Long Beach	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013305000	3	840	2626561	12%	13%	19%	4%	13%	20%	Antioch	CalEnviroScreen 4.0 Top 25%
6037980030	6	724	2569527	-3%	-2%	-34%	-4%	-4%	-34%	El Segundo	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6037121102	2	576	1759361	13%	14%	8%	11%	3%	10%	Los Angeles	CalEnviroScreen 4.0 Top 25%
6013309000	2	604	1707319	14%	15%	-26%	7%	17%	-26%	Pittsburg	CalEnviroScreen 4.0 Top 25%
6037408202	5	520	1230013	-8%	-7%	-52%	-10%	-14%	-51%	Industry	CalEnviroScreen 4.0 Top 25%
6095253500	4	460	1174463	6%	5%	-32%	3%	8%	-30%	Unincorporated Solano County area	CalEnviroScreen 4.0 Top 25%
6001437101	1	315	1110156	7%	7%	-26%	4%	10%	-25%	Hayward	CalEnviroScreen 3.0 Disadvantaged Communities Only
6025011400	3	288	923122	-10%	-21%	-38%	-8%	-36%	-37%	El Centro	CalEnviroScreen 4.0 Top 25%
6037310800	2	352	912543	19%	20%	3%	19%	13%	4%	Burbank	CalEnviroScreen 3.0 Disadvantaged Communities Only
6099003700	3	336	900861	-12%	-12%	-37%	-20%	-25%	-39%	Unincorporated Stanislaus County area	CalEnviroScreen 4.0 Top 25%
6037980002	1	400	756471	-40%	-39%	-86%	-29%	-44%	-87%	Carson	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013315000	1	127	735715	7%	6%	-40%	5%	10%	-40%	Unincorporated Contra Costa County area	CalEnviroScreen 4.0 Top 25%
6071009116	1	342	703639	7%	7%	-91%	8%	-30%	-92%	Adelanto	CalEnviroScreen 4.0 Top 25%
6029005103	17	880	671974	-28%	-29%	-53%	-16%	-26%	-51%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6085504602	5	318	611537	20%	22%	-50%	9%	22%	-52%	San Jose	CalEnviroScreen 3.0 Disadvantaged Communities Only
6037532400	2	134	445116	-4%	-4%	-61%	-5%	-9%	-63%	Vernon	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6013358000	3	65	429134	2%	3%	-11%	2%	3%	-10%	Rodeo	CalEnviroScreen 4.0 Top 25%
6085512602	4	258	290852	12%	10%	-65%	2%	5%	-64%	Unincorporated Santa Clara County area	CalEnviroScreen 4.0 Top 25%
6037980014	1	107	271741	-12%	-13%	-78%	-11%	-19%	-78%	Los Angeles	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6085505202	2	151	240191	21%	22%	-46%	8%	17%	-44%	Santa Clara	CalEnviroScreen 3.0 Disadvantaged Communities Only
6059087805	3	175	224290	-23%	-24%	-76%	-15%	-24%	-75%	Stanton	CalEnviroScreen 3.0 Disadvantaged Communities Only
6071007107	5	254	184908	-29%	-29%	-86%	-22%	-30%	-86%	Grand Terrace	CalEnviroScreen 4.0 Top 25%
6067004501	1	157	183869	-5%	-6%	-42%	-13%	-5%	-38%	Sacramento	CalEnviroScreen 4.0 Top 25%
6073016202	2	93	182588	-17%	-20%	-81%	-15%	-28%	-78%	El Cajon	CalEnviroScreen 4.0 Top 25%
6099000602	8	182	171137	-4%	-4%	73%	-13%	3%	79%	Modesto	CalEnviroScreen 4.0 Top 25%
6067005205	2	115	170062	1%	0%	-36%	-6%	-6%	-38%	Sacramento	CalEnviroScreen 4.0 Top 25%
6019006100	1	48	164917	-2%	-2%	-13%	-1%	-7%	-13%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%
6037294830	5	245	136895	16%	15%	-97%	42%	24%	-97%	Los Angeles	CalEnviroScreen 4.0 Top 25%

# Change in DAC generation from Status Quo EIM Scenario (cont.)

DAC ID	Generator Count	Total Capacity (MW)	SQ RT EIM Generation (MWh)	% Change in Generation from Status Quo EIM Scenario						Approximate Location	DAC Category
				Status Quo DA	1Mkt DA	1Mkt RTO	2Mkt A DA	2Mkt A RTO	2Mkt B RTO		
6019001500	2	97	130129	-14%	-15%	-68%	-5%	-11%	-66%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%
6099003002	4	212	122017	-24%	-26%	-97%	-18%	-11%	-96%	Unincorporated Stanislaus County area	CalEnviroScreen 3.0 Disadvantaged Communities Only
6071001906	2	80	116317	-47%	-47%	-92%	-31%	-47%	-92%	Ontario	CalEnviroScreen 4.0 Top 25%
6019003900	3	159	112298	-5%	-5%	-75%	-7%	-7%	-77%	Unincorporated Fresno County area	CalEnviroScreen 3.0 Disadvantaged Communities Only
6037570202	1	50	108688	-9%	-10%	-74%	-11%	-14%	-74%	Long Beach	CalEnviroScreen 4.0 Top 25%
6019008302	7	598	87632	-26%	-28%	-89%	-16%	-32%	-89%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%
6065030900	2	106	85434	-22%	-21%	-85%	-16%	-20%	-86%	Riverside	CalEnviroScreen 3.0 Disadvantaged Communities Only
6031001601	2	100	65840	-32%	-36%	-91%	-15%	-26%	-90%	Unincorporated Kings County area	CalEnviroScreen 4.0 Top 25%
6031001200	2	98	65180	-12%	-13%	-94%	-2%	-7%	-90%	Unincorporated Kings County area	CalEnviroScreen 4.0 Top 25%
6071002207	2	82	63560	-39%	-38%	-89%	-23%	-37%	-87%	Rancho Cucamonga	CalEnviroScreen 3.0 Disadvantaged Communities Only
6019000800	1	11	20755	3%	3%	-32%	-4%	-1%	-26%	Unincorporated Fresno County area	CalEnviroScreen 4.0 Top 25%
6029003303	3	75	20169	-22%	-23%	-77%	-16%	-41%	-81%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6037980033	1	47	19176	-55%	-56%	-89%	-42%	-61%	-91%	Long Beach	CalEnviroScreen 4.0 High Pollution Burden Score, Low Population Count
6067007301	1	74	16243	-48%	-50%	-80%	-46%	-59%	-81%	McClellan Park	CalEnviroScreen 4.0 Top 25%
6095252402	1	48	14398	-19%	-26%	-63%	-10%	-18%	-57%	Unincorporated Solano County area	CalEnviroScreen 4.0 Top 25%
6107004300	1	49	14234	-34%	-35%	-88%	-16%	-35%	-87%	Unincorporated Tulare County area	CalEnviroScreen 4.0 Top 25%
6037550300	1	47	12738	-42%	-44%	-83%	-23%	-42%	-85%	Norwalk	CalEnviroScreen 4.0 Top 25%
6065045707	4	80	10770	-11%	-51%	-99%	-52%	-78%	-99%	Coachella	CalEnviroScreen 3.0 Disadvantaged Communities Only
6099002002	2	124	4898	-11%	-5%	-96%	-4%	-40%	-96%	Empire	CalEnviroScreen 4.0 Top 25%
6025010600	2	50	3775	-6%	-33%	-99%	-42%	-85%	-99%	Brawley	CalEnviroScreen 4.0 Top 25%
6029006500	2	57	3059	-5%	-9%	-92%	-2%	-75%	-93%	California City	CalEnviroScreen 4.0 Top 25%
6029001600	2	63	2889	11%	17%	-35%	-7%	-22%	-24%	Bakersfield	CalEnviroScreen 4.0 Top 25%
6029003700	2	7	2223	-32%	-34%	-57%	-21%	-27%	-66%	Unincorporated Kern County area	CalEnviroScreen 4.0 Top 25%
6111002905	1	49	1643	-7%	-7%	-87%	-9%	-63%	-92%	Unincorporated Ventura County area	CalEnviroScreen 3.0 Disadvantaged Communities Only
6073005000	1	6	641	-15%	-17%	-79%	-15%	-43%	-73%	San Diego	CalEnviroScreen 4.0 Top 25%
6039000507	1	4	571	-3%	-3%	-86%	5%	-8%	-87%	Unincorporated Madera County area	CalEnviroScreen 4.0 Top 25%
6077003900	1	5	410	-14%	-15%	-79%	-14%	-47%	-73%	Unincorporated San Joaquin County area	CalEnviroScreen 4.0 Top 25%
6073013307	1	35	101	-9%	-9%	-100%	-22%	-39%	-100%	Chula Vista	CalEnviroScreen 4.0 Top 25%
Not in DAC	168	16475	39732399	-1.31%	-0.90%	-24.82%	-2.49%	-1.39%	-23.89%		