REGENERATE CALIFORNIA
POWER UP CLEAN ENERGY | POWER DOWN DIRTY GAS

Report
2023

CALIFORNIA'S UNDERPERFORMING GAS PLANTS

How Extreme Heat Exposes California's Flawed Plan for Energy Reliability

REGENERATE CALIFORNIA

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Disclaimer

This study was commissioned by Regenerate California, a coalition led by the California Environmental Justice Alliance[1] and the Sierra Club[2], in partnership with Center for Community Action and Environmental Justice[3], Central Coast Alliance United for a Sustainable Economy[4], and Communities for a Better Environment[5]. Regenerate's mission is to transition off of gas plants in California and create a just, clean energy economy with 100% renewable energy.

Executive Summary

In the past decade, California has confronted ever-increasing temperatures and extreme heat events driven by climate change. Meanwhile, the state is still reliant on expensive and polluting fossil fuel infrastructure that exacerbates climate change and disproportionately pollutes low-income communities and communities of color. The moral and legislative mandate for a just transition away from this system has dramatic impacts on California's power sector. Entrenched interests continue to advance a narrative that there is conflict between keeping the lights on and replacing the state's nearly 200 gas plants[6] with clean energy. This report provides the data debunking the myth that gas is the reliable resource when other resources are not, showing that not only are gas plants unreliable in times of extreme heat, but depending on them to provide electricity to meet peak energy demand has unacceptable air pollution impacts on environmental justice communities.

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Introduction

Over two days in August 2020, the California Independent System Operator (ISO) instituted brief rolling blackouts caused by high energy demand on consecutive days exceeding 100 degrees with high humidity and high overnight temperatures. This added to the years-long public angst around grid reliability. In 2021, despite transmission outages and a spectacular gas plant explosion reducing supply, California narrowly avoided outages thanks in part to new energy storage. In 2022, Governor Gavin Newsom authorized Assembly Bill 205, which included a controversial $2.2 billion "Strategic Reliability Reserve" that doubled down on investments in the same fossil-fueled resources that included gas plants and diesel backup generation in the name of ensuring adequate power supplies. Not only did AB 205 lead to the proposal of new gas plants in Lodi, Modesto and Turlock that are entirely exempt from the normal regulatory review process[7], it also disrupted plans to shut down gas plants in Huntington Beach, Long Beach, and Oxnard despite health and environmental concerns from local communities and advocates.

Shortly thereafter, climate change tested the efficacy of reliance on gas plants to meet extreme heat. From August 31 to September 9, 2022, the state was enveloped in one of the most extreme and prolonged heat waves in California's history. This drove energy demand to the record height of 52,061 MW[8]. Typical summer energy demand ranges between 42,000 MW and 50,000 MW[9]. Governor Newsom responded by issuing two consecutive Emergency Proclamations that suspended air pollution restrictions for gas plants and diesel backup generators (BUGs), allowed customers to be compensated for running diesel BUGs even if they are in disadvantaged communities, and encouraged ships to idle while docked at port, devastating air quality in port communities[10].

California came dangerously close to a power shortfall in this period, but state agencies were able to keep power flowing citing an increase in market coordination and battery storage[11]. Unfortunately, there was little analysis available at the time detailing how the state's gas fleet performed.

Further, there was no analysis of the emissions impact of relying on those gas plants along with the elimination of gas plant pollution restrictions.

In response to this dearth of information, Regenerate California aimed to quantify the efficacy and impacts of this strategy to build more gas plants and keep gas plants open that were slated for closure in response to extreme heat and grid stress. It commissioned Grid Strategies to conduct a two-pronged comparative analysis of gas plant performance and emissions from August 31, 2022 to September 9, 2022, using daily curtailment reports from the California Independent System Operator (CAISO) and the U.S Environmental Protection Agency Continuous Emissions Monitoring System (CEMS). Grid Strategies compared information gathered during the heatwave to figures for the week prior, as a baseline representative of energy needs and emissions during a typical summer day.

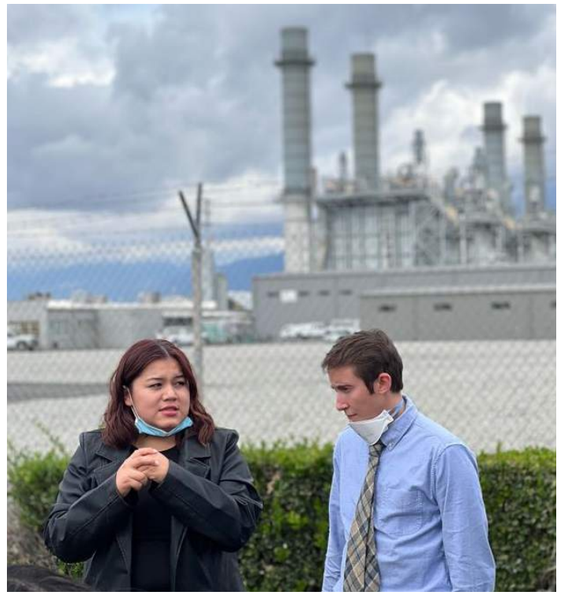
These data on emissions and performance are important, as decision makers must understand both the extent of the impacts to the grid and the resulting pollution burden on local communities. Communities most impacted, and the public at large, are also entitled to know the costs of these decisions.

Methodology

This analysis examines the performance of California gas plants during the 2022 heatwave, focusing on how outages and derates reduced their contributions to electricity supply, as well as the air emissions associated with their operation. The sources of the data and Grid Strategies analysis methods are documented in more detail in the methodology section at the end of this report.

Results and Key Findings

Key Findings: Data show that many of the state's gas plants failed to perform at their expected capacity during the heatwave, while significantly increasing the pollution burden for local communities. This tracks with previous heat wave experiences, including in August 2020[12] when unexpected power shortfalls from gas plants due to high heat and other factors contributed to rolling blackouts[13]. The data below calls into question the strategy of relying on gas generation as we experience more extreme weather, and as our understanding of its pollution and public health risks grows.



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Emissions

Emissions from gas plants spiked during the heatwave, creating significant climate and public health risk.

When extreme temperatures hit during the 2022 heatwave, emissions measured from the gas plants increased by an astonishing 60% compared to a baseline established by measuring pollution emitted in the 10 days prior, incurring $12.3 to $27.8 million in potential negative health impacts[14].

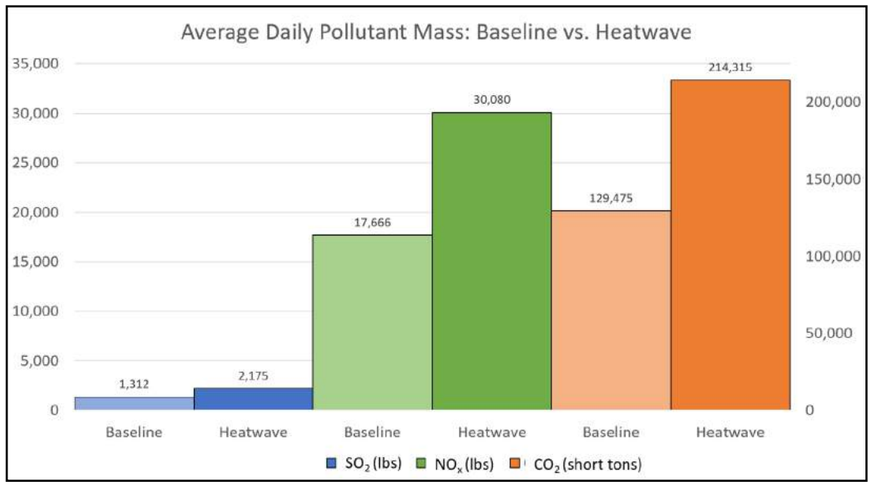

Figure 1. Average Daily Pollutant Emissions of SO_2, NO_x, and CO_2 During the Heatwave (August 31 - September 9, 2022), Compared to a Baseline.

According to the EPA Continuous Emissions Monitoring Analyzer (CEMS), the 107 California gas plants studied emitted an average of 214,000 short tons of carbon dioxide, 30,000 pounds of nitrogen oxide, and 2,200 pounds of sulfur dioxide daily across the August 31 - September 9, 2022 period. The carbon dioxide emissions from this period alone are equivalent to burning over 217 million pounds of coal – the same amount of pollution produced by 43,000 vehicles in a single year.

The pollution spikes were concentrated in highly populated regions, and specifically in environmental justice communities designated "disadvantaged" by the state.

Emissions on September 6th hit dangerous highs in the combined Los Angeles, Riverside, and San Bernardino Counties, even as several gas plants buckled under the heat and went offline. Emissions in this region reached 74,799 short tons of carbon dioxide, 10,674 pounds of nitrogen oxide, and 759 pounds of sulfur dioxide. Residents of these communities experienced a pollution impact at minimum equal to an additional 15,100 vehicles on the road in a year, or the burning of more than 76 million pounds of coal on this day alone[15]. This figure is conservative; it does not take into account the carcinogenic emissions incurred from also allowing the use of diesel BUGs in environmental justice communities as well as idling ships in port communities.

Ramping up gas generation by less efficient units creates dangerous pollution spikes.

Several gas plants contributed extremely high emissions of SO_2, CO_2 and/or NO_x during the heatwave, including units at the AES Alamitos plant and the AES Redondo Beach plant. An analysis of generation data shows these same units otherwise do not seem to run often — illustrating that pollution spikes come from less efficient units that are only run during peak load events.

Reliability

Gas plant power generation was significantly curtailed when Californians needed reliable power the most.

The gas plants studied failed to meet expectations of reliability during peak hours. Potential generation that was foregone due to gas plant outages and derates totaled more than 1.1 million megawatt hours (MWh), or nearly 5000 MW.

Grid Strategies estimates the total value of this lost power to be more than $280 million, based on prevailing power prices at the time of the outages.

The gas-fired generation that was offline during peak hours was enough to power 3.75 million homes[16] — or roughly 28% of the total households in California — a significant shortfall[17].

Outages and derates were around 200 MW higher during peak hours, when power was needed most, than non-peak periods. These outages were found to be primarily caused by high temperatures and were most common between 4 pm and 9 pm. The gas plant outages and derates due to high ambient temperatures closely aligned with CAISO hourly demand, illustrating that gas plants could not maintain reliable energy supply at the times it was most needed.

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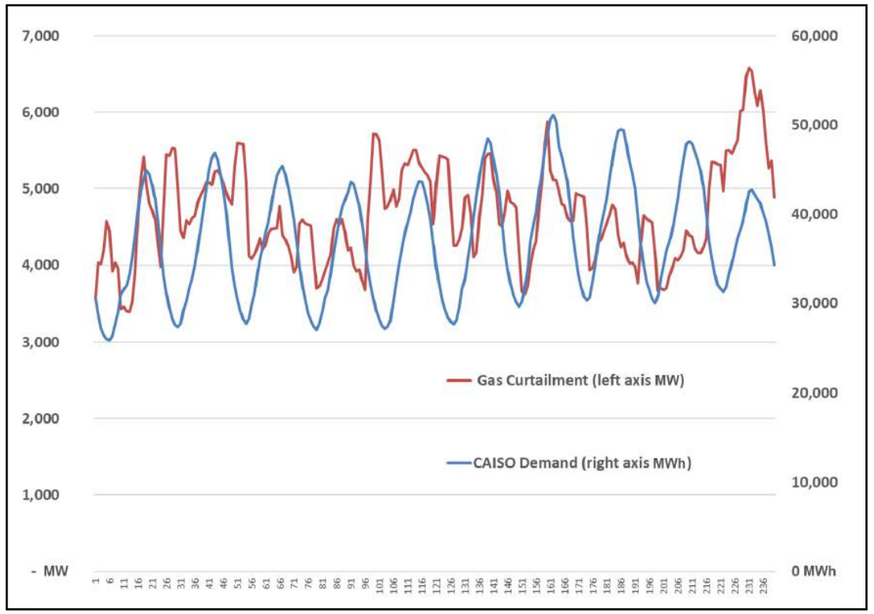


Figure 2. Outages and Derates Coincided with High Demand.

California gas plant curtailments track fairly closely with CAISO hourly demand during the heatwave, likely reflecting that derates due to high ambient temperatures coincide with periods of high electricity demand.

Some gas plants, including those kept online past their previously scheduled retirement dates, experienced unusually high curtailments during the heatwave.

Despite being originally scheduled to shut down in 2020, the Ormond Beach Generating Station was contracted to continue operating until 2023 to provide power in times of need. Yet two of the Ormond Beach units were ranked first and sixth in the top 15 gas plants with the highest rates of curtailment during the heatwave. Ormond Unit 1 had the first highest curtailment rates at 54,119 MWh, and Unit 2 had the sixth overall highest curtailment rates of curtailment at 35,248 MWh. The Ormond Beach Generating Station experienced especially high curtailment rates during the heatwave from midday September 5 until the end of the heatwave on September 9. Such high levels of curtailment casts serious doubt on the wisdom of contracting with this plant to meet urgent energy needs.

After energy reliability concerns forced the Sutter gas plant to remain open in 2012, CAISO decommissioned the facility shortly thereafter in 2015 amid economic concerns. However, the plant was then reopened for grid reliability. One-third of the Sutter gas plant's capacity was curtailed from September 5th through 6th due to high temperatures, and the plant experienced increased curtailment at peak hours almost daily.

Despite not landing among the top 15 gas plants with highest curtailment, Sutter's lack of reliability is significant considering that it was reopened *solely* to address reliability concerns.

Key Recommendations

The data show that gas-fired power generation created heightened pollution burdens in frontline communities during already impaired air quality days, and therefore should be considered an unjust, inappropriate solution to meeting grid reliability. Simultaneously, gas plants failed to live up to their purported reliability value, and our dependence on them came at a significant cost to EJ communities, during extreme heat events, and at all other times of the year.

In response, Regenerate California recommends the following solutions that the state should implement immediately to keep the lights on while relieving environmental justice communities of gas plant pollution:

1. Enhance coordination among energy agencies to transition our electric grid off fossil fuels.
    - Stop new investments in gas plants and instead procure clean energy resources to meet peak demand.
    - Plan the retirement of gas-fired power generation in disadvantaged communities by 2030, given their costly and dangerous impact to public health, the climate, and poor performance under extreme heat when we need reliable energy.

2. **Invest in Demand Side, Local, and Distributed Clean Energy Resources**
    - Let Residents Know They Can Get Paid to Conserve Energy During Times of Peak Demand: During last summer's heat wave, Californians responded to a text alert from California's Office of Emergency Services by conserving power - for free- and electricity use plummeted by 1.2 gigawatts[18] – enough electricity to power 900,000 homes. The state should increase investments in and better publicize demand response programs, such as the Emergency Load Reduction Program[19], that pay residents for reducing electricity demand during peak hours. An example is the Just Flex Rewards program, which pays low income and disadvantaged community customers when they reduce their electricity consumption during key periods.
    - Invest in local clean energy development, such as community solar and storage, microgrids, vehicle- to- grid pilots, and clean Distributed Energy Resources (DERs) like rooftop solar and batteries, with a priority for environmental justice communities to ensure community resilience and grid reliability.

3. **Center the goal of retiring fossil fuel resources in planning the buildout of clean energy and transmission.**

   - Investing in geothermal and wind can significantly decrease the amount of solar needed by half, lower dependence on imports and gas plants while supporting reliability through a more diverse resource mix[20].
     - Offshore wind generation on the California coast peaks around 6 pm year-round, when solar generation decreases.[21] [22] It couples well with other renewables and aligns well with evening peak demand when we otherwise would depend on gas plants to provide electricity.
     - Unlocking firm geothermal energy potential could serve not only overall grid reliability, but also the local needs of the communities in which they are located, which are often vulnerable to extreme heat and poor grid resilience.
   - Solar and co-located storage resources intentionally sited in transmission-constrained areas can replace polluting peaker plants.

4. The California Public Utilities Commission and California Independent System Operator should work together to prioritize transmission projects in capacity-constrained areas of the state, with the specific aim of delivering clean energy that displaces gas plants in environmental justice communities.

Background

From August 31 to September 9, 2022, California's power grid was tested by a severe heatwave. During the heatwave, the demand in California Independent System Operator (CAISO) footprint set a new electricity record of 51,426 MW, well above previous records set during a 2020 heatwave. Many California gas plants experienced outages or derates that reduced their output during the event, bringing CAISO perilously close to a supply shortfall. Thanks to recent growth of energy storage, and California customers responding to electricity conservation calls, the state was able to avoid rolling blackouts.

This analysis examines the performance of California gas generators during the 2022 heatwave, focusing on how outages and derates increased risks of power shortfalls by reducing the plants' contributions to electricity supply, imperiling reliability. The analysis also assesses the air emissions associated with the gas plants' operations during the heatwave. The data sources and analysis methods are documented in more detail in the methodology section at the end of this report.

Results

Part 1: Reliability

Grid Strategies analyzed outages and derates experienced by California gas plants over the period August 31-September 9, 2022. As explained in the methodology section, we used data compiled by CAISO[23] to track the curtailment of California gas generators due to outages and derates.

Figure 3 plots hourly gas plant outages and derates. The red hourly bars show that outages and derates were on average about 200 MW higher during peak hours (4-9 pm) than off-peak periods.

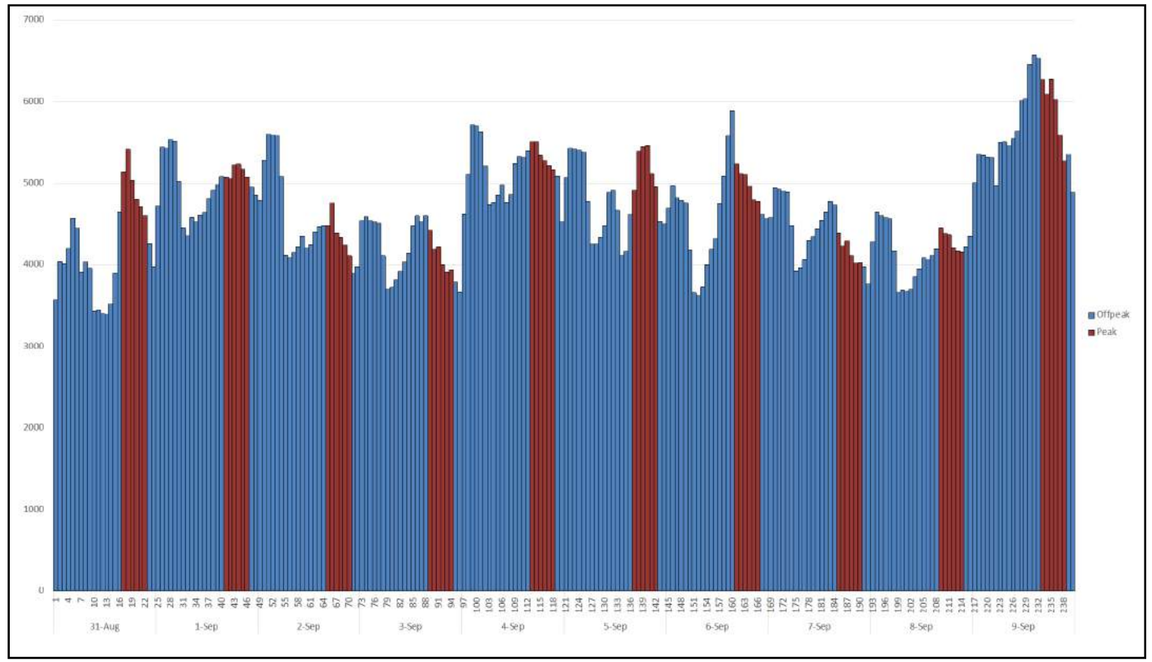


Figure 3. Total Gas Plant Curtailments by Hour

Figure 4 shows that California gas plant curtailments track fairly closely with CAISO hourly demand during the heatwave, likely reflecting that derates due to high ambient temperatures coincide with periods of high electricity demand. Figure 5 shows hourly outages and derates based on all the reasons recorded for curtailments combined into three CAISO categories - ambient due to temperature, forced (unplanned) outages, and planned outages.

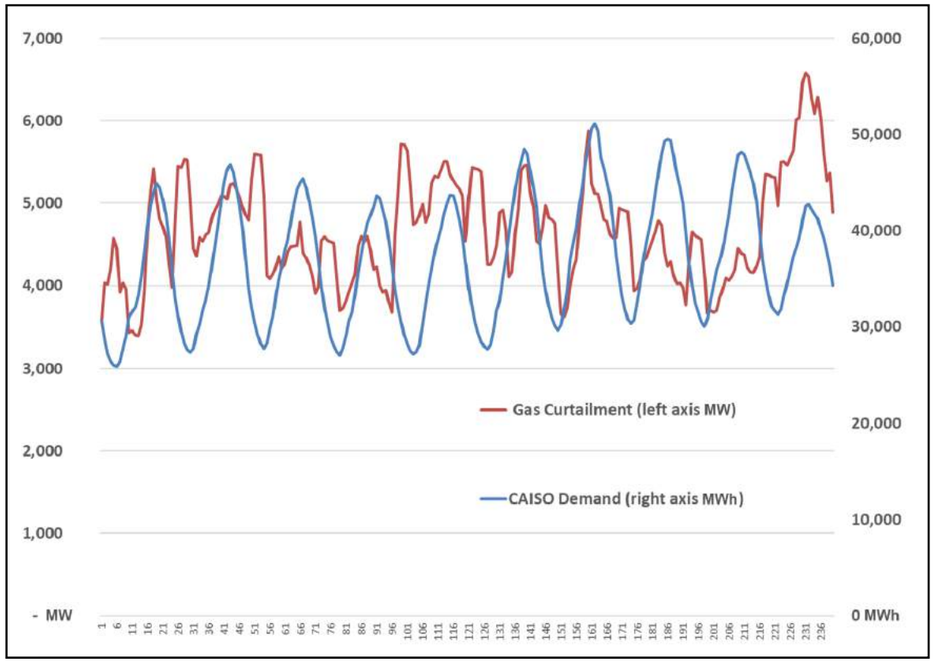


Figure 4. Total Gas Plant Curtailments by Hour vs. CAISO Hourly Demand

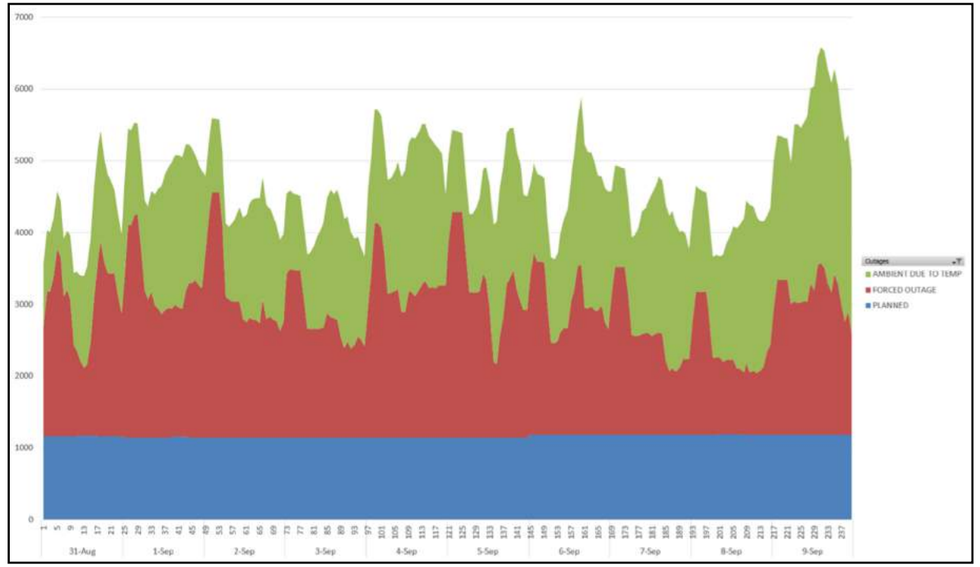


Figure 5. Total Hourly Gas Plant Curtailments by Category

In Figure 5, the three curtailment categories (ambient due to temperature, forced outages, and planned outages) are broken out by the specific type of curtailment[24]. The two types of curtailment that led to the most MWh of outages were still the two broad categories of ambient due to temperature and plant trouble.

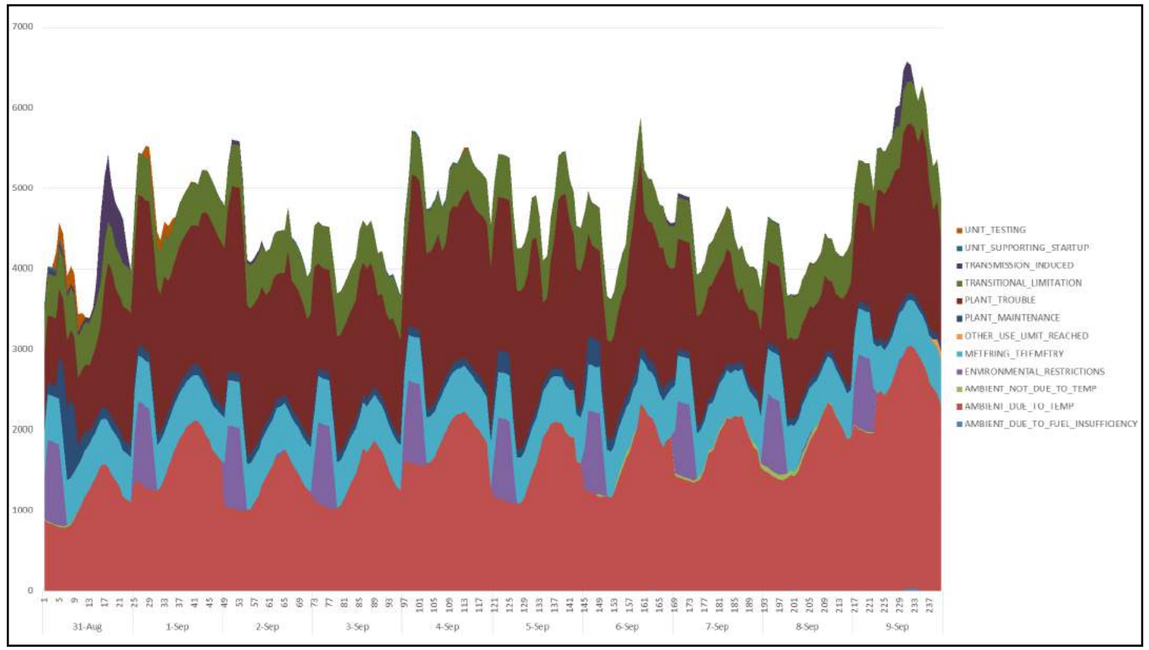


Figure 6. Total Hourly Gas Plant Curtailments by Type

During the heatwave, potential generation that was foregone due to gas plant outages and derates totaled over 1.1 million MWh, or just under 5,000 MW of curtailment on average. We estimate that the total value of this foregone gas generation is over $280 million dollars (Figure 7) based on prevailing power prices (Y axis) at the time (X axis) of those outages and derates.

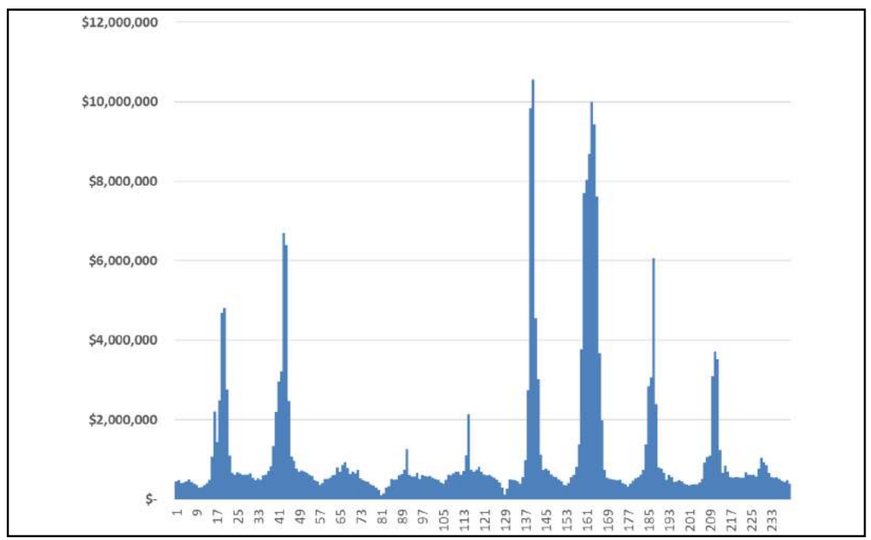


Figure 7. Estimated Hourly Value of Foregone Generation from Gas Outages and Derates. Value of lost gas generation totals $283M

Part 2: Emissions

During the 10-day heatwave, the 107 California gas plants tracked by the Environmental Protection Agency's Continuous Emissions Monitoring System (EPA CEMS) program[25] emitted an average of approximately 210,000 short tons[26] of carbon dioxide (CO_2) per day, 30,000 pounds of nitrogen oxides (NO_x) per day, and 2,200 pounds of sulfur dioxide (SO_2) per day. The EPA CEMS does not track all California gas plants, so these numbers likely underestimate the CO_2, NO_x, SO_2 emissions gas plants contributed to California's poor air quality during this short period.

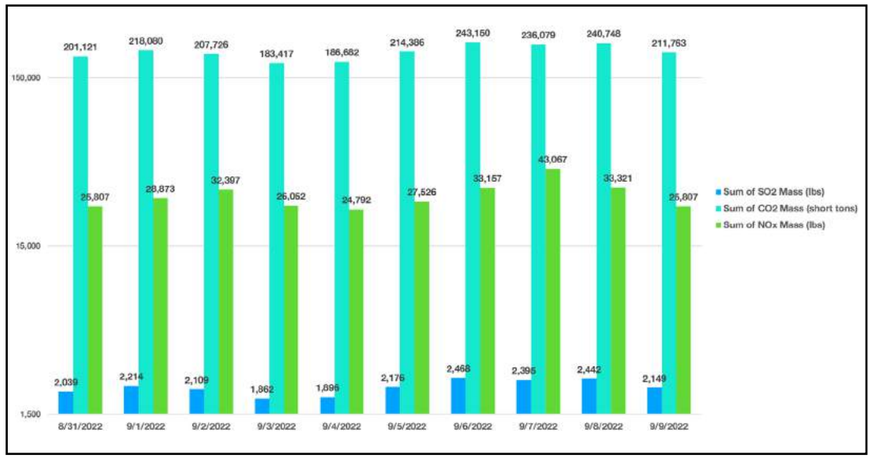
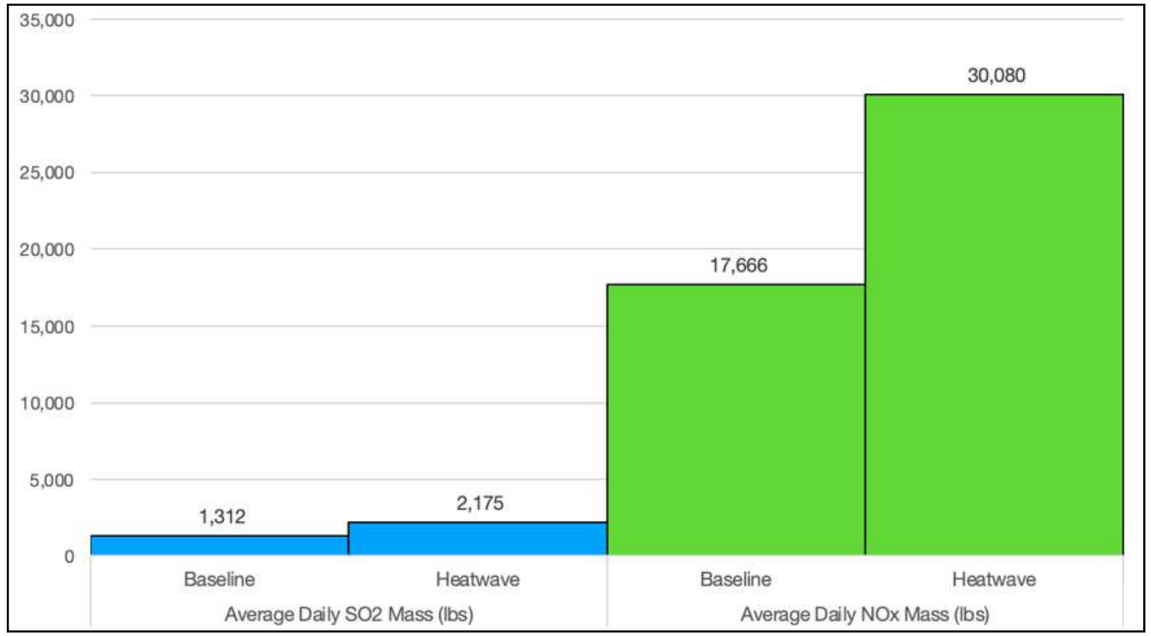
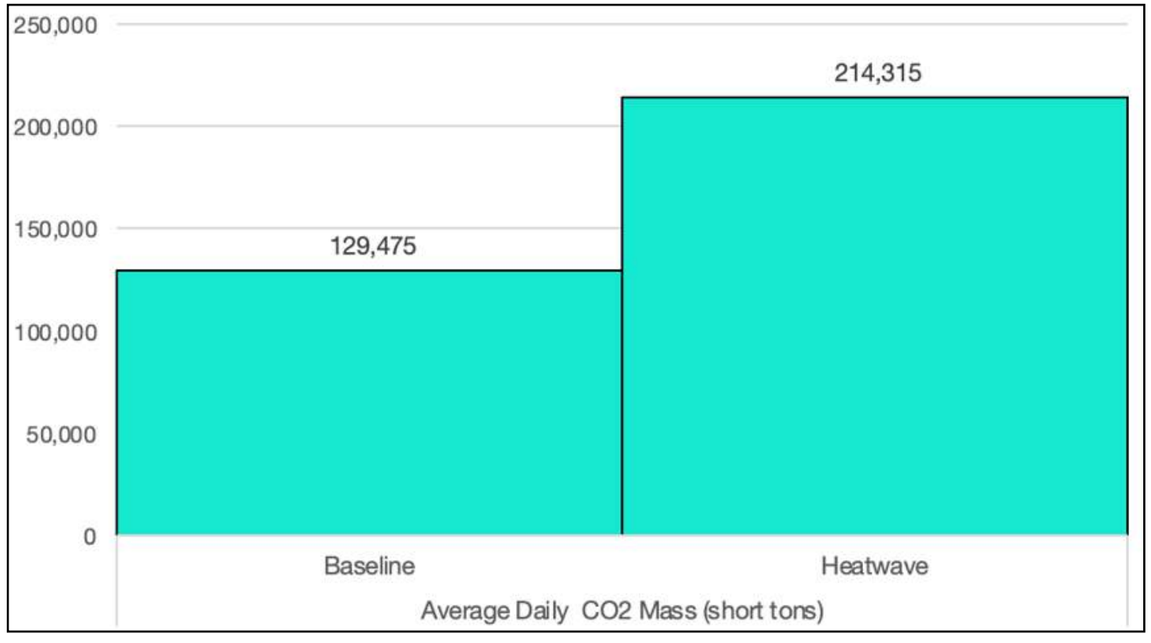


Figure 8. Total Daily Emissions from CEMS-tracked California Gas Plants During the Heatwave (8/31/22-9/9/22)[27]

We compared the emissions generated during the heatwave with emissions from August 19-28, 2022, a representative 10 day summer baseline period with average summer electricity demand.

Emissions associated with these gas plants during the heatwave, when emissions limits were lifted, were roughly 60% higher than during the baseline period (Figures 9 and 10). These emissions cause health harms to surrounding communities. Using EPA's Co-Benefits Risk Assessment Tool (COBRA), we estimate that in total, the SO_2 and NO_x emissions during the heatwave caused $12.3 to $27.8 million in potential negative health impacts.[28] Compared to the baseline, these potential costs are $5.0 to $11.3 million higher due to the additional emissions during the heatwave.[29] The monetized health impacts reported by COBRA represent several categories of impacts including avoided premature mortalities, avoided illnesses, and avoided lost workdays. Because COBRA doesn't include all pollutants or all impacts from each pollutant, this is a conservative estimate.





Figures 9 and 10. Average Daily SO_2, NO_x, and CO_2 Emissions from All California Gas Plants During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

We also examined air emissions from gas plants in certain highly populated regions with high exposure to air pollution. This included gas plants in Los Angeles County, the Inland Empire, San Joaquin Valley, Ventura County, and communities designated as "disadvantaged" by California Senate Bill 535 (SB535 communities), in that they are in the top 25% of metrics documented by CalEnviroScreen.[30]

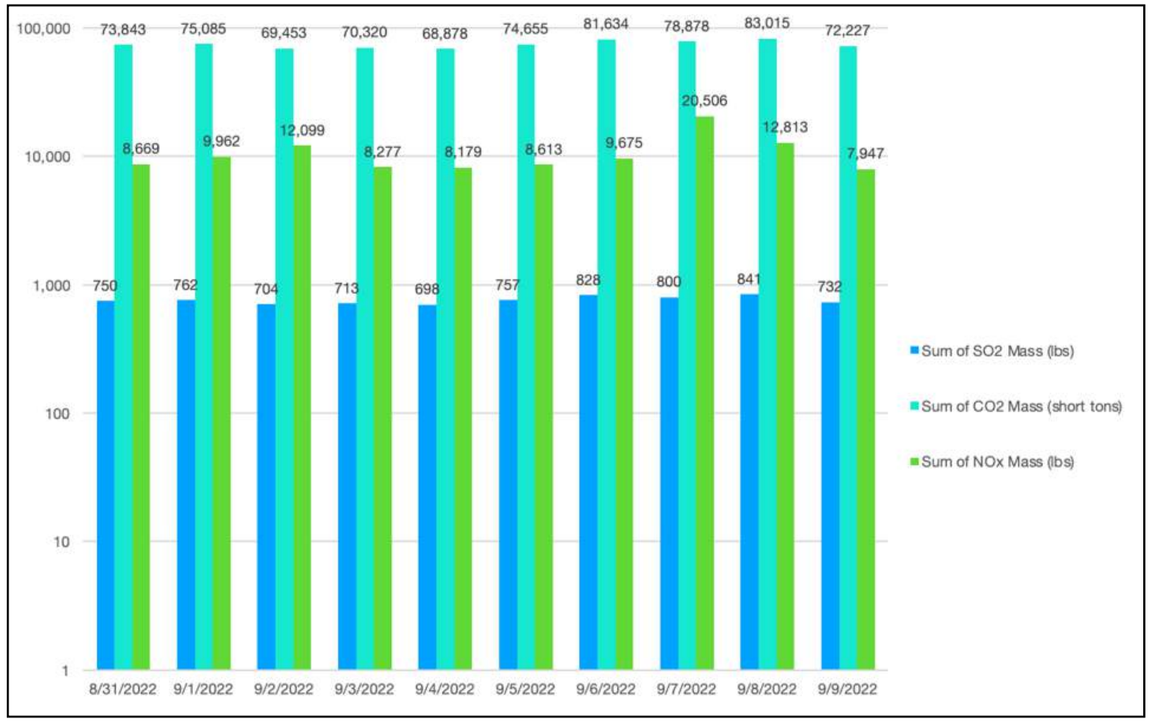


Figure 11. LA County and Inland Empire Priority Gas Plants Total Daily Heatwave Emissions

The LA County and Inland Empire gas plants make up 28 of the 107 gas power plants tracked by the CEMS database. During the heatwave, these gas plants accounted for roughly 35% of statewide gas plant emissions.

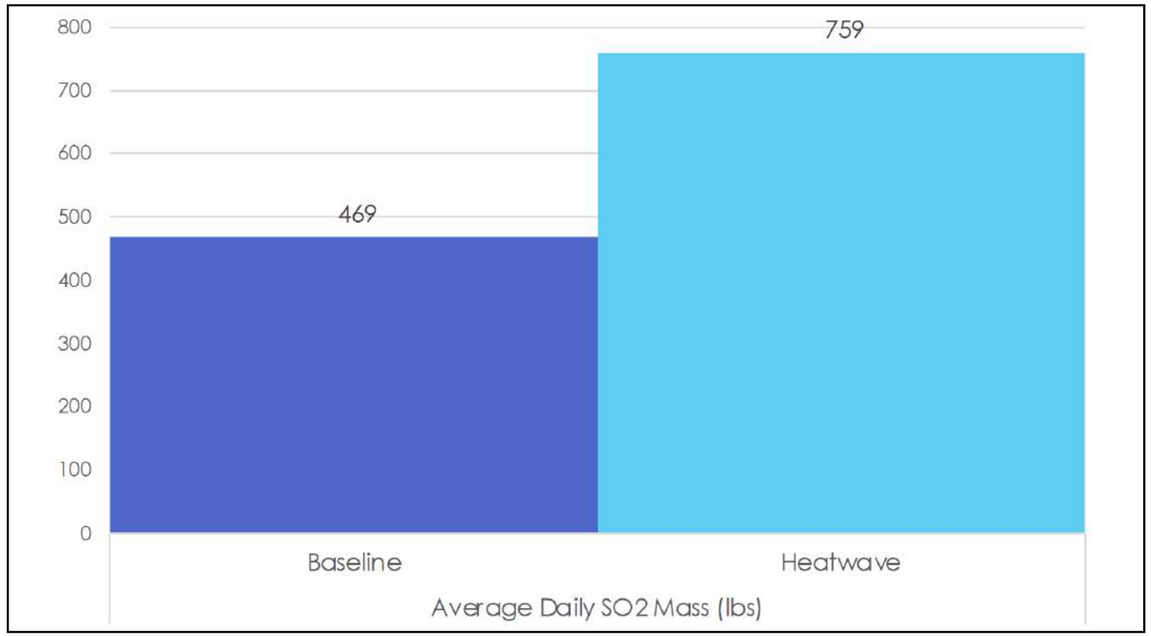


Figure 12. Average Daily SO_2 Emissions from LA County and IE Gas Plants During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

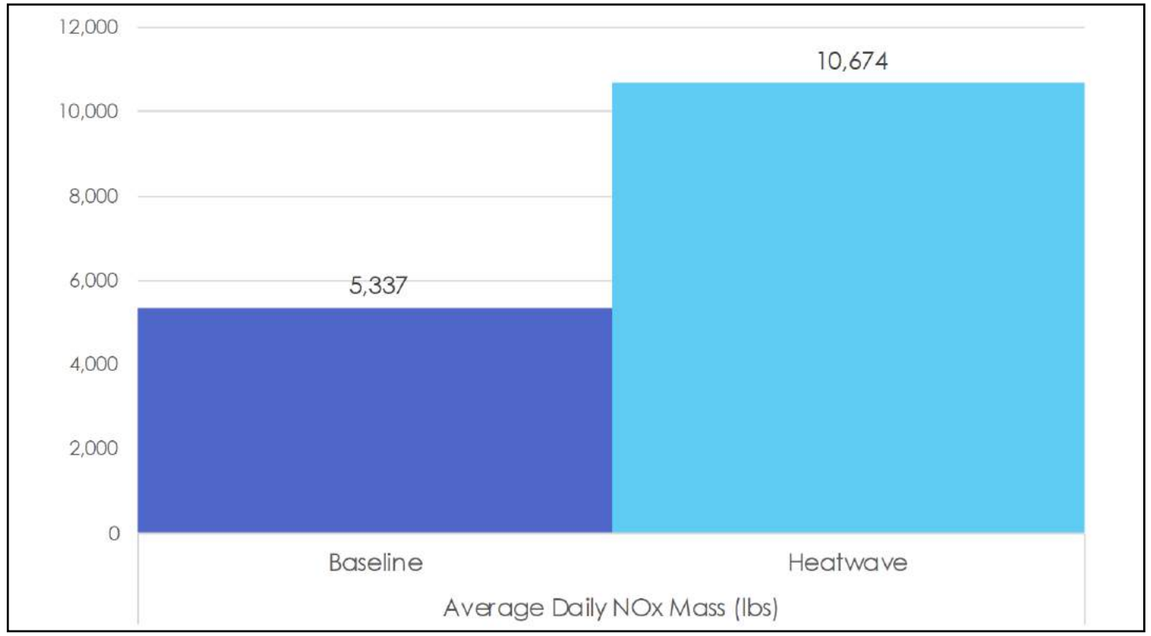


Figure 13. Average Daily NO_x Emissions from LA County and IE Gas Plants During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

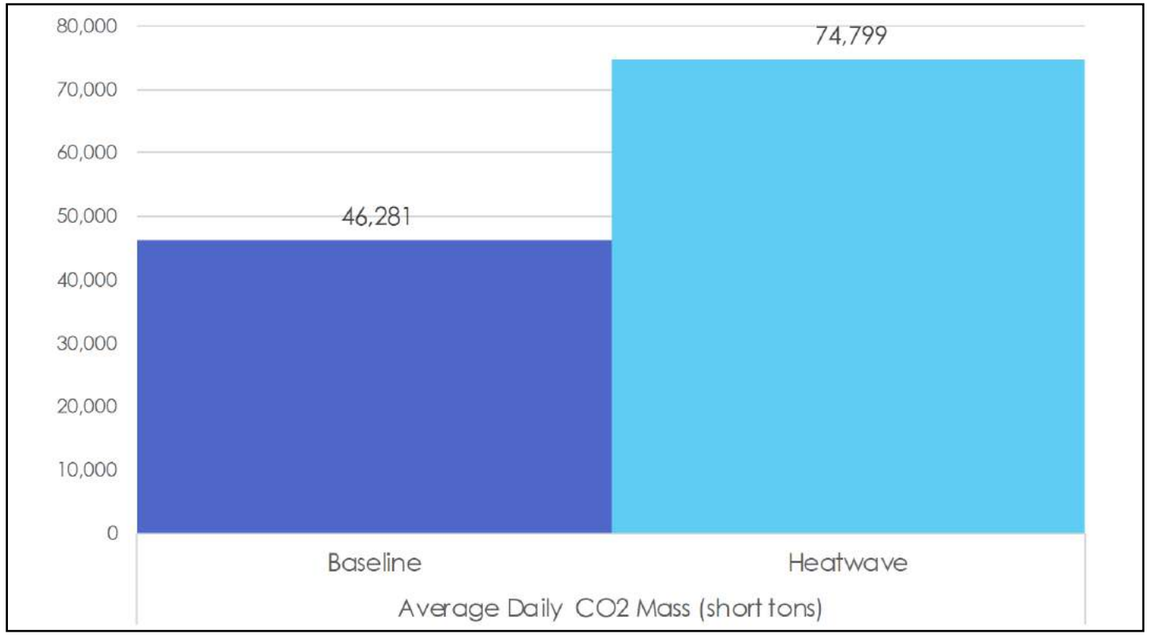


Figure 14. Average Daily CO_2 Emissions from LA County and IE Gas Plants During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

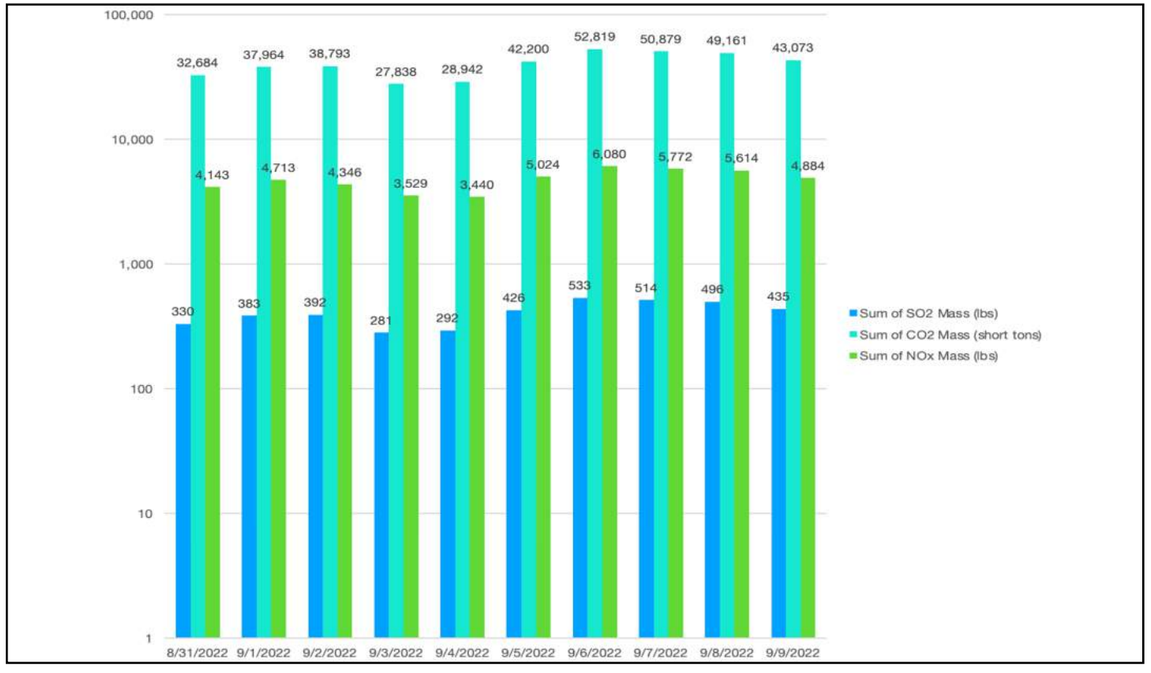


Figure 15. San Joaquin Valley & Ventura County Priority Gas Plants Total Daily Heatwave Emissions

The San Joaquin Valley and Ventura County gas power plants make up 17 of the 107 gas plants tracked by the CEMS database. During the heatwave, these gas plants accounted for roughly 18% of statewide gas plant emissions.

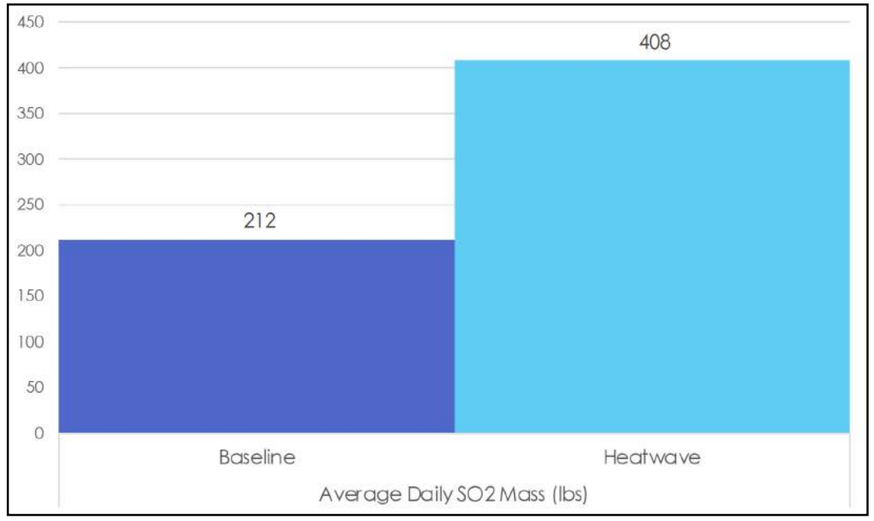


Figure 16. Average Daily SO_2 Emissions from San Joaquin Valley and Ventura County Gas Plants During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

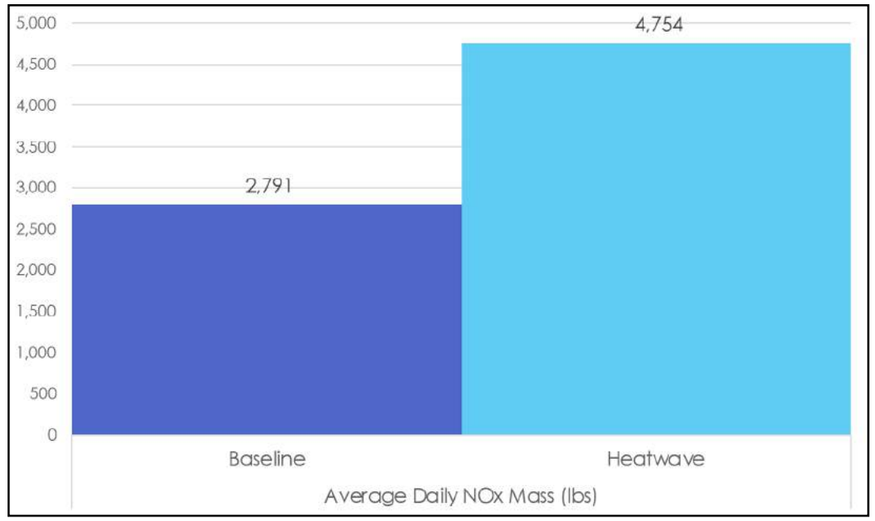


Figure 17. Average Daily NO_x Emissions from San Joaquin Valley and Ventura County Gas Plants During

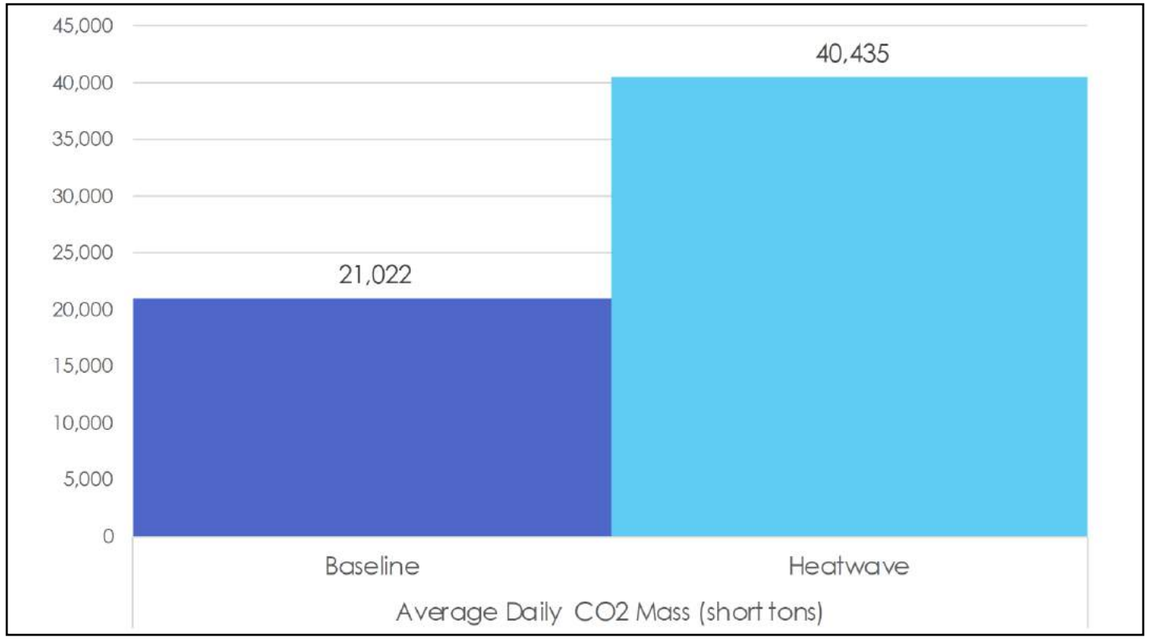


Figure 18. Average Daily CO_2 Emissions from San Joaquin Valley and Ventura County Gas Plants During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

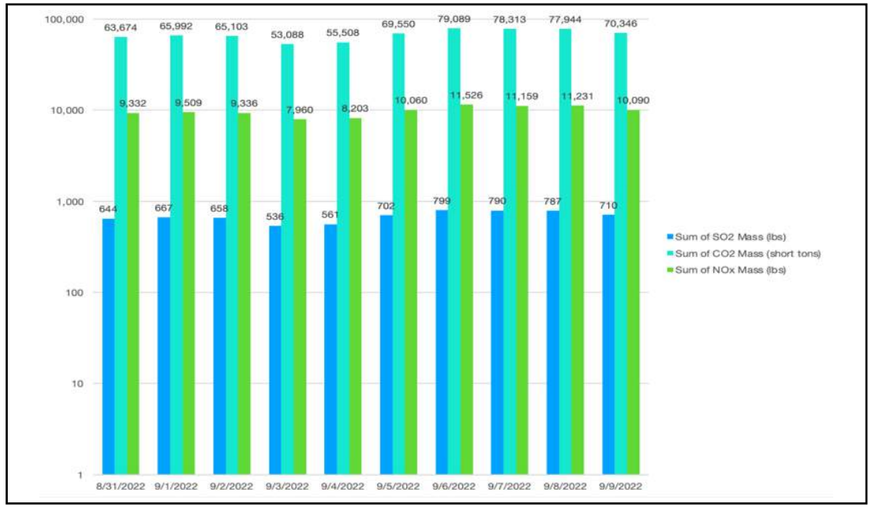


Figure 19. Gas Plants in SB535 Communities (Top 25th percentile) Total Daily Heatwave Emissions

The gas plants in SB535 communities make up 40 of the 107 gas plants tracked by the CEMS database. During the heatwave, these gas plants accounted for roughly 32% of statewide gas plant emissions.

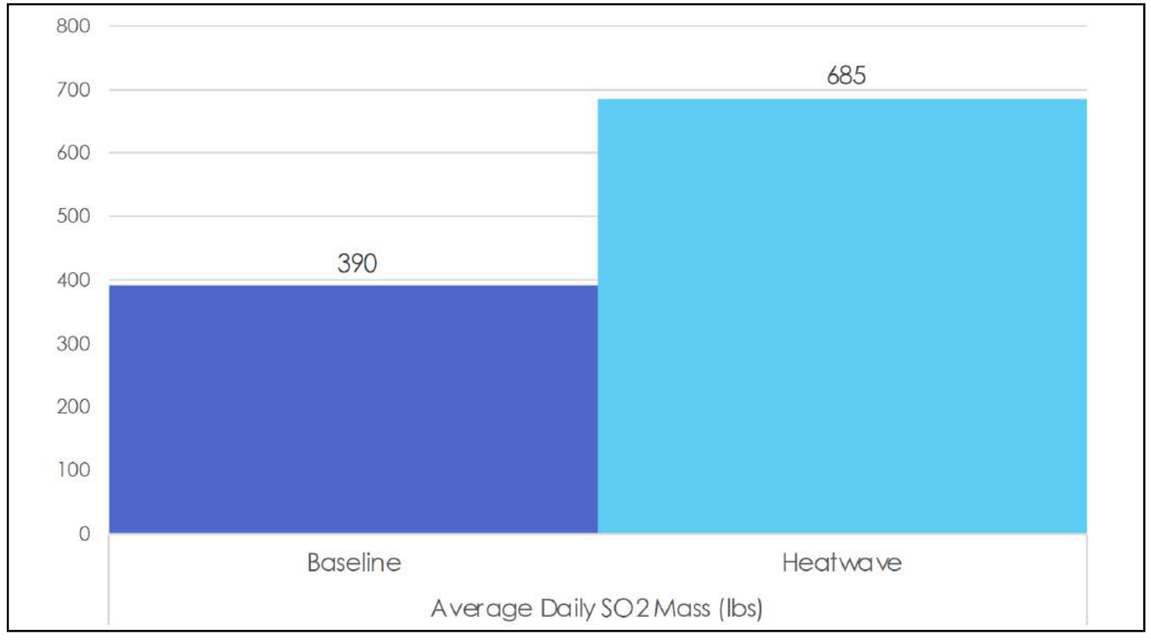


Figure 20. Average Daily SO_2 Emissions from Gas Plants in SB 535 Communities During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

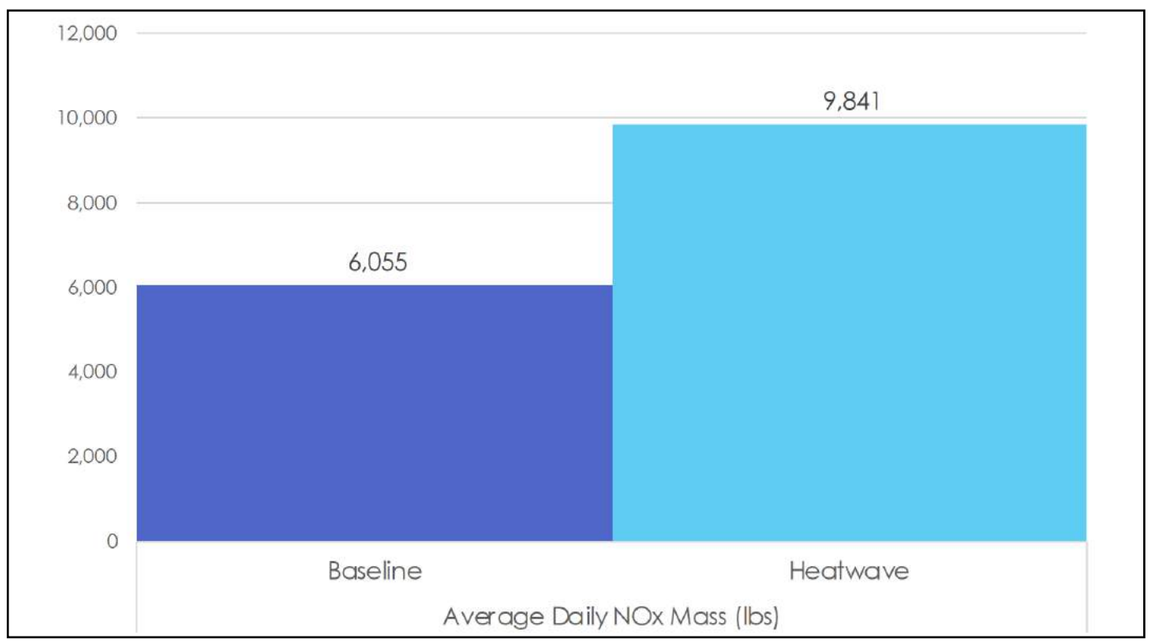


Figure 21. Average Daily NO_x Emissions from Gas Plants in SB 535 Communities During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

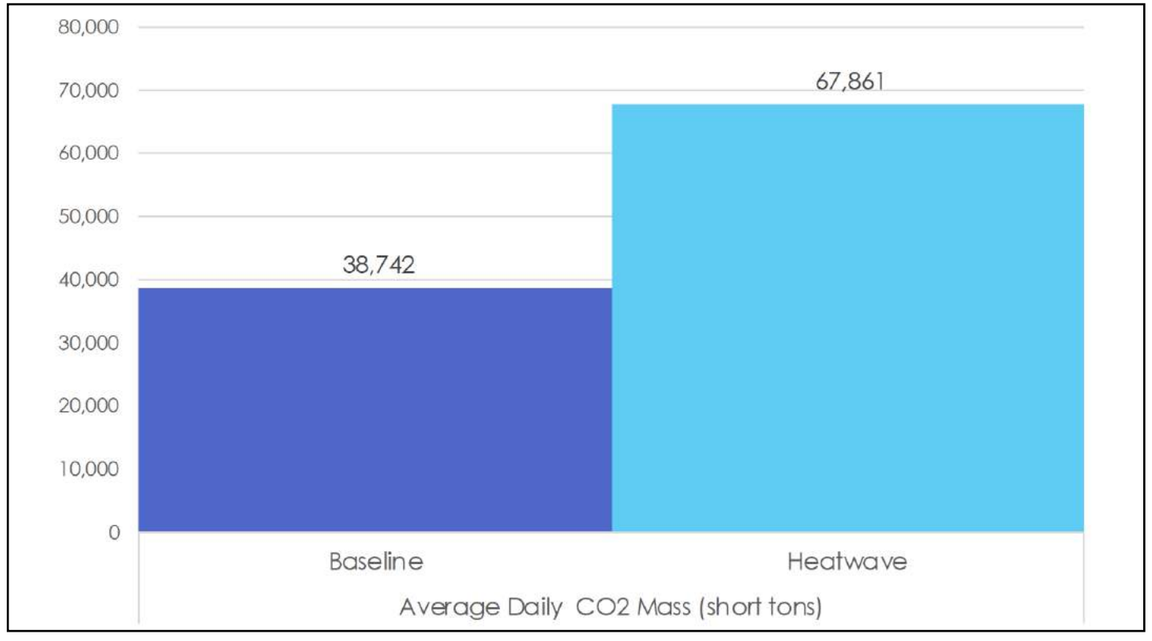


Figure 22. Average Daily CO_2 Emissions from Gas Plants in SB 535 Communities During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

Individual Plant Highlights

Our analysis found several gas plants had unusually high emissions during the heatwave. The disproportionate emissions from these gas plants can be found on the stacked emissions charts found in the additional figures in the **PowerPoint**.

For example, AES Alamitos had some of the highest SO_2, CO_2, and NO_x emissions throughout the heatwave. Unfortunately, CEMS does not provide data[31] for emissions from individual generating units within a power plant, but we were able to use EIA 923 monthly generation data from January to October 2022 to see if there were units operating during September that were not typically operating at other times. In the case of AES Alamitos, Generator Number 5 was not run from January through May, but in September 2022, that unit produced almost 55,000 MWh of electricity, accounting for over half of the total 104,000 MWh it produced during June, July, August, and September. This strongly indicates that the unit was running at a high level of output during the heatwave, and may have at least partially accounted for the large increase in emissions at AES Alamitos during that time.

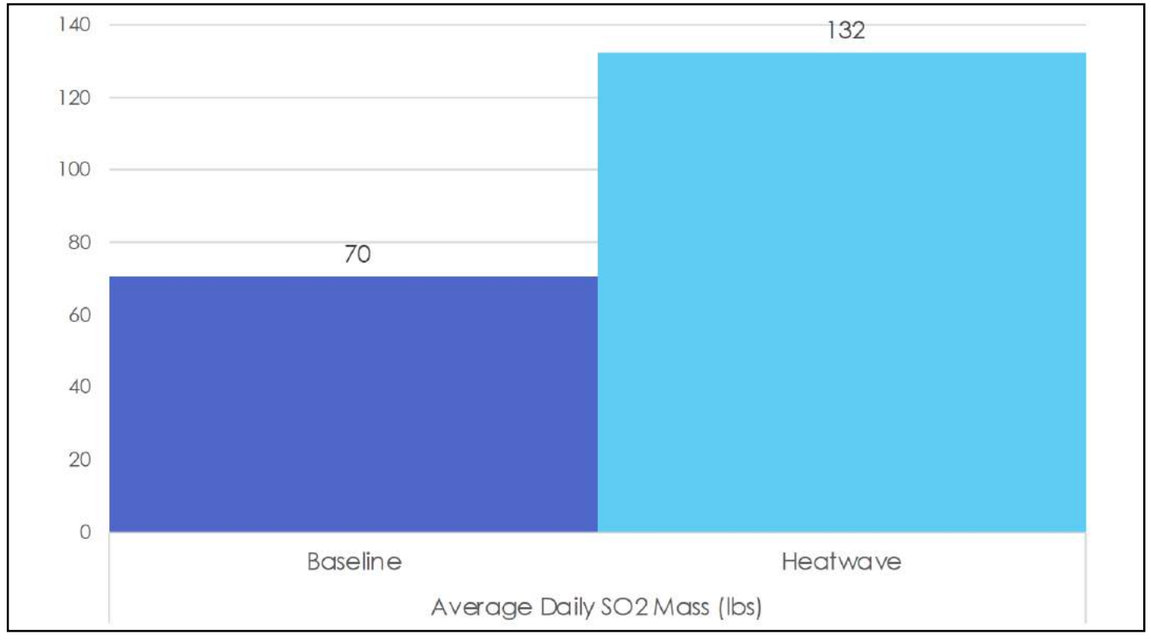


Figure 23. Average Daily SO_2 Emissions from AES Alamitos Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

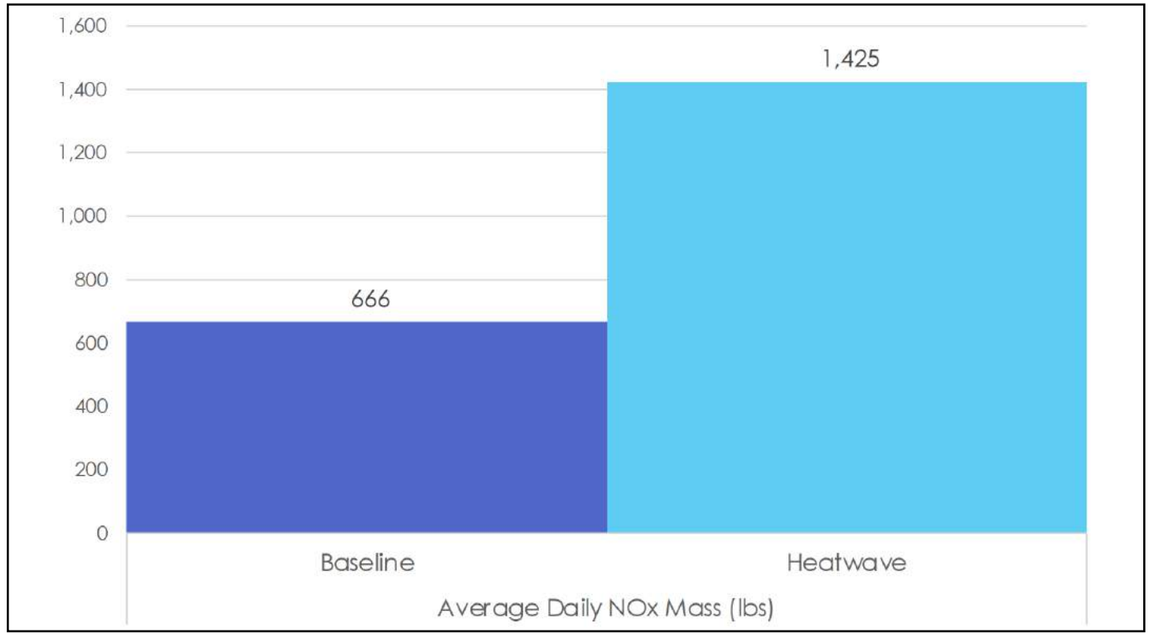


Figure 24. Average Daily NO_x Emissions from AES Alamitos Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

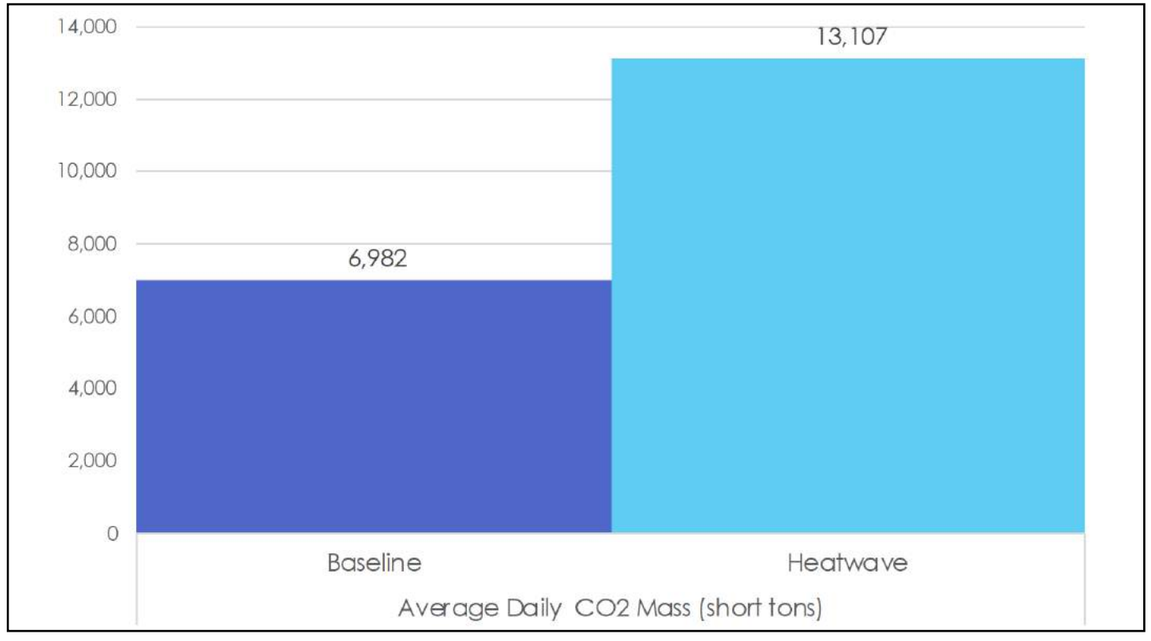


Figure 25. Average Daily CO_2 Emissions from AES Alamitos Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

Similarly, for AES Redondo Beach, the CO_2 and SO_2 emissions roughly doubled from previous levels starting on September 5. According to the EIA data, AES Redondo Generator Number 8 recorded over 60,000 MWh of electricity generation in September 2022, almost 60 percent of its net generation for 2022 to date through October 2022. This strongly indicates that both AES Alamitos unit 5 and AES Redondo Beach unit 8 are less efficient units that are only run during peak load events. This makes it likely that these units turning on at least partially caused the spike in emissions at AES Alamitos and Redondo Beach.

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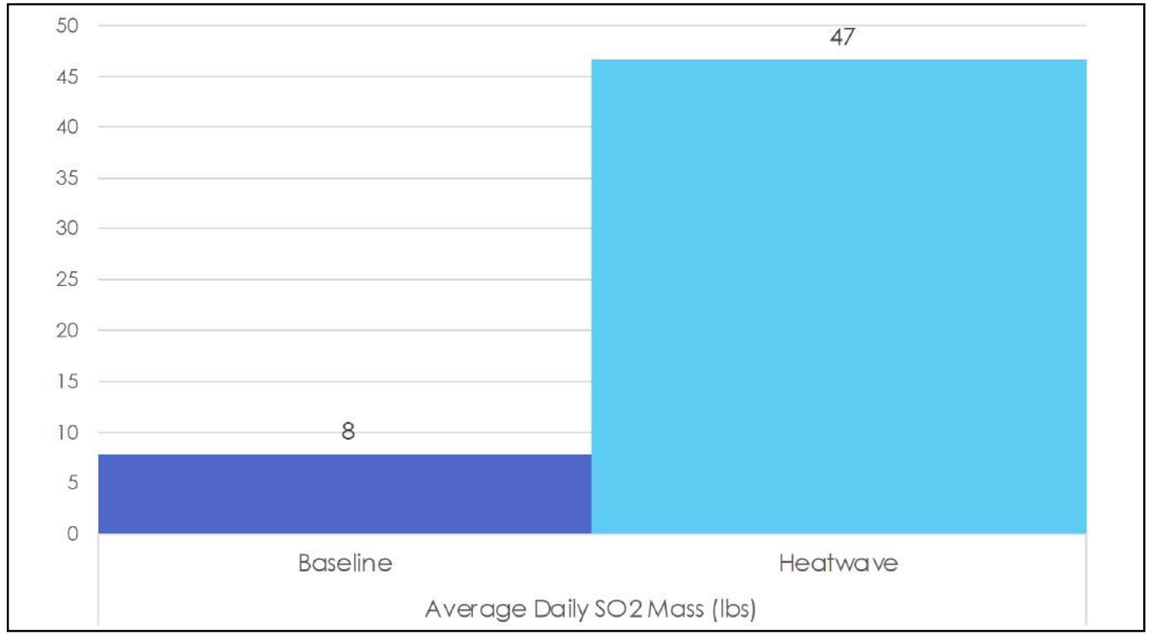

Figure 26. Average Daily SO_2 Emissions from AES Redondo Beach Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

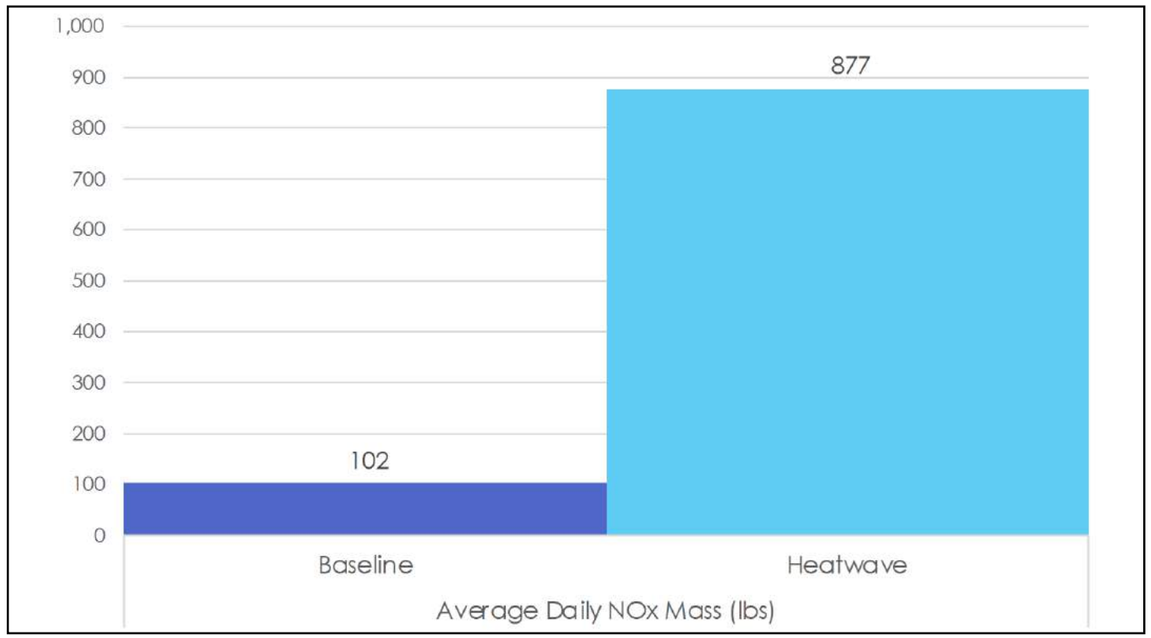

Figure 27. Average Daily NO_x Emissions from AES Redondo Beach Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

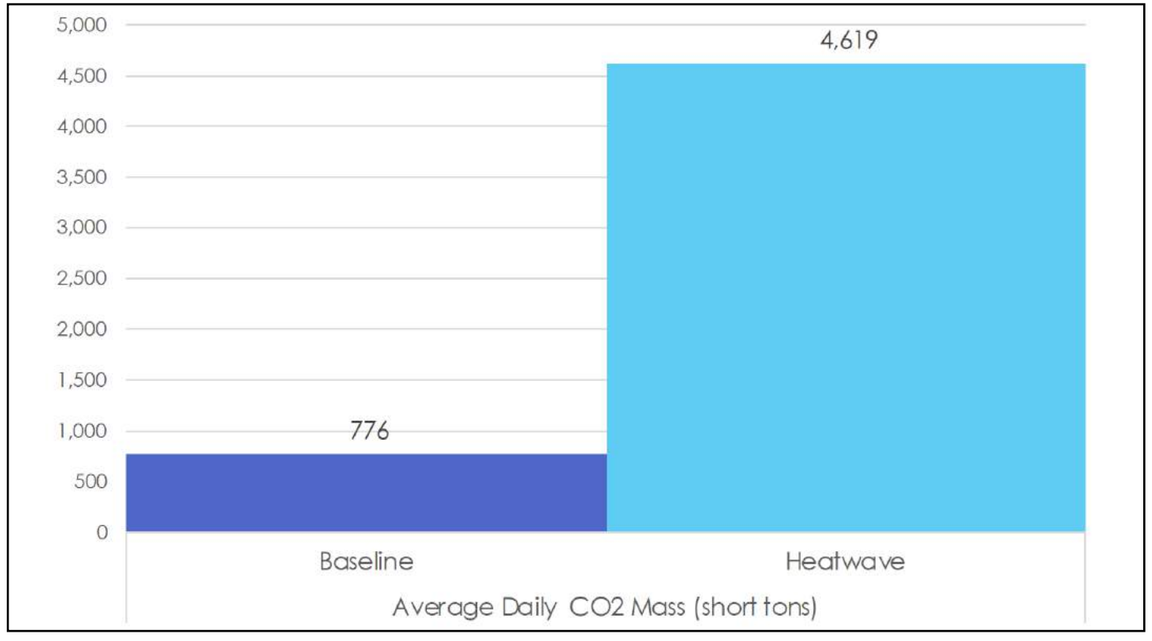

Figure 28. Average Daily CO_2 Emissions from AES Redondo Beach Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

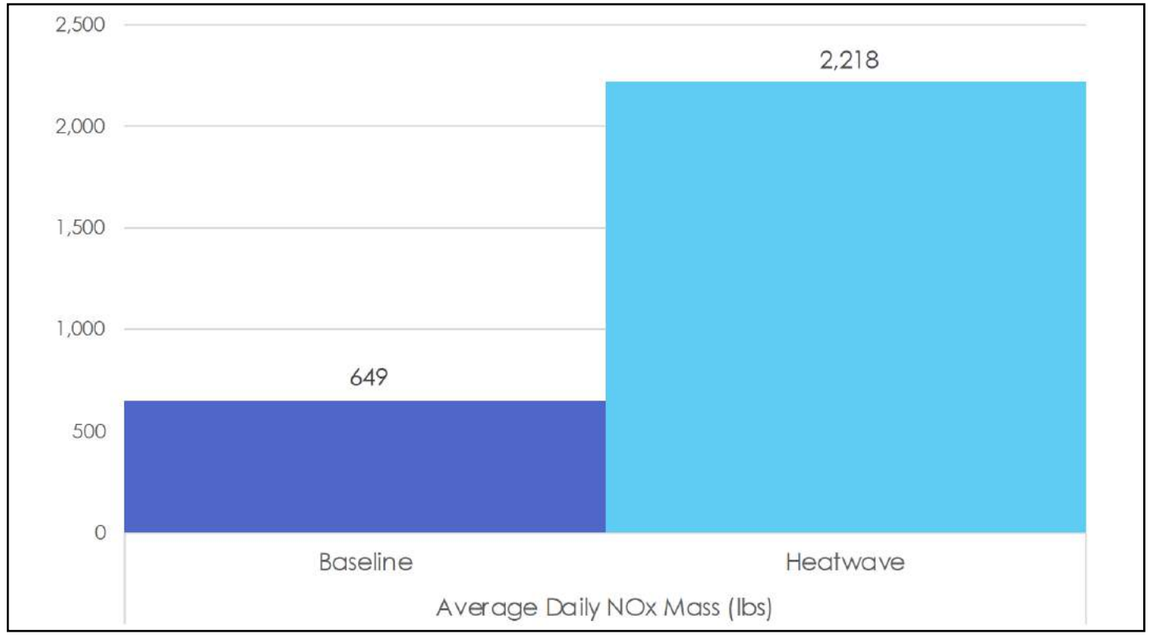

Figure 29. Average Daily NO_x Emissions from AES Huntington Beach During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

Several gas plants had relatively low emissions on most days of the heatwave, but with spikes on specific days. For example, Russell City Energy Company saw all emissions roughly double starting on 9/5/22. EIA 923 data seems to indicate that the plant as a whole was not running at max capacity in the early days of the heatwave, and then ramped up to max capacity on September 5th when California began to experience the highest load demands of the heatwave. As a combined cycle generator with two 200 MW combustion turbines attached to a single 235 MW steam generator, it is possible the increase in emissions occurred as the second combustion turbine ramped up and/or the plant shifted from operating in part-load combustion turbine mode to full output combined cycle mode.

On September 9, AES Huntington Beach reported very high NO_x emissions, accounting for close to a quarter of all California gas plant NO_x emissions for that day. EIA 923 data indicates that unit 2 was only operating from June through September 2022, with about a third of its generation coming in September 2022, so AES Huntington Beach Generator Number 2 is likely at least partially the cause of the spike. Given the size of the emissions anomaly, it is also possible that there was a monitoring error, or that the plant's emissions controls were not operating properly on that day.

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A handful of individual gas plants with unusually high curtailments during the heatwave should be noted. Table 1 shows the top 15 gas plants with the most MWh of curtailment during the heatwave.

Rank	Plant	Total Curtailment (MWh)
1	ORMOND BEACH GENERATING STATION, UNIT 1	54,119
2	EL SEGUNDO ENERGY CENTER, UNITS 7 & 8	53,332
3	CARLSBAD ENERGY CENTER, UNIT 1	40,526
4	REDONDO GENERATING STATION, UNIT 8	40,010
5	ORMOND BEACH GENERATING STATION, UNIT 2	35,248
6	GATEWAY GENERATING STATION	33,681
7	METCALF ENERGY CENTER	20,315
8	ALAMITOS GENERATING STATION, UNIT 5	19,761
9	DELTA ENERGY CENTER	19,176
10	WALNUT CREEK ENERGY PARK, UNIT 4	17,533
11	ALAMITOS GENERATING STATION, UNIT 3	16,290
12	HIGH DESERT POWER PLANT	15,484
13	ELK HILLS POWER PLANT	15,224
14	REDONDO BEACH GENERATION STATION, UNIT 5	15,152
15	SUNRISE POWER PROJECT	13,293

Table 1. Top 15 California natural gas plants in MWh of curtailment during the heatwave

The Ormond Beach Generating Station struggled during the heatwave. Two of Ormond's units were in the top ten in terms of MWh of curtailment during the heatwave. Figure 29 shows hourly outages for Ormond during the heatwave. On August 31, Ormond was experiencing expected curtailments due to plant maintenance. The curtailments then switched to plant trouble midway through the day on August 31. The plant trouble continued, but it appears there were efforts made to bring the plant back online. Midway through the day on September 5, during the maximum generation event Ormond was able to bring most of its generation back online but continued to struggle with curtailments due to the temperature through the rest of the heatwave.

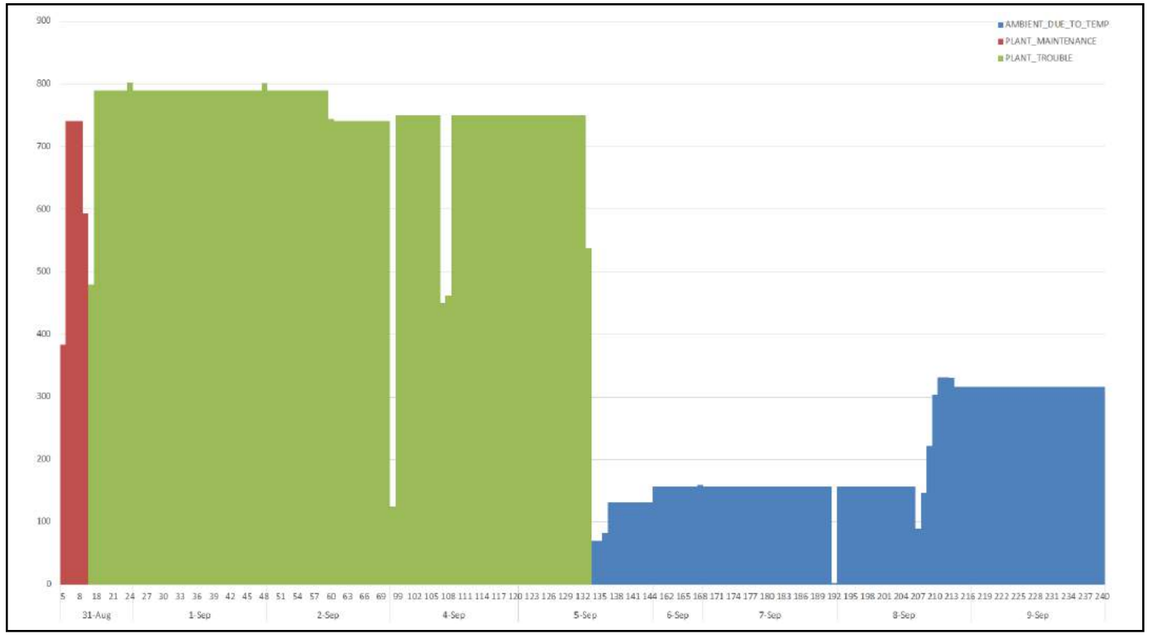

Figure 30. Total hourly curtailments by type for Ormond Beach Generating Station during the heatwave

The struggles to increase output from the Ormond Beach units were reflected in significant emissions increases. As shown in Figures 30, 31, and 32, during the heatwave the low-income community of color in Oxnard, which hosts the Ormond Beach units as well as several other gas generators, were subjected to enormous spikes in SO_2, NO_x and CO_2 emissions.

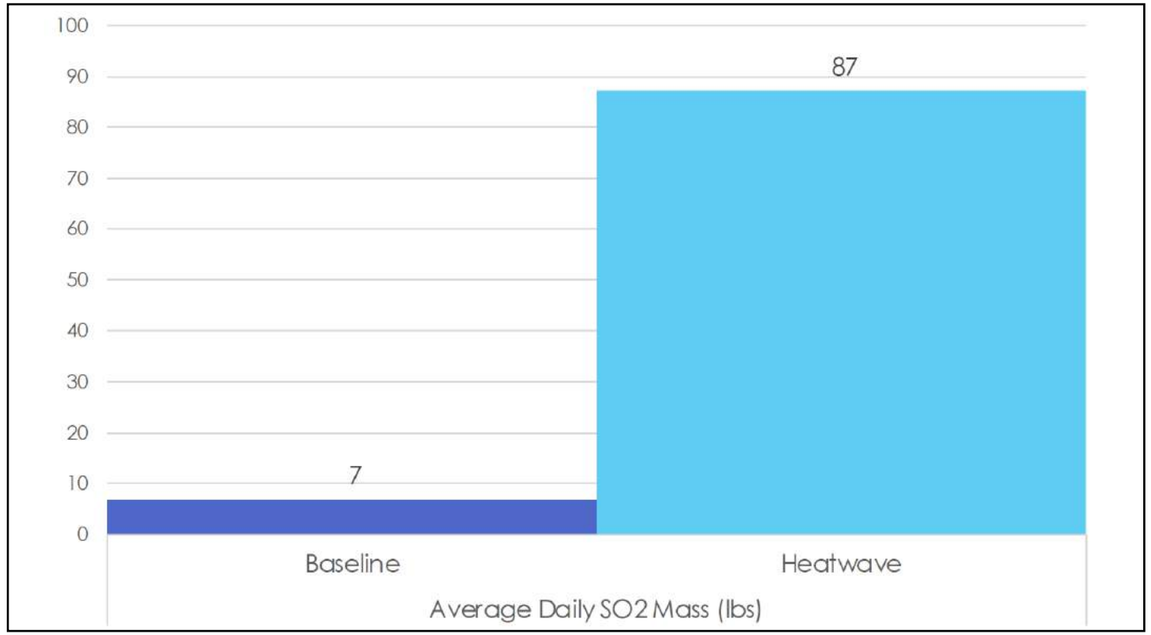

Figure 31. Average Daily SO_2 Emissions from Ormond Beach Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

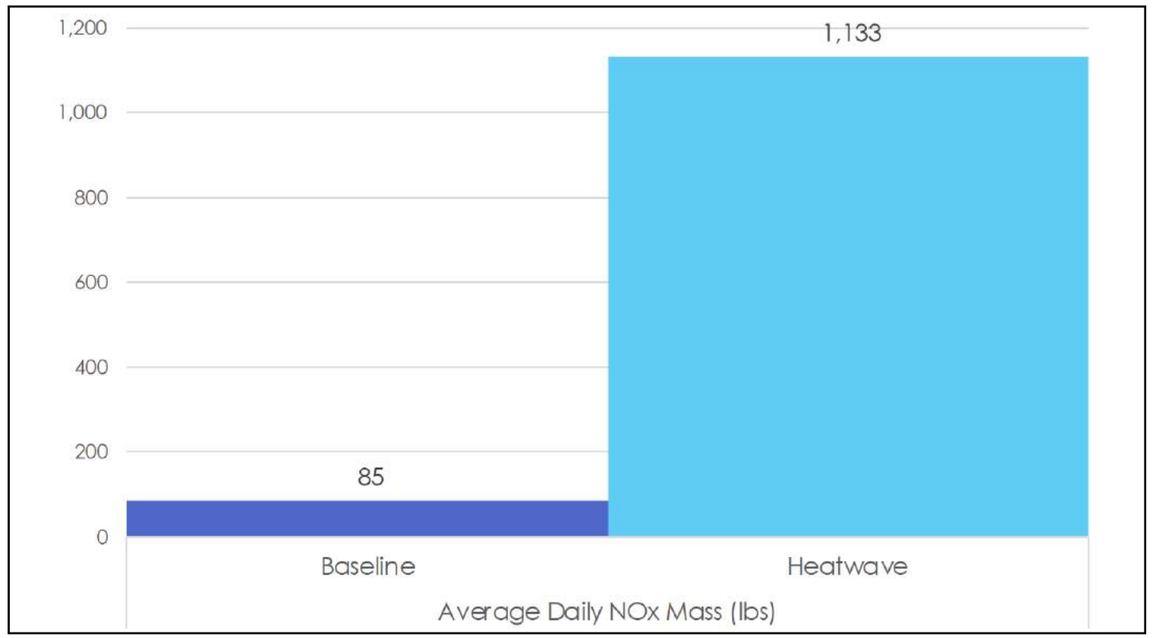

Figure 32. Average Daily NO_x Emissions from Ormond Beach Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

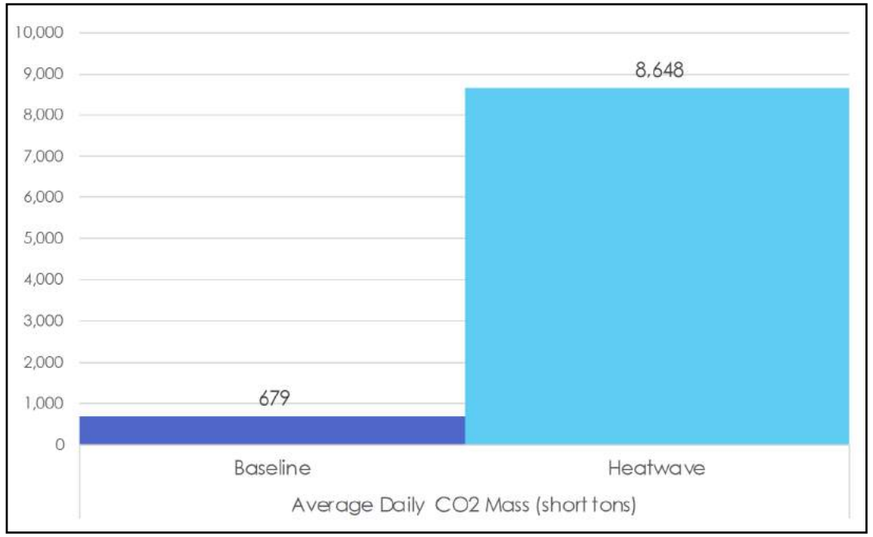

Figure 33. Average Daily CO_2 Emissions from Ormond Beach Power Plant During the Heatwave (8/31/22-9/9/22) Versus a Baseline Period (8/19/22-8/28/22)

As shown in Figure 10, the Sutter Power Plant also struggled with curtailments, mostly due to ambient temperature derates. Approximately one-third of the Sutter Power Plant's capacity was curtailed during some of the peak hours on September 5 and 6. Figure 10 also shows that the Sutter Power Plant struggled with curtailments during the hottest part of the day. Sutter Power Plant was ordered by CAISO to stay open for reliability reasons in 2012[32] and then was shut down again in 2015 due to it not being economically viable.[33]

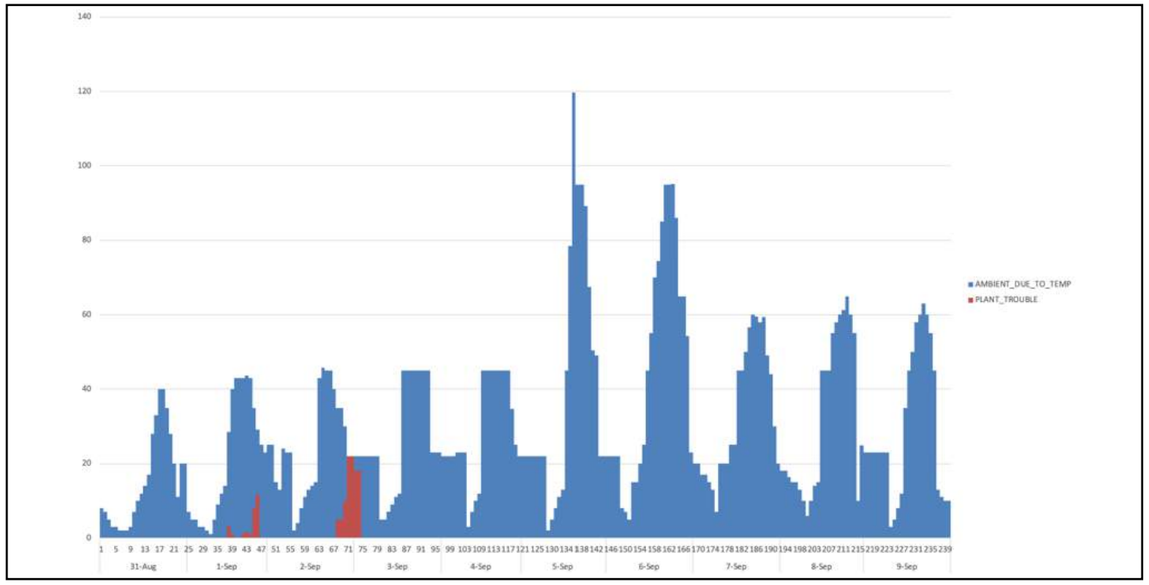

Figure 34. Total hourly curtailments by type for Sutter Power Plant during the heatwave

Methodology

Emissions Analysis

We retrieved emissions data from the U.S. Environmental Protection Agency Continuous Emissions Monitoring System (CEMS) data set for all California natural gas plants from August 1st to September 16th, 2022. We then narrowed our analysis to the emissions associated with the 10-day heatwave period from August 31 to September 9, 2022. We used the CEMS data to sum together the total emissions (CO_2, SO_2, and NO_x) for all natural gas plants in California during the heatwave.

We performed the same steps to calculate gas plant emissions for a baseline period that is representative of typical summer electricity demand, which was August 19-28, 2022. Per EIA 930 data[34], August 19-28 had the lowest CAISO generation during the August through September 2022 time period. Average hourly CAISO generation during this time period almost exactly matches average hourly CAISO generation for the whole summer period of June through mid-September 2022, and renewable generation was also about average for those ten days. Specifically, average hourly generation in CAISO for June 1st through September 13th, 2022, was 24,045 MW and the average generation in CAISO for our 10 day baseline of August 19-28, 2022, was 24,080 MW. Therefore, gas plant emissions for this period should be representative of a typical summer period.

To identify disadvantaged communities we looked at SB 535 communities, those in the top 25th percentile of the state of California's CanEnviroScreen. To match gas plants to SB535 communities we used EIA latitude and longitude points for each plant listed in CEMS and matched the coordinates to census tracts. Then the census tract of each gas plant was compared to each SB535 community, and gas plants within these communities were included and total emissions associated with all of these gas plants were summed.

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Reliability Analysis

For the reliability analysis, we used the Curtailed and Non-Operational Generator Prior Trade Date reports from CAISO[35] for the 10-day heatwave period from August 31 to September 9, 2022. We combined the CAISO outage reports into one data set. Then we added fuel type for each plant by cross-referencing the resource name to fuel types in the OASIS Master Control Area Generating Capability List. We then narrowed the dataset to natural gas plants. Manually, we also went through the fuel types labeled as "unknown" and added several other gas plants that were missing.

We then set the start and end time of any outage that started or ended outside of the heatwave to start at 8/31/22 at 12:00 am and end at 9/9/22 at 11:59 pm. We then removed duplicate entries based on outages that lasted across several days and were listed in each report. This was an issue with how CAISO reports curtailments that spanned several days. For example, if an outage went from 9/2/22-9/3/22 there would be an outage entry in the 9/2/22 report that said a curtailment started on 9/2/22 but never ended, but on the 9/3/22 report that same outage was reported but with an end to the curtailment. After we cleaned the dataset, we had individual entries for the total timespan of the curtailment. We used the elapsed time of those curtailments to expand each entry into hour intervals. We were then able to use the hour intervals to look at total curtailment in each hour of the 10-day heatwave period.

Value of Curtailment Calculation

To estimate the economic value of gas generation that was unavailable due to outages or derates, we multiplied the MW of unavailable gas capacity by the $/MWh Locational Marginal Price (LMP) in the CAISO real-time energy market for each hour. The LMP at the Southern California Edison-LADWP interface was used as the proxy for CAISO LMPs to reflect that load and outages during the event were heavily weighted towards Southern California. These hourly estimates of the economic value of unavailable gas capacity were then summed for the duration of the event. These results serve as a rough estimate of the cost of the gas generation that was unavailable, as the LMP reflects the marginal value of additional generation for each hour, though the total value of the unavailable generation may differ from the marginal value. A more complex method would be to estimate the change in production costs in each hour with and without the missing gas generation, though that would require hourly data on fuel prices for each generator (which is not publicly available) and an estimate of how gas prices would have been affected by the additional demand for gas if the gas plants were available – a counterfactual that would require complex analysis of gas system dynamics. Given the complexity and intractable uncertainty with that approach, we believe using LMP offers a reasonable estimate of the value of the unavailable gas generation.

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Generally, all gas-fired generation 25MW and above report CEMS data to EPA.

26 A short ton is an Imperial unit of mass. It is equal to 2,000 pounds. This is less than a metric ton (which is equal to 1,000 kilograms) or a long ton.

27 All emissions charts in this analysis except Figures 12 and 13 use a logarithmic scale on the y-axis to more easily show all three pollutants on the same chart.

Citations

28 Estimate was calculated using EPA's COBRA Web Edition. We increased COBRA's baseline SO_2 and NO_x emissions for California's gas electric utility fuel combustion to reflect the total emissions over the timeframe of the heatwave (i.e., heatwave average daily emissions * 10 days) to get an estimate. We used a 3% discount rate.

29 Estimate was calculated using EPA's COBRA Web Edition. We increased COBRA's baseline SO_2 and NO_x emissions for California's gas electric utility fuel combustion to reflect the total additional emissions over the timeframe of the heatwave (i.e., (heatwave - baseline average daily emissions) * 10 days). We used a 3% discount rate.

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