Building Decarbonization and Climate Impacts Policy Brief

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Executive Summary

Building decarbonization is a way of reducing greenhouse gas emissions by electrifying appliances and increasing energy efficiency. Since buildings account for about 39% of greenhouse gas emission contributions globally, building decarbonization must be prioritized if we plan to meet our goals in decreasing our contributions to climate change. As the transition to wider use of electricity is made, it is important that fuel sources are also taken into account.

Power plants are used to generate the energy required to have electricity and use different fuel sources to produce such energy. Focusing efforts on transitioning away from the use of natural gas for energy generation towards low and zero-emission fuel sources is crucial to reducing greenhouse gasses. In California, energy use accounted for 369.2 million metric tons of carbon dioxide (one type of greenhouse gas) emissions in 2020. Aside from their effects on greenhouse gas emissions, power plant types can also affect the health of communities. Pollution emitted by power plants includes particulate matter (PM), mercury, and other hazardous air pollutants. Health effects of living near power plants include heart and lung diseases and premature death.

California has the most power plants of any state located within a 3 mile radius of people of color and low-income communities. Many of these communities are considered environmental justice communities, or those facing excessive health risks due to where they live. Environmental justice communities may be getting left behind on building decarbonization efforts despite facing higher health impacts from greenhouse gas emissions and pollution from power plants. Policies that explicitly restrict greenhouse gas emissions for power plants will lead to faster decarbonization and reduced pollution for communities nearby. Once decarbonization efforts meet at least 80% implementation, pollution levels will be more equal across racial groups. If there are no policy changes in decarbonization efforts, then Black and Hispanics and low-income communities in California will continue to bear the greatest health burdens of pollution.

Several programs and regulations exist to encourage the adoption of decarbonization and assist stakeholders in accessing funding. These policies will require the adoption of technical assistance, increased funding for vulnerable communities, and widespread education about upfront costs versus lifetime benefits. An analysis of policy impacts was done to compare how close power plants are to the top 25% low-income and people of color communities. Scenarios where natural gas continues to be used, low and zero emission plants are used, and where power plants are retired were compared. This analysis can be used to target efforts locally to California.

In order for building decarbonization to be equitable, efforts must target communities living closest to power plants, low-income, and people of color communities. Efforts should focus on reducing upfront costs, reducing greenhouse gasses and pollution, and educating stakeholders. These can include monitoring systems by utility and construction companies and power plants, outreach and education programs, and targeted incentives.

Introduction

As climate change continues to be felt across the globe and in the US, efforts to slow down its effects and prevent larger disasters are at the forefront of leaders everywhere. Globally, buildings contribute at least 39% of greenhouse gas (GHG) emissions to climate change (World Green Building Council, 2019). Greenhouse gas emissions accelerate climate change and are formed from different sources of pollution. Sources of GHG emissions besides buildings that contribute to climate change include vehicles for transportation, agriculture, and industrial processes.

The majority (28%) of the global carbon emissions from buildings is generated from the operational needs of buildings including energy needed for heating, cooling, and powering them (World Green Building Council, 2019). Besides needing energy to operate, buildings can also leak GHG emissions depending on the appliances used. For example, one study found that gas stoves can leak methane emissions equal to the carbon dioxide (CO2) emissions released from 500,000 cars each year (Lebel et. al, 2022). Reducing the GHG emissions from buildings is an effective way to address the effects of climate change impacts.

Building decarbonization is a way of reducing GHG emissions through programs or active efforts (California Energy Commission [CEC], 2023a). Building decarbonization including the electrification of natural gas appliances in buildings improves climate mitigation efforts and can reduce or prevent harmful climate change impacts on communities. Climate mitigation refers to efforts aimed at slowing down climate change. Since building decarbonization addresses greenhouse gas emissions, this is one climate mitigation strategy. Reducing the impacts of climate change is important for the health of communities. Climate change can affect mental health, air and water quality, and increase extreme weather (Centers for Disease Control and Prevention, 2022). These problems can have detrimental effects for communities.

In the US, primary energy consumption per capita is 3.6 times higher than the entire world's (Ritchie et al., 2022). From the energy consumption taking place in the US, the primary energy consumption of gas per capita is more than the global energy consumption with all sources of energy combined (Ritchie et al., 2022). Most of the CO2 emissions from buildings come from the emissions created by the electricity used to power buildings, including the use of fossil-fuels or gas (Center for Climate and Energy Solutions, 2018). Addressing the use of gas as an energy source could help the US reduce its energy consumption and costs associated with using gas.

The Problem

California uses 9.1% more gas to generate its grid electricity than the national average (EPA, 2023b). Grid electricity refers to a connected network in which energy is stored and distributed to different areas of the state (EPA, 2023a). Using natural gas to generate energy like electricity requires burning to take place. Other fuel sources used to supply energy to people include wood, coal, petroleum, wind, solar, hydrothermal, hydroelectric, and nuclear. Although natural gas use may be better than other energy sources like coal, the ideal case scenario is an increase in low or zero emitting fuel sources. The EPA characterizes fuel sources from zero-emitting to emissions-

intensive with zero-emitting sources being those that produce less co-pollution and emissions-intensive being those that expel more pollution (EPA, 2023a). Emissions-intensive fuel sources include natural gas (gas), coal, petroleum, and other fossil fuels. Zero-emitting fuel sources include “nuclear, solar, wind, and hydro“ (EPA, 2023a).

In 2020 alone, the state of California emitted 369.2 million metric tons of CO2, which includes emissions resulting from imported electrical power (CARB, 2022). California plans to cut its use of fossil fuel consumption by 86% to achieve carbon neutrality by 2045 (California Air Resources Board [CARB], 2022). CO2 released into the atmosphere contributes to global warming, hence efforts to decarbonize buildings and electrify natural gas appliances to reduce greenhouse gas emissions and mitigate climate change impacts are ongoing. Using less harmful energy sources to produce electricity could help reduce the harmful emissions generated from using electricity.

It is important to note that there are some potential drawbacks and concerns about consolidating different energy sources into mostly electricity. Currently, a mix of fuel sources are used to produce energy. There are concerns that using mostly electricity could result in more power outages since the power grid will be overwhelmed, not enough electricity can be produced for everyone, or costs for electricity would be higher. There is also a concern that using only one or a few fuel sources could result in more frequent energy shortages since there will be less opportunities to use other fuel sources as a backup. These concerns could pose a risk to the national economy and security (U.S. Government Accountability Office, 2021). Other concerns are around potential health and environmental impacts that will be generated from new construction to build lower emission fuel sources to generate electricity (Plumer, 2023).

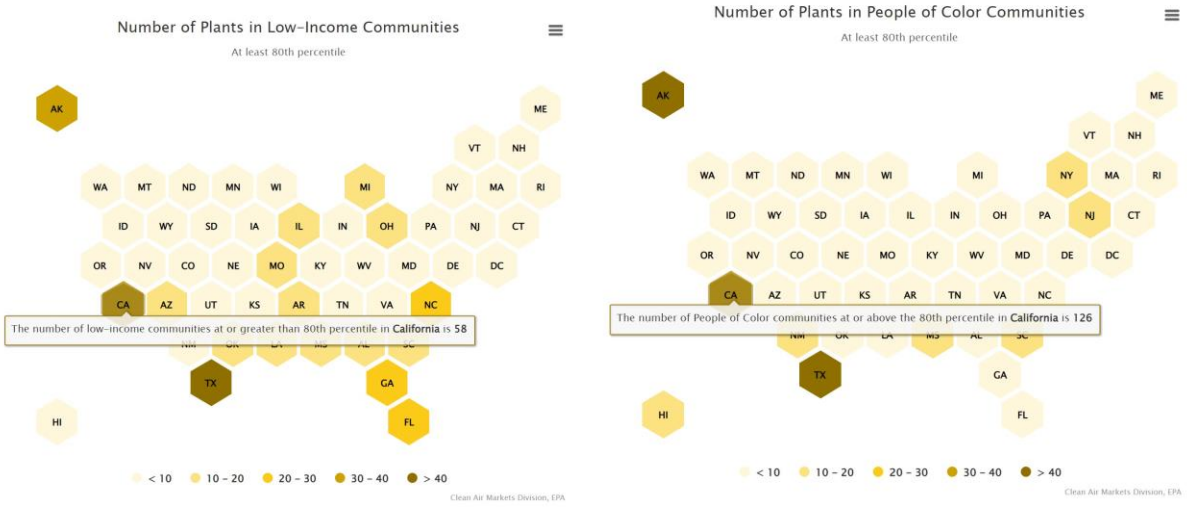
If building decarbonization in California leads to increases in electricity but does not address the retirement of existing emissions-intensive power plants, greenhouse gas emissions could potentially increase for lower-income and disadvantaged communities. The LA100 Study in Los Angeles, California determined that concentration of pollutants emitted from non-natural gas power plants could increase at the neighborhood level if the infrastructure design of these were to be changed in the transition to clean energy (Hettinger et al., 2021). This policy analysis will explore whether this relationship holds true and what the potential outcomes of increased electrification for building decarbonization could be for communities that typically live closer to emissions-intensive power plants.

Population Characteristics and Disparities

Conventional power plants burn gas or fossil fuels to generate energy, though as mentioned previously there are other types that produce less pollution if they don’t burn fuel (EPA, 2023a). According to the EPA (2023c), out of 3477 total power plants in the US, there are 388 (11.2%) and 421 (12.1%) power plants located within a 3 mile radius of people of color and low-income communities respectively. As the percentage of households in poverty increases, the number of power plants, fuel generation, and greenhouse gas emissions also increases for these households

(SO2, CO2, NOx) (EPA, 2022). SO2, CO2, and NOx are common pollutants that are emitted into the air by power plants. In the US, the state of California has the highest number of plants located near low-income communities than any other state (EPA, 2022). Unfortunately California also leads the way in having plants near communities with people of color as seen in Figure 1 and 2. Even when compared to other states with the high rankings of plants near people of color, California has twice the number of plants as the second highest state in the US (EPA, 2022).

Pictured Left to Right: Figure 1 Number of Plants in Low-Income Communities and Figure 2 Number of Plants in People of Color Communities



Besides greenhouse gasses, communities living near power plants also face potential exposures to particulate matter (PM), mercury, and hazardous air pollutants (EPA, 2023c). GHG and other pollutants emitted from power plants have many potential negative health outcomes including heart and lung diseases, premature death, and increased visits to emergency rooms and hospitals. Low-income and poor health individuals face increased vulnerabilities to these potential exposures of pollutants due to increased stress on the body, nutrition deficiencies, and lack of access to care (EPA, 2023c). Despite living closer to power plants, lower income individuals emit at least 25% less greenhouse gasses than higher income individuals (Goldstein, 2020).

It's important that policies aimed at addressing the use of gas to generate energy explicitly consider environmental justice communities. Environmental and climate justice communities are often left behind on building decarbonization efforts though they are likely to face the most climate impacts compared to other communities (Political Economy Research Institute [PERI], 2021). Environmental justice communities are more likely to be living power plants and energy producing industries that can create pollution as we see in California. When policies do not explicitly address co-pollutants of energy generation and environmental justice, they are less likely to improve environmental conditions for environmental justice communities (PERI, 2021). California is likely to face greater consequences than other states when policies are not explicit, especially among Hispanics and Blacks. The good news is that costs remain practically the same

regardless of whether policies do, or don't include these co-exposures, with only a 5% increase in costs (PERI, 2021). This 5% increase in monetary costs to address co-pollution and environmental justice reduces the health costs that would otherwise burden communities.

An epidemiological study by Goforth & Nock in 2022 found that if decarbonization policies are left as is, emission-intensive power plants would remain in operation and natural gas use would increase by about 20% in generating electricity. Scenarios in which CO2 emission reductions are supported result in lower emissions, higher use of zero-emitting fuel sources, and retirement of emissions-intensive plants over the years. Without a low-carbon policy, Goforth & Nock (2022) predict that natural gas would generate between 10-20% of energy. NOx, SO2, and PM2.5 emissions fell with the decreased use of natural gas. Until decarbonization reaches at least 80% implementation, Black and non-Hispanic White populations will face potential exposures to the highest amounts of NOx and PM2.5. The faster decarbonization takes place, the less burden these communities will face (Goforth & Nock, 2022).

Current Laws, Regulations, and Programs

Currently, there are several laws, regulations, and programs that exist to promote building decarbonization and address the potential impacts that come with increased electrification. At the federal level in the US, the Environmental Protection Agency (EPA) administers several programs aimed at protecting the environment. Through the Inflation Reduction Act, an EPA program called the Greenhouse Gas Reduction Fund was created. The Greenhouse Gas Reduction Fund will provide grants for clean energy projects aimed at reducing GHG emissions. Projects include clean technology, financing assistance for low-income and disadvantaged communities, and investment in community solar power (EPA, 2023d).

In addition, the EPA runs the ENERGY STAR program which aims to reduce energy and climate impacts. Through this program, the EPA partners with industries to improve the energy efficiency of appliances (ENERGY STAR, 2022). The program is voluntary and has led to billions of savings in electricity and energy costs and reduced GHG emissions. The program is beneficial for both industries and consumers because consumer energy bills are lowered with more energy efficient appliances. Since this program is federal, it is also applicable to California.

California specific programs include the EPIC program and CalEHP. The Electric Program Investment Charge Program (EPIC) is run by the California Energy Commission [CEC]. EPIC funds research around technology and science to help meet the state's electrification goals (CEC, 2023b). Over $130 million is invested by EPIC each year to "clean energy solutions" (CEC, 2023b). Noteworthy accomplishments from EPIC include helping fund renewable energy expansions, building infrastructure for the electricity system, advancing electric technology for buildings, decentralizing the electric grid, improving costs and health of communities, and supporting the economy (CEC, 2023b). CEC set a goal of having 25% of the program's technology funding go to disadvantaged communities and at least another 10% of the program's funding go to low-income communities.

Another program in California called California Electric Homes Program (CalEHP), is aimed at electrifying new buildings and was approved through Assembly Bill (AB) 137. The program provides incentives for builders and developers for the new construction of homes that are all-electric and "installation of energy storage" (CEC, 2023c). In addition to financial incentives, the program also has a technical assistance component that is aimed at assisting developers in obtaining this funding. Single family homes, multifamily, and manufactured homes are eligible for consideration through the program.

Lastly, the California Public Utilities Commission administers the Self-Generation Incentive Program (SGIP) which provides rebates and incentives for installing energy storage technology in homes, apartments, critical facilities, and new buildings (California Public Utilities Commission, 2021). The goal of this program is to encourage resilience in emergencies like power outages, especially in wildfire prone areas, areas that experience power outages often, low-income, and "medically vulnerable" communities. Critical facilities eligible for higher rebates include homeless shelters, cooling centers, emergency response, food banks, utilities, jails, and grocery stores. Higher rebates are available for these communities since they are considered the highest need. Rebates for communities not in these categories start at 25% of the costs of these energy storage technologies and the highest rebates cover 85-100% of the costs. The program explicitly includes a requirement that projects will reduce GHG emissions and includes regular evaluation reports.

Room for Improvement

As is the case with many programs and regulations, there is usually room for improvement. With the Greenhouse Gas Reduction Fund, the grant process is mainly aimed at organizations so it will be important that a technical assistance component is added. Organizations with less technical knowledge of applying to grant programs through the EPA could be left out of these funds and thereby leave out their respective communities. Technical assistance components can give opportunities to organizations that might otherwise be unfamiliar with the application process. EPA's staff should take an equitable approach in determining who receives funding.

Programs such as the EPA's ENERGY STAR and the California Public Utilities Commission SGIP program require upfront costs that may leave lower-income and disadvantaged communities out. In the case of the CalEHP program, it is aimed at new developments and leaves out those living in older buildings. Many buildings in the US are between 30-70 years old and are a lot more energy inefficient than newer buildings (Center for Climate and Energy Solutions, 2018). These buildings might lack amenities that could conserve energy and improve appliance efficiency. Upfront costs are high for some energy efficient appliances like heat pumps but the benefits are realized over the life course of these appliances (Center for Climate and Energy Solutions, 2018). For communities that do not have the money for upfront costs of energy efficient appliances, they could be facing higher energy bills and health costs.

Some caveats of a multiple of these programs are a lack of awareness and information and a lack of funding. Electricity users may not always have access to seeing how much energy they are using so upfront costs may seem higher than the savings that could be realized (Center for Climate and Energy Solutions, 2018). A lack of information about energy use could also cause problems in the SGIP program which requires a determination of how much energy individual households might need to be prepared for emergencies. Although there is an energy audit component, if the audit is not done holistically, some households may still be unprepared.

A lack of funding plagues many of the incentive programs and can be discouraging for applicants. For example, the SGIP program already exhausted funding for the 85% rebates and is also based on a first-come basis. Basing rebate programs on a first-come first-serve basis could discourage individuals from bearing the upfront costs if there is no guarantee that they will be reimbursed once the project is complete. If funding for the highest rebates is exhausted quickly, it means that there are a lot more people in need of assistance and likely a lot more have been excluded. Individuals that are better connected might be realizing the benefits of these programs sooner than individuals that are socially isolated or lacking technological resources to access these program applications.

Potential Impacts of Policy Changes

The tool used to assess potential impacts of policy changes is Geographic Information Systems (GIS). Two sets of maps showcasing different scenarios were made for comparisons of federal EPA data projections for California versus California provided data. According to the national Environmental Justice Index (EJI) tool, CalEnviro and local state tools should be better for California based calculations since they are more specific to local problems (Agency for Toxic Substances and Disease Registry [ATSDR], 2022).

The first set of maps looks at EPA data about power plants and GHG emissions emitted in California using the power plant profiler GIS portal. The baseline filter I used for these maps is a 75% demographic index in order to be comparable to the SB 535 layer that was later done for California produced data. The demographic index is a measure of being low-income and a community of color (ATSDR, 2022). The power plant profiler shows communities living within 3 miles of a power plant. One map shows natural gas plants, the next map shows biomass plants as a proxy for low and zero-emission plants, and a third map shows power plant retirements. Plant retirements are planned from 2019-2030 as shown in Figure 3 with 98% of 52 retiring plants are gas powered (EPA, 2022). To show natural gas and biomass compared to the demographic index, each layer was selected in their respective maps shown in Figures 1 and 2.

Figure 1 and Figure 2, Left to Right: Natural Gas to Biomass Plants Locations for 75% Demographic Index Percentiles from the EPA

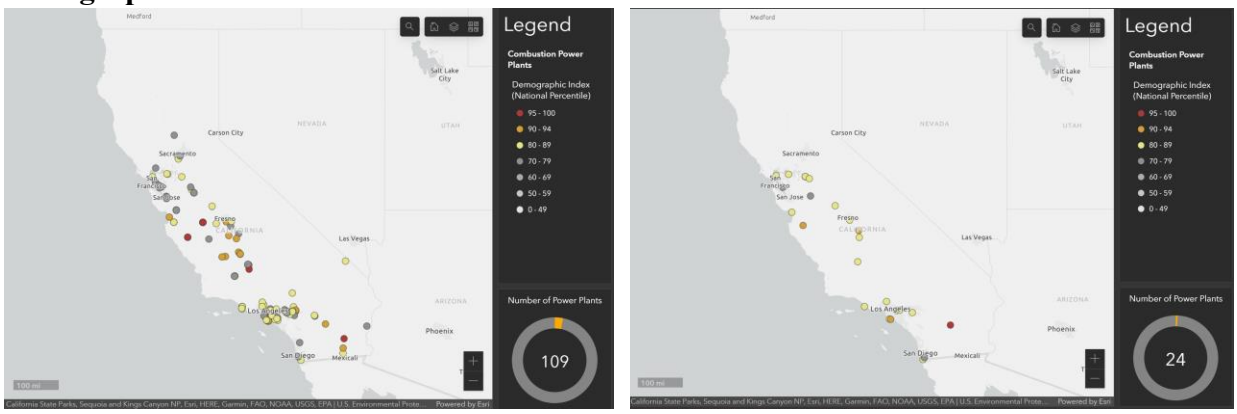
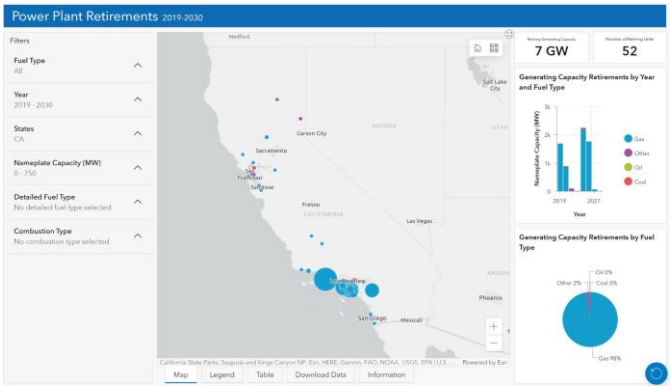


Figure 3 Power Plant Retirements from 2019-2030 from the EPA



The second set of maps looks at California produced data. Using GIS, the basemap layer is the SB 535 disadvantaged communities layer in the CalEnviro 4.0 screening tool, which highlights the 25% highest scoring census tracts, tracts that have high pollution and low populations, and tribal areas in California. The basemap layer was selected because it represents a quantitative measure of the most disadvantaged communities in California. Since CalEnviro accounts for population, population was not standardized. The next layer that was overlaid was the California power plant layer from the CEC. Spatial comparisons were made between proximity to SB 535 communities and power plants using natural gas, low and zero-emission sources, and plant retirements. The maps on the left are point maps and the maps on the right are heat maps meant to highlight hotspots. In the hotspot maps, a 3 mile buffer distance from power plants was set in order to determine how large the heat map area of influence should be and make the maps comparable to EPA's 3 mile distances. For natural gas locations, the CEC power plant layer was filtered for primary energy sources containing "NG" for natural gas and "GAS" and resulted in a selection of 337 power plants as seen in Figure 4. This is 3 times higher than the EPA's record. Low and zero-emission plants shown in Figure 5 included those with primary energy sources being solar, hydroelectric, wind, biomass, geothermal, and nuclear. Solar, water, and wind had the most plant counts. Retired plants had a value of 1 so these plants were filtered and shown near SB 535 communities in Figure 6 for a total of 233 retired plants. Since EPA's maps show only biomass and a larger date range for planned retirements, Figures 5-6 aren't comparable.

Figure 4 Natural Gas and Gas Power Plants Near SB 535 Communities

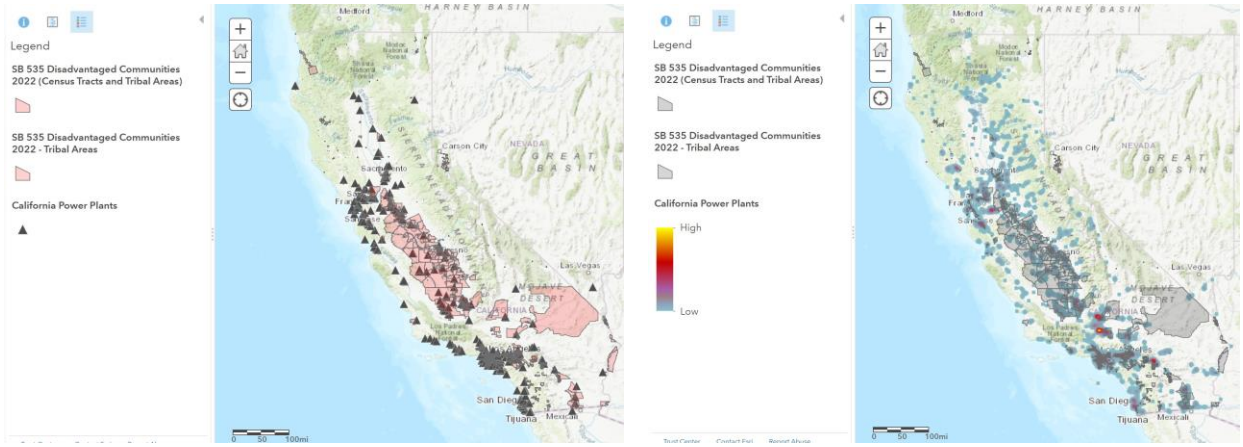


Figure 5 Low and Zero-Emission Plants Near SB 535 Communities

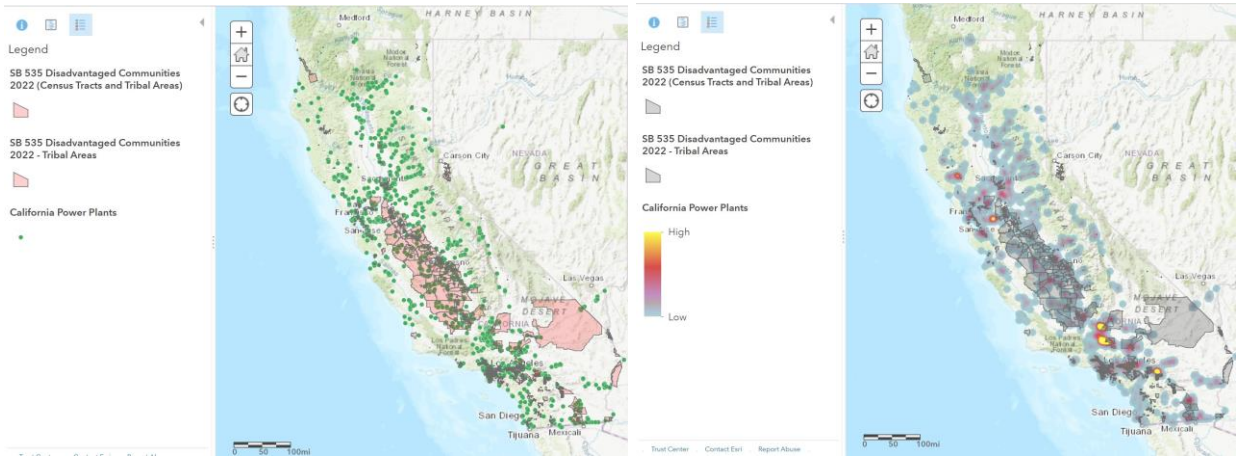
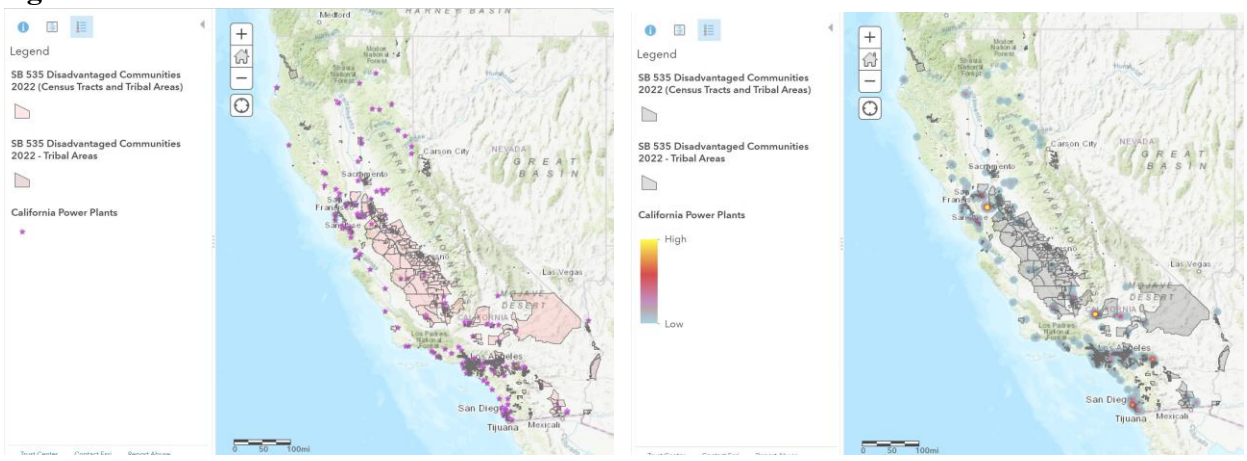


Figure 6 Plant Retirements Near SB 535 Communities



The reason for three separate maps being overlaid using federal and state data is to show different scenarios and projections. If the status quo remains as buildings in California are electrified then natural gas use will increase and could be affecting the health of populations living near power plants. If natural gas power plants are retired and low-emission power plant use is increased, it will be important to know what communities are facing the environmental

impacts of this alternative energy generation. Lastly, the third map overlays show trends in where power plant retirements are planned for and can highlight areas that should be targeted next.

Based on EPA data, Figure 1 and 2 show that there are 4.5 times more natural gas plants than biomass plants in communities in the 75th percentile of the demographic index. This is comparable to the maps in Figures 4 and 5 which show that there are a few hotspots of natural gas and low or zero emission plants near SB 535 communities. Notable hotposts of plant locations near SB 535 communities are in Southern California as shown with the yellow color in the right hand side maps of these figures. There is a focus and trend in the retirement of power plants in a few hot spots in Northern and Southern California, with more emphasis on Southern California as shown in Figure 6. Figure 3 shows that according to EPA available data, not many plants in Central California have plans of being shut down.

Limitations of Analysis

The first limitation of this method is that only the top 25% high scoring census tracts were used to analyze the affected populations. This was done by using the EPA's 75% demographic index and SB 535 highlighting the top 25% scoring census tracts. Populations that are below the 75th percentile including those that are in the border line populations likely would face similar issues if they are located near power plants due to location proximity. According to the EPA (2023c), even people living further than 3 miles could experience the effects of power plant emissions.

Another limitation is that data sources may not be directly comparable. There are differences between the EPA power plant profiler and the CEC power plants database for California. EPA's power profiler shows 27 more plants than what CEC has, once plant utilization is set to 2% in EPA's power profiler, then there is a 3 plant difference between the two databases. This could mean that the EPA database is also including retired or closed plants. Another difference is that the EPA power plant profiler only has the option for "biomass" and "other" fossil plants so only biomass was used to view zero or low-emissions plants. The biomass count for California from the EPA is 93 plants versus a biomass count of 88 from CEC.

Recommendations for Action

More than half of Americans believe climate policies are important, but less Americans now believe that climate change is being caused by people (Energy Policy Institute at the University of Chicago, 2023). Climate policies around decarbonization can be led by the California Energy Commission. Decarbonization efforts will require widespread education and information efforts to ensure that those involved in building infrastructure understand the impact that their choices can have on climate mitigation, adaptation, and health. Buy-in from stakeholders including the construction industry will be important to make these efforts successful. Policies to address education efforts could include statewide construction requirements and outreach programs for building decarbonization programs and power plants. Electrifying appliances in residences can decrease GHG emissions and reduce the pollution people are exposed to both inside and outside their homes. Efforts should be targeted to communities living near power plants since these will

be generating the energy in the electrification movement. Targeting efforts to these communities could reduce the amount of pollution communities have to deal with both inside and outdoors.

Policymakers in California should be aware of what tools are being used in the decision-making process to ensure that they are accurately depicting local problems within communities as was highlighted in the analysis portion of this report. Health impacts should be considered throughout decisions and fairness to communities living near active power plants should be a priority. One way to do this is by implementing a Health in All Policies approach where decisions of power plant locations, energy generation fuel sources, and greenhouse gas mitigation efforts are weighed against health impacts. Decarbonizing quickly will reduce negative health impacts for vulnerable communities living near power plants. Low and zero-emission plants generate less greenhouse gasses and co-pollutants, hence these should be prioritized as primary energy sources for electricity. Efforts to source energy from lower-emission sources should be continued in Southern California and additional efforts should be targeted to Central California due to a lack of planned natural gas plant retirements in the area. As we transition towards these less harmful energy sources, considerations should be made of how energy is being sourced, who is being affected by new constructions, and efforts should be made to track GHG and co-pollutant emissions as these sources become used more widely. This information should be provided publicly and should be easily accessible from utility companies. Utility companies and power plant facilities could be required to include these considerations in their reporting systems.

Funding and incentives are needed to ensure that decarbonization efforts are not stalled due to upfront costs. According to the Energy Policy Institute at the University of Chicago (2023), Americans engage in climate beneficial behaviors when it saves them money on energy bills and is not as costly to implement. Americans bought more energy efficient appliances but a smaller percentage owned an electric car. Despite this, Americans on the West Coast are more likely to purchase an electric car than any other areas in the US (Energy Policy Institute at the University of Chicago, 2023). Californians are ready to transition to using electricity but might be deterred by the costs of doing so. Funding for building decarbonization should target low-income communities, people of color, and those living within a 3 mile radius of power plants to ensure fairness of benefits reaped. Additionally, funding should also prioritize older buildings. New funding specific to those meeting this criteria could be created to reduce pollution impacts.

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