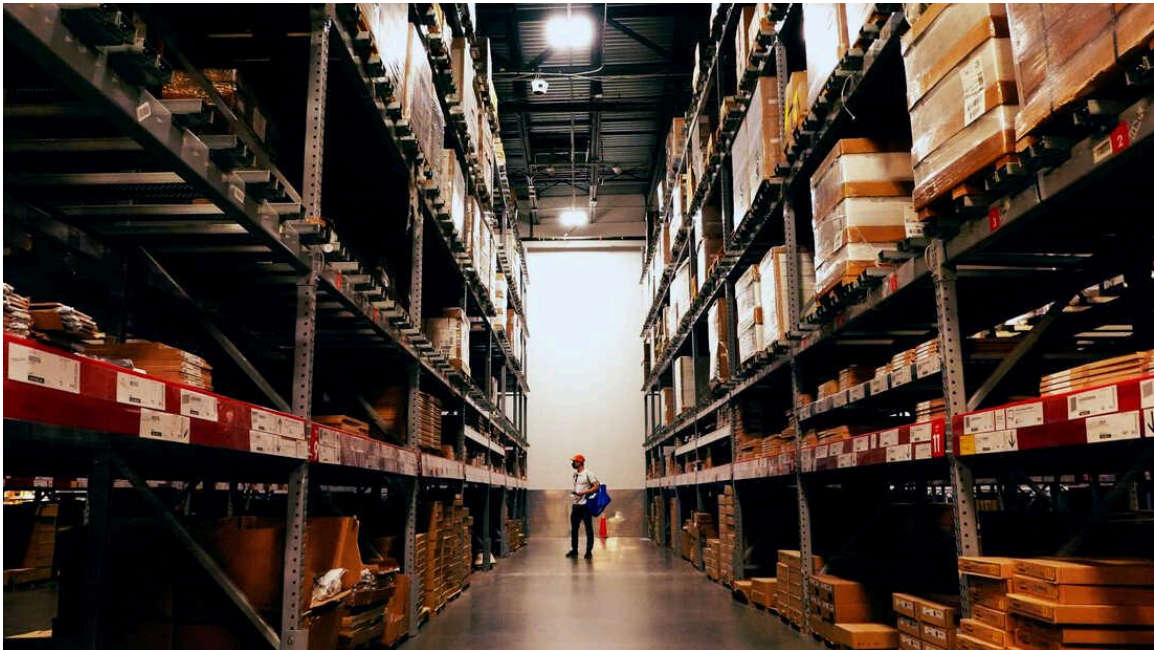


Addressing Environmental Justice Through

Warehouse Reforms

Final Report



CE 105

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5/7/2024

Team mission statement

Our mission is to develop an understanding of the issues faced by the community of Stockton due to the warehousing industry and to support community organizations in establishing effective industry regulations with the goal of improving local air quality and wellbeing.

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Introduction

Air pollution has detrimental impacts on human health and livelihood. The World Health Organization reports that air pollution causes around 7 million premature deaths worldwide each year, translating to a staggering 800 deaths every hour or 13 deaths every minute (Chen 2019). In 2016, the Stockton metropolitan area ranked the eighth-highest level of particulate matter in the U.S., placing nearly a third of its residents at a heightened risk of developing asthma or other respiratory conditions (Anderson, n.d.). One major source of particulate matter is the warehouse industry. A study conducted in Illinois found that residents living within half a mile of a warehouse showed increased rates of these air pollution-caused diseases, such as asthma (Mernit 2022). Disadvantaged communities, such as Stockton, located in the San Joaquin Valley of California, are caught in this cycle of economic reliability causing increased land designated to a polluting warehouse industry. In the last 24 years, Stockton has developed about 100 warehouses larger than 100,000 square feet, a growth that is 10% higher than the rest of the country (McGhee 2022).

The report examines the potential impact of air pollution caused by proximity to warehouses on local health. Specifically, it delves into the impact of the Mariposa Industrial Park Project, assessing the project's repercussions and exploring regulatory measures regarding warehouse operations. Our vision for Stockton revolves around adopting cleaner energy sources and implementing more stringent regulations, which will likely lead to a reduction in warehouse operations and, consequently, less air pollution. Additionally, the report provides a comprehensive overview of the economic and health effects of warehouses in Stockton. The team's research process has been in collaboration with community organizations and partners to help create a healthier and more sustainable future for the residents of Stockton, particularly the historically marginalized groups. In order to grasp the full scope of this issue, it is essential to delve into the background and history of Stockton.

Historical Background

After World War II, the Federal Housing Authority (FHA) provided developers with low-interest loans and backed mortgages for new buyers through the Home Owners Loan Association. The practice of redlining, implemented by the Home Owners' Loan Corporation, used color-coded maps to label certain neighborhoods as unworthy of investment, leading to the exclusion of non-white residents from new developments. This exclusion contributed to socioeconomic stagnation in BIPOC communities. In the 1970s, Stockton leveraged FHA funds to acquire land downtown for the Crosstown Freeway.

The Crosstown Freeway linked Interstate 5 and Route 99, facilitating truck movement between the two highways. These initiatives tore through the heart of downtown Stockton's Chinatown, Japantown, and Little Manila district, resulting in the displacement of approximately 12,000 Black, Hispanic, Asian, and Filipino residents (Ong et al. 2023).

A comparison of historic maps of Stockton's redlined areas (Figure 1) with PM 2.5 emissions (Figure 2), reveals a striking similarity, and highlights the environmental injustice rooted in past socioeconomic policies (Alkon 2023). Additionally, inadequate zoning laws, coupled with economic expansion and rising consumer demand, influenced the development of warehouses within BIPOC neighborhoods. Historically, South Stockton has been subject to redlining and public disinvestment, leaving BIPOC communities struggling. This lack of access to financial services, employment opportunities, and pathways to homeownership has led to disproportionately high poverty rates in neighborhoods affected by redlining (Soderling 2021). As a result, land values in South Stockton remained low, and **loose zoning regulations enabled an overwhelming influx of warehouses into these communities**. The economic pressures forced the local residents to work minimum wage jobs, often multiple, to barely make ends meet. This economic strain also left them with little time or resources to engage in self-advocacy regarding the air pollution caused by warehouses.

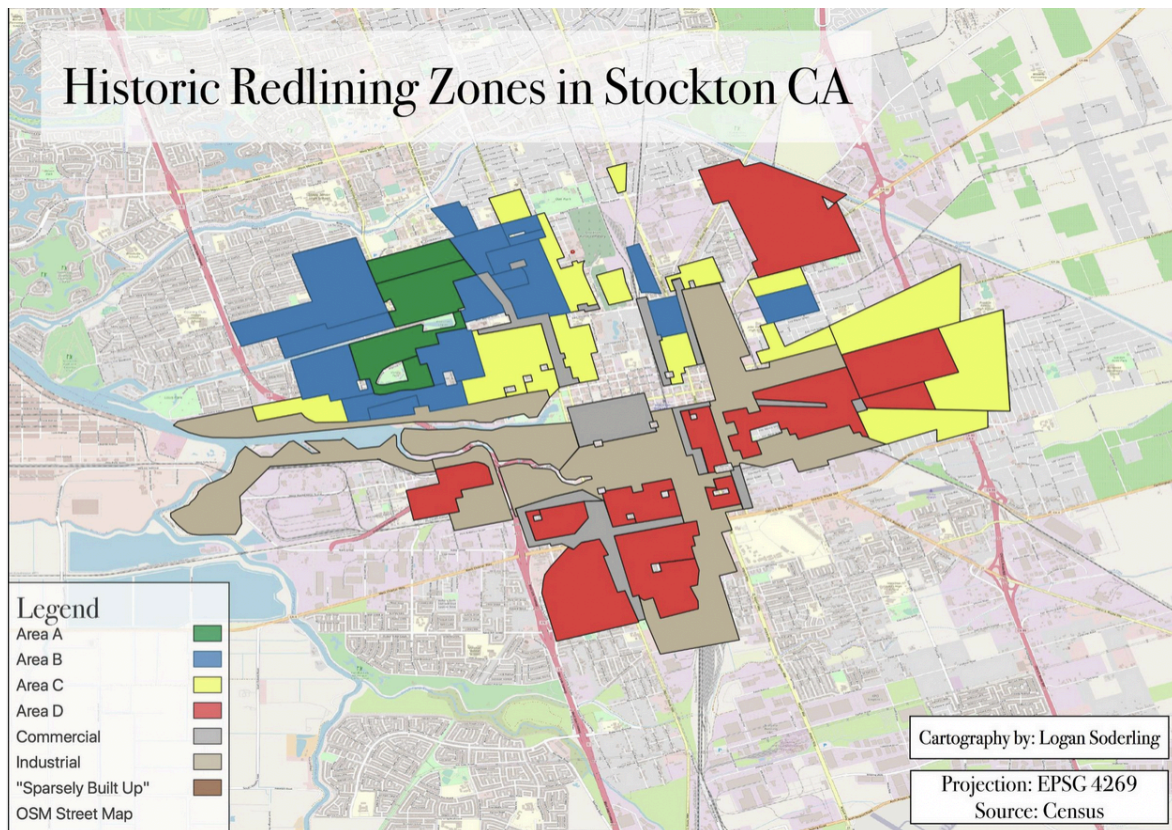


Figure 1. A map displaying the historic redlining in Stockton (Soderling 2021).

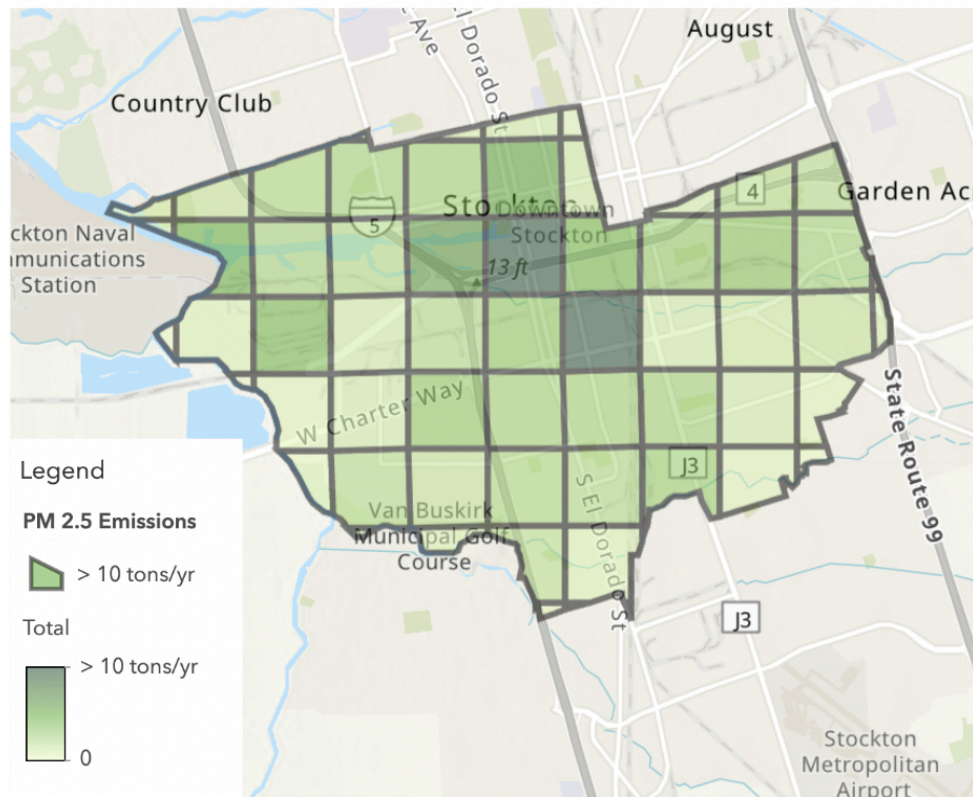


Figure 2. A map displaying the PM 2.5 emissions in Stockton. The map was created via ArcGIS. Link: (<https://arcg.is/05Sqrq>)

The industry sector, including transportation, warehouses, and utilities, increased by 74.3% in San Joaquin County from 2013 to 2018 (Anderson, n.d.). According to the Center for Business and Policy Research at the University of the Pacific, the county became the second highest concentrated warehouse metropolitan area in the US in 2019 (Alkon 2023). Stockton's history of redlining and displacement has led to environmental injustices, relating past socioeconomic policies to the present disproportionate exposure of BIPOC communities to poor air quality and health risks.

This report delves into the environmental injustices faced by Stockton's BIPOC communities due to the influx of warehouses, initiated by historic redlining and public disinvestment. **The city of Stockton's Mariposa Industrial Park Project in particular, was approved in recent years despite environmental impact concerns, likely due to a lack of initial community engagement.** This is a consequence of developers reaching out to building owners, rather than tenants. After increased awareness, the community became more involved with this issue and advocated for increased mitigations to lessen the impact of the warehouse project on their quality of life. However, the developers failed to incorporate these measures, prompting intervention by the Attorney General and

Sierra Club, a national grassroots environmental organization, which resulted in a legal settlement, known as the Mariposa Agreement. Jonathan Pruitt from the California Environmental Justice Alliance (CEJA) is actively working to update these measures. During a recent City Council meeting, city officials had predetermined changes to these measures without consulting community members. The Mariposa Industrial Park Project serves as a case study to examine potential improvements and its effects on the local community.

Our Vision for 2030 and Beyond

Our vision for the city of Stockton, CA is for the community to feel empowered, united, and heard by reducing the environmental impacts due to warehouse construction and operations. As a long term goal, the city needs to prioritize long-term economic growth in BIPOC and underprivileged areas to enable individuals to climb the socioeconomic ladder. This in turn leads to an increase in financial stability, which will give residents more time to advocate for change, resulting in the enactment of effective warehouse regulations and fewer warehouses overall. However, as a short term goal for 2030, the city needs to create a platform to listen to impacted communities and incorporate their perspectives into regulating warehouse development. Even if the entrenched systemic barriers are not addressed, the city can improve by listening to the community's environmental concerns, as they should have regarding the Mariposa Industrial Park Project.

Furthermore, this will lead to cleaner warehouse operations through the use of EV vehicles and clean energy sources, such as solar panels. Specifically, at a minimum we would see the EJ advocate amendments enacted into the Stockton Warehouse Ordinance as it is under revision following the Mariposa Industrial Park Project controversy. This would include that warehouses must use 100% clean energy sourcing (Measure #13), and a switch to electric vehicles with increased infrastructure for heavy duty and personal electric charging stations (Measure #14-15) (Stockton Environmental Justice Advocates 2023). In addition to this ordinance, there would be further regulations including a cap placed on how much land could be sold as industrial space and requirements to include landscaping or vegetation buffers such as trees and hedges which help blend different land uses by protecting the community from industry emissions and noise (Buldeo Rai 2023). These measures should be implemented as soon as possible. The voices of community members need to be at the center of warehouse development – not considered as an afterthought through a settlement.

As a result of increased warehouse green practices, there would not be disproportionate health impacts among BIPOC and lower income households when compared to white and high-income households. For example, the rate of asthma in the

San Joaquin Valley would not tower over the rates in California. The rate in the San Joaquin Valley would more closely reflect the rest of the state which is shown in Figure 3. Observing smaller percentages of asthma diagnosis in youth would indicate that air pollution reductions are reduced enough to see a trending decrease in resulting health effects.

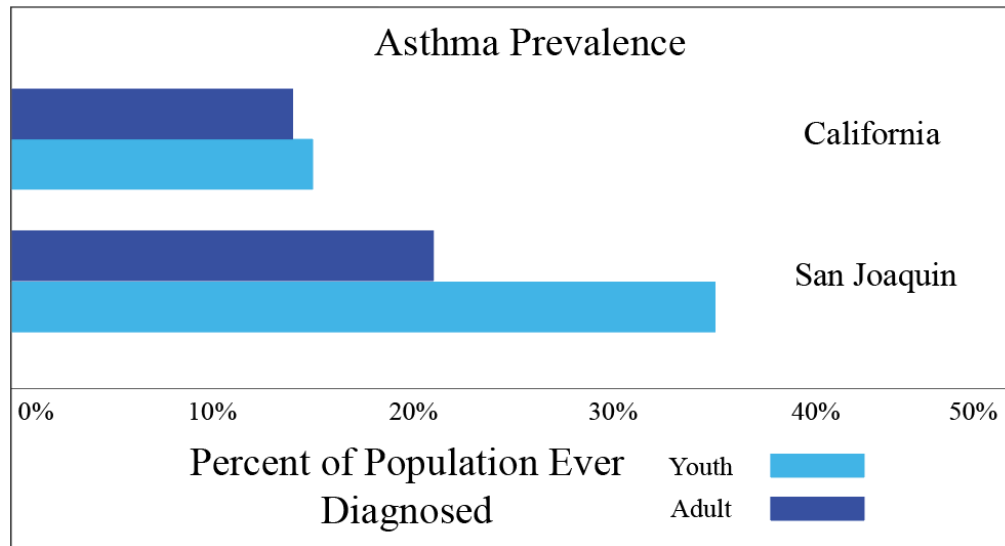


Figure 3. Data showing the current disproportionate asthma diagnosis percentage in adults and youth between San Joaquin and the rest of the state (Anderson, n.d.)

Overall, improved warehouse regulation that incorporates community perspectives is vital for the future of Stockton and the general San Joaquin Valley. The Mariposa Warehouse failed to engage with community members and environmental concerns in a genuine way. Increased engagement from community members will lead to more stringent warehouse regulations, which will likely reduce the number of warehouses and subsequently decrease air pollution. As a result, this will lower asthma rates and improve the overall quality of life within the community.

Key Areas of Concern

The escalating issue of air pollution in areas surrounding warehouses poses a significant health risk for BIPOC communities. The construction phase of warehouses and the subsequent emissions from operational trucks increases air pollution. As mentioned above, warehouses are often built in regions with lenient zoning regulations, disproportionately impacting marginalized groups and people of color. This correlation between increased air pollution in lower income areas is shown in Figure 4. Furthermore, the immediate vicinity of these warehouses often includes schools, hospitals, and residential areas, experiencing the bulk of the environmental impact.

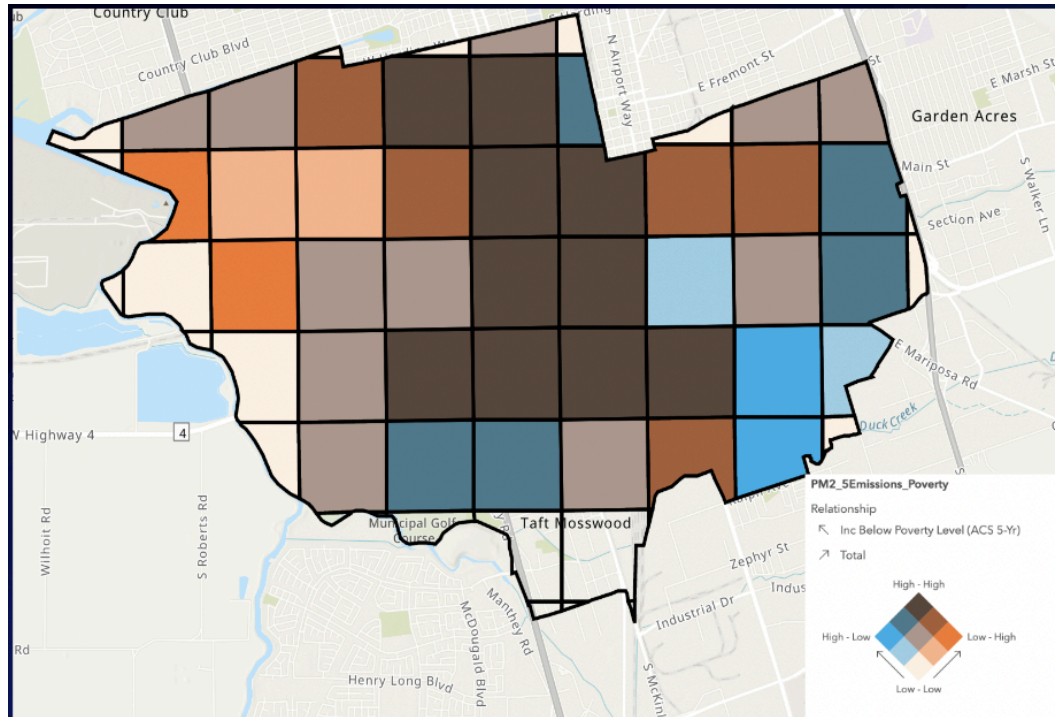


Figure 4. This map illustrates the correlation between PM2.5 pollution and poverty rate in Stockton, CA. Looking at the key, going to the right increases the PM2.5 pollution, thus a region that is orange has high pollution and little poverty. On the other hand, going to the left increases poverty, therefore a region that is blue has high poverty rates but lower pollution. An increase in both results in the brown regions. The map was created using ArcGis: (<https://arcg.is/1Xqmfa1>)

Despite the health concerns, in December of 2022, the Stockton city council approved a massive warehouse complex in hopes to boost the economy and increase jobs (“Zoning Update - City of Stockton” 2023). Currently, Stockton has an unemployment rate of 8.1%, which is 2% higher than the national average (“Stockton, CA Unemployment Rate” 2024). The Mariposa Industrial Park Project, proposed by the Greenlaw Partners, aims to establish a 3.6 million square foot warehouse complex spanning over 200 acres (Fitzgerald 2023). The initiative will create jobs across ports, warehouses, trucking, and other sectors. However, the project also raises environmental and health concerns, due to the estimated surge in pollution. Figure 5 shows the 1 hour rolling mean data for PM2.5 mass concentration values collected from two Clarity air sensors located near this project site, one along the Mariposa road side and the other facing Marfargoa road to the South-west of the site. The National Ambient Air Quality Standard of 35 $\mu\text{g}/\text{m}^3$ daily average is shown as the horizontal dashed line (CARB 2024). It can be seen that the PM2.5 values measured along this project site exceed this standard on multiple occasions throughout 2023 and 2024, following the start of construction on September 11, 2023, supporting the need for warehouse emission mitigations.

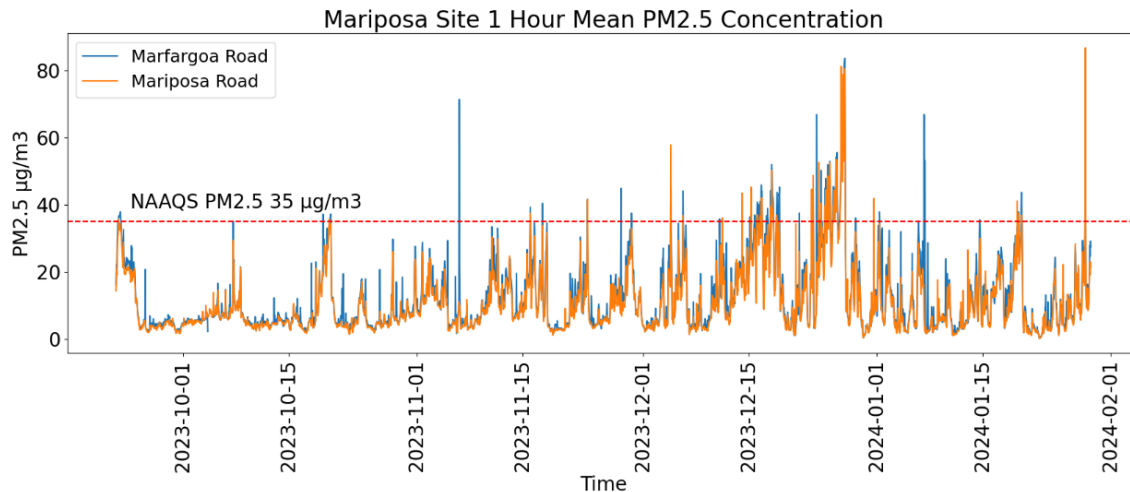


Figure 5. Clarity air sensor raw data for PM 2.5 near the Mariposa construction site.

Not only will poor air quality impact community members who live near the warehouse, but it will also impact construction and warehouse workers. Construction workers are at an increased risk of encountering health concerns, including hearing impairments, respiratory conditions, cancer, and chronic back pain. Compounding these risks is the fact that construction workers compensation is only marginally higher than the minimum wage, having to work long and strenuous hours (Forestell 2022). Moreover, warehouse employees often suffer from elevated heart rates and muscle cramps in the summer due to the extreme heat (Levin and Nalbandyan 2021). The workers are also required to remain standing for long periods of time, discouraged from taking bathroom breaks, and frequently experience musculoskeletal injuries (GEKLAW, Inc. 2024). Overall, while the unemployment rate in Stockton is higher than the national average, employment should not prevent people, especially BIPOC and low-income people from maintaining their health.

In addition to the impact on workers, the Mariposa warehouse will also lead to increased traffic pollution for the immediate and surrounding areas. Trucks are one of the primary pollutants from warehouse operations, not only contributing to deteriorating air quality but also posing a direct threat to the health of nearby residents (Garoupa 2023). The project is expected to attract over 12,000 daily vehicle trips, the influx of trucks significantly contributes to these challenges (“Attorney General Bonta Announces Agreement with City of Stockton to Address Environmental Impacts from Continued Warehouse Development” 2022). With a significant increase in vehicle traffic, the common practice of truck idling during loading and unloading, contributes substantially to local pollution levels. The resultant health issues include respiratory problems, such as asthma, leading to significant long-term health complications, absenteeism from work and school, and ensuing financial strain on affected families. Moreover, the increase in truck traffic associated with these warehouses causes traffic congestion, further

intensifying pollution and deepening the cycle of environmental injustice faced by these communities.

The expansion of warehouses, while fueling economic growth and the rapid delivery of goods, simultaneously increases local air pollution and health hazards in BIPOC communities, highlighting the urgent necessity for advocacy regarding environmental justice and health. In order to understand the interconnected issues that are exacerbating the impact of warehouses, the system map below (Figure 6) aims to show the relationship between the economy, air quality, and impact on BIPOC communities.

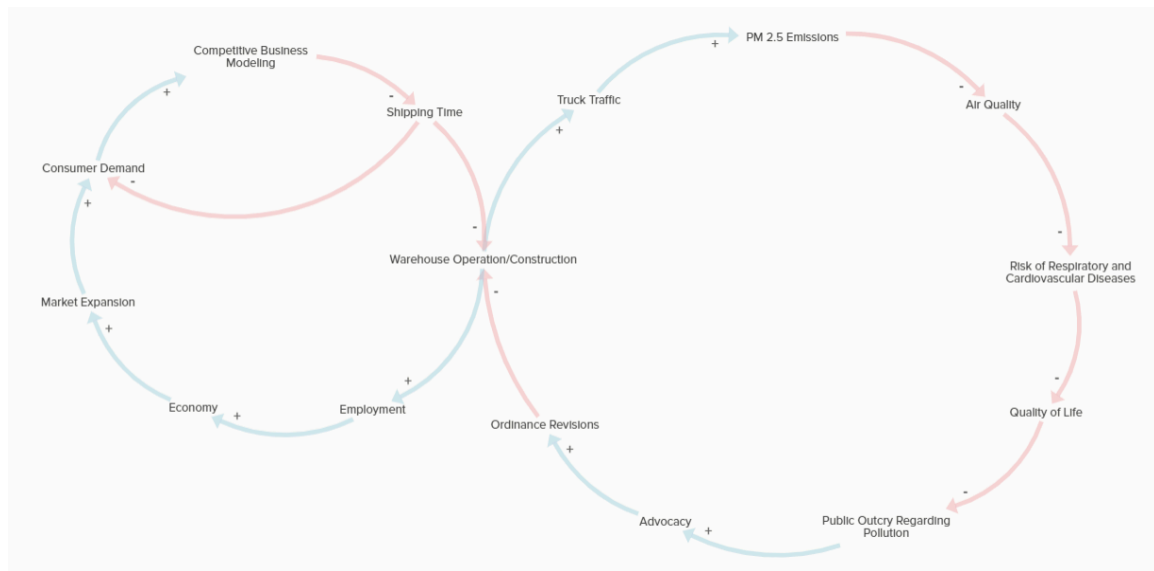


Figure 6. This system map highlights the effect warehouses have on the economy (left loop) and the impact on air quality and BIPOC communities (right loop). Systems map created in Kumu: <https://embed.kumu.io/895725d096a6b9cb5d5d3cd86664cce4>

External and Economic Impact of Warehouses (left loop): As the number of warehouses increases, employment increases. This results in an increase in economic activity, which then leads to market expansion and increased consumer demand. An increase in consumer demand increases the need for competitive business strategies, including a decrease in shipping time. To keep up with shipping times, more warehouses will be built to maintain competition and meet demand. This loop leads to continued growth of warehouses.

Shipping Time and Consumer Demand (nested left loop): There is also a connection between decreased shipping time and increased consumer demand, such that as the number of warehouses increase, the shipping time decreases and this high accessibility of goods creates increased demand. Theoretically, this is a positive feedback loop that shows

how a growing number of warehouses may promote even further expansion and development of industrial spaces.

Impact of Warehouses on Public Health (right loop): This loop indicates an ideal state, as increased advocacy and community engagement would lead to stricter regulations regarding warehouse development and operation. Initially, as the number of warehouses increases, the truck traffic in the surrounding environment increases, which leads to increased PM2.5 emissions. This results in a decrease in air quality, which results in an increase in risk of respiratory and cardiovascular disease, which then leads to a decrease in the quality of life. Accordingly, this leads to an increase in public outcry regarding air pollution, which leads to an increase in advocacy efforts, which in theory then leads to ordinance revisions, ultimately leading to a decrease in warehouse emissions. However, this is not the current state because advocacy efforts are currently being ignored by government officials. **Community engagement through advocacy needs to be bolstered, so they cannot be silenced, demanding action from government officials, increasing ordinance revisions.** Once advocacy efforts are strengthened, this loop is a balancing loop which will curb the growth of warehouses and promote equitable solutions for impacted communities.

To fully understand the challenges being faced, it's crucial to pinpoint the underlying problems and the associated symptoms. Beginning with the historical practice of redlining, this has directly contributed to a heightened poverty level. In response, Stockton has embarked on efforts to boost its economy and increase job opportunities, as seen by the approval of the Mariposa Industrial Park Project. The underlying problem of Stockton's struggle is poverty. The symptoms include land being inexpensive, leading to construction companies buying and developing them into warehouses. This drive to boost the economy, coupled with the construction of warehouses, has unfortunately led to worse air quality from heightened pollution levels. Another underlying problem is the lack of economic opportunity in BIPOC communities. Individuals often find themselves juggling multiple minimum wage jobs just to get by. This situation makes it difficult to engage in advocacy for policies that defend against environmental injustices. The unemployment rate within the BIPOC community contributes to financial difficulties, making it challenging for individuals to secure necessities like food, housing, and healthcare. Furthermore, the push for economic expansion has led to the construction of more warehouses, leading to more air pollution issues.

Data Visualization and Analysis

The Mariposa Industrial Park Project has been drawing significant attention due to its massive scale and lack of public engagement. As mentioned above, developers approached building owners directly, rather than reaching out to the tenants, who were not sufficiently informed of this environmentally unfriendly project. This lack of

transparency prompted the involvement from the Attorney General and the Sierra Club, focusing on the project's environmental impact. A settlement was negotiated that includes various environmental mitigation measures, such as a 100% electric on-site truck fleet, substantial setbacks, landscape barriers, and others. Additionally, the developer has committed \$200,000 to help mitigate the impacts of emissions exposure.

Even though Stockton has permitted the construction of the Mariposa Industrial Park Project, the city is at a critical turning point for the future of warehouse regulation. At a recent City Council meeting, community partner Jonathan Pruitt expected to discuss the measures with government officials, only to find that they had already been established. Option C of the current ordinance revisions was passed, however the Sierra Club wanted Option B and Jonathan wanted a more stringent version of Option B. Option B is proposed by the Sierra Club, whilst Option C is proposed by the warehouse developers. Based on Option C getting passed, this indicated a lack of community engagement in the development of warehouses. The desires of developers continue to be prioritized over the health of community members. The city allowed the developers with a bandaid 'solution' of a monetary commitment to silence community members. However, this behavior is unacceptable. The future of warehouse development in Stockton and all of California needs to uplift communities who will be most impacted. Their health and safety needs to be the top priority. In order to prove that the silencing of community concerns around the Mariposa Warehouse Ordinance is detrimental to environmental concerns, the specifics of the differences between ordinance measures are discussed below.

Measure #11 - Warehouse Setbacks

Measure 11 addresses sufficient setbacks, with community advocates proposing loading docks be at least 300 ft away from houses, schools, medical facilities, and more (Option B). In Option C, the current version of the ordinance includes a 2:1 ratio of building height to building setback. According to Peerless Research Group, the average warehouse height in 2021 was 31.1 feet, making the average building setback around 62.2 feet (Placek 2022). Due to warehouses close proximity to sensitive receptor groups, this puts them at an increased risk for developing respiratory problems. **The CARB Air Quality and Land Use Handbook recommends a 1000 ft setback of warehouses from houses, schools, medical facilities, and playgrounds** (Riordian 2005). Even though a setback of 1000 ft protects the community, the city proceeds with an average setback distance of 62.2 feet, following the 2:1 ratio of building height to building setback. Looking at Figure 7, there are currently 11 schools and 4 hospitals located within 1000 ft of a warehouse lot. Under the current 2:1 setback, these sensitive receptor groups are at heightened risk of air pollution exposure from industrial activities.

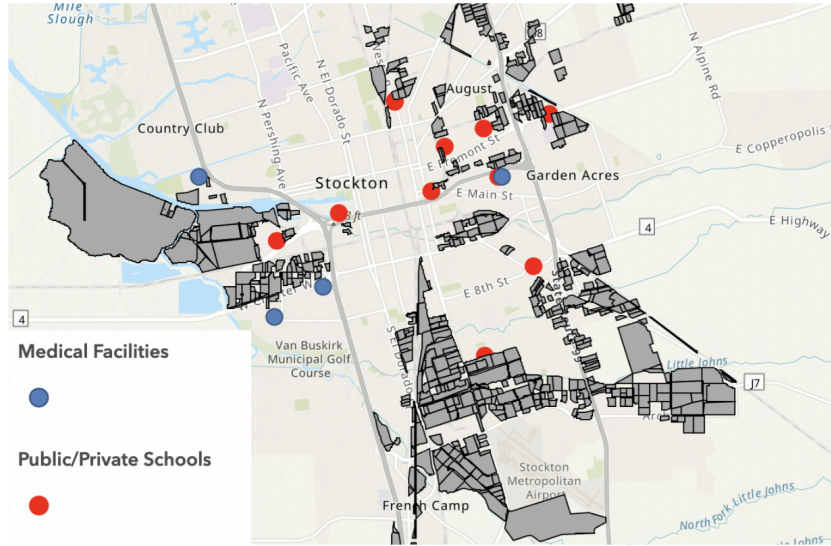


Figure 7. This map illustrates the hospitals and schools located within 1000 ft of warehouses. The gray regions represent the lots the warehouses are located on, also referred to as industrial zones. The map was created using ArcGis: (<https://arcg.is/1Xqmfal>)

Moreover, Figure 8 outlines the number of homes, businesses, and miscellaneous buildings surrounding the 3.6 million square feet of the Mariposa warehouse site. Within 300 feet, there are 22 homes, 1 business, and 9 miscellaneous buildings compared to 42 homes, 5 businesses, and 49 miscellaneous buildings at 1000 feet. These buildings are individually counted using Google Maps and StreetView.

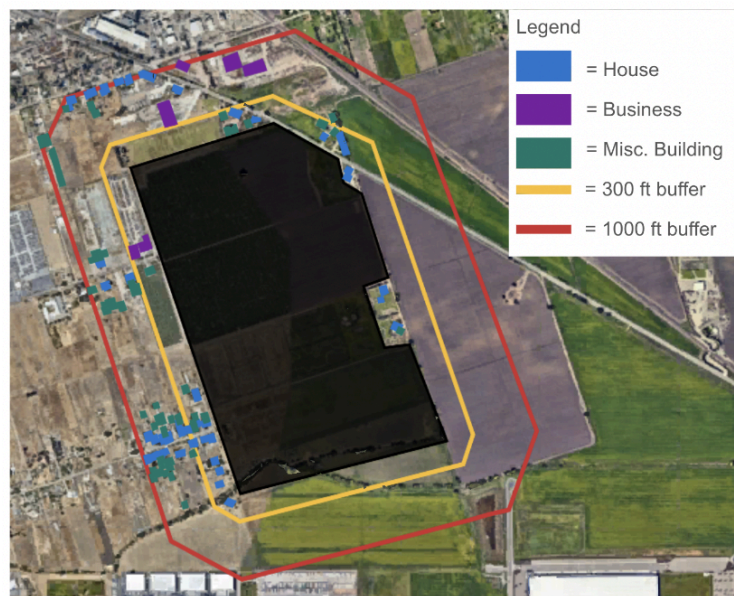


Figure 8. This map displays the location of the impacted buildings by the Mariposa Warehouse.. The legend indicates the building types as well as the buffers; black region on map is the warehouse. The map was constructed via Google Earth.

The Mariposa Agreement set up a \$200,000 community benefit fund for residents to replace their HVAC systems. After talking with a HVAC contractor in Stockton and using an online HVAC calculator, it has been estimated that the average cost for replacing a HVAC system, including a heat pump and AC unit, for a 2,000 square foot home is approximately \$10,592. Furthermore, Figure 9 displays the low and high end range as well as how many homes can be covered at each price range.

HVAC System Cost		
Low End: \$9,332	Mid Range: \$10,592	High End: \$13,071
Homes Covered by \$200,000		
Low End: 21	Mid Range: 18	High End: 15

Figure 9. The table displays various cost ranges for HVAC systems and indicates how many homes can replace their HVAC system within the \$200,000 fund (“New HVAC System Cost Calculator” 2024).

Additionally, we examine three other planned/approved warehouse projects: South Stockton Commerce Center, Sanchez-Hoggan Annexation Project (Sanchez), and the Airport Business Centre Project. The impact on the surrounding buildings is illustrated in Figures 10 to 12.



Figure 10. The red line displays a 1000 ft buffer zone from the South Stockton Commerce Center, while the yellow line displays a 300 ft buffer zone. The blue square represents homes, the purple represents businesses, and the teal represents miscellaneous buildings. The map was constructed via Google Earth.



Figure 11. The red line displays a 1000 ft buffer zone from the Airport Business Centre Project, while the yellow line displays a 300 ft buffer zone. The blue square represents homes, the purple represents businesses, and the teal represents miscellaneous buildings. The map was constructed via Google Earth.



Figure 12. The red line displays a 1000 ft buffer zone from the Sanchez-Hoggan Annexation Project (Sanchez), while the yellow line displays a 300 ft buffer zone. The blue square represents homes, the purple represents businesses, and the teal represents miscellaneous buildings. The map was constructed via Google Earth.

Using the maps shown above, Figure 13 displays the buildings affected for each warehouse project. This situation is concerning because these homes and buildings are essential to daily life and frequently serve as places where people spend a considerable amount of time.

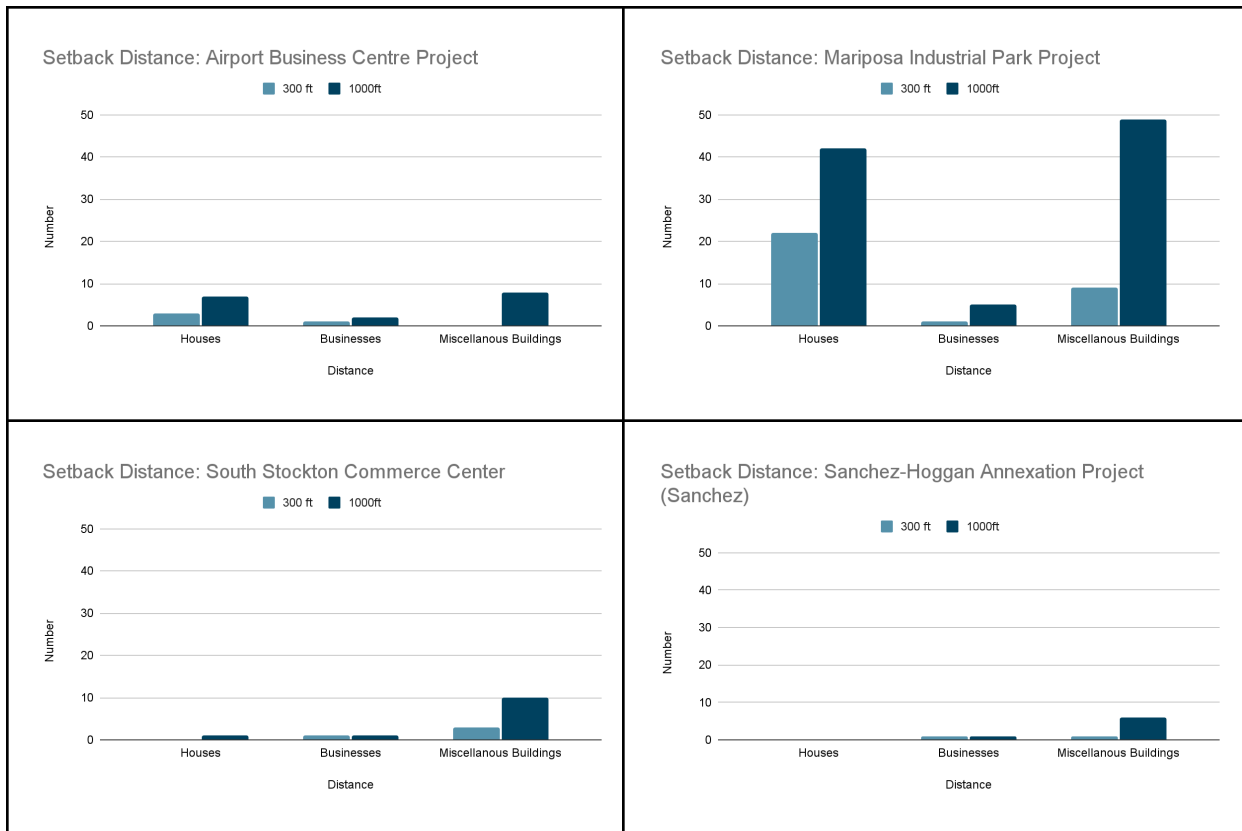


Figure 13. The figure displays the number of homes, business, and miscellaneous buildings impacted by each project at two different setback distances: 300 ft and 1000 ft.

Figure 13 shows that the Mariposa Industrial Park Project impacts the most homes, businesses, and miscellaneous buildings, likely due to the fact that it is located in a residential zone while the others are located in industrial zones. The current proposed ordinance contains a loophole allowing the avoidance of the 300-foot setback if considered physically infeasible, a vaguely defined term often exploited by developers. Consequently, many residential zone homes are adversely affected, highlighting the need for stricter regulations.

Moreover, under the current ordinance for the Mariposa Industrial Park Project, Option C, the expected setback is about 60 ft, while CARB recommends a setback of 1000 ft from warehouses in relation to schools, hospitals, and other sensitive groups. Regardless of a financial commitment or zoning laws, a setback of 1000 ft should be the standard for all residential homes in Stockton. The recommendations from the California Air Resources Board need to be honored to protect community members in Stockton and all of California.

Measure #13 - Clean Energy

Measures 13 includes clean energy implementations such as solar panels (PV). Solar Panels serve as a preventive measure, as they do not directly impact local air quality. Clean energy sources, such as solar panels, are a low pollution option, compared to conventional electricity generation which typically involves significant pollution emissions. To understand the feasibility of onsite clean energy, the energy use and cost of solar panels needs to be considered.

Warehouses consume 6.1 kWh of energy per square foot. This means that the Mariposa Warehouse is projected to use 21,960,000 kWh of energy, resulting in the emission of 0.86 pounds of carbon dioxide per kWh produced. This would lead to the community being exposed to 18,885,600 pounds of carbon dioxide. To mitigate these emissions for future warehouse projects, implementing solar panels and other renewable energy sources could help safeguard the community. Diving into the cost and benefits of solar panels, Appendix 1 and 2 contain the cost analysis for two separate solar panel installations on an average size warehouse. Although warehouses have the capacity to generate 176% of their annual electricity needs by fully utilizing their rooftop, the calculations only consider them producing 100% of their electricity requirements.

The annual energy cost of a warehouse is \$2.20 per square foot, while the installation cost for solar panels is \$25.40 per square foot. The average warehouse size in the US is 17,500 square feet. A warehouse uses 6.1 kWh of electricity per square foot, thus a typical warehouse consumes 106,750 kWh of electricity annually. Taking into account Stockton's average of 5.4 usable sunlight hours per day and a solar panel efficiency of 20%, the required energy for the solar panel system is 270,802 watts. With the cost of solar panels priced at \$1.64 per watt, the total installation cost for the solar panel system is \$444,115. Furthermore, from now until 2033, there is a 30% investment tax credit for businesses who install solar panels. The credit then diminished to 22.5% and 15% in successive years, and will ultimately fall to 0% in 2036 (USDE 2023). Taking advantage of these credits now, can offer significant future cost savings for companies. Additionally, solar panel systems will not be subject to income tax until after 2025. Applying the 30% tax credit brings the installation cost down to \$310,881. With an average annual electricity cost of \$38,340 for a warehouse, the payback period for the investment into solar panels is 9.2 years. A more detailed overview of the calculations can be seen in Appendix A.1. Solar panels will help spare companies using warehouses from costly spending on their electricity bills to power their operations. Not only can the energy harvested from solar panels be used for warehouse operations, but it can also be used in charging electric vehicles.

Measure #14 & #15 - Electric Vehicles and Charging Stations

Measure 14 and 15 cover electric vehicle (EV) fleets and charging stations respectively. Vehicle emission regulations within the warehouse industry are vital not only because of their impact on traffic, but also for utilizing heavy-duty diesel trucks (HDDTs) which contribute to over 25% of emissions, even though they constitute only 4% of on-road vehicles (Parker 2024). A study of simulations regarding the effectiveness of different policy strategies applied in Beijing, found that updating fuel and emission standards could yield 85-95% reductions to PM2.5 emissions from HDDTs (Cheng et al. 2023). This is important to consider for HDDTs contrary to electrification as there is ongoing research into the positive relationship between vehicle weight and non-exhaust PM emissions (Timmers and Achten 2016). However, mitigations for these vehicles are necessary and should be enforced and in accordance with the Environmental Protection Agency's recently updated emission standards for these heavy-duty vehicles (US EPA 2024). Regardless, lightweight EVs are better for improving air quality than gas powered vehicles because they reduce localized air pollution. A typical passenger vehicle emits about 4.6 metric tons of CO2 per year, while an EV is zero emission (EPA 2023). A five year long Bay Area study shows that the increasing number of electric vehicles on the road is reducing on-road emissions by about 2.6% each year (Asimow, Turner, and Cohen 2024). This reduction will keep increasing as more EVs hit the road.

To supplement this further, Measure #15 requiring electric charging stations, could serve as a potential to encourage building tenants, employees and community members to switch to EVs. Priority parking with accessible electric charging stations make EVs a more feasible and appealing switch. Figure 14 shows the current density of charging stations in Stockton to be sparse despite heavy traffic along the Crosstown Freeway, Interstate 5 and Route 99. Comparatively, more western cities in the Bay Area (left) show numerous locations with medium to high charging station densities.

Stockton is not given the opportunity to invest in EVs because they lack economic investment. **Since warehouses will increase overall traffic, and thus air pollution, they should be required to invest in city infrastructure, such as EV charging stations, to reduce overall traffic emissions.** Implementing and enforcing these updated measures would significantly cut emissions, enhance electric vehicle infrastructure, and align with global climate objectives aiming for 75% of new car sales to be electric by 2030 (Boudreau 2023).

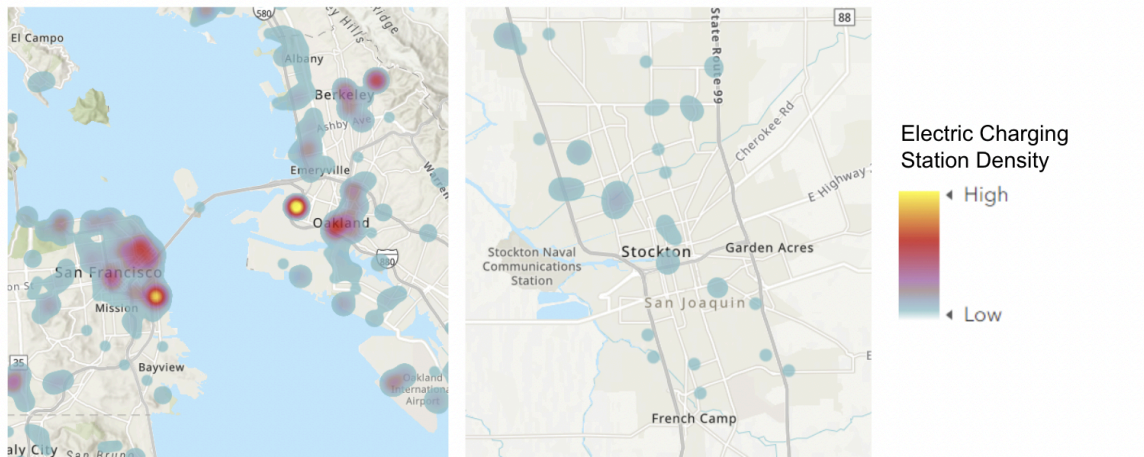


Figure 14. map of electronic vehicle charging stations of the bay area (left) compared to Stockton (right) (“Alternative Fuels Data Center: Electric Vehicle Charging Station Locations,” n.d.).

Case Studies

Constructed in 2020, Prologis' Eindhoven DC4 in the Netherlands stands as the world's first industrial building to achieve Zero Carbon Certification from the International Living Future Institute (ILFI). In Stockton, we can adopt some of the innovative techniques used in the construction and operation of the Eindhoven DC4. The construction of Eindhoven DC4 emphasized environmentally friendly materials and methods, including using responsibly sourced concrete and local suppliers to reduce carbon emissions. Additionally, the building generates 3.5 MWh of electricity annually while consuming only 1.7 MWh, thereby supplying renewable energy to the surrounding community.

Eindhoven DC4 incorporates landscaping and greenspaces to stimulate biodiversity, such as insect hotels, bird houses and native plants, which support local wildlife and enhance air quality. Approximately 80% of the office finish consists of recycled and biobased building materials. Furthermore, the FSC certification ensures that all wood products are sourced from well-managed forests. The sustainable strategies implemented in Prologis' Eindhoven DC4 warehouse serve as a model for warehouse construction and operation globally (Kuijken 2023).



Figure 15. Picture of Prologis' Eindhoven DC4 located in the Netherlands.

Design Plan for Stockton 2030

Our design plan is one that balances new warehouse construction, while boosting the implementation of sustainability in the industry. Our findings above reinforce that the main sources of air pollution in the warehouse industry are due to non renewable energy sources and truck emissions. However, the presence of warehouses increases job and economic opportunities. Therefore, the design plan would require a balance in how the warehouses are operating, without significantly deterring their construction.

The design plan is founded on four key regulations, aimed to be fully operational by 2030. The first regulation mandates that loading docks be located at least 300 feet away from schools, homes, and medical facilities. The next regulation requires warehouses to install sufficient solar panels to meet 100% of their annual energy usage. Additionally, it is crucial to invest in infrastructure, thus mandating warehouses to invest in EV charging stations to facilitate a transition to EVs. Lastly, warehouses should be required to transition to EVs to reduce air pollution due to increased truck traffic. The specific regulations and time frame are outlined in the timeline below.

The main leverage points in the industry come from implemented and enforced regulations at the state level such that sustainable operations are applied. In other words,

the industry has no choice but to make sustainable choices rather than moving and polluting elsewhere. A concept for how this implemented plan changes the warehouse industry system in Stockton would look is shown in Figure 16. The small loop on the left shows how the presence of warehousing increases employment, and the economy provides more funds for the warehouse industry to implement sustainable practices. The larger loop on the right shows that green warehouses, which implement clean energy sourcing and operation at a minimum, can reduce PM2.5 emissions which will improve the local air quality. This improved quality of life will want to be maintained such that advocacy will promote sustainable regulations on the industry. The smaller loop on the right shows how advocacy will also press the government to make land use decisions that benefit the environment and communities over economic advancement. This allows the growth of warehouses to be regulated. Evidence of similar systems can be seen in places like the Netherlands, home of the first zero-carbon certified warehouse in the case study above.

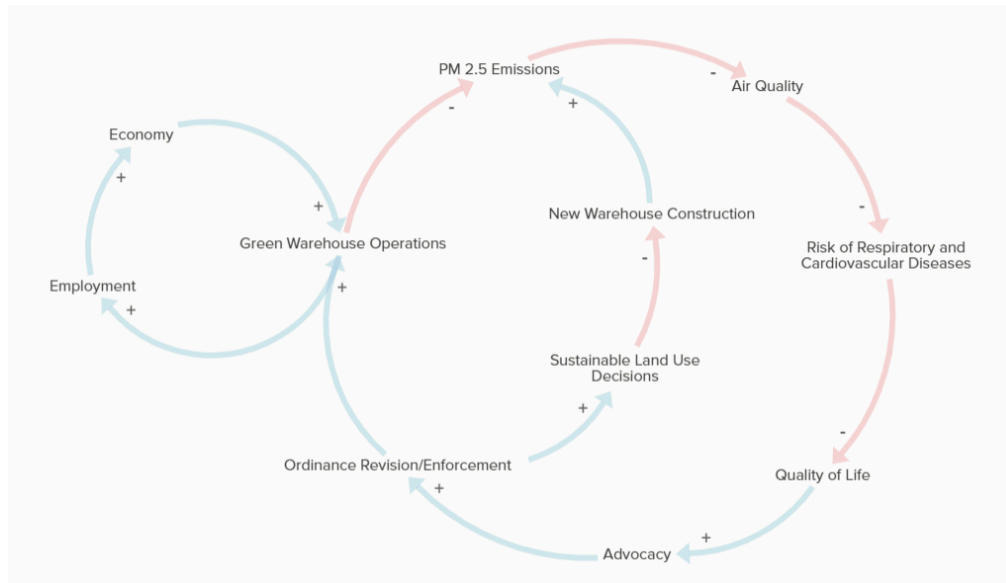
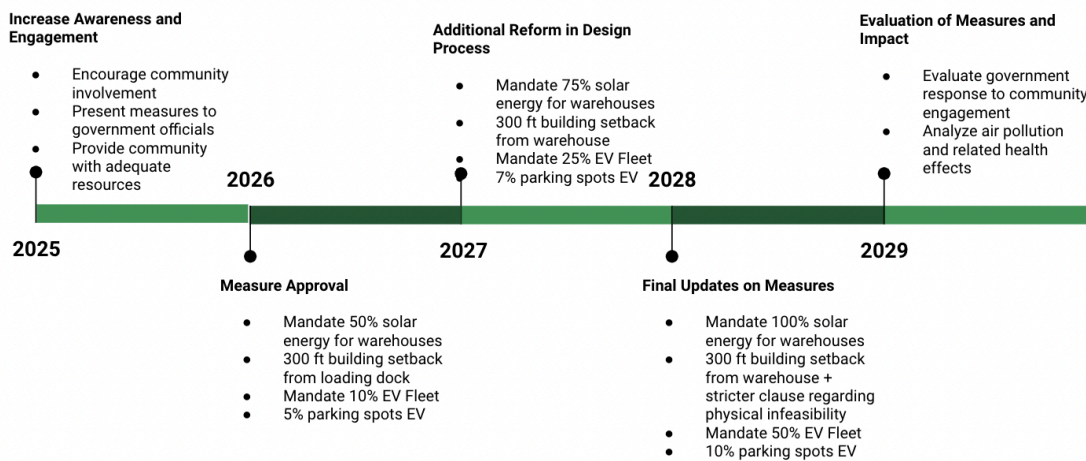


Figure 16. Green warehouse system map depicts an idealized warehouse industry that boosts the economy without harming the local community. Systems map created in Kumu: (<https://embed.kumu.io/1e330b6729498fe136773431d8d74e88>)

The 2030 design plan aims to increase community engagement and implement regulations that advance sustainability in the warehouse sector. Our strategy involves strict regulations, which are to be fully implemented by 2030, including mandating a minimum distance for loading docks from sensitive areas, requiring solar panels to cover annual energy use, and facilitating a shift to electric vehicles (EVs) with necessary charging infrastructure. **This approach not only seeks to reduce air pollution but also aims to establish a sustainable framework for warehouse operations.** This framework is intended to serve as a model for other cities in developing warehouse ordinances.

Climate change emerges as one of the most significant challenges of the 21st century. As climate change progresses, the need for immediate action intensifies. Rising temperatures will further decrease air quality, exacerbating conditions like asthma, which already disproportionately affects communities, as seen with the 35% asthma rate in children in the San Joaquin Valley versus 15% in California. By implementing these changes, we aim to evolve the industry to meet environmental and community health challenges. Immediate measures are crucial to prevent future issues and elevate the quality of life for the surrounding community.

Implementation Timeline



Strategies to Share Beyond Stockton

We hope the implementation plan timeline not only takes form in Stockton, but serves as a stepping stone for future warehouse development. **Ultimately, our goal is for the community to come together and make themselves a force to be reckoned with.** Our first step includes increasing awareness and education regarding the issue such that the community gains the passion and confidence to advocate for government decisions that prioritize their health and wellbeing, including strict regulations regarding warehouse development and operation. Once this is achieved, preliminary reform updates, including EJ Advocates Recommended Amendments to Option C, are more likely to succeed with the community's support. Next steps are to seek continuous improvement through additional reforms and gradually increasing preliminary goal percentages. Finally, assessing which changes have been most effective ensures that proper funding or other resources are used efficiently. We believe this sequence is an effective way to use

warehouse reforms in order to reduce emissions and improve air quality such that the drive for change cannot be easily dismissed.

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Appendix

A 1. Calculations of the cost of installation of a solar panel system. The calculation also includes the annual energy costs for operating a warehouse and the estimated payback period for the system.

Regular

Average Warehouse: 17,500 sq ft Average Energy Cost per sq foot: 6.1 kW-hours

$$17,500 \times 6.1 = 106,750 \text{ kW}$$

Total Energy per Year (kWh) $\div$ (Sunlight Hours per Day $\times$ 365 $\times$ Panel Efficiency)

Solar Panel Efficiency = 20% Avg Sunlight Per Day = 5.4 hours

$$= 106,750 / (5.4 \times 365 \times 0.2)$$

$$= 270,802 \text{ W}$$

$$= 1.64\$/\text{W} \times 270,802 \text{ W}$$

$$= \$444,115 \text{ Installation Cost } \rightarrow 30\% \text{ federal income tax credit } \rightarrow \text{Adjusted Cost: } \$310,880.5$$

Cost of Electricity = \$0.36 kW-hour

$$= 0.36 \times 106,750$$

$$= \$38,340 / \text{yr}$$

Maintenance = \$31 per kW hr

$$= \$31 \times 271$$

$$= \$8,401 / \text{yr}$$

$$\text{Adjusted Annual Return} = \frac{\text{Annual Return}}{(1 + \text{Inflation Rate})^n}$$

Payback Period = 9.2 years

A 2. Calculations of the cost of installation of a 1-axis tilt solar panel system. The calculation also includes the annual energy costs for operating a warehouse and the estimated payback period for the system.

1-Axis Tilt

Average Warehouse: 17,500 sq ft Average Energy Cost per sq foot: 6.1 kW-hours

$$17,500 \times 6.1 = 106,750 \text{ kW}$$

Total Energy per Year (kWh) $\div$ (Sunlight Hours per Day $\times$ 365 $\times$ Panel Efficiency)

Solar Panel Efficiency = 20% Avg Sunlight Per Day = 7.1 hours

$$= 106,750 / (7.1 \times 365 \times 0.2)$$

$$= 205,737 \text{ W}$$

$$= 1.64\$/\text{W} \times 205,737 \text{ W}$$

$$= \$337,208.68 + \$541,500 = \$878,708.68 \text{ Installation Cost } \rightarrow 30\% \text{ federal income tax credit}$$

$$\rightarrow \text{Adjusted Cost: } \$615,096.08$$

Cost of Electricity = \$0.36 kW-hour

$$= 0.36 \times 106,750$$

$$= \$38,340 / \text{yr}$$

Maintenance = \$31 per kW hr

$$= \$31 \times 271$$

$$= \$8,401 / \text{yr}$$

$$\text{Adjusted Annual Return} = \frac{\text{Annual Return}}{(1 + \text{Inflation Rate})^n}$$

Payback Period = 18.3 years