Chula Vista

Climate Equity Index

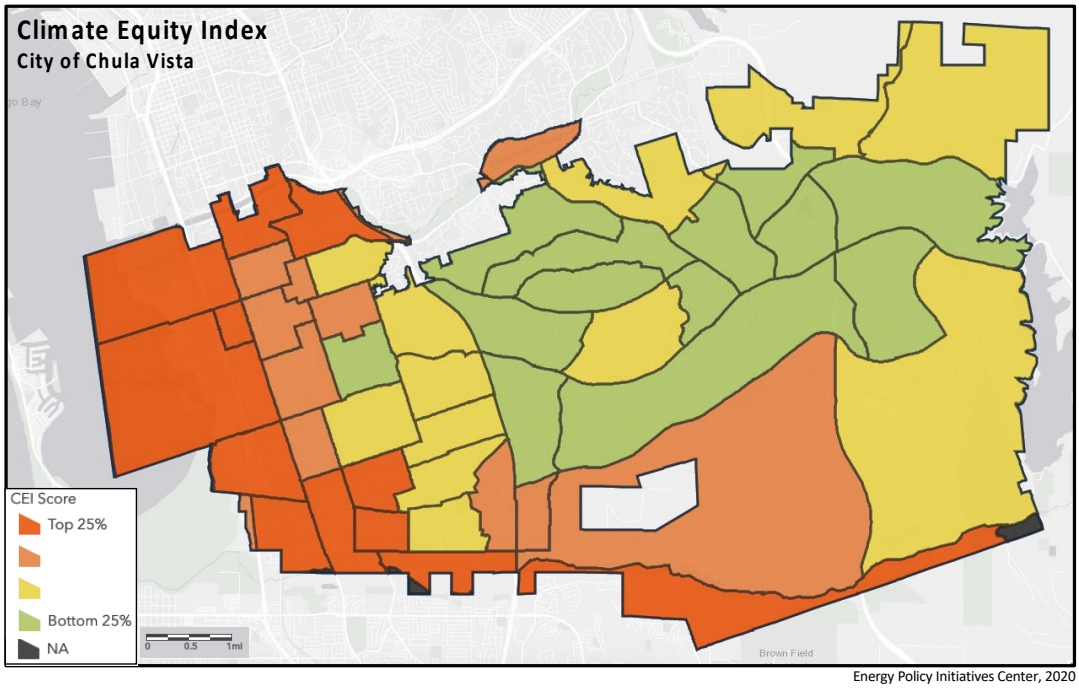
Table of Contents

Executive Summary

As Chula Vista and other cities developed, not all residents were treated fairly by institutions, such as governments and banks, or by fellow residents and businesses. Over decades, this inequality has had significant impacts to many communities, such as inequal economic participation, land-use and planning that can have negative health impacts or cause disparate educational achievement. These impacts have negatively affected Chula Vista residents and climate change will exacerbate those negative impacts. For example, if heat waves increase as expected under climate change predictions, it will be those residents who live in older buildings that typically are not well insulated or not air-conditioned, or residents who cannot afford to run older and less efficient air conditioners that will be impacted the most. To better understand and describe these types of impacts, the City initiated the Climate Equity Index. This study builds upon efforts other communities have taken across the nation to better spatially identify those communities most impacted by, or vulnerable to, climate and pollution burdens and address the historical inequality residents have faced to identify solutions that can help.

The City has already taken some steps to address the inequity, such as establishing the need to prioritize and allocate citywide resources which provide public facilities and services to communities in need, as well as to improve transportation options and accessibility for impacted community members in the most recent General Plan Update. Measures designed to increase equity were also included in the 2017 Climate Action Plan, but these efforts have been hindered by a lack of local analysis. For example, because of the statewide scale of the state's CalEnviroscreen tool, only a few census blocks are designated as disadvantaged communities and using that tool for local program needs would have excluded large portions of the City that our community members feel need more assistance. This Climate Equity Index (CEI) study, conducted by the City and the University of San Diego Energy Policy Initiatives Center (EPIC), provides the necessary localized information on the impacts of historic economic and environmental decisions on City residents today. Building off a similar effort completed by the City of San Diego, City staff worked with community stakeholders (listed below) to identify climate equity indicators that were the most informational and represented the concerns of residents in the impacted communities. Each of the city's 49 census tracts were evaluated based on the selected indicators and given a CEI score between 0-100. The census tracts were broken down into 4 quartile categories based on their relationship to other CEI scores in the community (Figure 1) and the average CEI score was 37.

Figure 1. Climate Equity Index Scores Across the City of Chula Vista

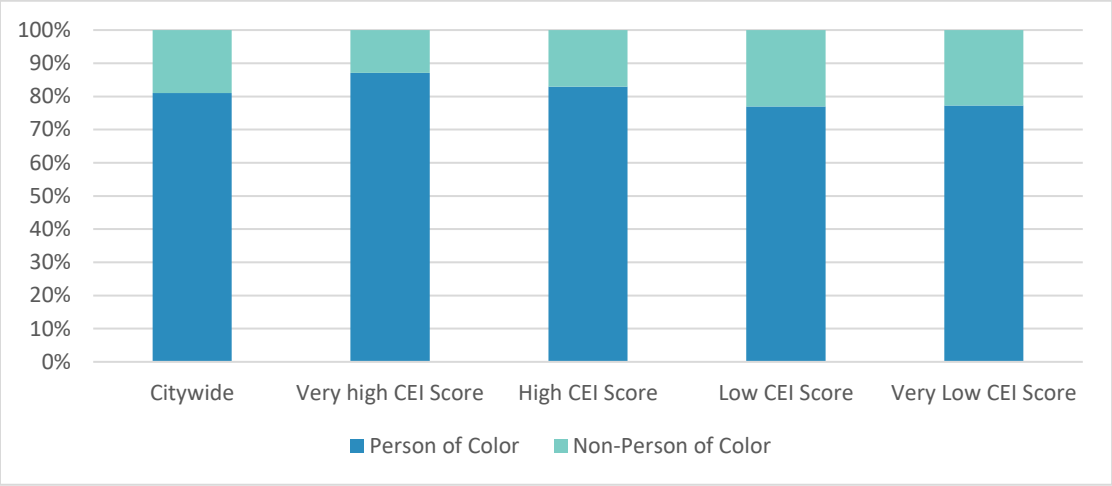


Energy Policy Initiatives Center, 2020

Census tracts that scored in the highest 50% and 75% of all Chula Vista census tracts were found to have a high and very high CEI, respectively. Due to the unique indicators that were selected by Chula Vista stakeholders and the scoring or calculation methodology used, it is not possible to directly compare the CEI scores of Chula Vista and other cities.

Demographic analysis, conducted as part of the CEI study, show that above average tracts are comprised of a disproportionate number of people of color (non-White and White Hispanic), as shown in Figure 2. People of color were found to make up 10% more in the highest scoring census tracts than the lowest scoring census tracts.

Figure 2. Percent of Population by Race/Ethnicity by CEI Score



In addition to incorporating the CEI scores into programs and policies, stakeholders and staff recommend the following actions to begin addressing climate equity in the City. More detailed potential actions to implement these recommendations are attached in Attachment B.

Recommendation 1	Increase outreach to and engagement with high scoring census tracts
Recommendation 2	Seek funding for high scoring census tracts
Recommendation 3	Update Climate Equity Index every 5 years

Background

City Planning and Equity

To recognize the growing importance of connecting online, the City adopted a ***Digital Equity and Inclusion Plan*** to help address the digital divide

Promoting equity is an ongoing goal of City planning. Environmental justice language is included in the City's most recent General Plan Update, Measure P funds are being prioritized in disadvantaged communities and the city is adopting a Digital Equity and Inclusion Plan. Similarly, equity is incorporated into the most recent Climate Action Plan (CAP), adopted in 2017, which includes actions designed to assist traditionally disadvantaged communities in the City. These include increasing efficiency to reduce utility bills, reducing local air pollution and promoting local green jobs. Additionally, stakeholders identified the need to track how the CAP was affecting equity in Chula Vista. After the CAP's adoption, City staff worked to implement the stakeholder's recommendations and reported back to the Climate Change Working Group (CCWG). Promoting equity through climate planning was a priority for the CCWG members who made a recommendation to conduct the Climate Equity Index (CEI) study as a way to better understand equity in Chula Vista and to determine how climate action planning can impact residents and track the impacts of actions over time.

Stakeholder Engagement

Throughout the nation, vulnerable populations are hit hardest by climate change[1]. As the City continues to plan to address those impacts it is imperative that decision-making tools are created and utilized to respond more effectively in communities that need it most. To attain climate equity, the City recognizes the need to acknowledge where disparities exist and identify ways to redress those disparities. The City developed the CEI, along with stakeholders, to provide a data-backed method to understand the inequities experienced by these communities.

The first step to addressing climate equity is to include the residents and organizations that represent affected communities in the decision-making process. To accomplish this, the City has established an informal Climate Equity Stakeholder Working Group to provide feedback and input on decisions for how the CEI was developed. This group may reconvene beyond the completion of the CEI to provide input on overall CAP and CEI implementation.

The stakeholder group was integral in advising the City on the working definition of climate equity (see next page), providing input on how to measure climate equity and helping develop the recommendations in this report. The Equity Stakeholder Working Group is

[1] Making Equity Real in Climate Adaption and Community Resilience Policies and Programs: A Guidebook (2019)

comprised of 10 organizations that serve Chula Vista communities and also includes 4 residents. A list of the Equity Stakeholder Working Group members is available in the Acknowledgements section of this report.

Climate Equity Index

Chula Vista's CEI was developed to spatially identify those communities most impacted by, or vulnerable to, climate and pollution burdens. For example, some census tracts have a lower index score as a result of greater access to public transit stops and pedestrian amenities, such as sidewalks and streetlights, or they spend a lower percentage of their income on housing, energy and transportation costs. These populations face relatively fewer barriers to commute to school or work or to invest in newer energy conservation technologies. The CEI identifies elements of climate equity for residents and provides a tool to measure inequity, allowing the City to prioritize areas with the highest impacts and begin dismantling historic barriers that have caused the identified disparities in communities with high index scores.

Climate equity

addressing historical inequities suffered by people of color to 1) allow everyone to fairly share the same benefits and burdens from climate solutions and 2) attain full and equal access to opportunities, including decision-making, regardless of one's background and identity.

This exercise applies best practices developed and applied in the equity space, but expanded to include specific indicators directly related to climate change impacts, adaptation and mitigation to describe conditions in Chula Vista. This descriptive approach to spatially represent equity has been used by other cities, as well. For example, the City of Tacoma, Washington, in partnership with Ohio State University's Kirwan Institute of Race and Social Justice, applied the same methods used here to develop its Equity Index.[2] This index is being used as a mapping tool to identify where Tacoma should focus resources and efforts to support equitable access and outcomes within the city. The Institute for State and Local Governance at the City University of New York has developed multiple equity tools for US cities using a similar method to help cities understand and measure equality and equity more broadly.[3] This type of assessment has also been done statewide, such as with the CalEnviroScreen, which identifies communities most affected by pollution and those populations most vulnerable to their effects.[4]

[2] City of Tacoma, Washington Equity Index
[3] CUNY Institute for State and Local Governance Equality Indicators
[4] California Office of Environmental Health Hazard Assessment CalEnviroScreen

Methodology

Indicators

City staff researched nationwide best practices, reviewed available sources of data and obtained input from the Climate Equity Stakeholder Working Group to measure equity across the City. This led to a list of indicators identified by the stakeholders as having some meaningful connection to equity in the community. A total of 39 indicators were selected for the CEI. In deciding on the final list of indicators, the City worked with the Equity Stakeholder Working Group and assessed each indicator with the following guidelines:

Equity Focus	Data identifies and represents equity issues within the City.
Climate Focus	Data has a close connection to the City's Climate Action Plan.
Clear Connection	The relationship between the indicator and climate equity is clearly understood.
Data Integrity	Quality data is available from reliable and trustworthy sources.
Data Update Frequency	The frequency of data updates should permit regular, future updates to the CEI and allow for indicators to be tracked over time.

All indicators fall into one of four broader categories: environmental, health, mobility and socioeconomic, shown below. The indicators that pertain to each category are identified in Table 1. For further discussion of individual indicators, refer to Appendix B.

Table 1. Climate Equity Index Indicators

Environmental
Indicator
Air Quality – Ozone*
Air Quality – Diesel PM*
Air Quality – PM 2.5*
Cleanup Sites*
Drinking Water Contaminants*
Extreme Heat Days
Fire Risk
Flood Risk (including sea level rise)
Groundwater Threats*
Hazardous Waste Generators and Facilities*
Impaired Water Bodies*
Parks & Open Space Access
Pesticide Use*
Solid Waste Sites & Facilities*
Toxic Releases from Facilities*
Traffic Density*
Tree Cover
Health
Indicator
Asthma Rate*
Cardiovascular Disease*
Food Access
Health Insurance Access (Insured)
Low Infant Birthweight*

Mobility
Indicator
Bicycle Access
Commute Time Burden
Pedestrian Access
Public EV Charging Infrastructure
Street Conditions
Transit Access
Transportation Cost Burden
Vehicle Ownership
Socioeconomic
Indicator
Educational Attainment*
Digital Access
Energy Cost Burden
Housing Cost Burden*
Limited English Proficiency*
Poverty Rate*
Preschool Enrollment
Solar PV Systems
Unemployment Rate*

* CalEnviroScreen indicator

Source: Energy Policy Initiatives Center, 2020. For more details about each indicator please see Attachment A.

Index Calculation

The CEI is calculated over census tracts, the smallest geographical area for which most indicator data is available or can be reasonably derived from a larger area. Every tract receives a value for each of the 39 indicators and these values are then used to determine its CEI score. General methods for this process are identified in Figure 3 and are further detailed in Appendix B.

Data was collected at the census tract level, where available. Data not aggregated at the census tract level required additional calculations (see Appendix B for further details).

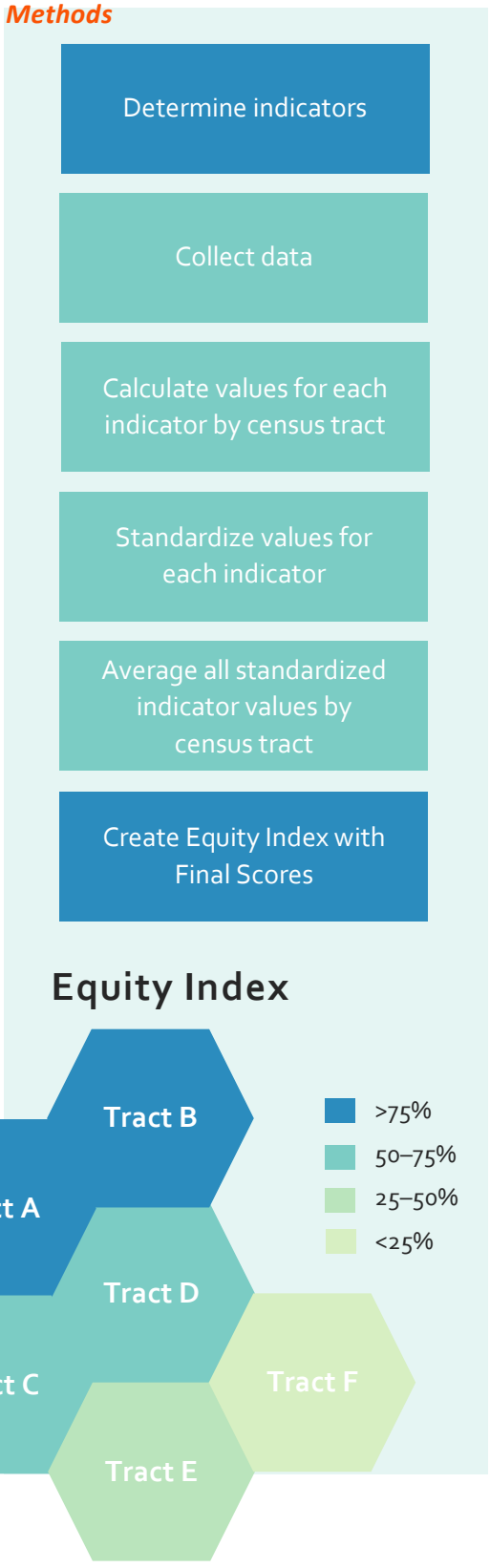
Next, all indicator values were standardized into z-scores, maintaining the relative difference in scores across census tracts while allowing for calculations across indicators. Final CEI scores were obtained by averaging all z-scores for a particular census tract and then indexing those scores to a value between 0-100 for easier interpretation of the results.

Additional analysis was conducted to show how even slight modifications to the method, aimed at capturing potential interactions or combined effects between indicators, would affect results. Two different ways of grouping indicators were tested. However, these modifications gave results for CEI scores that did not align with conditions known to be true within the City of Chula Vista today. For more information, see Appendix C of Attachment A.

Limitations

While the CEI highlights areas of concern for the City to focus on when addressing climate equity, there are some limitations that need to be acknowledged.

Figure 3. General Climate Equity Index Methods



Geopolitical Boundaries

Ideally, CEI scores would be calculated at the smaller, more localized census block level. Census tracts contain multiple census blocks. However, currently available data restricts the geographic scale to the census tract level. Therefore, the CEI scores represent data at the census tract level. Assigning fixed geographic boundaries permits CEI scores to be compared to the demographics of each tract; however, the benefits and/or burdens experienced are not always bound to these specific geographic areas. For instance, facilities and amenities offered in one census tract may be easily accessible to residents in neighboring census tracts. Conversely, if a hazardous waste site is located on the border of one tract, the potential pollution burden will be shared with the other tracts it borders even if the facility does not operate within them. Census tract boundaries do not adhere to jurisdictional boundaries or other planning boundaries used by the City, as in Community Plan Areas, for example. There are also multiple census tracts shared between the City of Chula Vista and one or more neighboring jurisdictions. Since most data were collected at the census tract level, CEI scores for these tracts reflect conditions across the entire tract, not just the portion located within the City.

Data Availability

There are several limitations that involve data availability that either restrict the potential for regular updates going forward or prevent the inclusion of certain indicators into the CEI. In assessing the City's tree canopy coverage, for example, there is currently no planned update to the 2014 data used to calculate CEI scores. Still, the stakeholder group felt this was an extremely important indicator since it is directly tied to the CAP. The CEI relies on other indicators that receive updates irregularly and may cause some uncertainty. This can potentially limit the ability of regular CEI updates to track how indicators, like tree canopy, change over time.

In addition to the indicators included in Table 1 above, there are several other datasets identified by the stakeholder group as being relevant for conversations around climate equity but were not included as indicators for one or more reasons, including: data reflects general population characteristics (e.g., age and race/ethnicity data), incompatible geographic scale (e.g., data is only available at the city or zip code level, whereas the CEI requires data to be available by census tract) and/or data quality concerns.

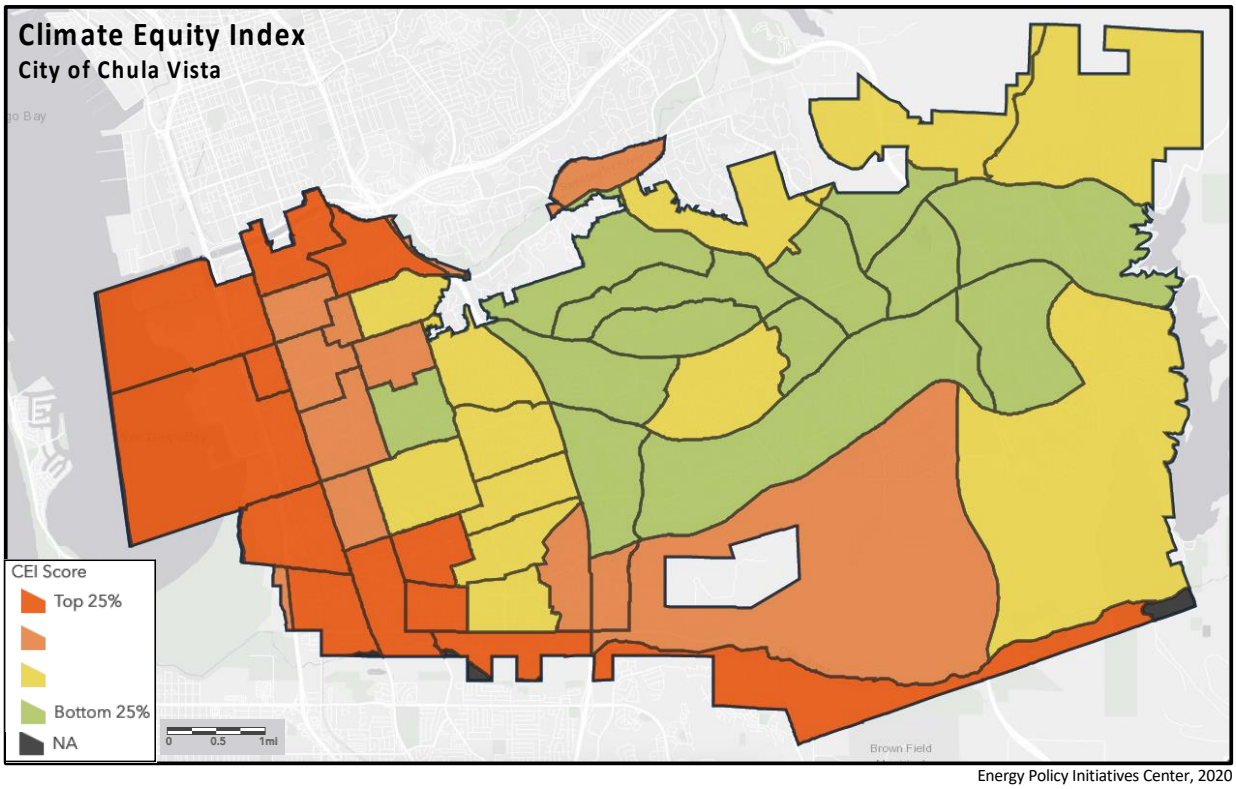
While the City acknowledges these limitations, it maintains confidence in the CEI to accurately measure climate equity within the City of Chula Vista. As better data becomes available for our citywide assessment, City staff will work with the Climate Equity Stakeholder Working Group to determine if additional indicators should be included in the CEI and assess any future need to adapt methods.

Findings

Figure 4 highlights the results of the CEI. Each of the 49 census tracts within the City has been assigned a score between 0 and 100, based on how each tract scores across all indicators. Scores illustrate the relative difference between census tracts, with the census tract performing the best across all indicators scoring the lowest (0) and the tract performing least best across all indicators the highest (100). Scores for other census tracts are scaled to demonstrate their performance relative to the highest and lowest scoring tracts. Each census tract score can be viewed in the Appendix B of Attachment A.

Four categories were developed to represent CEI scores and better identify the relative differences in access to opportunities among census tracts.

Figure 4. Climate Equity Index Scores Across the City of Chula Vista



Energy Policy Initiatives Center, 2020

The average CEI score across the City is 37, with a standard deviation of 26. Most of the City's tracts (30 or 61%) scored below average. There are 13 census tracts within the City that show a very high climate equity index score, see Table 2.

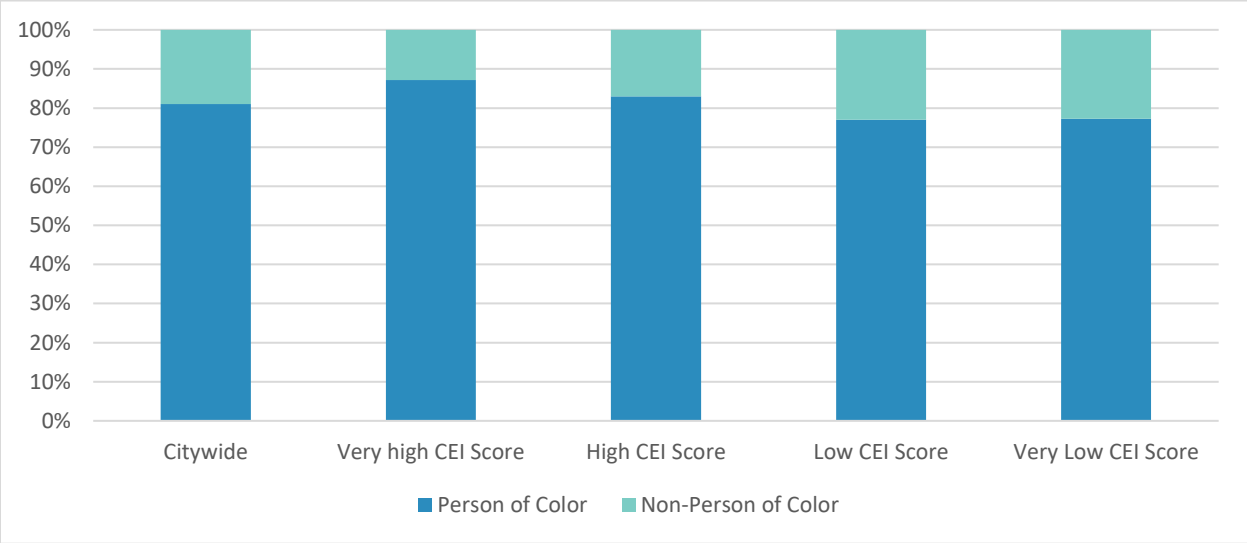
Table 2. Census Tracts by Quartile

Quartile	CEI Score Range	Number of Census Tracts
Upper Quartile (Top 25%)	55–100	13
2nd Quartile	32–54	12
3rd Quartile	18–31	12
Bottom Quartile (Bottom 25%	0–17	12

Energy Policy Initiatives Center, 2020

Demographic analysis was also conducted as part of the CEI study and the data show that there is a disproportionate amount of people of color in the City's above average tracts, as shown in Figure 5, below. People of color (non-White and White Hispanic) were found to make up 10% more in the highest scoring census tracts than the lowest scoring census tracts.

Figure 5. Percent of Population by Race/Ethnicity by CEI Score



Below are a few key demographic points:

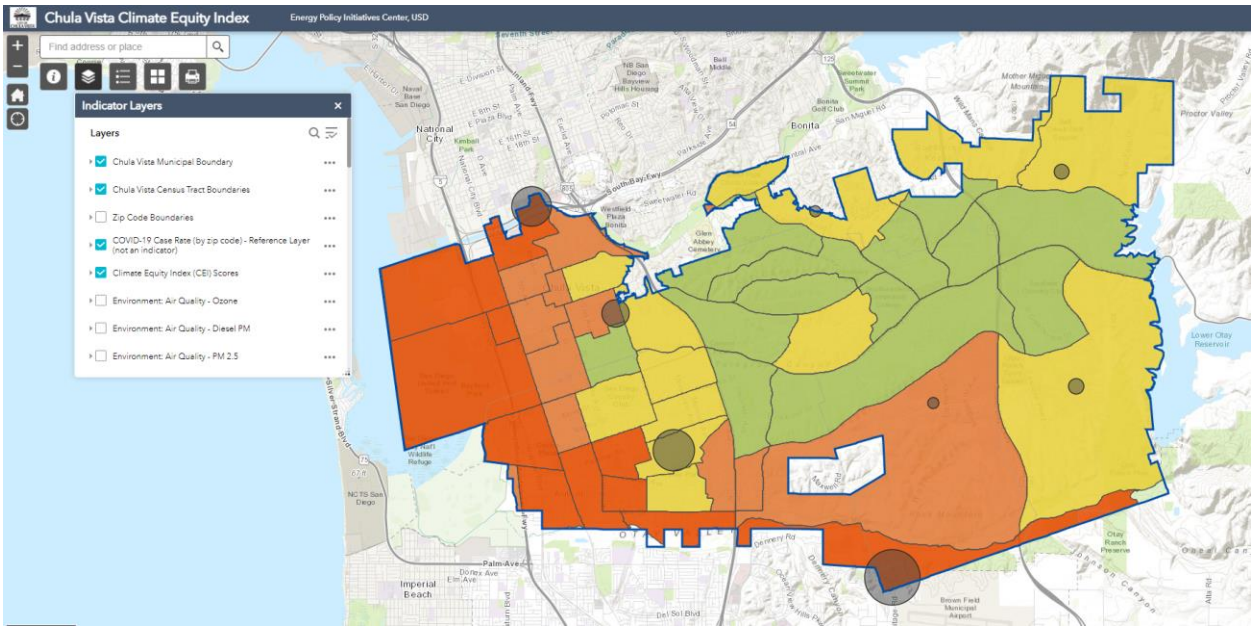
- Census tracts with a score in the top 25% account for 22% of Chula Vista's population and have a CEI score of at least 54.
- Census tracts with an above average CEI score represent 39% of the total population in all census tracts included in the analysis.
- The 13 census tracts with the highest Climate Equity Index are in the western and southwestern communities.
- Within the 13 census tracts with very high Climate Equity Index scores, 87% of residents identify as people of color.

- Within the 12 census tracts with high Climate Equity Index scores, 83% identify as people of color.
- Within the 12 tracts with low Climate Equity Index scores, 77% identify as people of color.
- Within the 12 tracts with very low Climate Equity Index scores, 77% identify as people of color.
- Citywide 81% of residents identify as people of color.

Online Map

An online map is available to view more detail about each individual indicator. This includes raw data and normalized scores based on other tracks, or an overlay with other data, such as state designations for Disadvantaged Communities and Low-Income Communities or Covid-19 cases. View the online map in the climate section of: chulavistaca.gov/clean.

Climate Equity Index Online Map with Covid-19 Cases Overlay



Recommendations

Implementation of the CAP affords the City of Chula Vista the opportunity to increase climate equity and become a leader in addressing this important issue. Progress is possible and the City is taking a major step in acknowledging concerns and moving forward with bold actions to address climate equity.

This multi-faceted task is a relatively new discipline for municipalities and governments to tackle. While there are some examples of success across the nation, due to the diverse nature of our communities, any approach the City takes to address climate equity will require unique solutions developed in close coordination with our communities. In addition to working with City staff to find ways to incorporate the CEI scores into programs and policies, equity working group stakeholders and staff made the high-level recommendations to begin addressing climate equity in the City. More detailed potential actions to implement these recommendations are attached in Attachment B.

Recommendation 1	Increase outreach to and engagement with high scoring census tracts
Recommendation 2	Seek funding for high scoring census tracts
Recommendation 3	Update Climate Equity Index approximately every 5 years

Acknowledgments

The following organizations comprised the City's informal Climate Equity Stakeholder Working Group. We thank every organization for their involvement and contribution of time and input in establishing the City's Climate Equity Index.

Environmental Health Coalition

South Bay 350

Sweetwater Authority

GRID Alternatives

Center for Sustainable Energy

Climate Action Campaign

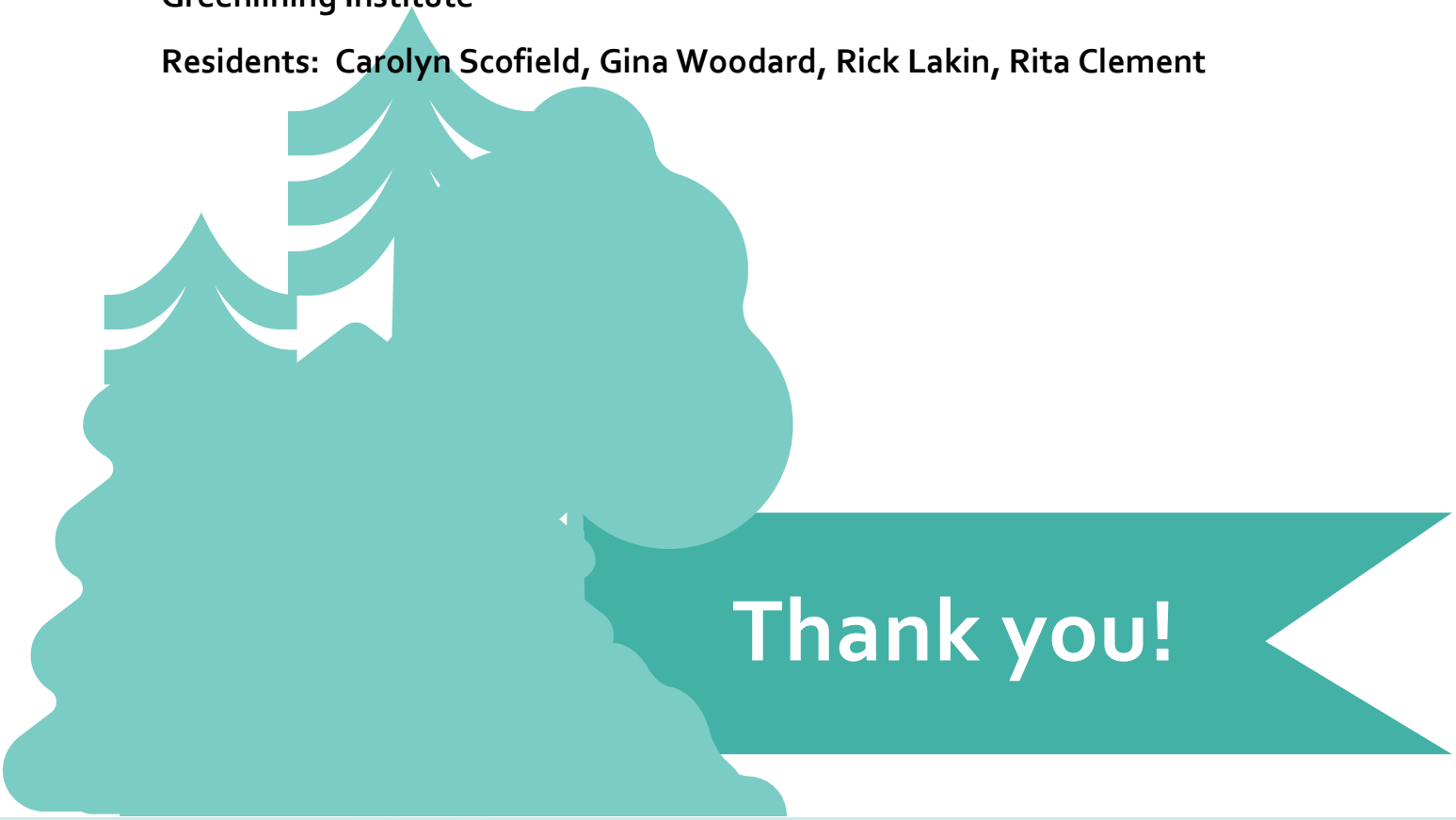
South County Economic Development Council

Southwestern College

South Bay Community Services

Greenlining Institute

Residents: Carolyn Scofield, Gina Woodard, Rick Lakin, Rita Clement



Attachment A

EPIC Chula Vista Climate Equity Index Methods and Findings

Attachment B

Chula Vista Climate Equity Index Implementation Actions

City of Chula Vista
Climate Equity Index

Revised March 2021

Prepared for the City of Chula Vista

CITY OF CHULA VISTA®

Prepared by the Energy Policy Initiatives Center

EPIC
ENERGY POLICY INITIATIVES CENTER
UNIVERSITY OF SAN DIEGO SCHOOL OF LAW

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About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

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1 | INTRODUCTION

The City of Chula Vista (City) adopted a Climate Action Plan (CAP) in 2017 that calls for a number of measures to mitigate greenhouse gas (GHG) emissions city-wide. The CAP identifies those measures that support traditionally disadvantaged communities in Chula Vista, but stops short of identifying those communities and the climate equity concerns within communities city-wide. Building on efforts by other jurisdictions in the region and in partnership with local community stakeholders, Chula Vista set out to identify climate equity concerns within the city and develop an index to spatially identify those communities most impacted by or vulnerable to climate and pollution burdens.

This exercise applies best practices developed and applied in the equity space, but expanded to include specific indicators directly related to climate change impacts, adaptation, and mitigation to describe conditions in Chula Vista. This descriptive approach to spatially represent equity has been used by other cities as well. For example, the City of Tacoma, Washington, in partnership with Ohio State University's Kirwan Institute of Race and Social Justice applied the same methods used here to develop its Equity Index.[1] This index is being used as a mapping tool to identify where Tacoma should focus resources and effort to support equitable access and outcomes within the city. The Institute for State and Local Governance at the City University of New York has developed multiple equity tools for US cities using a similar method to help cities understand and measure equality and equity more broadly.[2] This type of assessment has also been done statewide, such as with the CalEnviroScreen, which identifies communities most affected by pollution and those populations most vulnerable to their effects.[3]

This report provides the results of Chula Vista's Climate Equity Index (CEI) and summarizes the methods and indicators used to calculate the index. Section 2 provides discussion on the methods used for development of the index. Section 3 provides discussion on each of the 35 indicators used in the analysis including: what was measured, data source(s) used, indicator specific methods, and potential limitations.

1.1 Selection of Indicators

Indicators were selected based on relevance and data availability. Relevance was determined through a review of indicators included in similar assessments within the region and state, as well as through input gathered from community stakeholders. This led to a list of indicators identified by the stakeholders as having some meaningful connection to equity in the community. Thirty-nine indicators were identified for Chula Vista through this process (Table 1). These indicators fall into one of four broad categories, which were seen as relevant to climate equity: environmental, health, mobility, and socioeconomic. Additional information for each indicator is provided in Appendix A; this includes a general description of each, data sources, and individual indicator maps.

[1] City of Tacoma, Washington Equity Index
[2] CUNY Institute for State and Local Governance Equality Indicators
[3] California Office of Environmental Health Hazard Assessment CalEnviroScreen

Table 1. Chula Vista Climate Equity Index Indicators

Environmental Indicators
Air Quality – Ozone
Air Quality – Diesel PM
Air Quality – PM 2.5
Cleanup Sites
Drinking Water Contaminants
Extreme Heat Days
Fire Risk
Flood Risk
Groundwater Threats
Hazardous Waste Generators and Facilities
Impaired Water Bodies
Parks & Open Space Access
Pesticide Use
Solid Waste Sites & Facilities
Toxic Releases from Facilities
Traffic Density
Tree Cover
Health Indicators
Asthma Rate
Cardiovascular Disease
Food Access
Health Insurance Access
Low Infant Birthweight

Mobility Indicators
Bicycle Access
Commute Time Burden
Pedestrian Access
Public EV Charging Infrastructure
Street Conditions
Transit Access
Transportation Cost Burden
Vehicle Ownership
Socioeconomic Indicators
Educational Attainment
Digital Access
Energy Cost Burden
Housing Cost Burden
Limited English Proficiency
Poverty Rate
Preschool Enrollment
Solar PV Systems
Unemployment Rate

Energy Policy Initiatives Center, 2020

1.2 Additional Data

In addition to the indicators included above, there are several other datasets identified by the stakeholder group as being relevant for conversations around equity (Table 2). These data were not included as indicators for one or more reasons, including: data reflects general population characteristics,[4] incompatible geographic scale,[5] and/or data quality concerns.

[4] E.g., age and race/ethnicity data

[5] E.g., data is only available at the city or zip code level, whereas the CEI requires data to be available by census tract.

Table 2. Additional Data Identified

Additional Data
Age Profile
Race and Ethnicity
COVID-19 Case Rates
Blood Lead Levels
Cancer Rates
Diabetes & Obesity

Energy Policy Initiatives Center, 2020

A secondary analysis was conducted using population characteristics (age and race/ethnicity) to better understand the makeup of populations as they relate to CEI scores. For instance, what is the average age profile of census tracts scoring in the top 25% of the CEI and are persons of color disproportionately experiencing higher CEI scores? This information is presented alongside CEI results in section 3.

2 | METHODS

The CEI analyzes indicators at the census tract level, where each tract receives a value for each indicator and its 39 indicator values are then used to determine its CEI score. General methods for this process are identified in Figure 1 and described further in the sections that follow.

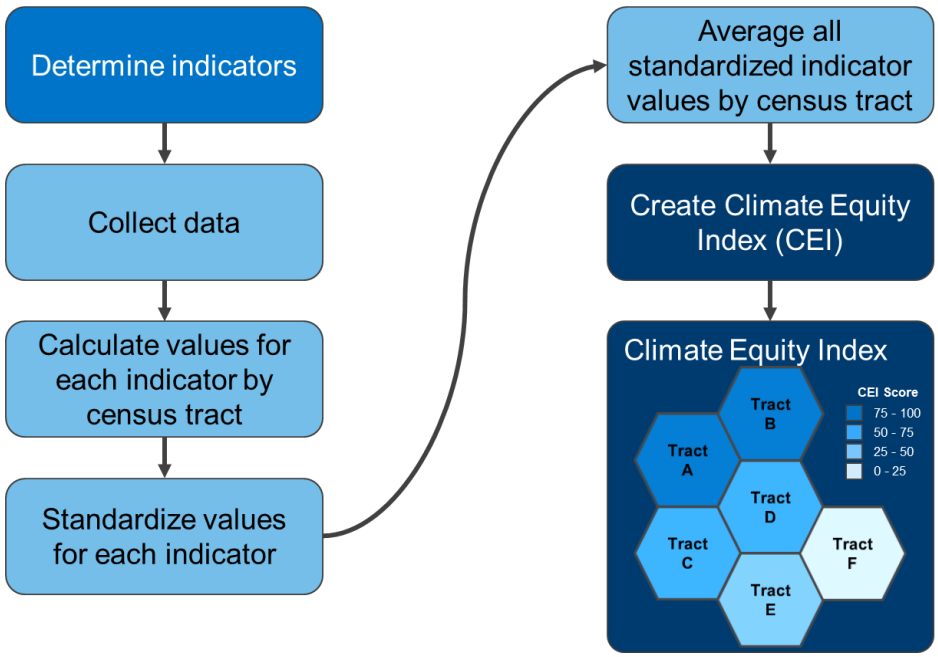

Figure 1. General Climate Equity Index Methods

2.1 Geographic Scale

The CEI uses census tract boundaries within the City of Chula Vista to analyze indicators (Figure 2). This geographic scale was chosen as it aligns with most available datasets for selected indicators and is consistent with similar types of indices developed in other jurisdictions and at the state level.[6]

[6] E.g., CalEnviroScreen, CalBRACE, City of San Diego's Climate Equity Index

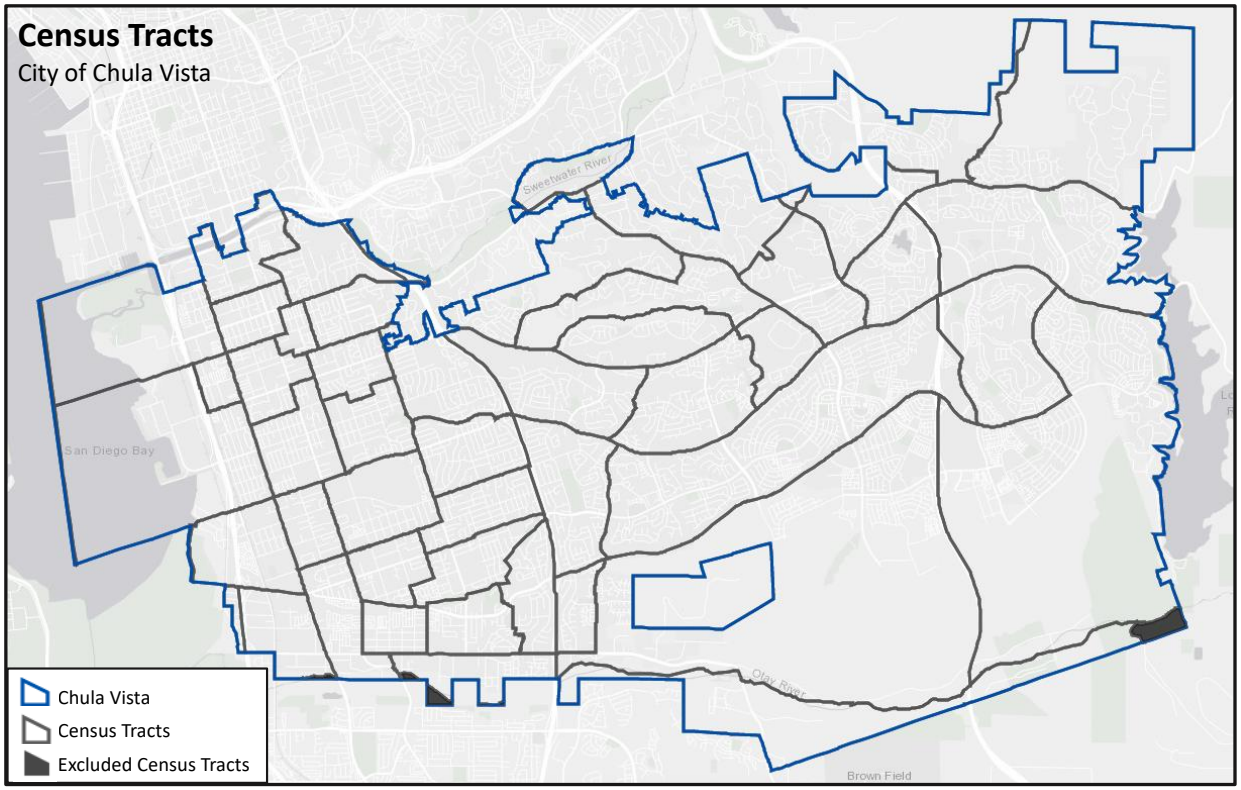

Figure 2. Census Tracts in Chula Vista

The drawback of using census tract boundaries is that they do not necessarily align with a city's boundary, as is the case with all census tracts along Chula Vista's jurisdictional boundary. For most indicators, data for census tracts that overlap with other jurisdictions are representative of the entire tract, not just the population/area within Chula Vista. While most census tracts that overlap with another jurisdiction contain a sizeable portion of the city's population, three census tracts were identified that have minimal overlap with Chula Vista and only cover small swaths of open space along the southern border of the city (Figure 2**,** dark grey tracts). To prevent population characteristics from exclusively outside Chula Vista from biasing results, these three tracts were removed from the analysis.

2.2 Data Collection

Data were collected that met certain criteria to maintain the integrity of the index. Key criteria for data used in this analysis include:

- reflect what community stakeholders know to be important identifiers of equity for communities in Chula Vista;
- available at the census tract level or in a manner that can be transformed to the census tract level;
- up-to-date or as current as possible; and

During the initial development of the CEI, other potential indicators were considered, but ultimately not included within the index because they failed to meet the criteria outlined above (see section 1.2 for more information on additional data). Those indicators excluded from the analysis may be reconsidered during future iterations of the CEI as adequate data becomes available.

2.3 Calculating Individual Indicator Values

Once data were collected for each indicator, single indicator values were calculated for each census tract. For some indicators, data collected were already available at the census tract level and required few or no further modifications. For instance, data collected from the U.S. Census Bureau's American Community Survey (ACS) or from CalEnviroScreen were provided at the census tract level. This includes many of the socioeconomic indicators such as median income, unemployment rate, and digital access. For indicators where data were not available by census tract, additional calculations were necessary to determine values for each tract. More details on indicator specific calculations are provided in Appendix A of this report.

2.4 Standardizing Indicators

Once values were calculated for each indicator at the census tract level, they were standardized so that indicators could be collectively aggregated into a single census tract score. Standardization is necessary since many of the indicators included in the index are measured in different units. For instance, the Parks & Open Space indicator measures the percent of population that lives within half mile of a park or open space. Conversely, the Housing Cost Burden indicator measures the average percentage of annual income that goes towards housing. By standardizing, the indicators are converted to a common value system that allows for an "apples to apples" comparison and permits calculations necessary to aggregate indicators into an overall CEI score (Figure 3).

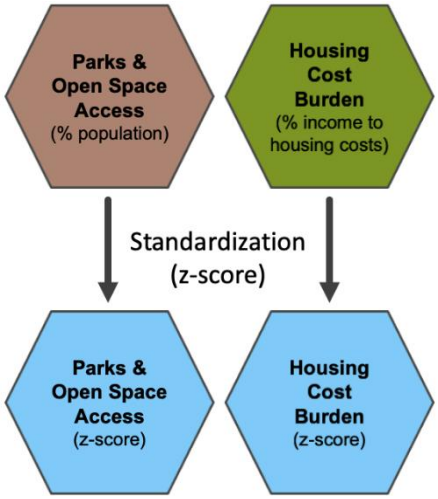

Figure 3. Standardization of Indicators

Indicators were standardized using z-scores.[7] A z-score is a statistical measure that identifies how many standard deviations a value is above or below the mean, or, more plainly, how far a given value is from the average. Z-scores maintain the magnitude in differences between values and acts as a common metric between datasets with different units. Z-scores were calculated for each indicator by census tract using Equation 1.

[7] Other methods have been identified to standardize across indicators, including ratios and percentages. Z-scores were selected to maintain the magnitude on differences across census tracts for a given indicator.

Equation 1. Z-score Formula

$$z_{ij} = \frac{x_{ij} - \mu_i}{\sigma_i}$$

Where,

x_{ij} = value for indicator *i* for census tract *j*
μ_i = average for indicator *i*
σ_i = standard deviation for indicator *i*

2.5 Calculating CEI Scores

Once z-scores were calculated for all census tracts across all indicators, indicators could be combined into a single census tract value. This was done by averaging all z-scores for each census tract (Figure 4). Equal weight was given to each indicator and averaged instead of summed to avoid penalizing census tracts that may have had data missing for one or more indicator. This method does not account for interactions between indicators which may enhance the vulnerability or lessen the adaptive capacity of a census tract.[8]

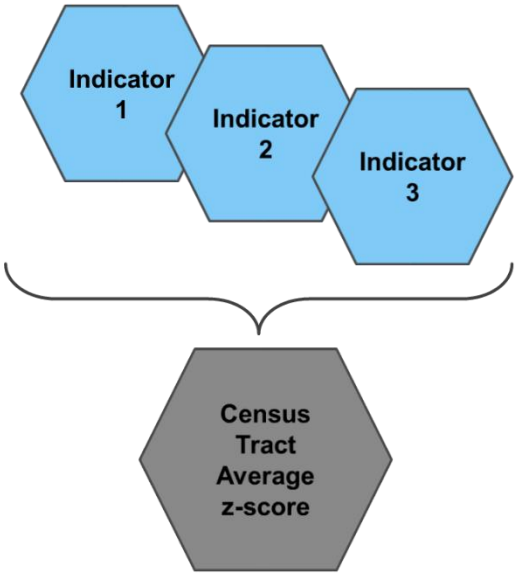

Figure 4. Average Census Tract Z-score

Average z-scores were then indexed to a scale of 0-100 for easier interpretation. This indexing was done using Equation 2 and determined the final index score for each census tract.

Equation 2. Z-score Formula

$$index_j = \frac{(index_{max} - index_{min})}{(z_{max} - z_{min})} * (z_j - z_{min}) + index_{min}$$

[8] A separate analysis was conducted to assess the feasibility of modifying the methods documented here to adjust for interactions among indicators. Preliminary results suggest that a more complex analysis would be required, with a degree of complexity that may complicate the overall process and diminish the ability to understand which indicators are key drivers in higher scoring tracts.

Where,

$index_j$ = index value (CEI score) for census tract *j*
$index_{max}$ = maximum possible index value (100)
$index_{min}$ = minimum possible index value (0)
z_{max} = maximum value for all average z-scores
z_{min} = minimum value for all average z-scores
z_j = mean z-score for census tract *j*

Indexed scores illustrate the relative difference between census tracts. The census tract with the greatest level of inequity as measured by indicators included in the index (highest average z-score) was scored the highest (100) and the tract with the lowest level of inequity (lowest average z-score) was scored the lowest (0). Scores for all other census tracts are scaled to demonstrate their performance relative to the highest and lowest scoring tracts.

2.6 Additional Methods Analysis

Additional analysis was conducted to show how even slight modifications to the method, aimed at capturing potential interactions or combined effects between indicators, would affect results.[9] Two different ways of grouping indicators were tested (see Appendix C).

However, these modifications gave results for CEI scores that do not align with conditions known to be true within the City of Chula Vista today based on a review of individual indicator data and a comparison with CalEnviroScreen scores. One reason for this may be that the initial groupings are simplified and not all indicators within one group will have a direct relationship with each in a second group. As relationships between subgroups are not easily available, such an analysis adds a level of complexity that was beyond the scope of this project.

As such, the methods used to calculate the current CEI describe conditions of inequity felt by the community according to the indicators, excluding any multiplicative effects that may exist where one equity issue strengthens or exacerbates another.

[9] Only the health sector has some examples of robust correlations between certain indicators and public health. See for example, Daniel Hogan et al, Technical Note, Developing an Index for the coverage of essential health services, World Health Organization, May 2016.

3 | RESULTS

Results of the analysis are provided in Table 3 and illustrated in Figure 5. Census tracts are grouped into quartiles with census tracts with the top 25% of CEI scores indicated in reddish and the lowest scoring 25% in the greenish color. Census tracts scoring in the top 25% of CEI scores account for 22% of Chula Vista's population and have a CEI score of at least 54. These census tracts are located along the western and southern borders of the city. The average CEI score across all census tracts is 37 and the standard deviation is 26. A complete list of census tracts and their respective scores are provided in Appendix B.

Table 3. Census Tracts by Quartile

Quartile	Score Range	Number of Census Tracts
Upper Quartile (Top 25%)	55 – 100	13
2nd Quartile	32 – 54	12
3rd Quartile	18 – 31	12
Bottom Quartile (Bottom 25%)	0 – 17	12

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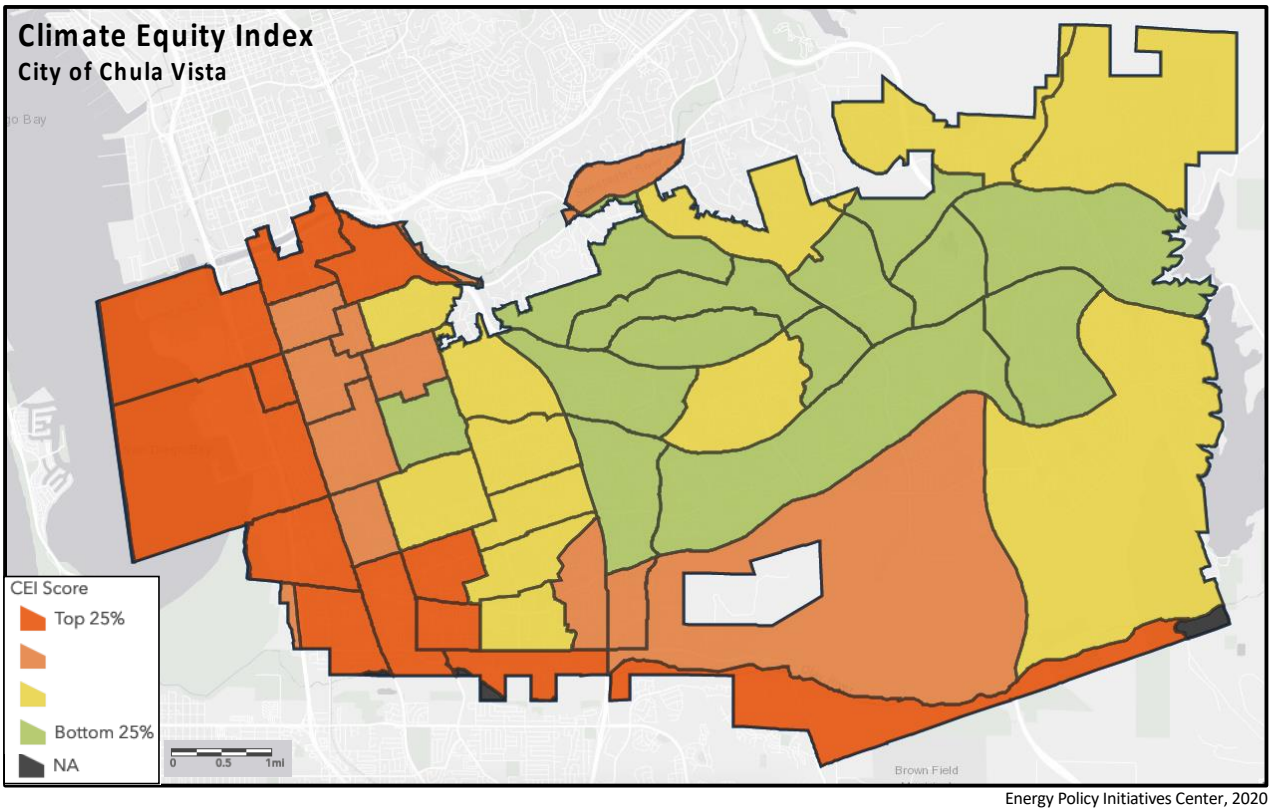

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Figure 5. Average Census Tract Z-score

CEI Scores and Age Demographics

It is understood that younger (e.g., less than 5 years of age) and older (e.g., older than 65 years of age) populations often experience a greater impact from climate and pollution burdens. A secondary analysis was done to understand the age characteristics of census tracts in Chula Vista by CEI scores to determine if certain age classes are disproportionately affected. Table 4 documents the percent of the population within each quartile of CEI scores by age class. While there are some slight differences when comparing the percentage of the population within each age class across the CEI score quartiles, results indicate that there are no significant differences in the age profiles for each group.

Table 4. Percent of Population By Age Class and By CEI Score Quartile

Age Class (years of age)	Percent of Population by CEI Score Quartile[1]			
	Upper quartile (Top 25%)	2nd quartile	3rd quartile	Lower quartile (bottom 25%)
Under 5	6%	7%	7%	6%
5-14	13%	13%	15%	14%
15-24	15%	14%	11%	12%
25-34	17%	18%	13%	13%
35-44	13%	14%	15%	14%
45-54	14%	12%	14%	14%
55-64	11%	9%	11%	12%
65+	12%	11%	12%	14%

[1] The upper quartile includes the top 25% of census tracts—those with the highest CEI scores.

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CEI Scores and Race/Ethnicity Demographics

In addition to age, a follow-up analysis was to understand the race and ethnicity characteristics of census tracts in Chula Vista by CEI scores to determine if certain groups of individuals are disproportionately affected. Table 5 documents the percent of the population within each quartile of CEI scores by race and ethnicity. Results of this analysis indicate that persons of color (non-White and White Hispanic populations) make up a higher percentage of the overall population in those census tracts that have higher CEI scores. In the upper quartile of CEI scores, these populations (non-White and White Hispanic) make up 87% of the total population compared to 77% in the lowest quartile of CEI scores. Of the various populations of color, the White Hispanic population is most indicative of this trend, accounting for 57% of the total population in the highest quartile and 40% in the lowest.

Table 5. Percent of Population By Age By CEI Score

Race/Ethnicity	Percent of Population by CEI Score Quartile			
	Upper quartile (Top 25%)	2nd quartile	3rd quartile	Lower quartile (bottom 25%)
White (Not Hispanic)	13%	17%	23%	23%
White (Hispanic)	57%	51%	40%	40%
Black/African American	6%	5%	4%	6%
American Indian/Alaskan Native	0%	0%	1%	0%
Asian	10%	14%	20%	17%
Hawaiian/Pacific Islander	1%	1%	1%	1%
Other	10%	7%	5%	7%
Two or More	4%	5%	6%	7%

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Appendix A. CLIMATE EQUITY INDEX INDICATORS

A.1 Environmental Indicators

Air Quality – Ozone

Th Air Quality – Ozone indicator measures the daily maximum 8-hour ozone concentration in parts per million (ppm) and is reported as the mean daily maximum during summer months (May through October) averaged over three years (2012-2014). Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A1 provides summary statistics for the Air Quality – Ozone indicator for census tracts within the City of Chula Vista.

Table A1. Air Quality – Ozone Indicator Summary Statistics

	Value(s)
Units	ppm
Mean	0.039
Range	0.035 – 0.044
Standard deviation	0.001

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Air Quality – Diesel PM

The Air Quality – Diesel PM indicator measures diesel particulate matter (PM) emissions in kg/day from on-road and non-road sources using a gridded spatial distribution. Measurements are for a 2012 summer day in July. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A2 provides summary statistics for the Air Quality – Diesel PM indicator for census tracts within the City of Chula Vista.

Table A2. Air Quality – Diesel PM Indicator Summary Statistics

	Value(s)
Units	kg/day
Mean	14.97
Range	2.97 – 28.14
Standard deviation	4.90

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Air Quality – PM 2.5

The Air Quality – PM 2.5 indicator measures the annual mean concentration of particulate matter (PM) 2.5 in µg/m^3 over three years (2012-2014) using the average of quarterly means. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A3 provides summary statistics for the Air Quality – PM 2.5 indicator for census tracts within the City of Chula Vista.

Table A3. Air Quality – PM 2.5 Indicator Summary Statistics

	Value(s)
Units	µg/m^3
Mean	12.04
Range	11.21 – 14.99
Standard deviation	0.91

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Cleanup Sites

The Cleanup Sites indicator measures the sum of weighted sites within each census tract as of December 2016 with calculations conducted as part of CalEnviroScreen. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A4 provides summary statistics for the Cleanup Sites indicator for census tracts within the City of Chula Vista.

Table A4. Cleanup Sites Indicator Summary Statistics

	Value(s)
Units	CalEnviroScreen site score
Mean	2.74
Range	0 – 17.70
Standard deviation	4.32

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Drinking Water Contaminants

The Drinking Water Contaminants indicator measures the drinking water contaminant index score for selected contaminants using data between 2005 and 2013 as reported in CalEnviroScreen. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A5 provides summary statistics for the Drinking Water Contaminants indicator for census tracts within the City of Chula Vista.

Table A5. Drinking Water Contaminants Indicator Summary Statistics

	Value(s)
Units	Contaminant index score
Mean	303.34
Range	253.60 – 751.80
Standard deviation	74.88

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Extreme Heat Days

The Extreme Heat Days indicator measures the projected annual number of extreme heat days in 2100 above the 98th percentile of computed maximum temperature for each location using 1961-1990 historical data as a baseline. Data for this indicator were collected directly from CalBRACE at the census tract level. CalBRACE data relies on modeled climate data available through Cal-Adapt, California's climate data repository

Table A6 provides summary statistics for the Extreme Heat Days indicator for census tracts within the City of Chula Vista.

Table A6. Extreme Heat Days Indicator Summary Statistics

	Value(s)
Units	Days
Mean	10.27
Range	8.60 – 14.90
Standard deviation	1.24

Energy Policy Initiatives Center, 2020

Data Source(s)

California Department of Public Health (CDPH) (2017). *California Building Resilience Against Climate Effects (CalBRACE)*. CSV

Fire Risk

The Fire Risk indicator measures the percentage of each census tract that is within the current very high fire hazard severity zone. ArcGIS was used to overlay a census tract boundary shapefile with a fire hazard boundary shapefile to determine the percent area of each tract within the very high zone.

Table A7 provides summary statistics for the Fire Risk indicator for census tracts within the City of Chula Vista.

Table A7. Fires Risk Indicator Summary Statistics

	Value(s)
Units	Percent area
Mean	8.61
Range	0 – 98.00
Standard deviation	21.96

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Data Source(s)

San Diego Association of Governments (SANDAG) (2015). *Fire Hazard Severity Zones*. SanGIS. Shapefile

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

Flood Risk

The Flood Risk indicator measures the percentage of each census tract that is within the 100-year flood plain and/or within the modeled boundary to experience inundation during a 100-year storm surge event given a 5-meter increase in sea level. ArcGIS was used to overlay a census tract boundary shapefile with boundary layers for each type of flood risk to determine the percent area of each census tract in one or both flood risk zones.

Table A8 provides summary statistics for the Flood Risk indicator for census tracts within the City of Chula Vista.

Table A8. Flood Risk Indicator Summary Statistics

	Value(s)
Units	Percent area
Mean	10.70
Range	0 – 92.29
Standard deviation	21.71

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Data Source(s)

San Diego Association of Governments (SANDAG), Federal Emergency Management Agency (FEMA), County of San Diego, Dept. of Public Works, Flood Control Engineering (2019). *Flood Plain*. SanGIS. Shapefile

Barnard PL., Erikson LH, Foxgrover AC, Limber PW, O'Neill AC, and Vitousek S. (2018). *Coastal Storm Modeling System (CoSMoS) for Southern California, v3.0, Phase 2 (ver. 1g, May 2018)*. U.S. Geological Survey data release. Shapefile

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

Groundwater Threats

The Groundwater Threats indicator measures the sum of weighted scores for sites within each census tract as of December 2016 with calculations done by CalEnviroScreen. CalEnviroScreen defines a site as

are pollution sources that impact groundwater and are identified in the State Water Resources control Board's GeoTracker database. Sites identified include: wells with contaminated water, leaking underground storage tanks, cleanup and land disposal sites, produced water ponds, industrial sites, airports, dairies, dry cleaners, and publicly-owned sewage treatment plants, Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A9 provides summary statistics for the Groundwater Threats indicator for census tracts within the City of Chula Vista.

Table A9. Groundwater Threats Indicator Summary Statistics

	Value(s)
Units	CalEnviroScreen site score
Mean	8.23
Range	0 – 112.75
Standard deviation	18.85

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Hazardous Waste Generators & Facilities

The Hazardous Waste Generators & Facilities indicator measures the sum of weighted permitted hazardous waste facilities as of December 2016 and hazardous waste generators between 2012-2014 within each census tract with calculations done by CalEnviroScreen. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A10 provides summary statistics for the Hazardous Waste Generators & Facilities indicator for census tracts within the City of Chula Vista.

Table A10. Hazardous Waste Generators & Facilities Indicator Summary Statistics

	Value(s)
Units	CalEnviroScreen score
Mean	0.32
Range	0 – 4.47
Standard deviation	0.85

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Impaired Water Bodies

The Impaired Water Bodies indicator measures the summed number of pollutants across all water bodies designated as impaired within the area using 2012 data. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A11 provides summary statistics for the Impaired Water Bodies indicator for census tracts within the City of Chula Vista.

Table A11. Impaired Water Bodies Indicator Summary Statistics

	Value(s)
Units	Number of pollutants
Mean	2.41
Range	0 – 7.00
Standard deviation	2.16

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Parks & Open Space Access

The Parks & Open Space Access measures the percent of the population living within ½ mile to a park or open space. ArcGIS was used to apply a ½ mile buffer around all parks and open space in or near the City of Chula Vista. This was overlayed with census block data to estimate the population living within that area and then compared to the total population within each tract. Data for parks and open space locations are current as of 2019.

Table A12 provides summary statistics for the Parks & Open Space Access indicator for census tracts within the City of Chula Vista.

Table A12. Parks & Open Space Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	96.15
Range	34.81 – 100
Standard deviation	11.14

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Data Source(s)

San Diego Association of Governments (SANDAG), County of San Diego, City of San Diego, City of Carlsbad, City of Chula Vista, City of Coronado, City of Del Mar, City of El Cajon, City of Encinitas, City of Escondido, City of Imperial Beach, City of La Mesa, City of Lemon Grove, National City, City of Oceanside, City of Poway, City of San Marcos, City of Santee, City of Vista, San Diego Port District, State Parks (2019). *Parks*. SanGIS. Shapefile

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Total Population (B01003). CSV

Pesticide Use

The Pesticide Use indicator measures the total pounds of selected active pesticide ingredients (filtered for hazard and volatility) used in production-agriculture per square mile, averaged over three years (2012-2014), and measured in lb/mi^2. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A13 provides summary statistics for the Pesticide Use indicator for census tracts within the City of Chula Vista.

Table A13. Pesticide Use Indicator Summary Statistics

	Value(s)
Units	lb/mi^2
Mean	0.25
Range	0 – 5.33
Standard deviation	0.99

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Solid Waste Sites & Facilities

The Solid Waste Sites & Facilities indicator measures the sum of weighted solid waste sites and facilities as of December 2016 with calculations done by CalEnviroScreen. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A14 provides summary statistics for the Solid Waste Sites & Facilities indicator for census tracts within the City of Chula Vista.

Table A14. Solid Waste Sites & Facilities Indicator Summary Statistics

	Value(s)
Units	CalEnviroScreen score
Mean	2.98
Range	0 – 34.55
Standard deviation	6.60

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Toxic Releases from Facilities

The Toxic Releases from Facilities indicator measures the toxicity-weighted concentrations of modeled chemical releases to air from facility emissions and off-site incineration between 2011-2013 with calculations done by CalEnviroScreen. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A15 provides summary statistics for the Toxic Releases from Facilities indicator for census tracts within the City of Chula Vista.

Table A15. Toxic Releases from Facilities Indicator Summary Statistics

	Value(s)
Units	Toxicity weighted concentrations
Mean	799.59
Range	178.19 – 2,469.02
Standard deviation	470.37

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Traffic Density

The Traffic Density indicator measures the sum of traffic volumes adjusted by road segment length (vehicle-kilometers per hour) divided by total road length (kilometers) within 150 meters of the census tract boundary. Data is from 2013 and is measured in vehicle-km per day per road-km. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A16 provides summary statistics for the Traffic Density indicator for census tracts within the City of Chula Vista.

Table A16. Traffic Density Indicator Summary Statistics

	Value(s)
Units	vehicle-km/day/road-km
Mean	1,011.23
Range	351.69 – 2,478.94
Standard deviation	531.07

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Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Tree Cover

The Tree Cover indicator measures the percentage of each census tract, excluding water bodies, with tree cover. ArcGIS was used to overlay tree cover identified in a 2014 Light Detection and Ranging (LiDAR) analysis done region-wide with census tract boundaries in Chula Vista to determine total coverage area.

Table A17 provides summary statistics for the Tree Cover indicator for census tracts within the City of Chula Vista.

Table A17. Tree Cover Indicator Summary Statistics

	Value(s)

Units	Percent area
Mean	12.65
Range	4.67 – 24.76
Standard deviation	4.90

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Data Source(s)

University of Vermont Spatial Analysis Laboratory, City of San Diego (2017). *TreeCanopy_2014_SanDiego*. Raster Dataset

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census_Tracts_2010*. Shapefile

A.2 Mobility Indicators

Bicycle Access

The Bicycle Access indicator measures the miles of bike lanes relative to major roadways (4-6 lanes) and is expressed as a percent. A shapefile containing current bicycle and roadway infrastructure was provided by City staff and overlaid with a census tract boundary shapefile to determine the miles of each within each census tract. The total bike lane miles were divided by the total major roadway miles to determine the relative percent for each tract.

Table A18 provides summary statistics for the Bicycle Access indicator for census tracts within the City of Chula Vista.

Table A18. Bicycle Access Indicator Summary Statistics

	Value(s)
Units	bike-mi/road-mi
Mean	83.14
Range	22.14 – 337.27
Standard deviation	51.63

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Data Source(s)

Bicycle infrastructure data provided by City staff to EPIC

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census_Tracts_2010*. Shapefile

Commute Time Burden

The Commute Time Burden indicator measures the percent of the population with a commute time over the regional average. This is a weighted average value that considers the regional average commute time for both those that commute by car (~30 minutes) and those by mass transit (~45 minutes) along with the total population that commutes by each. Population counts were collected for individuals who commute more than 30 minutes if commuting by car or more than 45 minutes if commuting by mass transit. The sum of these two groups was divided by the total population for each census tract to get the percent of the population with a significant commute burden (a commute time over the regional average). Data for this indicator were collected from the Census Bureau at the census tract level for the 2018 American Community Survey (ACS) 5-year estimate.

Table A19 provides summary statistics for the Commute Time Burden indicator for census tracts within the City of Chula Vista.

Table A19. Commute Time Burden Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	42.41
Range	25.57 – 56.51
Standard deviation	7.17

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Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Means of Transportation to Work by Travel Time to Work (B08134). CSV

Pedestrian Access

The Pedestrian Access indicator measures the miles of pedestrian infrastructure (sidewalks and trails) relative to major roadways (4-6 lanes) and is expressed as a percent. A shapefile containing current pedestrian and roadway infrastructure was provided by City staff and overlaid with a census tract boundary shapefile to determine the miles of each within each census tract. The total pedestrian infrastructure miles were divided by the total major roadway miles to determine the relative percent for each tract.

Table A20 provides summary statistics for the Pedestrian Access indicator for census tracts within the City of Chula Vista.

Table A20. Pedestrian Access Indicator Summary Statistics

	Value(s)
Units	pedestrian-mi/road-mi
Mean	85.21
Range	51.20 – 196.08
Standard deviation	27.04

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Data Source(s)

Pedestrian infrastructure data provided by City staff to EPIC

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

Public EV Charging Infrastructure

The Public EV Charging Infrastructure indicator measures the number of publicly available electric vehicle (EV) charging stations per 1,000 individuals (includes Level 1, Level 2, and DC Fact chargers). ArcGIS was used to identify the number of EV chargers within each census tract by overlaying EV charger data with a census tract boundary shapefile. The number of EV chargers were then divided by the total population and multiplied by 1,000 to get the total number of chargers per 1,000 individuals. Current EV charger data for this indicator were provided by location and population data was collected from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A21 provides summary statistics for the Public EV Charging Infrastructure indicator for census tracts within the City of Chula Vista.

Table A21. Public EV Charging Infrastructure Indicator Summary Statistics

	Value(s)
Units	EV chargers per 1,000 individuals
Mean	0.47
Range	0 – 9.10
Standard deviation	1.43

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Data Source(s)

U.S. Department of Energy, Alternative Fuels Data Center (2020). *Alternative Fueling Station Locator*. CSV

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Total Population (B01003). CSV

Street Conditions

The Street Conditions indicator measures the weighted average Pavement Condition Index (PCI) score for each census tract. The City maintains the PCI and provides periodic updates for public download. Data for this indicator were provided by City staff and contains a list of all streets within the City and their corresponding PCI score currently. PCI scores were weighted by the length of the roadway and averaged across all weighted PCI scores within a given census tract by overlaying this data with a census tract boundary shapefile in ArcGIS to determine census tract level scores.

Table A22 provides summary statistics for the Street Conditions indicator for census tracts within the City of Chula Vista.

Table A22. Street Conditions Indicator Summary Statistics

	Value(s)
Units	Weighted PCI
Mean	68.98
Range	47.00 – 83.76
Standard deviation	8.89

Energy Policy Initiatives Center, 2020

Data Source(s)

Provided by City staff to EPIC

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

Transit Access

The Transit Access indicator measures the percent of the population living within ½ mile walking distance of a transit stop. Transit stop data are from 2019 and include for rail, trolley, and bus. Using ArcGIS, a ½

mile walking distance buffer was applied to each transit stop using accessible routes, not "as-the-crow-flies." These buffered zones were overlaid with census block areas to determine the population living within each zone. This population was then divided by the total population for each census tract to determine the percent of the population within ½ mile of a stop.

Table A23 provides summary statistics for the Transit Access indicator for census tracts within the City of Chula Vista.

Table A23. Transit Access Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	89.10
Range	0 – 100
Standard deviation	20.72

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Data Source(s)

San Diego Association of Governments (SANDAG) (2019). *Transit Stops*. SanGIS. Shapefile

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Total Population (B01003). CSV

Transportation Cost Burden

The Transportation Cost Burden indicator measures transportation costs as a percent of income for the regional typical household. Data for this indicator were collected directly from the Housing and Transportation Cost (H+T) Index at the census tract level. The H+T Index was last updated in 2017.

Table A24 provides summary statistics for the Transportation Cost Burden indicator for census tracts within the City of Chula Vista.

Table A24. Transportation Cost Burden Indicator Summary Statistics

	Value(s)
Units	Percent income to transportation costs
Mean	22.00
Range	18.00 – 27.00
Standard deviation	2.24

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Data Source(s)

Center for Neighborhood Technology (CNT) (2019). *Housing and Transportation (H+T) Affordability Index*. CSV

Vehicle Ownership

The Vehicle Ownership indicator measures the percent of households without a vehicle. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A25 provides summary statistics for the Vehicle Ownership indicator for census tracts within the City of Chula Vista.

Table A25. Vehicle Ownership Indicator Summary Statistics

	Value(s)
Units	Percent of households
Mean	5.22
Range	0 – 21.59
Standard deviation	4.80

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Tenure by Vehicles Available (B25044). CSV

A.3 Socioeconomic Indicators

Educational Attainment

The Educational Attainment indicator measures the percent of the population within each census tract that is over the age of 25 and has less than a high school education. The number of individuals with below a high school education were divided by the sum of those with below and those with above a high school education. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A26 provides summary statistics for the Educational Attainment indicator for census tracts within the City of Chula Vista.

Table A26. Educational Attainment Indicator Summary Statistics

	Value(s)
Units	Percent of population over 25 years of age
Mean	20.64
Range	3.30 – 48.86
Standard deviation	11.74

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Educational Attainment for the Population 25 Years and Over (B15003). CSV

Digital Access

The Digital Access indicator measures the percent of households without internet access. Those considered to have internet access include both households with an active internet subscription and those without, but are still provided internet (e.g., student dorms where the university maintains the internet

subscription). Data is provided that identifies those with internet access (either with or without their own subscription) and those without access. To calculate the percent of the population within each census tract without internet access, the number of individuals without internet access was divided by the total number of individuals. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate. Data used for this indicator are also consistent with that used in the City of Chula Vista's Digital Equity and Inclusion Plan.

Table A27 provides summary statistics for the Digital Access indicator for census tracts within the City of Chula Vista.

Table A27. Digital Access Indicator Summary Statistics

	Value(s)
Units	Percent of households
Mean	13.45
Range	0.56 – 38.17
Standard deviation	9.14

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Internet Subscriptions in Households (B28011). CSV

Energy Cost Burden

The Energy Cost Burden indicator measures the average annual cost of energy as a percent of median household income. This includes utility customers on DR, DR-LI, GR and GR-LI rate schedules for years 2017-2019. Energy consumption 2018 income data is applied to 2019 as 2019 data is not yet available. The average total energy cost per household assumes that each household has one natural gas and one electricity meter. Historic rates for 2015-2017 were multiplied by the kWh or therms reported depending on the corresponding rate schedule. Only those customers on the standard (DR or GR) or low-income (DR-LI or GR-LI) rate schedules were included. Energy cost data was divided by income and expressed as a percent. Data provided by SDG&E and collected from the Census Bureau were at the census tract level.

Table A28 provides summary statistics for the Energy Cost Burden indicator for census tracts within the City of Chula Vista.

Table A28. Energy Cost Burden Indicator Summary Statistics

	Value(s)
Units	Percent income to energy costs
Mean	2.02
Range	1.24 – 3.28
Standard deviation	0.50

Energy Policy Initiatives Center, 2020

Data Source(s)

Energy data provided to EPIC through SDG&E

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Median Income in the Past 12 Months (S1903). CSV

Housing Cost Burden

The Housing Cost Burden indicator measures the median housing cost as a percent of median household income. Median housing costs for each census tract were divided by the median household income and expressed as a percent. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A29 provides summary statistics for the Housing Cost Burden indicator for census tracts within the City of Chula Vista.

Table A29. Housing Cost Burden Indicator Summary Statistics

	Value(s)
Units	Percent income to housing costs
Mean	29.80
Range	23.40 – 46.05
Standard deviation	5.17

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Median Monthly Housing Costs (B25105). CSV

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Median Income in the Past 12 Months (S1903). CSV

Limited English Proficiency

The Limited English Proficiency indicator measures the percent of limited-English speaking households within each census tract based on all primary language groups identified in the American Community Survey. The ACS identifies limited-English speaking households for the following language groups: Spanish, Asian and Pacific Island languages, other Indo-European languages, and other languages Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A30 provides summary statistics for the Limited English Proficiency indicator for census tracts within the City of Chula Vista.

Table A30. Limited English Proficiency Indicator Summary Statistics

	Value(s)
Units	Percent of households
Mean	10.49
Range	1.20 – 28.30
Standard deviation	7.07

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Limited English Speaking Households (S1602). CSV

Poverty Rate

The Poverty Rate indicator measures the percent of the population with income below 200% of the federal poverty level. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A31 provides summary statistics for the Poverty Rate indicator for census tracts within the City of Chula Vista.

Table A31. Poverty Rate Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	30.36
Range	7.69 – 65.86
Standard deviation	15.98

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Poverty Status in the Past 12 Months (S1701). CSV

Preschool Enrollment

The Preschool Enrollment indicator measures the percent of 3- to 4-year-olds enrolled in preschool, both public and private. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A32 provides summary statistics for the Preschool Enrollment indicator for census tracts within the City of Chula Vista.

Table A32. Preschool Enrollment Indicator Summary Statistics

	Value(s)
Units	Percent of 3 to 4 year olds
Mean	46.70
Range	0 – 92.24
Standard deviation	23.38

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Sex by School Enrollment by Type of School by Age for the Population 3 Years and Over (B14003). CSV

Solar Photovoltaic Systems

The Solar Photovoltaic Systems indicator measures the number of solar photovoltaic (PV) systems per 1,000 individuals. PV systems included are only those within the City boundary and installed through September 2020. ArcGIS was used to identify the number of PV systems within each census tract by overlaying PV data with a census tract boundary shapefile. The number of PV systems were then divided by the total population and multiplied by 1,000 to get the total number of systems per 1,000 individuals. PV data for this indicator were provided by City staff by location and population data was collected from the Census Bureau at the census tract level.

Table A33 provides summary statistics for the Solar Photovoltaic Systems indicator for census tracts within the City of Chula Vista.

Table A33. Solar Photovoltaic Systems Indicator Summary Statistics

	Value(s)
Units	PV systems per 1,000 individuals
Mean	35.58
Range	0.10 – 91.38
Standard deviation	24.33

Energy Policy Initiatives Center, 2020

Data Source(s)
Solar photovoltaic permit data was provided by City staff to EPIC

San Diego Association of Governments (SANDAG), U.S. Census Bureau (2014). *Census Tracts 2010*. Shapefile

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Total Population (B01003). CSV

Unemployment Rate

The Unemployment Rate indicator measures the percent of the population 16 years of age or older that is unemployed. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A34 provides summary statistics for the Unemployment Rate indicator for census tracts within the City of Chula Vista.

Table A34. Unemployment Rate Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	9.67
Range	0.40 – 20.00
Standard deviation	4.87

Energy Policy Initiatives Center, 2020

Data Source(s)
U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Employment Status (S2301). CSV

A.4 Health Indicators

Asthma Rate

The Asthma Rate indicator measures the spatially modelled, age-adjusted rate of emergency department (ED) visits for asthma per 10,000 individuals between 2011 and 2013. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A35 provides summary statistics for the Asthma Rate indicator for census tracts within the City of Chula Vista.

Table A35. Asthma Rate Indicator Summary Statistics

	Value(s)
Units	ED visits per 10,000 individuals
Mean	49.42
Range	14.21 – 68.62
Standard deviation	17.42

Energy Policy Initiatives Center, 2020

Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Cardiovascular Disease

The Cardiovascular Disease indicator measures the spatially modeled, age-adjusted rate of emergency department (ED) visits for heart attack (acute myocardial infarction, AMI) per 10,000 individuals between 2011-2013. Data for this indicator were collected directly from CalEnviroScreen v3.0 at the census tract level.

Table A36 provides summary statistics for the Cardiovascular Disease indicator for census tracts within the City of Chula Vista.

Table A36. Cardiovascular Disease Indicator Summary Statistics

	Value(s)
Units	ED visits per 10,000 individuals
Mean	7.15
Range	2.96 – 8.85
Standard deviation	1.66

Energy Policy Initiatives Center, 2020

Data Source(s)

California Environmental Protection Agency (Cal EPA) Office of Environmental Health Hazard Assessment (OEHHA) (2017). *CalEnviroScreen 3.0*. Shapefile

Food Access

The Food Access indicator measures the percent of the population within each census tract that has a lower level of access to healthy foods as measured by the USDA Food Access Research Atlas. Low access is considered greater than ½ mile for urban census tracts and greater than 10 miles for rural census tracts. The Food Access Research Atlas was last updated in 2015 and data contained within the atlas are reflective of that year. Data for this indicator were gathered at the census tract level from Food Access Research Atlas.

Table A37 provides summary statistics for the Food Access indicator for census tracts within the City of Chula Vista.

Table A37. Food Access Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	5.85
Range	0 – 81.23
Standard deviation	15.74

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Department of Agriculture (USDA) (2015). *Food Access Research Atlas*. Excel

Health Insurance Access

The Health Insurance Access indicator measures the percent of the population that is uninsured. Data for this indicator were collected directly from the Census Bureau at the census tract level for the 2018 ACS 5-year estimate.

Table A38 provides summary statistics for the Health Insurance Access indicator for census tracts within the City of Chula Vista.

Table A38. Health Insurance Access Indicator Summary Statistics

	Value(s)
Units	Percent of population
Mean	8.70
Range	2.14 – 19.30
Standard deviation	3.95

Energy Policy Initiatives Center, 2020

Data Source(s)

U.S. Census Bureau (n.d.). *2018 ACS 5-year estimates*. Selected Characteristics of Health Insurance coverage in the United States (S2701). CSV

Low Infant Birthweight

The Low Infant Birthweight indicator measures the percent of full-term births (37 weeks of gestation) within each census tract with a birthweight less than 2,500 grams between 2013 and 2015. Data for this indicator were collected directly from Tracking California at the census tract level.

Table A39 provides summary statistics for the Low Infant Birthweight indicator for census tracts within the City of Chula Vista.

Table A39. Low Infant Birthweight Indicator Summary Statistics

	Value(s)
Units	Percent of full term births
Mean	1.84
Range	1.73 – 1.97
Standard deviation	0.06

Energy Policy Initiatives Center, 2020

Data Source(s)

Tracking California, CA Department of Public Health, Office of Vital Statistics (2020). *Maternal and Infant Health*. CSV

Appendix B. CLIMATE EQUITY INDEX SCORES BY CENSUS TRACT

Table B1 provides a list of the 49 census tracts included in the analysis along with their final Climate Equity Index (CEI) score and the corresponding quartile to which they belong.

Table B1. Climate Equity Index Scores by Census Tract

Census Tract	CEI Score	Quartile[1]
6073012501	100	1
6073012302	35	2
6073013204	69	1
6073013104	49	2
6073012402	44	2
6073013312	39	2
6073012800	34	2
6073013203	64	1
6073012304	27	3
6073012700	54	1
6073013307	28	3
6073013415	12	4
6073012900	5	4
6073013301	23	3
6073013418	5	4
6073013302	23	3
6073013000	43	2
6073013306	40	2
6073013102	31	2
6073013205	83	1
6073013103	59	1
6073013303	28	3
6073013206	67	1
6073013308	63	1
6073013417	9	4

Census Tract	CEI Score	Quartile[1]
6073013420	2	4
6073013416	0	4
6073012303	57	1
6073013401	29	3
6073013414	20	3
6073013309	13	4
6073012401	60	1
6073003204	41	2
6073013311	4	4
6073013409	17	4
6073012502	96	1
6073013411	24	3
6073013421	8	4
6073010103	37	2
6073012600	89	1
6073013412	15	4
6073013419	6	4
6073003207	31	2
6073013310	17	3
6073013313	37	2
6073013314	27	3
6073013410	27	3
6073010014	78	1
6073021303	26	3

[1] Numbers within the quartile column indicate the respective quartile in which each census tract belongs. A "1" indicates the census tract scored in the top 25% of all census tracts and a "4" in the bottom 25%.

Energy Policy Initiatives Center, 2020

Appendix C. Additional Methods Analysis

EPIC conducted additional analysis to assess whether the methods used to develop the City of Chula Vista's Climate Equity Index could be used to capture the interactions between groups of indicators or better balance the contributions of indicator groups. This appendix summarizes the two modified options assessed during the CEI development process.

Table C1 below summarizes the 39 indicators used for the Chula Vista CEI separated into two groups with five subgroups that indicate pollution and climate burdens, resiliency characteristics, socioeconomic characteristics, and health characteristics. These groupings formed the basis for both modified method approaches.

Table C1. Methods Sensitivity Analysis Indicator Groupings

Pollution & Climate Burden	
Pollution Exposure & Environmental Effects	
Number	**Indicator**
1	Air Quality - Ozone
2	Air Quality - Diesel PM
3	Air Quality - PM 2.5
4	Cleanup Sites
5	Drinking Water Contaminants
6	Groundwater Threats
7	Hazardous Waste Generators and Facilities
8	Impaired Water Bodies
9	Pesticide Use
10	Solid Waste Sites & Facilities
11	Toxic Releases from Facilities
12	Traffic Density
Climate Impact Exposure	
Number	**Indicator**
1	Extreme Heat Days
2	Fire Risk
3	Flood Risk (inc. sea level rise)

Resiliency Characteristics	
Community Characteristics	
Number	**Indicator**
1	Parks & Open Space Access
2	Tree Cover
3	Bicycle Access
4	Pedestrian Access
5	Public EV Charging Infrastructure
6	Street Conditions
Socioeconomic Characteristics	
Number	**Indicator**
1	Commute Time Burden
2	Transit Access
3	Transportation Cost Burden
4	Vehicle Ownership
5	Educational Attainment
6	Digital Access
7	Energy Cost Burden
8	Housing Cost Burden
9	Limited English Proficiency
10	Poverty Rate
11	Preschool Enrollment
12	Solar PV Systems
13	Unemployment Rate
Health Characteristics	
Number	**Indicator**
1	Asthma Rate
2	Cardiovascular Disease
3	Food Access
4	Health Insurance Access (Insured)
5	Low Infant Birthweight

Method 1 – Two Groups with Five Subgroups of Indicators

The first method analyzed indicators after placing them into two main groups seen as representing pollution and climate burdens, and community resiliency characteristics, respectively. The effect of separating the climate risk indicators is to allow the average of three climate risk indicators (wildfire, flooding and extreme heat days) to have equal weight with the average of all 12 pollution indicators. Similarly, in the resiliency characteristics group, 7 community indicators were equated to 13 socioeconomic indicators and 5 health indicators.

Averages for each group were multiplied together to test the effect on CEI scores (Figure C1).

Figure C1. Method 1 Overview

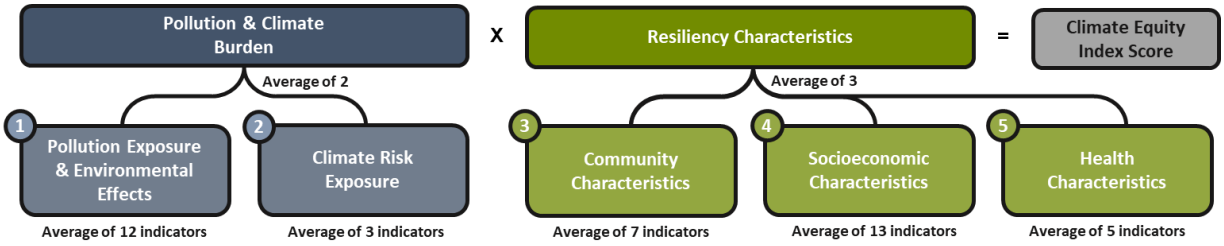
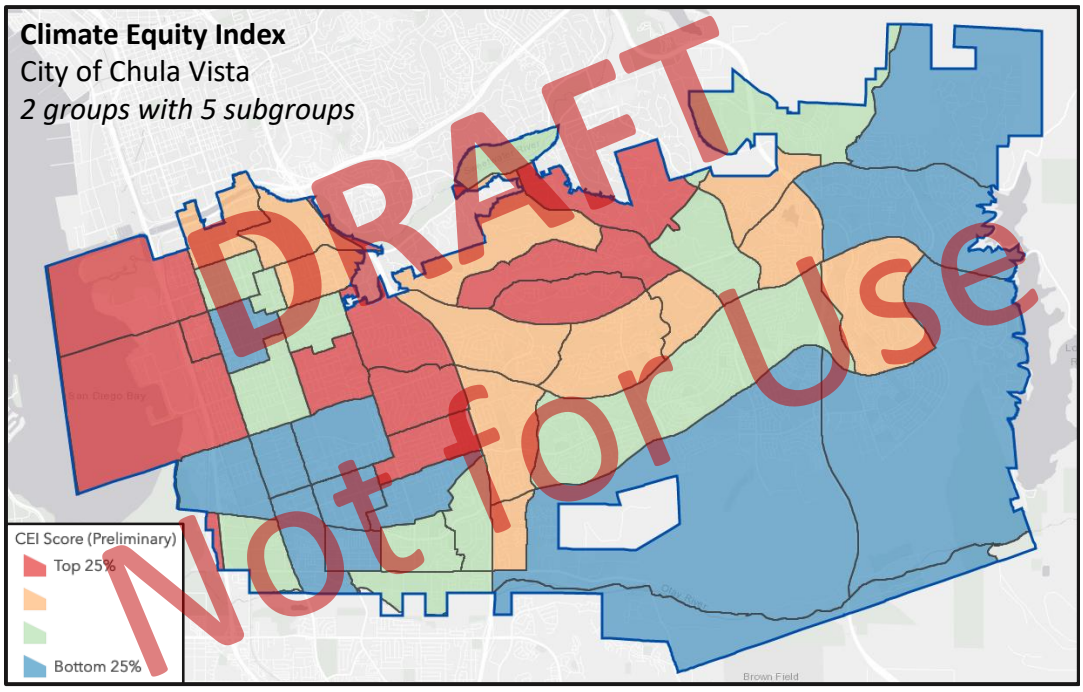


Figure C2. Preliminary CEI Scores Using Method 1



Method 2 – Two Groups with Four Subgroups of Indicators

The second method built off Method 1, but equalized the individual climate risk indicators with individual pollution indicators. To do this, all 15 indicators were averaged together as one subgroup (Figure C3).

Figure C3. Method 2 Overview

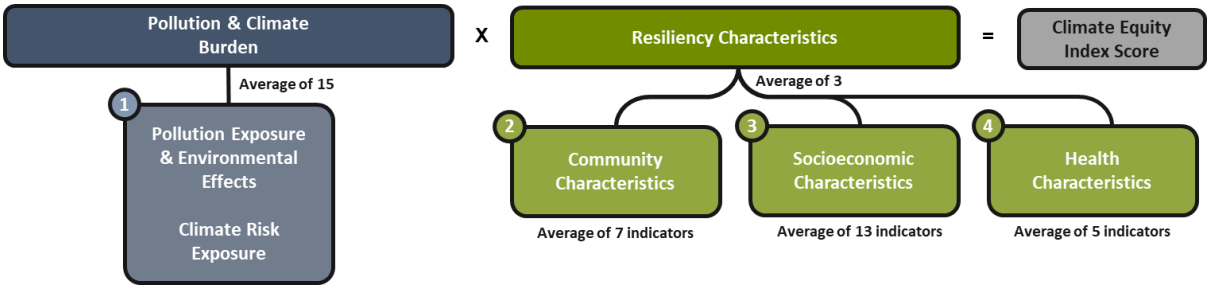
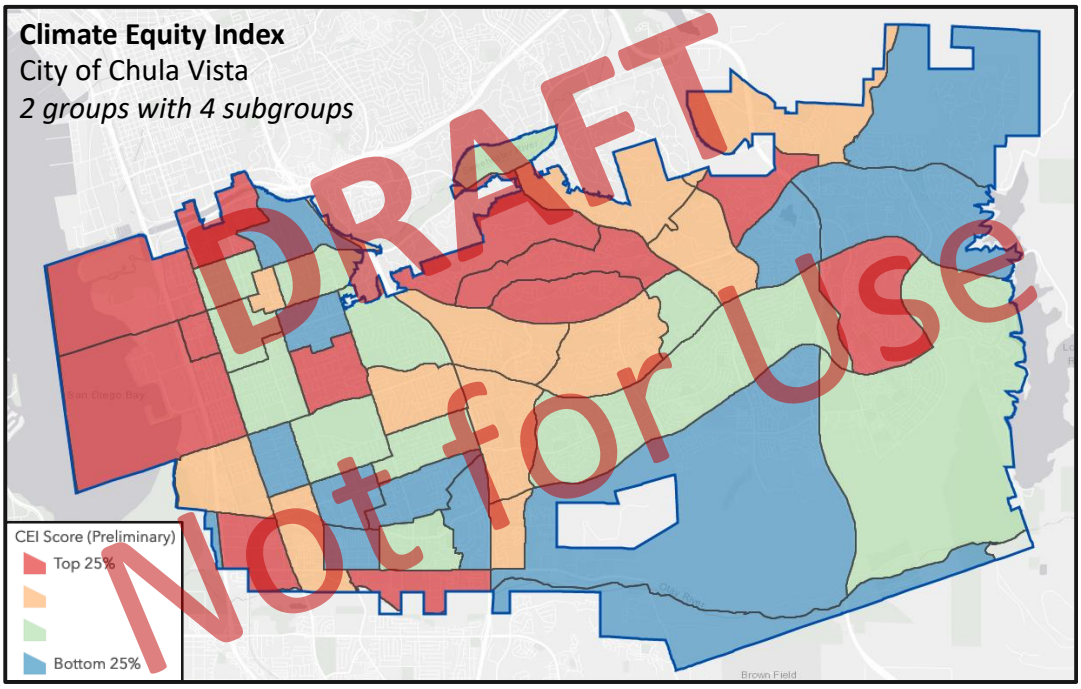


Figure C4. Preliminary CEI Scores Using Method 2



However, these modifications gave results for CEI scores that do not align with conditions known to be true within the City of Chula Vista today based on a review of individual indicator data and a comparison with CalEnviroScreen scores. One reason for this may be that the initial groupings are simplified and not all indicators within one group will have a direct relationship with each in a second group. As relationships between subgroups are not easily available, such an analysis adds a level of complexity that was beyond the scope of this project.

As such, these modifications to the methods outlined in Section 2 of this report were not used and the current CEI describes conditions of inequity felt by the community according to the indicators, excluding any multiplicative effects that may exist where one equity issue strengthens or exacerbates another.

Attachment B: Chula Vista Climate Equity Index Implementation Actions

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Next Steps

The recommendations are high level and, if supported by City Council, will be further developed by City staff. Potential implementation actions for each recommendation are listed below. Implementation steps, cost estimates, timelines and GHG reduction estimates, if available, for the various recommendations will be included in staff's efforts to being required implementation actions to relevant commissions and City Council for approval.

Attachment A: CCWG Recommendation and Actions

Climate Equity Index Recommendations & Actions	
1	Increase outreach to and engagement with high scoring census tracts
a	Invite leaders from high scoring census tracts to join the Climate Equity Index Stakeholder working group
b	Work to increase digital access and early education programs to create access to higher learning opportunities
c	Include stakeholder events with organizations and community members as a part of the Climate Action Plan update and implementation
d	Work with residents and landlords to increase solar and battery storage adoption and provide benefits to landlords and renters
e	Seek funding and partners to create a Climate Ambassador program to provide educational opportunities for youth
2	Seek funding for high scoring census tracts
a	Seek funding to retrofit existing homes for efficiency and electric appliances
b	Ensure all Chula Vista Business Associations have equitable access to funding
c	Compensate communities for environmental burden, mitigate climate impacts, and support economic opportunity, including project ownership
3	Update Climate Equity Index every 5 years

a	Review other climate and equity mapping tools to evaluate methodology and data updates
b	Provide annual updates to Climate Equity Index stakeholders