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# Energy and Climate Change Issues Around CSUDH


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# Energy and Climate Change Issues Around CSUDH

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**Abstract**

Climate change is posing significant challenges to California's energy sector. Extreme weather events (heat and cold) may pressure existing infrastructure. Many studies have indicated that extreme climate events would impact the energy system by affecting peak electricity demand. However, very few studies have been conducted to understand how disadvantaged communities (DACs) will be impacted. Because of unequal access to energy infrastructure (electricity generation and battery storage), DACs are more vulnerable to power outages due to the rising number of significant weather events caused by climate change. To address the issue of how DACs are disproportionately affected by climate change-related energy issues, we used DACs, infrastructure, and climate data. We identified the most vulnerable communities associated with climate change-related energy issues in areas around California State University Dominguez Hills (CSUDH). This study's findings will support building the resilience of energy infrastructure to climate change and minimize the energy burden on DACs.

## Introduction

Climate is changing worldwide, and extreme weather events are increasing. The recently released Intergovernmental Panel on Climate Change (IPCC) report concludes that the average global temperature is likely to rise 1.5 °C, or 2.7 °F, above preindustrial levels by 2040 (IPCC, 2021). The report also indicated that at that threshold, nearly 1 billion people could face life-threatening heat waves at least once every five years. Extreme weather events are the leading cause of power outages and a constant hazard to the nation's energy system (Reidmiller et al., 2018). Even though the energy sector is one of the most resilient United States (US) economic sectors, climate change is likely to pose considerable new challenges to this sector (Vine, 2012). Due to climate change, future extreme events that can cause power outages are projected to be more frequent and last longer (USGCRP, 2018). However, existing US energy infrastructures are not designed to operate under extreme weather events, and changes in climate have the potential to cause significant impacts (Zamuda et al., 2013). For example, heat waves increase energy demand from customers and can put pressure on the electric grid and result in grid failure.

It is important to note that climate change does not affect everyone similarly. However, very few studies have been conducted to understand how disadvantaged communities (DACs) will be impacted. These communities experience heightened risk and increased sensitivity to climate change and have less capacity and fewer resources to cope with, adapt to, or recover from climate impacts (CPUC, 2021). These disproportionate effects are caused by physical (built and environmental), social, political, and economic factors exacerbated by climate impacts. DACs are particularly vulnerable to power outages resulting from the rising number of significant weather events under changing climate. Decades-long pervasive socio-economic conditions—perpetuated by systems of inequitable power and resource distribution—are such that they may lack the financial and organizational resources to respond to and recover from climate disasters like drought, flooding, fires, and heatwaves (CNRA, 2017; Roos, 2018).

The increasing reliability of California's electricity sector for performing essential daily activities makes it vulnerable to climate change. Californians are facing three main challenges as a result – an increase in energy demand, the ability of the electricity generation system to adapt, and risk to transmission and distribution networks (Vine, 2008; 2012). Due to climate change, future building space cooling and heating demands could increase significantly. For example, a slight increase in mean temperature can result in a significant rise in Cooling Degree Days (CDD), which could lead to an increase in cooling energy and increase in heating energy (Heating Degree Days -HDD) in case of an extended cold period (Mutschler et al., 2021). Many studies (Zamuda et al., 2013; Wang & Chen, 2014; Burillo et al., 2019; Mutschler et al., 2021) indicated that extreme climate events would impact the energy system by affecting peak electricity demand. In one of the earliest studies on the effects of climate change on the California electricity sector, Baxter and Calandri (1992) indicated that increased demand for cooling may substantially outweigh the heating needs (Vine, 2012). This argument by Baxter and Calandri (1992) makes sense because Franco and Sanstad (2006) found a high correlation between the simple average daily temperature and daily peak electricity demand in California. Peak electricity demand of Los Angeles County residential and commercial sectors was projected to increase from 9.5-12.8 GW in 2010 to 12.3-16.7 GW (~30%) by 2040 and to 13.1-19.2 GW (~45%) by 2060 (Burillo et al., 2019). Extreme weather events will lead to more frequent use and additional installations of cooling and heating units in residential and business buildings. This will significantly increase the peak demands, and the probability of blackouts will increase during the peak demand periods. Therefore, greater climate-resilient energy is needed, and it will require improved technologies, policies, information, andstakeholder engagement (Zamuda et al., 2013).

To further understand how climate change may impact DACs' energy-related issues, we asked two questions:

- Is current infrastructure capable of future energy demand triggered by climate change?
- Are disadvantaged communities more vulnerable to climate change because of poor energy infrastructure?

To address these research questions, we:

- Identified the most vulnerable communities associated with climate change-related energy issues
- Assessed the grid reliability issues (Integration Capacity Analysis) around the CSUDH campus
- Determined critical physical infrastructure assets that are vulnerable or susceptible to failure under different climate change scenarios

## Methods

### *Study Area*

We focused our study around California State University Dominguez Hills (CSUDH) campus. CSUDH is a highly diverse, metropolitan university primarily serving the South Bay area of Los Angeles (LA) County (Figure 1). The current student population is around 17,000, and CSUDH is one of the rapidly growing CSU campuses. CSUDH is located in Carson and is surrounded by cities like Compton, Long Beach, Gardena, and Torrance. The majority of communities around CSUDH are classified as DACs.

### *Identifying Most Vulnerable Communities*

Identifying and mapping vulnerable communities associated with climate change-related energy issues is an essential part of the scientific foundation for understanding the state's changing conditions related to climate change (Roos, 2018). There are several indicators developed to identify the spatial pattern of vulnerable communities. We used Environmental Justice Cumulative Impact and CalEnviroScreen Scores to identify DACs and communities most vulnerable to climate change. Environmental Justice Screening Method (EJSM) was developed by USC / Occidental College (Hoffman, 2022). This was initiated by the proposed Green Zones Program at the Department of Regional Planning. California's Environmental Protection Agency (CalEPA) created a screening process known as "CalEnviroScreen 4.0." This tool determines which communities are disadvantaged based on detailed census data and 21 individual indicators (OEHHA, 2021). These 21 indicators are then combined and calculated to create an overall score known as the Cumulative Impact Score (CIScore).

### *SCE Resources*

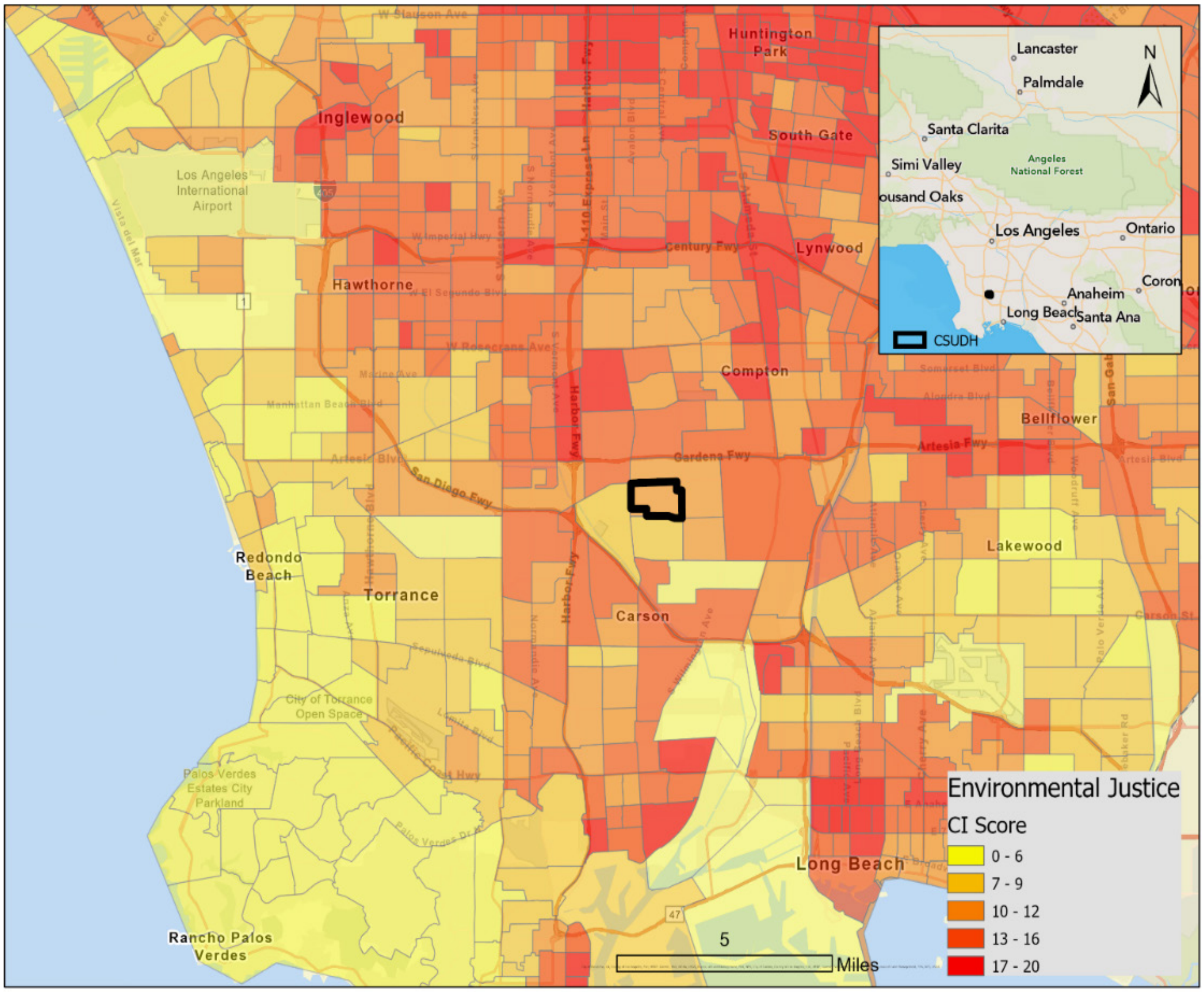
Southern California Edison's (SCE's) Integration Capacity Analysis (ICA) User Guide (updated 8/30/21) describes the uniform generation-static grid integration capacity, published to its Distribution Resources Plan External Portal (DRPEP), as being the final ICA result based on the most limiting power system criteria at the most limiting hour (SCE, 2021). In the ICA map, red colors represent areas of low integration capacity, and green represents higher integration capacity. SCE produced and made available the 576 hourly ICA values using a "technology-agnostic uniform generation and uniform load" approach, which generates ICA values independent of the type of Distribution Energy Resource (DER) technology. The 576-hourly profile is the monthly minimum and peak load that occurs during each of the 24 hours in a day (Stanfield et al., 2021).

Our approach overlaid the ICA results for uniform generation static grid (Megawatt - MW) with DACs, as defined by CalEnviroScreen, to examine whether the lowest integration capacity result of 100 kW or less was correlated with DACs in our study area. To visualize the ICA results for a wider area than the limitation of a 0.6-mile elevation imposed by SCE in viewing the data, the ICA – Circuit Segments dataset published by the SCE C-GIS Project was opened in ArcGIS Pro 2.8.3 and clipped with the geoprocessing tool to the Los Angeles County boundary. Following the guidelines laid out by Stanfield et al. (2021) regarding the conservative nature of values that account for operational flexibility, we opted to use uniform generation without operational flexibility in our study.

**Figure 1**

*California State University Dominguez Hills (CSUDH). Note: Inset map (upper left) shows 23 CSU campuses, and the inset map (upper right) shows the location of CSUDH in southern California.*

**Figure 2**
*Disadvantaged Communities (DACs) based on Environmental Justice CI Score Surrounding CSUDH Campus*




### *Identify Infrastructure Status in DACs*

To assess the infrastructures around CSUDH for climate change-related vulnerability, we obtained Countywide Building Outlines (2014) GIS data layer from the LA County eGIS Homepage (County of Los Angeles Open Data, 2021). The Countywide building outline dataset contains building outlines (over 3 million) for all buildings in Los Angeles County, including building height, building area, and parcel number (also known as building footprints). This data was captured from stereo imagery as part of the LARIAC2 Project (2008 acquisition) and was updated as part of the LARIAC4 (2014) imagery acquisition. Based on this dataset, we separated buildings older than 1970. We assumed that buildings older than 1970 are less likely to have cooling or heating units and lack the infrastructure that could support the future installation of cooling or heating units without a significant upgrade. We also obtained electric vehicle charging station data from the Alternative Fuels Data Center (AFDC) to analyze the spatial pattern distribution and association with DACs (US Department of Energy, 2021).

## Results

### *Disadvantaged Communities around CSUDH*

We investigated the spatial distribution pattern of DACs around CSUDH based on the Environmental Justice CI Score. A majority of the communities surrounding CSUDH fall under the high Environmental Justice CI Score (Figure 2). A high CI Score indicated the vulnerability of these communities to climate change.

### *Integration Capacity Analysis around CSUDH*

The following map depicts ICA values updated on October 21, 2021, for the areas surrounding CSUDH (Figure 3). CSUDH's campus falls within the large number of DACs running through central LA County. Areas of low integration capacity of less than 100 kW uniform generation static grid are depicted by the red lines (Figure 3). Many low-capacity areas exist in the non-DAC regions depicted on the map (Figure 3). However, there are also lines of higher integration capacity designated by green within the DAC. Therefore, a correlation between disadvantaged communities and an ICA result of less than or equal to 100 kW for a uniform generation static grid is not visually apparent in the selected study area.

### *Infrastructure Conditions Around CSUDH*

Infrastructures are very important for developing resilience to climate change. People living in substandard infrastructure are more vulnerable to climate change than people living in modern infrastructure. Figure 4 shows the building age (residential and commercial) around CSUDH, and the majority of the buildings were constructed before 1970. In case of extreme weather conditions, people living in these areas will need to take shelter in cooling and warming centers which are sparsely distributed around the Los Angeles area (Figure 5), and there are accessibility issues because of transportation and distance from home.

Inequality in infrastructure-related issues can be seen in the discrepancy in electric vehicle (EV) charging stations around LA County (Figure 6). The discrepancy shown in the map (Figure 6) is the high density of the electric vehicle charging stations in LA County service planning areas 4 (Metro) and 5 (West). The Metro area is home to the Crypto.com Arena and other tourist attractions, such as the Walt Disney Concert Hall and popular museums. The cluster of available charging stations accommodates those visiting the downtown area.

**Figure 3**
*Integration Capacity Analysis (ICA) around CSUDH. Note: Red lines in the map indicate low hosting capacity and pink polygons on the background represent disadvantaged communities (DACs).*

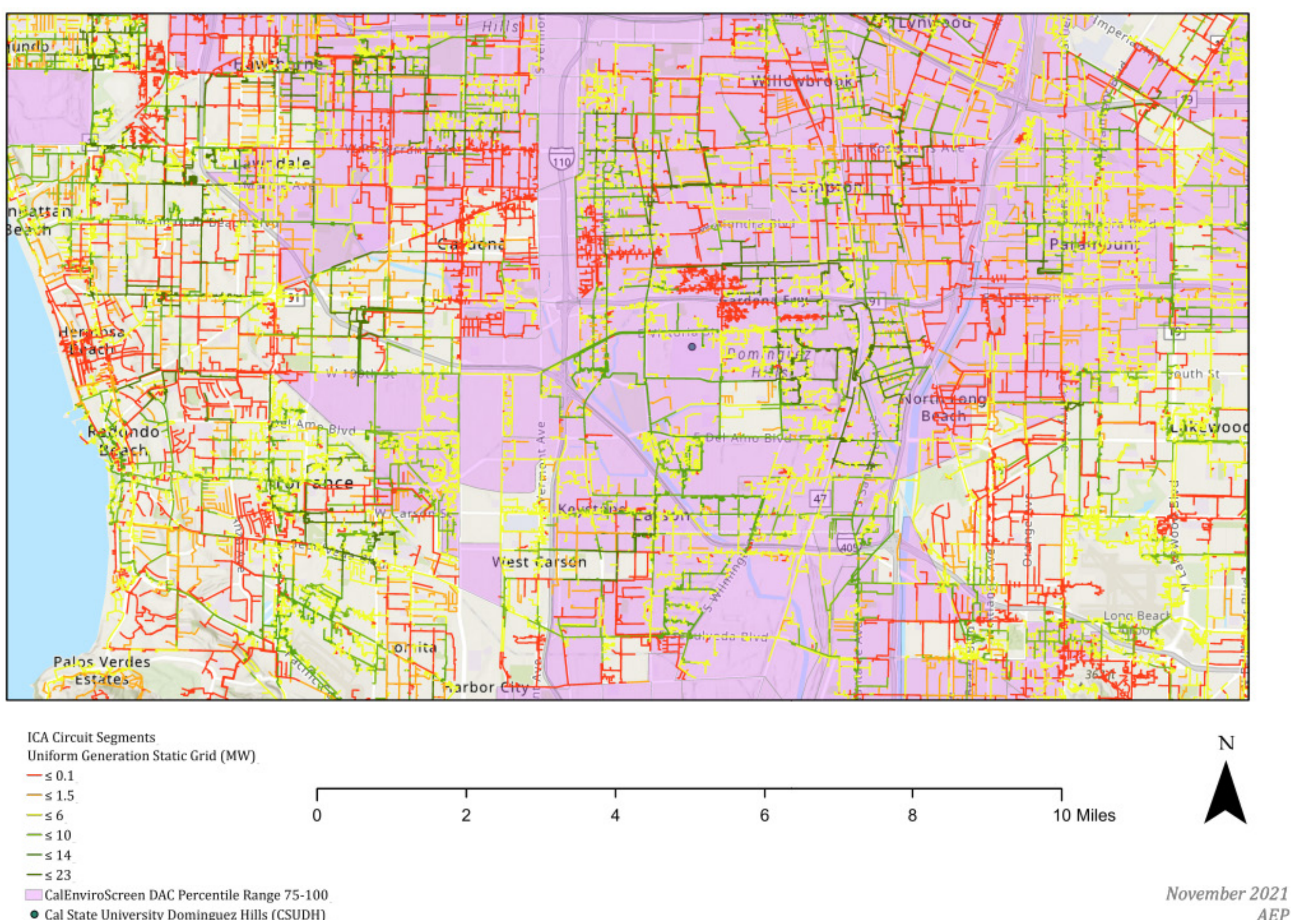
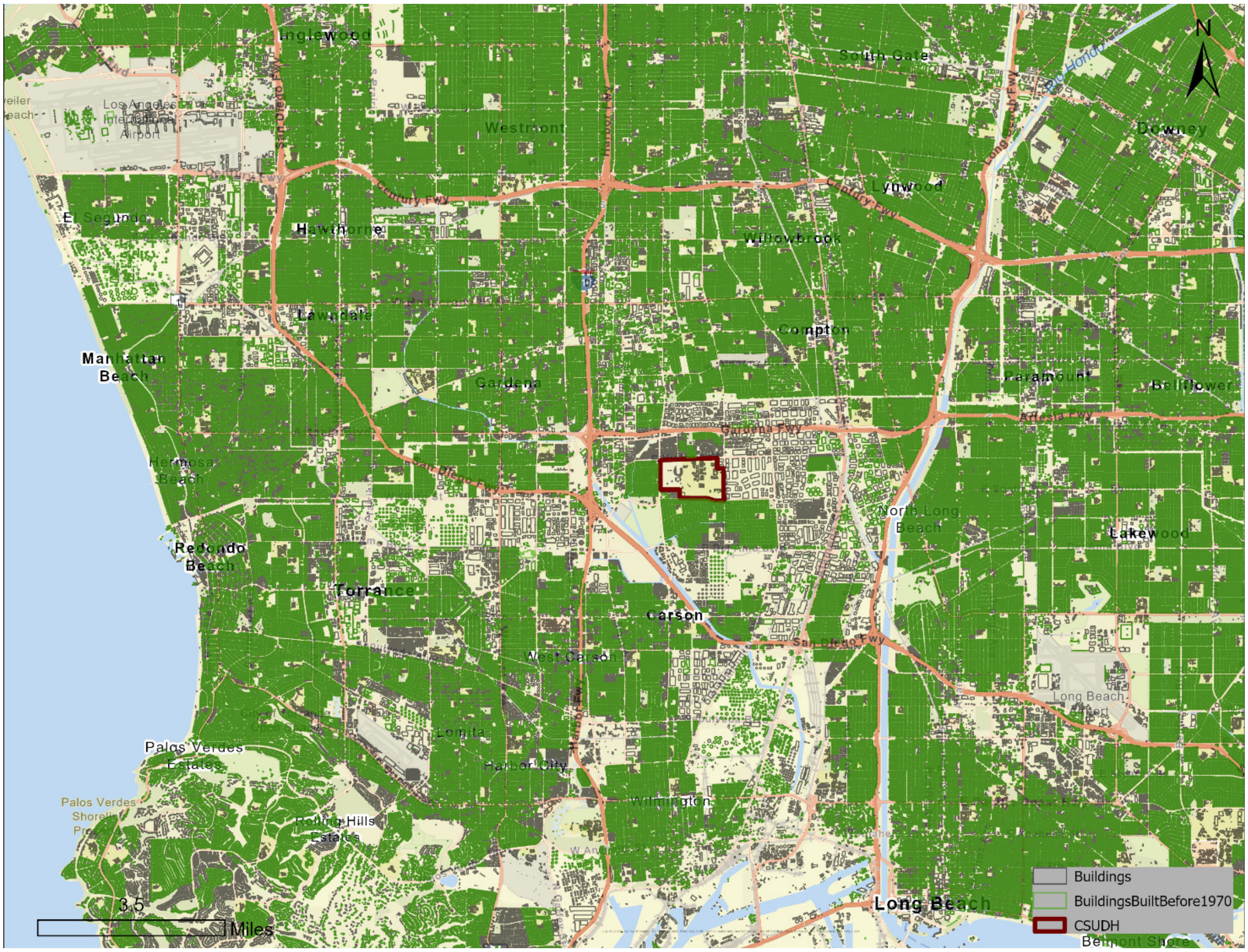


**Figure 4**
*Building Age around CSUDH. Note: Green polygons indicates buildings older than 1970.*




However, it is apparent that service planning area 6, the area with the highest population of households paying greater than 50% of their income towards their housing costs, also has the least adequate distribution of EV charging stations (Figure 6).

## Discussion

As seen in all the maps presented in this study, there is a clear need for action for the communities around the CSUDH area. Areas that have been historically identified as marginalized are visibly lacking the proper infrastructure that is meant to support the transition to cleaner energy systems. In the map shown in Figure 2, there is a visual correlation between the areas ranking highest with the Environmental Justice CI score, and in Figure 3 where we see communities ranking highest with the CalEnviroScreen CI score. This visual correlation, alongside the data presented in Figure 6, displays the concentrations of communities that we hope policymakers will focus on moving forward to minimize the impact of climate change.

The LA Service Area Planning Map shown in Figure 6 indicated that zone 6 has the highest concentration of households in all of LA County paying greater than 50% of their income towards their housing costs, which identifies them as housing burdened (OEHHA, 2021). That being said, we can see why most households cannot afford climate-resilient energy upgrades. With this data, we can assume that few families can afford to install solar panels and that most of these homes in service planning area 6—older than 1970—are less likely to have cooling or heating units. These disproportionate effects are caused by physical (built and environmental), social, political, and economic factors exacerbated by climate impacts (CPUC, 2021).

Figure 3 shows how strained the current hosting capacity is of the existing static grid, meaning that any upgrade that does take place from homeowners who can afford to do so will be adding to the current demand. This can potentially lead to more frequent blackouts as climate change becomes more unpredictable. Disadvantaged communities (DACs) that cannot adapt to climate change will be the hardest hit by extreme temperatures (Roos, 2018). Several studies (Shonkoff et al., 2012; English et al., 2013) have discussed climate change-related issues in DACs. Shonkoff et al. (2012) have argued that health impacts from climate change will disproportionately affect minority populations and low-income neighborhoods and have made the explicit link between environmental justice and climate health hazards. Former California Governor Jerry Brown signed into law Senate Bill 535 (SB 535), requiring a minimum of 10% of the potential revenue (estimated to be up to $1 billion) generated by the cap-and-trade program to be directed to disadvantaged communities to reduce pollution and develop clean energy to adapt to changing climate (English et al., 2013).

When we think about the impacts that SB 535 will have, we also need to consider the demographics of the communities. English et al. (2013) combined climate change population vulnerability scores with environmental justice scores to create Cumulative Impacts Plus Climate Change Vulnerability Scores. This score also indicated that communities surrounding CSUDH fall under high-risk areas. African Americans (46%) and Latinos (36%) reside in the two highest-risk categories (climate change population vulnerability scores of 4 or 5), while 30% of Whites live in these high-risk census tracts. African Americans were almost four times more likely than Whites to reside in census tracts ranked with the highest vulnerability

**Figure 5**
*Cooling and Warming Centers around Los Angeles County, CA. Note: Red polygons on the background represent disadvantaged communities (DACs).*

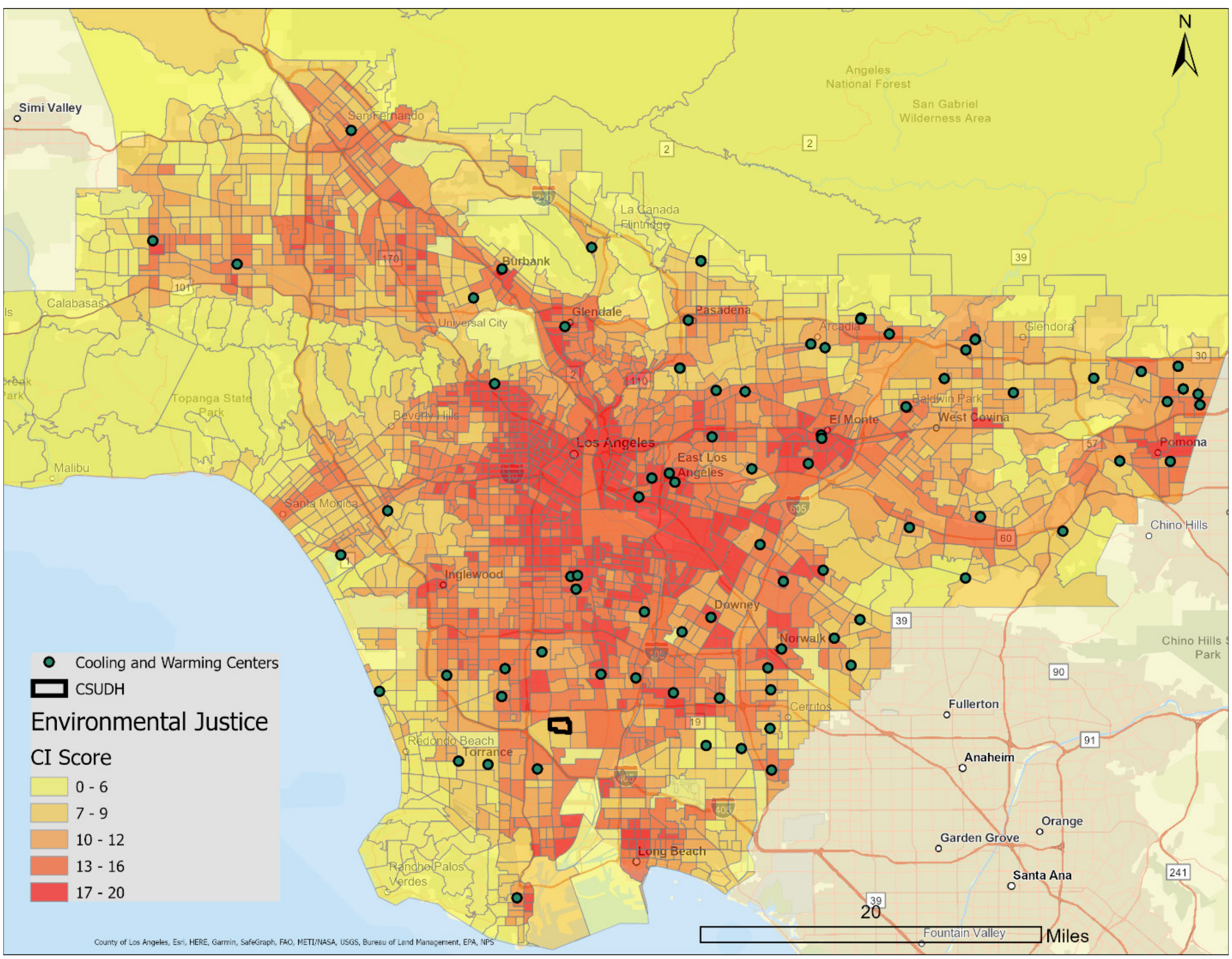
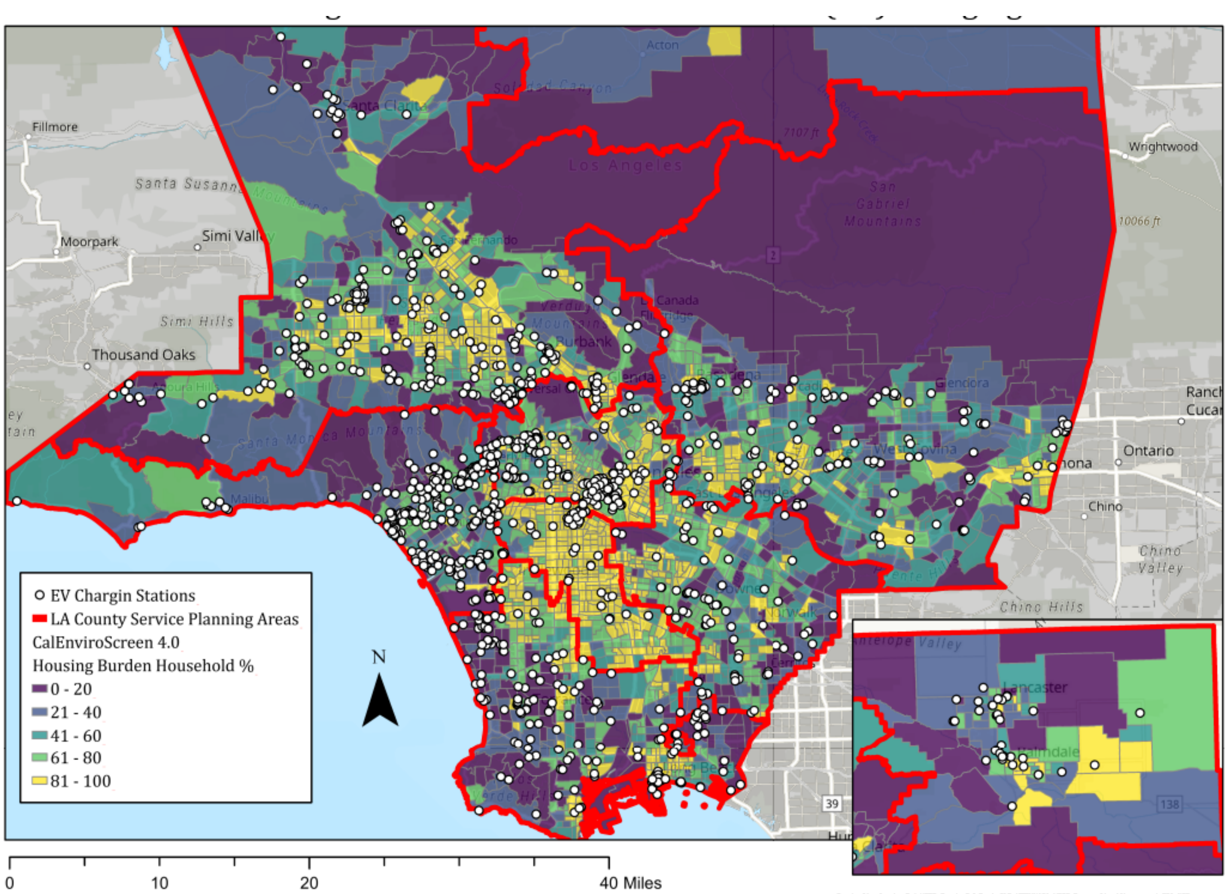


**Figure 6**
*CalEnviroScreen 4.0 Housing Burden Percentage by Census Tract in Los Angeles County Service Planning Areas Relative to Electric Vehicle (EV) Charging Stations*




than the lowest vulnerability; Latinos were almost twice as likely as Whites (English et al., 2013). People in the highest risk category were 44% more likely to have emergency room visits for heat illness during a heatwave than in the lowest risk category (English et al., 2013). Most communities around CSUDH are in the high-risk category because of their racial and economic status. These communities will face the extra burden of climate change.

A recent Los Angeles Times study indicated that extreme heat caused 3900 deaths in California over a decade (Wigglesworth, 2021). This number is six times higher than the official count of heat-related fatalities (Wigglesworth, 2021). The number of extreme weather-related fatalities has increased significantly in the last decade. We must identify the spatial pattern of extreme weather-related fatalities and the infrastructure conditions to mitigate these disasters.

To assist DACs with climate change-related energy issues, we must adopt policies and practices protecting people from energy insecurity. Recent policy initiatives have begun to highlight the apparent need to generate energy equity and justice by providing reliable, safe, and affordable energy where the costs and benefits of such energy services are disseminated fairly. However, the ways for measuring progress towards these goals are not yet clearly defined. We need to upgrade infrastructure, operations, and services to adapt to climate change and ensure safe and reliable electric energy service to all Californians, including those most vulnerable and disadvantaged (Disadvantaged Vulnerable Communities - DVCs). Besides focusing on policies and infrastructure upgrades, IOUs need to host maps on their websites to identify the DVCs in their respective service territories with documentation of data sources used to determine these DVCs and all source files. The IOUs must assess where they need to replace, remove, or upgrade their facilities and operations to adapt to climate change, which is what vulnerability assessments will do (CPUC, 2021). Moreover, the utilities need to consider green and sustainable remedies for the vulnerable infrastructure identified in assessing mitigation measures in their vulnerability assessments.

Limitations of this study include Integration Capacity Analysis (ICA) data validation, an issue carried over into the new Order Instituting Rulemaking (OIR). Hosting capacity, by its nature, needs to be continually updated to be useful. Although the IOUs were ordered to update user guides when map functionality changes in a ruling issued 1/27/21 in the R.14-08-013 proceeding, our study identified at least one instance of a user guide not being updated. The public's access to validated energy data will facilitate a smooth transition to a clean energy future. Programs to replace inefficient and natural gas-powered appliances are also necessary to support the transition to clean energy for everyone. Another limitation is that the data does not differentiate between renters, multifamily homes, or homeowners. Future research should attempt to examine how this might affect climate-resilient energy upgrades.

## Conclusions

Communities surrounding the CSUDH are economically unprepared for energy-related issues exacerbated by climate change and lack of adequate infrastructure. Because of socioeconomic vulnerability, DACs will have difficulty adapting to climate change. To promote equity, Investor Owned Utilities (IOUs) should conduct extra outreach and education activities in DACs. Future research should examine climate change's impact on energy insecurity.

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