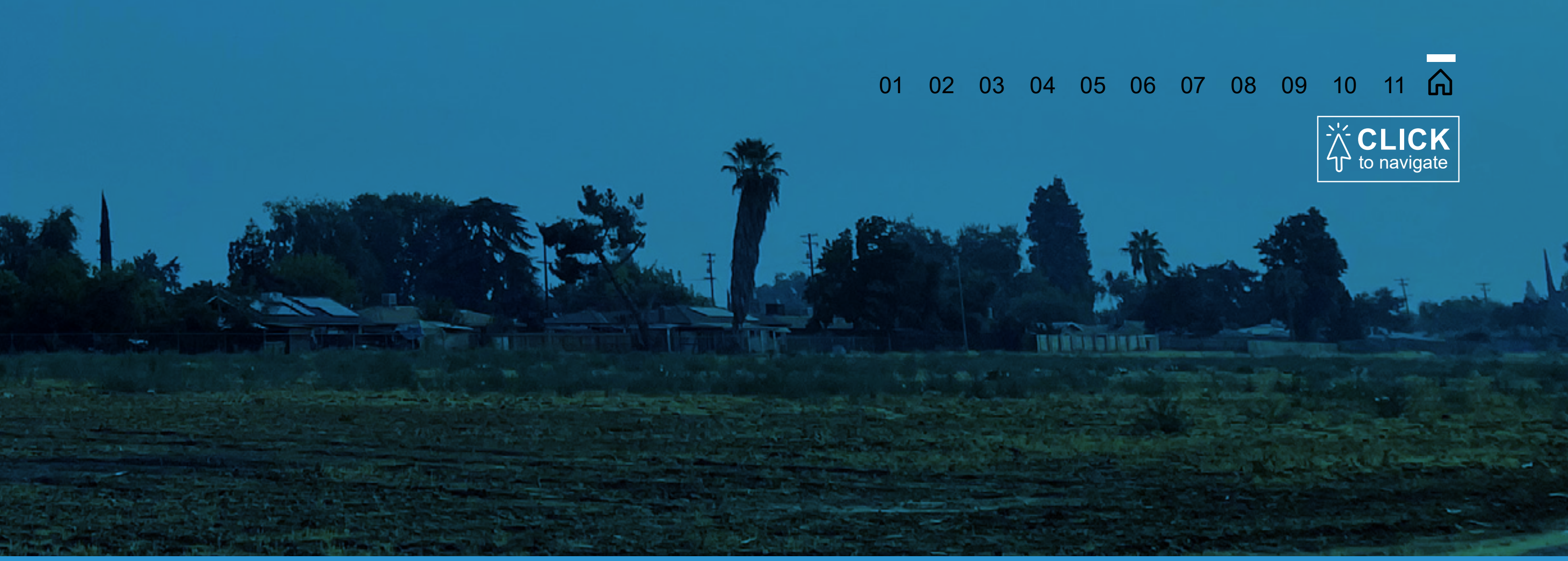
Electrical Grid Analysis Study

Fresno County Rural Transit Agency

Click to Advance

Contents

CLICK
Titles to navigate



List of Figures

List of Tables

List of Acronyms / Abbreviations

AC	Alternating current
ADA	Americans with Disabilities Act
API	Application Programming Interface
BCSD	Biola Community Services District
BE	Building Electrification
BEV1	Business Low Use EV Rate
BEV2	Business High Use EV Rate
BTM	Behind the meter
C&I	Commercial and industrial
CAIDI	Customer Average Interruption Duration Index
CARB	California Air Resources Board
CCC	Community Connection Committee
CCI	California Climate Investments
CEC	California Energy Commission
CED	Consolidated Electrical Distributors
CERT	Community Emergency Response Team
CMAQ	Congestion Mitigation and Air Quality Improvement
CMO	Clean Mobility Options
CNG	Compressed natural gas
CO_2	Carbon dioxide
COVID-19	Coronavirus
CPR	Cardiopulmonary resuscitation
CPUC	California Public Utilities Commission
CSA	County Service Area
CVA	Vulnerable Community Area
DAV	Disadvantaged community
DC	Direct current
DCFC	Direct current fast charging
DER	Distributed energy resource
DERA	Diesel Emission Reduction Act
DOT	Department of Transportation
ECAA	Energy Conservation Assistance Act
EE	Energy efficiency
EJ	Environmental justice
EJA	Environmental Justice Area
EO	Executive order
EPA	Environmental Protection Agency
EV	Electric vehicle
EVRP	Electric Vehicle Readiness Plan
EVSE	Electric vehicle supply equipment
FCIP	Fresno County Incentive Project
FCMA	Fresno-Clovis Metropolitan Area
FCOG	Fresno Council of Governments
FCRTA	Fresno County Rural Transit Authority
FY	Fiscal year
GHG	Greenhouse gas
GIS	Geographic information system
GNA	Grid Needs Assessment
HVAC	Heating, air conditioning, and ventilation
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program
I-5	Interstate 5
ICA	Integration Capacity Analysis
ICEV	Internal combustion engine vehicle
IPER	Integrated Energy Policy Report
ISO	Independent System Operator
KART	Kings Area Rural Transit
LCC	Lanare Community Center
LCJA	Leadership Counsel for Justice and Accountability
LCSD	Lanare Community Services District
MAIFI	Momentary Average Interruption Frequency Index
MED	Major event days
MID	Mid-demand Case
	North Coast Unified Air Quality Management District
NHPP	National Highway Performance Program
NHS	National Highway System
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen oxides
PEV	Plug-in electric vehicle
PG&E	Pacific Gas & Electric
PM	Particulate matter
PM_{10}	Particulate matter 10
$PM_{2.5}$	Particulate matter 2.5
PV	Photovoltaic
REV-UP	Rural Electric Vehicle Utilization Project
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SB	State Senate Bill
SCE	Southern California Edison
SGIP	Self-generation Incentive Program


EXCEPT FOR
ELECTRIC
VEHICLES
Funded in part by the
Valley
Air
District

1. Executive Summary

The Fresno County Rural Transit Agency (FCRTA) has prepared this Electrical Grid Analysis Study (Study) to identify the impacts of the anticipated increased electrification on the electric grid system and the unique challenges faced by rural communities serviced by FCRTA. Electrification is the transition from fossil fuels to electricity to power multiple sectors such as the transportation, residential and commercial buildings, industrial, and agriculture sectors.

To develop this Study, existing conditions within Fresno County were assessed to identify existing grid-related issues. This included reviewing data from sources that provided information about socioeconomic conditions, energy sources, electrification efforts, and an assessment of the electric grid system. Sources that were evaluated included Fresno County, FCRTA, Pacific Gas and Electric (PG&E), CalEnviroScreen 3.0, American Community Survey, and existing community general plans. Outstanding datasets that are important to meeting project objectives are also presented within the document. This work was supplemented by public outreach efforts intended to engage residents and community members within Fresno County. To protect public health, these engagements were largely held virtually and provided participants with context about the Study, the basics of electrification, and gave opportunities for discussion on areas of priority. Finally, a technical assessment, taking into account existing and forecasted grid conditions as well as the needs of an electrified FCRTA, was undertaken to identify potential grid constraints and solutions.

Through this analysis, the following recommendations for rural electric grid management were identified:

- Equitably upgrade and maintain electric grid infrastructure;
- Reduce risk and impacts of climate change;
- Ensure transportation system reliability;
- Build and sustain a foundation for innovative technologies and economic opportunity;
- Support streamlined planning including permitting.

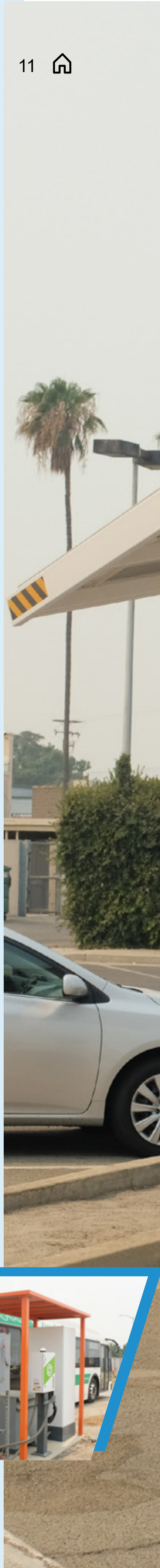
Our technical findings indicated that, while the rural Fresno County grid system generally holds sufficient capacity for future electrification, some constraints are forecasted in specific communities (Chapter 8). Specifically, the electrical feeder servicing both Selma and the unincorporated community of Tombstone is forecasted to be over capacity with addition of fleet charging at the planned maintenance site, underscoring the importance of a county-wide assessment and grid resilience enhancements, including distributed energy resources, in incorporated and unincorporated communities.

To mitigate these grid impacts, promote beneficial electrification, and secure the grid against anticipated extreme events due to climate change and catastrophic events, the following strategies have been identified in this report:

- Development of shared charging infrastructure and models with other public agencies;
- Redundant infrastructure which integrates solar and storage;
- Resilience hubs which can be leveraged for transportation, grid, and resilience benefits, particularly in unincorporated communities as well as economic opportunities.

The above findings are supplemented with an overview of available funding and financing resources to support implementation of these strategies.

As a whole, this report provides an actionable framework for FCRTA and rural Fresno County communities to understand the current and future state of the electric grid infrastructure and pursue innovative, integrative, and inclusive strategies to adapt to a changing energy and climate system while meeting the needs of vulnerable communities.




electrify
america
electrify
america
SPEED
LIMIT
25

2. Introduction

2.1 About FCRTA

The Fresno County Rural Transit Agency (FCRTA) provides general public transit service to rural communities throughout Fresno County. FCRTA provides scheduled, fixed route services with designated bus stops along specific inter-city routes, as well as reservation-based, real-time demand responsive service that offers curb-to-curb transportation. FCRTA provides services to thirteen rural incorporated cities of Fresno County:

- Coalinga
- Firebaugh
- Fowler
- Huron
- Kerman
- Kingsburg
- Mendota
- Orange Cove
- Parlier
- Reedley
- Sanger
- San Joaquin
- Selma

FCRTA also services the unincorporated rural cities and communities within Fresno County:

- Alder Springs
- Auberry
- Big Sandy Rancheria
- Biola
- Burrough Valley
- Cantua Creek
- Caruthers
- Cold Spring Rancheria
- Del Rey
- Dunlap
- Easton
- El Porvenir
- Five Points
- Friant
- Halfway
- Indian Rancheria
- Lanare
- Laton
- Marshall Station
- Meadow Lakes
- Miramonte
- New Auberry
- Pinehurst
- Prather
- Raisin City
- Riverdale
- Squaw Valley
- Table Mountain Rancheria
- Three Rocks
- Tombstone
- Tollhouse
- Tranquillity
- West Park

2.2 Electrical Grid Analysis Objectives

Key objectives of this Electric Grid Analysis Study (Study) are the need to identify electric grid enhancements which reduce the risk and impacts of climate change, provide resilient electric service for the FCRTA fleet, and ensure charging activities do not adversely impact the grid services of surrounding communities. Further, reliable grid infrastructure and associated resilience features are vital to supporting initiatives like transportation electrification and climate adaptation, that can equitably increase access to critical services for vulnerable populations including those in unincorporated communities. The following sections describe key recommendations based on the existing conditions research and community outreach conducted as a part of this Study for a sustainable and resilient rural Fresno County grid system.

2.2.1 Equitably Upgrade and Maintain Electric Grid Infrastructure

An assessment of Fresno County's socioeconomic conditions found numerous inequities, particularly across areas of environmental justice, pollution exposure, employment, income, access to jobs and critical services, and adverse health outcomes. Namely, Fresno County is a designated nonattainment district for air quality[1] and many residents experience high exposure to ozone, particulate matter 2.5 ($PM_{2.5}$), and diesel particulate matter (PM) pollution. The County asthma rate is 9% higher than that of the rest of the state of California. During community outreach efforts, participants indicated that improved air quality is of high importance to their communities and recognized the correlation between air quality and adverse health outcomes. Participants also expressed interest in grid enhancements that could support reliable and sustainable transportation electrification initiatives and consequently reduce emissions and improve air quality due to elimination of tailpipe emissions.

Many households within Fresno County are both low income and highly burdened by the costs of housing and transportation. Fresno County residents were found to earn 32% less than the California state average, resulting in a County poverty rate 10% higher than that of the rest of the state. Poverty and low-income indexes are key indicators of housing, transportation, and energy burden. Increased access to local renewable energy sources or availability of Community Choice Aggregation programs when paired with energy storage may increase grid reliability and efficiency while supporting increased energy affordability and aid in reducing energy burden for Fresno's vulnerable populations.

Additionally, transportation costs within Fresno County were found to consume more than 45% of household income in all cities except Kingsburg. The significant local cost burden of transportation is a compelling case for transportation electrification, with its lower operations, power, and maintenance costs and forecasts of decreasing upfront and purchase costs in the near future. Community outreach participants expressed interest in lowering transportation costs with electric vehicles (EVs). Participants also noted a few ongoing vehicle electrification efforts in the County such as deployment of EV chargers and educational and awareness campaigns focused on EV benefits, costs, and safety. They also noted that a reliable grid is also needed to further support transportation electrification efforts.

Throughout the analysis, it was evident that the disparities experienced by rural Fresno County's vulnerable and disadvantaged populations are interrelated and their negative impacts are experienced with a compounding effect. As such, recommended grid advancements should be made with the vision that they have the potential to positively impact the livability of the local community in many aspects. Therefore, the consideration of equitable upgrades that aim to alleviate community concerns (e.g., energy burden, transportation burden, air quality) should be prioritized in grid advancements. For example, use of energy generated by local solar photovoltaic (PV) arrays instead of traditionally generated energy can lower energy costs for consumers. Additionally, the availability of local solar PV powered EV chargers in rural communities can significantly lower fuel costs for EV users and decrease transportation costs.

Upgrades of aging electric grid system infrastructure can lead to increased reliability, hosting capacity, and security. Equitable grid upgrades to electric grid infrastructure throughout the County will support electrification advancements and future implementation of technologies such as distributed energy resources (DERs) and microgrids while improving system resiliency and supporting critical and essential services.

2.2.2 Reduce Risk and Impacts of Climate Change

Climate change and its negative impacts continue to affect residents of rural Fresno County. Without proactive steps to curb the impacts of climate change, extreme events are expected to become more frequent and severe. In California, the transportation sector was found to be the largest emitting sector and accounts for 41% of the state's emissions. The analysis conducted as part of the Study as well as the preceding Fresno Council of Governments' (FCOG's) Electric Vehicle Readiness Plan (EVRP)[2] found that electrification opportunities for light, medium, and heavy-duty vehicles are significant and electrifying the transportation sector can be key to addressing climate change.

Climate change exacerbates pollution exposure, health, education, and economic inequities. Grid modernization and electrification are key to mitigate climate change, improve community resilience, and meet local and state greenhouse gas (GHG) reduction goals. During a community outreach

1 San Joaquin Valley Air Pollution Control District (n.d.). *Ambient Air Quality Standards & Valley Attainment Status.* https://www.valleyair.org/aqinfo/attainment.htm
2 Fresno Council of Governments (2021). *Electric Vehicle Readiness Plan.* https://www.fresnocog.org/wp-content/uploads/2017/06/FCOG-EVRP-2021-1.pdf

workshop, 80% of participants indicated that creating a more reliable, resilient grid interests them most when asked "*what benefits of electrification interest you the most?*" Other options included job and economic development opportunities, smart use of electricity (efficiency, demand response, renewables), and potential for reduced vehicle operating and maintenance costs. Community workshop participants also expressed concerns about experiencing rolling blackouts during summer months and expressed interest in improving system reliability and redundancy through a more distributed energy system.

If a sufficient EV charging network becomes available to support the forecast EV adoption rates, the carbon dioxide (CO_2) emissions decrease is expected to be significant, even when accounting for CO_2 emissions increases due to additional electric generation. In a similar vein, Pacific Gas & Electric (PG&E) has forecasted an increase in annual EV related sales, but a net zero impact to its load forecast due to the simultaneous expected increase in energy efficiency (EE). Additionally, increased electrification can be supplemented with other DERs such as EV demand response, battery storage, rooftop solar PV, and microgrids as resilience hubs. Doing so will allow rural Fresno County to aggressively push forward electrification to reduce emissions and meet climate goals without negatively impacting the grid.

Even so, it is still important to invest in grid improvements and advancements. For example, the effects of increased solar adoption are already apparent within rural Fresno County. Solar capacity has grown rapidly and is now the third largest source of generation in the County, with 62 solar farms and a combined 800 MW capacity. Fresno County is expected to experience a reduction of about 400 GWh annually in imports of electricity from other areas in large part due to increasing solar capacity. Important to this Study, solar development has caused a significant dip in the average and minimum day load profiles which could cause voltage and frequency issues at the grid level.

While electrification is key to mitigating climate change, climate change impacts are already being experienced. Various parts of California, including rural Fresno County, have experienced severe drought, extreme heat, and fires, all of which are significant threats to the people, economy, and environment. In addition to supporting electrification and reducing GHG emissions, a reliable grid supports energy resilience and critical/essential services during extreme events. While most historical fire activity in Fresno County is located away from most transit routes, some key generation and transmission assets are located in high-risk areas. PG&E's resilience plans for addressing forecasted climate impacts on electricity network safety, security, and reliability are primarily focused on improved monitoring of Fresno's grid system. While monitoring is key, there is a significant opportunity to increase resilience through proactive grid enhancements and maintenance, particularly to the rural areas most susceptible to wildfires.

2.2.3 Improve Transportation System Reliability

One of the differentiating characteristics of rural Fresno County is its geography of vast fields and farmlands. Its place as the sixth largest county in in-land California has supported its emergence as a national agricultural leader and economic hub within the San Joaquin Valley. However, the large land area also creates challenges for many communities in accessing critical services.

Analysis found that many rural residents travel long distances to access cooling centers, medical facilities, or even bus stops to provide necessary transport. This can be crippling in the face of medical emergencies or even in maintaining regular employment. For example, City of Huron residents must travel at least 30 minutes in a vehicle (assuming direct travel) to reach the nearest cooling center in Coalinga, while residents from Three Rocks must travel upwards of an hour to reach a designated cooling location. Many of the residents who would be most in need of access to a cooling center lack their own vehicle to reach these locations and could not afford the costs of a ride-share. Not only are reliable grid systems critical to ensuring the reliability and redundancy of critical services, they can also be vital in ensuring access to these services.

During community outreach, participants showed interest in EV adoption for personal, organization, and city fleet vehicles. Many participants had already adopted EVs and some rural cities indicated that they had already begun to convert to EV fleets. This trend is expected to continue and is reinforced by forecasts that found that the cost of acquiring an EV is expected to fall significantly in the near future. Coupled with the simultaneous forecast of increased gas fuel costs, EV adoption is expected to become increasingly financially viable and advantageous.

Transportation electrification is one of the major strategies to help meet California's aggressive emissions reductions targets as mandated by the California Air Resources Board (CARB). Without broad adoption, meeting the goals will be effectively impossible. As such, cities are beginning to prepare for EV readiness by providing their communities with guidance that includes topics such as incentives, rebates, permitting, and the basics of charging. Even so, during public outreach, city representatives expressed concern in allocating city funds towards charging infrastructure without assurance that the grid would be reliable and supportive.

A reliable and efficient transportation system is essential for moving people and connecting places and resources. In order to adopt EVs and electric transportation services, drivers and passengers should be confident that their chosen mode of transportation will get them to their destination and meet their needs. For transportation service providers, a reliable fleet is essential for maintaining a positive perception of service among passengers. Doing so requires a reliable electric grid, an integral part of ensuring a successful transition to robust EV adoption for FCRTA, local businesses, critical service providers, residents, and rural municipalities.

2.2.4 Build a Foundation for Innovative Technologies and Economic Opportunity

A supportive electric grid system is essential for adoption of new technologies, increased need for electricity, and evolving energy needs and use patterns. New grid technologies are crucial for meeting California's electrification targets and mandates. Innovative technologies may include renewable energy sources, microgrids, storage, EVs, or electric heating, ventilation, and air conditioning (HVAC) systems or stoves. Community outreach participants expressed excitement around introduction of new technologies and their benefits and noted that they already see or own innovative technologies such as solar and EVs in their communities. Participants were interested in other new technologies such as storage and microgrids. Increased demand for new technologies and services will also create a need for a workforce to install, operate, and maintain them, leading to new career and training opportunities.

Introduction of new technologies creates a significant opportunity for economic development, job growth, and training opportunities that would financially benefit residents. Fresno County educational attainment falls below the state average and Fresno County residents earn 32% less than Californians contributing to a County poverty rate 10% higher than that of California. While creating jobs and job training opportunities are not within the scope of this Study, valuable work will be needed to implement and maintain grid enhancements and to service new infrastructure such as DERs and microgrids. Because financial wellbeing is also an indicator of health wellbeing, career development can have a multiplying effect.

It is also important to note that the aforementioned recommendations (equitable grid upgrades, reducing impacts of climate change, and supporting building and transportation electrification) each offer a unique opportunity for transit agencies, utilities, and communities to become leaders in introducing energy innovation and technologies to addresses community needs.

2.2.5 Support Streamlined Planning

The findings of this Study indicate a need for long-term visioning and streamlined planning to enable many of the recommendations. At the state level, the majority of analysis and forecast utilized in this Study will look outwards to ten, twenty, and even thirty years from present in order to characterize expected changes and anticipated outcomes. At regional and local levels, the horizon is only three to four years. Grid planning for any advancement should utilize longer-term time increments in order to achieve meaningful climate goals, emissions reductions, electrification advancement, and community benefit. Many communities within Fresno County are already integrating electrification into their General Plans and proactive planning can create opportunities for alignment between many entities such as transit agencies, utilities, local governments, and community organizations to collectively advance their goals.

3. Existing Conditions

Through this study, a review of existing conditions relevant to grid infrastructure, socio-economic vulnerability, and climate impacts was performed for all of rural Fresno County. This review included: population demographics, migration from rural into urban areas, new transportation patterns, aging infrastructure of the electric grid system, and increased adoption of DERs. This assessment was executed in accordance with the Research Plan, which entailed a review of existing conditions from a number of sources, including Fresno County, FCRTA, and PG&E, as well as publicly available data such as CalEnviroScreen 3.0 and the American Community Survey.

The findings of this assessment are summarized in the below sections. They indicate numerous disparities between rural Fresno County and its urban centers, that include socioeconomic conditions and access to critical services. Additionally, technical analysis indicated that while Fresno County is a net exporter of electricity, there has also been a decrease in system reliability due to sudden high demand surges, extreme events, and limited grid capacity, which could limit availability or timing of depot chargers. Further, the practice of near-term forecasts for only three to four years outwards provides limited forward visibility of network investments to enhance and upgrade infrastructure. Strategic planning of grid enhancements can address many of these barriers and concerns and will be presented throughout the Study.

3.1 Rural Fresno County Overview

At approximately 6,000 square miles, Fresno County is the sixth largest county in the in-land area within California and is an economic hub within the San Joaquin (Valley). Its vast farmlands and valley weather patterns make it an agricultural powerhouse for the nation, producing nearly $7.9 billion worth of agriculture in 2018 alone[3]. More than a third of the nation's produce comes from the state of California, and Fresno's farmers, ranchers, and agricultural workers are key contributors in that sector. The exports include 300 different types of commodities ranging from alfalfa, grapes, raisins, and pistachios, to wood.

Despite being a regional economic backbone, Fresno County has some of the highest poverty levels in the state. While the County's considerable farmlands are assets for commodity production, the rural landscape creates barriers in providing access to critical services such as jobs, education, public transit, and health care. Additionally, while the County's valley location creates favorable weather patterns for agriculture, these geographical conditions trap air emissions.

In assessing future grid infrastructure needs, it is important to distinguish the rural parts of Fresno County, the focus of this study, from the metropolitan area that includes the Cities of Fresno and Clovis. As such, the distinction between rural and metropolitan areas was applied when evaluating existing conditions in order to understand barriers and disparities within rural Fresno County that may not face the urban area.

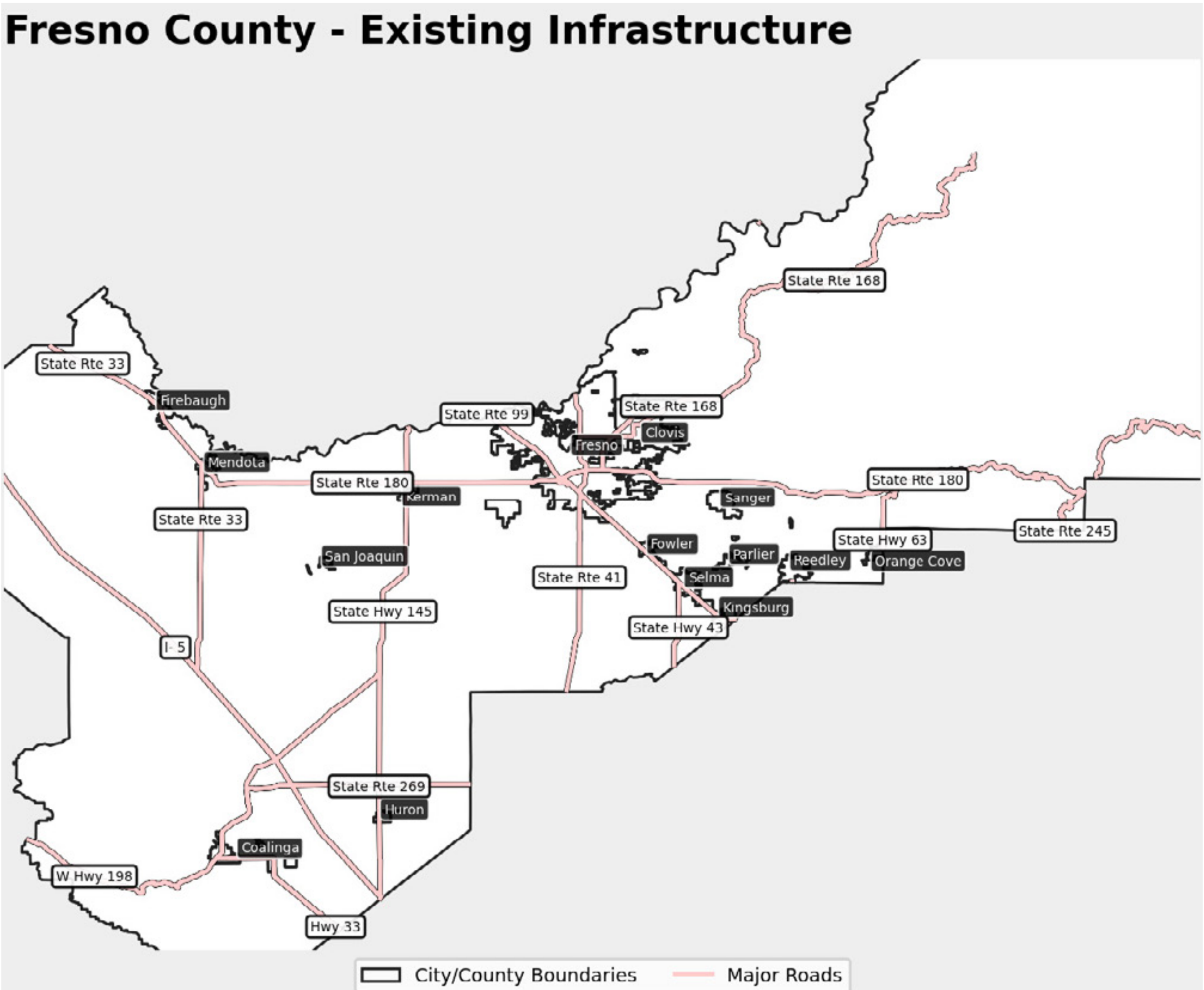
Fresno County is comprised of 13 rural incorporated cities and many unincorporated communities, for which the County still serves as the local government. Major unincorporated communities include Del Rey, Caruthers, Riverdale, and Easton. While this section primarily focuses on the incorporated cities, Section 8.2 of the Study details needs of unincorporated communities which are critical to assessing overall grid impacts and needs.

Geography

As illustrated in Figure 1, Interstate 5 (I-5) runs through the west of the County and California State Route (SR) 99 through the center are the primary north-south through-fares. SR 180 spans much of the county from east to west. Most of the eastern part of the county is mountainous and sparsely populated.

3 Tim Sheehan (2019, September 10). Fresno County farms set $7.9 billion record for crop value. Here's what topped the list. *The Fresno Bee*. https://www.fresnobee.com/news/local/article234928912.html

Figure 1: Fresno County Existing Infrastructure



Source: Fresno County Public Geographic Information System Data (accessed 2019)

Demographics

Population is a key driver of demand for transportation services, both public and private, as well as demand for electricity and natural gas. Fresno County is home to approximately one million residents. Over half of the population is located in the City of Fresno or Clovis, with the remainder distributed across 13 other incorporated cities and various unincorporated areas. Most of these cities have a population of around 10,000 people, with Reedley, Sanger, and Selma closer to 20,000 and San Joaquin closer to 5,000.

Socioeconomic Considerations

The contrast of one of the nation's major agricultural producers also being one of the California counties with the highest poverty level is an indicator of the levels of vulnerability that can be found throughout Fresno County. Fresno County residents median income is 32% less than that of Californians ($51,261 and $71,228, respectively) and the poverty rate in Fresno County is 10% higher than that of California as a whole (24.1% and 14.3%, respectively). Income can be another key driver of demand for electricity and gas, due to factors such as larger homes or a mix of transportation service options, including EVs.

Environmental Justice

The majority of rural Fresno County cities have been identified as Environmental Justice Areas (EJAs) or Vulnerable Community Areas (VCAs), and this trend is likely similar in the unincorporated areas that surround them. Local vulnerability has been exacerbated due to the recent coronavirus (COVID-19) pandemic. A comparison of the Central California Food Bank saw an increase of 43% in food distribution between April 2019 and April 2020, with more than 60% of that need in rural Fresno County areas.

Equity is an important consideration when planning new infrastructure, especially in the context of transportation. An efficient, reliable, and affordable electric grid system is essential to alleviate Fresno County's key challenges and to increase access to critical services. A reliable and resilient grid system is needed to meet new electricity needs for electrified fleets, reliable transportation services, and public and private electric transportation options. Electric grid enhancements should be equitably distributed and upgrade efforts should strategically focus on geographic areas that are most socially, environmentally, and economically vulnerable.

Additionally, the lack or condition of existing infrastructure due to historic inequitable investment in Fresno County's most rural and vulnerable communities presents a barrier to introduction of new infrastructure, technologies, or transportation services. In some cases, this may increase the upfront costs for future infrastructure improvements, prolong the project development process, and limit access to adequate funding.

Particular areas of vulnerability within Fresno County that were assessed as part of the Existing Conditions Report include:

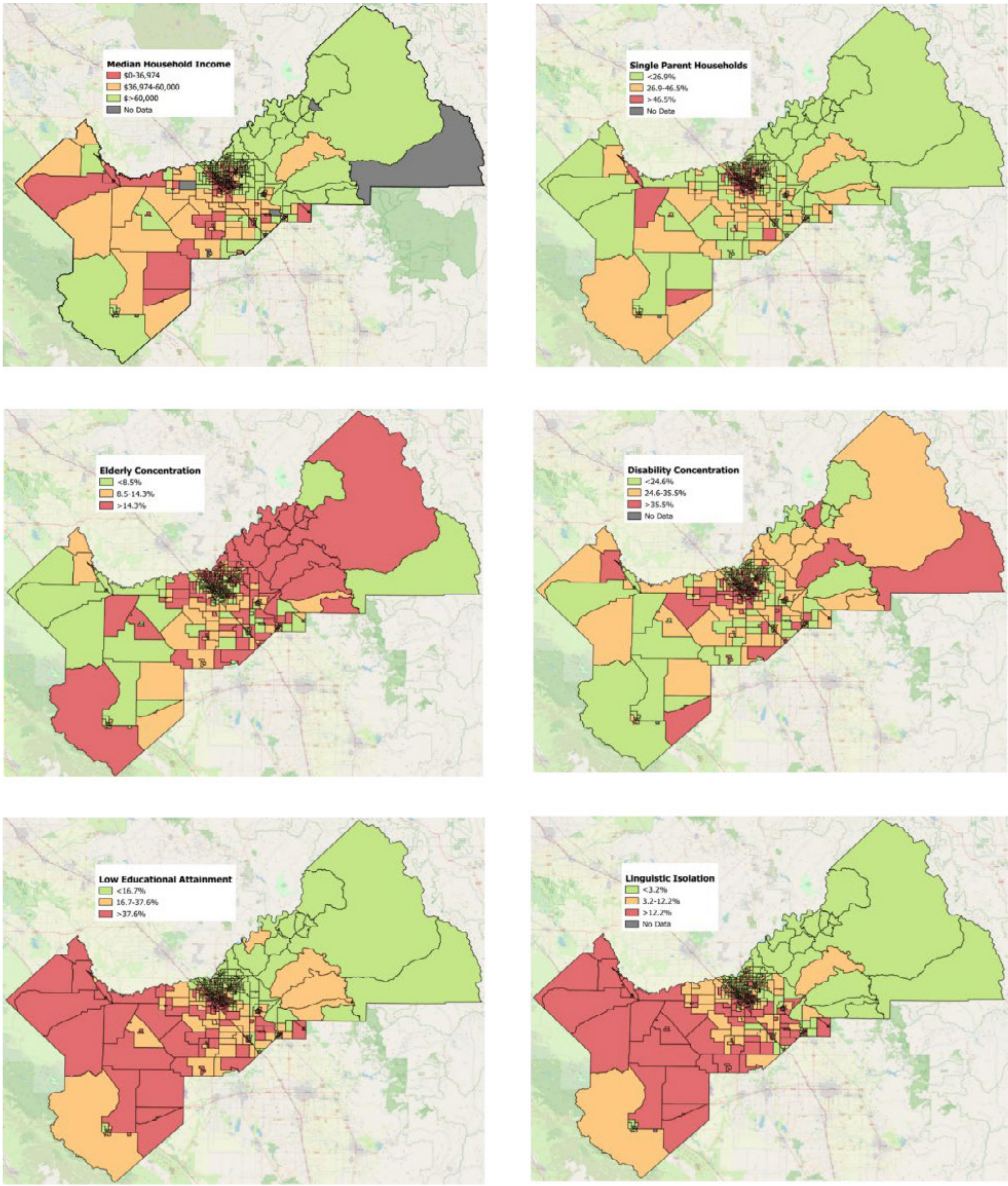
- Pollution exposure and health implications
- Housing costs
- Transportation costs
- Education levels
- Poverty
- Unemployment
- Income

Figure 2 illustrates cross-sections of the parameters that inform the above EJA and VCA disadvantage classifications. While a larger portion of the population are elderly and have lower incomes in the northeast areas of the county, the southwest areas struggle instead with low education attainment and linguistic isolation.

Pollution Exposure and Health Implications

Fresno County lies near the geographic center of the Valley, surrounded by mountains, stagnant air, hot summers, and foggy winters. While these create prime agricultural conditions, they also encourage poor air quality by trapping air pollutants, such as ozone and particulate matter. As a result, Fresno County is considered to be a non-attainment area for ozone, carbon monoxide, particulate matter 10 (PM_{10}) and $PM_{2.5}$. Exacerbating this issue is the need for Fresno County residents and commuters to travel long distances to access jobs and services within the County or surrounding employment hubs like the Bay Area and Sacramento. This need adds to emissions from transportation, the largest GHG emitting sector in California. According to the San Joaquin Valley Air Pollution Control District (SJVAPCD), vehicles account for 80% of the Valley's smog with light-duty vehicles emitting a third of most nitrous oxides.

Figure 2: Socioeconomic Disadvantages



Source: United States Census (2019)

Socioeconomic Factors

While the effects of climate change affect all people and air pollution cannot be contained in one geographic area, populations of color and low-income populations experience disproportionate impacts of climate change and air pollution. They also often lack resources to react to these impacts. This trend has become increasingly evident through the COVID-19 pandemic. Factors that contribute to vulnerability levels and access to resources include educational attainment, employment, household income and poverty, linguistic isolation, transportation access, and commute times.

Electric grid enhancements and electrification efforts can provide fruitful opportunities for job creation and economic gain. They can also supply new jobs including, but not limited to, those related to construction, public transit, alternative fuel vehicles, energy storage, microgrids, and renewable energy. Electric grid enhancements can support existing businesses and services by providing more reliable and affordable energy services. Additionally, they can be used to provide transit access to critical services such as healthcare and educational opportunities as well as areas of greater employment opportunity.

Many households within Fresno County are both low income and highly burdened by the costs of housing and transportation. Housing and transportation affordability are determinants that have been associated with overall health, and burdened individuals often suffer adverse health impacts. Nearly 60% of renters within Fresno County spend at least 30% of their income on housing, constituting them as 'rent burdened.' Low-income families within Fresno County are disproportionately burdened and typically pay about 73% of their income on rent and housing costs.

Since transportation costs are a significant local burden, providing electrification initiatives that can reduce the costs associated with transportation due to their lower fuel and maintenance costs is an important opportunity. As a second-hand EV market opens, with significant decreases in up-front capital costs, the reduction in costs compared to internal combustion engine vehicles (ICEVs) is expected to be substantial. As such, ensuring that the local grid is capable of supporting additional load in areas that can most benefit from EV charging infrastructure is key.

3.2 Climate, Energy, and Electrification Policies

Policy and regulatory environments can be a key enabler of implementing electrification technologies and initiatives. California is a national leader regarding policies, emissions targets, and regulations intended to encourage electrification and reduce negative climate impacts. In 2019, 43% of the state's in-state electricity generation was supplied by natural gas, 8% from nuclear power, and 19% from hydroelectric power[4]. As natural gas is decommissioned and more stringent state targets are introduced, these percentages are expected to change and impact all communities within the state, including Fresno County. The results of electrification policies can have significant grid impacts and were therefore reviewed and assessed as part of this Study. These policies are presented in Table 1.

4 World Nuclear Association (2021, April). *California's Electricity.* https://www.world-nuclear.org/information-library/country-profiles/others/californias-electricity.aspx

Table 1. Electrification Targets and Mandates

Target/Mandate	Year	Description
State Assembly Bill (AB) 32 – GHG Cap and Trade	2006	Designed by CARB to create incentives for utilities to reduce their GHG emissions, improve operational efficiency, and provide credits for clean energy and EE programs.
State Senate Bill (SB) 2 (1X)	2011	Required electricity companies to provide 33% of power from renewables by 2020.
Zero Emission Vehicle (ZEV) Program (CARB)	2012	As part of the Advanced Clean Cars program, targets were set to require ZEVs comprise 10% of new vehicle sales by 2025.
Executive Order (EO) B-16-2012	2015	Set a target of 1.5 million ZEVs on state roadways by 2025.
SB 350 (Renewable Portfolio Standard)	2018	Enacted the Clean Energy and Pollution Reduction Act into law, targeting a 40% reduction in state GHG emissions by 2030, obtaining 100% of electric power from renewable sources by 2045, and increasing the initial goal of 33% by 2020 and 50% by 2030.
SB 100	2020	Requires renewable energy and zero-carbon resources supply 100% of electric retail sales to end-use customers by 2045.
California Public Utilities Commission (CPUC) Target	2020-2025	CPUC voted to approve updating the target provided in SB 350 to require a 56% decrease of emissions below 1990 levels.
EE Resource Standard	2020	Incremental targets average about 1.6% (gross) of retail electric sales.
EO N-79-20	2020	By 2035, all new cars and passenger trucks sold in California must be ZEVs.
Title 24 California Solar Mandate	2021	Title 24 of the Building Standards Energy code requires new single-family and multi-family homes up to three stories high be built with a solar electricity system.
SB 350 (2020 Update)	2021	Provides updates to some of the 2030 GHG planning targets for load serving entities.
SB 100 Joint Agency Report	2021	An initial assessment on achieving 100% clean electricity in California by 2045 per SB 100 provided by the California Energy Commission (CEC), CPUC, and CARB. States that California will need to triple its current electricity grid capacity and building 6 GW of renewable resources annually.
SB 1014: Clean Miles Standard	2021	CARB requires that transportation network companies (TNCs) such as Uber and Lyft begin electrification of their fleets starting in 2023. By 2030, TNCs must achieve zero GHG emissions and 90% fully EV miles.
2022 Building Energy Code	2023	The CEC updates Building Energy Code standards every three years. The process of improving upon 2019 Building Energy Code is underway. The new standards will be proposed in 2021 and become effective in 2023.

Perhaps as a result of the aforementioned state policies, nine of the thirteen rural incorporated cities within Fresno County have begun to adopt language supporting electrification into their General Plans. These policies include electrifying fleets, encouraging electric vehicle adoption, and encouraging charging station installation. The City of Kerman's General Plan could be considered the most holistic in this regard and includes policies for electrifying fleet vehicles, streamlining permitting processes, encouraging private charging station installations, supporting EV adoption, updating building and zoning ordinances, and improving standardization or mitigation measures.

To aid Fresno County communities in their electrification goals, the FCOG was the recipient of the 2019 California Department of Transportation (Caltrans) Sustainable Communities Planning Grant. The funding enabled FCOG to pursue development of its EVRP, intended to aid local communities in meeting the aforementioned state emissions targets and electric vehicle adoption goals.

These policies continue to influence introduction of programs within the area. Most recently, Electrify America (the largest open direct current (DC) fast charging (DCFC) network within United States [U.S.]) deployed eight solar-powered, off-grid Level 2 charging units within Fresno County in order to meet their goals of equitable access to electrified mobility.[5] Notably, the units are available for free access to residents of Fresno County. Yet another program, the Rural Electric Vehicle Utilization Project (REV-UP) was launched in 2020 in partnership with Inspiration Transportation to offer $5 round trip rides in EVs.[6]

Despite the strong correlation between transit and emissions, a smaller number of communities have developed plans specifically targeting GHG emissions or climate action. These communities are the cities of Clovis, Fresno, and Reedley, and Fresno County. While the Fresno County plan does encompass the broader county, its goals are broad and individual communities are encouraged to develop plans with specific and localized actions.

Efforts have been made to integrate renewable energy sources to replace natural gas power plants. In 2020, Southern California Edison (SCE) signed seven long-term contracts for 770 MW of battery storage resources, one of which is at Fresno County's Tranquillity solar project location. The effort has a contract term of 20 years and a contracted capacity of 72 MW. Operations are expected to begin in August 2021.

Electric Utility Tariffs

Within rural Fresno County, several tariffs are available which can be leveraged to support transportation electrification projects and incentivize use of grid infrastructure during off peak hours.

Currently, PG&E has two rate tariffs for businesses, Business Low Use EV Rate (BEV1) and Business High Use EV Rate (BEV2),[7] each of which allows for customers with separately metered charging to subscribe to blocks of demand, with the goal of ensuring predictable demand charges for customers. Additionally, customers are billed for electric usage on a time-of use (TOU) rate. Such rates can enable fleet vehicle operators to optimize for charging at low-cost nighttime hours.

Additionally, there are several rates which benefit the wider community in supporting EVs and other grid-responsive or grid-interactive programs. These rate programs are described in Table 2.

5 New Mobility (2020, October 1). *Electrify America launches solar-powered EV charging stations in rural Fresno County.* https://newmobility.global/smart-infrastructure/electrify-america-launches-solar-powered-ev-charging-stations-in-rural-fresno-county/
6 The Business Journal (2020, October 1). *Fresno County Rural Electric Rideshare Program Kicks Off Monday.* https://thebusinessjournal.com/fresno-county-rural-electric-rideshare-program-kicks-off-monday/
7 Pacific Gas & Electric (n.d.). *Business Electric Vehicle (EV) rate plans.* https://www.pge.com/en_US/small-medium-business/energy-alternatives/clean-vehicles/ev-charge-network/electric-vehicle-rate-plans.page

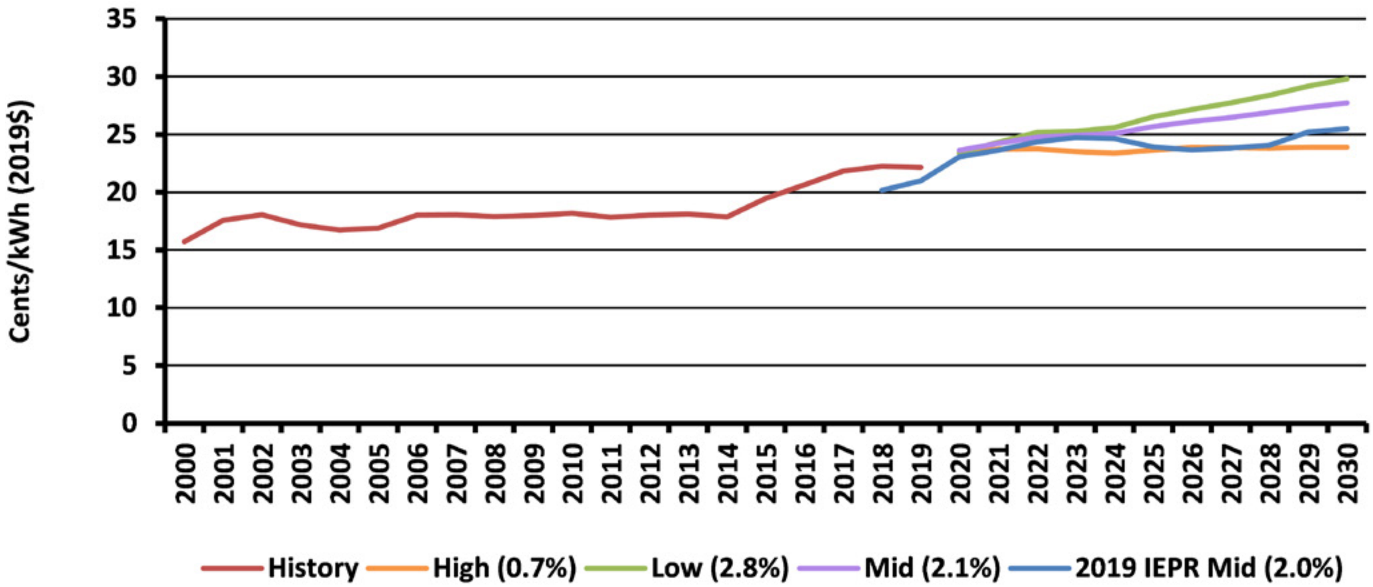
Table 2. PG&E Rates Applicable to Demand Response, EE, and EV Charging

Target/Mandate	Description
Economic Development Rate	Customers under select rates, including bundled, direct access, and community choice aggregation, as well as small business rates, that have usage in excess of 150 kW.
Energy Financing Line Item Charge - PILOT (EFLIC)	Residential customers who are current on their bills and have purchased eligible energy efficiency measures through a loan provider approved by PG&E and installed at the service address associated with the customer's account.
Residential Smart A/C Program (E-RSAC)	Intended to be a service option for individually metered residential customers on the bundled, direct access, and community choice aggregation programs.
Residential Time-of-Use Service (E-6)	Includes bi-annual climate credits.
Residential Time-of-Use Service (E-TOU)	Option A (no longer accepting customers and has been discontinued)
Residential Time-of-Use Service (EM-TOU)	Option B no longer accepting new customers and will be phased out in October 2025.
	Residential users in single phase or polyphase service where multi-family residential units are serviced by their own meter and not sub-metered.
Residential Time-of-Use (Peak pricing 4-9pm everyday) (E-TOU-C)	Residential customers who opt-in or were auto enrolled.
Residential time-of-use (peak pricing 5-8 pm on non-holiday weekdays) (E-TOU-D)	Voluntary rate for residential customers.
Residential Time-of-Use Service for Plug-in electric vehicles (EV)	Rate A (no separately metered recharging outlet)
	Rate B (separately metered recharging outlet)
	Residential customers that are net metered, and Rate A is closed to new entrants.
Residential Time-of-Use Service for Plug-in electric vehicles (EV2)	Functionally the same as EV Rate A.

Electric Utility Prices

As shown in Figure 3, PG&E residential retail prices have increased significantly over the last 5 years, leveling off near $0.22 from a previous stable trend around $0.18. The forecasted range for the average price per kilowatt-hour in 2030 is about $0.24 to $0.30, with the variance largely dependent on underlying demand. High, middle, and low indicators are variable according to total kilowatt-hour sale by the utility, as higher usage drives lower prices.

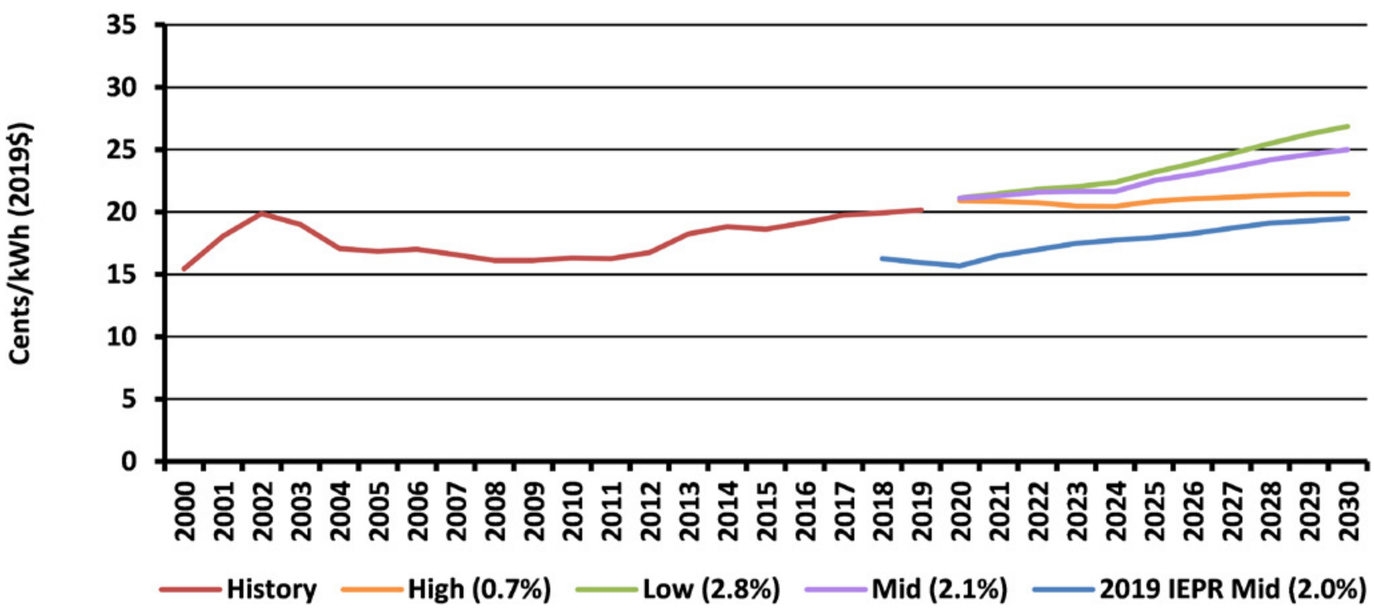
Figure 3: PG&E Residential Prices by Scenario



Source: CEC (2019); Note: Percent is average annual growth from 2019-2030

Commercial rates have not risen as sharply as residential rates, but they are trending up more strongly. Forecasts estimate a range of $0.20 to $0.27 per k by 2030, as illustrated in Figure 4.

Figure 4: PG&E Commercial Prices by Scenario

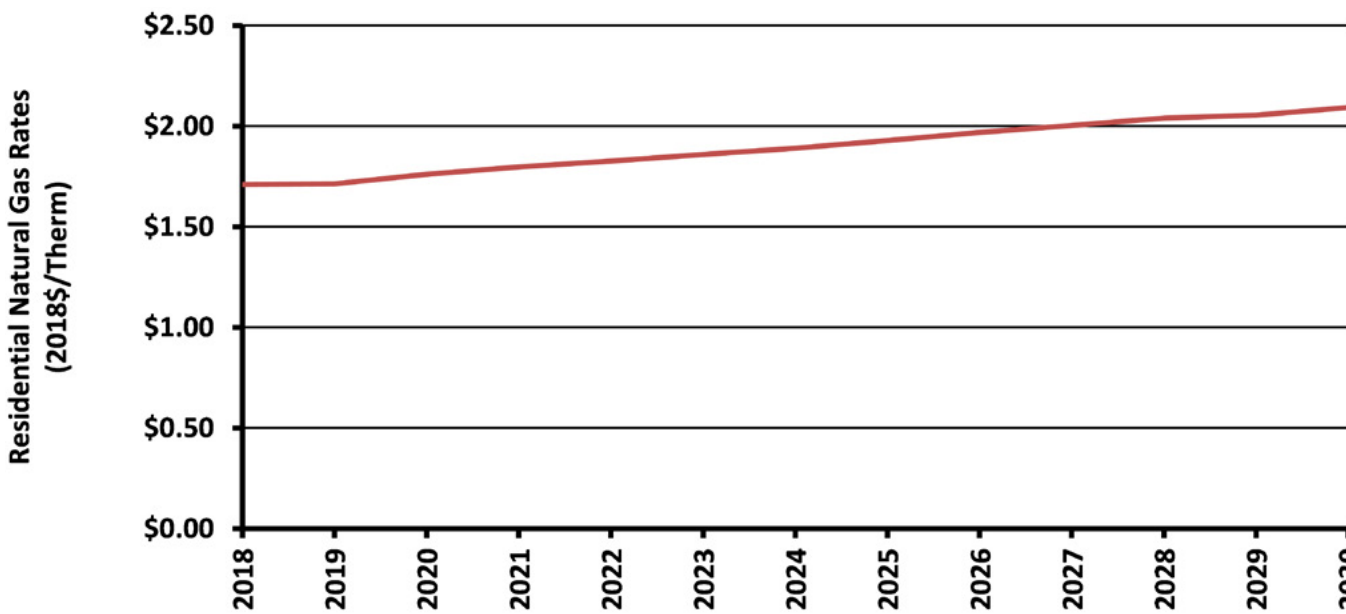


Source: CEC (2019); Note: Percent is average annual growth from 2019-2030

Natural Gas Utility Tariffs

Residential gas prices are expected to slowly rise over the next 10 years, from approximately $1.70 per therm to nearly $2.10 per therm, as shown in the CEC forecast in Figure 5.

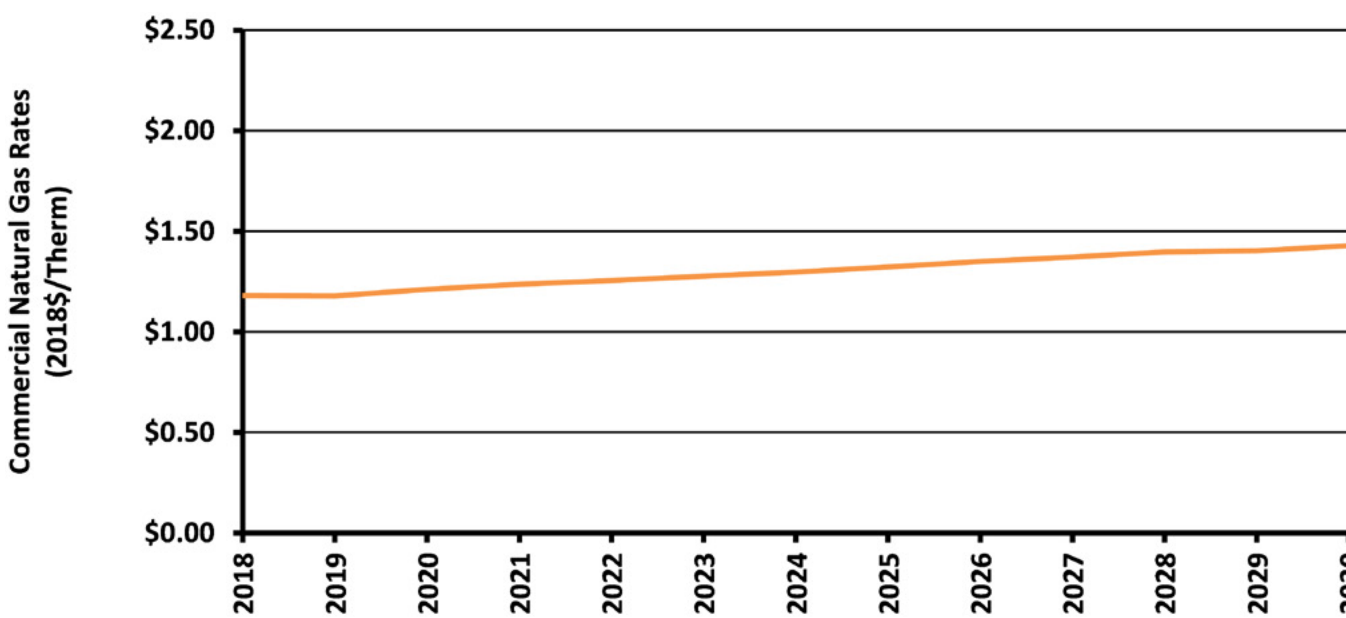
Figure 5: PG&E Residential Prices



Source: CEC (2019), California Energy Demand 2020 - 2030 Baseline Forecast - Mid Demand Case

Commercial prices are generally lower per unit, and are expected to remain that way, despite increases similar to those of residential prices. CEC commercial price forecasts are provided in Figure 6.

Figure 6: PG&E Commercial Prices

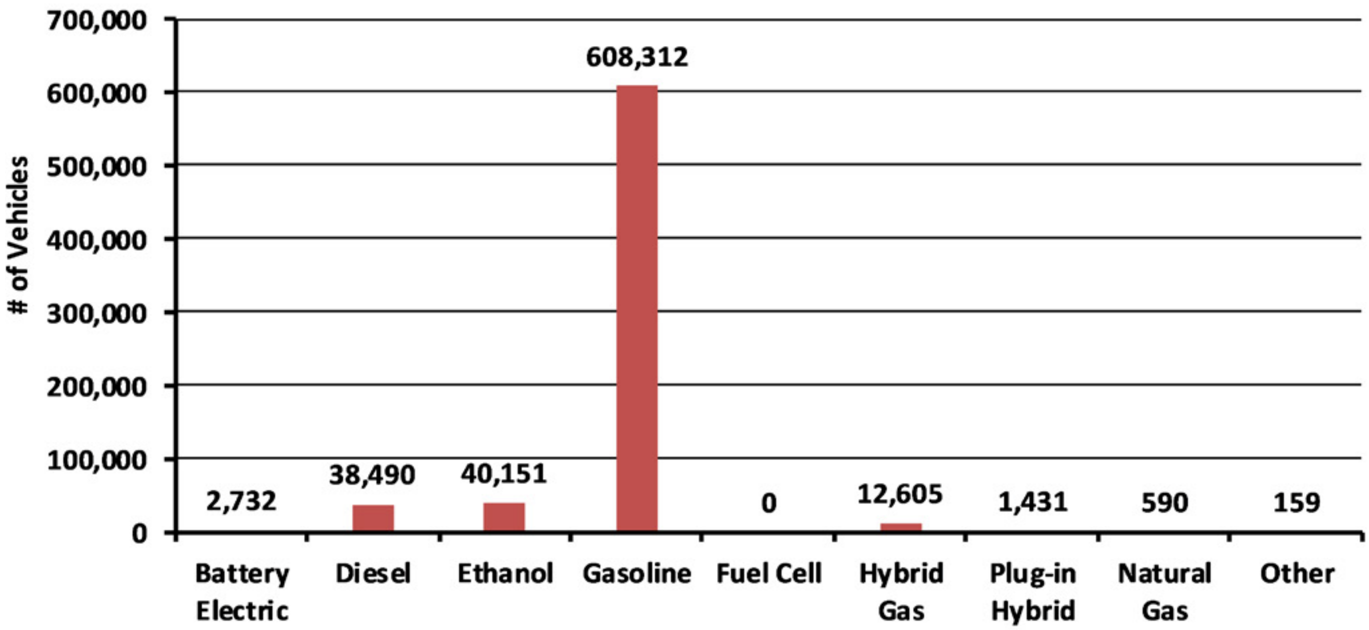


Source: CEC (2019), California Energy Demand 2020 - 2030 Baseline Forecast - Mid Demand Case

3.3 Transportation System

Fresno County is home to over 700,000 passenger vehicles, the vast majority of which are gasoline, diesel, or ethanol. There is, however, a small and growing stock of battery electric, hybrid, and plug-in hybrid EVs, as indicated in Figure 7.

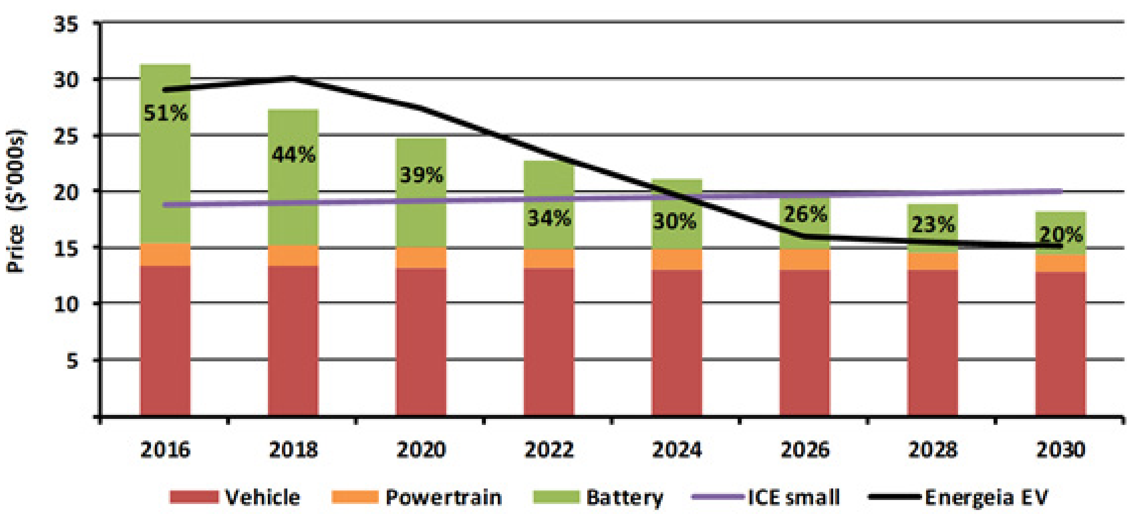
Figure 7: Passenger Vehicles by Fuel Type



Source: California Department of Motor Vehicles (2018), Energeia

The vehicle purchase cost forecast presented in Figure 8 sees plug-in electric vehicles (PEVs) becoming cheaper to buy than ICEVs by 2026. Additionally, PEVs are expected to be cheaper in total cost of ownership terms, which includes the cost of fuel and maintenance, by around 2024, excluding subsidies. With subsidies, many PEVs are already cheaper on a total cost of ownership basis.

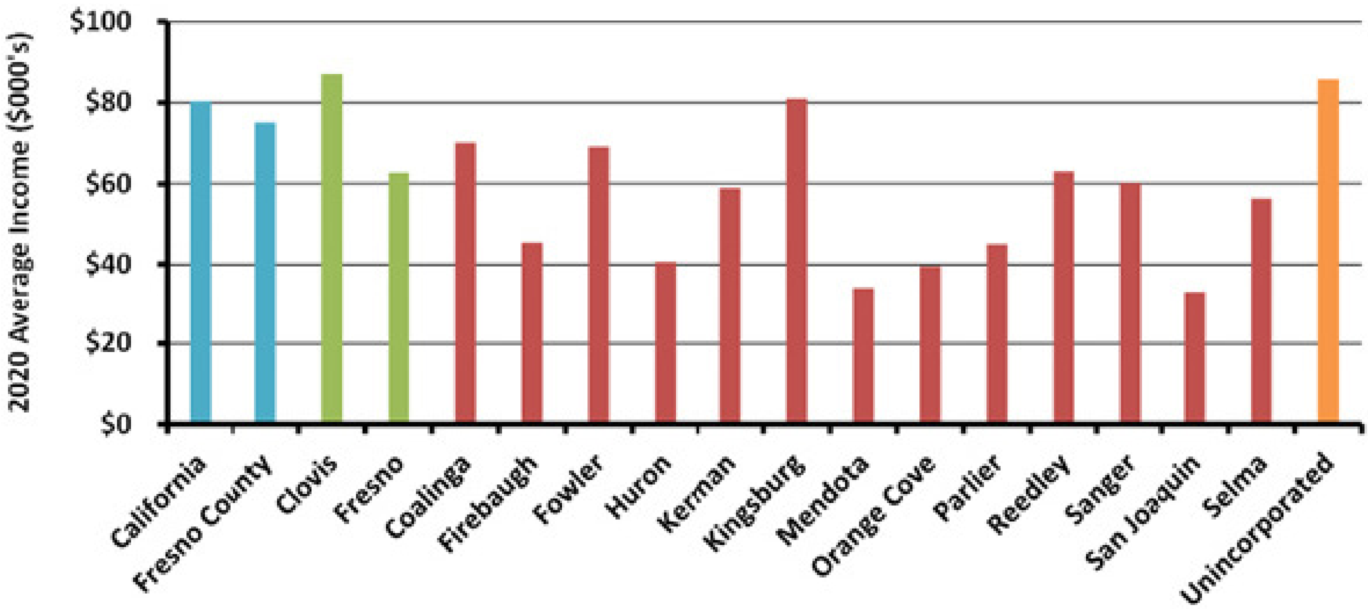
Figure 8: Vehicle Purchase Costs by Cost Factor



Source: Alternative Fuels Data Center (2016), Energeia

Previous studies have found a strong correlation between income, rooftop solar adoption and PEV adoption. Places in Fresno County with higher or lower incomes can therefore be expected to see accordingly higher or lower DER adoption, which is shown in Figure 9 below. Although this is currently the status quo, these indicators may change as electric vehicle charging becomes more available.

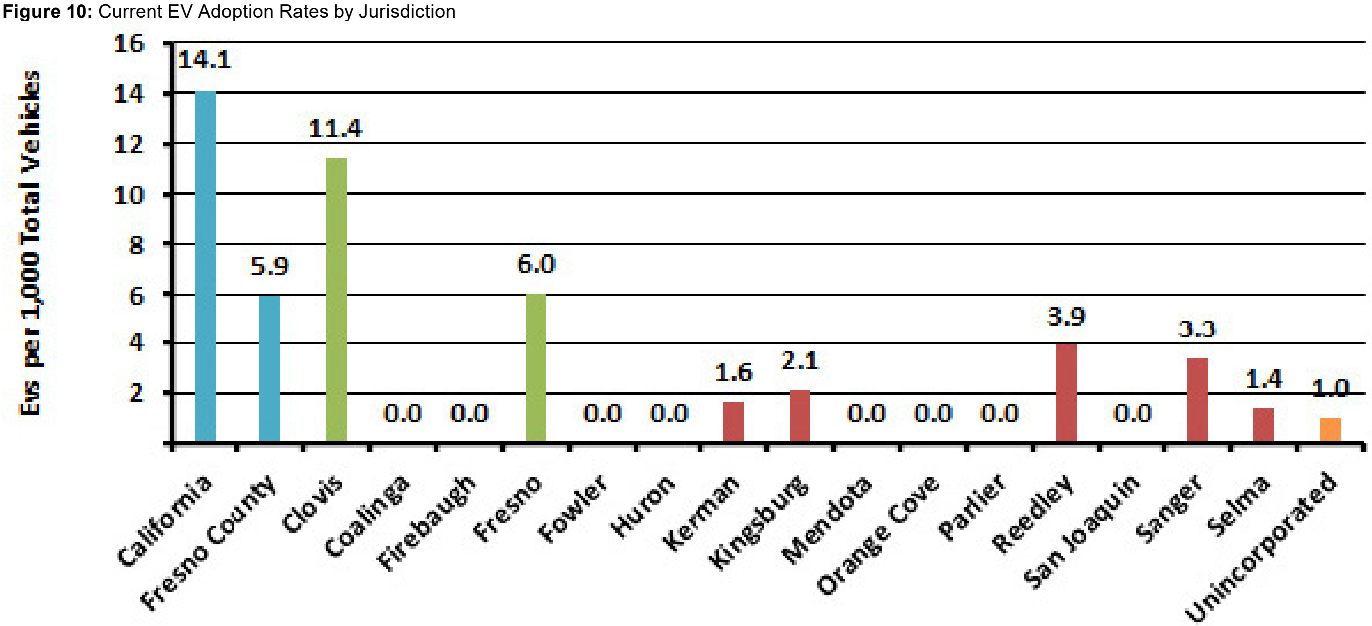
Figure 9: Mean Household Income as an EV Uptake Indicator



Source: U.S. Census (2017), Energeia

As suggested by the income distribution and shown in Figure 10, Fresno County EV adoption levels are lower than the state average, though Clovis is much closer than other areas in the county. The City of Fresno is about half the rate of Clovis, and equal to the county rate; however, it is clear that the county rate is dominated by Fresno City and Clovis' size. The smaller towns are showing only a very limited level of adoption to date. This is likely attributed to the fact that rural and vulnerable communities often face additional barriers to EV adoption.

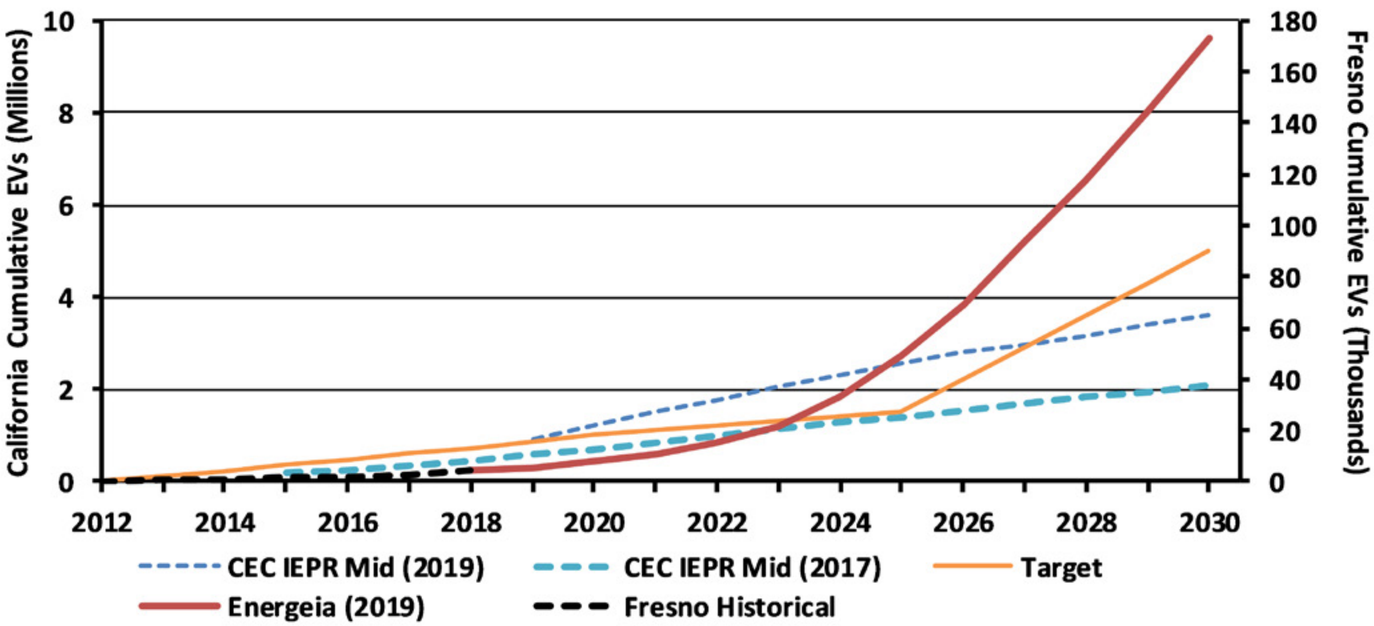
Figure 10: Current EV Adoption Rates by Jurisdiction



Source: California Department of Motor Vehicles (2018), Energeia

The regional forecast of PEV adoption in Fresno County over the next 10 years is reported in Figure 11, alongside historical adoption since 2012, recent pro-rata state forecasts by the CEC, and pro-rata state PEV adoption targets. This forecast is based on more recent and regionally specific PEV adoption drivers, becomes higher than the most recent CEC forecast and state target levels by 2025. This is largely due to the higher weighting of expanding EV model availability as a key driver of uptake, a factor that the CEC forecast considers, but does not weigh as strongly.

Figure 11: EV Adoption by Forecast



Source: CEC Integrated Energy Policy Report (2017, 2019), Energeia

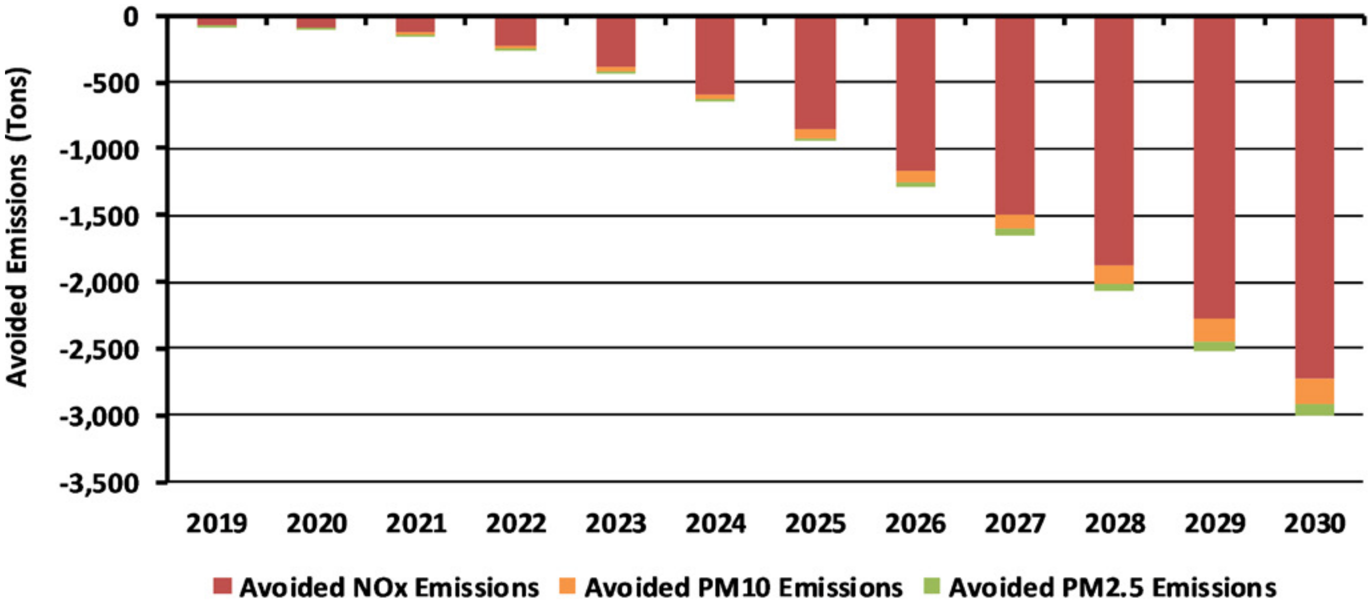
Importantly, the above forecast assumes the full and timely implementation of required levels of public charging infrastructure solutions. Figure 11 shows that barriers due to a lack of public charging infrastructure could reduce the forecast adoption to over 75%.[8]

8 Drivers that own their own home are assumed to be able to charge one PEV at home on average.

Environmental Impacts

EV adoption in the residential segment will have a significant emissions impact, as illustrated in Figure 12. This forecast is based on an assumption that there will be sufficient public charging infrastructure development to support the economic potential of uptake.

Figure 12: Forecasted Nitrogen Oxides (NOx), PM10 and PM2.5 Benefits of Public Charging EVs

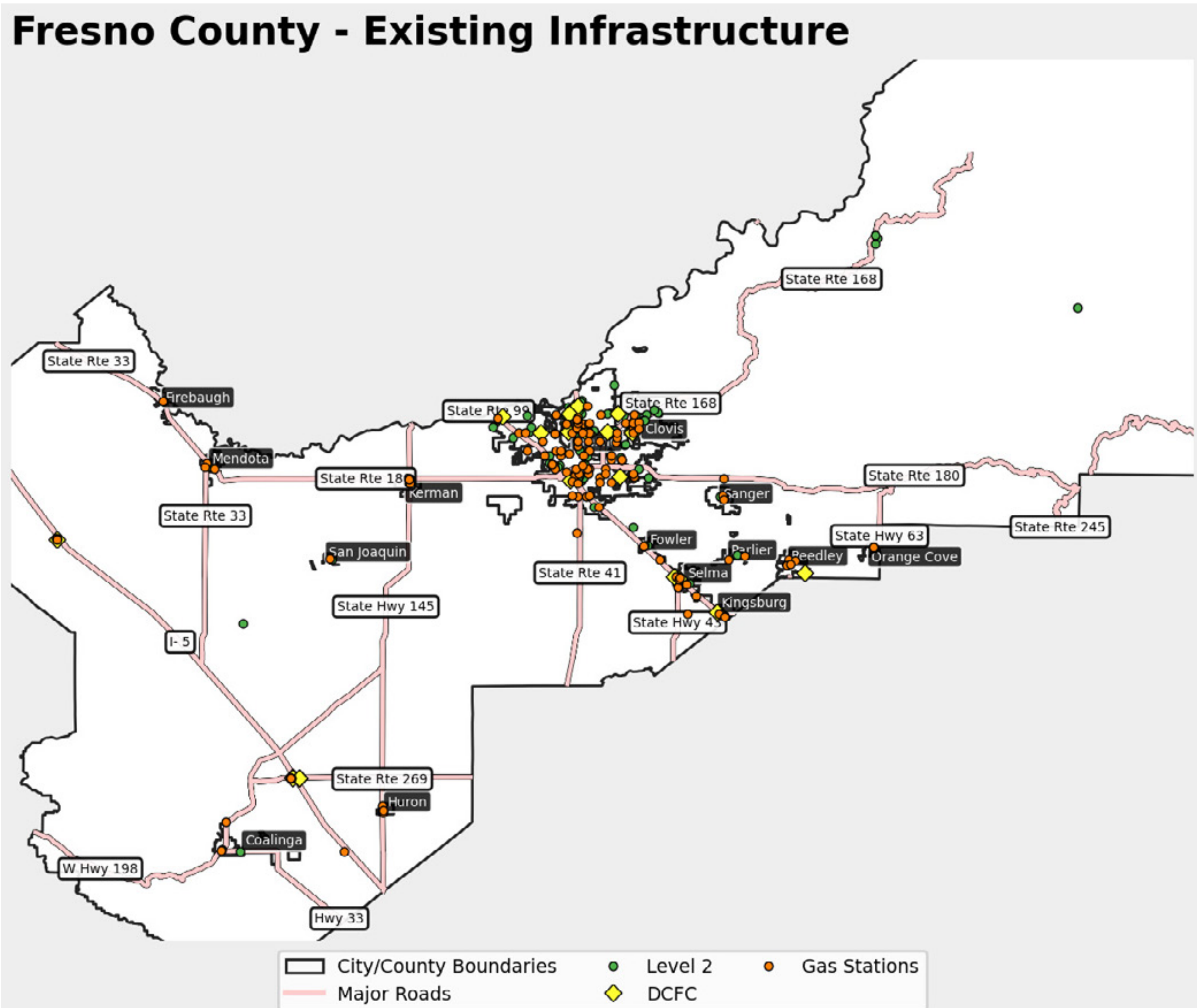


Source: CARB (2016), Energeia Analysis

Refueling Infrastructure

Figure 13 displays the existing refueling infrastructure in Fresno County, for both ICEVs and EVs. The gas station network is extensive, especially within Fresno and along SR 99. Outside of Fresno, there are only a handful of EV chargers, creating gaps in the EV network and significant need for increased charging infrastructure investment.

Figure 13: Fresno County Fueling Stations

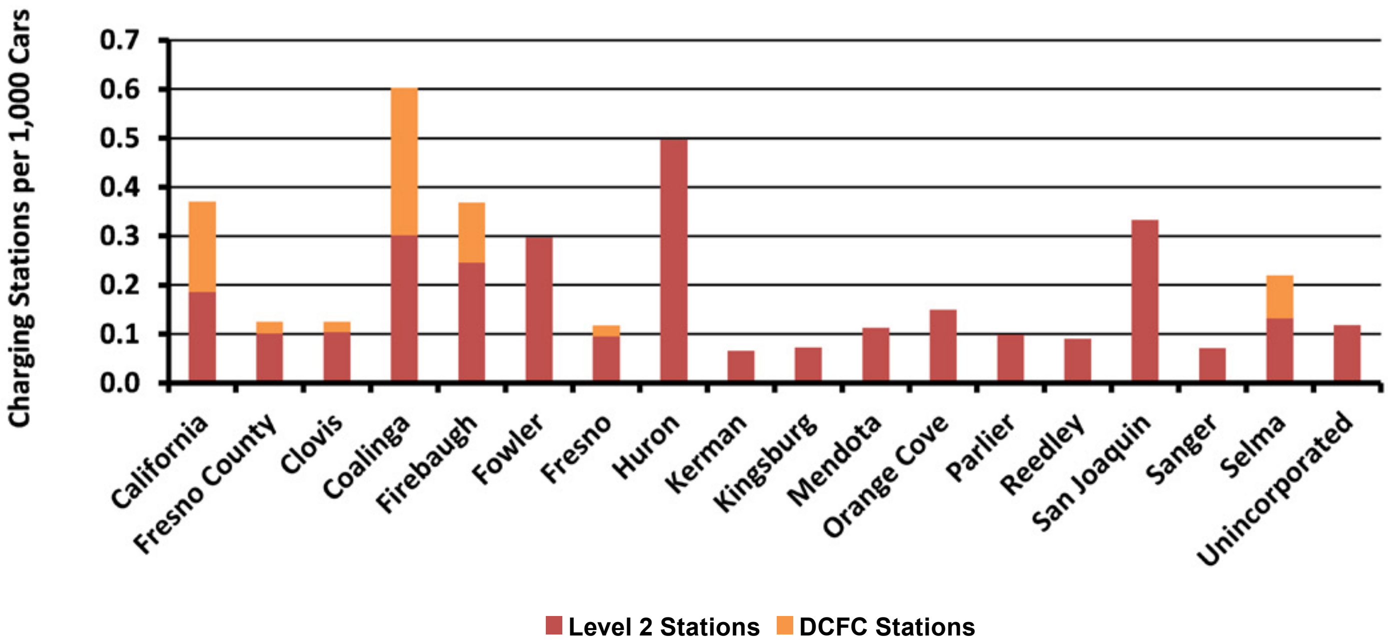


Source: City of Fresno Request for Information

Figure 14 shows that charger installation rates are lower in Fresno County than the state average, but they are higher per EV. This implies that Fresno County is on track for charger installation given its lower EV adoption. However, it will need to increase its charger installation rate to achieve the fully enabled PEV uptake forecast.

Charger installation rates also vary significantly among the rural cities, with Coalinga, Firebaugh, Fowler, Huron, and San Joaquin at or above California rates for Level 2 stations, and Coalinga above California rates for DCFC stations as well. Other rural towns and the unincorporated areas hover around the county average.

Figure 14: EV Charging Station Adoption by Jurisdiction

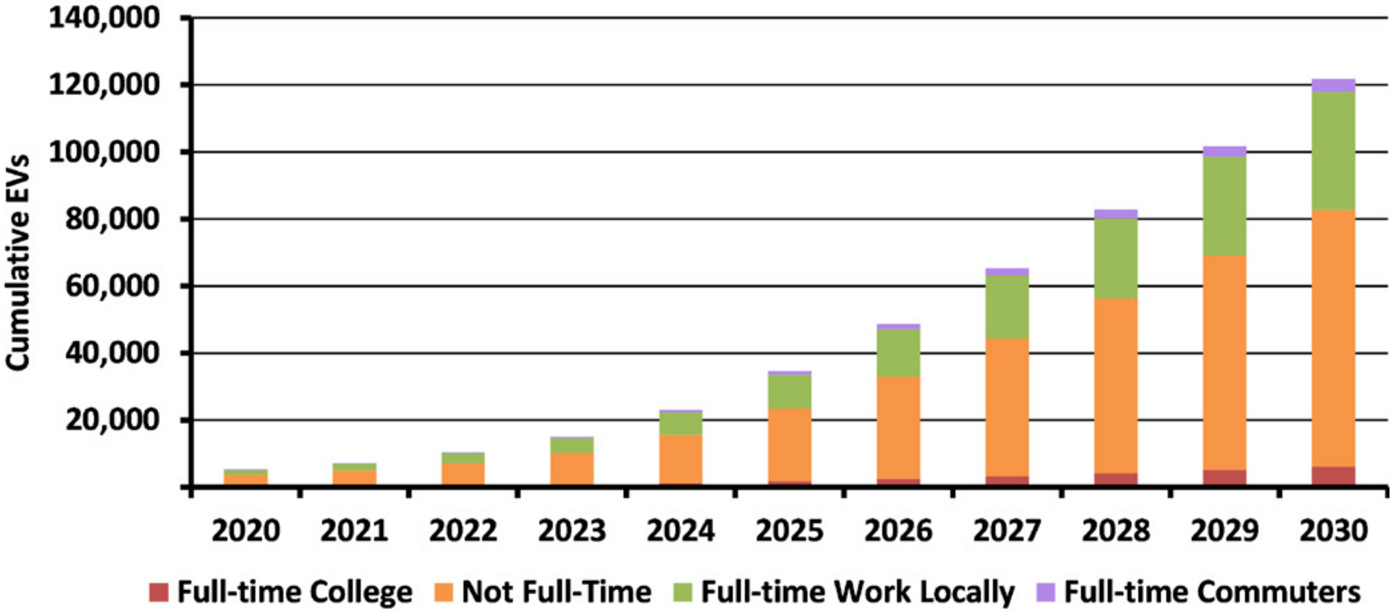


Source: U.S. Department of Energy (2019), California Department of Motor Vehicles (2018), Energeia

Public Charging

Forecasting public charging infrastructure needs for Fresno County begins at the driver level, using census data to identify the likely mix of drivers requiring an assured public charging solution, which is reported in Figure 15. The largest segment shown, 'Not Full-Time', includes retired or unemployed drivers, for whom a workplace solution does not apply. Local full-time workers who can utilize a workplace solution are the second-largest segment. The smaller two segments are full-time college students, who can utilize a charger on campus, and full-time commuters, who work outside of Fresno County and may be best served by a DCFC solution along their commute.

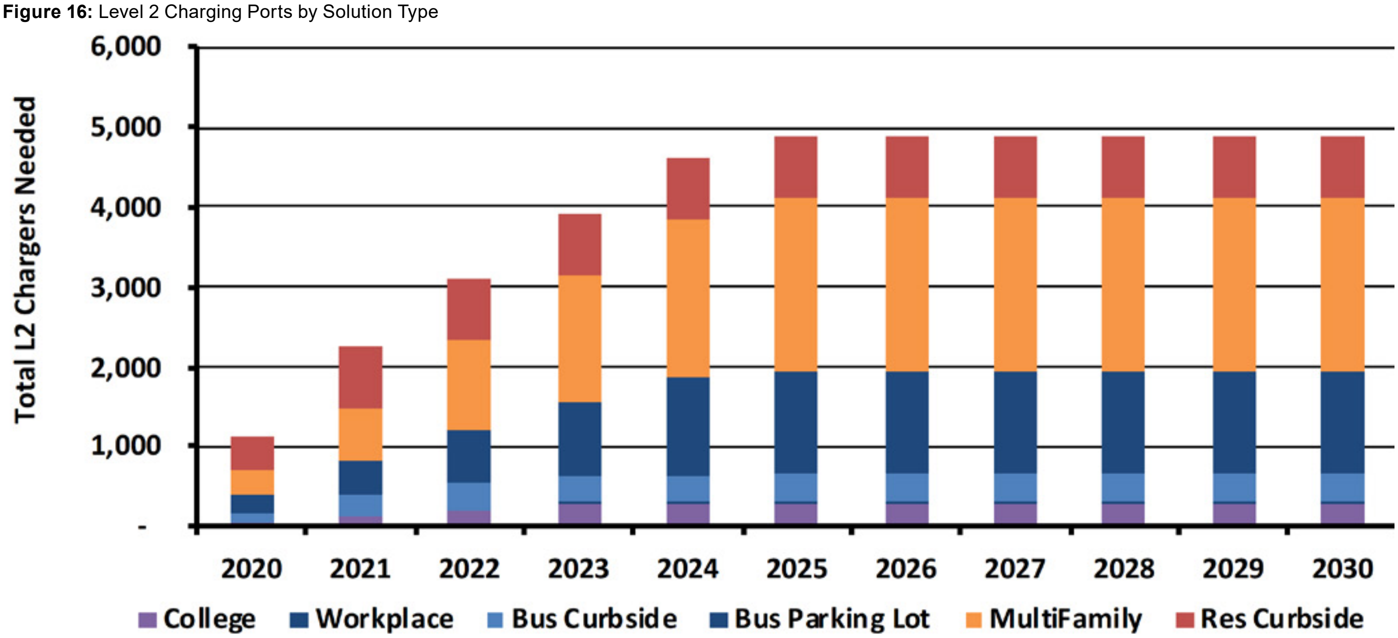
Figure 15: Estimated Public Drivers by Charging Segment (Enabled Scenario)



Source: U.S. Census (n.d.), Energeia

For a recent project analyzing EV charging infrastructure for FCOG, the project team developed a framework for driver segmentation. The optimized Level 2 public charging infrastructure, as shown in Figure 16, sees most public charging sites located at workplaces and multifamily sites, with around 20% of sites being residential curbside and business curbside solutions.

Figure 16: Level 2 Charging Ports by Solution Type

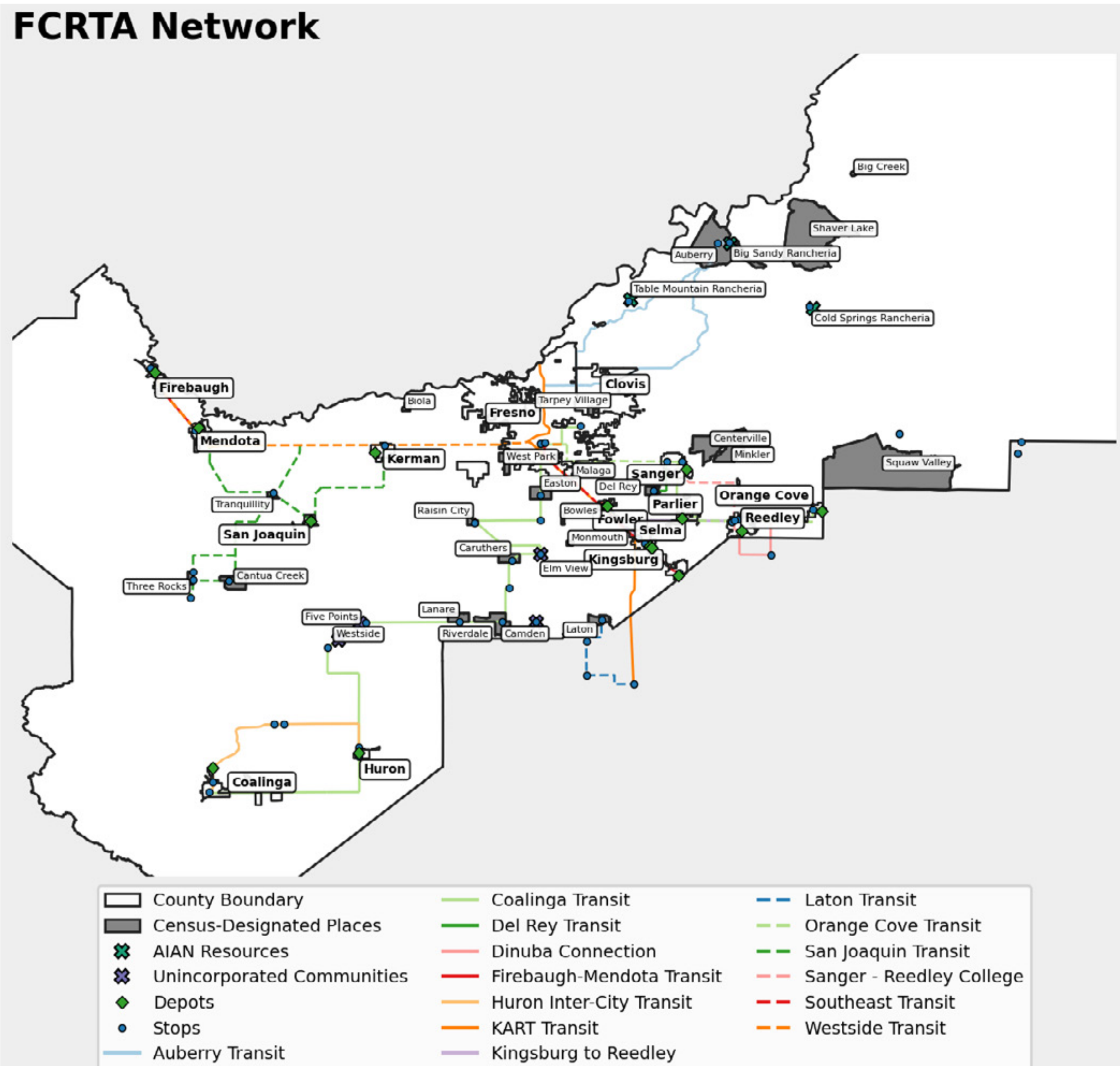


Source: Energeia Analysis

Public Transit

FCRTA provides public transportation services for the rural areas of Fresno County and particularly strives to provide service to residents in need. Services include scheduled, fixed route services with designated bus stops along specific routes with connections to the Fresno-Clovis Metropolitan Area, as well as reservation-based, demand responsive service that offers curb-to-curb transportation. FCRTA specifically provides service to the 13 rural incorporated cities and 29 unincorporated communities of Fresno County, including Native American Tribal Lands and Reservations, such as Big Sandy, Cold Springs, and Table Mountain. FCRTA also contracts with outside transportation providers to enable access to Fresno County for residents of neighboring Kings and Tulare Counties. The FCRTA routes are illustrated in Figure 17.

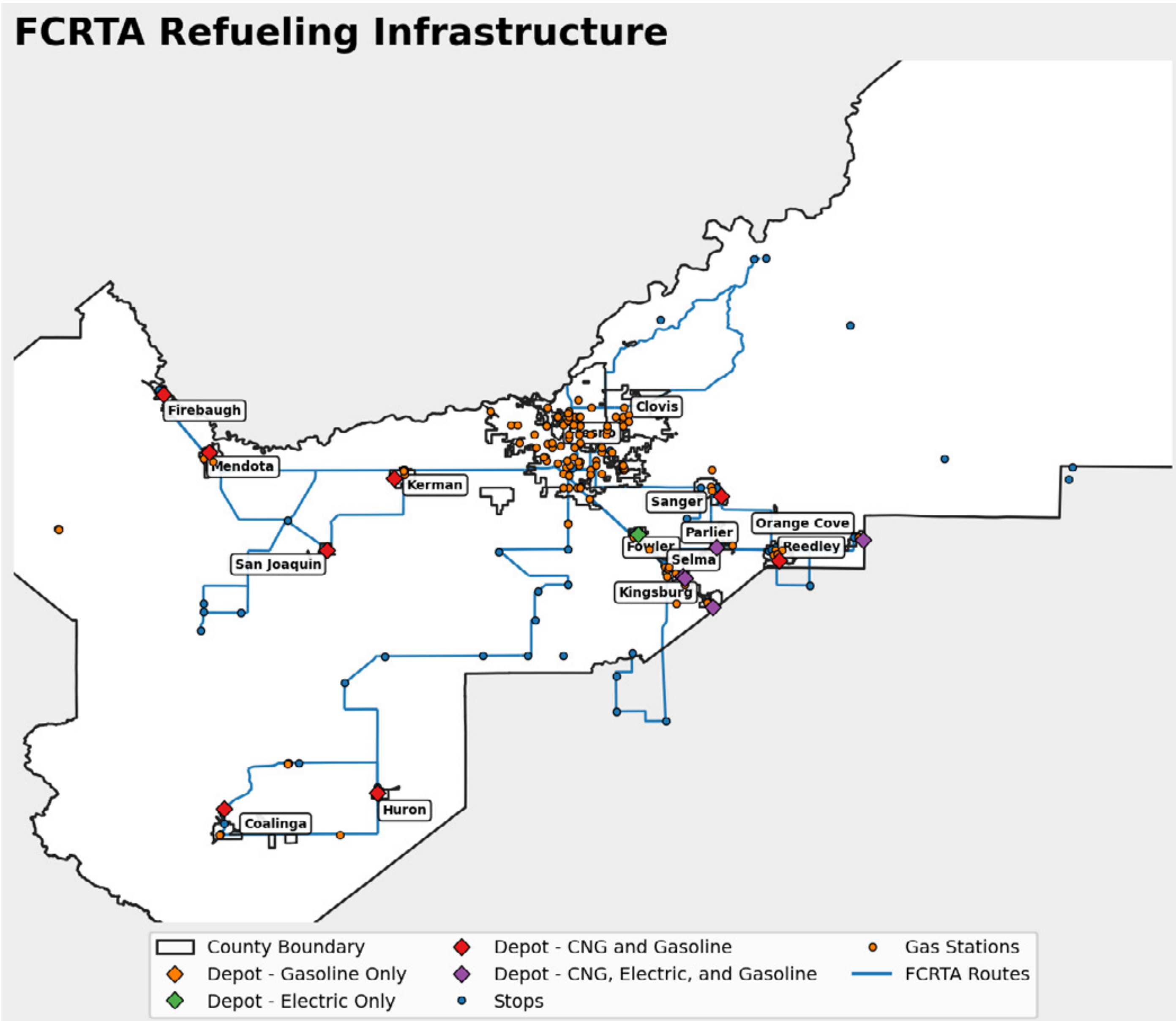
Figure 17: FCRTA Network



Source: FCRTA, accessed 2021

Figure 18 shows the known, existing infrastructure for FCRTA's transport vehicle fleet. Each depot is shaded depending on the mix of fuel types in its vehicles, and the existing gas station network in the county is shown to illustrate the distribution of current refueling infrastructure.

Figure 18: FCRTA Fueling Stations



Source: City of Fresno Request for Information

Electrical Infrastructure Needs for EV Charging

Electrical infrastructure requirements and costs for installing charging infrastructure can be divided into three major categories: network upgrade costs, electricity rates, and electric vehicle supply equipment (EVSE) (including equipment, labor, and other associated fees).

PG&E has two rate plans in place specifically for non-residential customers[9] with EV chargers, as detailed in Figure 19. These rates would apply to the depot EVSE electricity consumption.

Figure 19: PG&E EV Program Rate Options

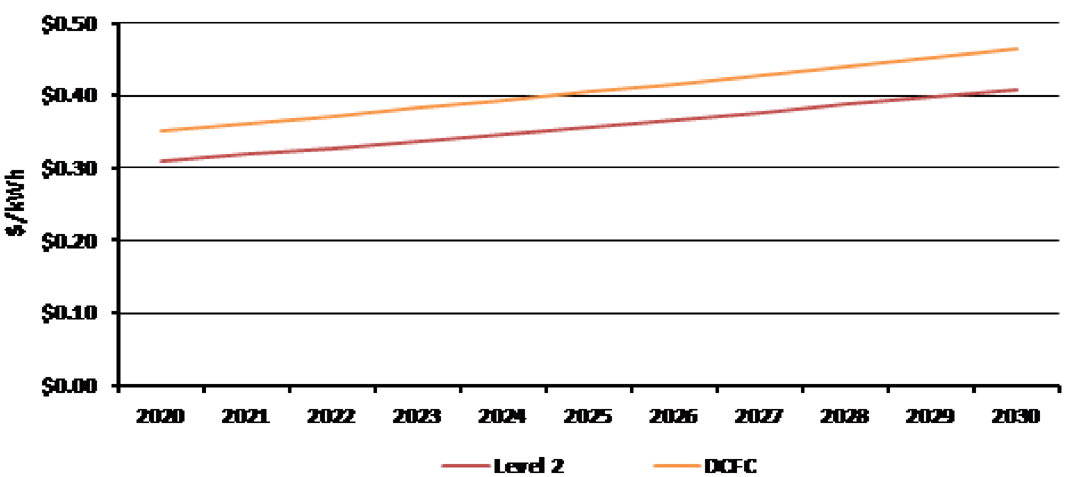
BEV 1	BEV 2
• Charging installations up to 100kW • Subscription in blocks of 10kW • Secondary voltage service • Small and Medium SA type NOTE: Customers who wish to subscribe to 100kW can choose either rate	• Charging installations 100kW and over • Subscription in blocks of 50kW • e.g. fleets, fast charging, and larger sites • Secondary and Primary voltage service • Transmission voltage service offered at Primary rate • Medium SA type

Source: PG&E

PG&E estimates significant cost savings for all EV rate plans when compared to gasoline or diesel alternatives. The Commercial and Industrial (C&I) Rate is their standard C&I rate plan, included to illustrate the benefits of their new rate plans that specifically target EV charging.

As seen below in Figure 20, Level 2 charging is likely not a viable option for bus recharging due to the level of energy needed per day, which Level 2 chargers are unable meet.

Figure 20: Estimated Average Charging Cost per kWh by Charger Type

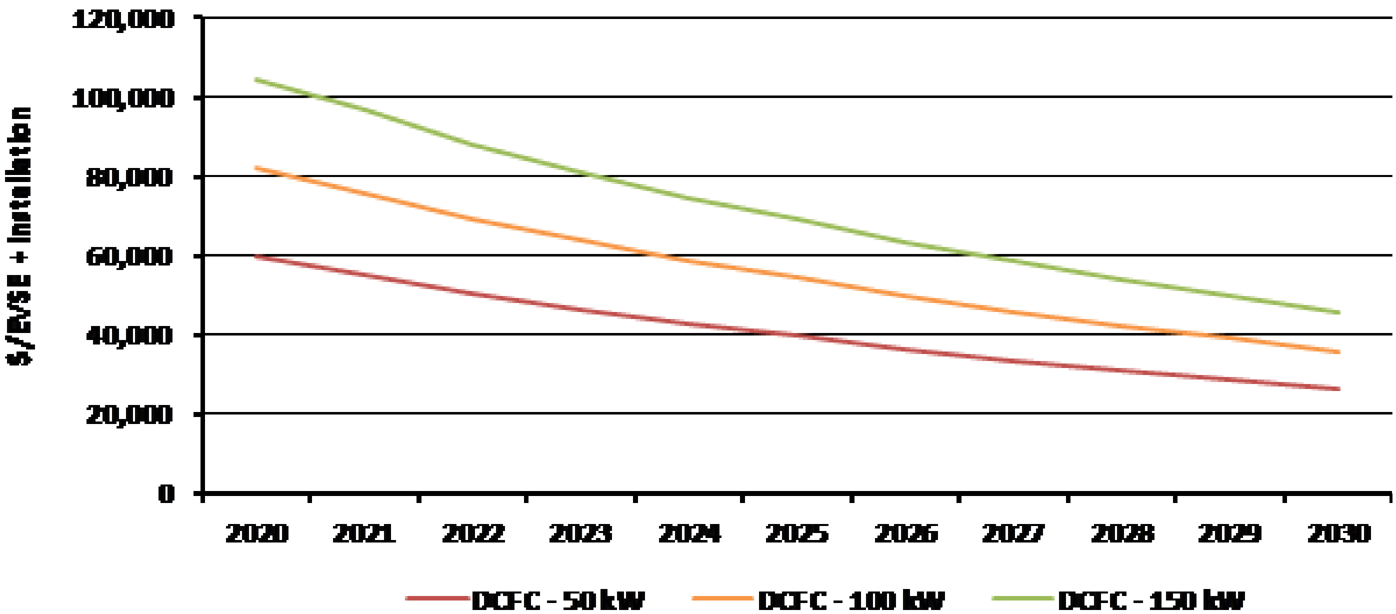


Source: International Council on Clean Transportation (2019), Energeia Analysis

9 Additional EV charging rates for residential customers are detailed in Section 22

As for charger installation costs, DCFC costs are higher than Level 2 charger costs, but are expected to decline over the next 10 years, so appropriate sizing and timing is important to minimize costs. Figure 21 shows the forecast cost decline for three bands of DCFC size.

Figure 21: DCFC Capital Expenditure Forecast (Including Installation)



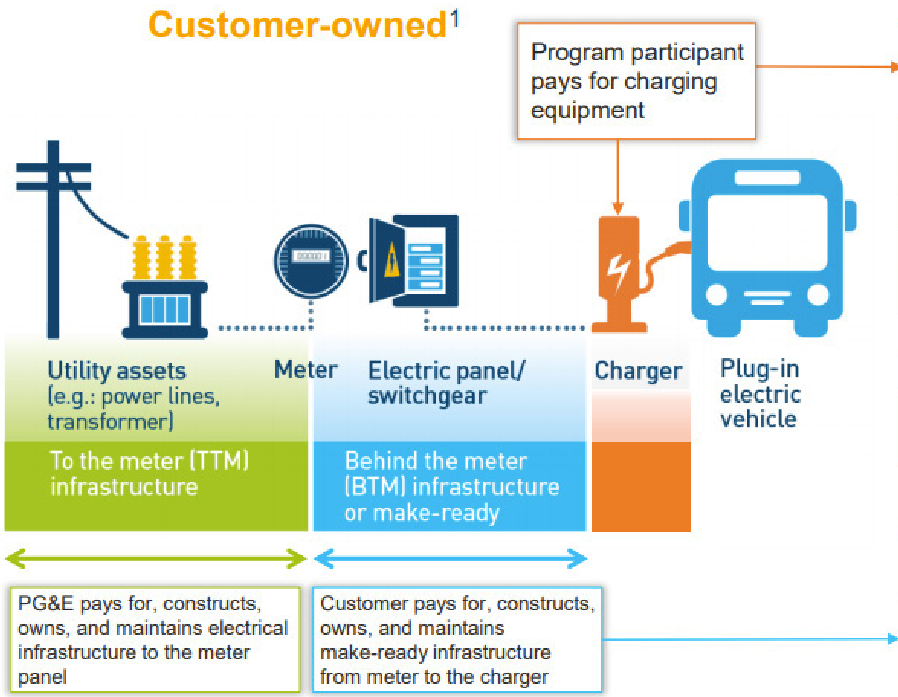
Source: International Council on Clean Transportation (2019), Energeia Analysis

Grid Upgrades

PG&E is responsible for the cost of electricity network infrastructure up to the meter, including transformer, feeder, and substation upgrades as needed. The infographic in Figure 22 details PG&E's EVSE connection and grid upgrade arrangements. PG&E cannot guarantee that spare capacity is available, and locations where upgrades are required could see delays, as a result. PG&E also is not responsible for the cost of reliability or backup systems requested by the customer.

Figure 22: PG&E Infrastructure Investment

PG&E pays for infrastructure cost up to the customer meter



Charging equipment rebates for Schools, Transit Agencies and Disadvantaged communities

EVSE power	Max. rebate amount[3]
Up to 50kW	$15,000 per charger
50-150kW	$25,000 per charger
150kW+	$42,000 per charger

Customer-owned infrastructure

Eligible for incentive up to capped amount based on vehicle sector

Vehicle type	Per vehicle incentive cap[2]
Transit buses & Class 8 trucks	$9,000 per vehicle
Transportation refrigeration units, truck stop electrification, ground support equipment & forklifts	$3,000 per vehicle
School buses, local delivery trucks, and other vehicles	$4,000 per vehicle

[1] At PG&E discretion. PG&E will determine eligibility based on project scope and associated costs. Some exceptions may apply to customers who hold Primary Service with PG&E.
[2] Limited to 25 vehicles per site; sites with more vehicles to be considered on an individual basis.
[3] EVSE rebate amounts subject to change based upon EVSE RFQ. Rebate not to exceed 50% of charger equipment and installation costs. EVSE must meet minimum and standard requirements to be eligible for rebate.

Source: CARB

Table 3 reports on the level of charging capacity forecast needed to be installed at each depot, which is a function of both overall fleet size, vehicle types, and total number of vehicles. This forecast assumes a 40 kW DCFC charger is installed for each bus, and that each bus, including backup buses, could be charging at the same time.

Table 3. Depot Electricity Requirements

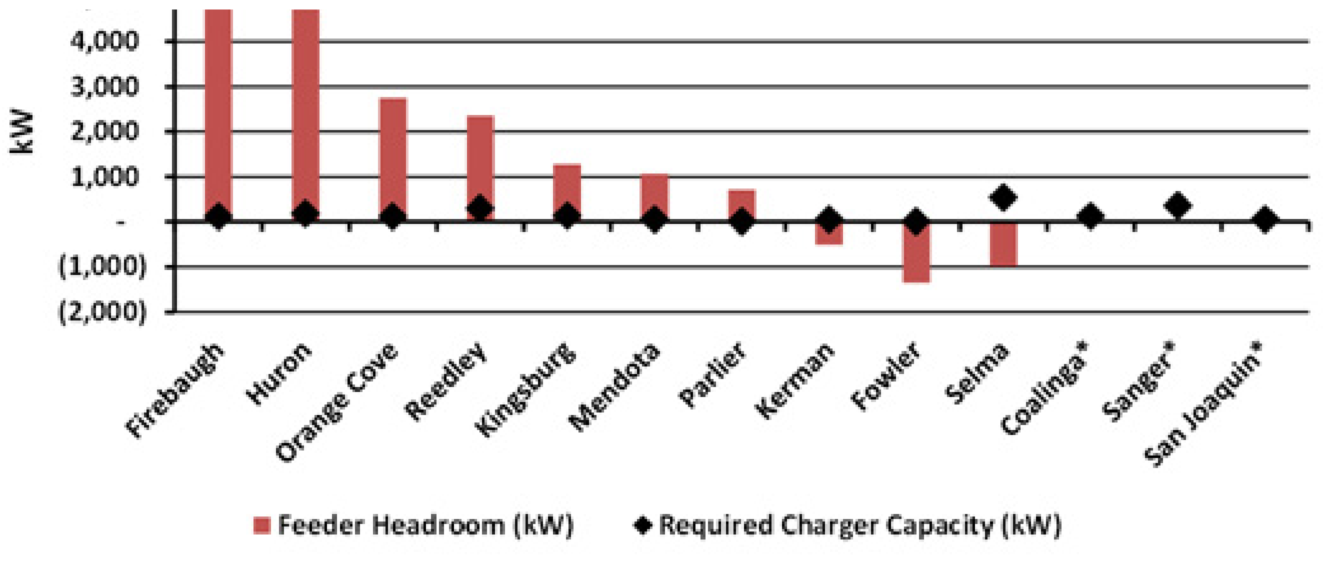
Depot	Buses	Vans	Sedans	Avg. Daily Miles per Vehicle	Avg. Daily kWhs per vehicle	Avg. Daily kWh per Depot	Total Charger Nameplate kWW
Coalinga	2	1	0	154	235	706	129.6
Firebaugh	3	0	0	127	206	619	180.0
Fowler	0	1	0	36	21	21	9.6
Huron	3	0	0	80	129	387	180.0
Kerman	1	0	0	79	128	128	60.0
Kingsburg	2	2	0	88	112	448	139.2
Mendota	1	0	0	65	106	106	60.0
Orange Cove	2	0	0	180	291	582	120.0
Parlier	0	1	0	74	44	44	9.6
Reedley	5	0	0	76	123	617	300.0
San Joaquin	1	0	0	130	210	210	60.0
Sanger	6	0	0	89	145	870	360.0
Selma	7	1	0	102	95	1327	487.2

Source: Energeia

The charger size analysis can be combined with the replacement plan analysis to estimate the grid impacts of transit electrification at the system level, which is reported below. This analysis assumes all chargers are at their maximum power at the same time, which is unlikely, but a typical assumption for electricity infrastructure planning.

Geographic information system (GIS) analysis of PG&E's feeder network allows the estimation of available capacity on each feeder that a bus depot is connected to. PG&E redacts the data of some feeders for customer privacy reasons, so the headroom of the Coalinga, San Joaquin and Sanger depot feeders are unknown. Figure 23 shows that all depots are forecast to have sufficient infrastructure to support the optimized level of charging, except for Kerman, Fowler, Selma, the planned maintenance facility location, and potentially Coalinga, San Joaquin, and Sanger.

Figure 23: Depot Feeder Capacity (PG&E Forecast)



Source: PG&E Grid Needs Assessment dataset, Energeia GIS Analysis

3.4 Electric Grid System

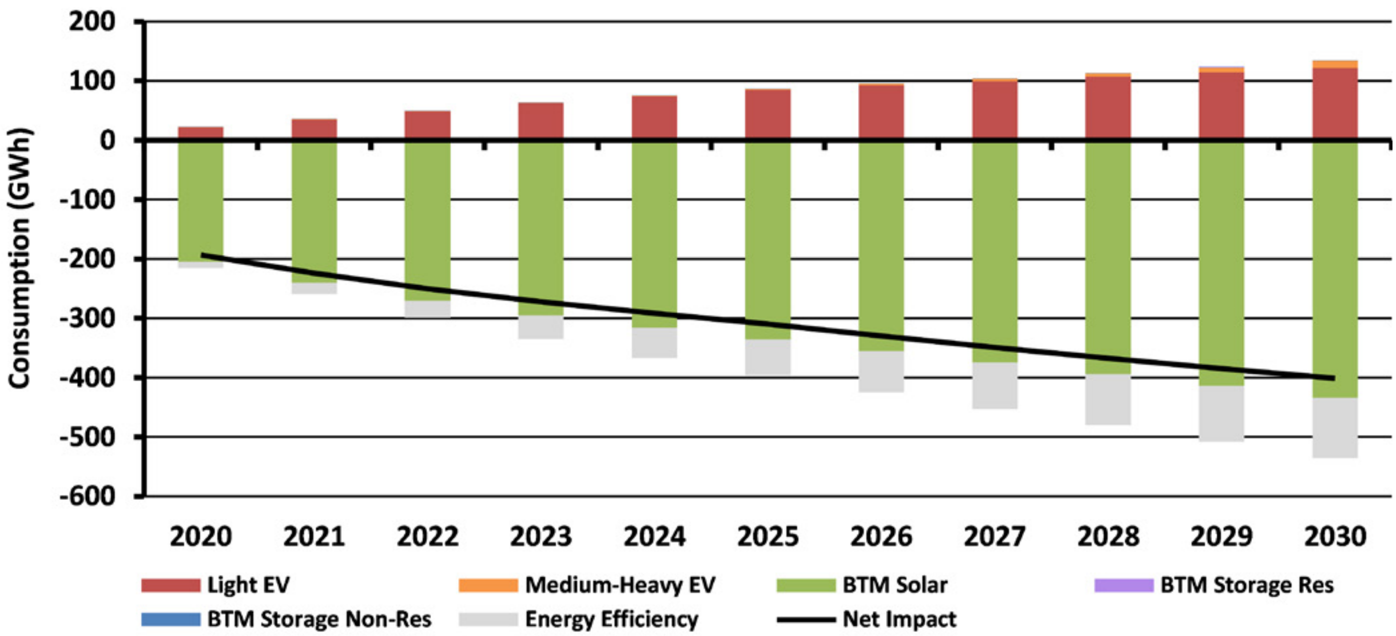
The electric grid system in Fresno was assessed in terms of recent trends, key drivers, and forecasts of electricity demand for the years 2020 through 2030. Fresno County is presently home to about 374,000 PG&E customers, projected to rise to 434,000 by 2030 if connections trend with population. Existing PG&E analysis does review near-term planning for this projected growth, and these projections have been included as inputs for the analysis performed in development of this study.

Distributed Energy Resources

DERs are defined as electricity resources behind-the-meter (BTM), which can be used to provide grid services using virtual power plant aggregation technology. Key DER includes EE, EV demand response, battery storage, rooftop solar PV and microgrids. Aside from the individual capabilities of DER, they also offer combined value to the grid and customer base. These benefits include adding energy and capacity capabilities, flexibility, and flattening the load.

The net effect of all forecast DERs on overall consumption is a reduction of about 400 GWh annually, mostly due to rooftop solar. Reductions due to solar and EE are expected to more than compensate for the new load from EVs, as illustrated in Figure 24.

Figure 24: Forecasted DER Consumption Impacts (GWh)



Source: CEC (2019), Consolidated Electrical Distributors 2019 Hourly Results – PG&E – Mid-demand Case, Energeia

PG&E forecasts[10] EE levels to grow steadily over the next 10 years, averaging 10 GWh in reduced consumption per year. PG&E forecasts BTM rooftop PV to approximately double in the next 10 years, from 110 MW presently installed to about 220 MW in 2030. Storage is expected to grow more than solar, more than tripling in the next 10 years from less than 3 MW to 10 MW in 2030.

Microgrids are an emerging technology to support resilience and grid constraints. A microgrid is a DER that can serve as a self-sufficient energy system. They are able to dynamically respond to needs of the broader energy system and can continue to provide energy during outages. They provide advantages like easing the ability to integrate renewable energy systems (e.g. solar and wind) into the larger grid and can decrease utility costs by deferring the need for transmission line upgrades.

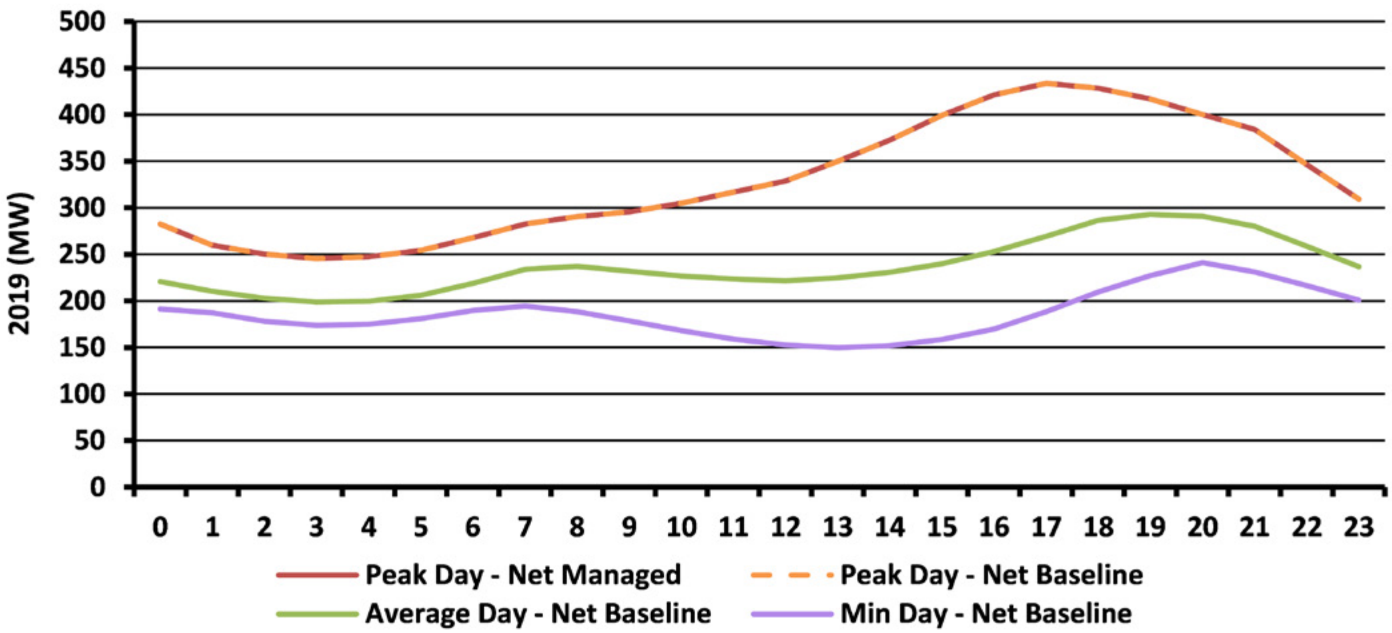
10 PG&E forecasts for Fresno County are not in the public domain. All PG&E forecasts have therefore been adjusted on a pro-rata basis using Fresno County's population.

Load Profile

Generation must balance load in real-time, and transmission and distribution (T&D) networks must be sized to meet forecast peak demand. The impact of DER, each of which has its own load profile, is impacting on the net load profile for generators and T&D networks, and understanding its evolution is key to infrastructure planning.

Figure 25 summarizes the estimated minimum, average, and peak load days for PG&E's network in rural Fresno County in 2020. The average day is relatively constant, staying between 200 and 300 MW, and peaking at 7 pm. The effects of solar are already apparent, causing a dip in the average and minimum day load shapes in particular. The peak is close to 440 MW and occurs at 5:00 p.m. on a summer day.

Figure 25: Electricity System Load Profile Average, Peak & Minimum Days (2019)

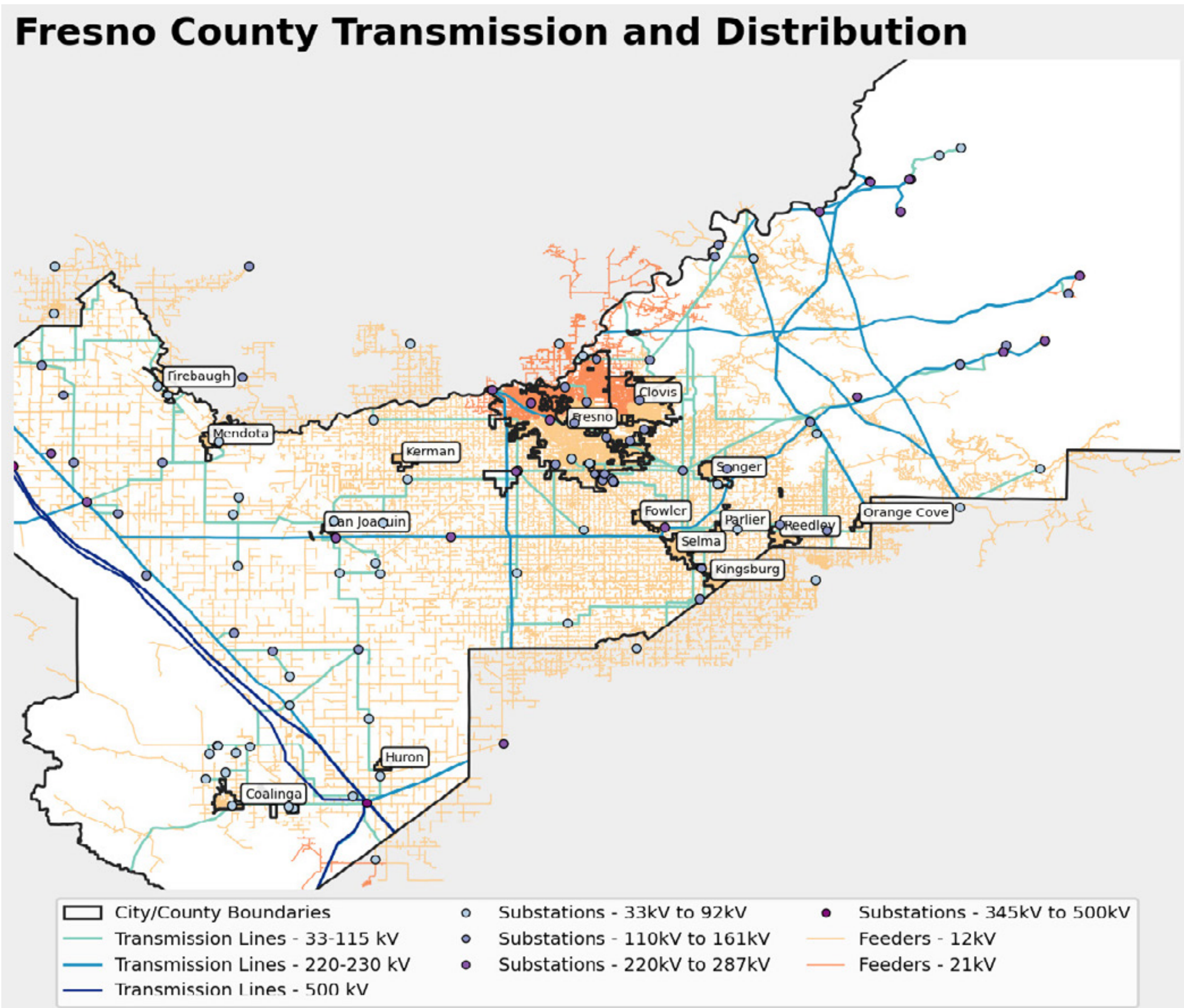


Source: CEC (2019), Consolidated Electrical Distributors (CED) 2019 Hourly Results - PG&E - Mid-demand Case, Energeia

3.5 Distribution and Transmission

There is a substantial amount of electricity transmission and distribution network infrastructure serving Fresno County. Two 500 kV transmission lines and a web of 220-230 kV lines along I-5 carry power between northern and southern California, but power is mainly transmitted to and from Fresno County via PG&E's 220 kV and 230 kV transmission network. PG&E's 33-115 kV sub-transmission network then delivers it across the county to distribution injection points. From there, the county's electricity customers are primarily served by PG&E's 12 kV feeder network, but a smaller 21 kV feeder network also serves the higher density and newer northern areas in Fresno and Clovis. These T&D networks are illustrated in the comprehensive map in Figure 26.

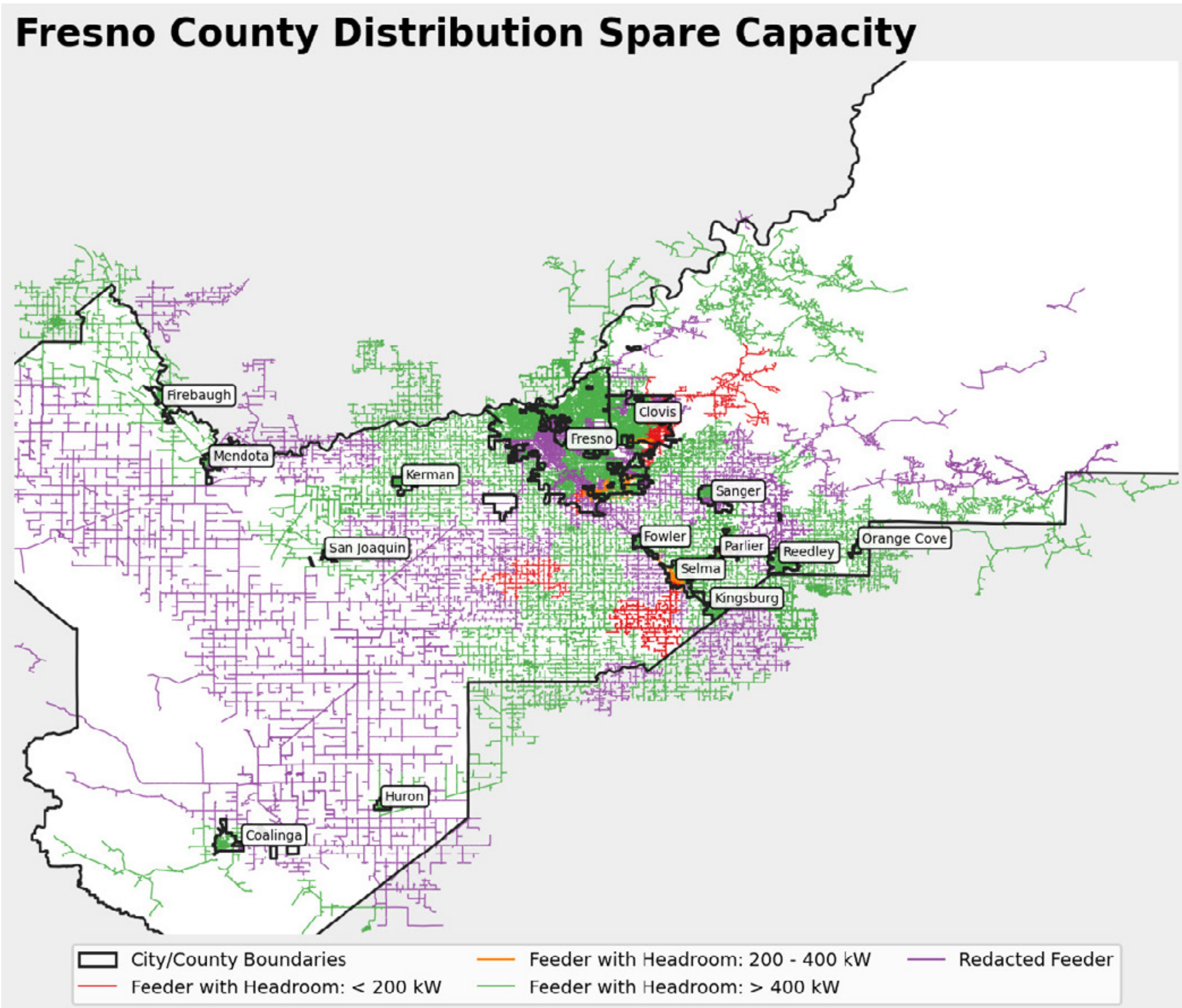
Figure 26: T&D Network by Voltage



Source: PG&E Integration Capacity Analysis dataset (2020), CEC

PG&E publishes spare capacity data for its distribution network, save for certain feeders that meet its redaction criteria (generally fewer than a certain threshold of customers, such that individual customer load may be identified). Figure 27 groups feeders by headroom and suggests that the grid generally has capacity for 3-6 bus charging upgrades in most cases, assuming 40 kW loads.

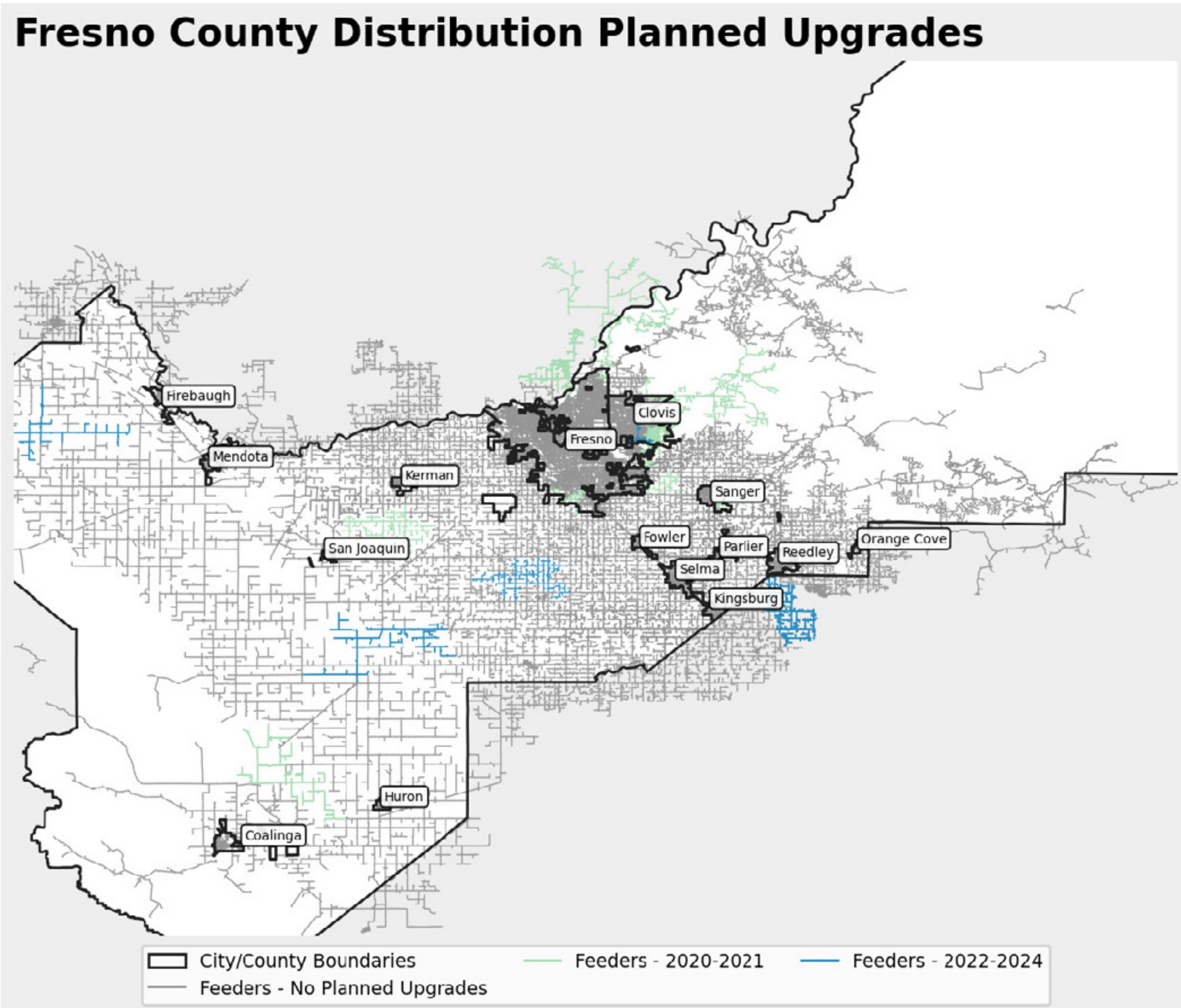
Figure 27: Fresno County Distribution Spare Capacity



Source: PG&E Grid Needs Assessment dataset, CEC

In many cases where a feeder has little headroom, PG&E is already planning to upgrade the network to accommodate for growth. Figure 28 shows PG&E's published upgrade plans, grouped by the planned upgrade year for each feeder.

Figure 28: Distribution Network Upgrade Timing



Source: 2020 PG&E Distribution Deferral Opportunity Report (DDOR) (study, CEC GIS Data (2020)

Table 4 shows PG&E's reliability indexes (System Average Interruption Duration Index [SAIDI], System Average Interruption Frequency Index [SAIFI], Momentary Average Interruption Frequency Index [MAIFI], and Customer Average Interruption Duration Index [CAIDI]), including Major Event Days (MED) from 2009 to 2018 for the Fresno division. MEDs are typically system interruptions related acts of nature. The data suggests that reliability at the customer level, reported as CAIDI improved significantly over the 2009 to 2016 period, but has started to erode since 2017. It is worth noting that the data below includes MEDs and is therefore an accurate reflection of the actual customer reliability experience.

Table 4. PG&E Reported Reliability Trends – MED Included

Year	SAIDI	SAIFI	MAIFI	CAIDI
2009	153.30	1.30	1.91	118.10
2010	175.40	1.28	1.95	137.60
2011	164.90	1.12	2.01	147.00
2012	100.10	1.07	2.36	94.00
2013	95.00	1.10	2.10	86.40
2014	81.60	1.00	1.78	81.50
2015	100.30	1.15	2.06	87.20
2016	85.10	1.13	1.98	75.50
2017	102.50	0.99	1.91	104.00
2018	113.90	1.05	1.55	108.90
2019	139.2	1.09	1.70	127.80
2020	130.3	1.21	1.46	108.10

Source: 2018 PG&E Annual Report (2019)

Table 5 shows the same reliability indexes for the 2009-2020 time period, but excluding planned outages, Independent System Operator (ISO) outages,[11] and MEDs. MED is called when the reliability for the day is higher than 3 standard deviations from the mean and is designed to exclude outlier events. It should also be noted that extreme events are continuing to occur and pose significant resilience challenges. This view is a more accurate picture of the underlying level of reliability in the PG&E distribution system as ISO outages are beyond control of the utility and MEDs occur randomly, underlying trends in core network reliability.

Table 5. PG&E Reported Reliability Trends – MED Excluded

Year	SAIDI	SAIFI	MAIFI	CAIDI
2011	109.6	0.974	1.163	112.5
2012	110.7	1.036	1.796	106.8
2013	95.8	0.969	1.523	98.9
2014	91	0.879	1.39	103.5
2015	80.7	0.787	1.585	102.5
2016	93.8	0.94	1.487	99.8
2017	97.3	0.878	1.487	110.8
2018	99.6	0.96	1.356	103.8
2019	117.7	1.009	1.269	116.6
2020	125.8	1.068	1.292	117.8

Source: 2018 PG&E Annual Report (2019)

Overall, the presented data is showing underlying reliability (CAIDI) has been varied from a low of 99.8 to a high of 117.8 since 2011, and that major events including wildfires can have a substantial impact on customer reliability. This can potentially drive customers to invest in backup power including microgrids, and supports application of resilience hubs and redundant power supplies.

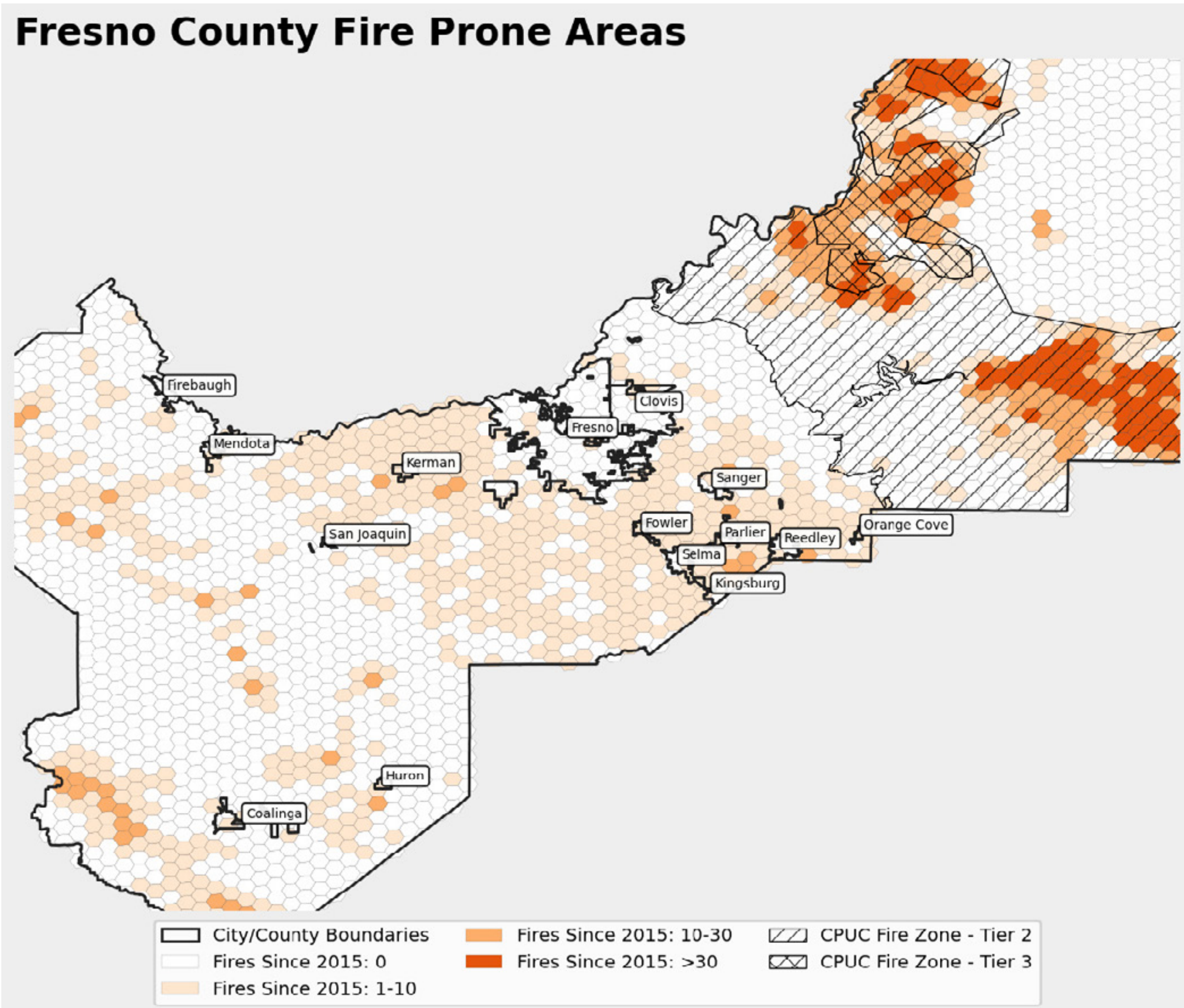
Resilience

Wildfire shutoffs are an important consideration when evaluating the resilience of the distribution network. A growing risk to safety or reliability due to wildfires could signal the need for future changes to the distribution network to better manage the risks, including greater use of microgrids. It could also signal greater adoption of microgrids and backup resources including battery storage by customers.

11 ISO outages are regularly scheduled and coordinated outages for maintenance, repair, and construction within the ISO grid to maintain system reliability.

Most historical fire activity in Fresno County is in the eastern hills, away from most bus routes and distribution infrastructure, as shown Figure 29. However, key hydroelectric generation and associated transmission assets are in high-risk areas, especially the stations to the northeast along the San Joaquin River.

Figure 29: Wildfire-Prone Areas in Fresno County



Source: CEC GIS Data (2020), U.S. Department of Agriculture Forest Service

Historical wildfire activity resulting in power shutoffs in Fresno County is not published. PG&E's resiliency plans for meeting climate driven changes to electricity network safety, security, or reliability are mostly focused on improved monitoring of Fresno County's grid, as demonstrated in Table 6. PG&E does not report on the impact these improvements will have on electricity distribution network safety, security, or reliability. This could hinder any future proposed improvements without critical information on PG&E's planned improvements.

Table 6. PG&E Wildfire Resiliency Plans for Fresno

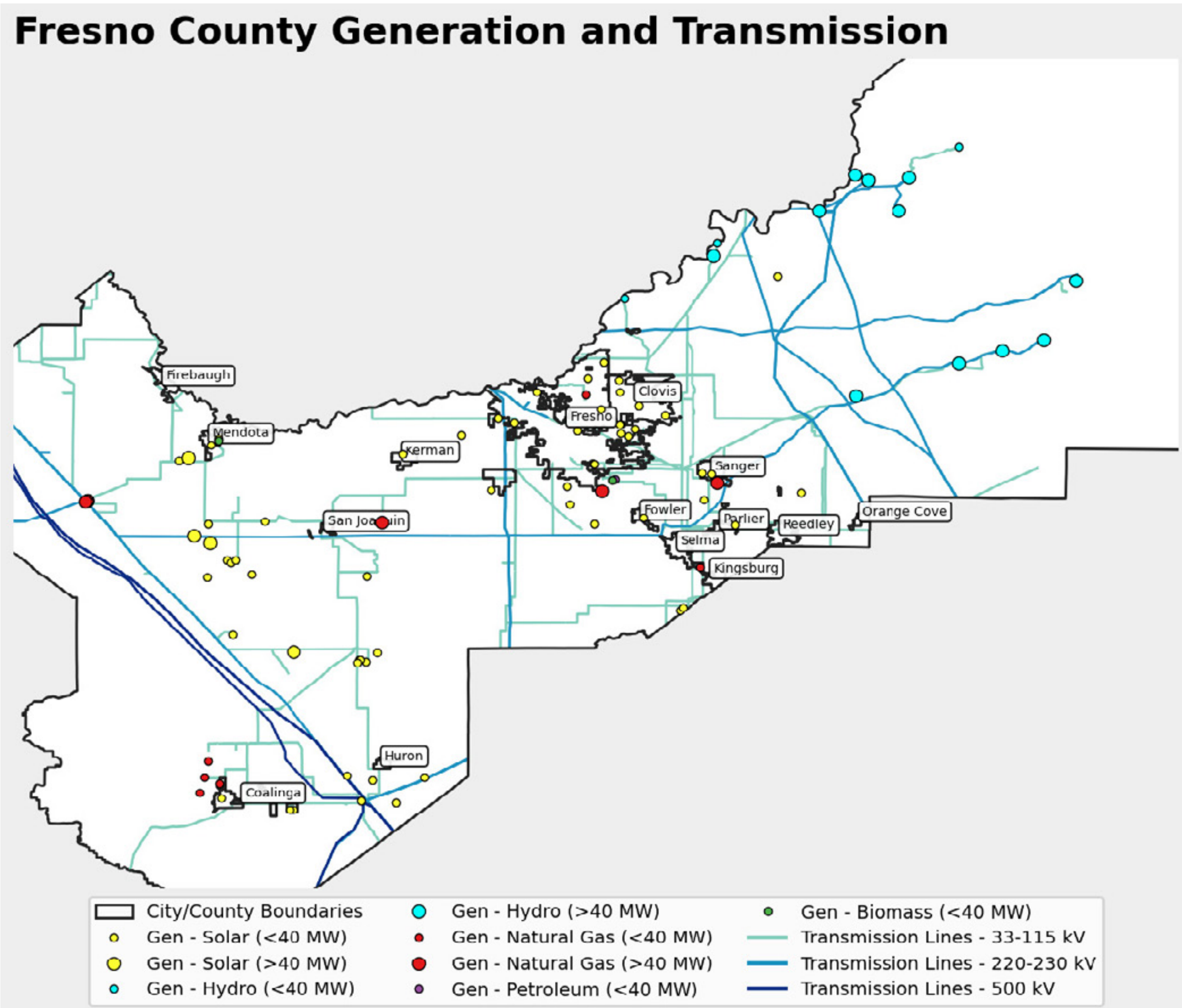
	2019	2020	
	Complete	Planned	Complete
Weather Solutions Installed*	**28** Stations	N/A	**13** Stations
High-Definition Cameras Installed*	**4** Cameras	N/A	**1** Camera
Sensationalizing Devices Installed	**2** Devices	**0** Devices	**3** Devices
Transmission Line Switches Installed	N/A	**6** Switches	**0** Locations
Substations Ready for Temporary Generation	N/A	**0** Locations	**4** Switches
System Hardening Complete	**0.4** Line Miles	**0** Line Miles	**0** Line Miles
Enhanced Vegetation Management Complete**	**6** Line Miles	**89** Line Miles	**72** Line Miles
Community Resource Centers Sites Ready***	**0** Locations	**6** Locations	**6** Locations

Source: PG&E
** New locations identified monthly*
*** Work plans subject to change due to weather, access or other schedule constraints*
**** Includes indoor and outdoor locations*

3.6 Generation

Fresno County is a net exporter of electricity, with a large number of generating units. There are 16 hydroelectric stations along the San Joaquin and Kings Rivers which generate the bulk of the county's energy, with a combined 2,448 MW capacity. An additional 13 natural gas generating units have a combined 1,056 MW of capacity. Solar takes third place, with 62 solar farms and a combined 800 MW capacity. Most solar farms are smaller than 40 MW. These generating assets are shown in Figure 30.

Figure 30: Generation and Transmission Network by Voltage

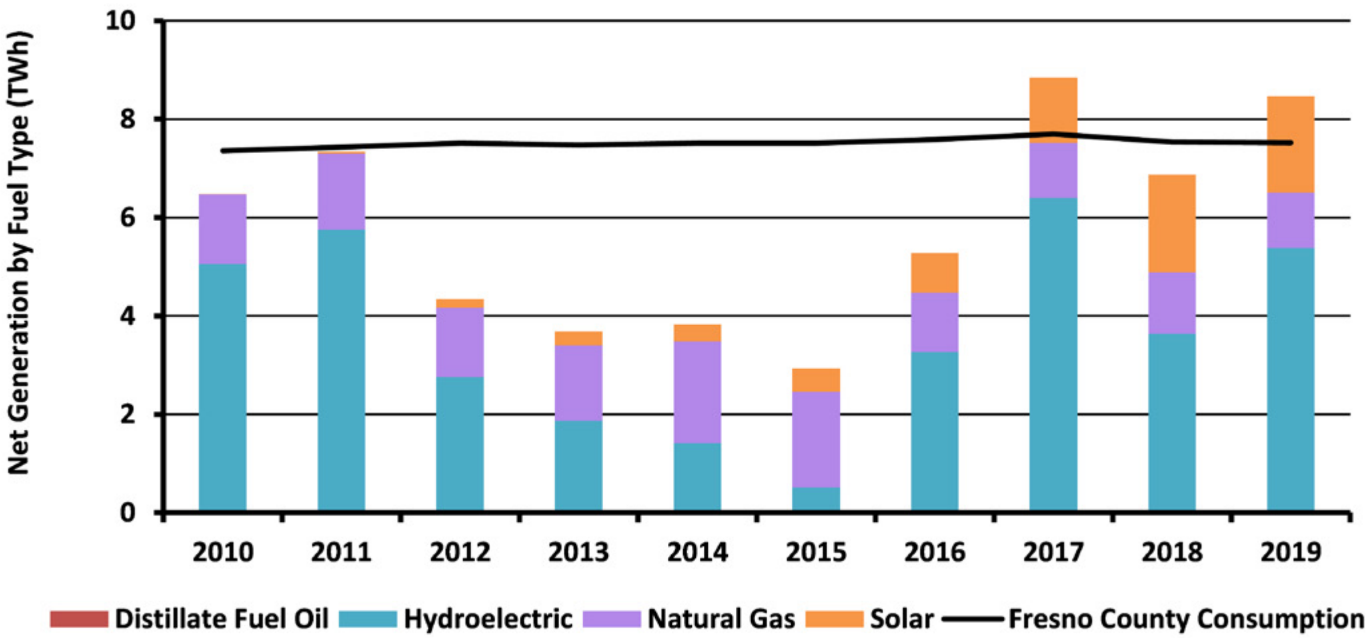


PG&E Integration Capacity Analysis dataset (2020), CEC GIS Data (2020)

Figure 31 shows the net annual generation by fuel type in each of the past 10 years. Despite a dip from 2012 to 2016, hydroelectric generation has returned as the bulk of Fresno's generation in the last four years, with solar also claiming a growing share of the county's roughly 8 TWh of annual generation. Consumption is depicted as a line, to provide context about the county's net import and export position.

\Though this study is focused on impacts to the distribution system, it was observed during analysis and community engagement that drought, especially when exacerbated by climate change, are likely to reduce hydroelectric generation production in Fresno County, increasing the importance of renewable energy sources such as solar.

Figure 31: Net Generation in Fresno County by Fuel Type



Source: US Energy Information Administration (2019)

3.7 Natural Gas System

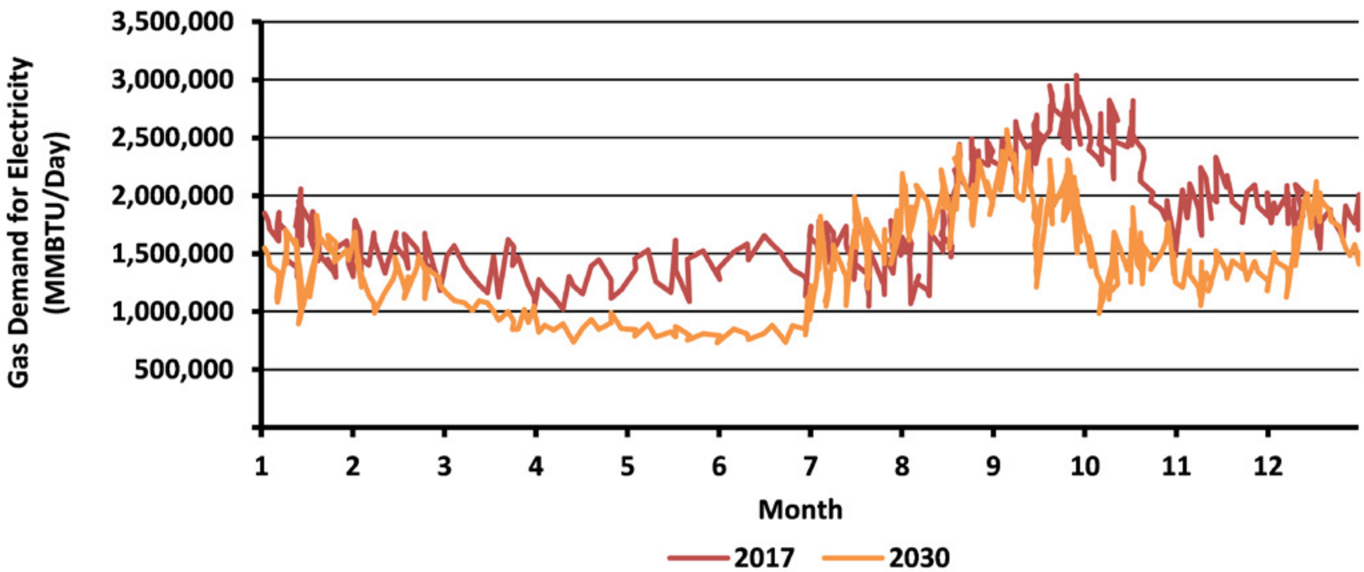
Most gas customers in Fresno County are served by PG&E's gas network, with the remainder served by Southern California Gas Company (SoCalGas). Due to differences in regulations, there is significantly less available data for the gas system than for the electricity system.

Understanding the gas system will enable the study to properly account for the potential grid effects of building electrification, as well as overall GHG emission levels as they relate to California's targets. The key issue to identify is where gas decommissioning efforts could lead to additional electricity load on crucial depot-connected feeders, potentially delaying FCRTA's own electrification efforts.

Gas consumption is expected to be relatively stable over the next 10 years, with the CEC forecasting an increase from 2020 to 2025 followed by a modest decrease from 2025 to 2030 mainly due to the impact of increased solar PV generation (summer impact) and building electrification (winter impact).

The change in the monthly gas demand profile over the next 10 years is displayed in Figure 32, which shows gas demand for electricity generation decreasing in the spring and fall compared to 2017. Gas demand from July to October could be significantly lower than the forecast below due to the impact of rising solar PV generation pushing out gas fired generation.

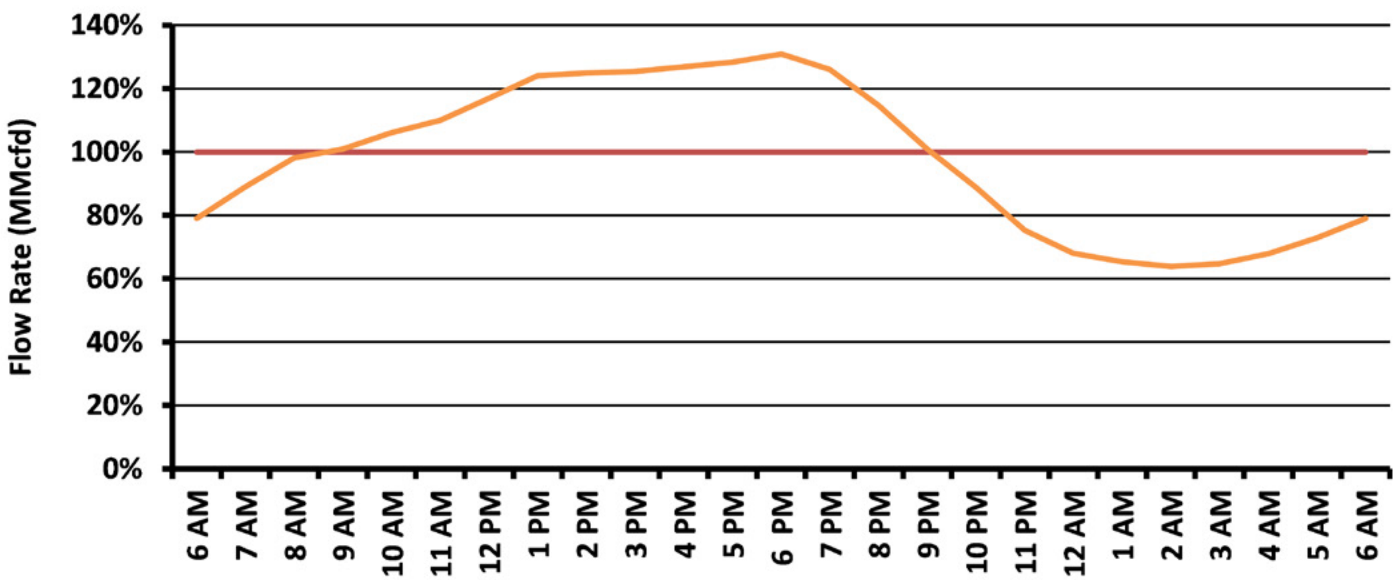
Figure 32: Past and Projected Gas Demand



Source: California Council on Science and Technology (2018)

Natural gas networks are generally designed for a flat delivery profile, and storage in facilities like Gill Ranch in Madera County (discussed in the following section) is used to match changes in demand. Figure 33 illustrates how the ratio of gas demand and constant-flowing supply fluctuates during an average day. Excess demand during working hours and the early evening is met by depleting storage, which is then restored during the lower-demand nighttime hours.

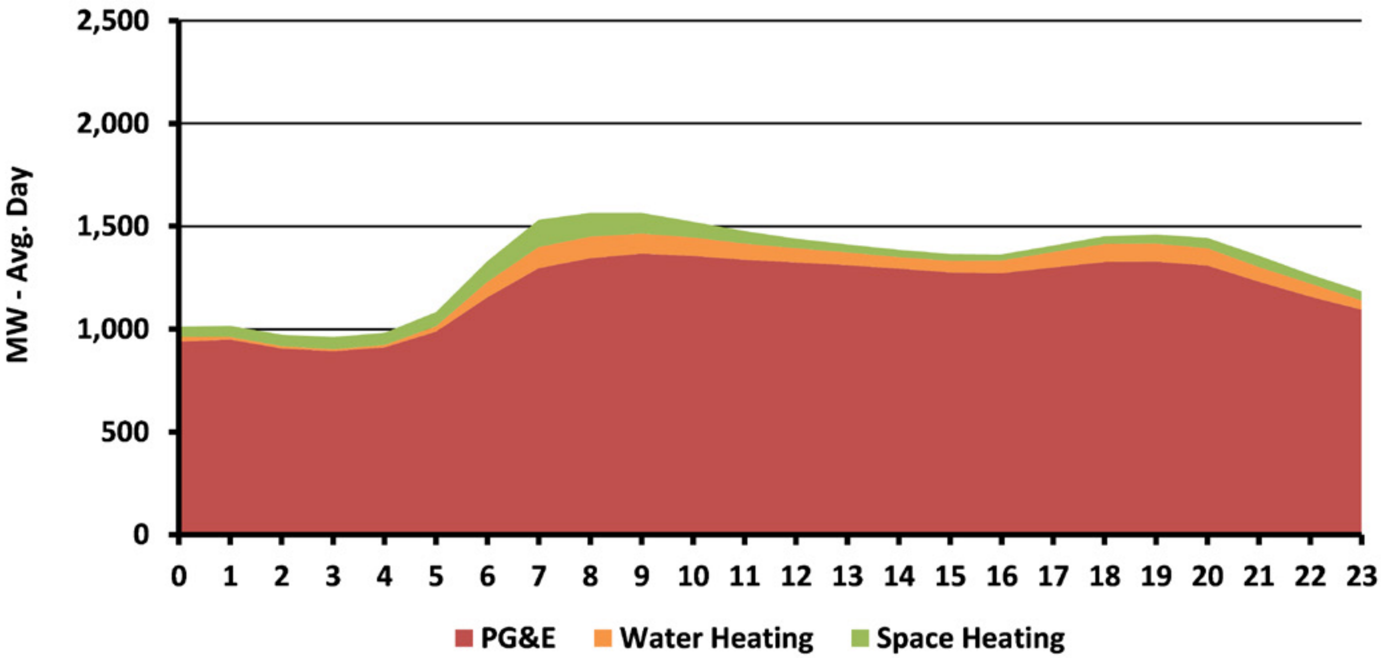
Figure 33: Capacity vs. Demand and Daily Role of Storage



Source: California Council on Science and Technology (2018)

The transition from gas to electric appliances, especially water and space heating, could add significant load to Fresno County's electric grid, particularly during the winter months. Figure 34 shows the potential[12] daily building electrification load against the peak day electricity load in 2019, indicating a change in the peak from 9:00 am to 8:00 am, and generally elevated demand levels throughout the day.

Figure 34: Peak Day Electricity Load Profile



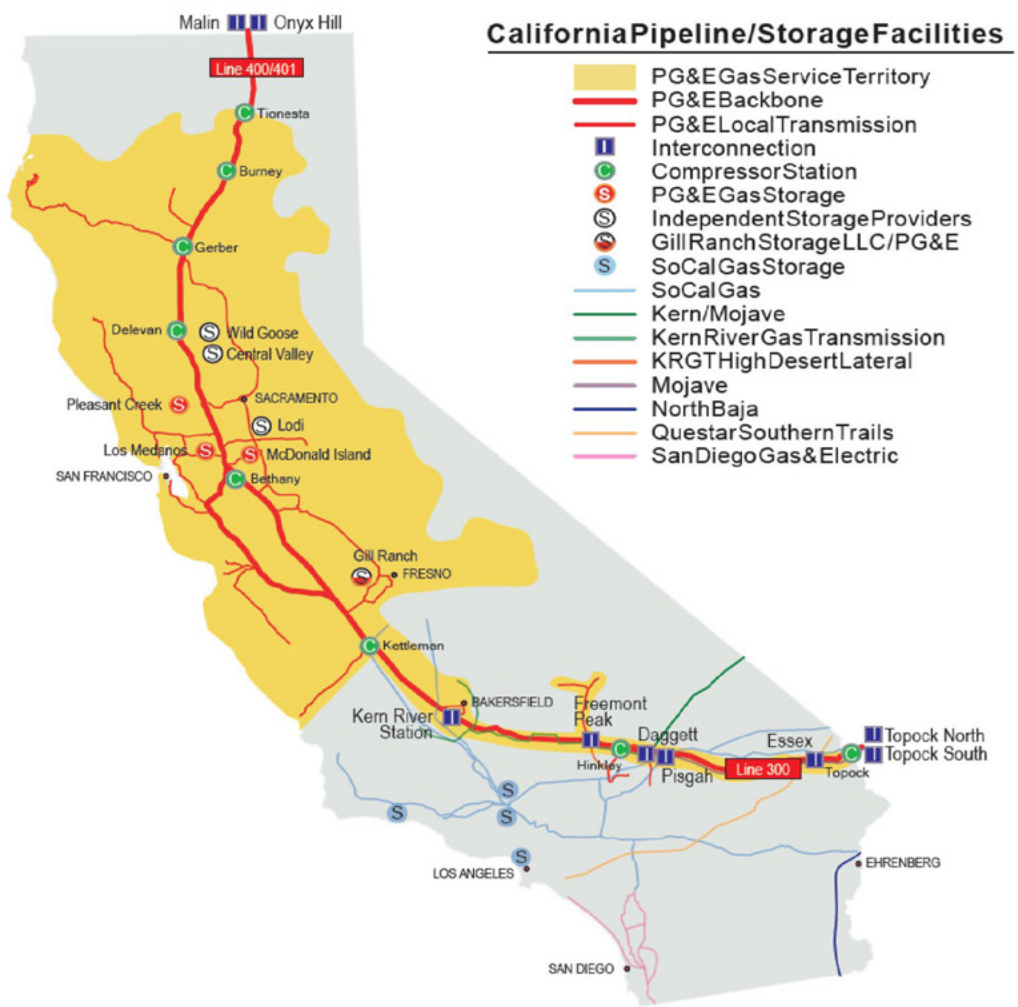
Source: CEC (2019) Fuel Substitution: An Exploratory Assessment of Electric Load Impacts, Open Energy Information (2013), Energeia Analysis

12 This analysis assumes 100% of natural gas fueled space heating and water heating demand is converted to electric heat pump technology.

Gas Distribution Infrastructure

Fresno County is served primarily by PG&E's gas transmission and distribution system. The Gill Ranch storage field, which serves much of California's central valley, is located in adjacent Madera County, just over the county line. Figure 35 puts these elements in the context of the statewide gas system.

Figure 35: Transmission System in California



Source: CPUC (2020), Natural Gas Reliability Standards

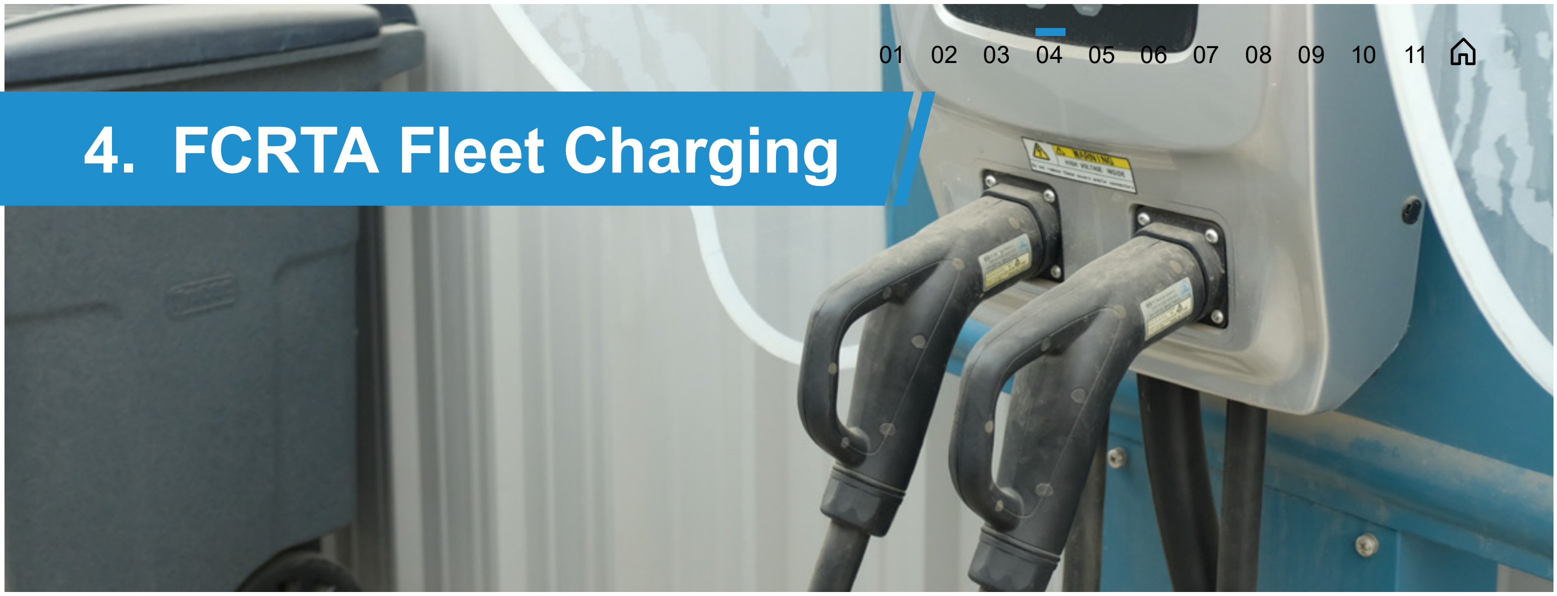
Renewable Natural Gas

Renewable natural gas refers to gas that is primarily composed of biomethane, produced from organic matter. This includes agricultural crops, wooden construction waste, manure, and other organic sources. It is a full renewable energy source and a relatively new technology. Renewable natural gas can be used in many ways and can be interchanged with natural gas to create heat for homes and other spaces. It can also be used to fuel vehicles and even generate electricity through reciprocating engines, turbines, or fuel cells.

PG&E was the first energy company in California and the third in the nation to begin to integrate renewable natural gas into its pipeline.[13] PG&E offers several tools to assist users such as a gas supply absorption capacity map to allow customers to determine whether PG&E can accept gas supply. PG&E also offers initial feasibility study capabilities for customers.

13 Interconnecting biomethane supply. PG&E's commitment to biomethane. (n.d.). https://www.pge.com/en_US/for-our-business-partners/interconnection-renewables/interconnections-renewables/biomethane.page?WT.+mc_id=Vanity_biomethane&ctx=large-business

4. FCRTA Fleet Charging

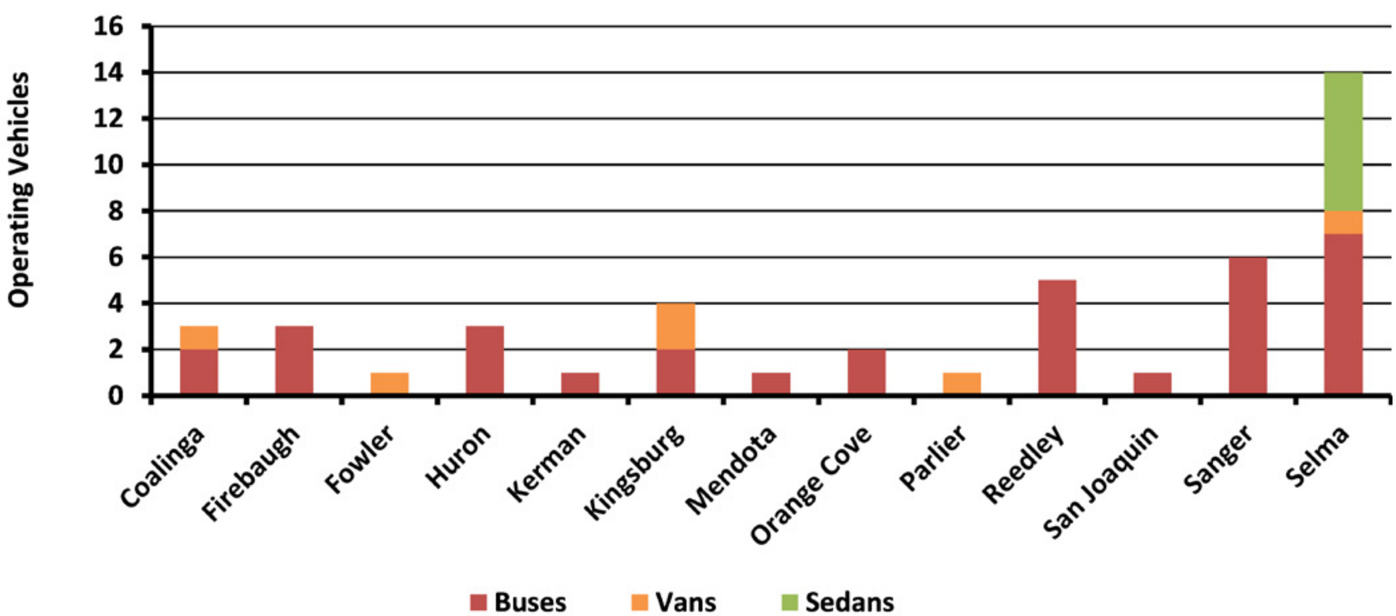


Electrification of the FCRTA fleet, including its buses, vans, and sedans, in the coming years poses new challenges in managing electric costs and understanding potential impacts on the surrounding electric grid system. This section provides an overview of fleet electrification, implications for charging cost of service, and strategies for grid impact management. This section also describes potential opportunities for partnership with other local public agency fleet charging.

4.1 Fleet Electrification Overview

FCRTA operates 33 buses across 13 bus depots spread across the county (as shown in Figure 36), with the principal depot in Selma housing 14 vehicles, most of them for maintenance. Each other depot has a handful of buses, of which at least one is used for backup in case of a breakdown to ensure a reliable transportation service under rural conditions.

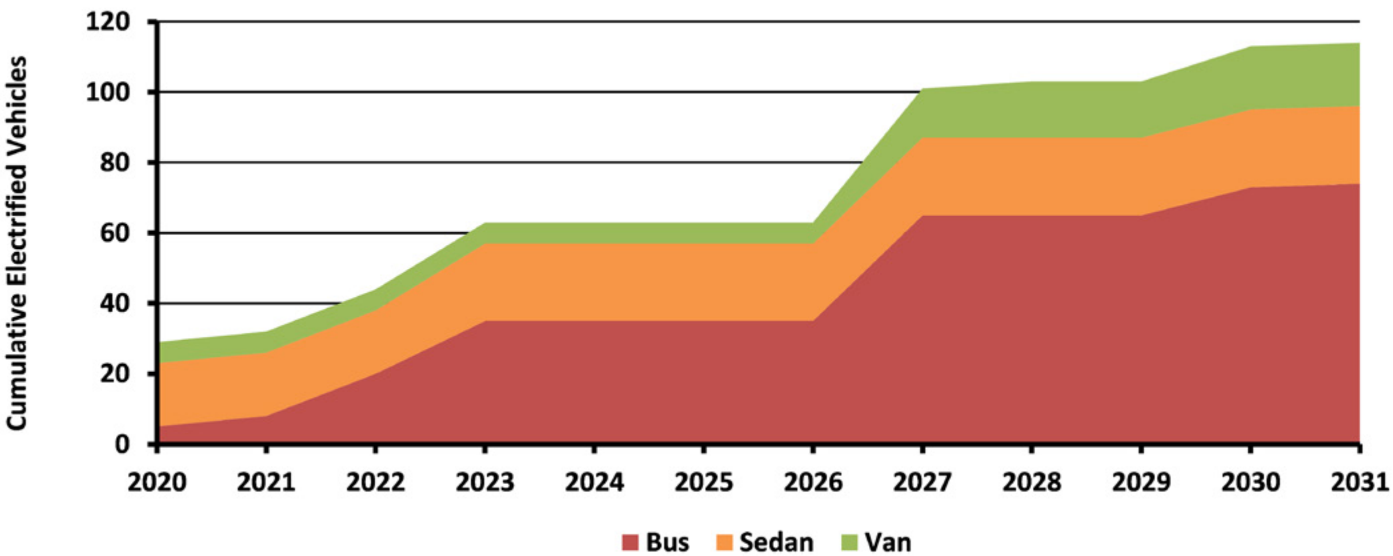
Figure 36: Bus Count by Depot



Source: FCRTA (2021), Energeia Analysis

Figure 37 summarizes FCRTA's vehicle replacement plan, showing that over 100 vehicles will be replaced in the next 10 years. There are significant spikes in bus replacements in 2023 and 2027, which will mean that depots will need to be ready by then if they are to support electrified buses.

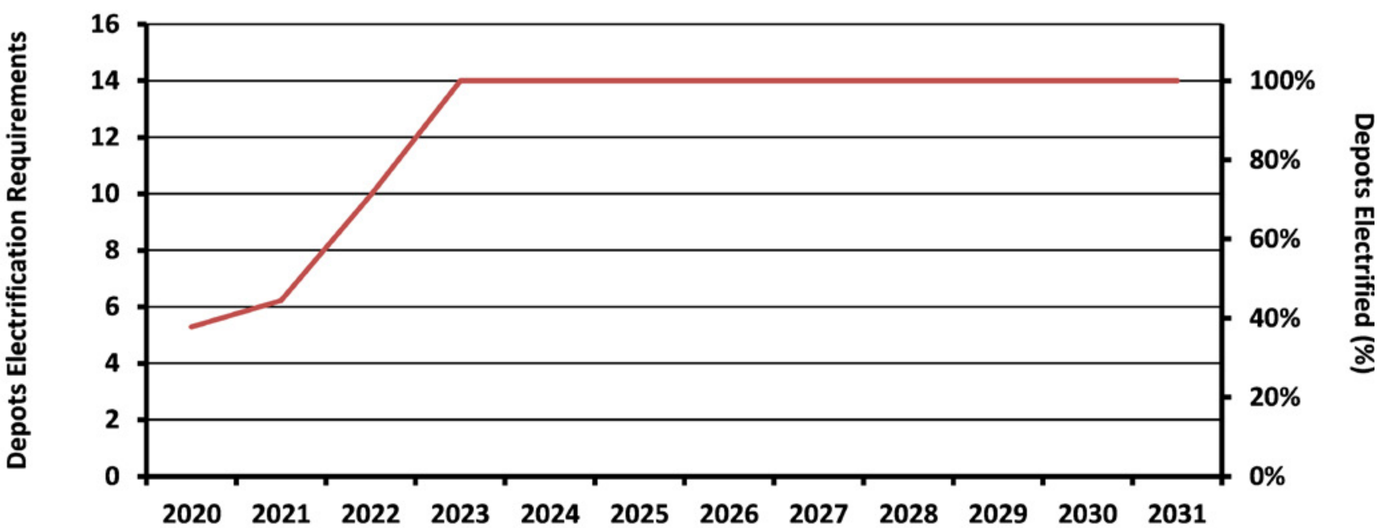
Figure 37: Forecasted Bus Electrification



Source: FCRTA (2019), Energeia Analysis

Electrifying buses requires electrified depots that are capable of providing the recharging needed each day. Figure 38 reports on the forecast rate of depot electrification needed to meet the above fleet electrification forecast, assuming that Selma is the first depot and can support the first 30 electrified buses. Excluding the main depot at Selma, the forecast assumes that the average number of buses per depot will be ready one year before the buses are electrified.

Figure 38: Forecasted Depot Electrification



Source: FCRTA (2019), Energeia Analysis

4.2 Fleet Charging Cost of Service

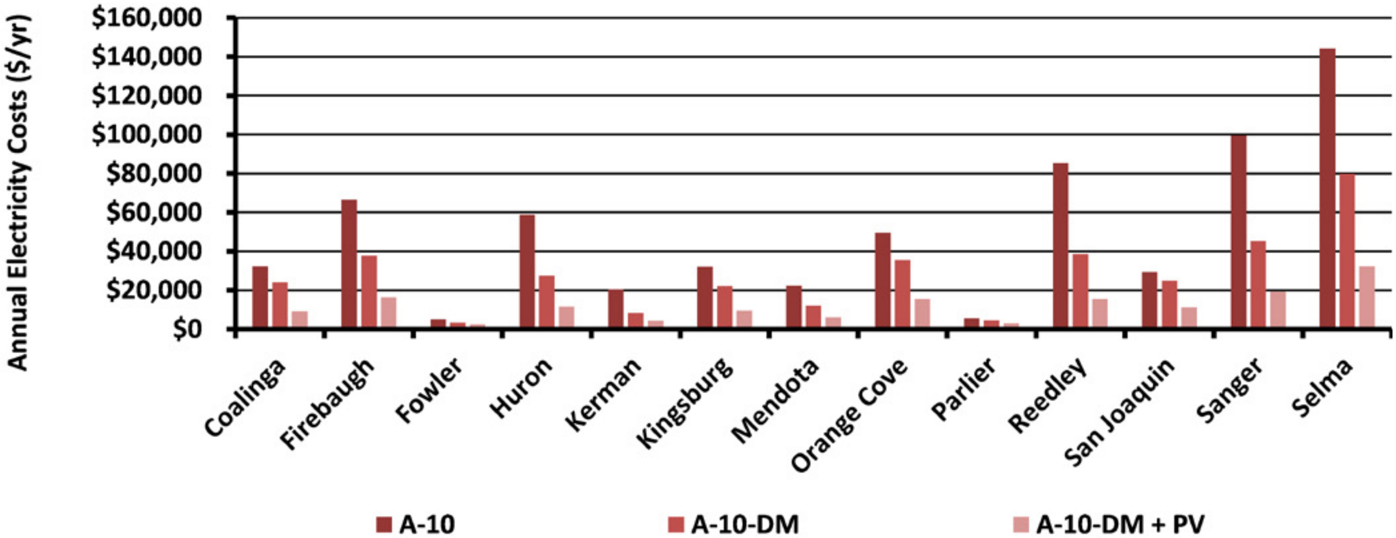
To support fleet charging electric cost management, existing PG&E rates, demand management, and solar PV opportunity for depot sites was analyzed to determine electric utility costs.

Figure 39 shows the annual cost of a fully electric fleet using the current PG&E standard commercial rate under three scenarios:

- A-10: No demand management or PV
- A-10-DM: Demand management with no PV
- A-10-DM + PV: Demand management and PV

Though the smaller depots, such as Fowler and Parlier, do not tend to benefit from demand management or PV, the larger depots can see significant savings due to reduced demand and peak-period energy charges. Note that the capital cost of PV is excluded here.

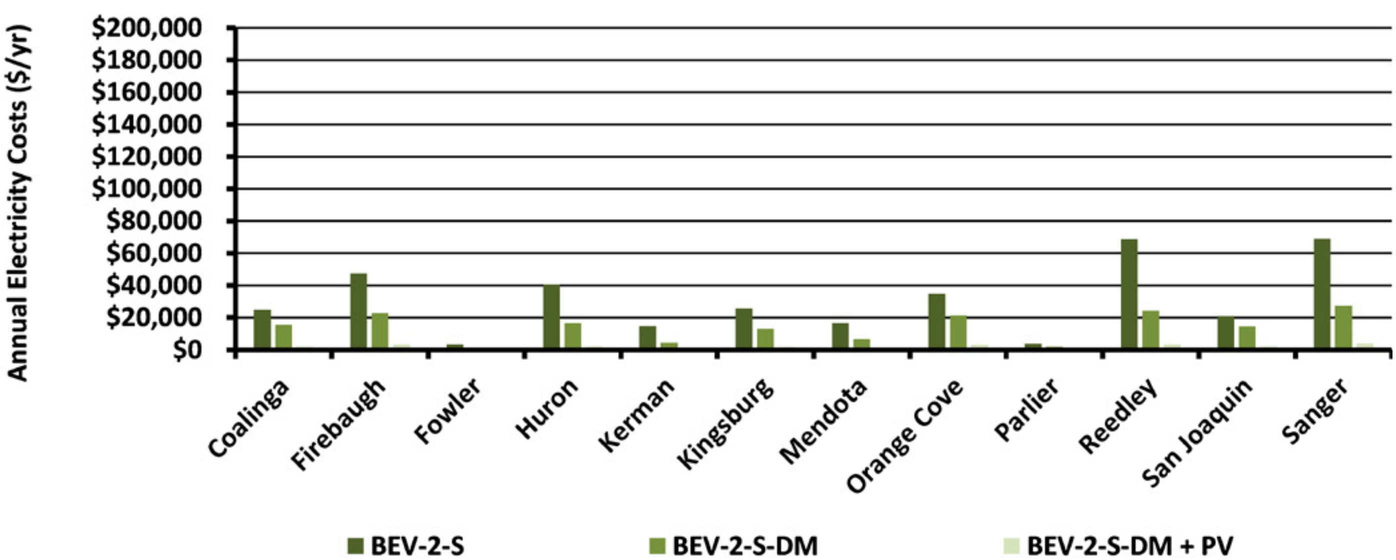
Figure 39: Commercial Rate Comparison



Source: FCRTA Request for Information, Energeia Analysis

The team also considered the same scenarios under PG&E's Electric Vehicle Fleet Rate (BEV-2), which includes a secondary connection for vehicle charging. The modeling results in Figure 40 show that BEV-2 offers a significant annual cost reduction for the two scenarios without PV but results with PV are similar.

Figure 40: Electric Vehicle Fleet Rate Comparison



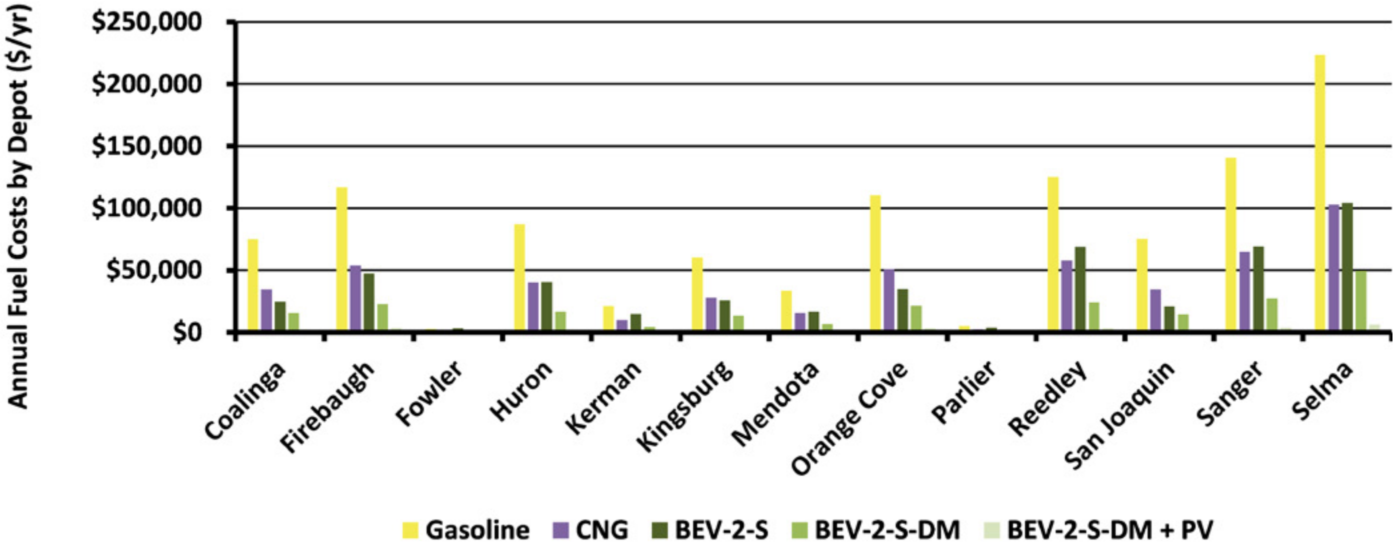
Source: FCRTA Request for Information, Energeia Analysis

4.3 Fleet Charging Grid Impacts and Management

This section covers a comparison of fuel types across FCRTA's different modes of transport, including the hypothetical cost of electricity for electric buses under the different BEV-2 scenarios discussed in the previous section.

The first figure below (Figure 41) compares the costs on an annual, per-depot basis, showing gasoline to be by far the most expensive, but also illustrating that the low cost of compressed natural gas (CNG) is competitive with PG&E's EV rate in the absence of demand management and PV. However, the implementation of demand management and PV solutions could dramatically reduce FCRTA's annual refueling costs. Also, CNG is not considered to be zero emissions per the CARB regulations.

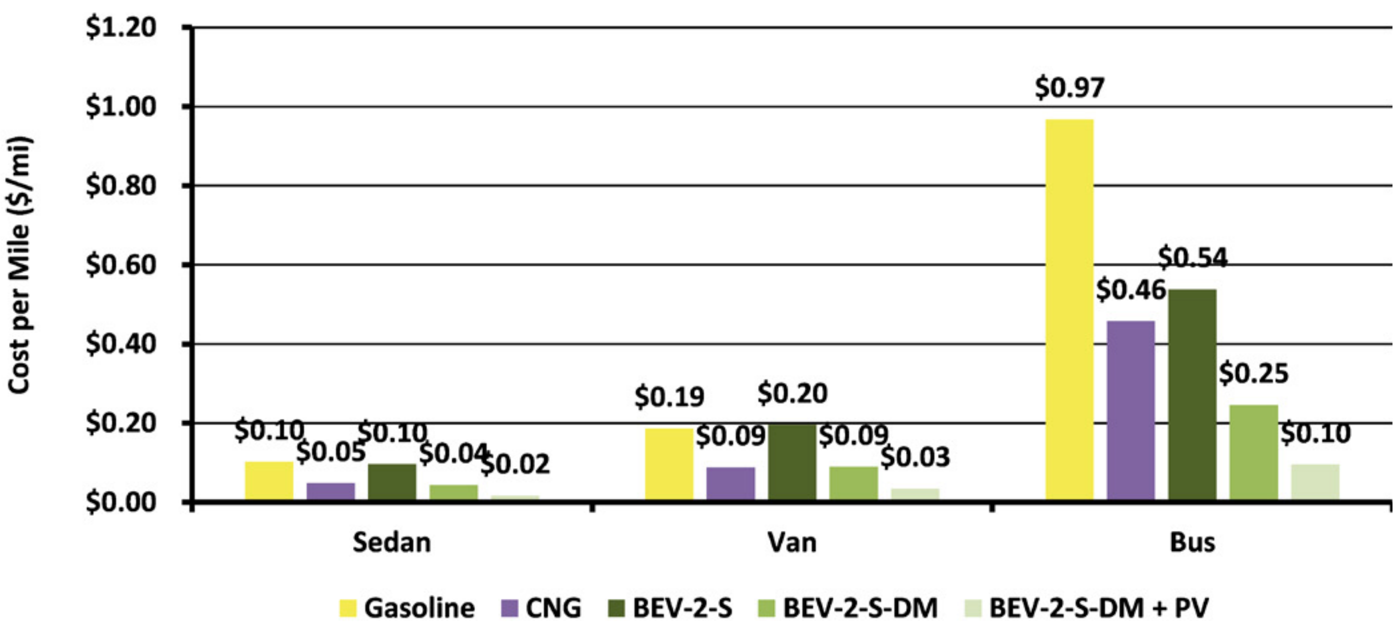
Figure 41: Annual Fuel Costs by Depot



Source: FCRTA Request for Information, Energeia Analysis

The next view in Figure 42 illustrates the same cost comparison on a per-mile basis, comparing across FCRTA's three modes of transport, assuming volume-weighted average characteristics across depots. The per-unit costs are consistent with the annual costs, highlighting CNG as the most competitive fossil fuel, but still more expensive than electricity with DER. Notably, PG&E's BEV-2 rate delivers a lower cost-per-kWh effective rate for higher-utilization applications, such as buses.

Figure 42: Costs per Mile



Source: FCRTA Request for Information, Energeia Analysis

4.4 Shared Charging Need and Findings

The installation of chargers by FCTRA presents an opportunity to share charging infrastructure resources with other public agencies in rural Fresno County. The following section provides an overview findings from outreach conducted as a part of this study as well as some considerations in sharing charging infrastructure.

4.4.1 Public Agency Access to Charging

In March of 2021, an EV Fleet Survey was conducted over the rural Fresno area where 11 municipal entities, 14 school districts, and 2 transit agencies were surveyed. From the responses it was noted that 145 EVs were owned by all organizations collectively with plans for additional EV acquisitions in the next 2 years. Of the 27 entities that responded, 15 responded "Yes" or "Possibly" for their interest in charging at FCRTA sites as referenced in Table 7 below. Sharing FCRTA charging infrastructure with these entities can have a ripple effect in encouraging agencies and schools to expand their EV fleets, knowing they will have the support of additional charging stations to supplement their needs. Shared charging can also allow more flexibility in the fleet charging schedule, which can optimize the time a vehicle spends charging and reduce dwell time.

Table 7. Current EV Fleet and Future Purchases by Entities Interested in Using FCRTA Charging Infrastructure

Current EV Fleet and Future Purchases by Entities Interested in Using FCRTA Charging Infrastructure

	Passenger Vehicles		Busses		Med-Heavy-Duty		Other	
	Current Fleet	Future Purchases	Current Fleet	Future Purchases	Current Fleet	Future Purchases	Current Fleet	Future Purchases
Municipalities	27	15	0	1	0	3	12	2
Schools	6	4	2	18	0	0	44	7
Transit	1	2	0	1	0	0	0	0
Total	34	21	2	20	0	3	56	9

Shared Charging Infrastructure Considerations

To understand the capability of chargers to be shared, a general overview of different charging technologies must be provided. Plug-in charging stations are the most common charger types and physically connect to the vehicle via a connector. For passenger vehicles, charging power varies between 3.3-7.2kW for Level 2 alternating current (AC) charger and can get up to 150kW using DCFC. For buses, charging power varies between 40-150kW for either AC or DC chargers. Recharging times range from as little as 20 minutes to over 8 hours for passenger vehicles and 1 to 8 hours for buses, with higher power chargers taking the shortest time. Due to the long charging times, plug-in chargers are commonly used for overnight charging but DCFC can be used for rapid charging for light duty vehicles at public locations.

Not every light duty vehicle is capable of utilizing the same DCFC infrastructure due to the connector type of the vehicle. There are four common connectors for vehicles sold in the U.S.:

- J1772: Also known as the universal connector, this is the most common connector type of Level 1 and Level 2 charging and used by all vehicle manufacturers with the exception of Tesla.
- J1772 Combo: A similar plug type as the J1772 but it enables to vehicle to charge with DCFC.
- CHAdeMO: A DCFC connector type used by some vehicle manufacturers, including Nissan Mitsubishi.
- Tesla Combo: A connector used solely for Tesla vehicles that allows for Level 1, Level 2, and DCFC charging

It should be noted that adaptors are widely available for every plug type to be compatible with the vehicle's connector type; however, connectors dedicated for Level 1 or Level 2 charging are unable to use DCFC. Thus, any vehicle capable of DCFC can use any charger with the appropriate connector adapter types.

Differences also exist with the maximum charging power able to be used by each vehicle. The vehicle can still charge at the respective station but may be unable to fully utilize the charger's capacity. For example, a vehicle limited to 50kW can still use a 100kW charging station, but half of the available power is underutilized. This can lead to inefficiencies if a shared high-power charger is plugged into a vehicle that is unable to fully use the power available over a vehicle that could fully utilize the power.

Other charging options include conductive charging and inductive charging, which are primarily applicable for mainly medium and heavy-duty vehicle types. Conductive charging, also known as overhead catenary charging, transmits DC electricity through an overhead plate to plate connection. These chargers potentially allow on-route or layover charging and thus allow smaller batteries capacities or can be placed at the depot charging. Charging power varies between 175-500kW and has a recharge time of 5 to 20 minutes. Manufactures are beginning to develop charging stations that are compatible for both plug-in and overhead charging applications. The main barrier is ensuring the vehicle is compatible for overhead charging. While cross compatibility is limited, many bus manufactures, such as Proterra, offer vehicles that are equipped with plug-in ports and overhead bars to allow both charging options. It is expected this cross-compatibility trend will continue with medium and heavy-duty vehicles; however, light duty vehicles will likely not utilize conductive charging.

Inductive charging is a more novel technology that provides wireless charging through plates in the roadway or parking area which transfers electricity to a plate on the bus. Charging can be both AC and DC with power ratings between 5 and 500kW, correlating to 5 minutes to 8-hour recharge times. This charging technology is especially applicable to public transit modes due to their fixed route nature. Charger inefficiency and the high infrastructure costs are the main limiting factors for this technology currently. Vehicles only outfitted with plug-in chargers are incompatible with wireless charging.

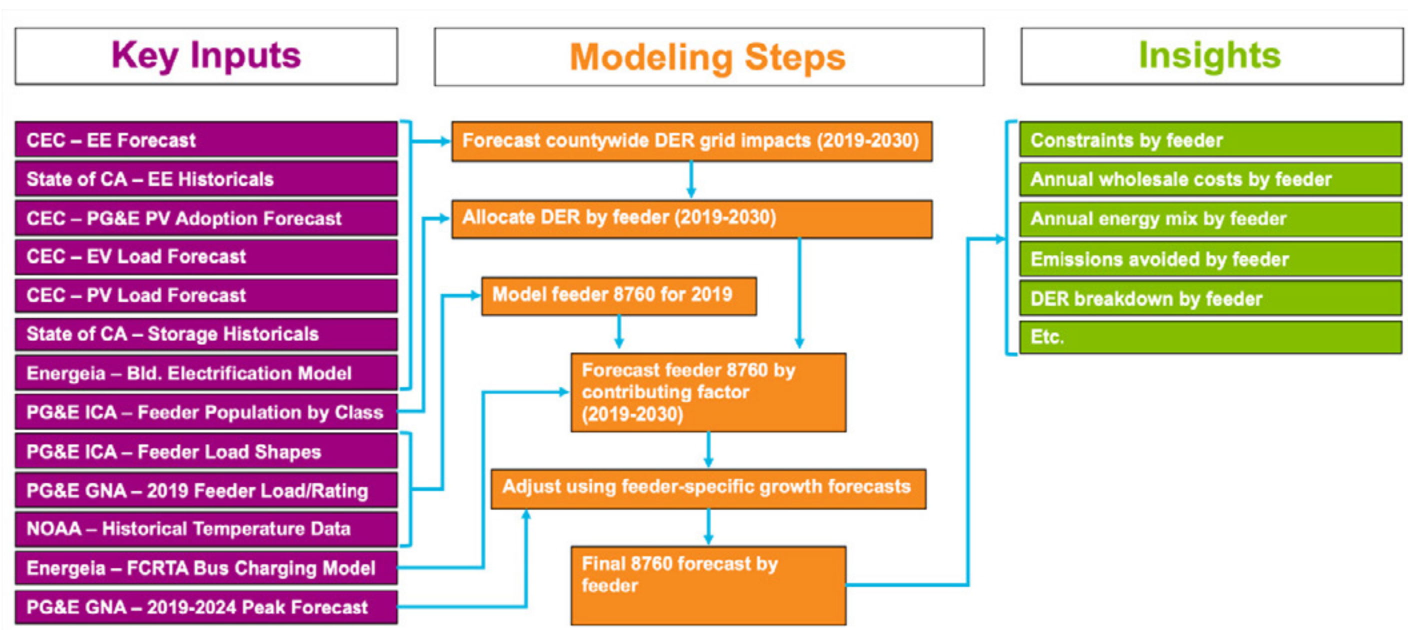
5. Rural Fresno County Grid Assessment

To understand overall impacts of FCRTA fleet electrification on the rural electric grid system in the context of a changing energy system, future impacts of including energy efficiency, EV adoption, building electrification were modeled and then compared to forecasted fleet charging needs. The following section details the modeling methodology and key results. Detailed results for feeders serving specific rural cities or unincorporated communities are provided in Section 8.

5.1 Feeder Analysis and Forecasting

The feeder load and constraint forecasting modelling approach used in this study is summarized in Figure 43, which shows the key inputs flowing into each of the modelling steps, and the sequencing of those step, and the key insights generated from modelling outputs.

Figure 43: Methodology Overview



Source: Energeia

This constraint forecasting model draws from a broad spectrum of definitive public domain information and data sources, including the CEC, State of California (State), PG&E, and the National Oceanic and Atmospheric Administration (NOAA). These inputs are detailed in the left column of the diagram in Figure 43.

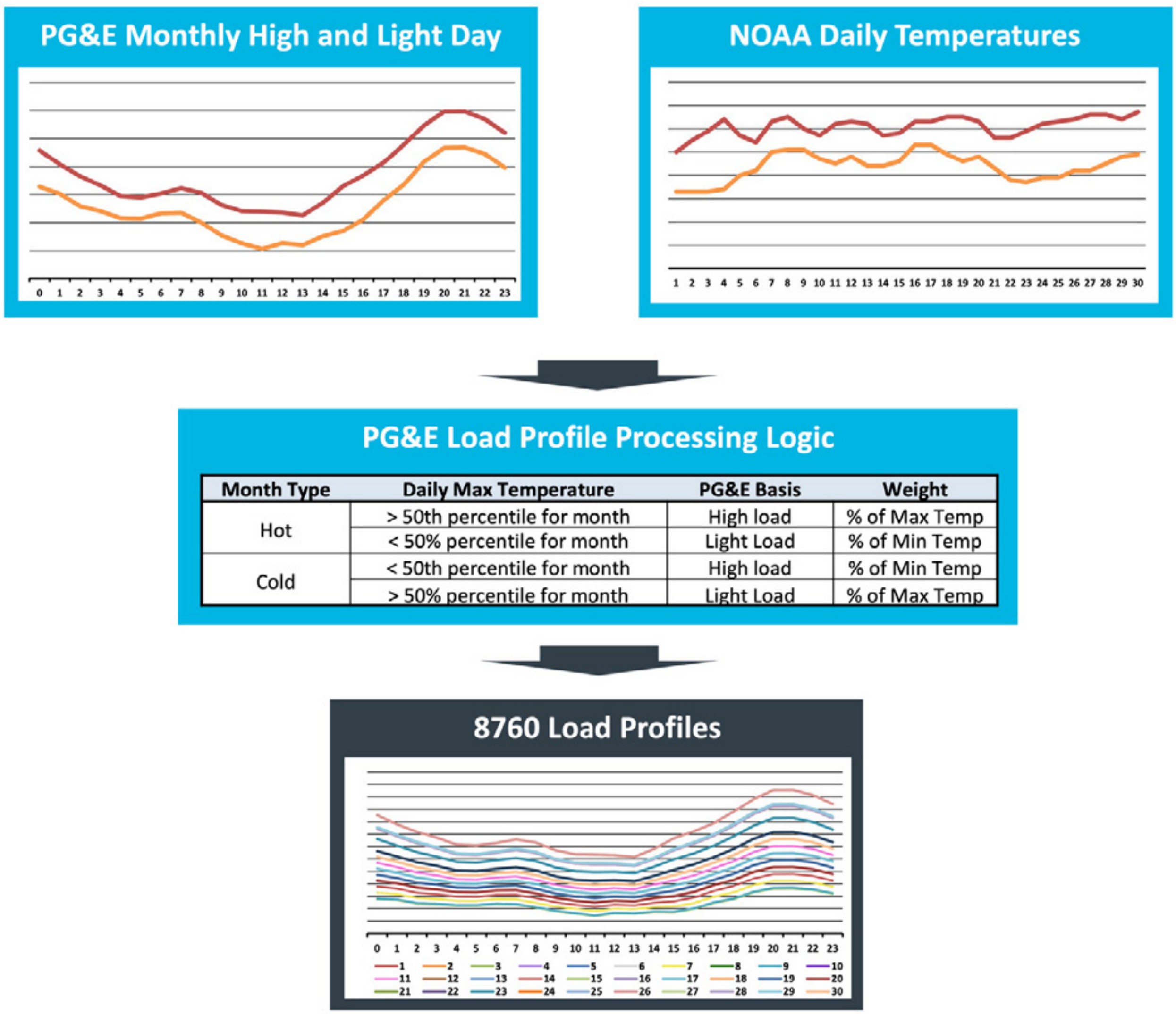
The following sections detail each of the key modelling methodologies used in the feeder model.

5.1.1 Estimating Feeder 8760 Profiles

The diagram in Figure 44 details the modeling approach for developing full-year hourly feeder load profiles (i.e., feeder 8760 profile) based on limited publicly available load shape data. PG&E feeder load profiles are available to the public as two 24-hour loads per month: one for a characteristic high-load day, and one for a characteristic low-load day.

The project team then used NOAA daily temperature data for the Fresno Yosemite Airport in 2019 to drive high and low day relativities across the month. The hottest day in July, for example, would be assigned the feeder's peak demand level, and the coolest day in July would be assigned the low day shape. In cooler months where load is more driven by heating loads, the coldest day would be assigned the high day shape, and the warmest the low day shape.

Figure 44: Feeder Load Profile Estimation Methodology Diagram



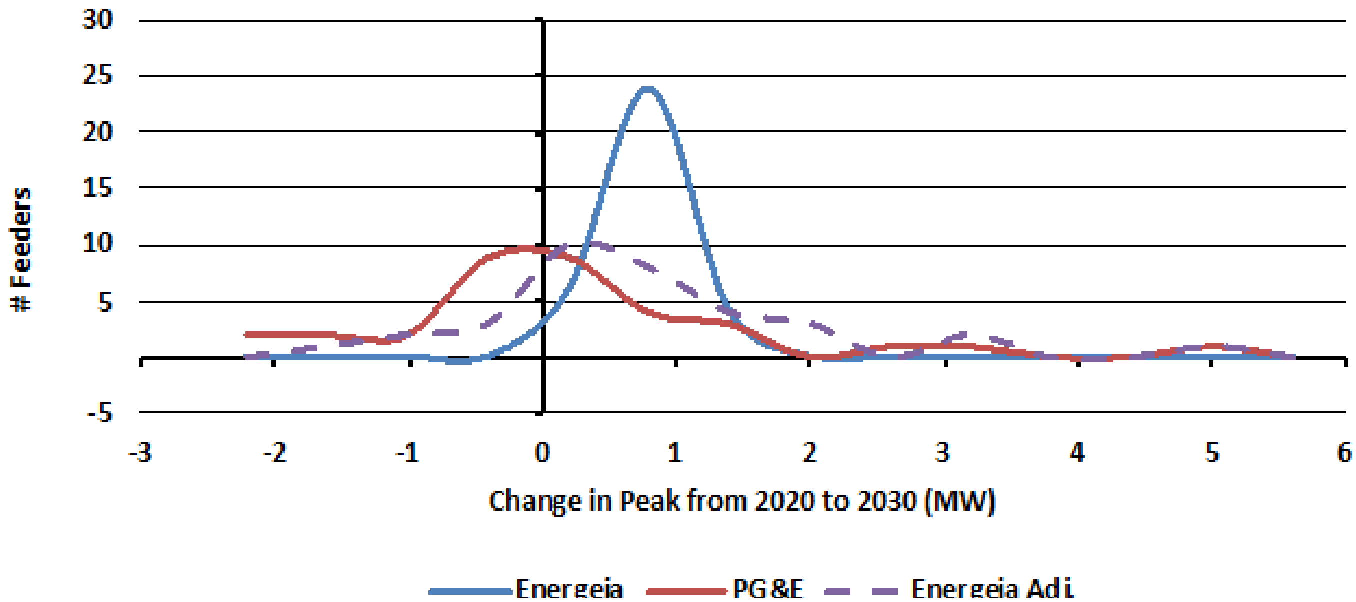
Source: Energeia

Following estimation of each feeder's 8760 profile, the study team then estimated feeder peak demand to 2030.

5.1.2 Forecasting Feeder Peak Demand

The feeder peak demand forecast is based primarily on CEC energy and DER forecasts, which are assigned to Fresno County's distribution network in proportion to the number of residential, commercial, and industrial customers served by each feeder. This results in a tidy normal distribution, as shown in blue in Figure 45. The peak of the shape shows that the median feeder in Fresno County will see a peak demand increase of 0.8 MW from 2020 to 2030.

Figure 45: Feeder Peak Demand Growth Distributions (Kernel View)



Source: PG&E Grid Needs Assessment forecast (2019), Energeia modeling

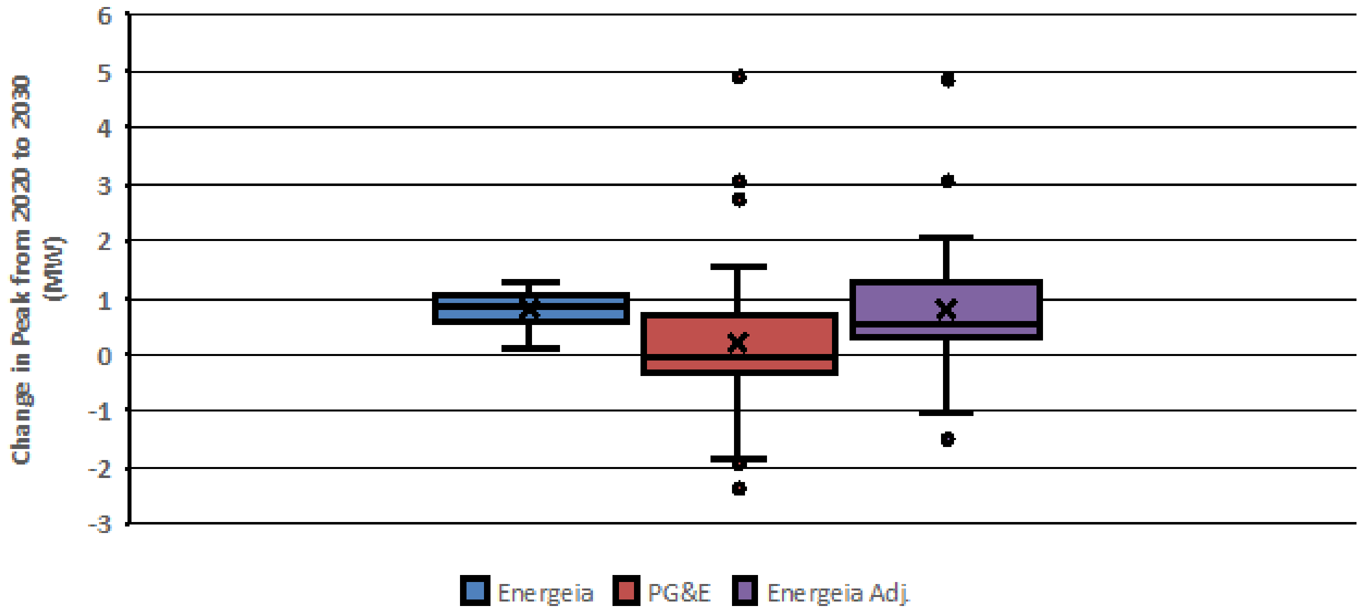
Applying these top-down, PG&E system-wide figures from the CEC to individual feeder forecasts may produce accurate results on average, but there may be a significant margin of error when feeders are considered individually. To correct for this, the team has incorporated PG&E's Grid Needs Assessment[14] (GNA) forecast.

A 6-year linear extrapolation of the PG&E 4-year distribution is included in Figure 45 as a red line. To incorporate these feeder-level characteristics, we determine the peak demand target for each feeder by shifting the PG&E distribution uniformly, so that it has a mean of 0.8 MW, the correct top-level value. This resulting distribution is shown as a dotted purple line in Figure 45.

The 'box and whiskers' chart in Figure 46 illustrates an alternate view of the feeder peak growth distributions, clarifying that the Energeia and Energeia Adjusted (Energeia Adj.) distributions share the same mean, while the PG&E and Energeia Adj. distributions share (essentially) the same range. The adjusted distribution is intended to be the best of both worlds – it includes the feeder-specific data of the GNA study, as well as the best-practice DER modeling of the top-down approach.

14 PG&E's GNA study is based on non-public, feeder-specific data through 2024.

Figure 46: Feeder Growth Distributions (Box View)



Source: PG&E GNA forecast (2019), Energeia modeling

5.2 Grid 5-10 Year Connection Barriers

This section presents the results of the grid study, including forecasted peak demand for each feeder, optimal DER sizing for each depot, and detailed case studies for each forecasted grid constraint.

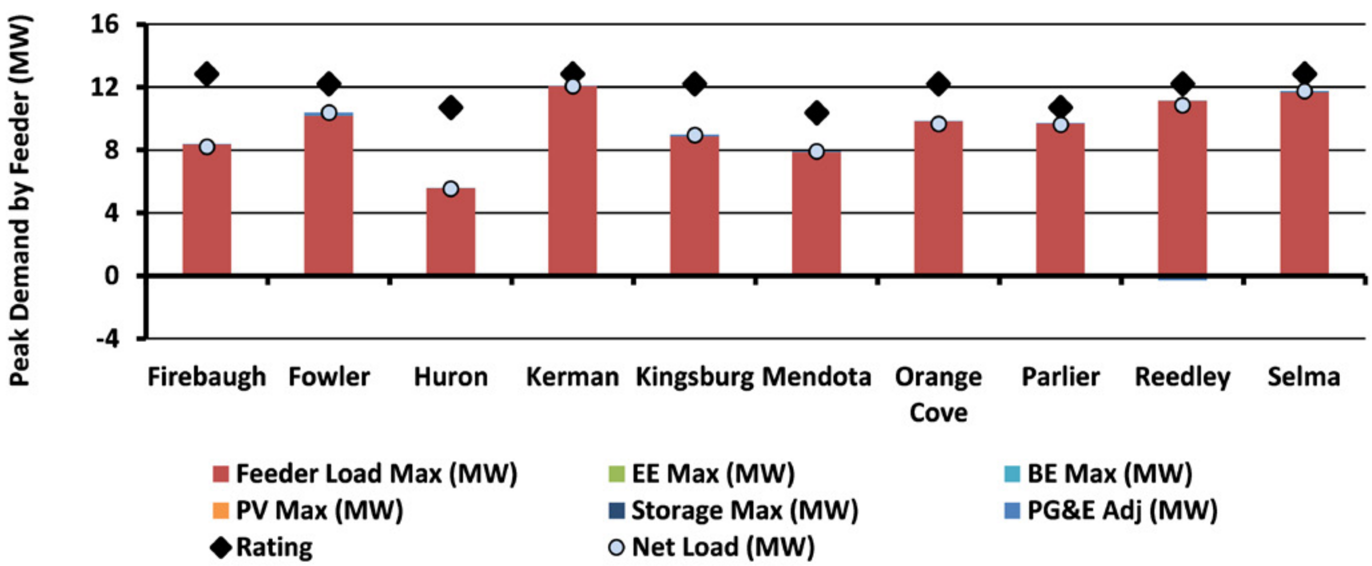
5.2.1 Feeder Peak Demand

5.2.1.1 Depot-Connected Feeders

Figure 47 shows the peak demand conditions for each depot-connected feeder in 2020, the initial year of the study. The light blue dots represent current net peak demand, and the black diamonds represent the rated capacity of the feeders. The closer the two markers for a given feeder, the less headroom for additional load. Kerman, Parlier, Reedley, and Selma have particularly low headroom.

Note that the feeders connected to the depots in Sanger and Coalinga have been omitted, as the data has been redacted by PG&E based on their 15-100-15 rule: "If a feeder has fewer than 15 non-residential customers, fewer than 100 residential customers, or a single customer makes up more than 15% of the load, the load data must be redacted."[15]

Figure 47: Depot-Connected Feeder Peak Demand – 2020



Source: Energeia modeling

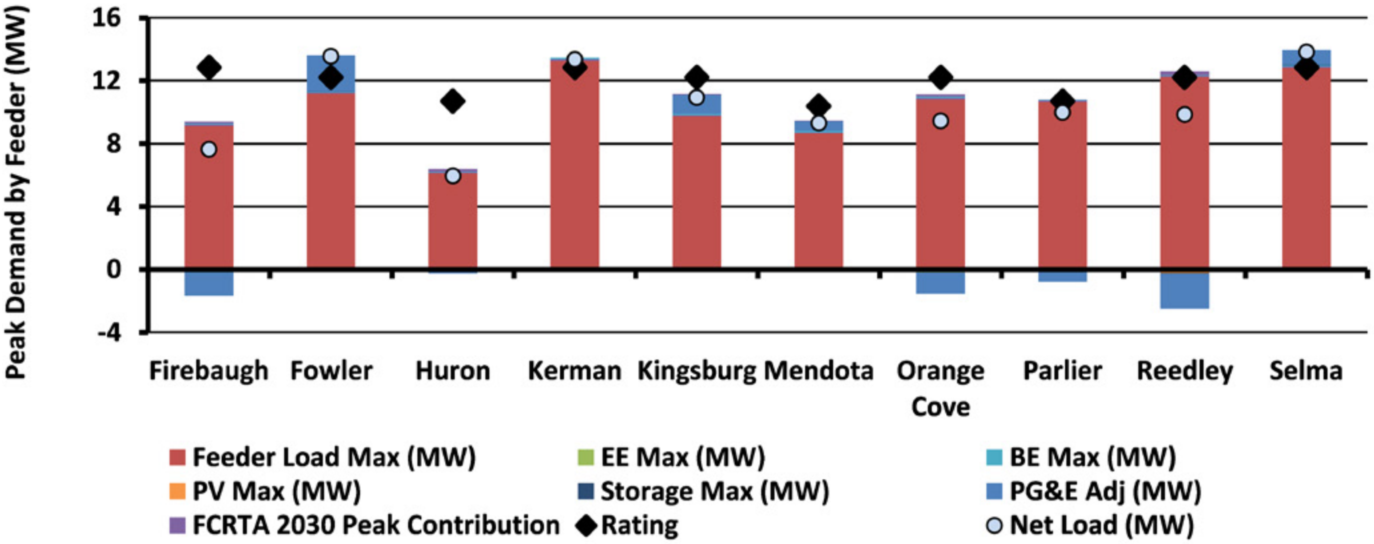
The contributors to load at the peak hour included in the legend are as follows:

1. Feeder Load Max – The underlying customer load
2. EE Max – The (negative) contribution from customer energy efficiency adoption
3. Building Electrification (BE) Max – The (positive) contribution from customer building electrification
4. PV Max – The (negative) contribution from rooftop solar PV
5. Storage Max – The (negative) contribution from behind-the-meter energy storage discharge
6. PG&E Adj – The adjustment factor used to align the results to the peak demand forecast from PG&E's GNA study
7. Rating – The feeder's rated capacity
8. Net Load – The sum of the underlying feeder load and all the other listed contributors

15 Pacific Gas & Electric (2021, September 30). *PG&E Integration Capacity Analysis (ICA) Map User Guide.* (https://www.pge.com/b2b/distribution-resource-planning/downloads/integration-capacity/PGE_ICA_Map_User_Guide.pdf)

The next figure (Figure 48) shows that, by 2030, our modelling shows that net peak demand is expected to exceed rated capacity for three depot-connected feeders: Fowler, Kerman, and Selma. The Fowler and Kerman feeders are expected to be overloaded regardless of FCRTA's bus charging equipment, but for Selma, FCRTA's expected 478 kW load is a key contributor to peak demand.

Figure 48: Depot-Connected Feeder Peak Demand – 2030



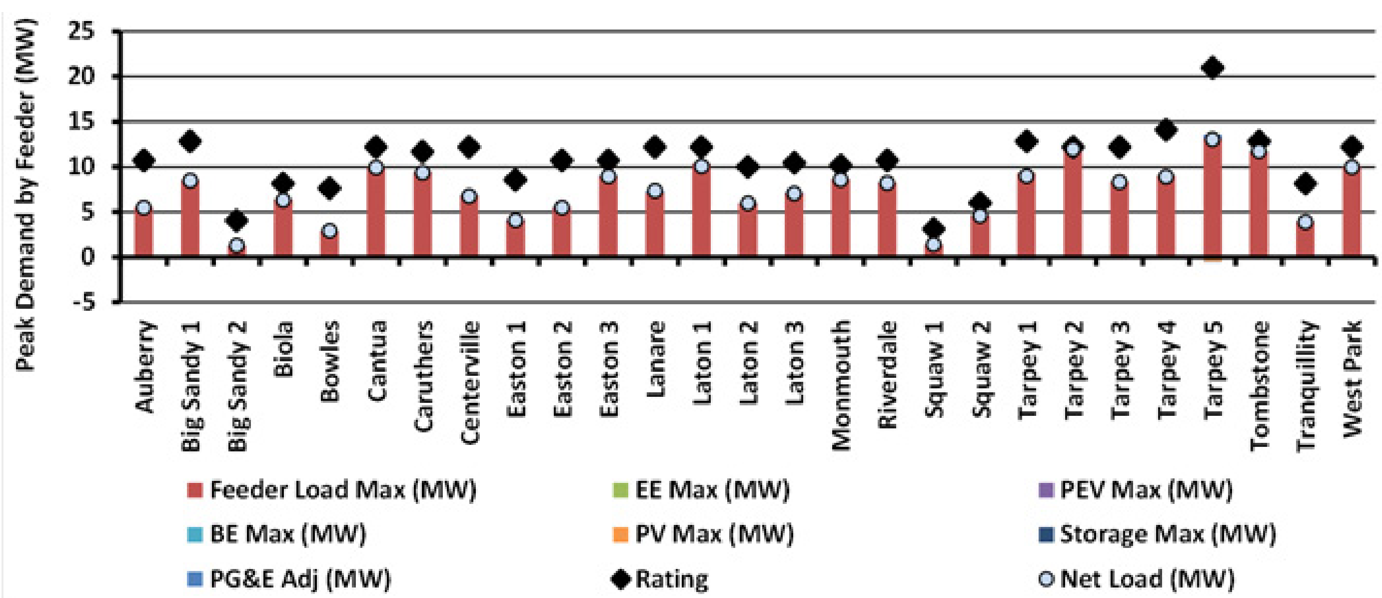
Source: Energeia modeling

5.2.1.2 Unincorporated Community Feeders

Unincorporated communities, including census-designated places and American Indian and Alaska Native Resources, while not housing FCRTA depots, are an important component of the Study, as they may need grid overhead to support elements of potential resilience hubs, especially rural communities far from urban centers and essential services.

Figure 49 shows the net load and rated capacity for each unincorporated community feeder in 2020. Most have considerable overhead, except for Tombstone, which is connected to the same feeder as Selma, and Tarpey 2, which serves part of Tarpey Village in the greater FCMA.

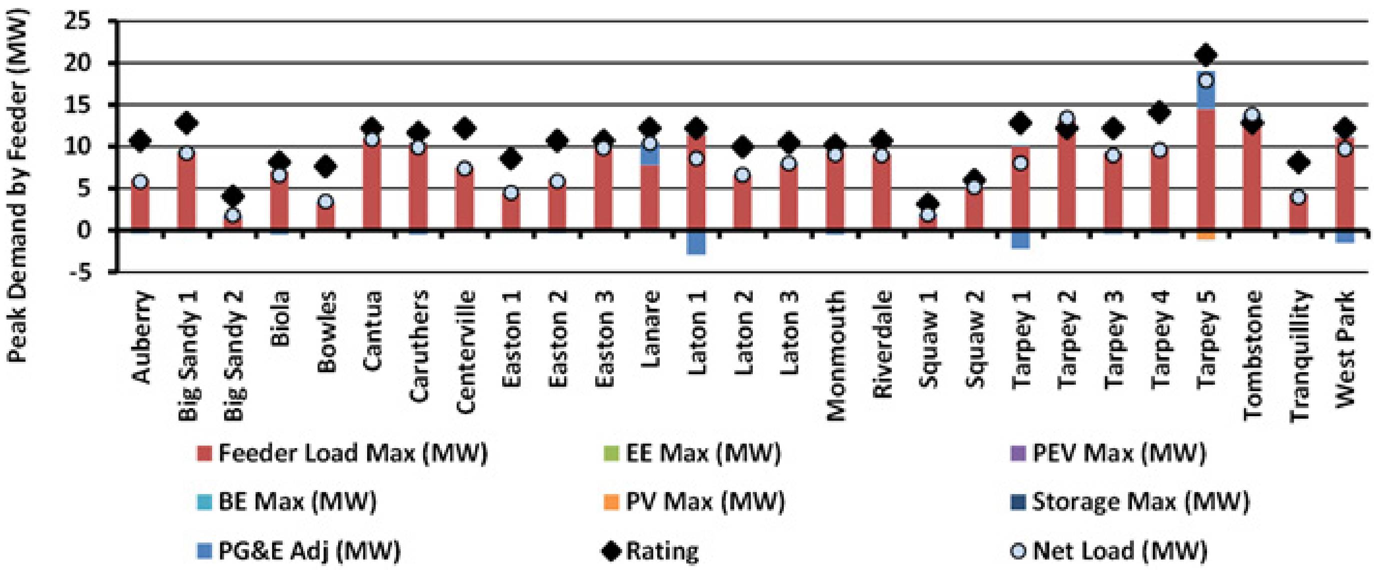
Figure 49: Unincorporated Community Feeder Peak Demand – 2020



Source: Energeia modeling

By 2030, as shown in Figure 50, this modelling shows Tombstone and Tarpey 2 to be experiencing a grid peak demand constraint, and the only unincorporated community feeders to be overloaded.

Figure 50: Unincorporated Community Feeder Peak Demand – 2030

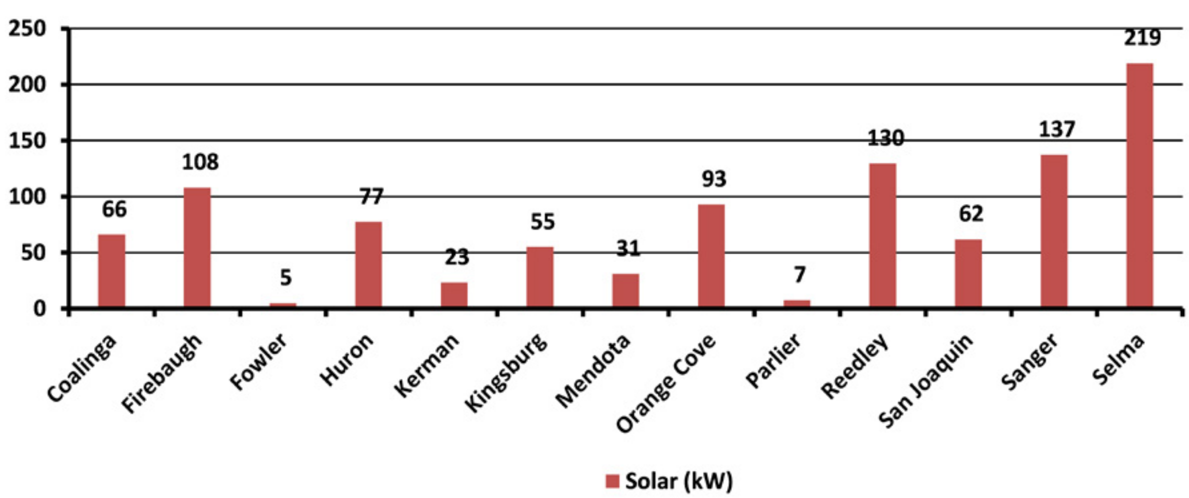


Source: Energeia modeling

5.3 Solar PV Connections

Solar PV and battery energy storage are two tools that can be applied to support further reduction in energy cost savings. PG&E's solar PV hosting tool shows zero hosting capacity[16] across key feeders in Fresno County, as shown in Figure 51. Nevertheless, the CEC forecast for Fresno County suggests 27,287 MW of solar PV will be installed to 2030. Key questions include how PG&E will connect this capacity, where it will connect, and the role that transportation electrification could play improving solar PV hosting capacity.

Figure 51: Optimal PV Size by Depot

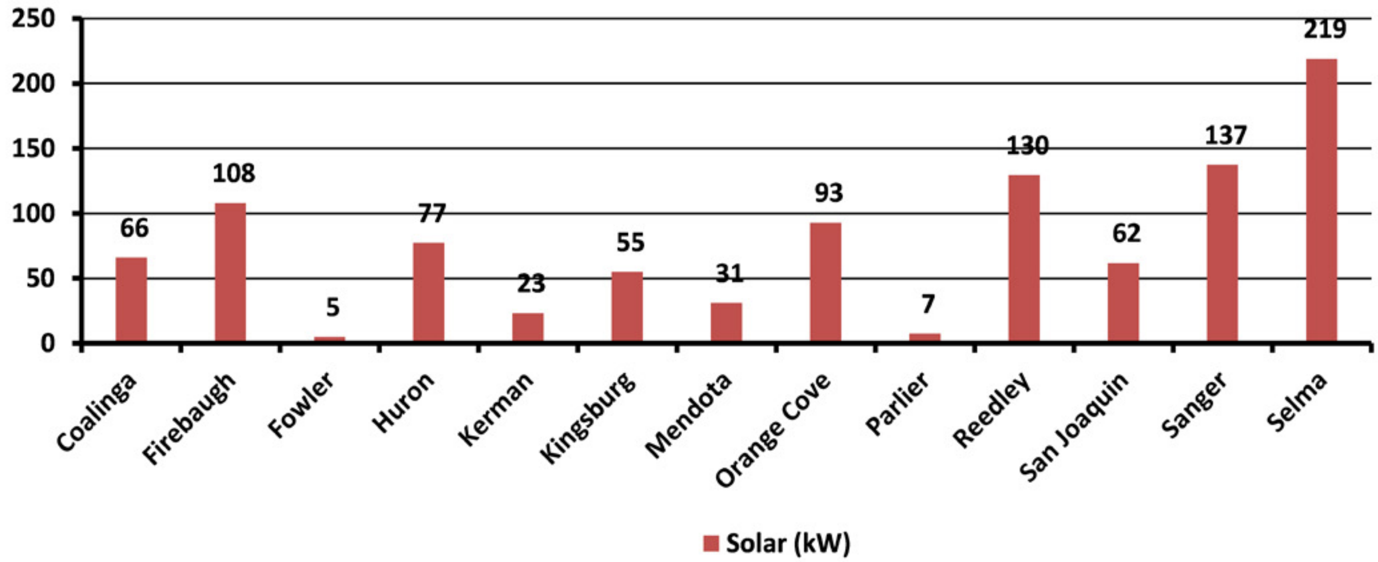


Source: Energeia modeling

16 The study team is seeking feedback from PG&E regarding these numbers, which seem very low.

This study also assessed the potential of DER installed at FCRTA depots to minimize total electricity costs, and further identified the optimal combination and size of PV and storage by depot, assuming current energy costs and technology costs. Figure 52 shows that higher level of solar PV and storage may eventually be justified by resiliency requirements, but the solar sizes illustrated in the figures below reflect only optimal economic benefits. The largest depot, Selma, would benefit from a 265 kW PV system onsite.

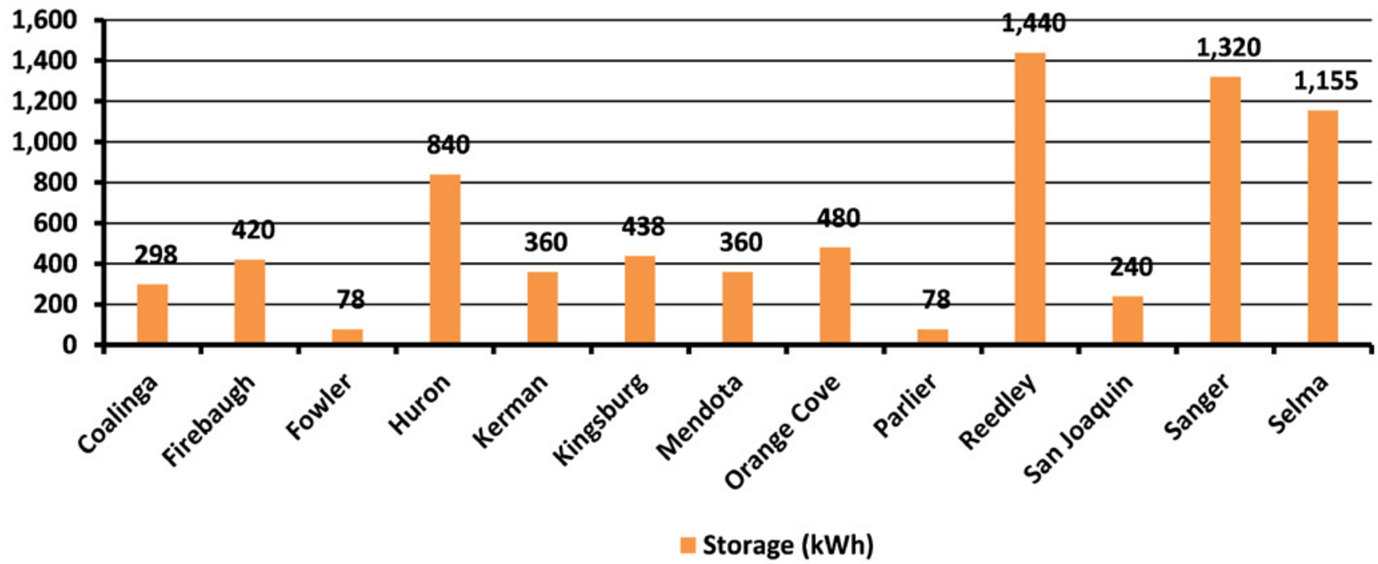
Figure 52: Optimal PV Size by Depot



Source: Energeia modeling

These levels of solar will produce enough generation to offset about 80% of average daily energy usage. PG&E's data suggests that there is no hosting capacity available, so exporting overgeneration would generally not be an option. However, storage could be used to ensure no exports, in addition to achieving the lowest overall cost. The optimal amount of battery storage for each depot to minimize electricity costs is shown in Figure 53. FCRTA will be able to use Net Energy Metering (NEM) or BCT (Bill Credit Transfer) rates, which both provide credits for energy produced in excess of current usage. These credits do not expire and they are able to be refunded directly once annually.

Figure 53: Figure 53 Optimal Battery Storage Size by Depot



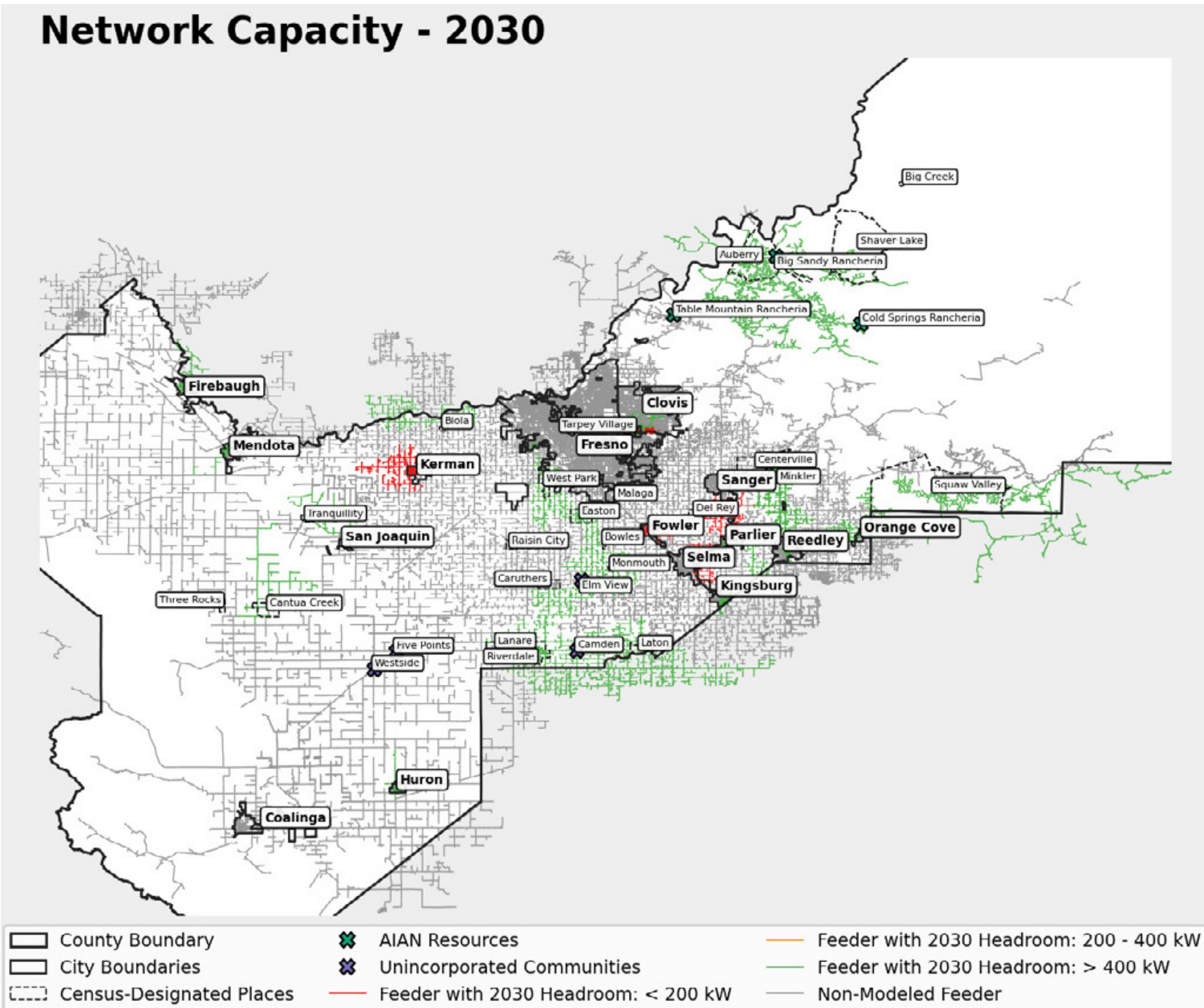
Source: Energeia modeling

In summary, while bus charging could help increase PG&E's solar PV capacity hosting capacity where it was charging in the middle of the day, most FCRTA routes do not involve a return to the depot in the middle of the day, and the study team therefore concluded that the impact on PG&E solar PV hosting capacity would be minimal. Additional application of solar and storage to support redundancy of FCRTA operations is provided in Section 8.18.13.

5.4 Grid Constraints

The feeder results shown in the sections above identify grid constraints by 2030 on four feeders: MC CALL 1107 (Selma depot), MC CALL 1103 (Fowler depot), KERMAN 1102 (Kerman depot), and CLOVIS 1101 (Tarpey Village). These feeders are shown on the map in Figure 54 in red, in the context of the rest of the distribution network in Fresno County, which largely is either redacted (grey) or has over 10% remaining peak demand headroom by 2030 (green).

Figure 54: County View of Feeder Capacity – 2030



Source: Energeia modeling

Section 8.1 describes on the results of our detailed study of each feeder by locality, providing background on the feeder's customer mix, a detailed peak demand forecast, and a view of the load shape on the 2030 forecasted peak day.

6. Resilience Assessment

6.1 Methodology and Indicators

6.1.1 Fresno County Resilience

This Study included an assessment of local resilience to ensure that grid impacts and resources considered community needs, particular areas of vulnerability, and access to critical services. In order to assess resilience equitably, both incorporated and unincorporated areas were accounted for. The effort then utilized these findings to prioritize locations for the implementation of resilience hubs.

The need for resilience is driven by shifts in weather patterns, more frequent and intense extreme weather events, and longer fire seasons – all of which are associated with a continuously warming planet. Research continues to show that low income and minority communities are often the most vulnerable to the impacts associated with these climate changes. These impacts are exacerbated by a number of social considerations, such as socioeconomic status, educational attainment, and public health – all of which play a vital role in the overall resilience of a community and its ability to thrive in the face of challenges. In this section, various vulnerability factors were analyzed to determine which communities within Fresno County were most at risk for experiencing such effects and their resource capacity to recover from them.

Communities that were identified to be particularly vulnerable were prioritized for the implementation of resilience hubs. The concept of a resilience hub is relatively new and emerged in 2014 in response to increasing natural disasters, floods, and fires. It originated as a grassroots effort to find trusted leadership and facilities that could support afterschool childcare, homework help, summer jobs, voter registration, snow removal, grocery shopping trips for elderly communities, and emergency meal distribution among other services. Initial hub locations often included local community centers and faith-based groups. Research has shown that better connected communities are more resilient in emergency events. A study[17] on the role of community in the 2010 Chile Earthquake found that "the role of social networks, organization, cooperation, trust, local knowledge, and participation was crucial at all stages of the disaster."

Today, the definition of resilience has broadened to account for infrastructure needs and their impacts on vulnerable populations. Modern concepts of resilience hubs now look towards incorporating mobility needs, energy resources, and connectivity components. During a disruption, the hub is intended to empower communities to access needed support and resources. For this work, resilience hubs were defined as dynamic spaces that could contain different components to best serve the community in which they were being introduced. At a minimum, each resilience hub is supported by a microgrid (solar and storage) that can operate in island mode in the event of a power outage to provide continued electricity, air conditioning, air filtration, Wi-Fi, and the ability to charge electric mobility options (e.g. bikes, scooters, vehicles, pods) as a redundancy to public transit options.

The vulnerability indicators that were assessed, the components of the resilience hubs, and the prioritized locations for resilience hub implementation are described in this section.

An example of a resilience hub can be seen in Ann Arbor's Northside Community Center with its latest 23 kW solar and battery installation to serve 100% of building loads and provide backup power for up to 3 days. The Northside Community Center is an administrative site for the Community Action Network and offers three weekly emergency food distributions to those in need via Catholic Social Services.

6.1.2 Resilience Vulnerabilities

To support the development of a resilience hub network in Fresno County, a vulnerability analysis was conducted to determine the needs of these communities and particular points of vulnerability in order to best determine locations to place these hubs as well as relevant hub components to best alleviate vulnerabilities. The assessment was conducted to ensure that hubs were placed in locations most prone

17 Moreno, J. (2018). The role of communities in coping with natural disasters: Lessons from the 2010 Chile Earthquake and Tsunami. Procedia Engineering, 212 (2018), 1040-1045. https://doi.org/10.1016/j.proeng.2018.01.134

to extreme events, such as fires and heat waves, while also serving communities with the fewest resources and greatest needs.

Table 8 defines the priority levels assigned to each vulnerability indicator. The priority levels range from 1 through 3, with priority level 1 indicating that the vulnerability indicator could be alleviated or reduced by the presence of a resilience hub and therefore would make a strategic candidate for a resilience hub. Priority level 3 indicates that the vulnerability indicator would not be directly alleviated or reduced by the presence of a resilience hub, and other interventions may be more strategic than a resilience hub (e.g., employment programs or skills training opportunities). Table 9 then presents a summary of the vulnerability indicators that were included in the analysis and their designated priority levels.

Table 8. Vulnerability Priority Level

Level	Description
1	Vulnerability indicator can be alleviated or reduced by presence of a resilience hub
2	Vulnerability indicator can be indirectly alleviated or reduced by presence of a resilience hub
3	Vulnerability indicator is not alleviated or reduced by presence of a resilience hub, but can potentially be impacted or improved by addressing other vulnerability indicators

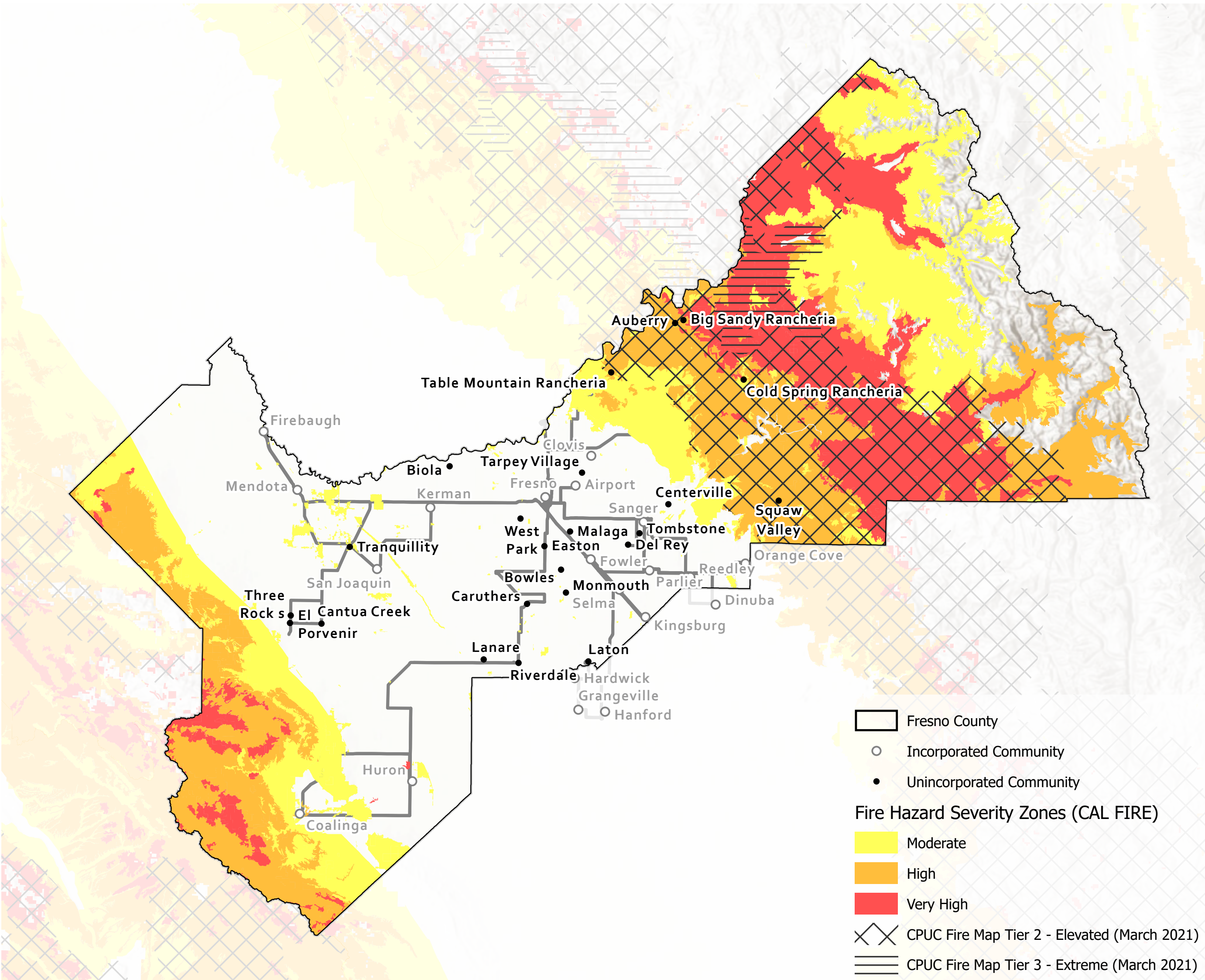
Table 9. Vulnerability Indicators and Priority Levels

Priority Level	Vulnerability Indicator
1	Fire Prone Areas
1	Mean Temperature
1	Proximity to Cooling Centers
1	PG&E Feeders
1	Access to Public Transit
2	Asthma Percentile
2	Housing Burden
2	Housing and Transportation Index
2	Environmental Justice (EJ) Communities
3	Proximity to Emergency Departments
3	Poverty
3	Linguistic Isolation

6.2 Assessment Results and Grid Implications

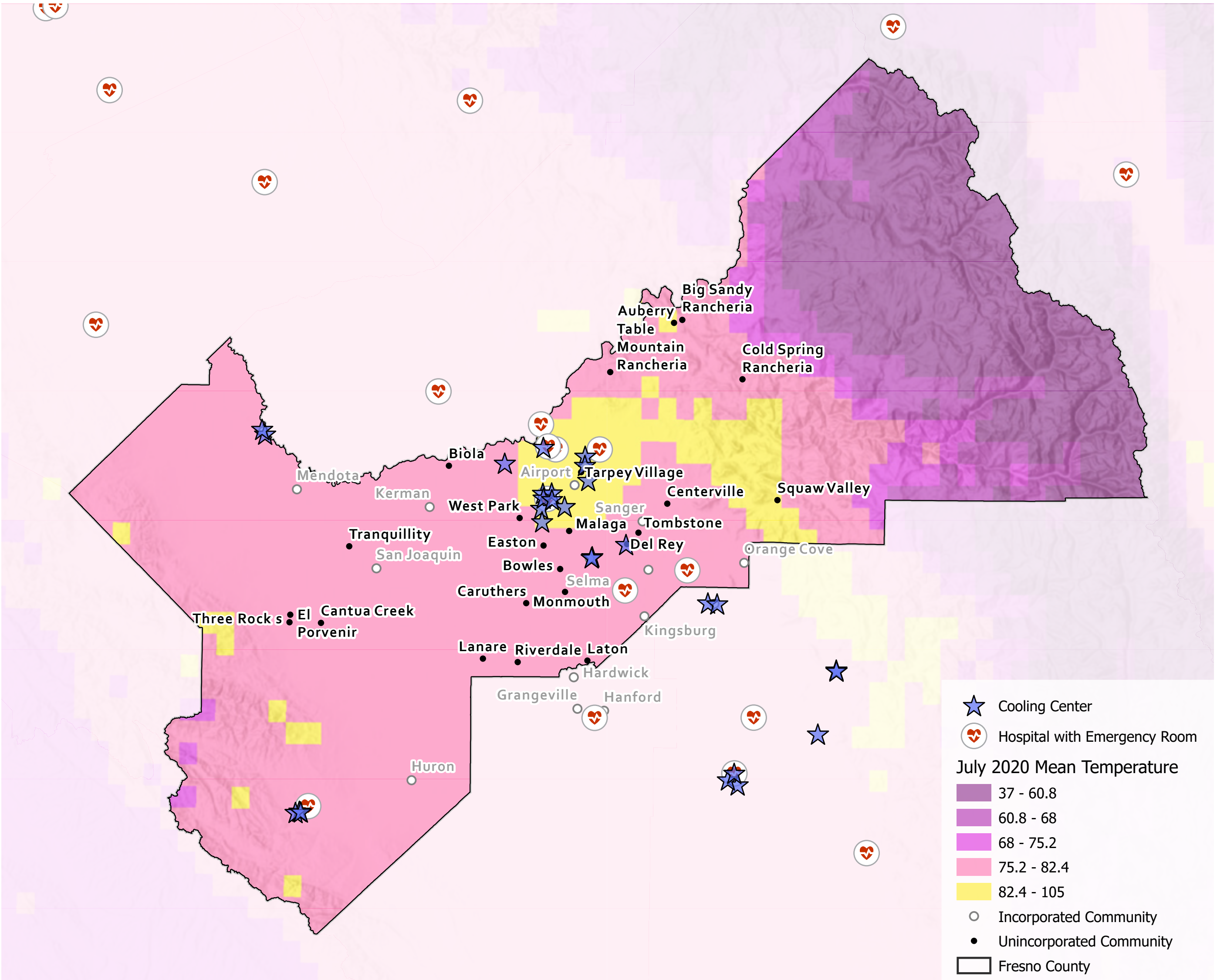
To visualize the impact of each vulnerability indicator on Fresno County and the neighboring area, individual graphics were constructed in a 'heat map' style in Figures 55-66 below.

Figure 55: Fire Prone Areas



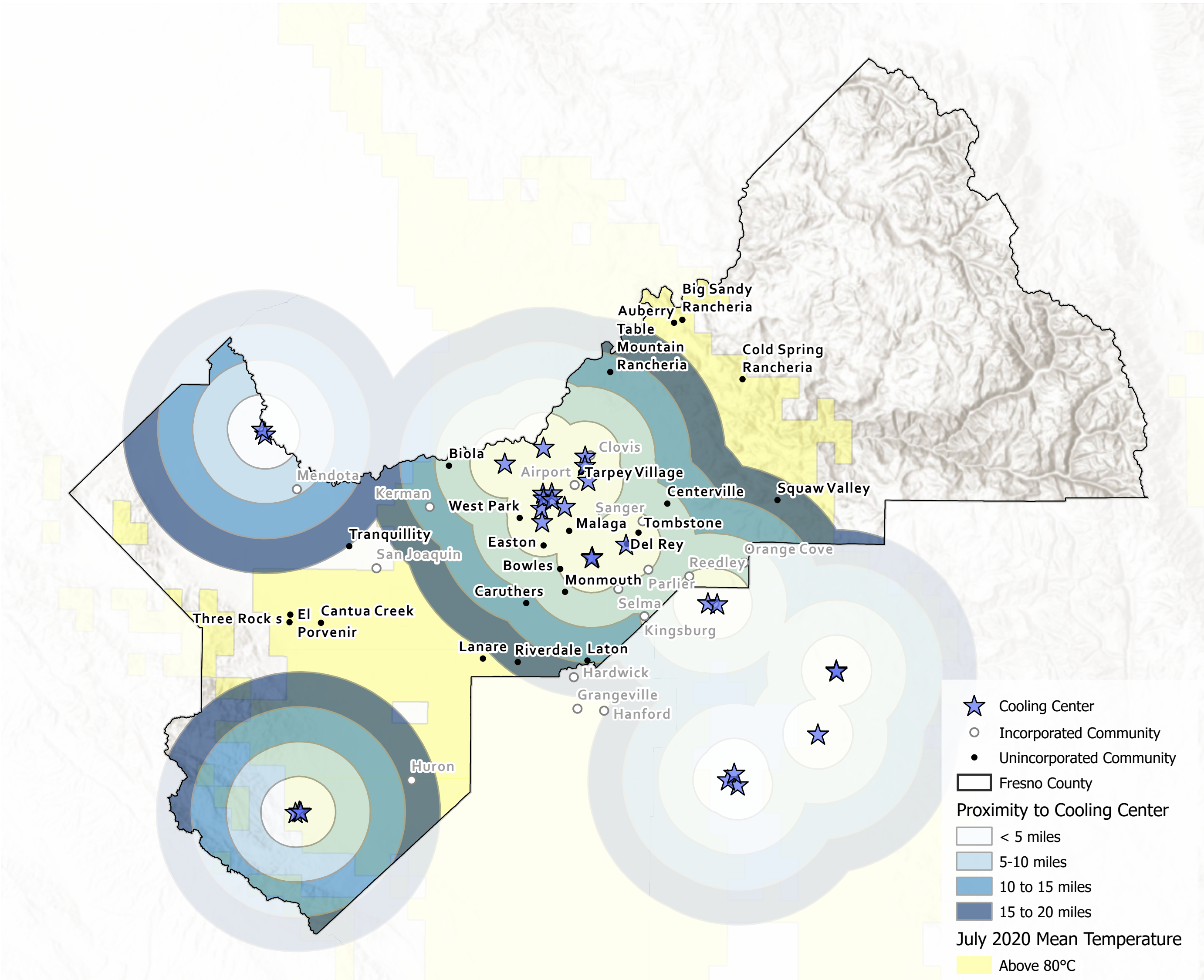
Source: AECOM GIS Analysis

Figure 56: Mean Temperature



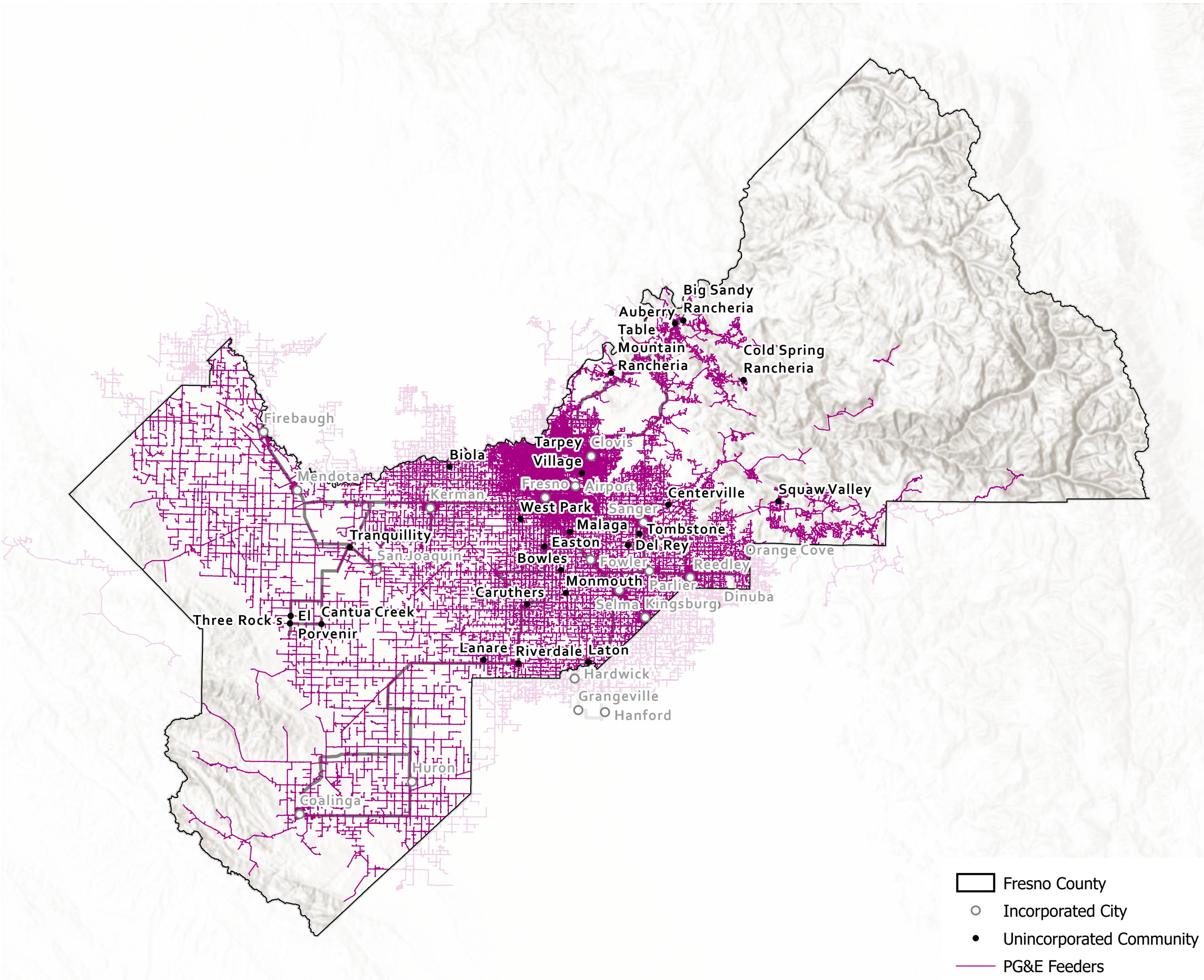
Source: AECOM GIS Analysis

Figure 57: Proximity to Cooling Centers



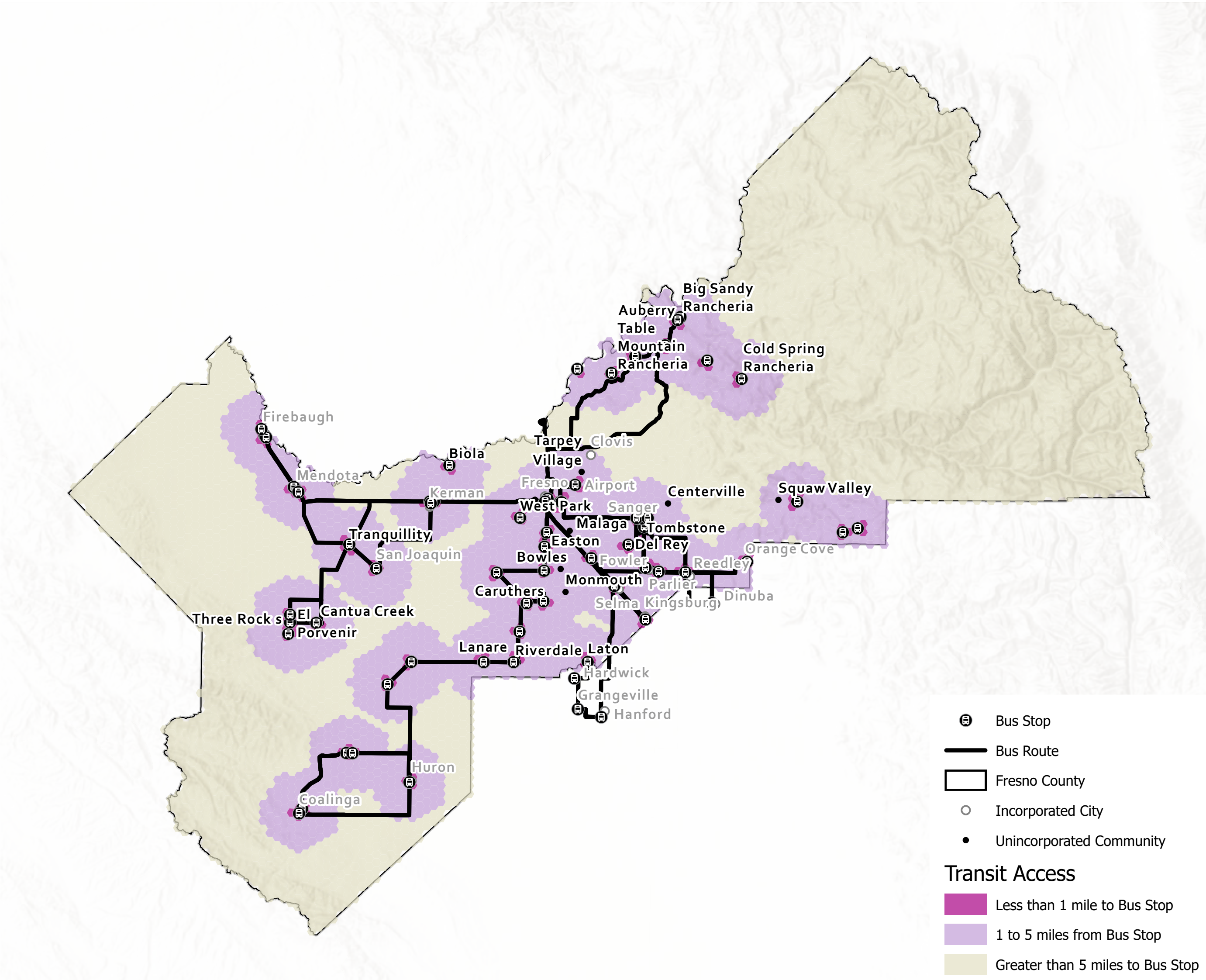
Source: AECOM GIS Analysis

Figure 58: PG&E Feeders



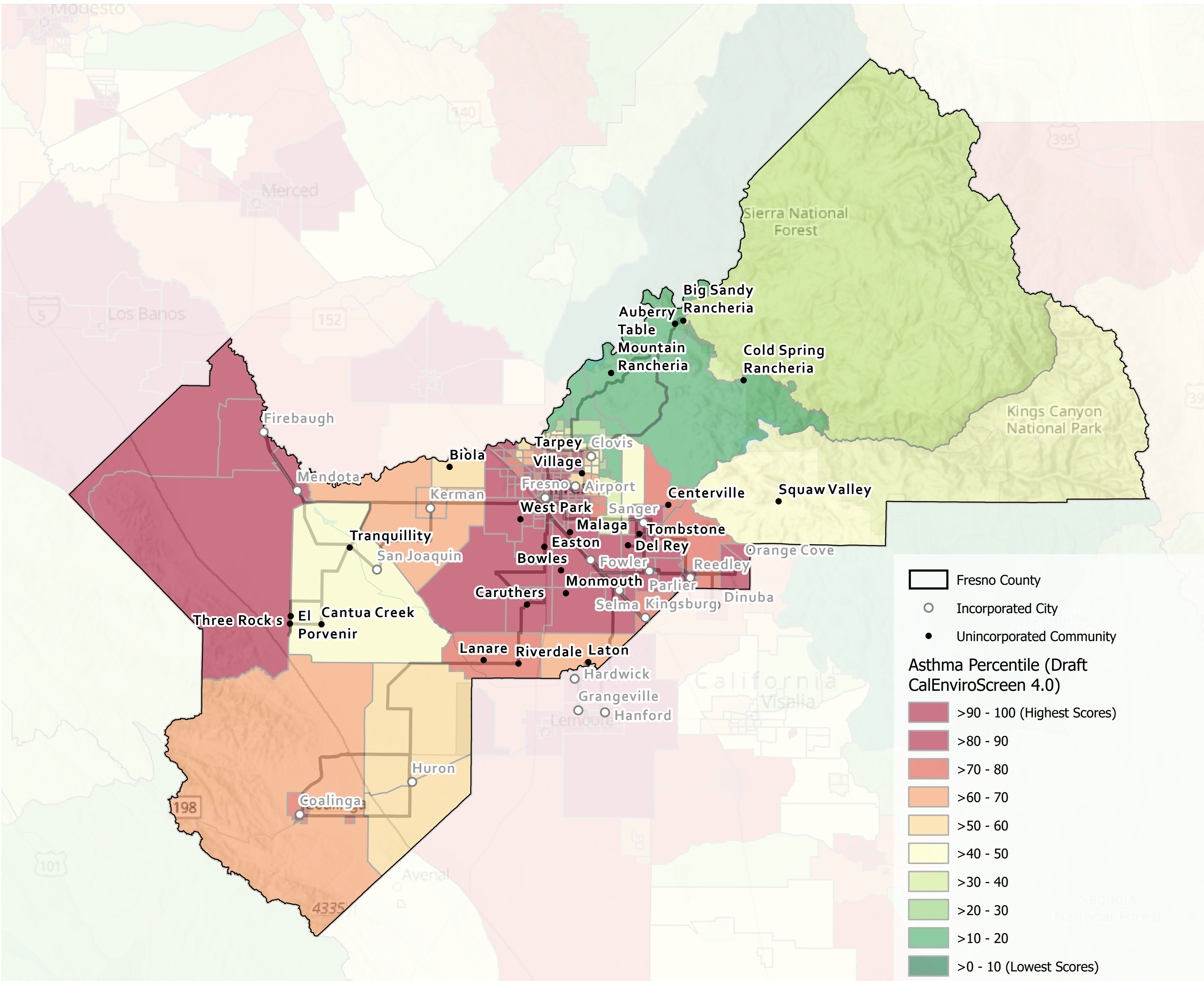
Source: AECOM GIS Analysis

Figure 59: Access to Public Transit



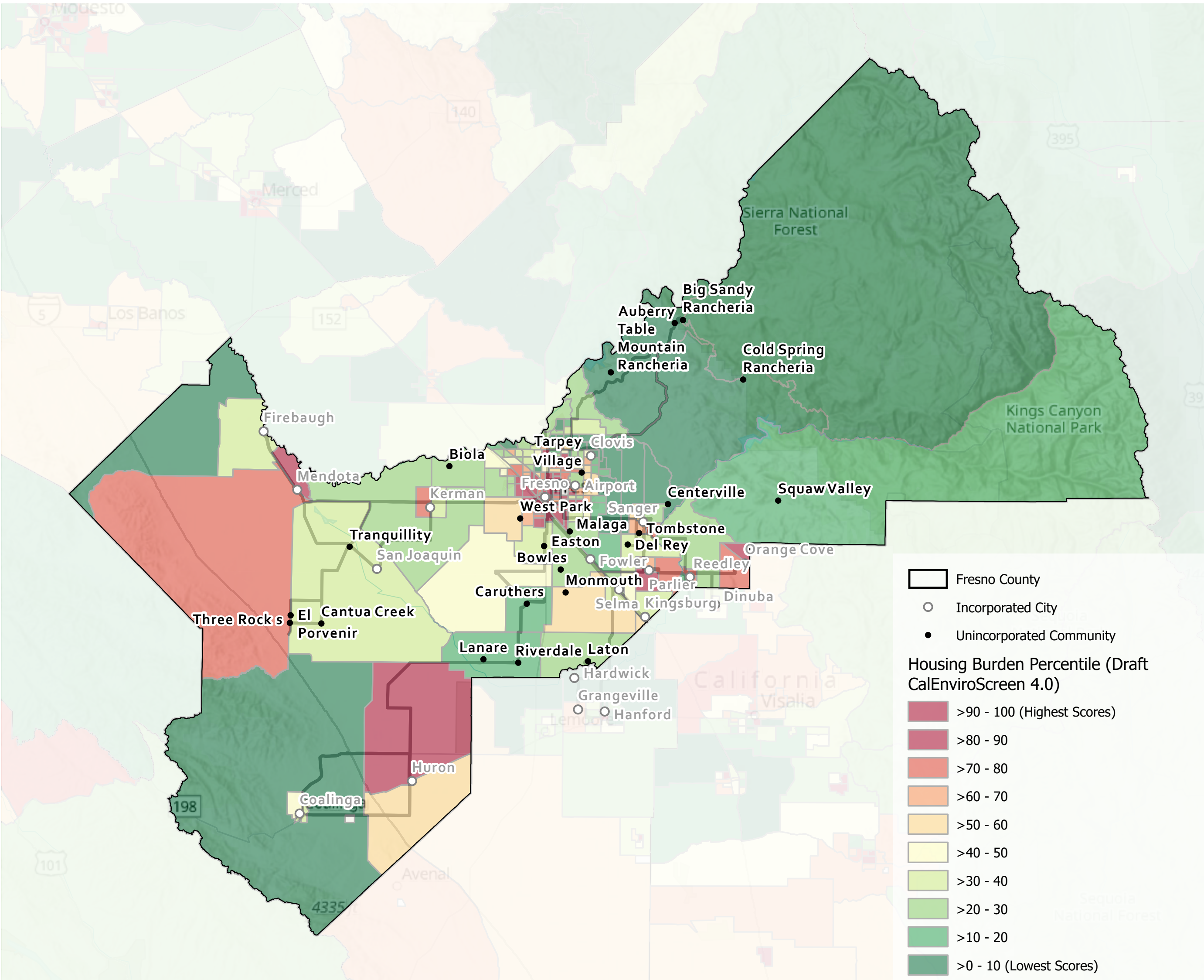
Source: AECOM GIS Analysis

Figure 60: Asthma Percentile



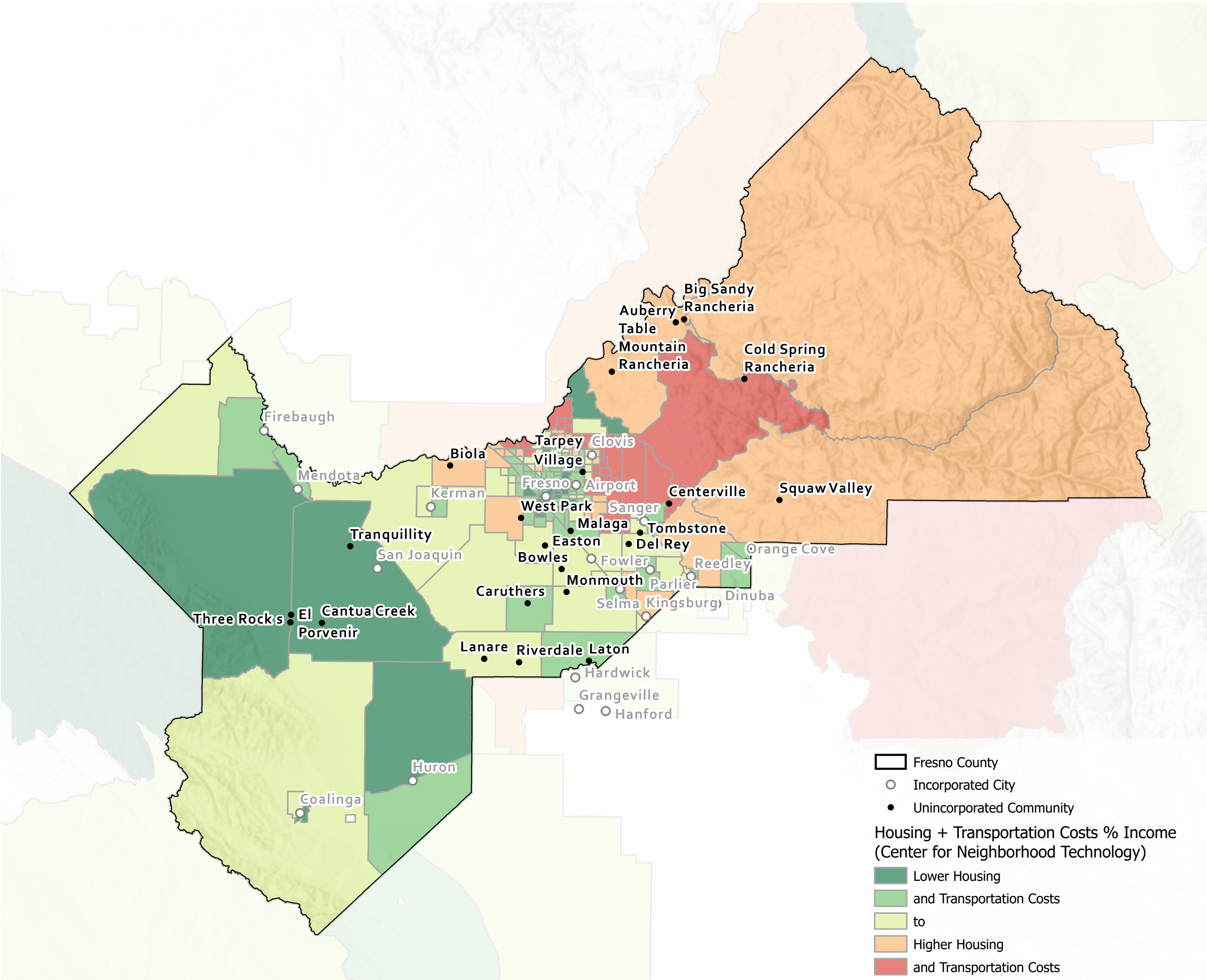
Source: AECOM GIS Analysis

Figure 61: Housing Burnden



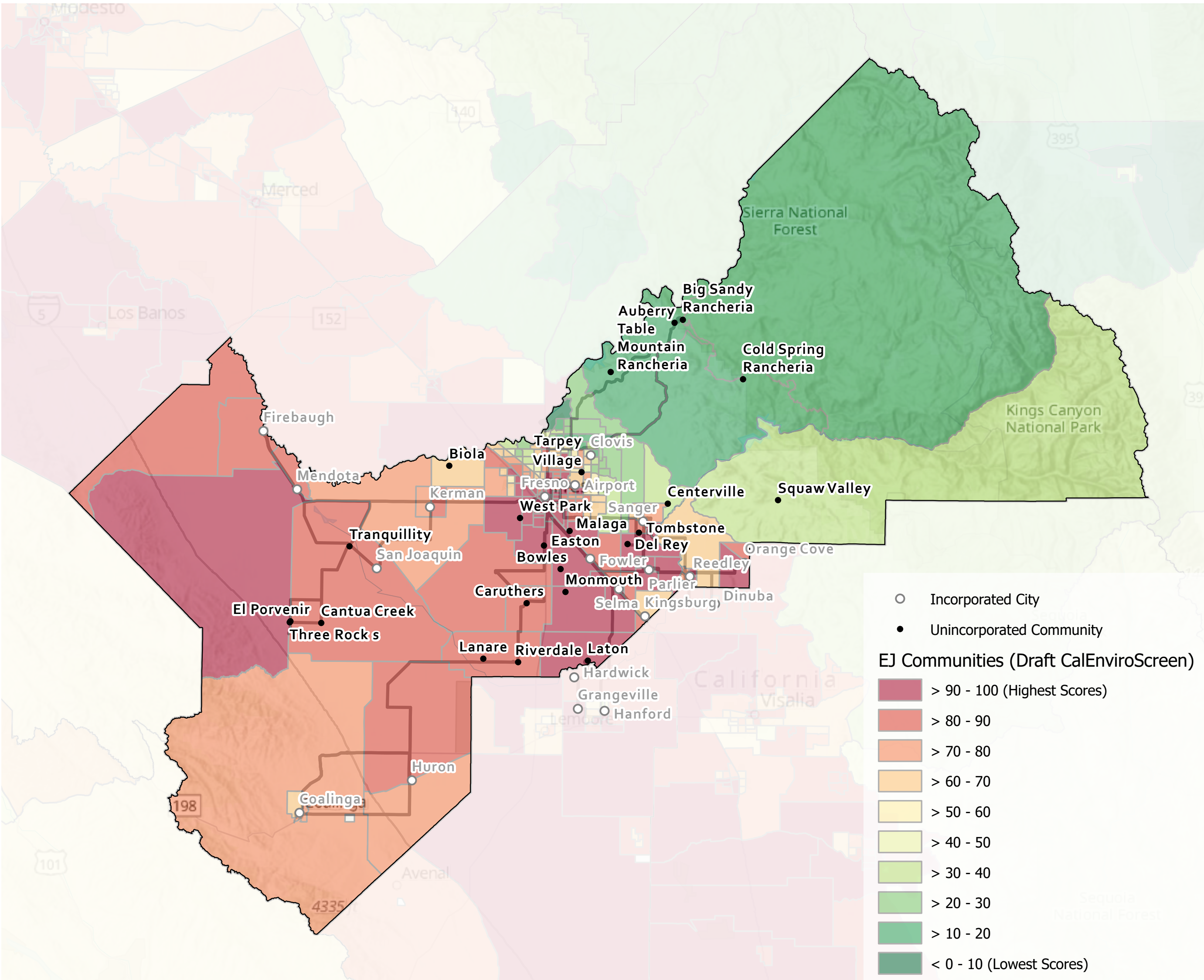
Source: AECOM GIS Analysis

Figure 62: Housing and Transportation Index



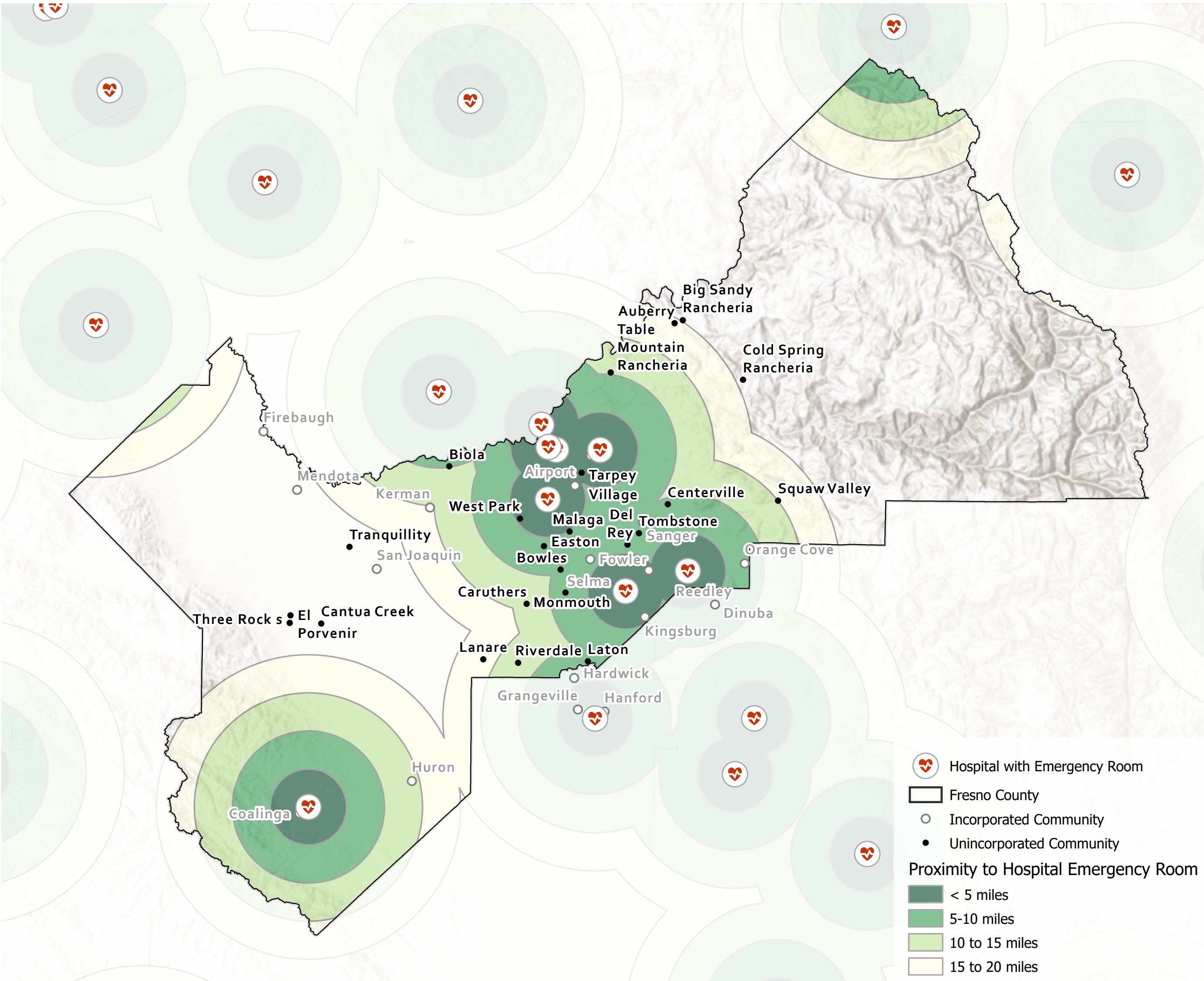
Source: AECOM GIS Analysis

Figure 63: EJ Communities



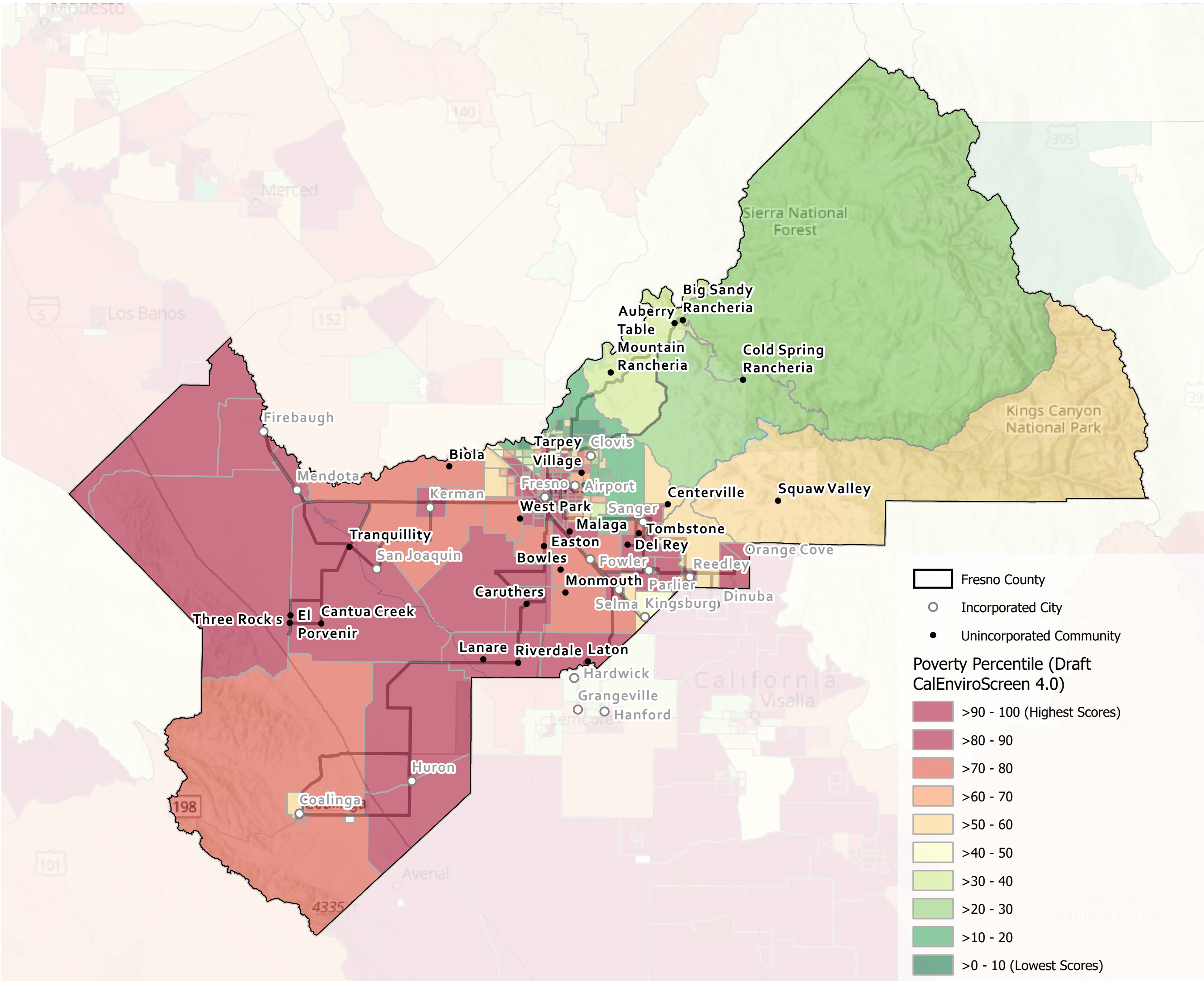
Source: AECOM GIS Analysis

Figure 64: Proximity to Emergncy Department



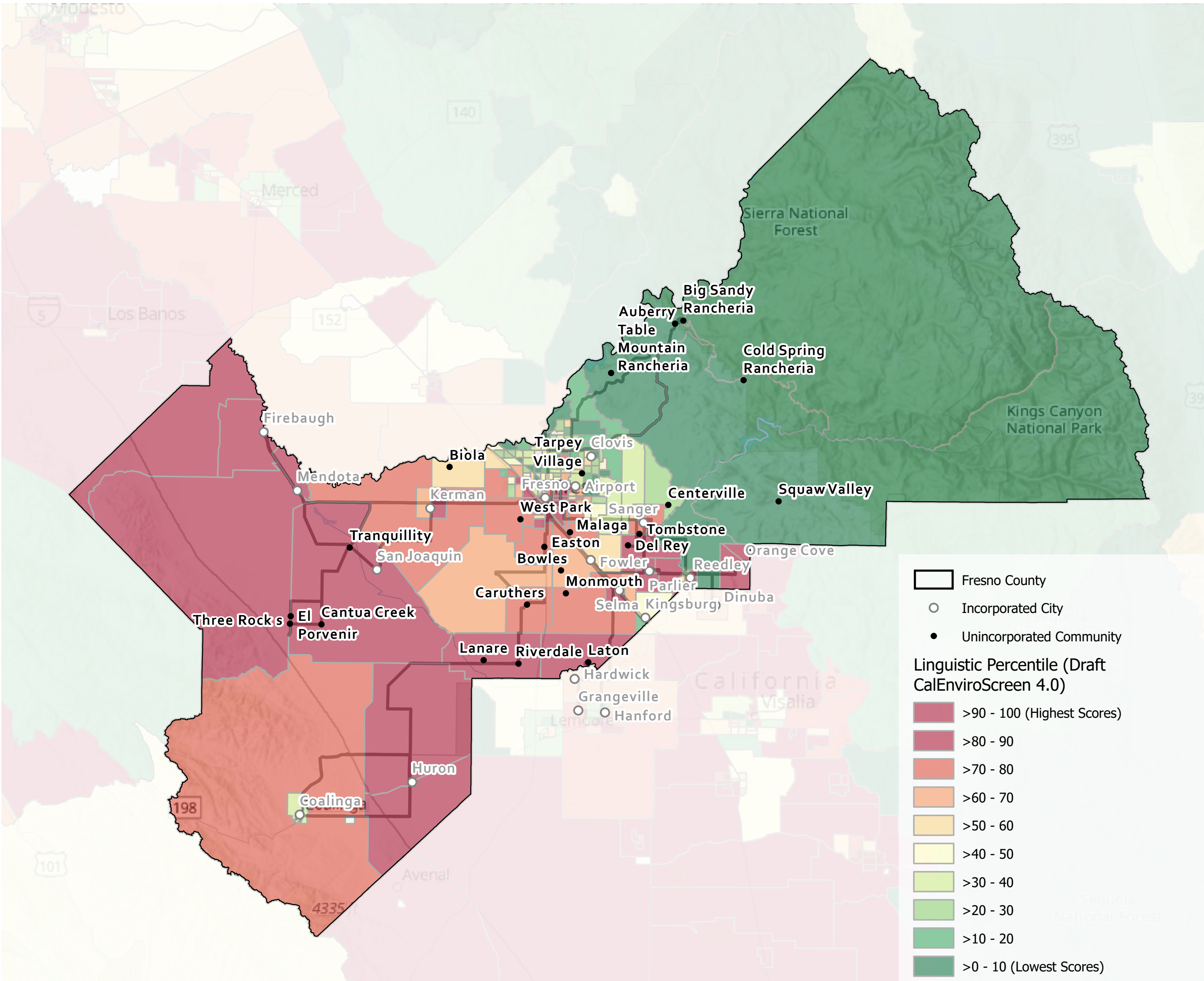
Source: AECOM GIS Analysis

Figure 65: Poverty



Source: AECOM GIS Analysis

Figure 66: Linguistic Isolation

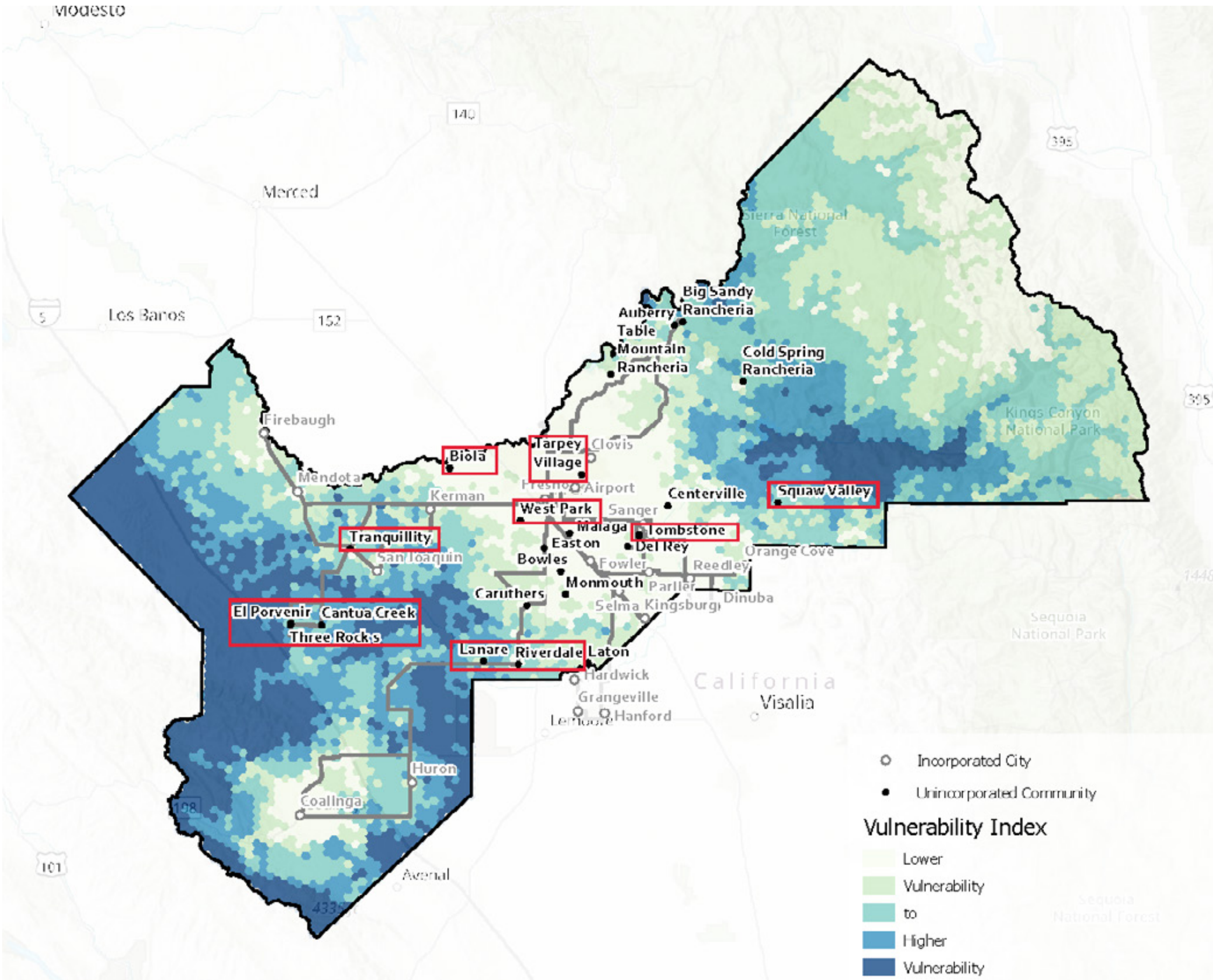


Source: AECOM GIS Analysis

Resilience Hub Locations

In addition to determining individual indicators, this study combined vulnerability indicators to determine overall community vulnerability to address resilience in a holistic manner. Individual vulnerability indicators were statistically weighed and combined to produce overall vulnerability. Figure 67 presents overall vulnerability utilizing a gradient heat map approach. The outputs of this map informed the prioritization of resilience hub locations in Fresno County.

Figure 67: Resilience Analysis and Proposed Resilience Hub Locations



Source: AECOM GIS Analysis

Based on this work, eight locations were identified as areas where a resilience hub would alleviate vulnerabilities. These locations were identified as the following unincorporated community areas:

- Tarpey Village
- Cantua Creek, El Porvenir, Three Rocks
- Tranquillity
- Lanare, Riverdale
- West Park
- Biola
- Tombstone Territory
- Squaw Valley

7. Resilient Electric Infrastructure Models

The following sections detail the solutions proposed to alleviate the impact of fleet charging on the local electrical grid, particularly in constrained areas, and options for onsite solar and storage solutions to provide redundance. Due to existing air quality conditions within rural Fresno County, solutions which would emit additional air pollutants, such as back-up diesel and natural gas generators, were excluded from consideration.

7.1 Redundancy Analysis

This analysis provides an overview of the needed infrastructure to support electric charging and estimates the onsite solar PV that would be needed at each FCRTA facility to fully power the housed fleet. Additionally, various energy storage systems are proposed to meet different outage scenarios to enhance resiliency of FCRTA facilities.

To accomplish this, first, the amount of energy each EV requires to fully recharge after completing its daily operation is determined. Previous reports have provided insight on the recommended number and type of transit vehicles stored at each site as well as their daily mileage. Daily energy needs are calculated using the assumptions listed in Table 10.

Table 10. Assumptions on Fleet Vehicle Energy Consumption

Vehicle Type	Energy Consumption
Bus	2.3 kWh/mile
Sedan	0.3 kWh/mile
Van	0.6 kWh/mile

The approximate charging time can also be determined for each vehicle type assuming the peak power charging stations can provide, as shown in Table 11. Charging rates are derived by expecting buses to utilize DCFC charging devices while vans and sedans use L2 chargers. Vehicles are expected to charge simultaneously at every site (versus sequentially).

Table 11. Charger Power Assumption

Vehicle Type	Energy Consumption
Bus	60 kW per vehicle
Sedan	9.6 kW per vehicle
Van	9.6 kW per vehicle

7.1.1 Cost Estimates

Understanding the peak power and charging duration is useful in confirming that the vehicles can fully recharge overnight as well as size the necessary electrical infrastructure, such as switchgear and energy storage system, to support power drawls. A unity power factor was assumed for vehicle charging devices (1 kVA = 1 kW). Switchboard options are based on the specifications listed in Table 12. Identifying the appropriately sized switchboard is based on the assumption 480 V, three phase service is provided to each facility. Sizing of the energy storage system will be discussed later in this section.

Table 12. Switchboard Specifications

Basis of Design: Eaton Pow-R-Line C	
Switchboard Sizing: 48” W x 24” D x 90” H	
Switchboard Design Options	Cost
200 A, 35 kA Switchboard	$8,000
400 A, 35 VA Switchboard	$10,000
800 A, 35 kA Switchboard	$12,000
1200 A, 65 kA Switchboard	$15,000
1200 A, 65 kA Switchboard	$30,000

Next, an estimate of the needed solar capacity to cover the daily energy needs at each facility was determined. This required assigning the assumptions listed in Table 13 on system design components and generation capability. It should be noted that the generated solar energy is used to offset charging since fleet vehicles typically charge overnight when solar power in unavailable. The exception to this is storing the electricity in energy storage systems for later use instead of sending it back to the grid immediately.

Table 13. Solar System Specifications

Solar Installation Design: 2' x 4', 20-degree tilt, ballast mount
Solar Wattage: 310 W per panel
Installation Cost: $1.72 per Watt[18]
Assumptions: No geographic seasonal factor applied to calculations. Assume 6 hours of available sunlight per day.

Finally, an energy storage solution was proposed for three outage scenarios (1, 3, and 7 days). As previously mentioned, the energy storage system and resiliency components are intended to store the solar electricity for use during night hours. The main benefit of this solution is the fleet can still complete daily operation even if the main power grid is offline. Table 14 presents the energy storage specifications used for this analysis.

Table 14. Switchboard Specifications

Basis of Design: Tesla Powerpack				
Battery Type: Lithium-ion, 3-phase, 480V AC voltage, 130kW output, 232 kWh capacity				
Installed Cost: $708 per kWh[17]				
Battery Component	Length	Width	Height	Weight
Powerpoint Unit	50.9"	38.1"	86.1"	4847 lbs.
Powerpack Inverter	41.1"	54.9"	86.2"	2470 lbs.

18 Feldman, D., Ramasamy, V., Fu, R., Ramdas, A., Desai, J., and Margolis, R. (2021, January). *U.S. Solar Photovoltaic System and Energy Cost Benchmark: Q1 2020.* National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy21osti/77324.pdf

7.2 Shared Charging Model

As noted in Table 15, FCRTA currently uses plug-in charger types with J1772 for Level 1 and Level 2 charging or J1772 Combo for DCFC chargers.

Table 15. Current FCRTA Fleet and Charging Needs

FCRTA	Current Quantity	Type	Connector	Compatible Connections	V2G Compatible
DCFC (60kW) Proterra Chargers	8	Plug-In	J1772 Combo	J1772 Combo	Yes
Level 2 (9.6kW) JuiceBox Chargers	16	Plug-In	J1772	J1772, J1772 Combo	No
Level 2 (40kW) BYD Chargers	3	Plug-In	J1772	J1772, J1772 Combo	No
Level 2 (4.3kW) Envision Solar Arc Chargers	23	Plug-In	J1772	J1772, J1772 Combo	No
DCFC (16.5kW) Solar Tree	0	Plug-In	J1772 Combo	J1772 Combo	No

Table 16 shows the current FCRTA fleet makeup and their charging needs. The existing charging infrastructure is sufficient for the current fleet; however, continuing to add charging infrastructure with J1772 Combo plug types at higher power levels is recommended to reduce recharge time and accommodate shared charging with public agency vehicles that require higher battery capacities.

Table 16. Current FCRTA Fleet and Charging Needs

Current FCRTA Fleet Vehicles			
Model	Max Rate	Type	Connector
2016 Zenith Ram 3500 Van	Unknown	Plug-In	Unknown
2018 Proterra 40 FT Bus	60 or 120kW	Plug-In	J1772 Combo
2019 Chevy Bolt Sedan	55kW	Plug-In	J1772 Combo
BYD 2019 K9S 35 FT Bus	150kW	Plug-In	J1772 Combo
BYD 2020 K7M 30 FT Bus	80kW	Plug-In	J1772 Combo

Table 17 provides recommended charger power outputs for each vehicle class. New chargers are also equipped with smart technology that allows numerous ports, sequential charging, and dynamic charging patterns to align with grid signals.

Table 17. Recommended Power Outputs by Vehicle Class

Vehicle Class	EVSE
Class 1	7.2kW
Class 2	7.2kW
Class 3	24kW DCFC
Class 4	24kW DCFC
Class 5	54kW DCFC
Class 6	54kW DCFC
Class 7	150kW
Class 8	184kW

Another consideration is that overhead and wireless charging are not currently available onsite. Installing an overhead conductive charger or wireless charging pad for larger vehicles types may be advantageous to accommodate different vehicle types (i.e., medium/heavy duty vehicles equipped with overhead charging/wireless vehicle pad) and provide fast charging capabilities. Both options would be capable of providing sequential charging to various fleet vehicles that have the necessary onboard equipment.

With the existing infrastructure, FCRTA should be able to accommodate infrastructure for other interested entities. The next step would be to ensure charging compatibility by collecting information from the interested entities on specific connectors, adaptor types, and charging plugs needed for their current and future fleets. Based on this information, FCRTA can look into different procurement strategies. Following this, a charging schedule should be developed to ensure Class 4-8 vehicles have access to the chargers with the highest power output during overnight hours and Class 1-3 during the day for high-speed charging. Many of the existing chargers are lower power levels which will require larger vehicles to be plugged in for longer durations. According to Table 7, the vast majority of interested entities' current and future vehicles are light duty (labeled as "other") or passenger vehicles— which would allow them to use FCRTA charging stations during the day for short durations. Using input from interested entities, a schedule can be optimized to allow FCRTA vehicles to charge overnight while other entities can charge during the day.

7.3 Resilience Hub Model

A Resilience Hub Toolkit was developed for FCRTA to account for the varying resilience needs of Fresno County. Each resilience hub was customized to include components from the Resilience Hub Toolkit that address specific needs and vulnerabilities of the community, with the objective of alleviating vulnerability indicator (Chapter 6).

The features within the Resilience Hub toolkit are presented in Table 18. Features with an asterisk indicate the minimum features that must be included in each FCRTA resilience hub (Hub). This includes transit solutions and a local microgrid. The remaining features are categorized into two groups: primary and secondary. Primary features are those that should be strongly considered for inclusion in each resilience hub in Fresno County based on community needs. The secondary features are also important features for consideration to better support community strengthening and emergency preparedness but are supplementary and would not need to be prioritized for immediate implementation. All features are organized into four groupings of basic hub components to be considered for each location: Facility, Transit, Community Programming, and Energy. Additionally, for each feature, a description of the value add is included to understand how the specific feature will support communities and why it should be considered. The final column lists the vulnerability indicators that can be relieved if the feature is implemented. This allows users to sort features based on preference and type as well as relevance for each community and their needs.

This toolkit was used in Section 8.2 to inform recommended features for the chosen communities.

Table 18. Resilience Hub Toolkit Features

Item	Type	Category	Resilience Hub Features	Description	Value Add	Which Vulnerability indicators can be relieved?
1	Primary*	Transit	City/County bike program/5-10 bikes for rental by community members	City/County bike share program if nearby or the Hub can rent out bikes for a full day to community members	This allows for greater access to jobs and opportunities for communities with no car or lengthy commute times. In the event of a disruption, community members can use bikes as a way to get to family or friends in need if public transportation stops running.	Access to public transit, Housing Burden, Housing and Transportation Index, EJ Communities
2	Primary*	Transit	Electric scooter (e-scooter)/electric bike (e-bike) stations nearby for rent where available (Bird, Lime, Lyft)	Coordinate with e-scooter/e-bike companies to provide a number of E-scooters/ E-bikes near the Hub each day	This allows for greater access to jobs and opportunities for communities with no car or lengthy commute times. In the event of a disruption, community members can use e-scooters/e-bikes as a way to get to hospitals or aid family or friends in need if public transportation stops running.	Access to public transit, Housing Burden, Housing and Transportation Index, EJ Communities
3	Primary*	Transit	EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	EVs can be charged with rooftop solar+battery storage system and run to local spots regularly each day	This can support community members with the first and last mile problem and help to create a more connected community especially for elderly or disabled communities. In the event of a disruption, community members can use the EV pod as a way to get to family or a hospital if public transportation stops running. This can lessen the load of emergency dispatchers during high volume times.	Access to public transit, Housing Burden, Housing and Transportation Index, EJ Communities, Proximity to Emergency Departments
4	Primary	Transit	Air Conditioning and Air filtration Systems	Temperature controlled, well insulated building with air filtration	Provides a cool and clean place for community members during heat waves, fires, or days with high air quality index values, especially during power outages. This is of particular importance for communities with high asthma rates.	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
5	Primary	Facility	Building EE features	Smart technologies and intentional building design can make the building more energy efficient and resilient	This could include smart meters, smart thermostat, energy efficient lighting, potential HVAC retrofit, south facing windows, green roof, greywater reuse onsite, biophilic design standards, net zero energy. These features ensure building loads are minimized and not depleting the battery storage system for nonessential tasks. Green infrastructure features (subsurface infiltration, bioretention, porous pavement) can also support water storage and prevents flooding in time of heavy rainfall.	Mean Temperature, Proximity to Cooling Centers

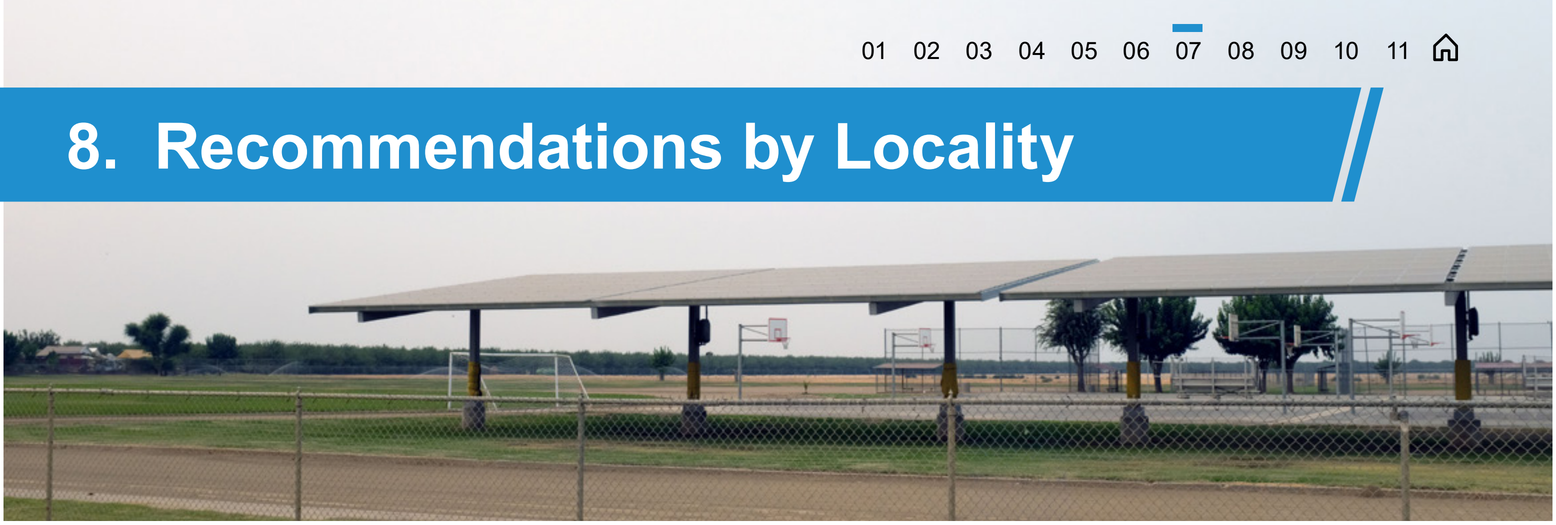
Item	Type	Category	Resilience Hub Features	Description	Value Add	Which Vulnerability indicators can be relieved?
6	Primary	Facility	Create a Fire Resistant Building and Fire Repellant Environment	1. Remove Flammable Material from Around the Building: The California Building Code requires that homeowners clear flammable vegetation within 100 feet (or the property line) around their buildings to create a defensible space for firefighters and to protect their homes from wildfires. 2. Construct the Building of Fire Resistant Material: The California Building Code requires the building to be constructed to resist burning embers. Fire resistant construction creates a barrier around the structure to minimize the likelihood of burning embers entering the building.	Fire prone areas should follow certain procedures to ensure buildings do not catch fire. The Hub can be a model of communities for how to properly prepare and can act as a safe haven in the event of a fire.	Fire Prone Areas
7	Primary*	Energy	Local Microgrid (individual resilience hub)	Solar and BESS installation is rooftop/ carport/ ground mounted with direct benefits to community members on their monthly utility bills. The system can transition to a standalone/island mode to continue to provide power as a microgrid in a power outage.	In normal times, directly benefits community members who are subscribers of the community solar program. During disruptions, families can rely on this hub to provide continued electricity for charging EVs and cell phones as well as continued air filtration, cooling, and a place to connect with and support other community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers
8	Primary	Community Programming	Emergency kits + Emergency Planning Workshops	In the event of a blackout, this Hub can provide emergency kits filled with nonperishable foods, water, radio, batteries, first aid kit. Workshops can be held monthly to help residents prepare.	These kits would be available year-round for residents to be proactive and prepared for potential blackouts. They can build their kit at the Hub to place in their car, home, and workplace in case of power shutdowns from fires, earthquakes, and other natural disasters.	Fire Prone Areas, Proximity to Emergency Departments

Item	Type	Category	Resilience Hub Features	Description	Value Add	Which Vulnerability indicators can be relieved?
9	Primary	Community Programming	Community Resource Map	Create a resource map for the community that includes all locations with solar and battery storageresources, water bodies, homes with cars, and homes with EVs. This can also include potentially hazardous areas in the event of a flood or fire- (the zones to avoid.) This can be an electronic and physical map all community members have access to.	Learning from the experiences of survivors of Hurricane Maria in Puerto Rico, this map was the key to locating resources for the broader community in the aftermath of the hurricane. Having a good idea of where community resources are located can save lives in an outage or extreme weather event.	Fire Prone Areas, EJ Communities, Poverty
10	Primary	Facility	Americans with Disabilities Act (ADA) site compliance	Access and support for low-mobility residents	This creates an inclusive space for all, especially those who require wheelchairs, other equipment for mobility.	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
11	Secondary	Facility	Floodproofing and Stormwater Management	Solutions can include engineered flood vents, water resistant building materials, flood gates, permeable pavers, green roofs.	In the event of heavy rainfall, a weatherproofed and water-resistant building will be vital to structural integrity of the building and continued resilience for community members.	EJ communities, Poverty
12	Secondary	Facility	Wi-Fi and Phone Charging Stations	Free Wi-Fi with charging stations for phone and laptops	During normal operation, this encourages a safe space for youth to gather and gain access to educational resources. In the event of a power outage, this helps community members with phone calls, messaging, and coordination with emergency responders.	Fire Prone Areas, Housing Burden, Poverty
13	Secondary	Facility	Trees and Greenspace	Trees and greenspace for public use	Trees can help to cool down the surrounding area, provide shade, areas for children to play, a path for running/exercise, and trauma and healing spaces. Marginalized communities normally have less access to green spaces which can negatively impact mental health and overall wellbeing.	Proximity to Cooling Centers, Housing Burden, Housing and Transportation Index, EJ communities, Poverty
14	Secondary	Facility	Kitchen + Food Storage	A space to make hot meals and hot beverages, refrigerator to store food for 50+ families	This can be especially useful for before/after school meals for children and houseless community members. There could be programming developed for hot meals to be served on a weekly or biweelky schedule. In the event of a disruption, this Hub could provide meals to those in need, similar to what some community centers resorted to in Puerto Rico to recover from Hurricane Maria. Community centers served food in their kitchens for over a year after the hurricane.	Housing Burden, EJ Communities, Poverty, Fire Prone Areas, Mean Temperature

Item	Type	Category	Resilience Hub Features	Description	Value Add	Which Vulnerability indicators can be relieved?
15	Secondary	Facility	Bathrooms, Locker Rooms, Showers	Running water to wash up, lockers to safely store valuables	Can support houseless communities in areas with few public bathrooms. In the event of a disruption, can provide a place to freshen up and allows community members to stay for long periods of time.	Housing Burden, EJ Communities, Poverty, Fire Prone Areas, Mean Temperature
16	Secondary	Facility	Video Chat with Medical Professionals	Web based video chat with a doctor in private room (Walgreens or other service can provide this)	Arrangement with local hospital to help address resident needs who cannot go to the hospital for cost or distance reasons	Asthma Percentile, Housing Burden, Housing and Transportation Index, EJ Communities, Poverty, Linguistic Isolation
17	Secondary	Community Programming	Jobs for Community Members	Enlist community members to support operation of the Hub and teach classes, prepare meals, keep the facility clean, and help others find information/ resources they need	With COVID-19 leaving many without jobs and many parents at home with children, there is an opportunity to provide community care and support. The Hub could employ and compensate community members for looking after children, cleaning the facility, teaching classes, preparing food, and supporting the general operation of the Hub.	Housing Burden, Housing and Transportation Index, EJ Communities, Poverty
18	Secondary	Community Programming	Community Emergency Response Team (CERT) Trainings and Workshops (www.ready.gov)	Trainings for volunteer community members to act as first responders locally	CERT leaders can assist community members that are in need of immediate support and assist in recovery needs.	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers
19	Secondary	Community Programming	Community-led classes	Free or pay what you can opportunity to facilitate community connectiveness, awareness, and preparedness.	These can be classes for teaching the elderly computer skills, English/Spanish language classes, how to provide emergency care like cardiopulmonary resuscitation (CPR), emergency prep for fires and earthquakes, trainings for the CERT, COVID information classes (How to schedule vaccine, etc.), art and music classes, and tailor certain classes for kids to substitute as a daycare or after-school programming	Housing Burden, Housing and Transportation Index, EJ Communities, Poverty, Linguistic Isolation
20	Secondary	Community Programming	Workspace with computers	A quiet space to utilize for working, access to computers and Wi-Fi	To best support students that do not have a quiet space to focus at home, provide access to those who need computers, offer a space for collaboration.	Housing Burden, Poverty

Item	Type	Category	Resilience Hub Features	Description	Value Add	Which Vulnerability indicators can be relieved?
21	Secondary	Community Programming	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Regular communication about how resilience hubs can be improved and best serve the community	Good forum to continue to improve the Hub and make sure it is serving the community.	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, EJ Communities, Poverty, Linguistic Isolation
22	Secondary	Community Programming	Event Room	Space for community events, organizing, campaign work, sign making, knowledge sharing, collaboration	A venue for open mics, community leader presentations, forums, lectures open to the public, organizing protests	EJ Communities, Poverty
23	Secondary	Community Programming	Online Forum or App to connect local resilience hubs	Online platform for communication among Hubs network	All Hubs can have an online forum in place to communicate in the event of a disruption so groups can share information about resources and community needs.	Fire Prone Areas
24	Secondary	Community Programming	Create a Zello app group (https://zello.com/) and draw awareness.	Learning from the experience of survivors in Texas during Hurricane Harvey in 2017, informal rescue groups came together to support calls for help on the Zello app (like CajunNavy and Texas Volunteer Relief group).	In the event of a disruption, community members can call for help to their specific community group. Using Hub micromobility options (E-scooters, E-bikes, EVs) community members and volunteers can mobilize and rescue those in need.	Fire Prone Areas
25	Secondary	Facility	Greenhouse/ Community Garden	A greenhouse or garden for growing produce for the community	This is a source of fresh, healthy food for communities in need. It can be maintained by a local gardener or community supported by volunteers. The vegetables can be used in the kitchen to make meals each day or sold at a local farmer's market. In the event of an emergency, this is a way to ensure some food production.	Housing Burden, Housing and Transportation Index, EJ communities, Poverty
26	Secondary	Facility	Smart Lighting System	To ensure Hubs are well lit at the entrance and in the surrounding area	Especially in rural areas there are not many streetlights. Adding a smart lighting system powered by solar strengthens security and accessibility to the Hub.	Housing Burden
27	Secondary	Facility	Water Filtration System	Provide clean drinking water through tap via water filtration system	Provide clean drinking water especially for communities who are supplied bottled water due to well contaminations, etc.	Housing Burden, Poverty

8. Recommendations by Locality



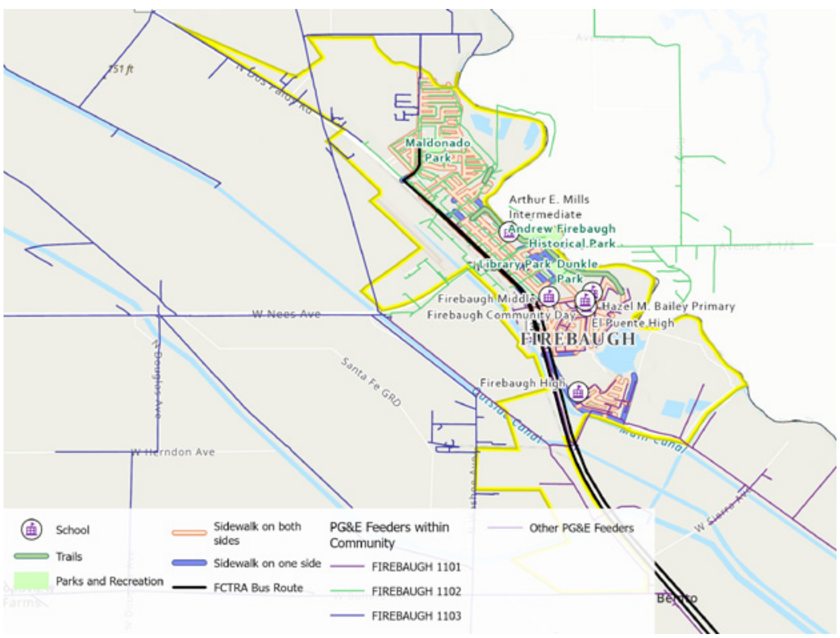
8.1 Rural Cities

In this section, thirteen rural cities are examined and a redundancy analysis is done based on each depot's energy consumption to determine the amount of solar panels required to offset charging loads.

8.1.1 Firebaugh

Firebaugh is a city along the San Joaquin River with a population of about 8,300. It is located about 40 miles west of Fresno. It was incorporated in 1914 and is one of the oldest towns on the west side. The city's borders can be seen in Figure 68 and includes the Firebaugh Airport; the Firebaugh-Las Deltas Joint Unified School District which serves 2 elementary schools, one junior high, and one high school; and a couple of vocational schools and community colleges. The San Joaquin Valley Railroad and SR 33 pass through the city's main streets as well.

Figure 68: Firebaugh Map



The City of Firebaugh is run by a Council-Manager form of government, where five elected council members serve four-year overlapping terms, and the Mayor is appointed by the council. The City manages the water supply and sewer system services and the community is served by the Firebaugh Police Department and Firebaugh Fire Department to assist in emergency situations. The Firebaugh General Plan was created in 2006 to plan development of the community through 2030. It addresses land use, transportation, housing, open space, conservation, safety, and notice.[19]

Firebaugh residents benefit from the Westside Transit line and Firebaugh-Mendota Transit line that makes stops in the community. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the

19 Fresno County Economic Development Corporation (2014, July). *Firebaugh. City of Firebaugh*. https://firebaugh.org/wp-content/uploads/2014/07/Profile.Firebaugh.2014.pdf

opportunity to reserve rides ahead of time during regular service hours. The city also has 1.7 miles of bicycle facilities and 33 miles of sidewalks.[20]

8.1.1.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Firebaugh facility. As summarized in Table 19, the fleet is estimated to consume 876.3 kWh based on each vehicle traveling 127 miles per day. Based on the assumed charger specifications, 180 kW of power demand is added from the charging stations. A 400A, 35kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 4.8 hours to recharge.

Table 19. Firebaugh Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Average Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	3	180	292.1	876.3
Sedan	0	0	38.1	0
Van	0	0	76.2	0
Total				**876.3**

The Firebaugh facility would need to install 472 solar panels onsite, taking up 3,800 ft² of space, to cover the charging load. Table 20 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

Table 20. Firebaugh Redundancy Equipment List

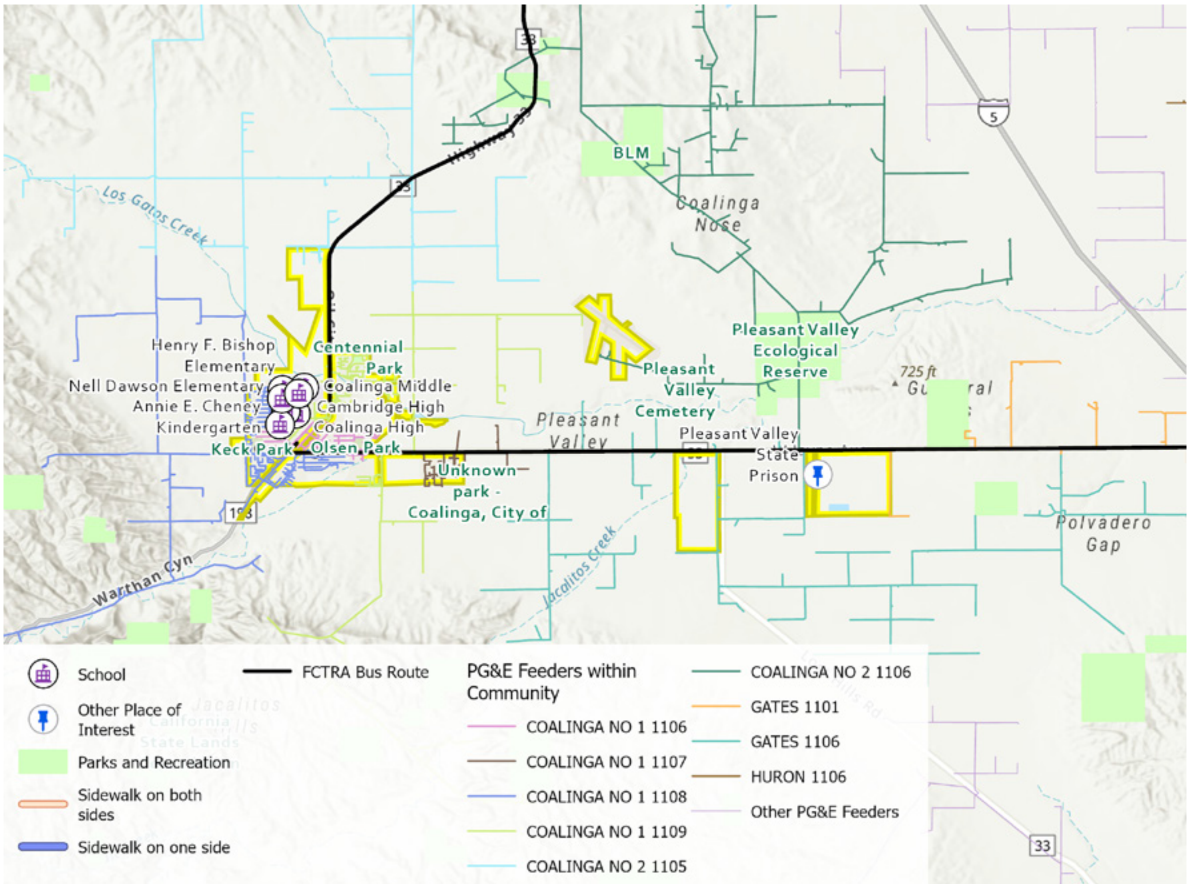
Equipment List	
(3) 60 kW charging stations	
Redundancy Equipment	**Cost**
400 A, 35 kA switchboard	$10,000
(472) 310 W Solar PV Panels	$252,000
1 Day Outage Coverage: 4 Powerpacks + 150 kVA Inverter	$657,000
3 Day Outage Coverage: 12 Powerpacks + 150 kVA Inverter	$1,971,000
7 Day Outage Coverage: 27 Powerpacks + 150 kVA Inverter Redundant Utility Feeder	$4,435,000

20 Fresno Council of Governments (2018, January). Chapter 7: Firebaugh. *Fresno County Regional Active Transportation Plan.* https://2ave3l244ex63mgdyc1u2mfp-wpengine.netdna-ssl.com/wp-content/uploads/2016/01/7FresnoRegATPReport_Firebaugh.pdf

8.1.2 Coalinga

Coalinga is a small city southwest of Fresno, in the San Joaquin Valley with a population of just under 17,000 people. Main industries in the region include oil and agriculture. The city's borders are shown in Figure 69 below and include the Pleasant Valley State Prison and Coalinga State Hospital.

Figure 69: Coalinga Map



Coalinga has developed a 2005-2025 General Plan that aims to protect the city center, encourage job growth, support development, and provide housing type diversity among other goals.[21] The City of Coalinga also developed the Natural Hazard Mitigation Plan to reduce the impact of natural disasters in the future. The City of Coalinga is responsible for providing fire department, police services, and treatment and distribution of water to residents.

Coalinga residents are able to drive anywhere in their town within 5 minutes, but it takes over an hour to reach other neighboring cities. Residents benefit from the Huron Inner-City Transit and Coalinga Intercity Transit lines to travel to the eastern region of the county. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours. In 2017, Coalinga developed its own active transportation plan for development of bike lanes, crosswalks sidewalks, and school site improvements.[22]

8.1.2.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Coalinga facility. As shown in Table 21, the fleet is estimated to consume 800 kWh based on each vehicle traveling 154 miles per day. Based on the assumed charger specifications, 129.6 kW of power demand is added from the charging stations. A 400 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 6 hours to recharge while vans take 9.6 hours.

21 City of Coalinga (2009, June). *General Plan 2005-2025.* https://www.coalinga.com/DocumentCenter/View/120/Coalinga-General-Plan-2025-PDF
22 City of Coalinga (2017, March). *Coalinga Active Transportation Plan.* https://www.coalinga.com/195/Coalinga-Active-Transportation-Plan

Table 21. Coalinga Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avg. Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	2	120	354.2	708.4
Sedan	0	0	46.2	0
Van	1	9.6	92.4	92.4
Total				**800.8**

The Coalinga facility would need to install 431 solar panels onsite, taking up about 3,450 ft² of space, to cover the charging load. Table 22 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

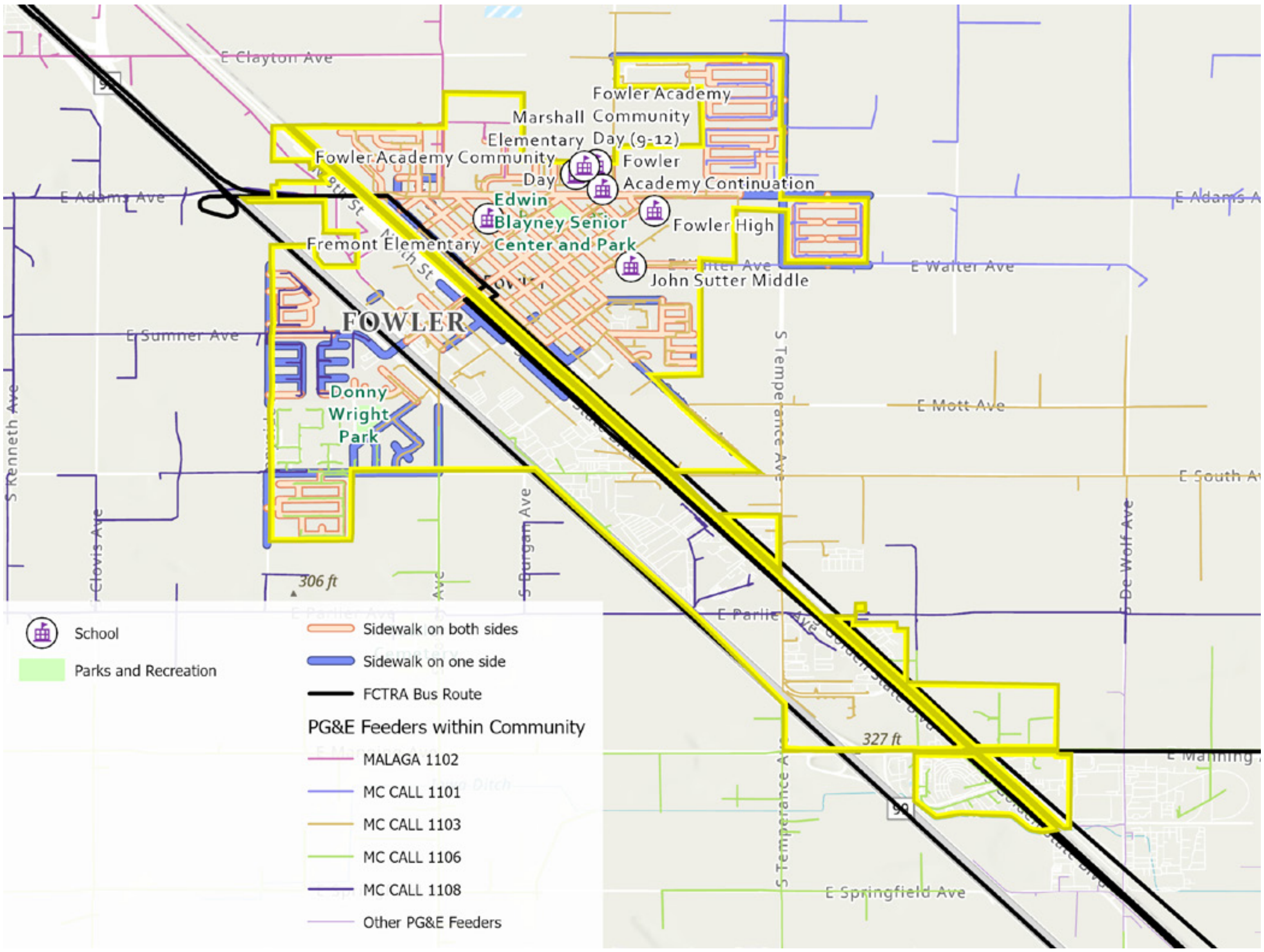
Table 22. Coalinga Redundancy Equipment List

Equipment List	
(2) 60kW charging stations (1) 9.6 kW charging station	
Redundancy Equipment	**Cost**
400 A, 35 kA switchboard	$10,000
(431) 310 W Solar PV Panels	$230,000
1 Day Outage Coverage: 4 Powerpacks + 200 kVA Inverter	$657,000
3 Day Outage Coverage: 11 Powerpacks + 200 kVA Inverter	$1,800,000
7 Day Outage Coverage: 27 Powerpacks + 200 kVA Inverter Redundant Utility Feeder	$4,100,000

8.1.3 Fowler

The City of Fowler is located 10 miles southeast of Fresno and was incorporated in 1908. It has a population of about 6,500 people and is located off of Golden State Highway 99. Fowler's city border can be seen in Figure 70 below. The City of Fowler is known as the Blossom Trail City and is the home to Champion Raisins. The area has a number of raisin and nut packaging plants.

Figure 70: Fowler Map

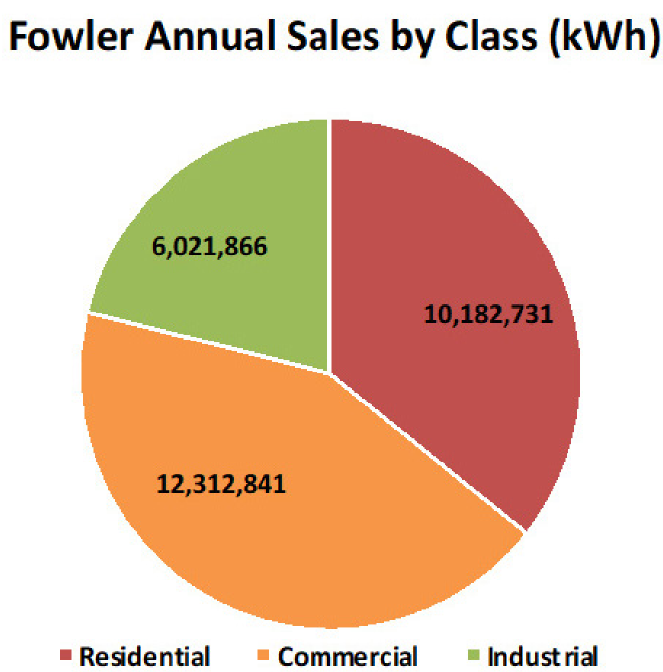


The City of Fowler has a City Manager that is appointed by the City Council. The City is responsible for providing general administrative, community and economic development, police, fire, water, recreation, and senior citizen services, while the sewer service is provided by the Selma-Kingsburg-Fowler Sanitation District and solid waste management by U.S.A. Waste, Inc. The City of Fowler's current General Plan was adopted in June 2004 and runs through 2025. The City is working on updating the plan to run through 2040, addressing new social and environmental issues and accurately representing current community conditions.

Residents currently benefit from the Southeast Transit, Kings Area Rural Transit (KART), and Kingsburg to Reedley College Transit routes. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours. The City of Fowler currently has about 42.9 miles of sidewalks, 7 miles of Class II bike lanes, and 1 miles of Class III bike routes.

MC CALL 1103, the feeder connected to the Fowler depot, has relatively little residential load, and primarily serves C&I customers, as shown in Figure 71.

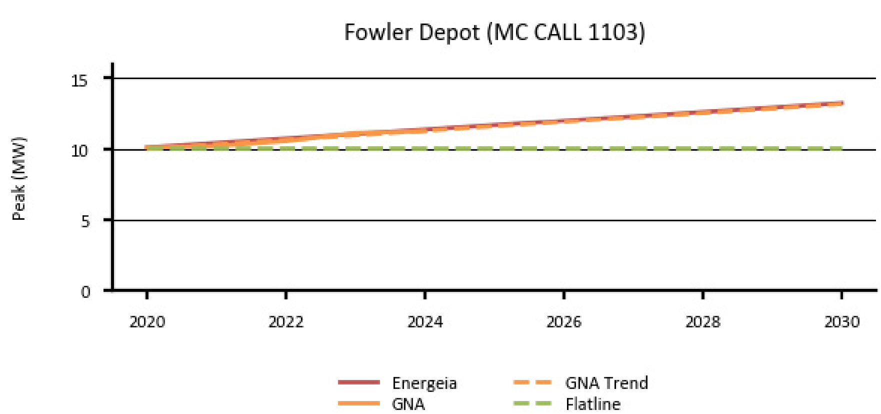
Figure 71: 2020 Sales by Class (kWh) – MC CALL 1103



Source: Energeia modeling

PG&E's GNA study indicates that MC CALL 1103 is expected to see fairly steady growth, illustrated in Figure 72.

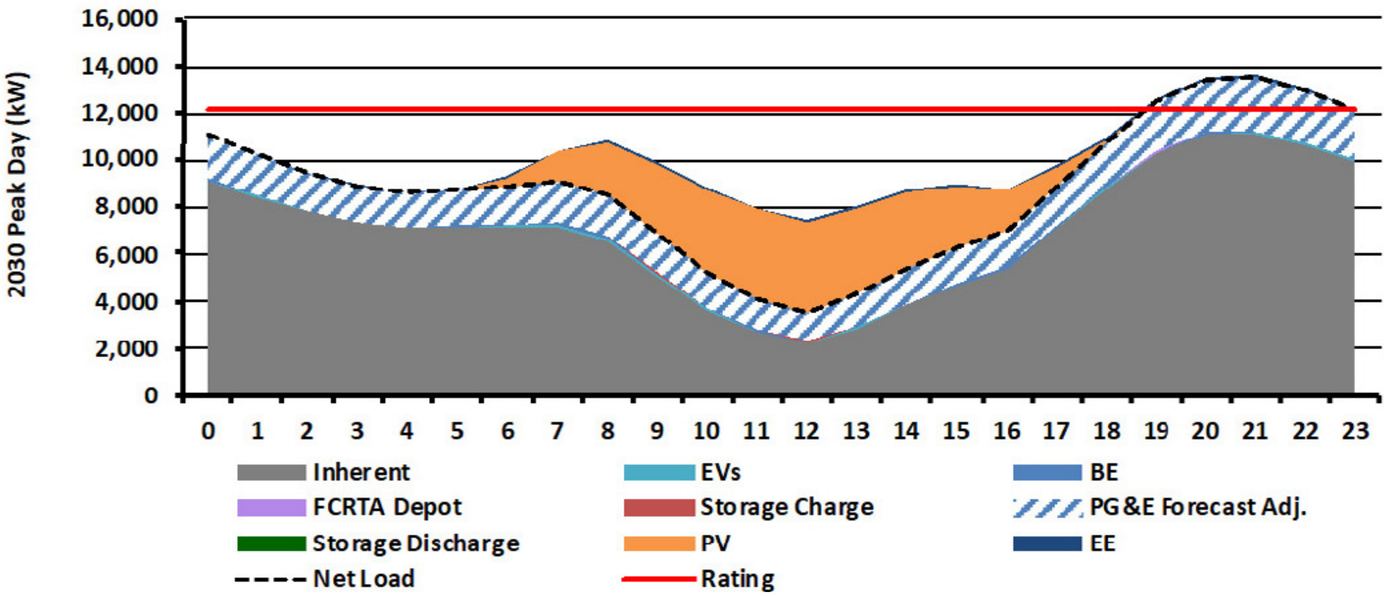
Figure 72: Peak Demand Forecast – MC CALL 1103



Source: Energeia modeling

In the load shape curve in Figure 73, the PG&E forecast adjustment (representing expected base load growth on the feeder) is the primary driver of the constraint. The Fowler depot only contributes a negligible 10 kW (the equivalent of about 3 residential clothes dryers) to the feeder's peak demand, or 0.07%.

Figure 73: 2030 Peak Day Load Shape by Component – MC CALL 1103



Source: Energeia modeling

The recommended level of storage for the Fowler depot could be part of a non-wires alternative solution but is too small on its own to defer or avoid feeder augmentation.

8.1.3.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Fowler facility. The fleet is estimated to consume 21.6 kWh based on each vehicle traveling 36 miles per day (shown in Table 23). Based on the assumed charger specifications, 9.6 kW of power demand is added from the charging stations. A 200 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in vans estimated to take about 2 hours to recharge.

Table 23. Fowler Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avg. Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	0	0	82.8	0
Sedan	0	0	10.8	0
Van	1	9.6	21.6	21.62
Total				**21.62**

The Coalinga facility would need to install 12 solar panels onsite, taking up about 100 ft² of space, to cover the charging load. Table 24 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

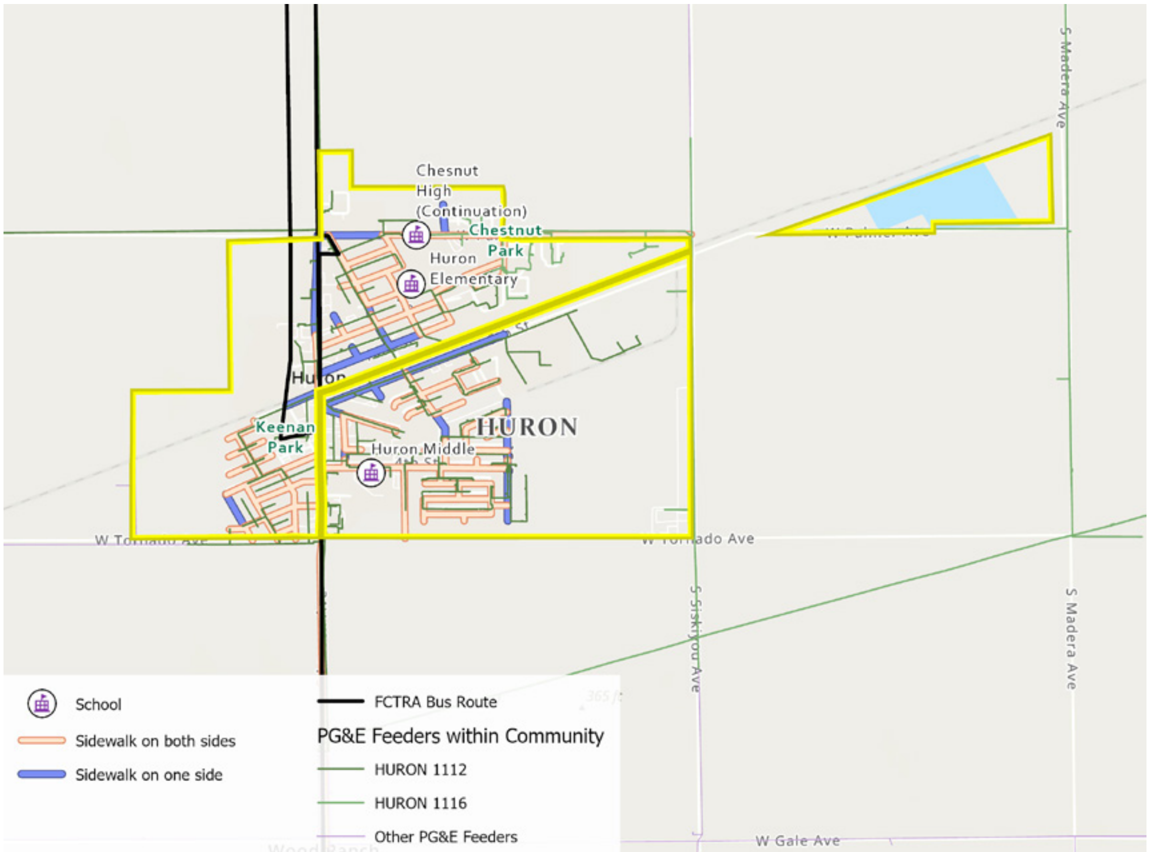
Table 24. Fowler Redundancy Equipment List

Equipment List	
(1) 9.6 kW charging station	
Redundancy Equipment	**Cost**
200 A, 35 kA switchboard	$8,000
(12) 310 W Solar PV Panels	$6,400
1 Day Outage Coverage: 1 Powerpacks + 70 kVA Inverter	$165,000
3 Day Outage Coverage: 1 Powerpacks + 70 kVA Inverter	$165,000
7 Day Outage Coverage: 1 Powerpack + 70 kVA Inverter Redundant Utility Feeder	$165,000

8.1.4 Huron

The City of Huron is about 50 miles southwest of Fresno, incorporated in 1951. It has a population of just over 7,000, with this number increasing to 15,000 during the harvest season due to increased number of migrant workers. The farmland in this region is primarily used to grow lettuce, tomatoes, and onions. See Figure 74 below to see the city's borders.

Figure 74: Huron Map



The City of Huron has a Mayor that is elected every two years in a general election and four members of City Council who are elected for four-year terms. The City is responsible for providing all municipal services in the community and has a General Plan that was adopted in 2007, providing goals and strategies for development through 2025[23].

Residents benefit from the Coalinga and Huron Intercity Transit lines that have a stop in the community. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours. The City of Huron has 18 miles of existing sidewalks and 0.5 miles of Class II bike lanes.

23 Alcorn, J. (2007, July 18). *General Plan 2025: Policies Statement.* City of Huron. http://cityofhuron.com/wp-content/uploads/2014/08/City-of-Huron-General-Plan-2025-Policies-Statement1.pdf

8.1.4.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Huron facility. Per Table 25 below, the fleet is estimated to consume 552 kWh based on each vehicle traveling 80 miles per day. Based on the assumed charger specifications, 180 kW of power demand is added from the charging stations. A 400 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 3 hours to recharge.

Table 25. Huron Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avg. Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	3	180	184	552
Sedan	0	0	24	0
Van	0	0	48	0
Total				**552**

The Huron facility would need to install 297 solar panels onsite, taking up about 2,400 ft² of space, to cover the charging load. Table 26 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

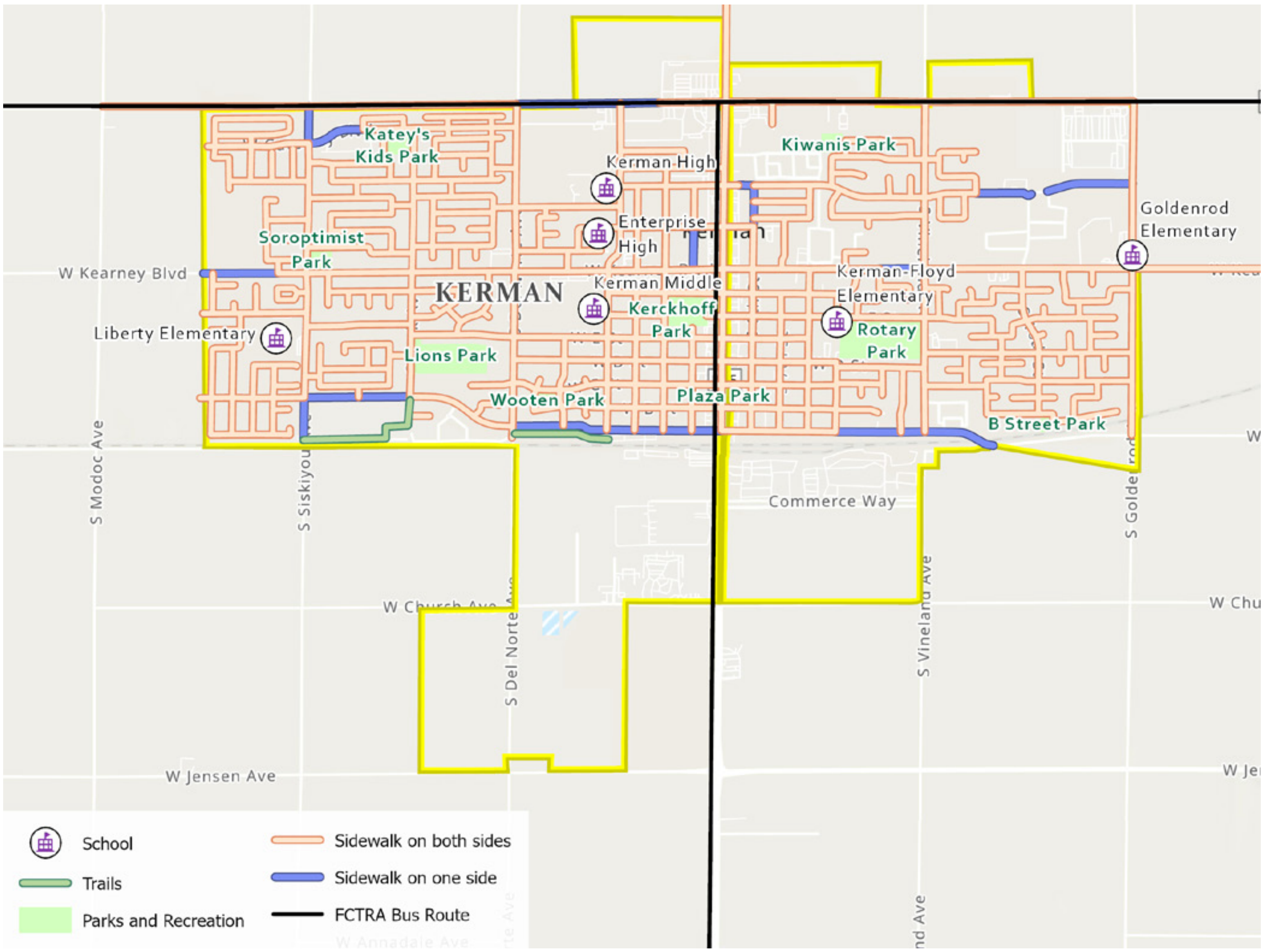
Table 26. Huron Redundancy Equipment List

Equipment List	
(3) 60kW charging stations	
Redundancy Equipment	**Cost**
400 A, 35 kA switchboard	$10,000
(297) 310 W Solar PV Panels	$159,000
1 Day Outage Coverage: 3 Powerpacks + 250 kVA Inverter	$493,000
3 Day Outage Coverage: 8 Powerpacks + 250 kVA Inverter	$1,314,000
7 Day Outage Coverage: 17 Powerpacks + 250 kVA Inverter Redundant Utility Feeder	$2,793,000

8.1.5 Kerman

Kerman is located 15 miles west of Fresno with a population of about 14,800 people. It was incorporated in 1946. The city's borders are seen in Figure 75 below. The area is primarily agricultural but is developing an industrial park and has a number of growing businesses. Kerman has over 47 acres of developed parks, including Lions Park, Wooten Park, and Kerckhoff park. The community is served by the Kerman Unified School District with over 4,500 enrolled students across 7 campuses.[24]

Figure 75: Kerman Map



24 City of Kerman (n.d.). *About*. https://cityofkerman.net/about/

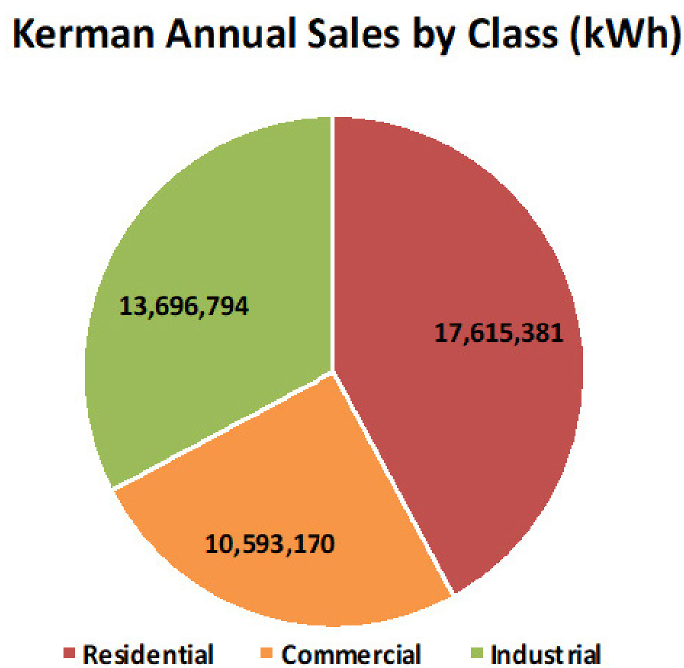
The City of Kerman has four City Council members and a Mayor. The City is responsible for providing facilities, programs, and services to the community within the Parks and Recreation Department, Police Department, and Public Works.

The City of Kerman 2040 General Plan was adopted by the City Council in July 2020.[25] The plan establishes standards for new development and city improvements. The City Council also approved the Economic Development Strategy in February of 2021 with goal of focusing on business expansion, attraction, and entrepreneurship.[26]

Residents benefit from MV Transportation's Dial-A-Ride which transports residents within the Kerman city limit on the Kerman Transit Bus. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours. FCRTA operates the Westside Transit line as well which provides access to all of the westside cities. Kerman currently has 82 miles of sidewalks, and about 18 miles of bike paths/lanes.

KERMAN 1102 is a more typical feeder in terms of customer mix, with residential customers consuming most of the energy on an annual basis, as shown in Figure 76.

Figure 76: 2020 Sales by Class (kWh) – KERMAN 1102

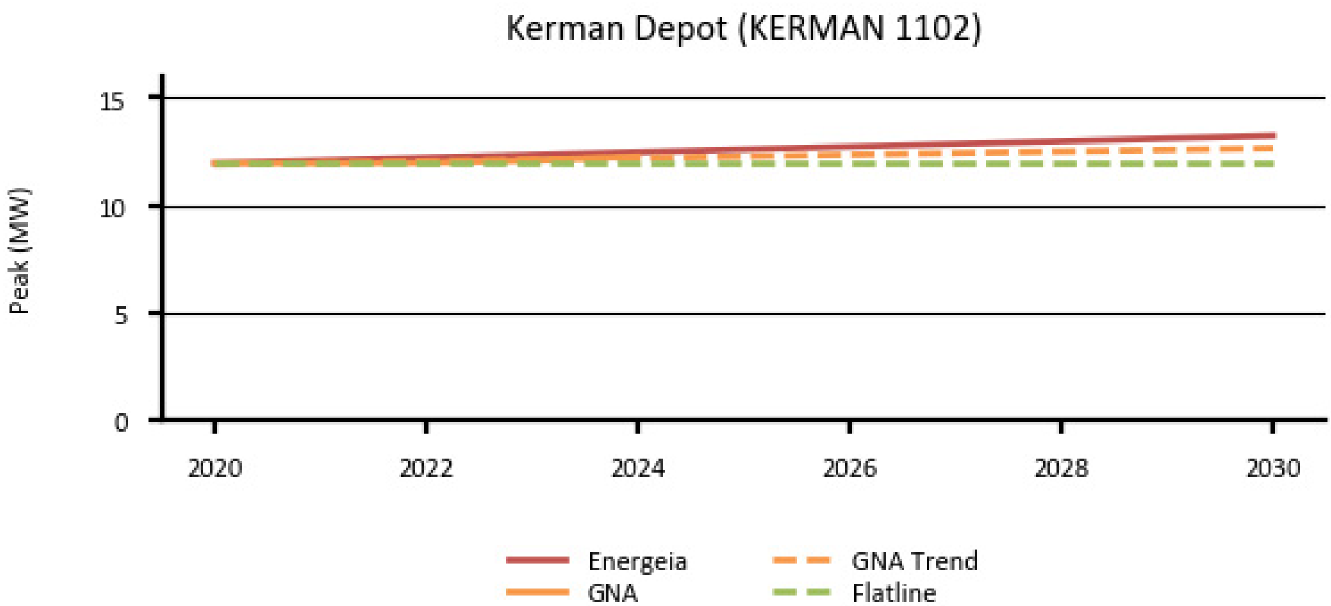


Source: Energeia modeling

25 City of Kerman (2020, July). *2040 General Plan: Policy Document.* https://kermangp.com/images/docs/kpgu_final_general_plan.pdf
26 City of Kerman (n.d.). *Economic Development.* https://cityofkerman.net/economic-development/

As illustrated in Figure 77, modest growth is forecasted for KERMAN 1102, with electric vehicle impacts having a moderate effect on peak demand due to the higher residential density.

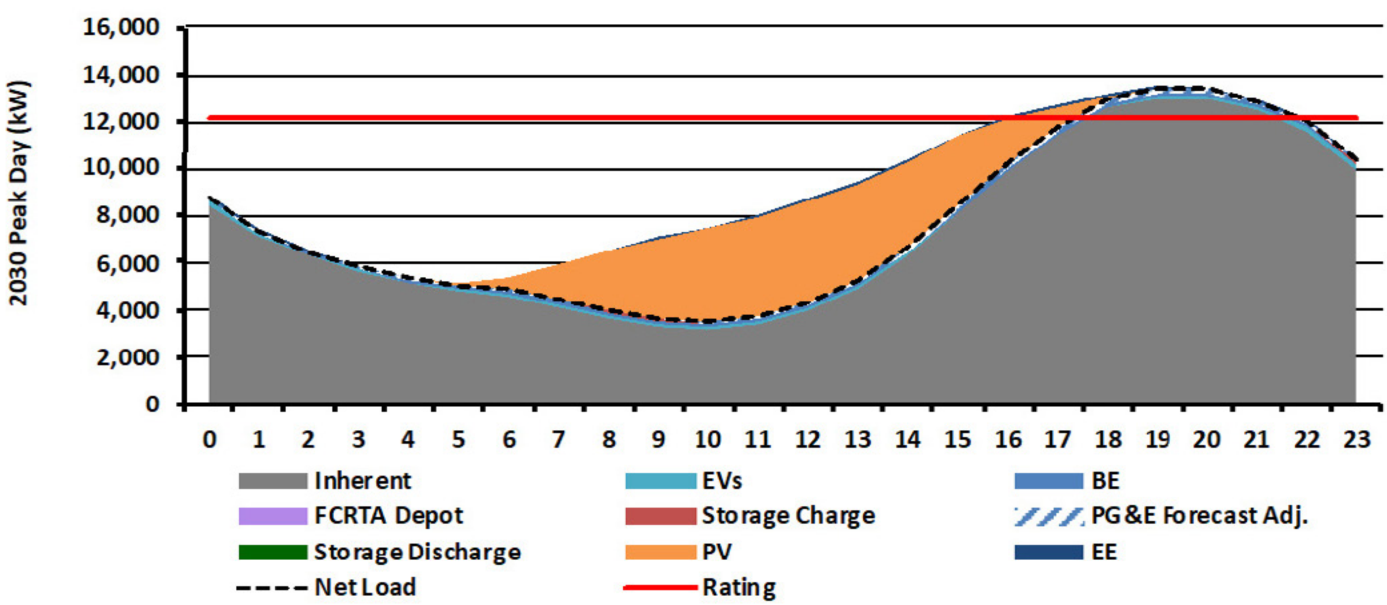
Figure 77: Peak Demand Forecast – KERMAN 1102



Source: Energeia modeling

Like many other Fresno County feeders, KERMAN 1102 peaks at 8 pm, after solar generation wanes. Bus charging at the FCRTA depot only contributes about 60 kW (0.5%) to peak demand, though the overload margin is similarly small. This is demonstrated in Figure 78.

Figure 78: 2030 Peak Day Load Shape by Component – KERMAN 1102



Source: Energeia modeling

The recommended storage capacity for this site may be able to defer the timing of augmentation. While it is only 360 kWh, it appears to be sufficient to avoid the 2030 overload condition shown above.

8.1.5.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Kerman facility. The fleet is estimated to consume 187.1 kWh based on each vehicle traveling 79 miles per day. These figures are provided in Table 27. Based on the assumed charger specifications, 60 kW of power demand is added from the charging stations. A 200 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take about 3 hours to recharge.

Table 27. Kingsburg Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Average Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	1	60	181.7	181.7
Sedan	0	0	23.7	0
Van	0	0	47.4	0
Total				181.7

The Kerman facility would need to install 98 solar panels onsite, taking up 790 ft² of space, to cover the charging load. Table 28 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

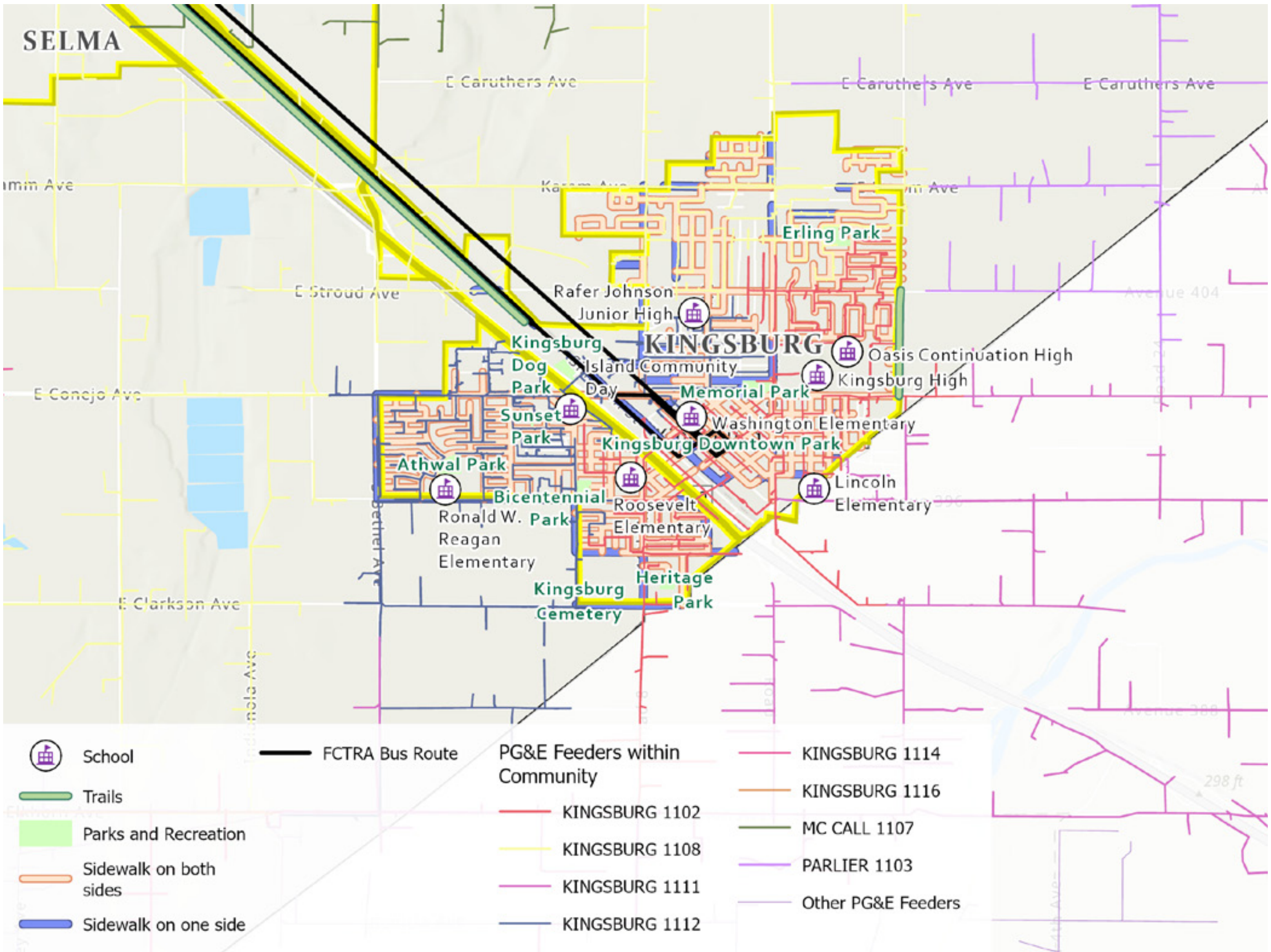
Table 28. Kerman Redundancy Equipment List

Equipment List	
(1) 60 kW charging station	
Redundancy Equipment	**Cost**
200 A, 35 kA switchboard	$8,000
(98) 310 W Solar PV Panels	$53,000
1 Day Outage Coverage: 1 Powerpacks + 125 kVA Inverter	$165,000
3 Day Outage Coverage: 3 Powerpacks + 125 kVA Inverter	$493,000
7 Day Outage Coverage: 6 Powerpacks + 125 kVA Inverter Redundant Utility Feeder	$986,000

8.1.6 Kingsburg

Kingsburg is located about 20 miles southeast of Fresno and 5 miles southeast of Selma. The city is located along Highway 99 and has a population of about 12,000 people. The city was incorporated in 1908 and was originally known as "Little Sweden" for the Swedish-style buildings and 94% Swedish American population. Kingsburg is known for its supply of raisins and table grapes and is the location of Sun Maid Grower headquarters, the largest raisin cooperative in the world.[27] See Figure 79 for the city's map.

Figure 79: Kingsburg Map



The City of Kingsburg is governed by four members of the City Council and the mayor. The City is responsible for providing waste management, water, public works, public safety, and parks and recreation services. It has launched a number of incentives and programs to support expansion of small and large businesses in the town. Local parks in the city include Athwal Park, Bicentennial Park, and Memorial Park. The city is served by the Kingsburg Elementary Charter School District and Kingsburg High School.

Residents enjoy access to the Kingsburg to Reedley College Transit and Southeast Transit lines provided by FCRTA. Currently there are 74 miles of sidewalks and almost 10 miles of bike paths/lanes. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

27 City of Kingsburg (2019). *Economic Overview.* https://www.cityofkingsburg-ca.gov/DocumentCenter/View/1070/City-of-Kingsburg-2019-Economic-Profile

8.1.6.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Kingsburg facility. The fleet is estimated to consume 510.4 kWh based on each vehicle traveling 88 miles per day, as exemplified in Table 29. Based on the assumed charger specifications, 139.2 kW of power demand is added from the charging stations. A 400 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 3.4 hours to recharge, and vans take 5.5 hours.

Table 29. Kingsburg Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Average Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	2	120	202.4	404.8
Sedan	0	0	26.4	0
Van	2	19.2	52.8	105.6
Total				510.4

The Coalinga facility would need to install 275 solar panels onsite, taking up 2200 ft² of space, to cover the charging load. Table 30 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

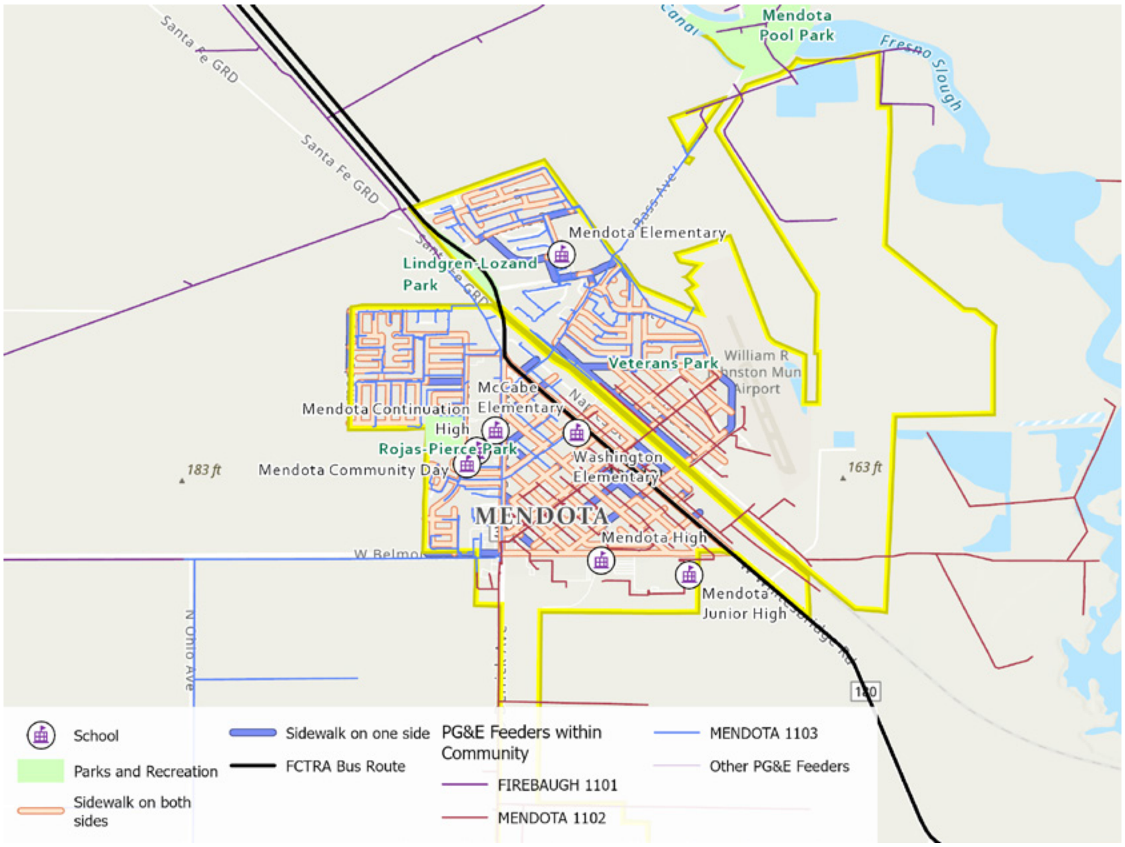
Table 30. Kingsburg Redundancy Equipment List

Equipment List	
(2) 60 kW charging stations (2) 9.6 kW charging stations	
Redundancy Equipment	**Cost**
400 A, 35 kA switchboard	$10,000
(275) 310 W Solar PV Panels	$147,000
1 Day Outage Coverage: 3 Powerpacks + 275 kVA Inverter	$493,000
3 Day Outage Coverage: 7 Powerpacks + 275 kVA Inverter	$1,150,000
7 Day Outage Coverage: 16 Powerpacks + 275 kVA Inverter Redundant Utility Feeder	$2,629,000

8.1.7 Mendota

Mendota is about 30 miles west of Fresno and 8 miles southeast of Firebaugh. The city has a population of over 11,500 people and was incorporated in 1942. Mendota is known as the “Cantaloupe Center of the World,” due to its large production of melons. See Figure 80 below for the city map.

Figure 80: Mendota Map



The City of Mendota General Plan 2005-2025 was adopted in 2009. The plan addresses the importance of preserving agricultural jobs in the community but as more jobs become mechanized, looks at opportunities to expand its economic base.[28]

The City of Mendota has four council members and a mayor. The City of Mendota also has a number of recreational opportunities including four city parks and the Mendota Wildlife Refuge. It also has an active youth sports program that has won many awards.

Residents benefit from the Firebaugh-Mendota Transit and Westside Transit lines. Mendota currently has 45 miles of sidewalks and 1.2 miles of bike lanes. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

28 City of Mendota (2009, August 11). *General Plan Update 2005-2025*. http://ci.mendota.ca.us/wp-content/uploads/2014/06/City-of-Mendota-General-Plan-Update.pdf

8.1.7.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Mendota facility. As summarized in Table 31, the fleet is estimated to consume 149.5 kWh based on each vehicle traveling 65 miles per day. Based on the assumed charger specifications, 60 kW of power demand is added from the charging stations. A 200 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 2.5 hours to recharge.

Table 31. Mendota Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Average Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	1	60	149.5	149.5
Sedan	0	0	19.5	0
Van	0	0	39	0
Total				**149.5**

The Mendota facility would need to install 81 solar panels onsite, taking up about 650 ft² of space, to cover the charging load. Table 32 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

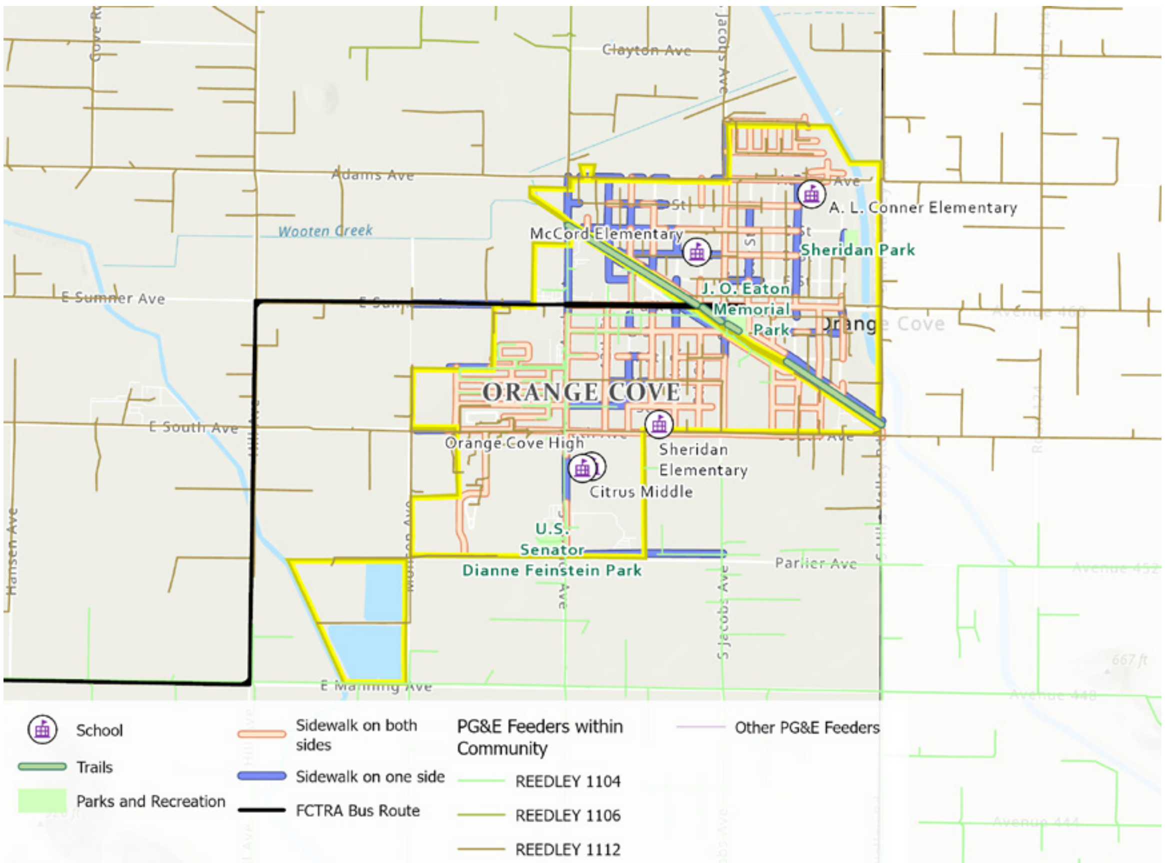
Table 32. Mendota Redundancy Equipment List

Equipment List	
(1) 60 kW charging station	
Redundancy Equipment	**Cost**
200 A, 35 kA switchboard	$8,000
(81) 310 W Solar PV Panels	$44,000
1 Day Outage Coverage: 1 Powerpacks + 300 kVA Inverter	$165,000
3 Day Outage Coverage: 2 Powerpacks + 300 kVA Inverter	$329,000
7 Day Outage Coverage: 5 Powerpacks + 300 kVA Inverter Redundant Utility Feeder	$822,000

8.1.8 Orange Cove

Orange Cove is located about 35 miles southeast of Fresno with a population of over 10,000 people. It was incorporated in 1948 and lies along the eastern foothills of the Sierra Nevada Mountains. Orange Cove is known for its hundreds of acres of orange and lemon citrus fruit that grow year-round. Many packing houses are located around the community to process the fruit. The City is also the site of the annual Fresno County Blossom Trail event which kicks off the growing season in the spring. See Figure 81 below for a map of the city.

Figure 81: Orange Cove Map



Orange Cove has a Council-Manager form of government with four City Council Members and the Mayor. The City Council recently established the Orange Cove Police Department in 2009. The City is responsible for providing programming and services to the community through their departments of Finance, Planning & Building, Public Works, and Police. The Orange Cove General Plan spans from 2003 through 2030 and establishes guidance for future planning.

Residents currently benefit from the Orange Cove Intercity Transit route provided by FCRTA. Currently there are 34.5 miles of sidewalks and 3.5 miles of bike paths/lanes. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

8.1.8.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Orange Cove facility. The fleet is estimated to consume 828 kWh based on each vehicle traveling 180 daily miles per day – shown below in Table 33. Based on the assumed charger specifications, 120 kW of power demand is added from the charging stations. A 400 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take about 7 hours to recharge.

Table 33. Parlier Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avgerage Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	2	120	414	828
Sedan	0	0	54	0
Van	0	0	108	0
Total				**828**

The Orange Cove facility would need to install 341 solar panels onsite, taking up 2,728 ft² of space, to cover the charging load. Table 34 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

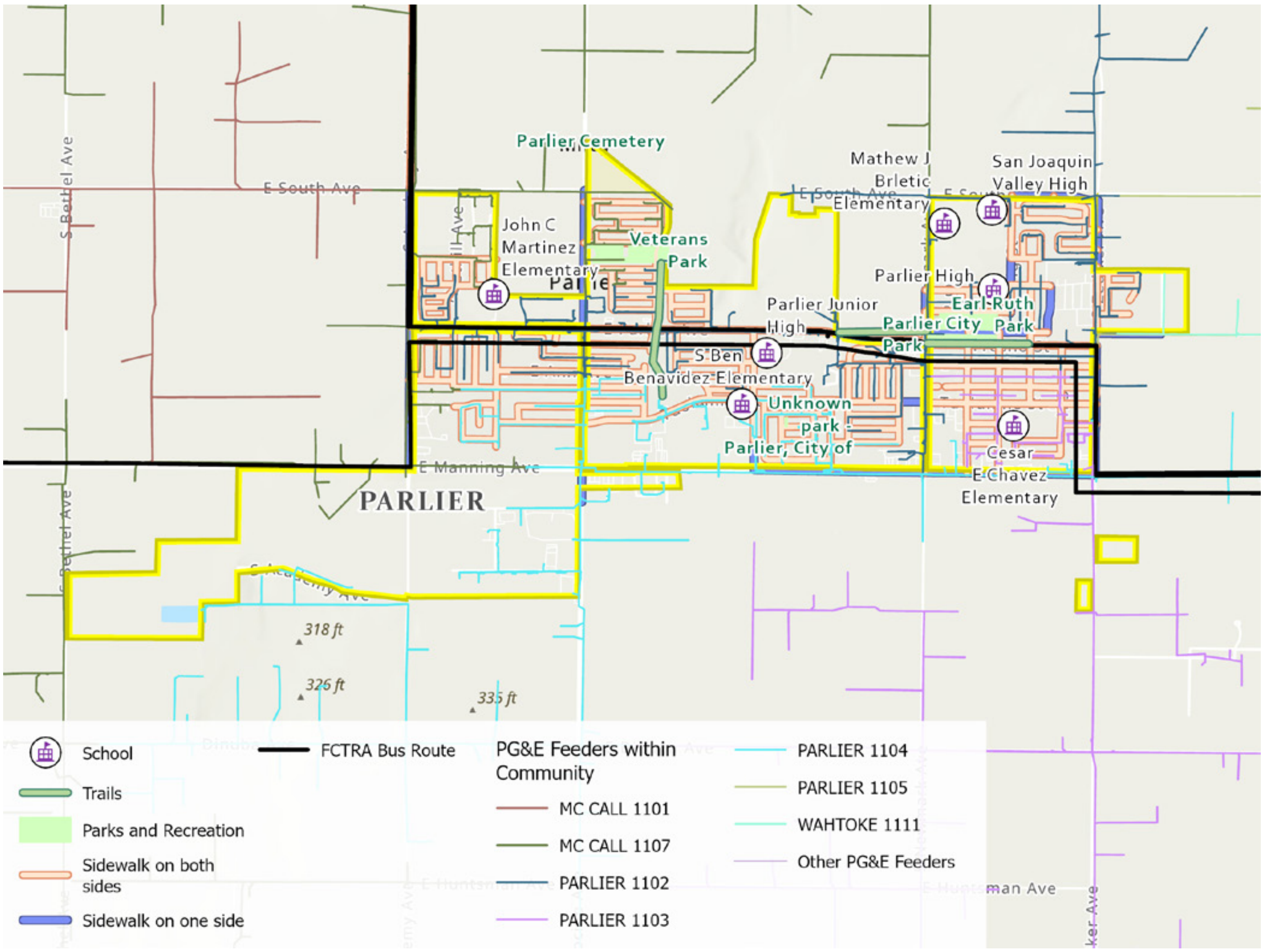
Table 34. Orange Cove Redundancy Equipment List

Equipment List	
(2) 60 kW charging stations	
Redundancy Equipment	**Cost**
400 A, 35 kA switchboard	$10,000
(446) 310 W Solar PV Panels	$238,000
1 Day Outage Coverage: 4 Powerpacks + 275 kVA Inverter	$658,000
3 Day Outage Coverage: 11 Powerpacks + 275 kVA Inverter	$1,807,000
7 Day Outage Coverage: 25 Powerpacks + 275 kVA Inverter Redundant Utility Feeder	$4,107,000

8.1.9 Parlier

Parlier is a city about 20 miles southeast of Fresno and 8 miles northeast from Selma with a population of about 15,000 people. It was incorporated in 1921 and is primarily an agricultural community that produces grapes, raisins, and tree fruit. See Figure 82 below for the city map.

Figure 82: Parlier Map



Parlier has a Council-Manager form of government with four City Council Members and the Mayor. The City is responsible for providing programming and services to the community through their departments of Finance, Planning & Building, Public Works, and Police. The City of Parlier support growth of small and large businesses through incentive programs and is developing a 297 acre site for a new business/industrial park. The City adopted an update to the Parlier General Plan in 2010 which establishes guidance for planning measure through 2030.

Parlier residents benefit from FCRTA's Kingsburg to Reedley College and Orange Cove Intercity Transit lines. Currently the city has about 54 miles of sidewalks and 11 miles of bike paths/lanes. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

8.1.9.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Parlier facility. The fleet, summarized in Table 35, is estimated to consume 44.4 kWh based on each vehicle traveling 74 miles per day. Based on the assumed charger specifications, 9.6 kW of power demand is added from the charging stations. A 200 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in vans estimated to take 4.6 hours to recharge.

Table 35. Parlier Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Average Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	0	0	170.2	0
Sedan	0	0	22.2	0
Van	1	9.6	44.4	44.4
Total				**44.4**

The Parlier facility would need to install 24 solar panels onsite, taking up 200 ft² of space, to cover the charging load. Table 36 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

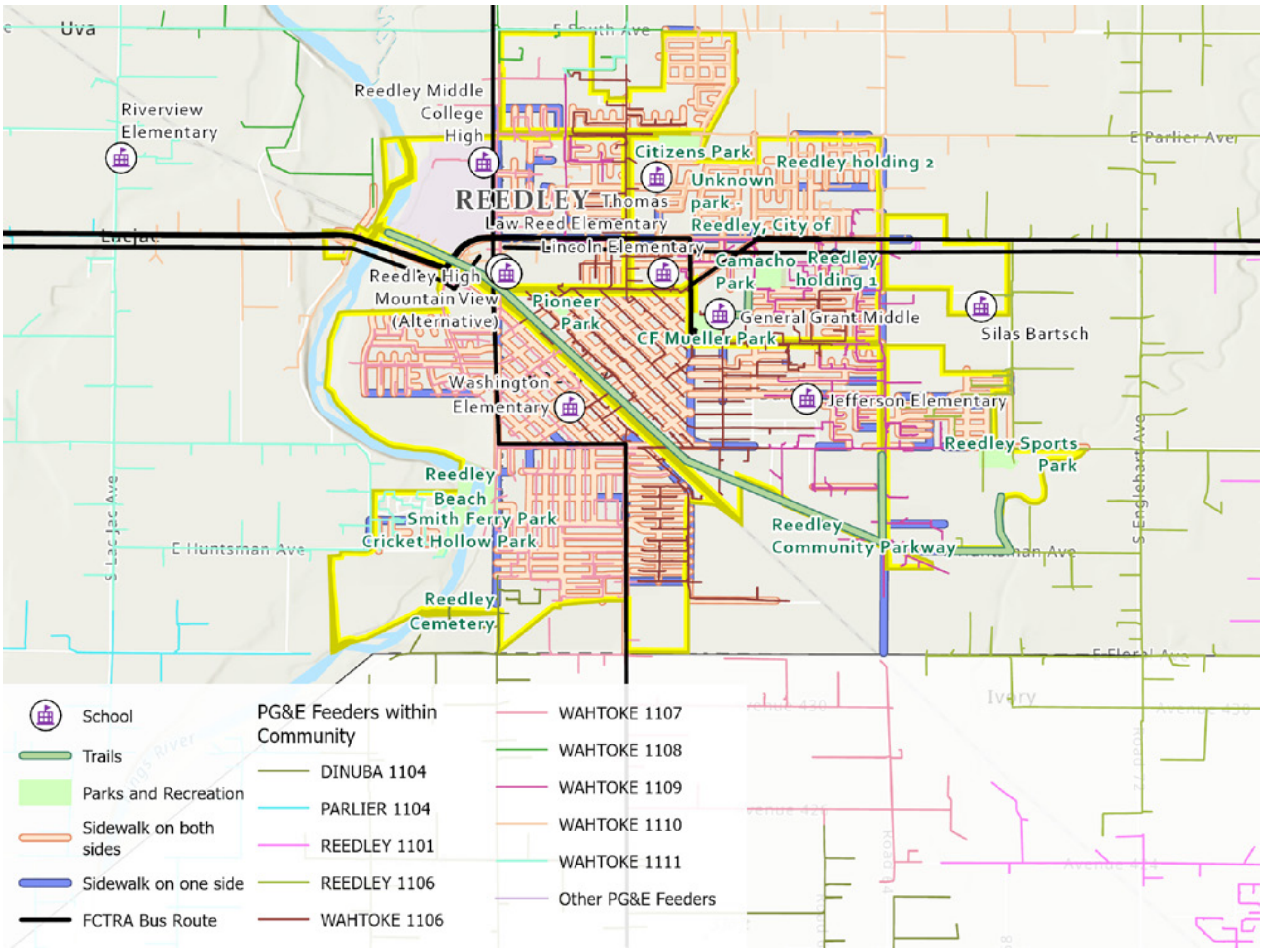
Table 36. Parlier Redundancy Equipment List

Equipment List	
(1) 9.6 kW charging station	
Redundancy Equipment	**Cost**
200 A, 35 kA switchboard	$8,000
(24) 310 W Solar PV Panels	$13,000
1 Day Outage Coverage: 1 Powerpack + 200 kVA Inverter	$165,000
3 Day Outage Coverage: 1 Powerpack + 200 kVA Inverter	$165,000
7 Day Outage Coverage: 2 Powerpacks + 200 kVA Inverter Redundant Utility Feeder	$329,000

8.1.10 Reedley

Reedley is located about 20 miles southeast of Fresno along Kings River. It has a population of almost 26,000 people and was incorporated in 1913. Reedley is known as the "World's Fruit Basket" for its ability to produce and ship fresh fruit of different variety. It has over thirty fruit and vegetable packing and cold storage facilities as well as wineries. Some landmarks in the city includes the Reedley Beach along Kings River and the Reedley Museum which shows the history of the town. See Figure 83 below for a map of the city.

Figure 83: Reedley Map



The City of Reedley is governed by a City Council and Mayor. The Planning Commission has provided full city services including a municipal airport, water system, sewer plant, and trash collection. Recently a modern hospital has also been developed with a new birthing center. The Reedley General Plan was adopted in 2014 for guidance on planning and development efforts through 2030.

Reedley is served by the Kings Canyon Unified School District which include seven elementary, three junior, and two high schools that are both public and private. In total the school system serves over 6,000 students. Reedley is also home to Reedley College, offering students select certificates and associated degree programs.[29]

Reedley residents benefit from FCRTA's Kingsburg to Reedley College, Dinuba Connection, and Orange Cove Intercity Transit lines. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours. Currently Reedley has 126 miles of sidewalks and about

29 City of Reedley (n.d.). *History.* https://reedley.ca.gov/about-reedley/history/

15 miles of Class I, II, and III bike paths. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

8.1.10.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Reedley facility. Demonstrated in Table 37 below, the fleet is estimated to consume 874 kWh based on each vehicle traveling 76 daily miles per day. Based on the assumed charger specifications, 300 kW of power demand is added from the charging stations. An 800 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take about 3 hours to recharge.

Table 37. Reedley Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avgerage Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	5	300	174.8	874
Sedan	0	0	22.2	0
Van	0	0	45.6	0
Total				**874**

The Reedley facility would need to install 470 solar panels onsite, taking up 3800 ft² of space, to cover the charging load. Table 38 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

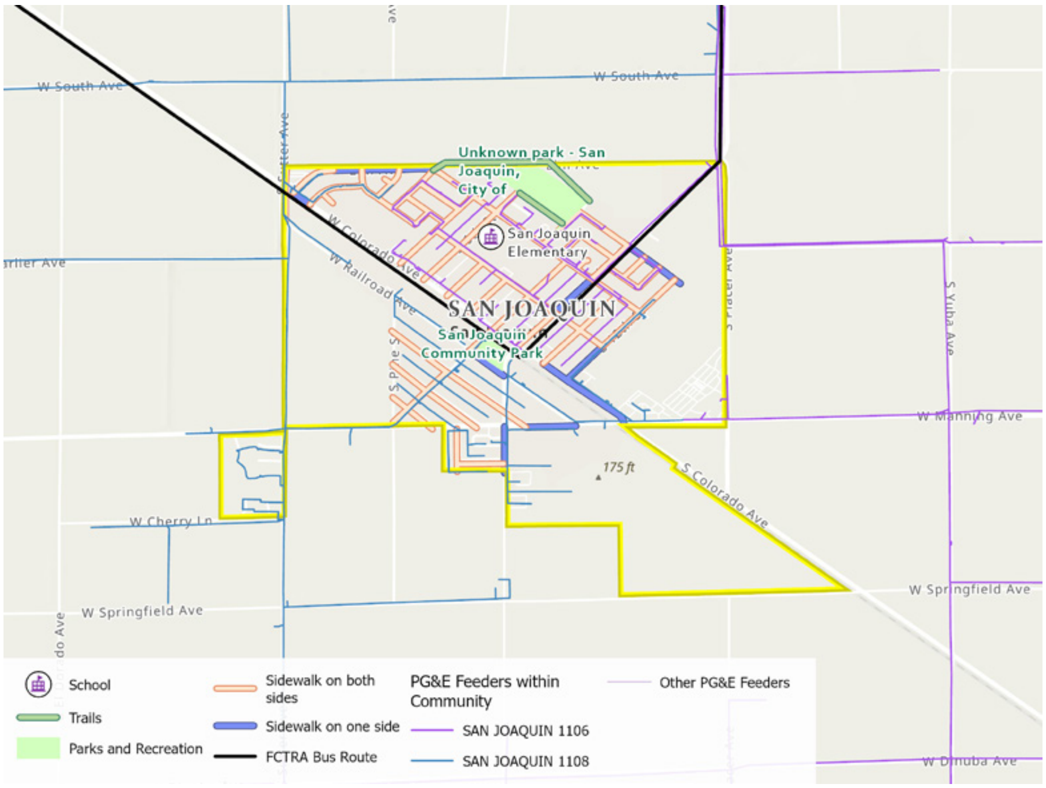
Table 38. Reedley Redundancy Equipment List

Equipment List	
(5) 60kW charging stations	
Redundancy Equipment	**Cost**
800 A, 35 kA switchboard	$12,000
(470) 310 W Solar PV Panels	$251,000
1 Day Outage Coverage: 4 Powerpacks + 375 kVA Inverter	$658,000
3 Day Outage Coverage: 12 Powerpacks + 375 kVA Inverter	$1,972,000
7 Day Outage Coverage: 27 Powerpacks + 375 kVA Inverter Redundant Utility Feeder	$4,435,000

8.1.11 San Joaquin

The City of San Joaquin is located 30 miles southwest of Fresno and 11 miles southwest of Kerman. It has a population of about 4,000 people and was incorporated in 1920. It is located near I-5 and SRs 33, 180, 145, 41, and 99. The Parks and Recreation department has developed 6 areas in the community including the Leo Cantu Community Center in downtown, San Joaquin Veterans Memorial Hall, The San Joaquin Senior Center providing programming for individuals over the age of 55, the San Joaquin Park Sports Complex, and Peter Rusconi Park. See Figure 84 below for the city map.

Figure 84: San Joaquin Map



San Joaquin has a Council-Manager form of government consistent of four council members that elect a Mayor. The City has provided full services to residents through their Finance, Public Works, Utilities, Police, and Fire departments. The San Joaquin General Plan adopted in 2014 incorporates the 2040 Community Plan that was prepared by the California Polytechnic State University at San Luis Obispo School of City and Regional Planning,[30] Valley Blueprint Integration Program, recommendations of the City of Joaquin Mobility and Revitalization Plan, and recommendations from the City of San Joaquin Model Energy Efficient Plan for Rural Housing.

San Joaquin residents benefit from FCRTA's San Joaquin Intercity Transit route that runs through the city. The city currently has 13.8 miles of sidewalks and 2.8 miles of bicycle paths/lanes. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

30 California Polytechnic State University at San Luis Obispo Graduate Community and Regional Planning Studio (2011, June). Volume I: Background Report. *City of San Joaquin 2040 Community Plan. City of San Joaquin.* https://www.cityofsanjoaquin.org/policies/volume3/San%20Joaquin%20Background%20Report.pdf

8.1.11.1 Redundancy Analysis

This section presents required equipment and redundancy options for the San Joaquin facility. The fleet is estimated to consume 299 kWh based on each vehicle traveling 130 miles per day (refer to Table 39 for details). Based on the assumed charger specifications, 60 kW of power demand is added from the charging stations. A 200 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 5 hours to recharge.

Table 39. San Joaquin Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avgerage Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	1	60	299	299
Sedan	0	0	39	0
Van	0	0	78	0
Total				**299**

The San Joaquin facility would need to install 161 solar panels onsite, taking up 1,300 ft² of space, to cover the charging load. Table 40 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

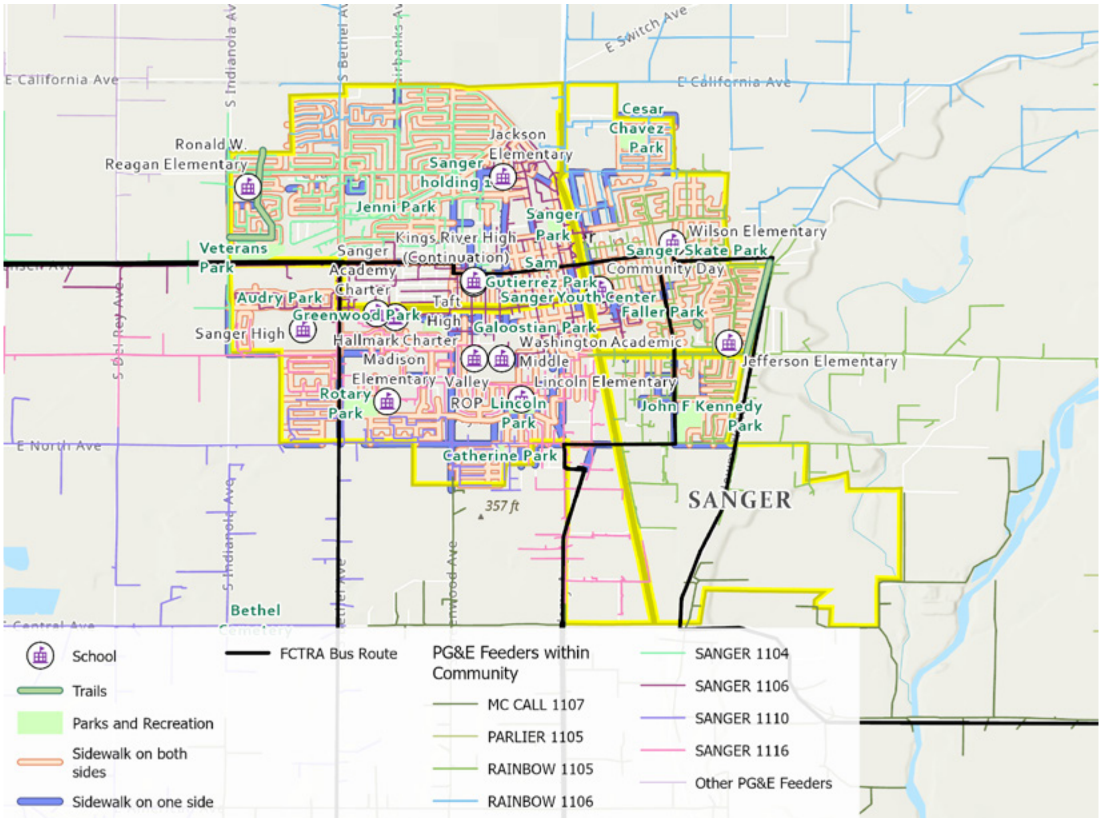
Table 40. San Joaquin Redundancy Equipment List

Equipment List	
(1) 60 kW charging station	
Redundancy Equipment	**Cost**
200 A, 35 kA switchboard	$8,000
(161) 310 W Solar PV Panels	$86,000
1 Day Outage Coverage: 2 Powerpacks + 375 kVA Inverter	$329,000
3 Day Outage Coverage: 4 Powerpacks + 375 kVA Inverter	$658,000
7 Day Outage Coverage: 10 Powerpacks + 375 kVA Inverter Redundant Utility Feeder	$1,643,000

8.1.12 Sanger

Sanger is located about 15 miles southeast of Fresno and has a population of about 25,000. It was incorporated in 1911 and is known as the “Nation’s Christmas Tree City”. Major landmarks in the city include the Sanger Depot Museum which used to be the Sanger Railroad Depot and Sanger High School. See Figure 85 below for the city map.

Figure 85: Sanger Map



The City of Sanger is governed by a City Council and Mayor. The City Council has provided full city services including programming, emergency services, water system, sewer plant, and trash collection through its various departments. The last General Plan that was formerly adopted was the 2025 General Plan in 2003. The Plan has been updated as of 2020, but still remains as a draft version on the city’s website. The goal of the General Plan is to guide growth, community change, and environmental conservation through 2035.[31]

Residents benefit from FCRTA’s Sanger-Reedley and Orange Cover Intercity Transit routes that run through the community. Sanger currently has 128.4 miles of sidewalks and 22.8 miles of Class I, II, and III bike paths. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours.

31 City of Sanger (n.d.). *2035 General Plan Update and North Academy Corridor Master Plan.* https://www.ci.sanger.ca.us/458/2035-General-Plan-Update

8.1.12.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Sanger facility. The fleet is estimated to consume 1,228.2 kWh based on each vehicle traveling 89 miles per day, as shown in Table 41. Based on the assumed charger specifications, 360 kW of power demand is added from the charging stations. An 800 A, 35 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 3.4 hours to recharge.

Table 41. Sanger Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avgerage Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	6	360	204.7	1228.2
Sedan	0	0	26.7	0
Van	0	0	53.4	0
Total				**1228.2**

The Sannger facility would need to install 661 solar panels onsite, taking up 5,300 ft² of space, to cover the charging load. Table 42 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

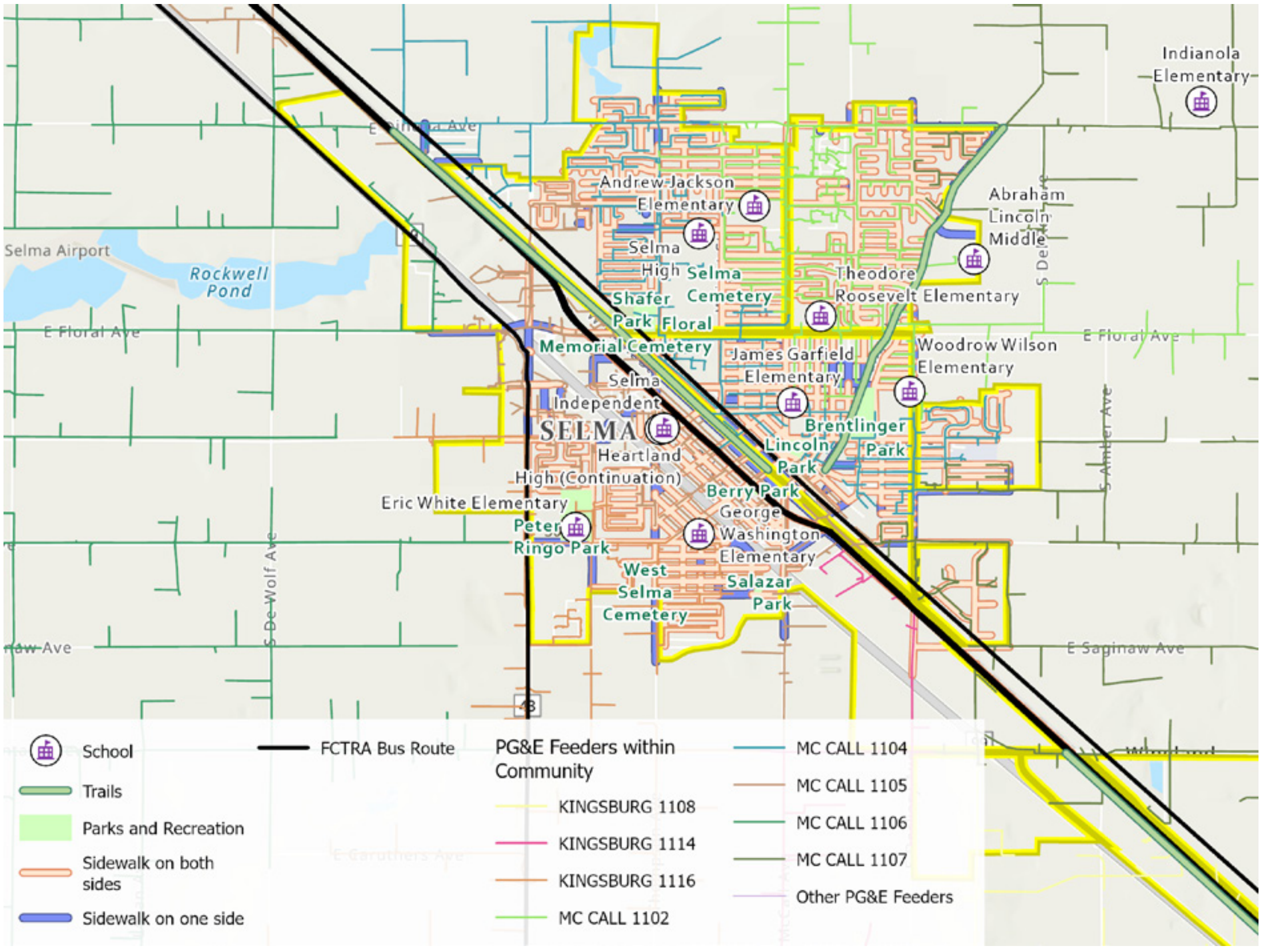
Table 42. Sanger Redundancy Equipment List

Equipment List	
(6) 60 kW charging stations	
Redundancy Equipment	**Cost**
800 A, 35 kA switchboard	$12,000
(661) 310 W Solar PV Panels	$353,000
1 Day Outage Coverage: 6 Powerpacks + 425 kVA Inverter	$986,000
3 Day Outage Coverage: 16 Powerpacks + 425 kVA Inverter	$2,629,000
7 Day Outage Coverage: 38 Powerpacks + 425 kVA Inverter Redundant Utility Feeder	$6,242,000

8.1.13 Selma

Selma is located 16 miles southeast of Fresno with a population of about 25,000 people. It was incorporated in 1896 and is known as “Raisin Capital of the World” for 93% of the word’s raisins are produced within a few miles of Selma.[32] Major landmarks in the town include W.H. Shafer Park, Selma Arts Center, and Selma District Chamber of Commerce. See Figure 86 below for the city map.

Figure 86: Selma Map



The City of Selma is governed by a City Council and Mayor. The City Council has provided full city services including programming, recreational activities, emergency services, water system, sewer plant, and trash collection through its various departments. The Selma General Plan 2035 Update was adopted in October of 2010.

The Selma Unified School District serves about 6,500 students in the community with a total of 11 schools including elementary, middle, high school, and alternative schools.

Selma residents benefit from FCRTA’s Southeast Transit, KART, and Kingsburg to Reedley College Transit lines. Currently, there are 134.6 miles of sidewalks and no bikeways or trails within the city. Additionally, FCRTA demand-response intra-city transit services operate in all 13 rural cities, providing residents the opportunity to reserve rides ahead of time during regular service hours. The Selma Active Transportation Plan details out plans for expansion over the few years.[33]

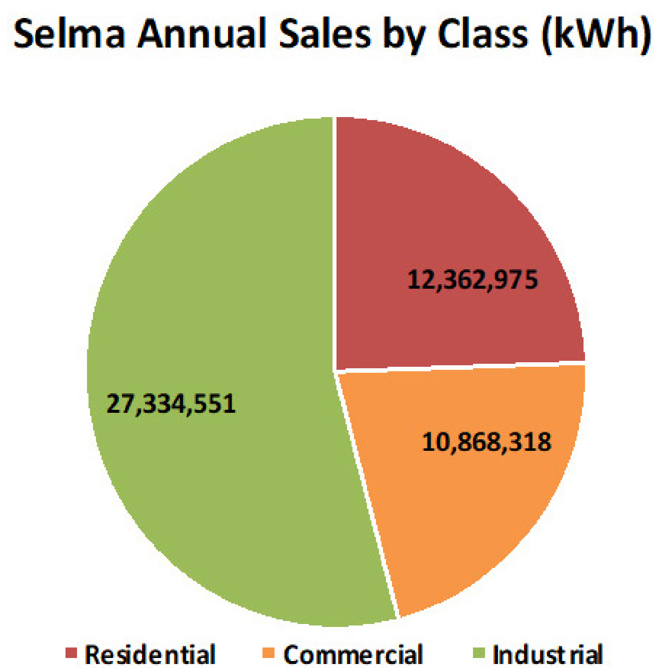
32 Selma Chamber of Commerce. (2019, March 7). Facts and figures. Selma Chamber of Commerce. Retrieved from https://selma-chamber.com/facts-and-figures/

33 City of Selma (2018, April). *City of Selma Active Transportation Plan.* https://cms9files.revize.com/selma/Document_Center/Department/Community%20development/Planning/General%20Plan%20And%20Planning%20Documents/General%20Plan/SelmaATPReport_Final%20Low%20Resolution.pdf

Selma is the largest depot in FCRTA's network. As shown in Figure 87, the connected feeder, MC CALL 1107, is dominated by industrial load, with the remaining ~45% split almost evenly between residential and small-medium commercial customers. The unincorporated community of Tombstone (Section 8.2.7) is also attached to this feeder.

Each feeder's load split is significant because load mix drives the timing of peak demand, and it also drivers the forecast mix of DER, and its impact on peak demand levels and timing.

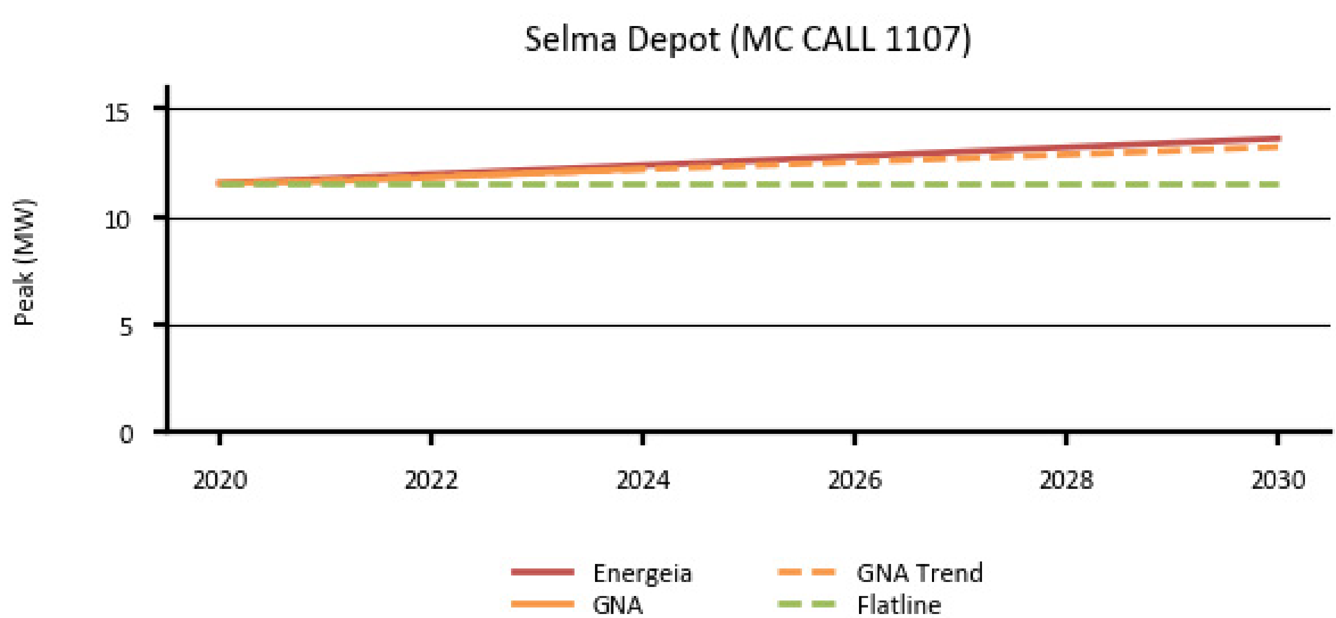
Figure 87: 2020 Sales by Class (kWh) – MC CALL 1107



Source: Energeia modeling

Figure 88 shows this study's peak demand forecast in red, the GNA study in orange, and a flatline in green for reference. There is very little difference between PG&E's trended forecast and that of our own in this case.

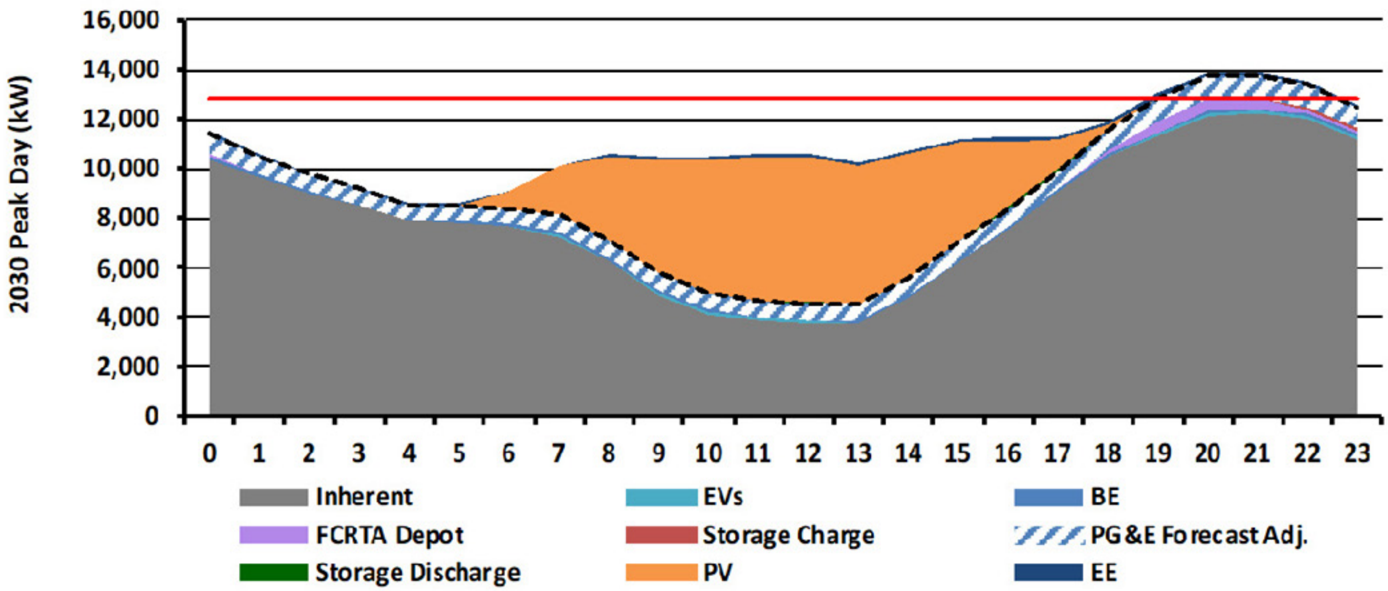
Figure 88: Peak Demand Forecast – MC CALL 1107



Source: Energeia modeling

Figure 89 shows a detailed view of the load shape and key contributors to peak demand on the forecasted peak day in 2030. Notably, the Selma bus depot is expected to contribute 478 kW to MC CALL 1107's peak demand at 8 pm. Solar and storage may be used to mitigate this, but the feeder is expected to require augmentation before the depot can be electrified regardless.

Figure 89: 2030 Peak Day Load Shape by Component – MC CALL 1107



Source: Energeia modeling

The recommended storage sizing from Figure 53 may be able to defer the timing of the above constraint.

8.1.13.1 Redundancy Analysis

This section presents required equipment and redundancy options for the Selma facility. As illustrated in Table 44, the fleet is estimated to consume 1,887 kWh based on each vehicle traveling 102 miles per day. Based on the assumed charger specifications, 487.2 kW of power demand is added from the charging stations. A 1200 A, 65 kA switchboard would be required to support the added charging stations. The expected charger power results in buses estimated to take 4 hours to recharge while vans take 6 hours and sedans 3 hours.

Table 43. Selma Fleet Energy Consumption

Vehicle Type	Available	Power (kW)	Avgerage Daily kWh Consumed per Vehicle	Total Daily kWh Consumed
Bus	7	420	234.6	1642.2
Sedan	6	57.6	30.6	183.6
Van	1	9.6	61.2	61.2
Total				**1887**

The Selma facility would need to install 1,015 solar panels onsite, taking up 8,200 ft² of space, to cover the charging load. Table 44 summarizes the required equipment, costs of the electrical infrastructure upgrades, and results from each outage scenario.

Table 44. Selma Redundancy Equipment List

Equipment List	
(7) 60 kW charging stations (7) 9.6 kW charging stations	
Redundancy Equipment	**Cost**
1200 A, 65 kA switchboard	$15,000
(1015) 310 W Solar PV Panels	$542,000
1 Day Outage Coverage: 9 Powerpacks + 650 kVA Inverter	$1,479,000
3 Day Outage Coverage: 25 Powerpacks + 650 kVA Inverter	$4,107,000
7 Day Outage Coverage: 57 Powerpacks + 650 kVA Inverter Redundant Utility Feeder	$9,363,000

8.2 Unincorporated Communities

In this section, eight unincorporated communities will be introduced and examined as potential locations for resilience hub development. For each community, Priority 1 vulnerability indicators will be mapped and the Resilience Hub Toolkit will be used to determine which hub features would most benefit each community.

In each of the communities below, a rough cost estimate is provided for the proposed Hub features. The next step would involve engaging the community to inform siting of suitable Hub locations. While no formal community outreach and siting has been initiated at this stage of the project, select sites for each community have been analyzed at a high level for potential Hub retrofits based on available space and location. Community engagement is recommended to identify partners and organizations residents trust, with a central location accessible to all parts of the community.

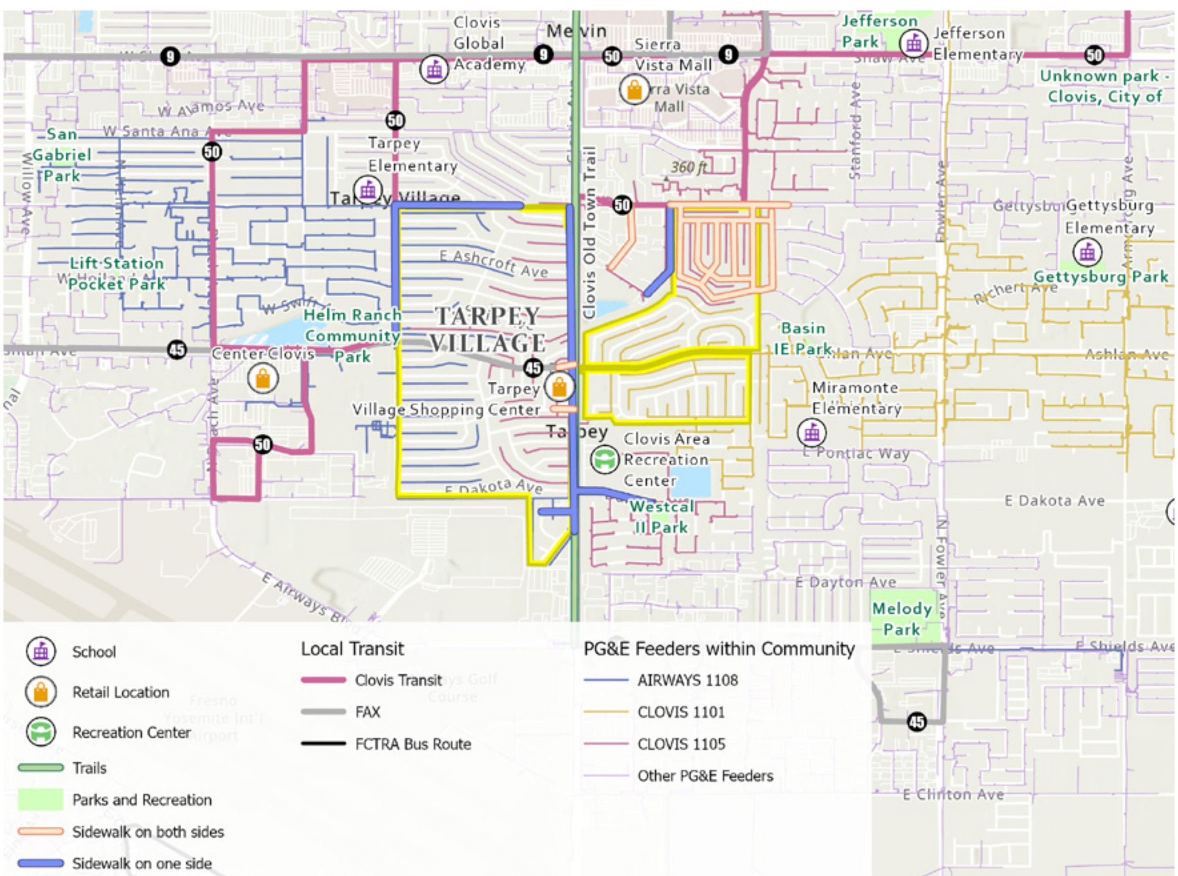
Since the most basic version of a resilience hub would include a microgrid and EV charging infrastructure, the siting process would look similar to a microgrid siting. This includes checking for existing headroom in the breakers of the electrical panel at the selected site, available space for solar on or adjacent to the building, analyzing site-specific requirements for utility interconnection, reviewing historic utility bills to determine annual load, and conducting a production analysis by looking at local weather conditions and site shading.

In each of the communities below, a rough microgrid cost estimate is provided with assumptions on the size of the system and storage capacity of the batteries, with a layout of where the system would be installed on the property.

8.2.1 Tarpey Village

Tarpey Village is an unincorporated community approximately 401 acres on both sides of Clovis Avenue between Dakota and Gettysburg Avenues. The Tarpey Village region can be seen in Figure 90 below, with a couple main landmarks indicated: Clovis Area Recreation Center and Mirmonte Elementary School. The closest incorporated communities are Clovis (2 miles north) and Fresno (8 miles southwest).

Figure 90: Tarpey Village Map



Tarpey Village has a population of about 3,600 people according to the 2019 census. Clovis Public Utilities Department provides retail water delivery to the community while the City of Fresno provides wastewater collection and treatment. It falls within the Clovis Unified School District.

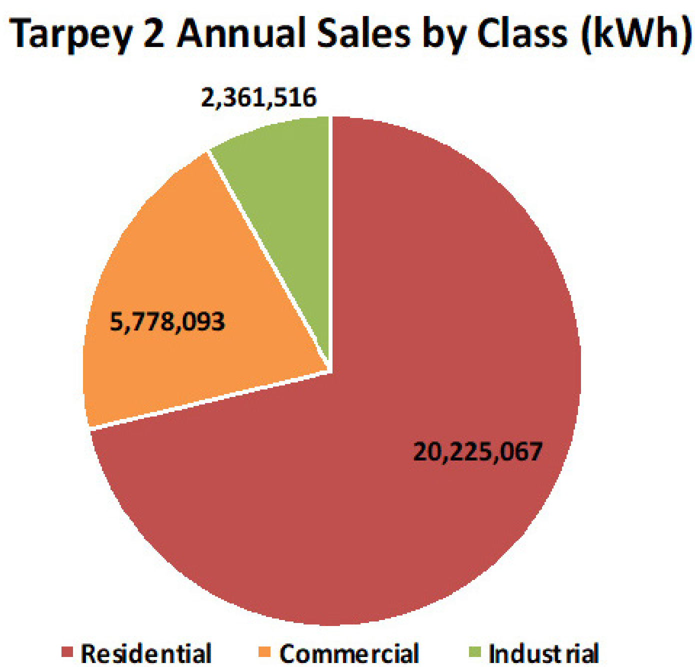
While FCRTA doesn't have any routes that run through Tarpey Village, the Clovis Transit System has Stagelines Route 45 and Route 50 that run all around the community. Tarpey Village residents can also enjoy the Clovis Old Town Trail that runs right by the Clovis Recreation Center with a rest stop nearby that includes shelter and a water fountain.[34] See Figure 91 below for an image of this route. From City of Clovis 2019 update, there will be an expansion of the existing Gould Canal Trail to run through Tarpey Village as well.[35]

Figure 91: Clovis Town Trail

34 City of Clovis (2020). Clovis Transit System Map. https://cityofclovis.com/wp-content/uploads/2020/07/System-Map-Int-2020.pdf
35 City of Clovis (2019, October 8). Trails of Clovis. https://cityofclovis.com/wp-content/uploads/2018/10/Clovis-Parks-and-Trails-Map.pdf

The CLOVIS 1101 distribution feeder near the center of the FCMA is dominated by residential load, as shown in Figure 92. This feeder is being analyzed for potential upgrades by PG&E due to forecasted load increases.

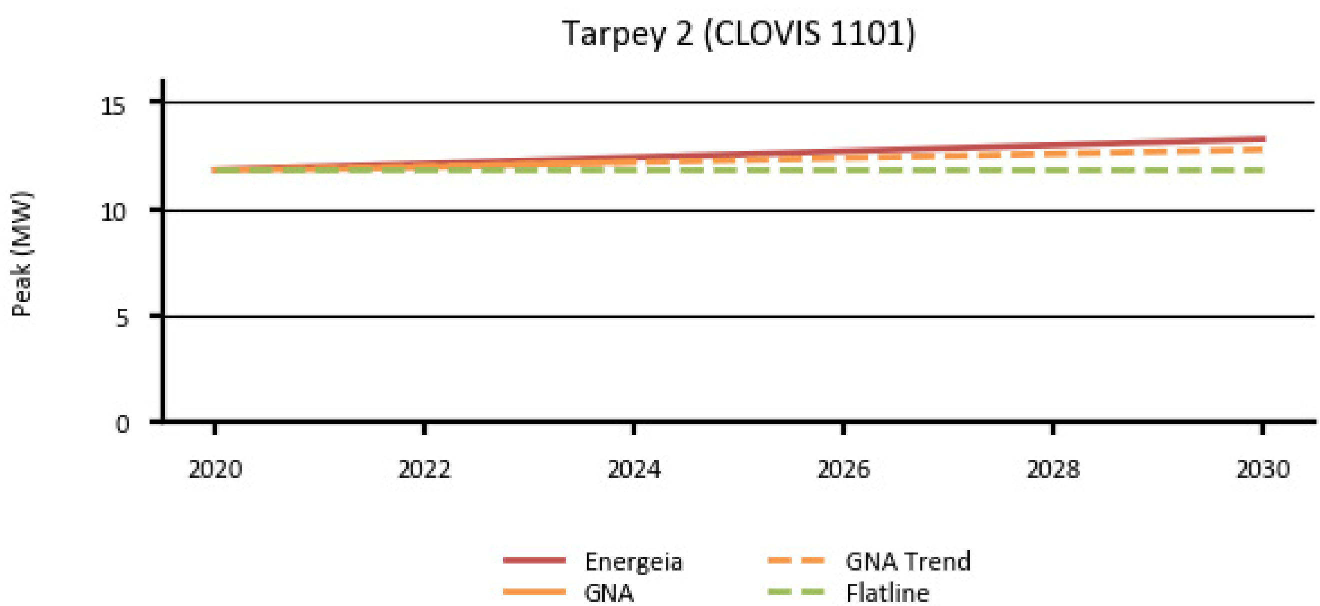
Figure 92: 2020 Sales by Class (kWh) – CLOVIS 11017



Source: Energeia modeling

As demonstrated in Figure 95, CLOVIS 1101 is already near its rated capacity in 2020, and PG&E does forecast a constraint in the next 4 years, so the feeder presumably has planned upgrades.

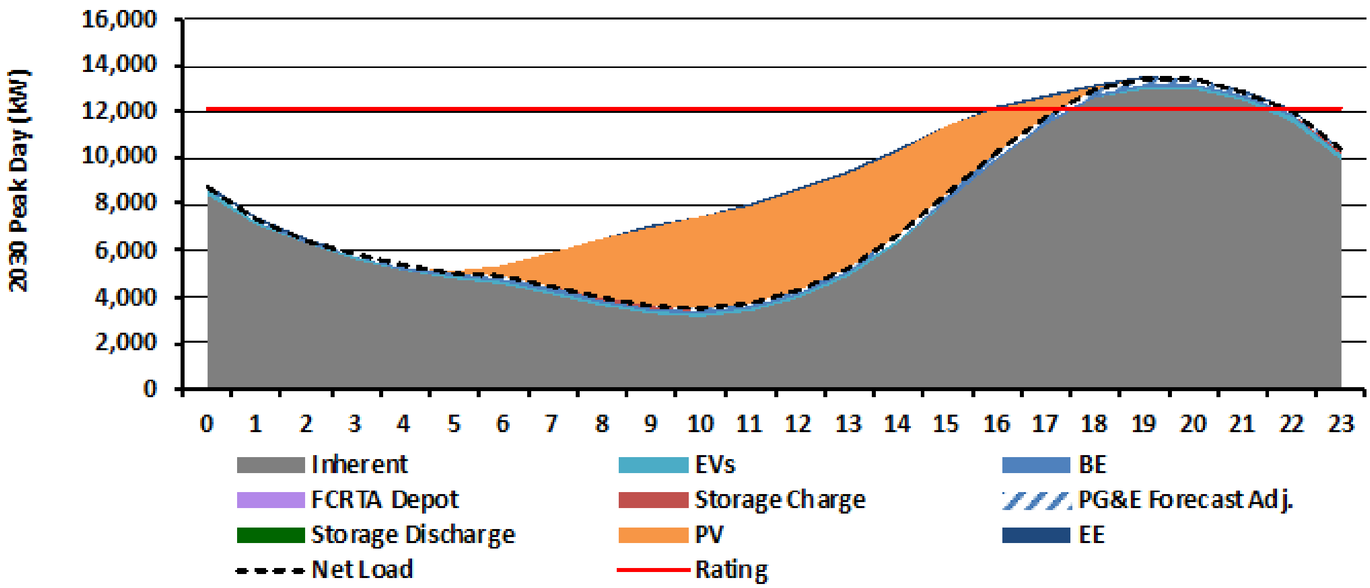
Figure 93: Peak Demand Forecast – CLOVIS 1101



Source: Energeia modeling

Due to all the residential load, rooftop solar PV is expected to have a significant impact in reducing mid-day load, but it will not impact the peak around 7-8 pm. This is shown in Figure 94.

Figure 94: 2030 Peak Day Load Shape by Component – CLOVIS 1101



Source: Energeia modeling

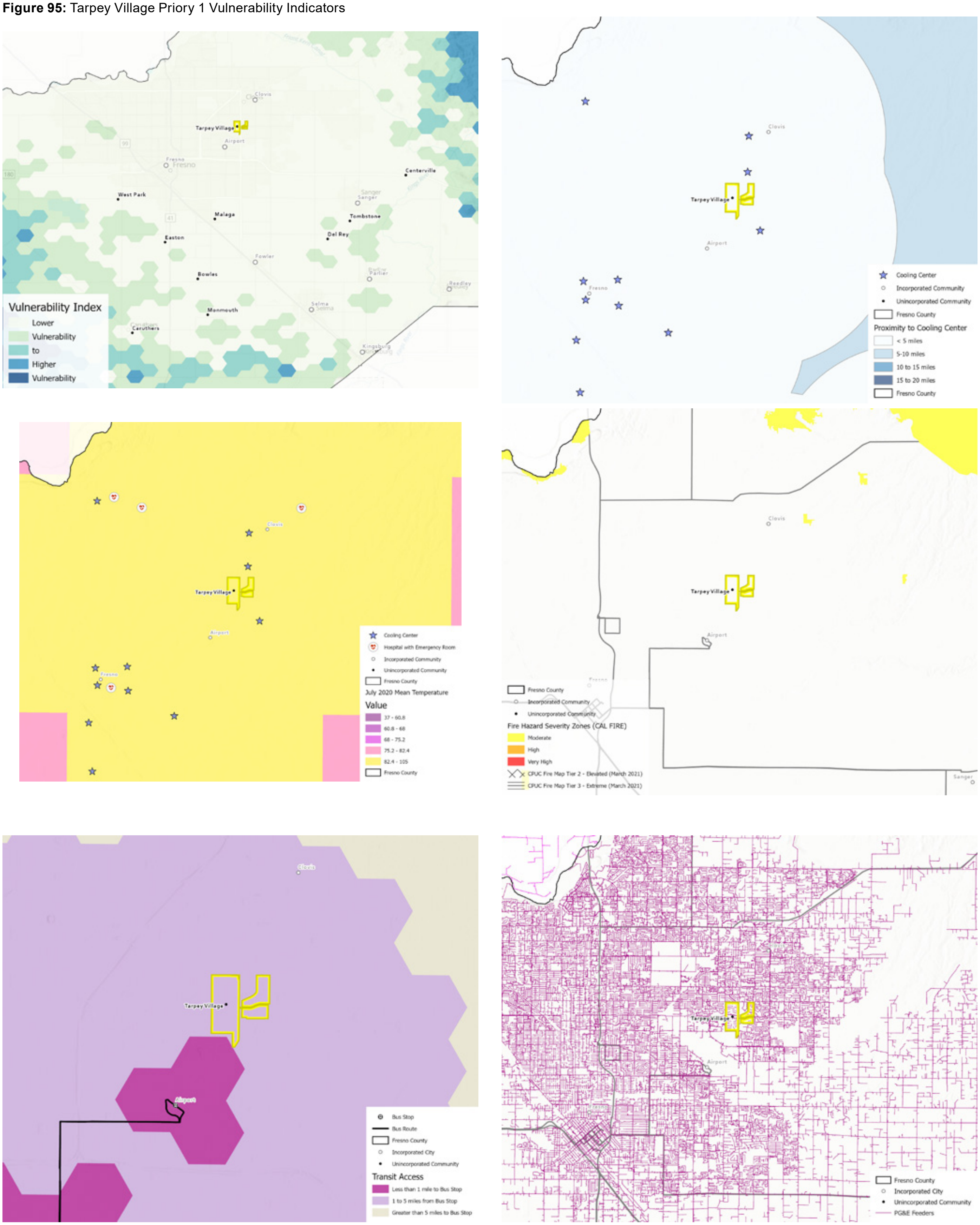
There is no recommended storage solution for Tarpey because there is no depot there, and therefore no exposure to electricity charges.

Tarpey Village experiences higher than average mean temperatures putting already vulnerable community members at risk. A resilience hub in this community could provide relief for vulnerable community members during a heat wave, especially those with asthma, and provide a temperature-controlled shelter for those in need. See Table 45 for the analyzed vulnerability indicators that exceeded thresholds and Figure 95 for a complete heatmap of Priority Level 1 indicator performance throughout Tarpey Village.

Table 45. Tarpey Village Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	
1	Mean Temperature	●
1	Proximity to Cooling Centers	
1	PG&E Feeders	●
1	Access to Public Transit	●
2	Asthma Percentile	●
2	Housing Burden	●
2	Housing and Transportation Index	
2	EJ Communities	●
3	Proximity to Emergency Departments	
3	Poverty	●
3	Linguistic Isolation	

Figure 95: Tarpey Village Priory 1 Vulnerability Indicators



Given the vulnerabilities experienced in Tarpey Village, the services detailed in Table 46 below should be deployed at this location's resilience hub.

Table 46. Tarpey Village Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	Electric Vehicles (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building EE features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Create a Fire Resistant Building and Fire Repellant Environment	Fire Prone Areas
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Planning	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Planning	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Planning	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Planning	CERT Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Workspace with computers	Housing Burden, Poverty
Secondary	Community Planning	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Planning	Event Room	Housing Burden, Poverty
Secondary	Community Planning	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile
Secondary	Community Planning	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments
Secondary	Community Planning	Greenhouse/Community Garden	Housing Burden, Poverty

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Facility	Smart Lighting System (Solar powered)	Housing Burden
Secondary	Facility	Water Filtration System	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the cost estimate in Table 47 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

Table 47. Tarpey Village Resilience Hub Cost Estimate

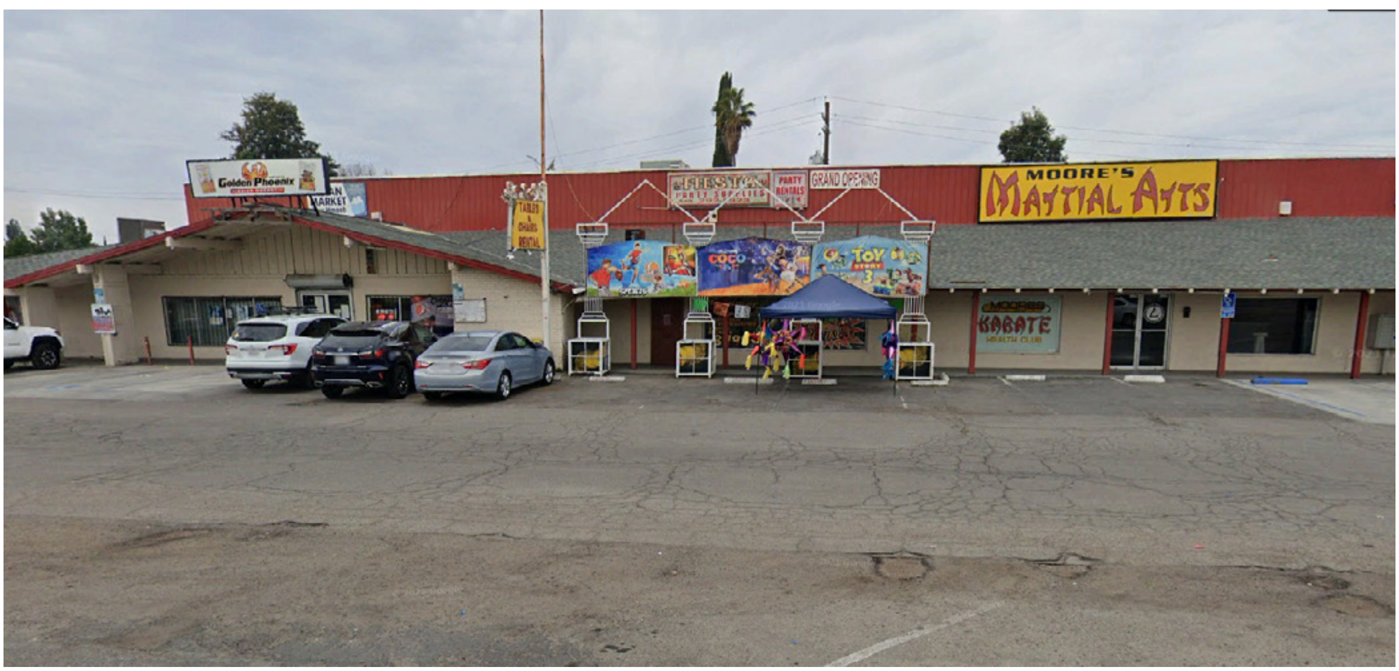
Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EVs and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Fire Resistant Building	$2,500-$40,000	On the low end is fireproofing landscaping on the high end is retrofitting exterior walls
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees. $300-$1,200 to transplant a single tree 8-12 ft
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen

Equipment	Cost Estimate	Assumption
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse 6' by 8' from Amazon, on the high end is a 12' by 12' full construction of a greenhouse
Smart Lighting System	$100-$400	Motion sensor security lights outside the Hub entrance
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

Within Tarpey Village, the Tarpey Village Shopping Center and Clovis Area Recreation Center were identified as potential resilience hub locations.

The Tarpey Village Shopping Center is a good candidate for its central location in the community. It includes many shops including a pet grooming facility, beauty salon, Asian market, party supply store, martial arts studio, and liquor store. All housed under 1 building with a flat roof, there is enough space for rooftop solar installation that could have direct benefits for the shopping center's energy bills and offer a safe haven for residents in the event of a disruption. The parking lot also offers the basic infrastructure needed for EV charging station installations. See Figure 96 below.

Figure 96: Tarpey Village Shopping Center



The proposed cost for microgrid implementation at Tarpey Village Shopping Center and assumptions are defined in Table 48 below:

The proposed cost for microgrid implementation at Tarpey Village Shopping Center would require the installation of solar and battery energy storage to power building and charging loads. Scenario A proposes a new 392 kW solar array, which would be 980 panels (400 W each), and three 232 kWh battery banks. The solar array roughly equaling two-hundred 9' by 12' car ports. The system would cover the entire building load (916 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation. Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling 19 carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 48 below:

Table 48. Microgrid Cost Estimate for Tarpey Village Shopping Center

Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
392 kW new solar	$670,000	Assumed to cover the full load of 1011 kWh/day
Three 232 kWh batteries	$490,000	Assumed 12 hours of night load needs to be stored
Total	**$1,160,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 97 below for the proposed location of the proposed solar array at Saber's Market for Scenario B, due to inadequate space for Scenario A array, that informed the cost estimate:

Figure 97: Aerial view of Tarpey Village Shopping Center with proposed solar array for Scenario B in the red box. Scenario A is feasible but would require the majority of the site equipped with solar panels.

The Clovis Area Recreation Center is right outside the border of Tarpey Village but provides benefits to residents due it its proximity. It is owned by the City of Clovis and offers senior center programs that include exercise classes, book clubs, and craft sessions, adult sports leagues, and youth leagues. With multiple events throughout the week, this center is a trusted resource by the community. It is a large concrete building with a parking lot that wraps around the whole building and an open lot behind the property as seen in Figure 98 and Figure 99.

Figure 98: Clovis Recreational Center (Entrance)

Figure 99: Clovis Recreational Center (Back Lot)

The large parking lot and open lot presents opportunities for solar development for either carports or ground mounts. Depending on the roof conditions and age, a rooftop installation could be feasible. The existing paved parking provides basic infrastructure needed for EV charging installation.

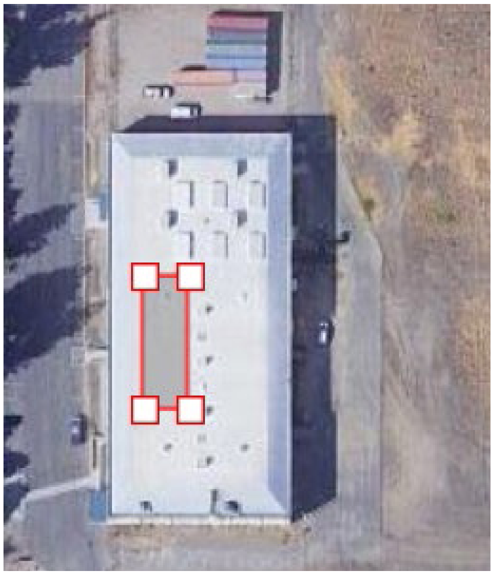
The proposed cost for microgrid implementation at Clovis Recreation Center would require the installation of solar and battery energy storage to power building and charging loads. Scenario A proposes a new 497 kW solar array, which would be 1242 panels (400 W each), and three 232 kWh battery bank. The system would cover the entire building load (1186 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation. Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling 19 carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 49 below:

Table 49. Microgrid Cost Estimate for Clovis Recreation Center

Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
497 kW new solar	$850,000	Assumed to cover the full load of 1281 kWh/day
Three 232 kWh batteries	$490,000	Assumed 12 hours of night load needs to be stored
Total	**$1,340,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 100 below for the proposed location of the proposed solar array at Clovis Recreation Center that informed the cost estimate:

Figure 100: Aerial view of Clovis Recreation Center with proposed solar array in the red box. Scenario A array is represented on the left side and Scenario B on the right.



Another scenario to consider when designing the resilience hub is the possibility of every household in Tarpey Village having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 1379 households had a single EV, the total energy output per day would be 7,584.5 kWh/day. This would require a 1,738 kW solar system (5,606 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Tarpey Village installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

8.2.2 Cantua Creek, El Porvenir, Three Rocks

The Cantua Creek, El Porvenir, and Three Rocks cluster was determined as a potential location for a resilience hub.

Three Rocks was established on agricultural land along Highway 33 prior to 1960.[36] The area had no community water, sewer services, or access to running water and electrical services. In response to poor living conditions at Three Rocks, in the early 1970s El Porvenir, and later Cantua Creek, was created to provide affordable housing for displaced Three Rocks residents. El Porvenir unfortunately dealt with surface and deep ground subsidence which damaged the community's water and sewer infrastructure, as well as homes and streets. This was in addition to ongoing issues with solid waste collection, park maintenance, and little community organization. To solve this, Porvenir established a County Service Area (CSA) to make the community eligible for state and federal grant funds and resources such as surface water and water treatment systems, both of which were installed.

In the early 1980s, Fresno County purchased the 20-acre parcel which became known as Cantua Creek. The region was to be used for developing farm workers housing for displaced Three Rocks families. Since there was no permanent closure of Three Rocks, it was later reoccupied and continues to house residents, with no apparent improvement of conditions.[37]

Currently these communities are comprised of mostly Latinx farmworkers of about 440 people combined. The area has dealt with a number of droughts over the last few decades, resulting in elevated water prices.

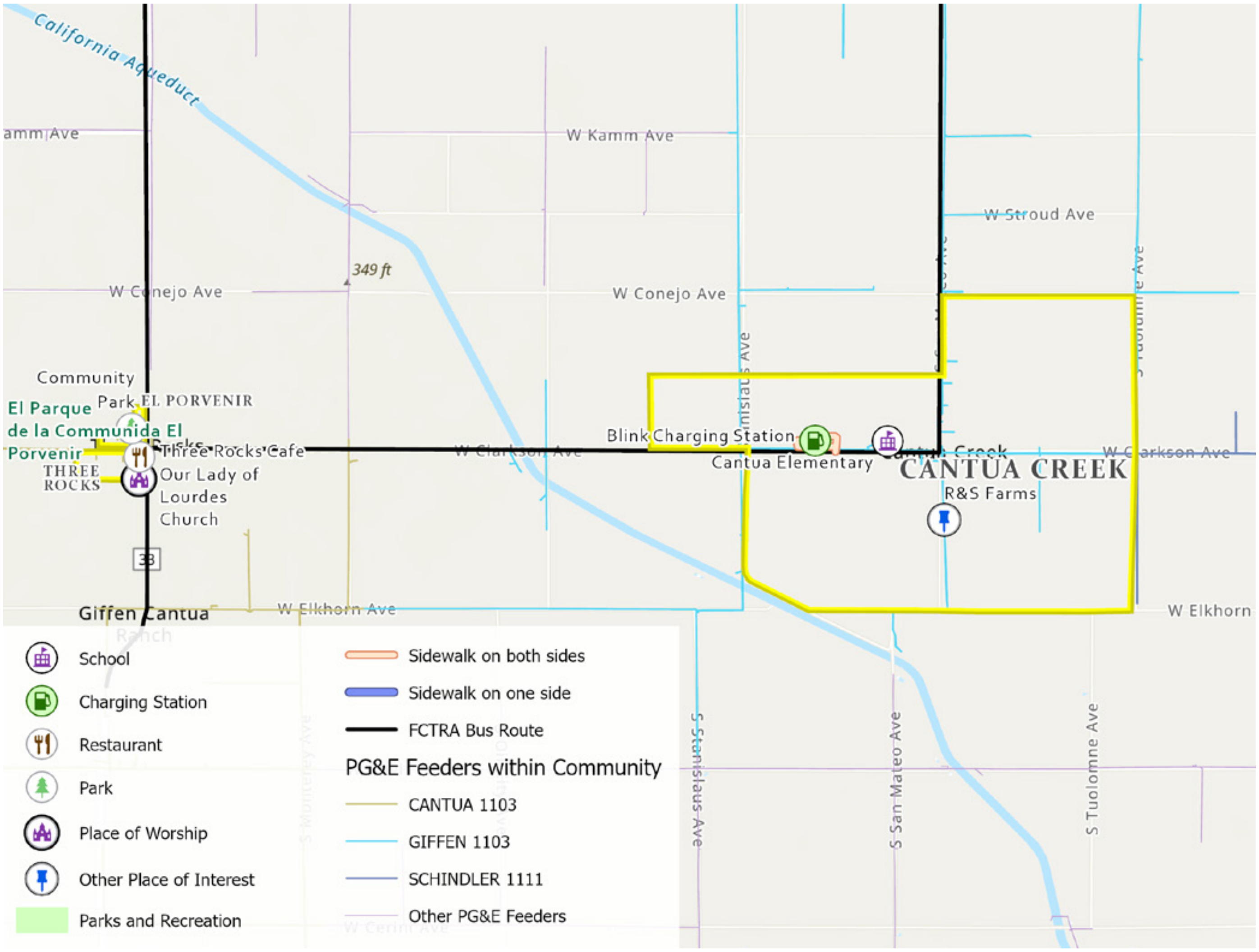
Cantua Creek and El Porvenir are considered CSAs, governed by the county's Board of Supervisors which provide them basic services like water. With the current drought and well development projects, community members are paying upwards of $190/month for water compared to the City of Fresno average of $50/month. Even with the high prices, many are skeptical of the water quality, and since 2015, the State Water Resource Control Board (State Water Board) has been providing bottled water for residents.

The Cantua Creek region can be seen in Figure 101.

36 Weaver, A. (2011, February 16). Board Briefing Report: El Porvenir and Cantua Creek—Community History and Outreach. County of Fresno. https://www.co.fresno.ca.us/home/showpublisheddocument/10854/636381482919130000

37 Vad, J. (2021, September 12). Fresno County towns with no drinking water drown in debt while hope fades for new well. The Fresno Bee. https://www.fresnobee.com/fresnoland/article254077153.html

Figure 101: Cantua Creek, El Porvenir, and Three Rocks Area Map



Cantua Creek operates under CSA 32 under the Board of Supervisors for the County of Fresno which provide services that include community water, sewer, garbage collection, and street lighting. CSA 32 is made up of 79 parcels which include 73 single family residential units, Cantua Elementary School, school homes, a mobile home park, and 3 out of district residential properties that receive services. According to their 2021-2022 Fiscal Year (FY) Budget Information, current projects include a groundwater test well, water main replacements, and wastewater treatment facility upgrades.

El Porvenir operates under CSA 30 under the Board of Supervisors for the County of Fresno which provide services that include maintenance and operations of water and sewer systems, street lighting, and refuse disposal. CSA 30 is made up of 58 parcels which include 54 residential lots, a county park, and 3 county owned outlots. According to their 2021-2022 FY Budget Information, current projects include a groundwater test, well water main replacements, and wastewater treatment facility upgrades.

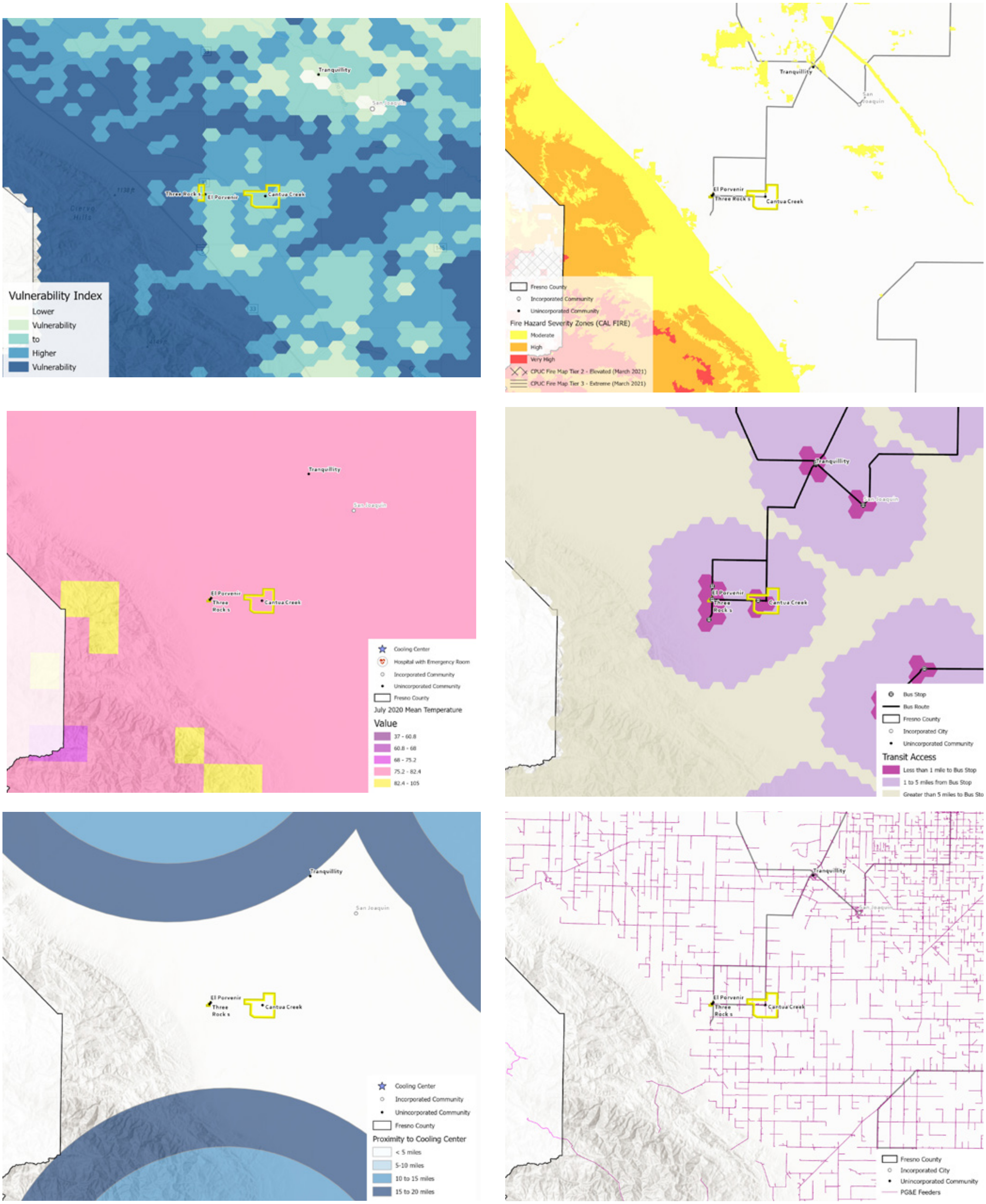
Three Rocks, El Porvenir, and Cantua Creek benefit by having the FCRTA San Joaquin Intercity Transit route run through each of these communities, directly connecting them to the nearest incorporated community San Joaquin. This also provides connecting access to the Westside Transit route.

Table 50 indicates the vulnerability indicates that exceed the medium threshold in Cantua Creek,El Porvenir, and Three Rocks communities; Figure 102 provides a visual mapping of these indicators.

Table 50. Cantua Creek, El Porvenir, Three Rocks Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	
1	Mean Temperature	●
1	Proximity to Cooling Centers	●
1	Access to Public Transit	
1	PG&E Feeders	
2	Asthma Percentile	●
2	Housing Burden	
2	Housing and Transportation Index	
2	EJ Communities	●
3	Proximity to Emergency Departments	●
3	Poverty	●
3	Linguistic Isolation	●

Figure 102: Cantua Creek, El Porvenir, and Three Rocks Area Priority 1 Vulnerablility Indicator



These communities experience high temperature levels yet have limited access to nearby cooling centers. Additionally, the area officially classifies as an EJ community and has a high poverty level. Improving air quality and transit access is critical. By implementing clean micromobility and EVs there is potential to improve local air quality while providing a low-cost mobility option. Enhancing the energy infrastructure through installations of EE measures and microgrids create a resilient environment to ensure critical systems such as cooling systems remain operational.

Based on the specific vulnerabilities and pain points identified, using the Resilience Hub Features Toolkit, it is recommended the following services detailed in Table 51 be deployed in this community's resilience hub:

Table 51. Cantua Creek, El Porvenir, Three Rocks Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building EE features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Planning	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Planning	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Planning	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Planning	CERT Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Workspace with computers	Housing Burden, Poverty
Secondary	Community Planning	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Community Planning	Event Room	Housing Burden, Poverty
Secondary	Community Planning	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile
Secondary	Community Planning	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments
Secondary	Community Planning	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Smart Lighting System (Solar powered)	Housing Burden
Secondary	Facility	Water Filtration System	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the below cost estimate in Table 52 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

Table 52. Cantua Creek, El Porvenir, and Three Rocks Resilience Hub Equipment Cost

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EVs and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating

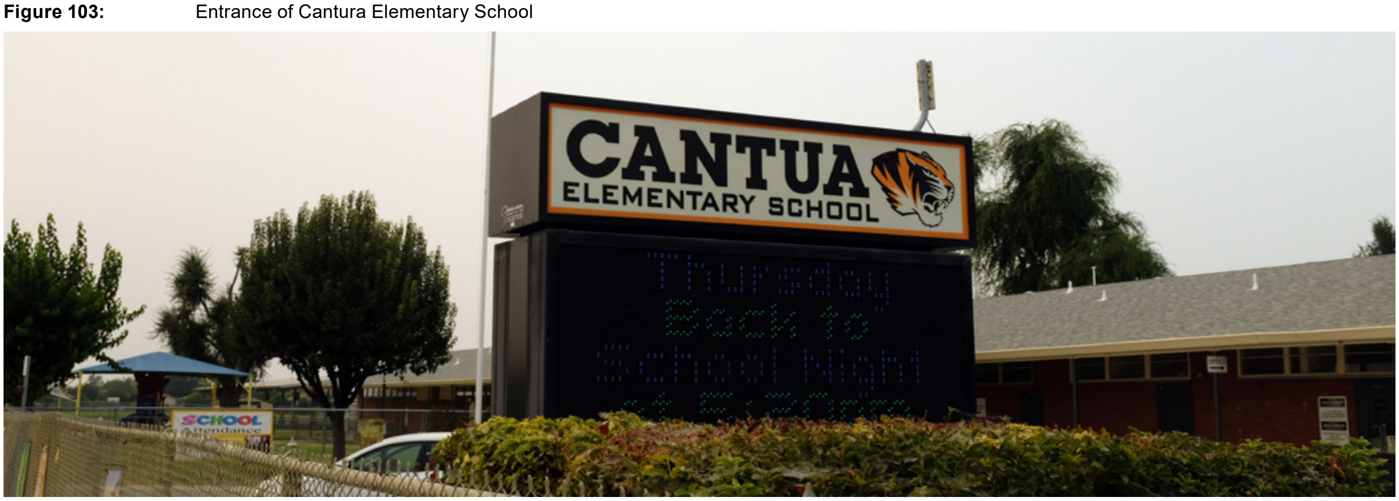
Equipment	Cost Estimate	Assumption
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees. $300-$1,200 to transplant a single 8-12 ft tree
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse 6' by 8' from Amazon, on the high end is a 12' by 12' full construction of a greenhouse
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

The following sites have been identified as potential resilience hub locations: Cantua Elementary School, the Blink EV Charging Stations in Cantua Creek, and Our Lady of Lourdes Catholic Church in Three Rocks.

Cantua Elementary School, pictured in Figure 103 and located off West Clarkson Avenue (Figure 104), is the first choice for development because it already has solar panels installed on the school grounds[38] (Figure 105). Families and community members would mostly likely be familiar with the building and have trust in the school to attend afterschool community events, use the facility, and take shelter in the event of a power outage or disruption.

Barriers to implementing the proposed services include the need for some basic EV charging infrastructure to be installed. This would include a few charging stations that could connect to the existing service panel, ideally an energy storage system, as well as a curb and sidewalk for the EVs, e-scooters, or e-bikes to be parked while charging. Additionally, since this is a school with young children, opening it to the public for facility use after hours could be a safety hazard. Screening or background checks of community members would most likely need to be conducted to ensure safety. This process could deter community members from using the facility altogether.

Figure 103: Entrance of Cantura Elementary School



38 Correa, T. (2012, June 13). *Fresno County: Rural School Gets Facelift Courtesy of PG&E, Volunteers. PG&E Currents.* https://www.pgecurrents.com/2012/06/13/fresno-county-rural-school-gets-facelift-courtesy-of-pge-and-volunteers/

Figure 104: West Clarkson Avenue (Road Adjacent to Cantua Elementary School)

Figure 105: Solar Panel Installation on Field Adjacent to Cantua Elementary School

The proposed cost for microgrid implementation at Cantua Elementary School would include the use of the existing solar panels in addition to another solar installation (carport or ground mount) with battery energy storage. Scenario A proposes a new 738 kW solar array, which would be 1,845 panels (400 W each), and five 232 kWh battery banks. The system would cover the entire building load (1,999 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation. Scenario B proposes a single 232 kWh battery bank in addition to the existing solar array.

This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. Similarly, this scenario can provide electricity for an extended duration if sufficient solar generation. The cost breakdown and assumptions are defined in Table 53 below:

Table 53. Microgrid Cost Estimate for Cantua Elementary School

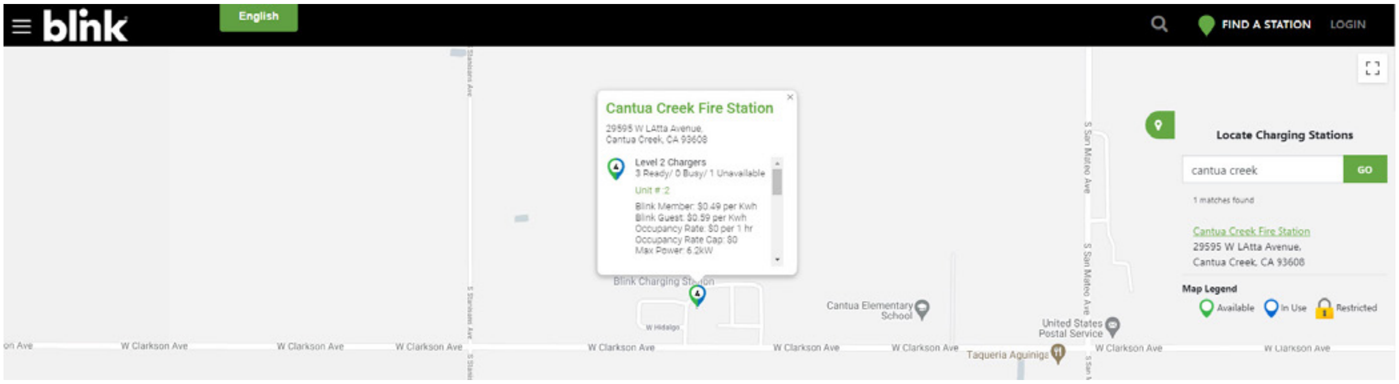
Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
738 kW new solar (in addition to the existing 75 kW solar)	$1,270,000	Assumed to cover the full load of 2094 kWh/day
Five 232 kWh batteries	$820,000	Assumed 12 hours of night load needs to be stored
Total	**$2,090,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
Existing solar can cover loads	$0	No additional solar needed
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$160,000**	

See Figure 106 below for the proposed location of the additional solar array at Cantua Elementary that informed the cost estimate:

Figure 106: Aerial view of Cantua Elementary with Proposed Solar Array in the Red Box

The second proposed location would be the facility adjacent to three Level 2 Blink EV chargers further west on Clarkson Avenue within a residential hub. These chargers were installed many years ago as a result of the Demonstration Care Share Program, a collaboration between the Leadership Counsel, San Joaquin Valley Air District Pollution SJVAPCD, CARB and Green Commuter. Three chargers are active on the Blink EV network as shown in Figure 109 below. Maximum power for two of the stations is 6.2 kW and 5 kW for the other charger. For a Blink guest, the charging rate is $0.59/kWh. For a Blink member, the charging rate is $0.49/kWh.

Figure 107: Active Blink EV Chargers in Cantua Creek



The existing chargers, shown in Figure 108, provide a great starting point for Hub development with cost savings. Further investigation would need to be conducted to ensure the chargers could be used to charge the EVs that will be procured, and if further retrofits or upgrades would be needed. The existing building, pictured in Figure 109, is promising, but looks outdated and out of use. Certain upgrades may be required to make it usable for the community.

Figure 108: Blink EV Charging Station in Cantua Creek

Figure 109: Google Street View (Dated May 2013) that Shows the Existing Building

The proposed cost for microgrid implementation at Blink EV Charging Station would require the installation of solar to power building and charging loads.

Scenario A proposes a new 79 kW solar array, which would be 197 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling forty 9' by 12' car ports. The system would cover the entire building load (124 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation.

Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling 19 carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. Similarly, this scenario can provide electricity for an extended duration if sufficient solar generation.

The cost breakdown and assumptions are defined in Table 54 below:

Table 54. Microgrid Cost Estimate for Blink Charging Station

Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
79 kW new solar	$140,000	Assumed to cover the full load of 219 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$300,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 110 below for the proposed location of the proposed solar array at the Blink EV Charging Station that informed the cost estimate:

Figure 110: Aerial View of Blink Charging Station with Proposed Solar Array in the Red Box

Another scenario to consider when designing the resilience hub is the possibility of every household in Cantua Creek having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 111 households had a single EV, the total energy output per day would be 610.5 kWh/day. This would require a 140 kW solar system (451 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Cantua Creek installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

The third potential location is Our Lady of Lourdes Catholic Church in Three Rocks, captured in Figure 111. This is an ideal spot with a robust structure for frequent use by residents. Another benefit is its proximity to the Three Rocks Café (Figure 112). A partnership between the Church and café to support a resilience hub could benefit residents in the event of an outage, where food supply may be scarce. Further investigation would have to be done to see what opportunities exist for solar and battery energy storage installation onsite.

Figure 111: Our Lady of Lourdes Catholic Church, Located in Three Rocks

Figure 112: Three Rocks Café is located within 2-minute walking distance of the Catholic Church, providing easy access to food resources in the event of a disruption.

The proposed cost for microgrid implementation at Our Lady of Lourdes Catholic Church would require the installation of solar and battery energy storage to power building and charging loads. Scenario A proposes a new 93 kW solar array, which would be 232 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling forty-seven 9' by 12' car ports. The system would cover the entire building load (160 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation. Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling nineteen carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 55 below:

Table 55. Microgrid Cost Estimate for Our Lady of Lourdes Catholic Church

Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
93 kW new solar	$160,000	Assumed to cover the full load of 256 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$310,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 113 below for the proposed location of the proposed solar array at Our Lady of Lourdes Catholic Church that informed the cost estimate:

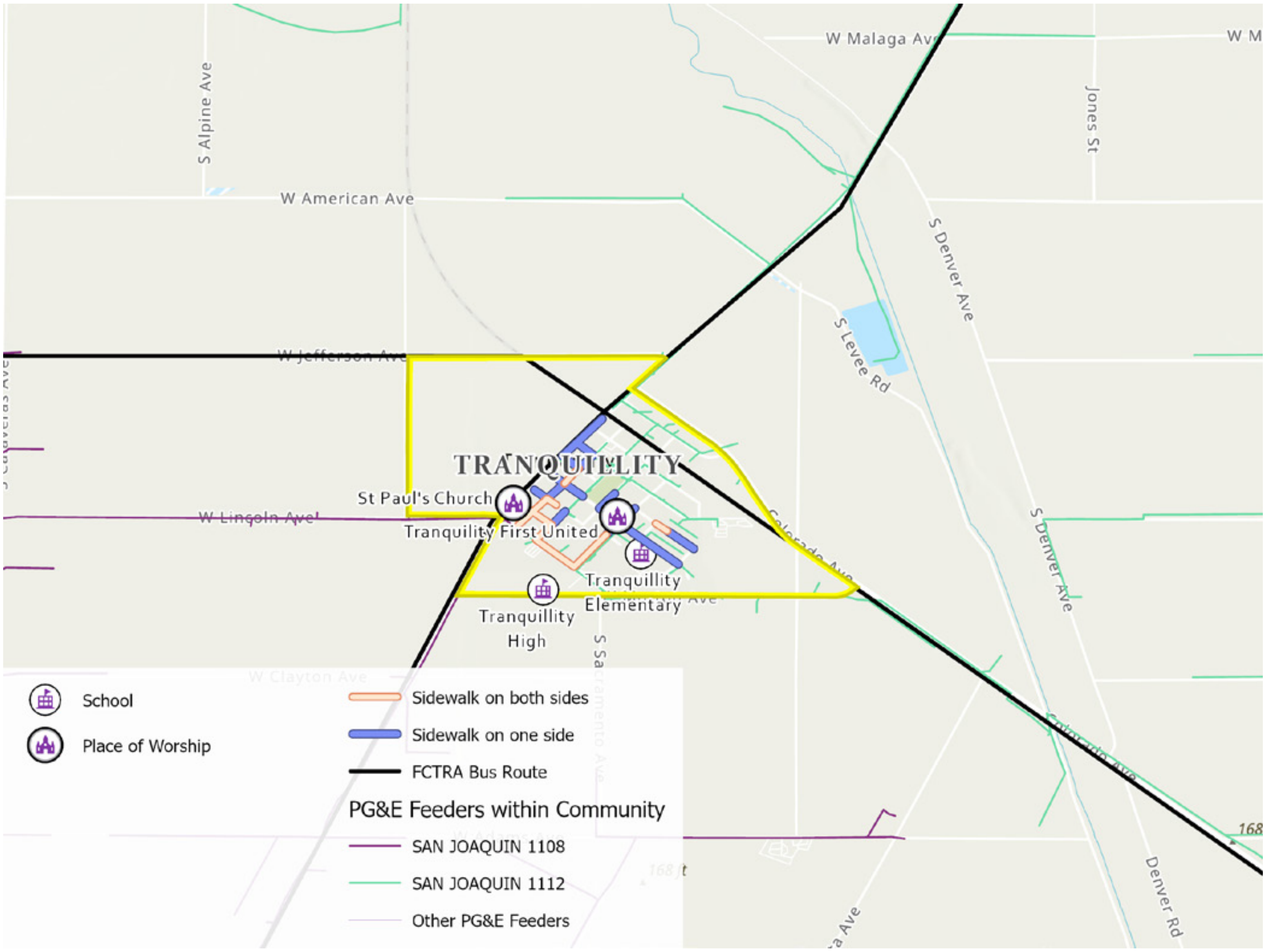
Figure 113: Aerial View of Our Lady of Lourdes Catholic Church with Proposed Solar Array in the Red Box

If all 71 households in Three Rocks owned a single EV, the total energy output per day would be 390.5 kWh/day. This would require an 89 kW solar system (289 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Three Rocks installed solar, each home would need to install a 1.26 kW system (4 solar panels).

8.2.3 Tranquillity

Tranquillity is an unincorporated community on either side of South James Road, between West Jefferson Avenue and West Morton Avenue as seen in Figure 114 below. The community has a population of approximately 800 people according to 2020 Census data. Major landmarks in the area include Tranquillity High School, Tranquillity Elementary School, St Paul's Catholic Church, and Tranquillity First United.

Figure 114: Tranquility Community Map



»

Tranquillity is also located within 15 miles of a 205 MW utility scale solar plant (RE Tranquillity, LLC). A satellite view of this solar plant is provided in Figure 115. This was built in partnership by Southern Power and Recurrent Energy and entered commercial operation in 2016.

Figure 115: RE Tranquillity, LLC Solar Plant

Tranquillity is located 10 miles southeast of Mendota, the nearest city. The Tranquillity Irrigation District provides water services and the Tranquillity Public Utilities District provides sewer services. Residents enjoy access to the FCRTA San Joaquin Intercity Transit route that passes through the community.

The community has been identified as a resilient hub priority due to high temperatures, limited access to cooling centers, designation as a EJ community, and has a high poverty level. See Figure 116 and Table 56 below for a summary of the vulnerability indicators in this region.

Figure 116: Tranquillity Area Priority 1 Vulnerability Indicators

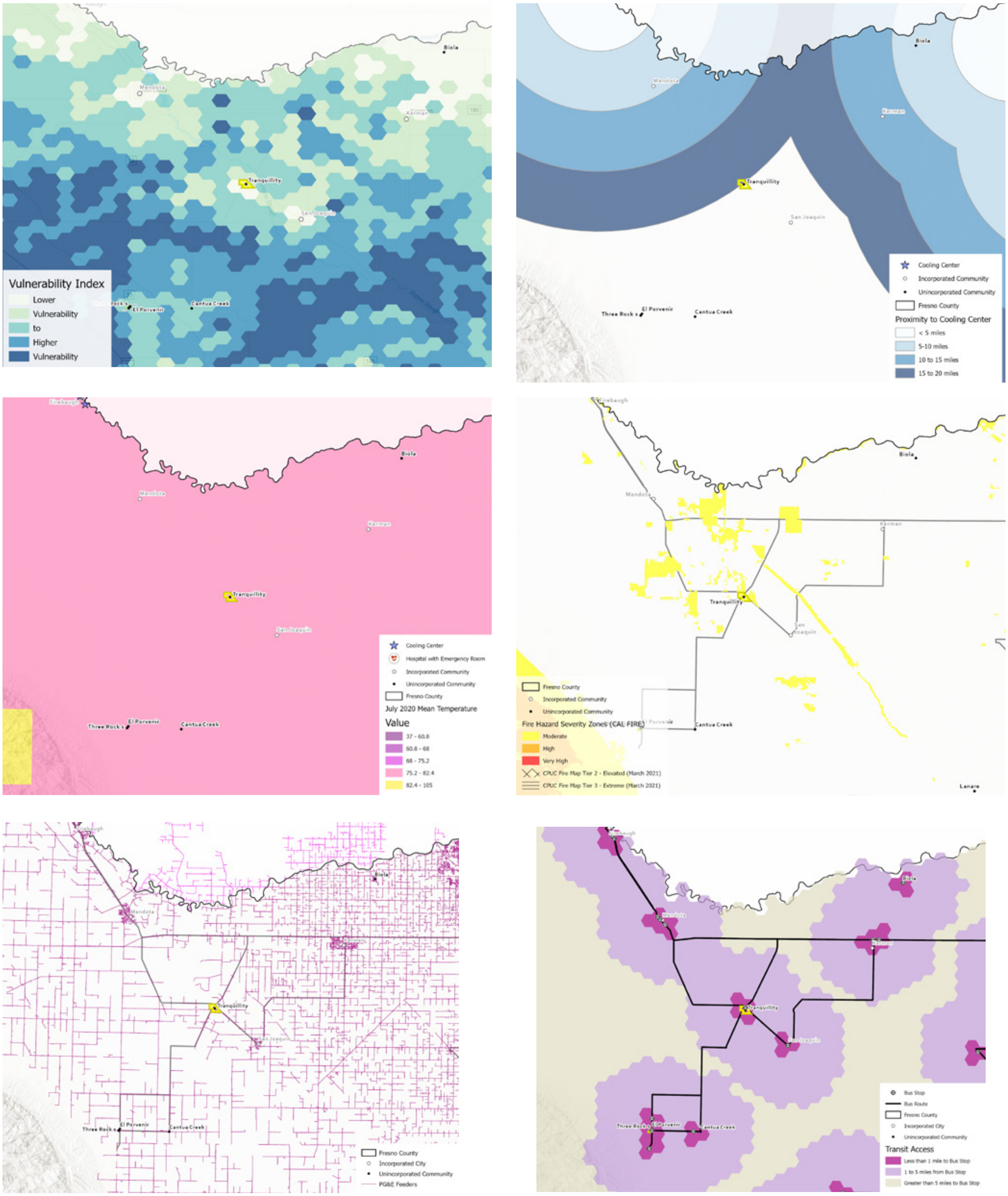


Table 56. Tranquillity Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	●
1	Mean Temperature	●
1	Proximity to Cooling Centers	●
1	Access to Public Transit	
1	PG&E Feeders	
2	Asthma Percentile	●
2	Housing Burden	
2	Housing and Transportation Index	
2	EJ Communities	●
3	Proximity to Emergency Departments	●
3	Poverty	●
3	Linguistic Isolation	●

Given the vulnerabilities experienced in Tranquillity, the services detailed in Table 57 should be deployed at this location's resilience hub.

Table 57. Tranquillity Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	Electric Vehicles (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building Energy Efficiency features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Create a Fire Resistant Building and Fire Repellant Environment	Fire Prone Areas
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Programming	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Programming	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Community Programming	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Programming	Community Emergency Response Team(CERT) Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Programming	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Programming	Workspace with computers	Housing Burden, Poverty
Secondary	Community Programming	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Programming	Event Room	Housing Burden, Poverty
Secondary	Community Programming	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile
Secondary	Community Programming	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments
Secondary	Facility	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Water filtration system	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the below cost estimate in Table 58 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

Table 58. Tranquillity Resilience Hub Cost Estimate

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EV and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Fire Resistant Building	$2,500-$40,000	On the low end is fireproofing landscape, on the high end is retrofitting exterior walls

Equipment	Cost Estimate	Assumption
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees. $300-$1,200 to transplant a single 8-12 ft tree
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse 6' by 8' from Amazon, on the high end is a 12' by 12' full construction of a greenhouse
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

Within Tranquillity, the Tranquillity First United Methodist Church (Tranquillity First United) was identified as a potential resilience hub location. Tranquillity First United, pictured in Figure 117, is located on the east side of town, around the corner from Valley Family Market and the post office. The building offers ample rooftop space for a solar installation and the existing wrap around parking lot and sidewalks supports the basic infrastructure needed for charger installations and provides easy accessibility to the facility. Tranquillity First United's website mentions it to be a "friendly and informal church" for all, with no dress code.

Figure 117: Tranquillity First United Church

The proposed cost for microgrid implementation at Tranquillity First United would require the installation of solar and battery energy storage to power building and charging loads.

Scenario A proposes a new 106 kW solar array, which would be 265 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling fifty-five 9' by 12' car ports. The system would cover the entire building load (178 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation.

Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling 19 carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 59 below:

Table 59. Microgrid Cost Estimate for Tranquillity First United

Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
106 kW new solar	$180,000	Assumed to cover the full load of 273 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$310,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 118 below for the proposed location of the proposed solar array at Tranquillity First United for Scenario B, due to insufficient area for a 106 kW system in Scenario A, that informed the cost estimate:

Figure 118: Aerial View of Tranquillity First United with Proposed Solar Array in the Red Box. Note this is for the 37kW system described in Scenario B

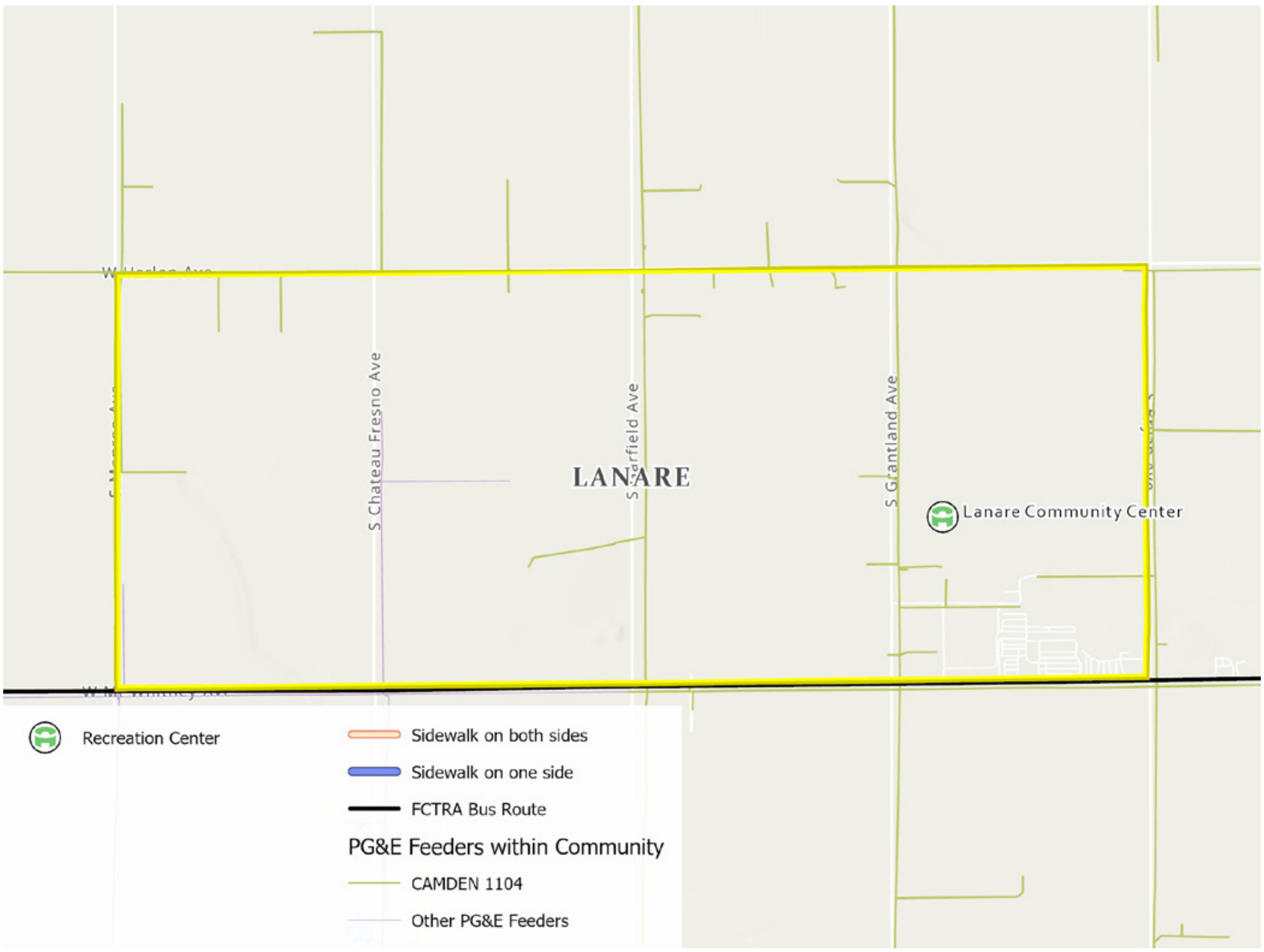
Another scenario to consider when designing the resilience hub is the possibility of every household in Tranquillity having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 239 households had a single EV, the total energy output per day would be 1,314.5 kWh/day. This would require a 301 kW solar system (972 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Tranquillity installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

8.2.4 Lanare, Riverdale

Lanare and Riverdale are the southernmost unincorporated communities in Fresno County, located at a minimum of 25 miles away from major incorporated cities like San Joaquin, Kerman, and Fresno.

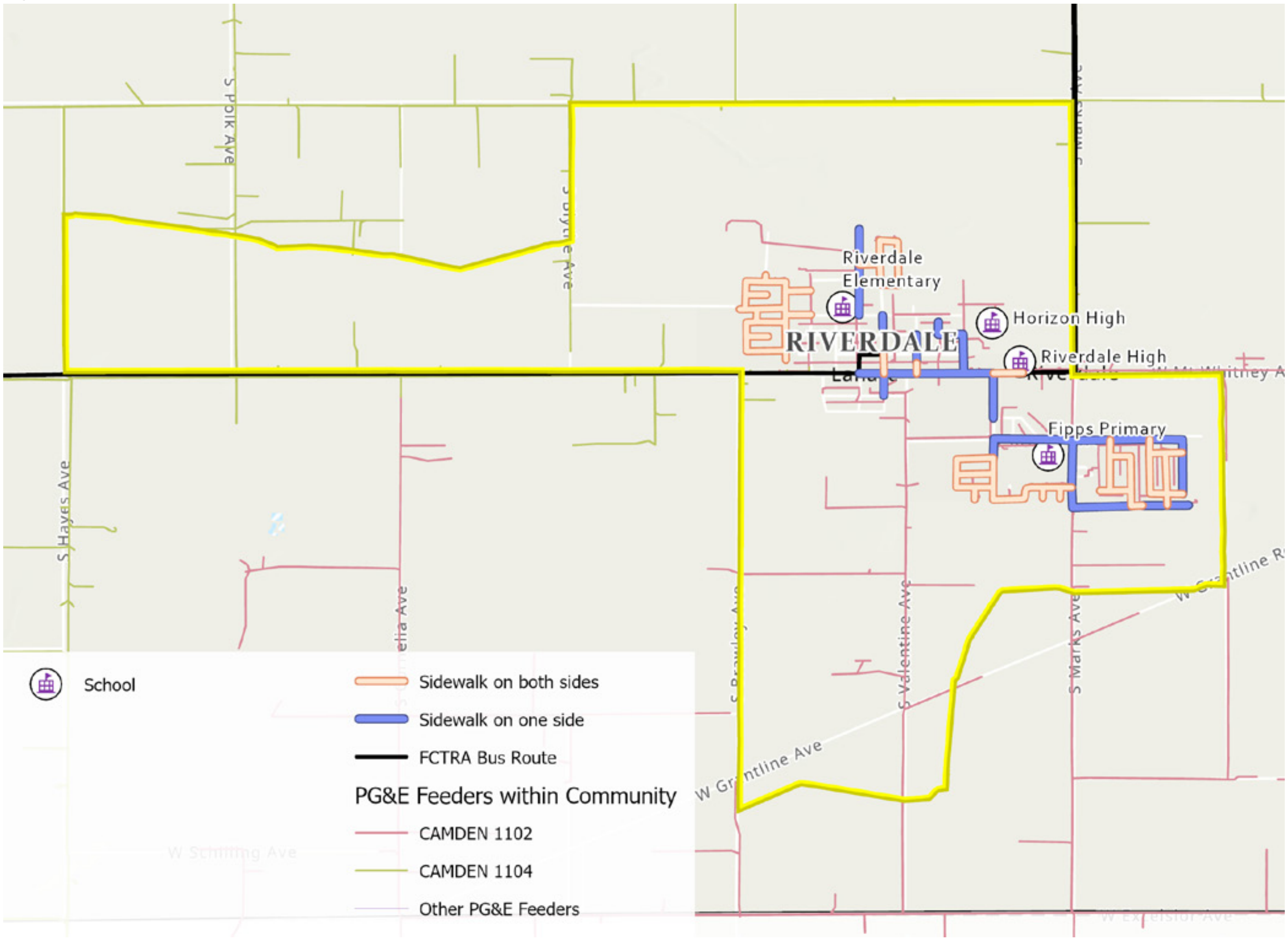
Lanare is located between West Harlan Avenue and West Mt Whitney Avenue with Lanare Community Center (LCC) as one of the main landmarks of the town as shown in Figure 119 below.

Figure 119: Lanare Map



Riverdale is 4 miles east of Lanare along West Mount Whitney Avenue Its major landmarks are Riverdale High School and State Foods Supermarket as shown in Figure 120 below.

Figure 120: Riverdale Map



According to 2020 Census data, Riverdale has a population of about 3,400. The Riverdale Public Utility District was formed in 1935 to provide water and sewer services within Riverdale. Today, the Riverdale Public Utility District provides public street lighting, municipal water, sewer, storm drainage, solid waste disposal, and fire protection. The Riverdale Community Plan was last updated in 2013 and anticipates that Riverdale could accommodate 221 new residential units in the community with potential for 154 to be multi-family units. Approximately 110 acres of land have been identified for future development opportunities. The Riverdale Joint Unified School District is also active in the community and serves over 1,600 students, operating two elementary schools, one high school, and one continuation high school.

Comparably, Lanare has a smaller population of about 540 as of 2020 Census data. From “Lanare: A Brief Narrative History,” Anne Bellows writes about the great need the Lanare community filled for low-income Black and Latinx farmworkers employed by West Fresno’s industrial farms.[39] Over the last 50 years, racism and poverty had made it more difficult for marginalized groups to move into historically white neighborhoods like Riverdale. Lanare formed out of a need to establish long lasting community among minority farm workers.

The Lanare Community Services District (LCSD) was formed in 1971[40] and maintains the community center, park, and community water system in Lanare. The LCSD board is made up of local volunteers.

39 Bellows, A. (2013, April). *Lanare, California: A Brief Narrative History.* University of California Berkeley School of Law. https://archive.org/details/693731-lanare-a-brief-narrative-history/page/n1/mode/2up

40 Ballantyne, R. & Schmidt, D. (2007, December 5). *Fresno Local Agency Formation Commission (LAFCo) Executive Officer’s Report: Consider Adoption—Municipal Service Review and Sphere of Influence Update Prepared for Lanare Community Service District.* Fresno Local Agency Formation Commission. https://www.fresnolafco.org/documents/staff-reports/Approved%20MSR’s/Lanare%20CSD%20MSR.pdf

Since 2006 Lanare has struggled with high levels of arsenic in their drinking water. In 2007, state grants were used for construction of a treatment plant[41], however the funding wasn't enough to provide ongoing maintenance and had to be shut down. It was only until 2019, when two new drinking water wells were installed using state grant funds, did the issue resolve.

Lanare and Riverdale have been identified as resilient hub priorities due to high temperatures, limited access to cooling centers, designation as a EJ community, and high poverty level.

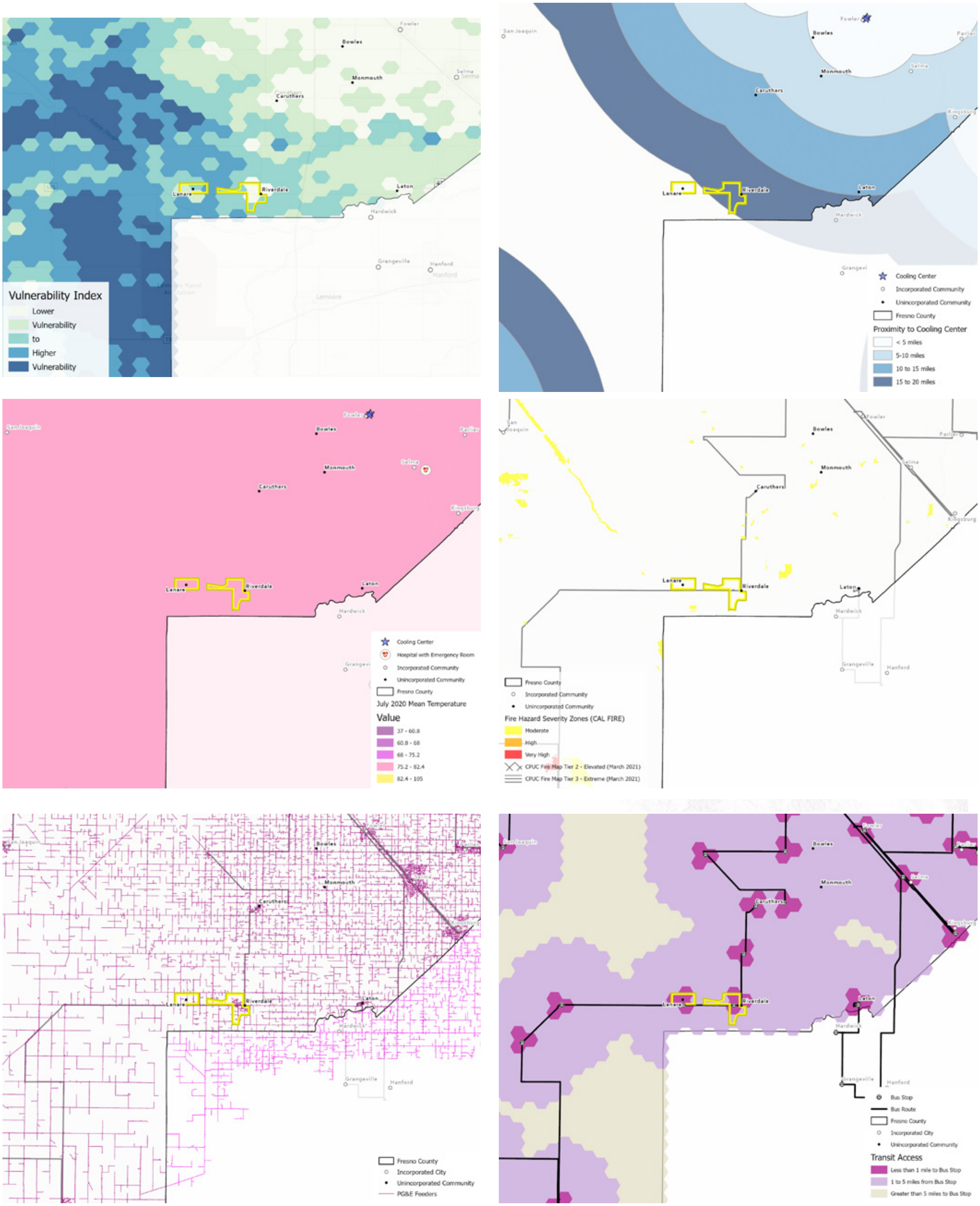
Table 60 and Figure 121 provide a summary of priority 1 vulnerability indicators for the communities of Lanare and Riverdale.

Table 60. Vulnerability Indicators that Exceed Threshold for Lanare and Riverdale

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	
1	Mean Temperature	●
1	Proximity to Cooling Centers	●
1	Access to Public Transit	
1	PG&E Feeders	
2	Asthma Percentile	●
2	Housing Burden	
2	Housing and Transportation Index	
2	EJ Communities	●
3	Proximity to Emergency Departments	●
3	Poverty	●
3	Linguistic Isolation	●

41 Klein, K. (2019, July 2). *After More Than A Decade, Lenare's Water Is Finally Safe To Drink. KVPR.* https://www.kvpr.org/post/after-more-decade-lanare-s-water-finally-safe-drink

Figure 121: Lanare and Riverdale Area Priority 1 Vulnerability Indicators



Given the vulnerabilities experienced in Lanare and Riverdale, the services detailed in Table 61 below should be deployed at this location's resilience hub.

Table 61. Resilience Hub Features for Lanare and Riverdale

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building EE features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Planning	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Planning	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Planning	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Planning	CERT Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Workspace with computers	Housing Burden, Poverty
Secondary	Community Planning	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Planning	Event Room	Housing Burden, Poverty
Secondary	Community Planning	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Community Planning	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments
Secondary	Community Planning	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Smart Lighting System (Solar powered)	Housing Burden
Secondary	Facility	Water Filtration System	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the cost estimate in Table 62 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

Table 62. Lanare and Riverdale Resilience Hub Cost Estimate

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EVs and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/12 year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 Cost for transplanting 10 trees $300-$1,200 to transplant a single tree 8-12 ft

Equipment	Cost Estimate	Assumption
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse (6x8) from Amazon, on the high end is a 12x12 full construction of a greenhouse
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

Within Lanare and Riverdale cluster, the LCC was identified as a potential resilience hub location.

The Leadership Counsel for Justice and Accountability (LCJA) would agree with this based on their blog post from June 2021, explaining the benefits the LCC already provides to the community, additional services it could provide with the right funding, and opportunities for the facility to act as a resilience hub for surrounding unincorporated communities in the area. The LCJA estimates that the cost to retrofit the facility would be around $500 million over 2 years to pay for building upgrades, building construction, land acquisition, clean energy infrastructure, and assets.

The LCC, photographed in Figure 122, is a 10 acre property operated by the LCSD with an office that was built in the 1960s. It is maintained by a local volunteer group Community United, however the building state is poor with no temperature control systems in place and need of significant upgrades. The LCC supports three monthly food distributions to almost 300 families and provides an opportunity to work with Fresno County leaders and discuss community needs. Recently, the community center was also a site for COVID-19 testing and was a vaccination clinic for over a thousand farmworkers.

The accessibility of the LCC, with its existing service offerings, and its location within a historically marginalized community, proves to be a great location for a potential resilience hub. The open field adjacent to the office provides a great opportunity for ground mount solar, provided there are no environmental concerns. The existing parking lot already supports the basic infrastructure needed for charging station installation and potential solar carport installations.

Figure 122: Lanare Community Center

The proposed cost for microgrid implementation at Lanare Community Center would require the installation of solar and battery energy storage to power building and charging loads. Scenario A proposes a new 75 kW solar array, which would be 187 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling thirty-nine 9' by 12' car ports. The system would cover the entire building load (98 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation. Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling nineteen carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 63 below:

Table 63. Microgrid Estimate for Lanare Community Center

Scenario A: Microgrid is able to cover all building loads(including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
75 kW new solar	$130,000	Assumed to cover the full load of 98 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$290,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

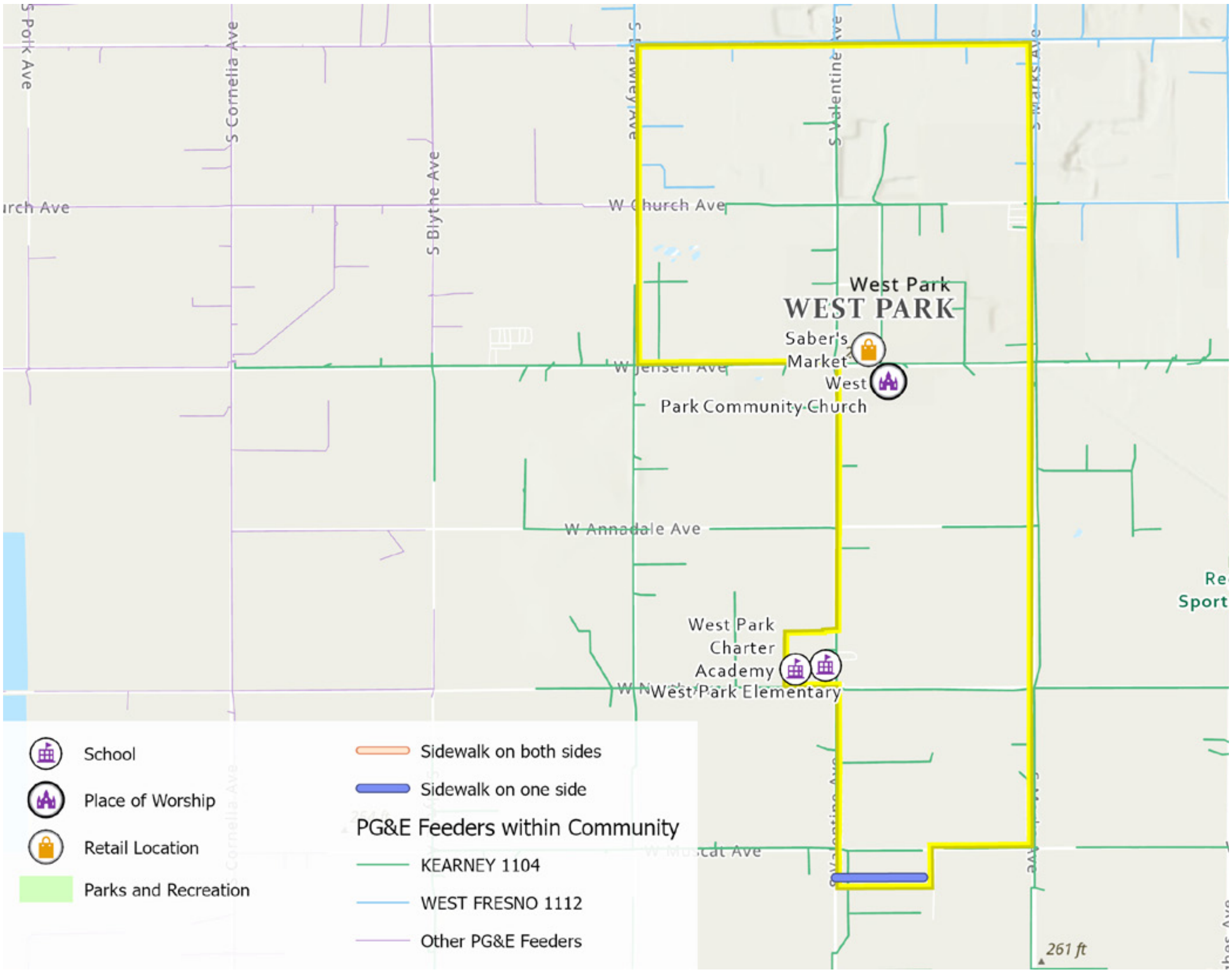
Figure 123: Aerial View of Lanare Community Center with Proposed Solar Array

Another scenario to consider when designing the resilience hub is the possibility of every household in Lanare having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day , and that all 61 households had a single EV, the total energy output per day would be 335.5 kWh/day. This would require a 77 kW solar system (248 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Lanare installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

8.2.5 West Park

West Park is an unincorporated community located 5 miles southwest of the City of Fresno and has a population of about 1,000. Major landmarks include Saber's Market, West Park Elementary School District, and West Park Community Church as seen in Figure 124 below.

Figure 124: West Park Community Map



In the last few decades, the West Park community has been impacted by poor infrastructure and lack of sidewalks, bike lanes, street lighting, and sewer systems. Despite its proximity to the Fresno city border, residents have had to walk or bike over a mile to access the nearest bus stop. In 2017, a local group called "Los Olvidados" ("The Forgotten") formed to voice their concerns to FCOG. They worked with California Rural Legal Assistance, who advocated for increased transit service in West Park.[42] By the end of 2017, FCRTA committed to developing a transit project that serviced the community.

Most recently, FCRTA partnered with Inspiration Transportation on REV-UP, which will offer $5 round trip rides in Chevy Bolt electric vehicles. The pilot program launched in West Park in October 2020 with plans for expansion to nearby rural communities.[43]

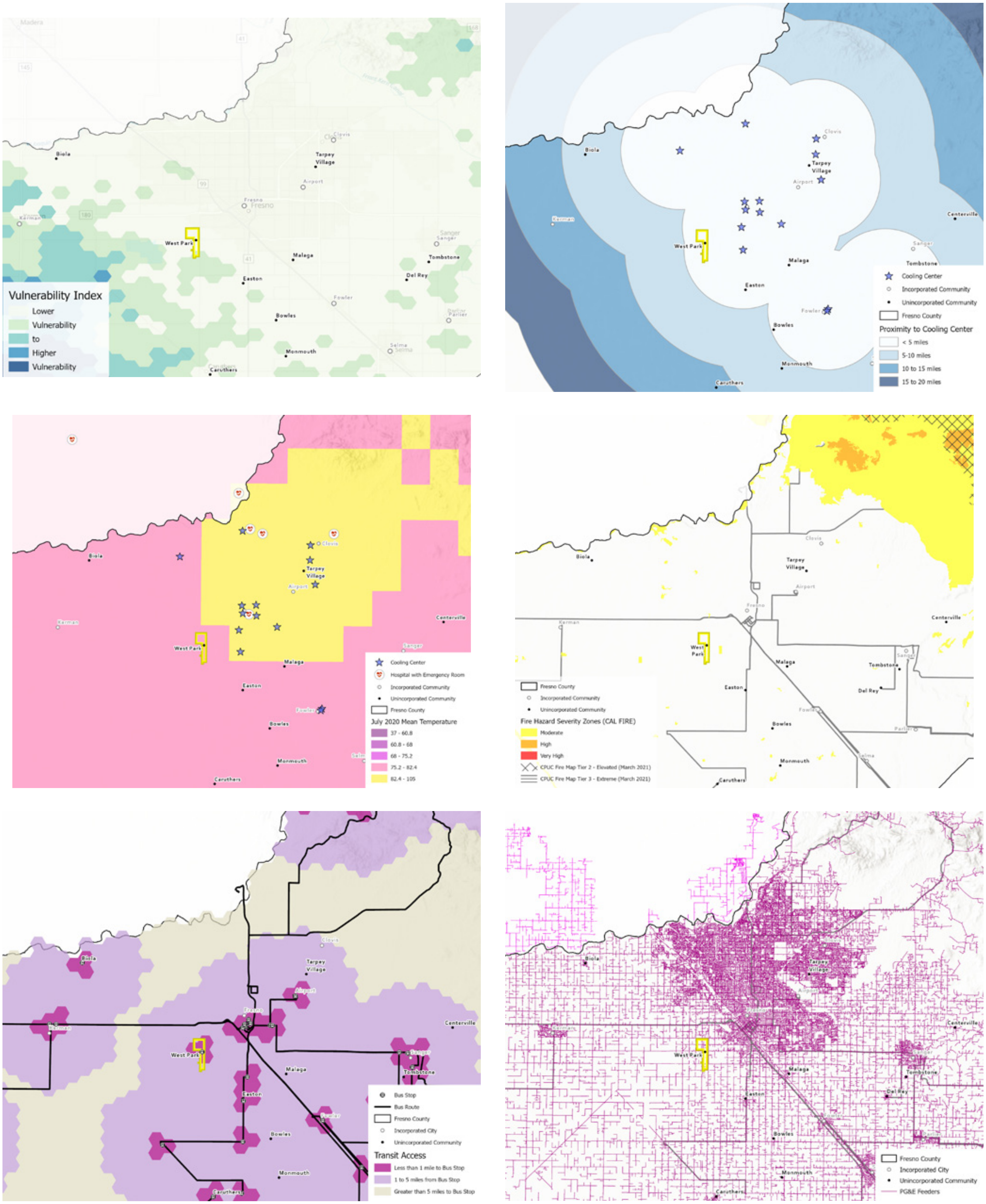
42 California Rural Legal Assistance, Inc. (2017, November 7). Forgotten No More: Rural Residents Win New Transit Line for Historically Underserved Community in Fresno County [Press Release]. https://archive.crla.org/forgotten-no-more-rural-residents-win-new-transit-line-historically-underserved-community-fresno.html

43 Thompson, M. (2017, December 20). These Central Valley Residents Designed Their Own Public Transit Line, and They're Just Getting Started. ACLU Northern California. https://www.aclunc.org/blog/these-central-valley-residents-designed-their-own-public-transit-line-and-they-re-just-getting

Table 64. West Park Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	
1	Mean Temperature	●
1	Proximity to Cooling Centers	
1	Access to Public Transit	
1	PG&E Feeders	
2	Asthma Percentile	●
2	Housing Burden	●
2	Housing and Transportation Index	●
2	EJ Communities	●
3	Proximity to Emergency Departments	
3	Poverty	●
3	Linguistic Isolation	●

Figure 125: West Park Priority 1 Vulnerability Indicators



Given the vulnerabilities experienced in West Park, the services detailed in Table 65 below should be deployed at this location's resilience hub.

Table 65. West Park Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building EE features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Planning	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Planning	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Planning	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Planning	CERT Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Workspace with computers	Housing Burden, Poverty
Secondary	Community Planning	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Planning	Event Room	Housing Burden, Poverty
Secondary	Community Planning	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Community Planning	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments
Secondary	Community Planning	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Smart Lighting System (Solar powered)	Housing Burden
Secondary	Facility	Water Filtration System	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the below cost estimate in Table 66 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

Table 66. West Park Resilience Hub Cost Estimate

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EV and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees $300-$1,200 to transplant a single tree 8-12 ft

Equipment	Cost Estimate	Assumption
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse 6' by 8' from Amazon, on the high end is a 12' by 12' full construction of a greenhouse
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

Within West Park, Saber's Market was identified as a potential resilience hub location.

Saber's Market is a local shop along South Prospect Avenue, the main road in the community. It's also in proximity of the West Park Community Church. While the parking lot looks to be unpaved, there is opportunity for a small-scale solar carport or ground mount installations.

Figure 126: Saber's Market

The proposed cost for microgrid implementation at Saber's Market would require the installation of solar and battery energy storage to power building and charging loads.

Scenario A proposes a new 89 kW solar array, which would be 93 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling forty-six 9' by 12' car ports. The system would cover the entire building load (135 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation.

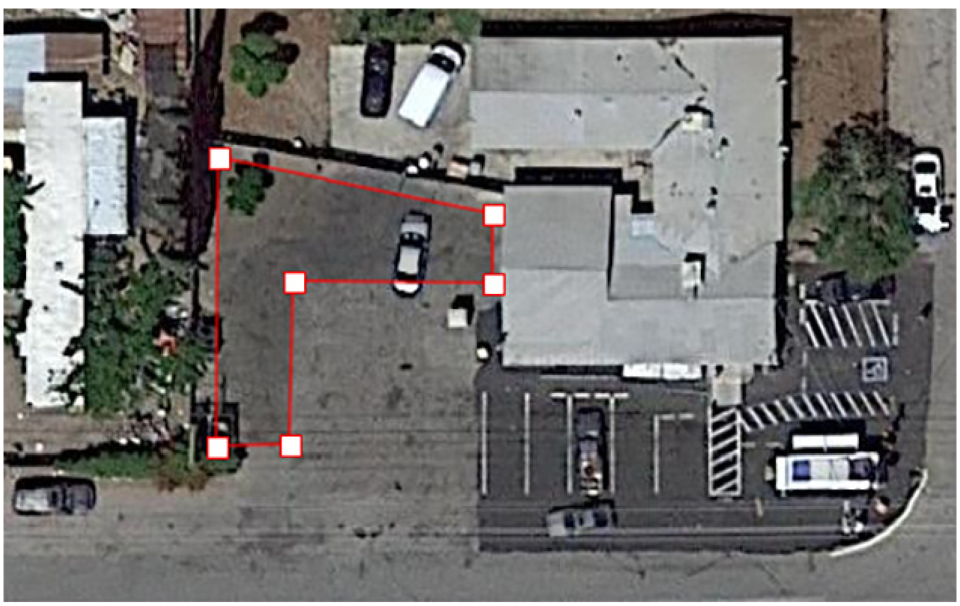
Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling nineteen carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 68 below.

Table 67. Microgrid Cost Estimate for Saber's Market

Scenario A: Microgrid is able to cover all building loads (including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
75 kW new solar	$150,000	Assumed to cover the full load of 135 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$310,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 127 below for the proposed location of the proposed solar array at Saber's Market for Scenario B, due to inadequate space for Scenario A array, that informed the cost estimate:

Figure 127: Aerial view of Saber's Market with proposed solar array for Scenario B in the red box



Another scenario to consider when designing the resilience hub is the possibility of every household in West Park having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 282 households had a single EV, the total energy output per day would be 1,551 kWh/day. This would require a 355 kW solar system (1,146 solar panels) to be installed in a central location in the community to offset the energy use. If every household in West Park installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

8.2.6 Biola

Biola is an unincorporated community located northeast of Fresno with a population of about 1,700. Major landmarks in the community include the Biola Community Services District, Biola-Pershing Elementary School, Biola Branch Library, and Biola Congregational Church as seen in Figure 128 below.

Figure 128: Biola Community Map

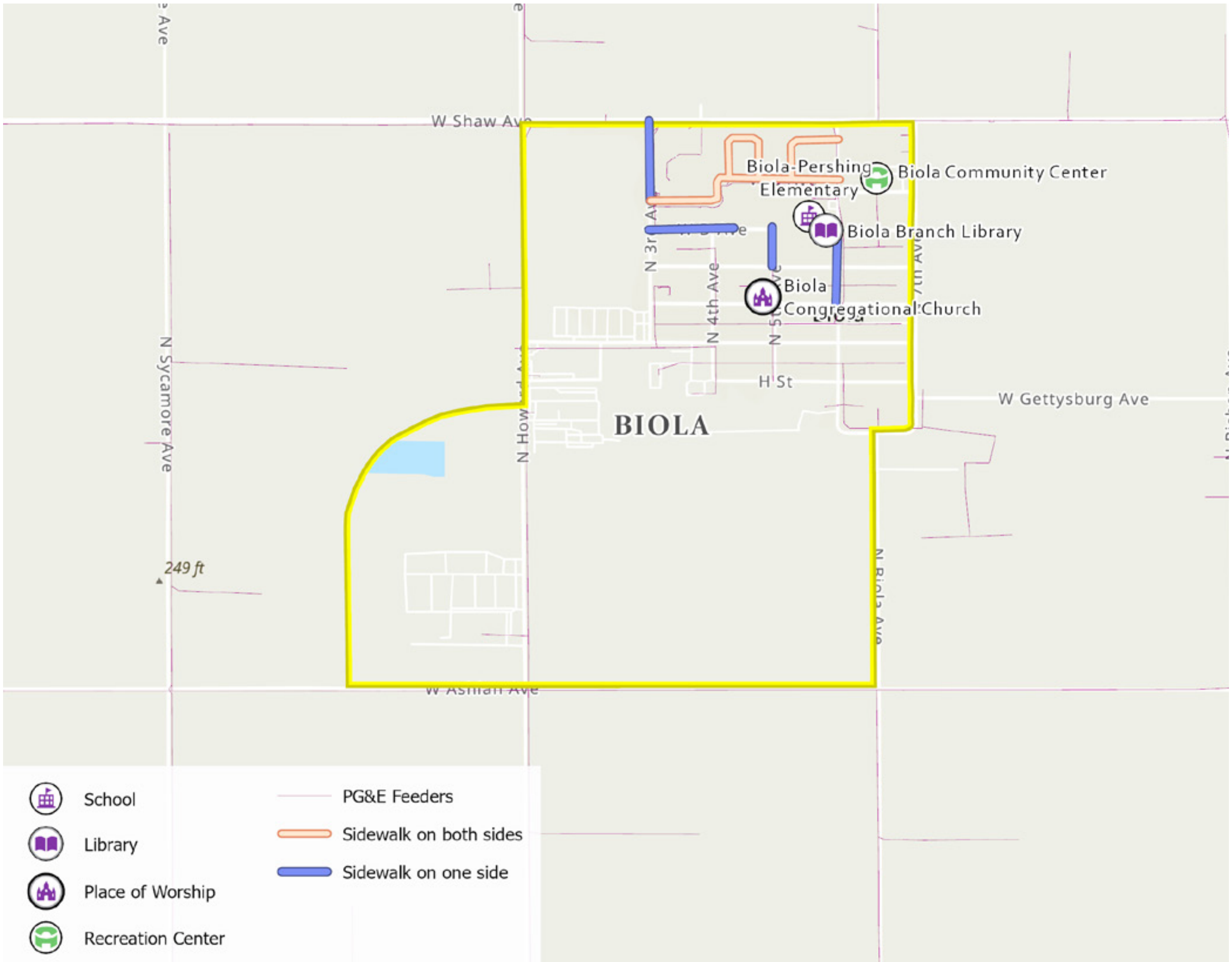
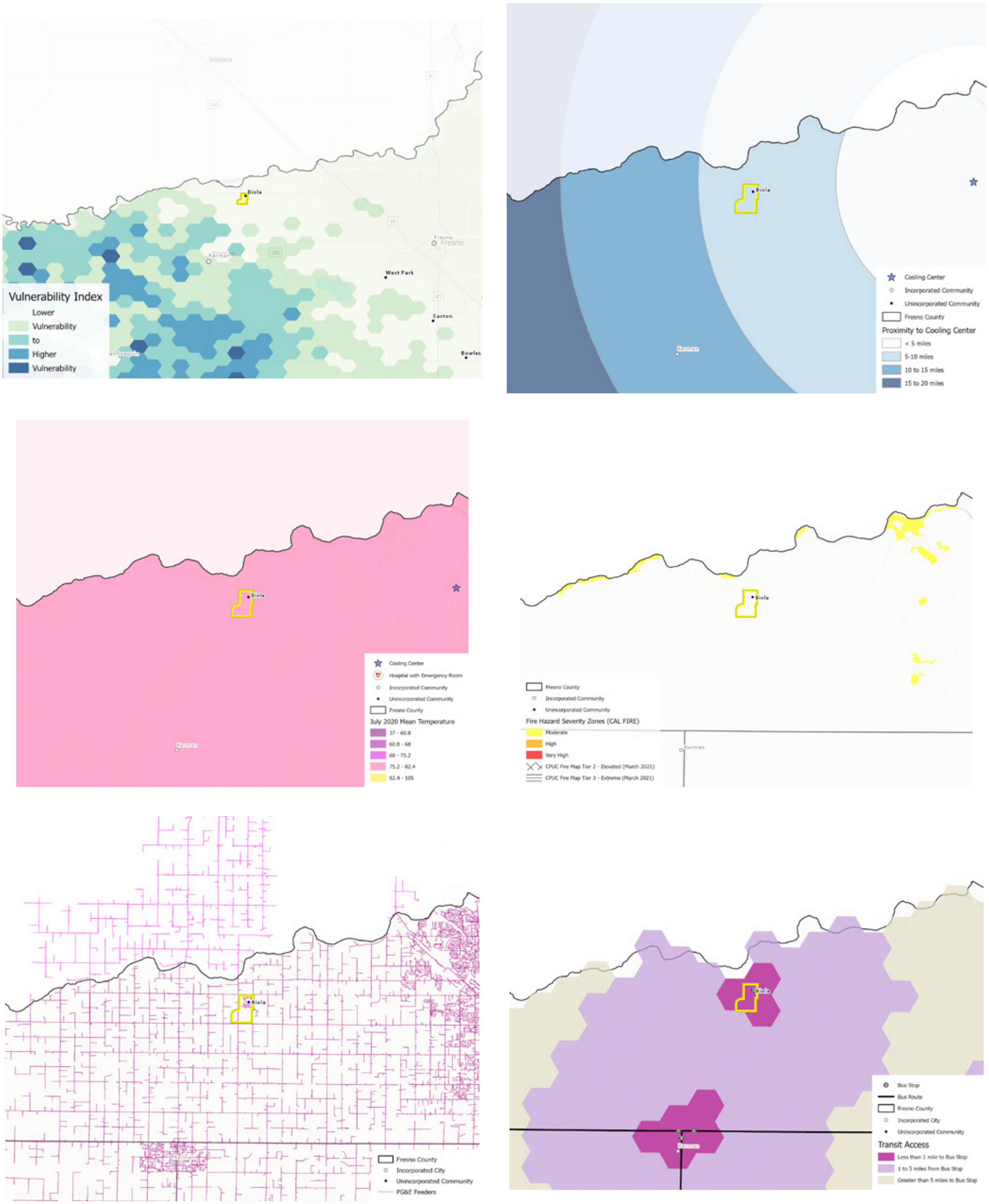


Table 68. Biola Priority 1 Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	
1	Mean Temperature	●
1	Proximity to Cooling Centers	
1	Access to Public Transit	
1	PG&E Feeders	
2	Asthma Percentile	●
2	Housing Burden	
2	Housing and Transportation Index	●
2	EJ Communities	●
3	Proximity to Emergency Departments	●
3	Poverty	●
3	Linguistic Isolation	●

Figure 129: Biola Priority 1 Vulnerability Indicators



Given the vulnerabilities experienced in Biola, the services detailed in Table 69 should be deployed at this location's resilience hub.

Table 69. Biola Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building EE features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Planning	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Planning	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Planning	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Planning	CERTTrainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Workspace with computers	Housing Burden, Poverty
Secondary	Community Planning	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Planning	Event Room	Housing Burden, Poverty
Secondary	Community Planning	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile
Secondary	Community Planning	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Community Planning	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Smart Lighting System (Solar powered)	Housing Burden
Secondary	Facility	Water Filtration System	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the below cost estimate in Table 70 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2

Table 70. Biola Resilience Hub Cost Estimate

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EV and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/12 year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees $300-$1,200 to transplant a single tree 8-12 ft
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen

Equipment	Cost Estimate	Assumption
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse 6' by 8' from Amazon, on the high end is a 12' by 12' full construction of a greenhouse
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

The Biola community is made up primarily of agricultural workers that have limited English proficiency. There are currently no existing public transportation options, leading many to walk for many miles to get to the nearest bus stop to access grocery stores and other services from Fresno or Kerman, the nearest cities. With few sidewalks, bike lanes, and well-lit roads, the only option for most is driving. Due to language barriers, long work hours, and only 50% of the community having a high school degree, this community is left out of the planning process, with their needs unmet.

In 2020, FCRTA was awarded $36,885 from the Clean Mobility Options Voucher Pilot Program to support the community of Biola with clean energy transportation solutions after conducting a thorough needs assessment with community members.

Within Biola, the Biola Community Services District (BCSD) building, shown in Figure 130, was identified as a potential resilience hub location.

The BCSD building is already a well-known location for Board Members to hold meetings and plan events. The BCSD has used the hall as a community food bank, drought box distribution site, meeting site for the Biola Chamber of Commerce, and offers the opportunity for locals to rent the space for private events. The facility includes a large hall, a modern kitchen with stainless steel appliances, food storage and refrigeration, and two stoves for meal preparation as seen in Figure 131. There is also a large parking lot on two sides of the building with a wraparound sidewalk which supports the basic infrastructure needed for EV charger installation. The large parking lot could also support carport solar installations. The BCSD building has an active Facebook page and shares resources for seniors, local opportunities for job training, and most recently has been hosting events with FCRTA on electrification transportation.

Figure 130: Biola Community Center

Figure 131: Biola Community Center Kitchen

The proposed cost for microgrid implementation at the BCSD building would require the installation of solar and battery energy storage to power building and charging loads. It is assumed the proposed building would be 4,757 ft².

Scenario A proposes a new 115 kW solar array, which would be 289 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling sixty 9' by 12' car ports. The system would cover the entire building load (202 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 95 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation.

Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling nineteen carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 71 below:

Table 71. Microgrid Cost Estimate for Biola

Scenario A: Microgrid is able to cover all building loads(including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
115 kW new solar	$200,000	Assumed to cover the full load of 297 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$360,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 132 below for the proposed location of the proposed solar array at Biola that informed the cost estimate:

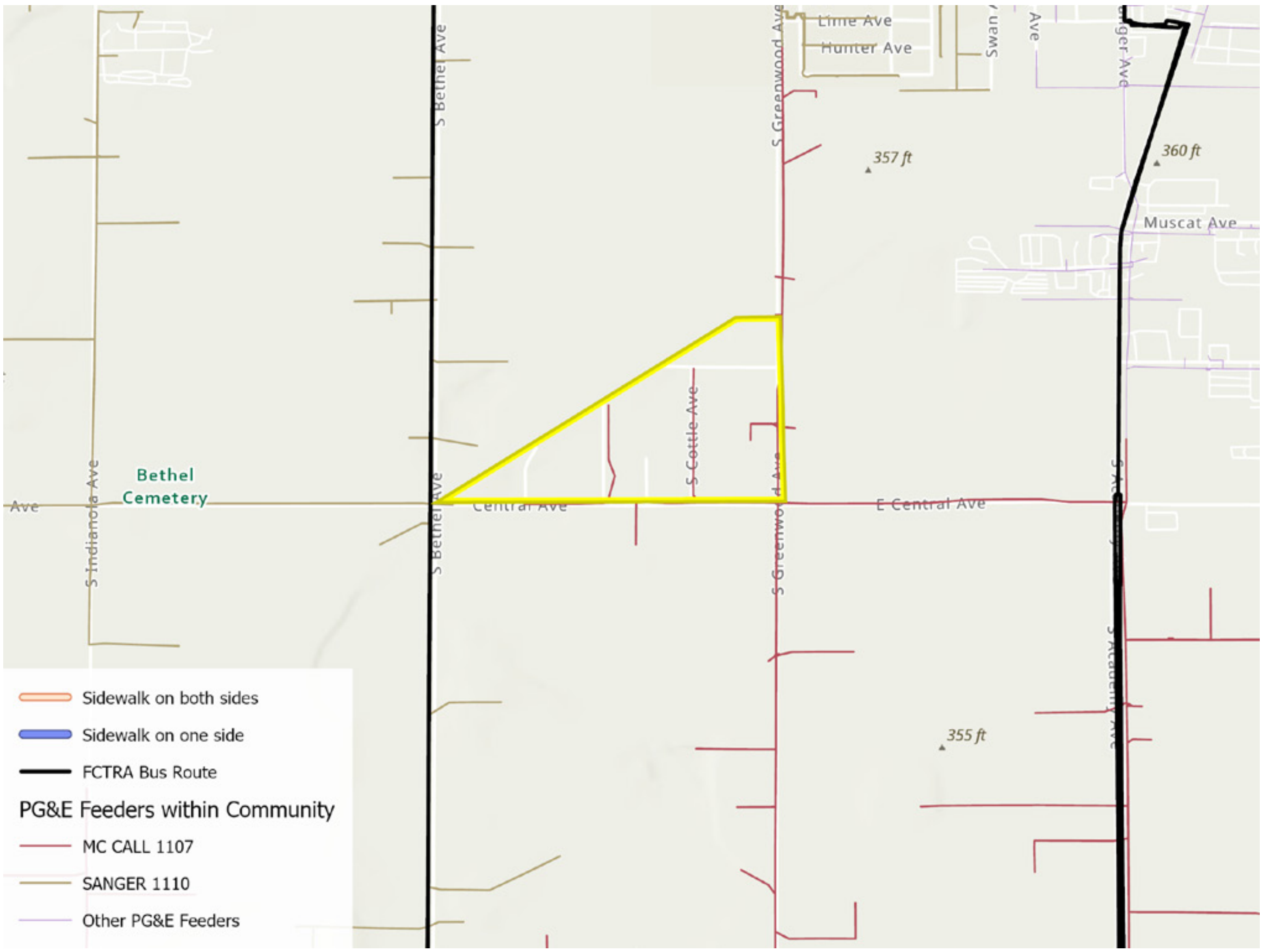
Figure 132: Aerial view of Biola with proposed solar array for Scenario A in the red box

Another scenario to consider when designing the resilience hub is the possibility of every household in Biola having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 378 households had a single EV, the total energy output per day would be 2,079 kWh/day. This would require a 476 kW solar system (1537 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Biola installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

8.2.7 Tombstone

Tombstone Territory is an unincorporated community located in the eastern region of Fresno County, a mile outside of Sanger. The community has less than 40 homes across 4 blocks as seen in Figure 133. There is no record online of Tombstone's Community Plan, despite its existence for multiple decades.

Figure 133: Tombstone Community Map



Clean drinking water access has been an issue in this community for many years. While Sanger has a centralized water system, Tombstone residents rely on private wells for water access. Private wells are more susceptible to aquifer contaminants (from nearby agricultural activities and chemicals) and falling groundwater levels. In June of 2019, California Governor Gavin Newsom signed SB 200 in Tombstone Territory, allocating $130 million to the implementation of a Safe and Affordable Drinking Water Program.[44]

In April 2021, the State Water Board approved the financing of the Tombstone Territory Water Connection Project, which will connect the City of Sanger's water distribution system to Tombstone Territory through installation of over 13,000 ft of water main pipelines and associated hydrants. This project is funded by the State Water Board's Drinking Water State Revolving

44 California Water News Daily (2019, July 26). Fresno County's Tombstone Territory Home to Signing of Safe and Affordable Drinking Water Bill. http://californiawaternewsdaily.com/legislation/fresno-countys-tombstone-territory-home-to-signing-of-safe-and-affordable-drinking-water-bill/

Fund (SRF).[45]

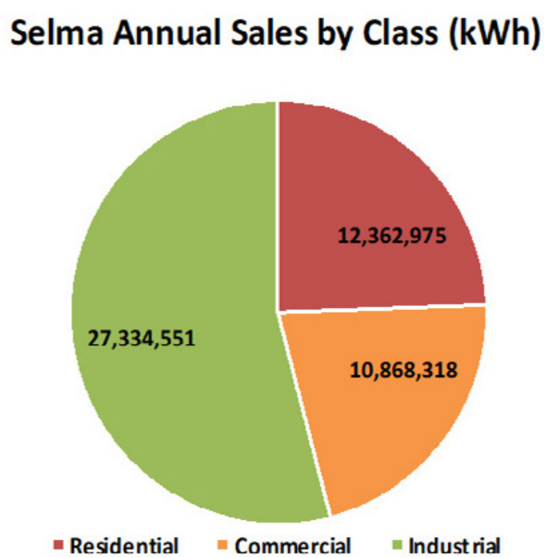
In addition to water quality issues, Tombstone Territory is prone to higher-than-average temperatures, has a large asthma percentile, and a large percentage of the population experiences high cost of housing and poverty. A resilience hub could alleviate some of the community needs by implementing a centrally located temperature-controlled shelter with air purification and community building opportunities.

Tombstone is connected to the same feeder as Selma (Section 8.18.13), and as such the community may be impacted by the expansion of the planned maintenance facility. This connection heightens the criticality of network upgrades and available solar and storage resources.

As shown in the pie chart figure below, the connected feeder, MC CALL 1107, is dominated by industrial load, with the remaining about 45% split almost evenly between residential and small-medium commercial customers.

Each feeder's load split is significant because load mix drives the timing of peak demand, and it also drives the forecast mix of DER, and its impact on peak demand levels and timing.

Figure 134: 2020 Sales by Class (kWh) – MC CALL 1107

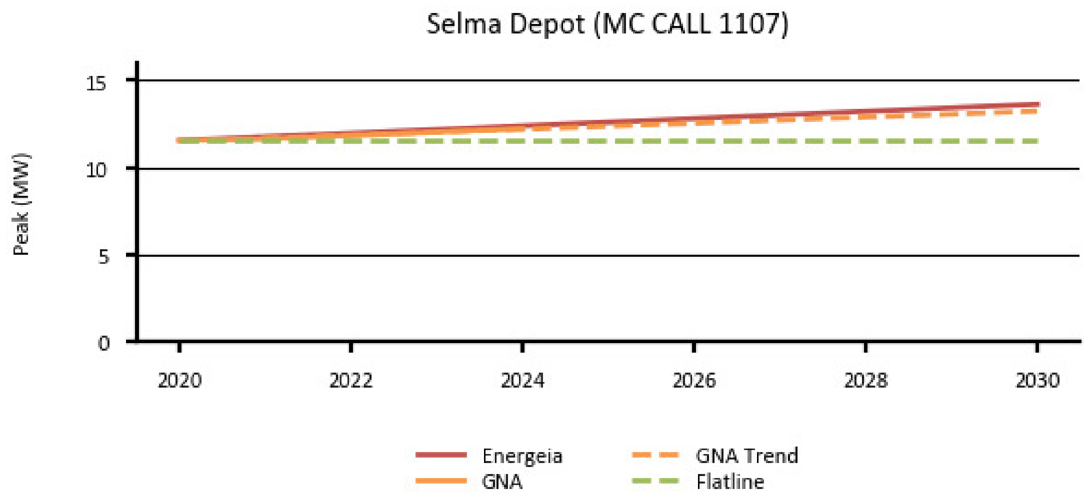


Source: Energeia modeling

45 State Water Resources Control Board (2021, April 16). Notice of Determination: Tombstone Territory Water Connection Project. https://files.ceqanet.opr.ca.gov/263606-5/attachment/DO5-99CYrO7ADTmbGrnSwutrw4j4H4_wgMMaXWSJ4x8tGCpxw6Oi3BfvyHHuo-ew2Mwlx5KJEuxejnYN0

The below Figure 135 shows this study's peak demand forecast in red, the GNA study in orange, and a flatline in green for reference. There is very little difference between PG&E's trended forecast and that of our own in this case.

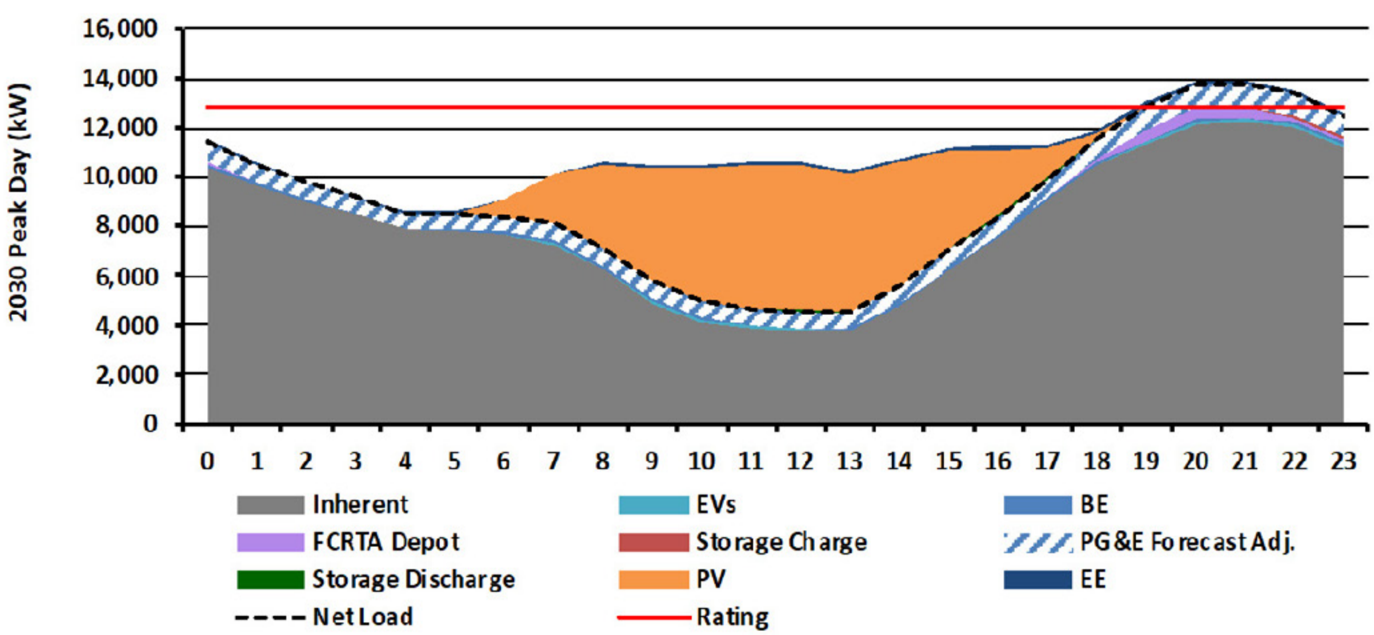
Figure 135: Peak Demand Forecast – MC CALL 1107



Source: Energeia modeling

Figure 136 shows a detailed view of the load shape and key contributors to peak demand on the forecasted peak day in 2030. Tombstone is a relatively minor contributor to peak demand, but additional vehicle electrification is expected to contribute to MC CALL 1107's peak demand at 8 pm. Solar and storage may be used to mitigate this but would need to be deployed in the next few years to defer the need for network investment.

Figure 136: 2030 Peak Day Load Shape by Component – MC CALL 1107

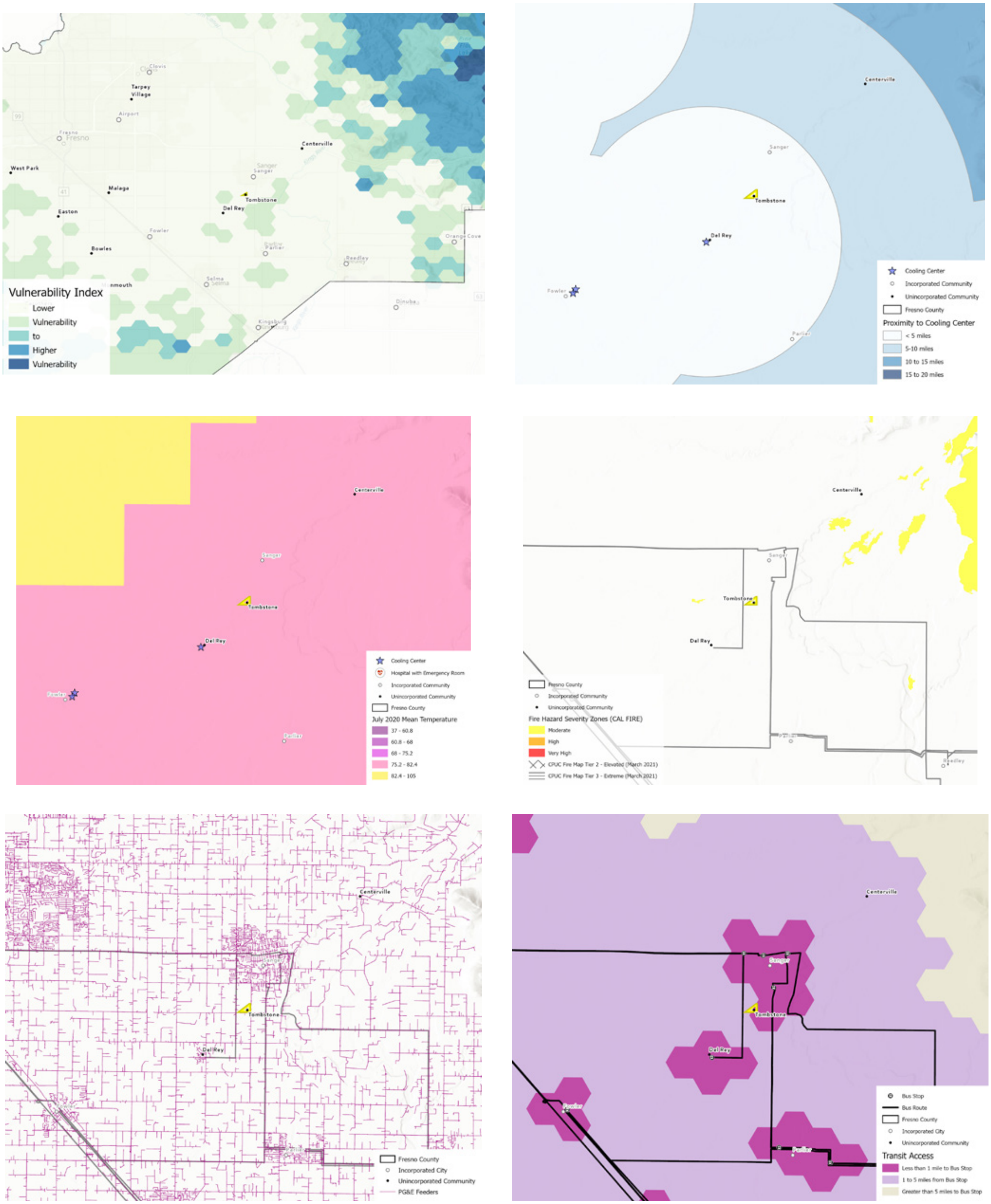


Source: Energeia modeling

Table 72. Tombstone Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	
1	Mean Temperature	●
1	Proximity to Cooling Centers	
1	PG&E Feeders	●
1	Access to public transit	
2	Asthma Percentile	●
2	Housing Burden	●
2	Housing and Transportation Index	
2	EJ communities	●
3	Proximity to Emergency Departments	
3	Poverty	●
3	Linguistic Isolation	●

Figure 137: Tombstone Priority 1 Vulnerability Indicators



Given the vulnerabilities experienced in Tombstone Territory, the services detailed in Table 73 below should be deployed at this location's resilience hub.

Table 73. Tombstone Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building EE features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Planning	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Planning	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Planning	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Planning	CERT Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Planning	Workspace with computers	Housing Burden, Poverty
Secondary	Community Planning	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Planning	Event Room	Housing Burden, Poverty
Secondary	Community Planning	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Community Planning	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments
Secondary	Community Planning	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Smart Lighting System (Solar powered)	Housing Burden
Secondary	Facility	Water Filtration System	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the below cost estimate in Table 74 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

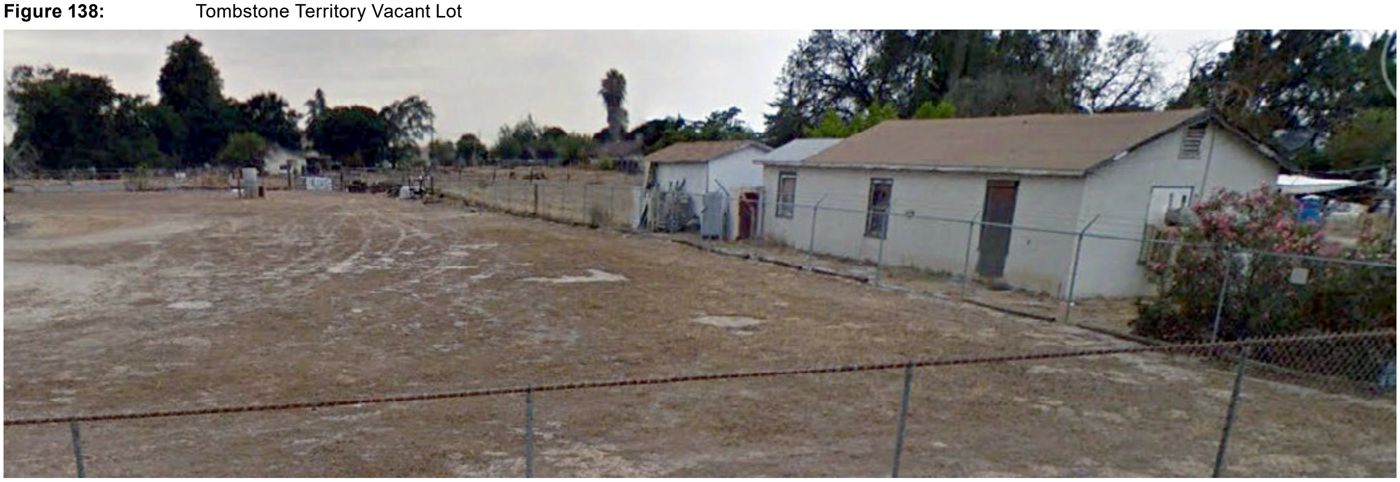
Table 74. Tombstone Resilience Hub Cost Estimate

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EV and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/12 year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees. $300-$1,200 to transplant a single tree 8-12 ft

Equipment	Cost Estimate	Assumption
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Full Time Personnel	$90,000	3 full time personnel/Hub at rate of $14/hour, About $90k annually split between 3 people: Admin/Event Coordinator, Security, Rotating teaching position
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Public Computers	$6,000	3 desktop computers for public use at $2000/ each
Greenhouse/ Community Garden	$350-$25,000	On the low end is a small portable greenhouse 6' by 8' from Amazon, on the high end is a 12' by 12' full construction of a greenhouse
Water Filtration System	$50-$2,000	Average total price, will require additional research to determine best filter type to meet each community's needs

Because Tombstone Territory is a primarily residential area, it would make the most sense to look at open lots for resilience hub development. The vacant lot in Figure 138 below is across the street from 3852 South Cottle Avenue and could be a great potential Hub location as it's walking distance from many of the homes. It would require basic infrastructure development to make it useable for the community and to add on the above Hub features. Additional costs of permitting and building construction is not included in the above cost estimate and would need to be assessed based on available funds and chosen features.

Figure 138: Tombstone Territory Vacant Lot



The proposed cost for microgrid implementation at Tombstone would require the installation of solar and battery energy storage to power building and charging loads. It is assumed the proposed building would be 1,900 ft^2.

Scenario A proposes a new 68 kW solar array, which would be 93 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling thirty-five 9' by 12' car ports. The system would cover the entire building load (81 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation.

Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling nineteen carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 75 below:

Table 75. Microgrid Cost Estimate for Tombstone

Scenario A: Microgrid is able to cover all building loads(including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
68 kW new solar	$120,000	Assumed to cover the full load of 176 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$280,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 139: Aerial view of Tombstone with proposed solar array for Scenario A in the red box below for the proposed location of the proposed solar array at Tombstone that informed the cost estimate:

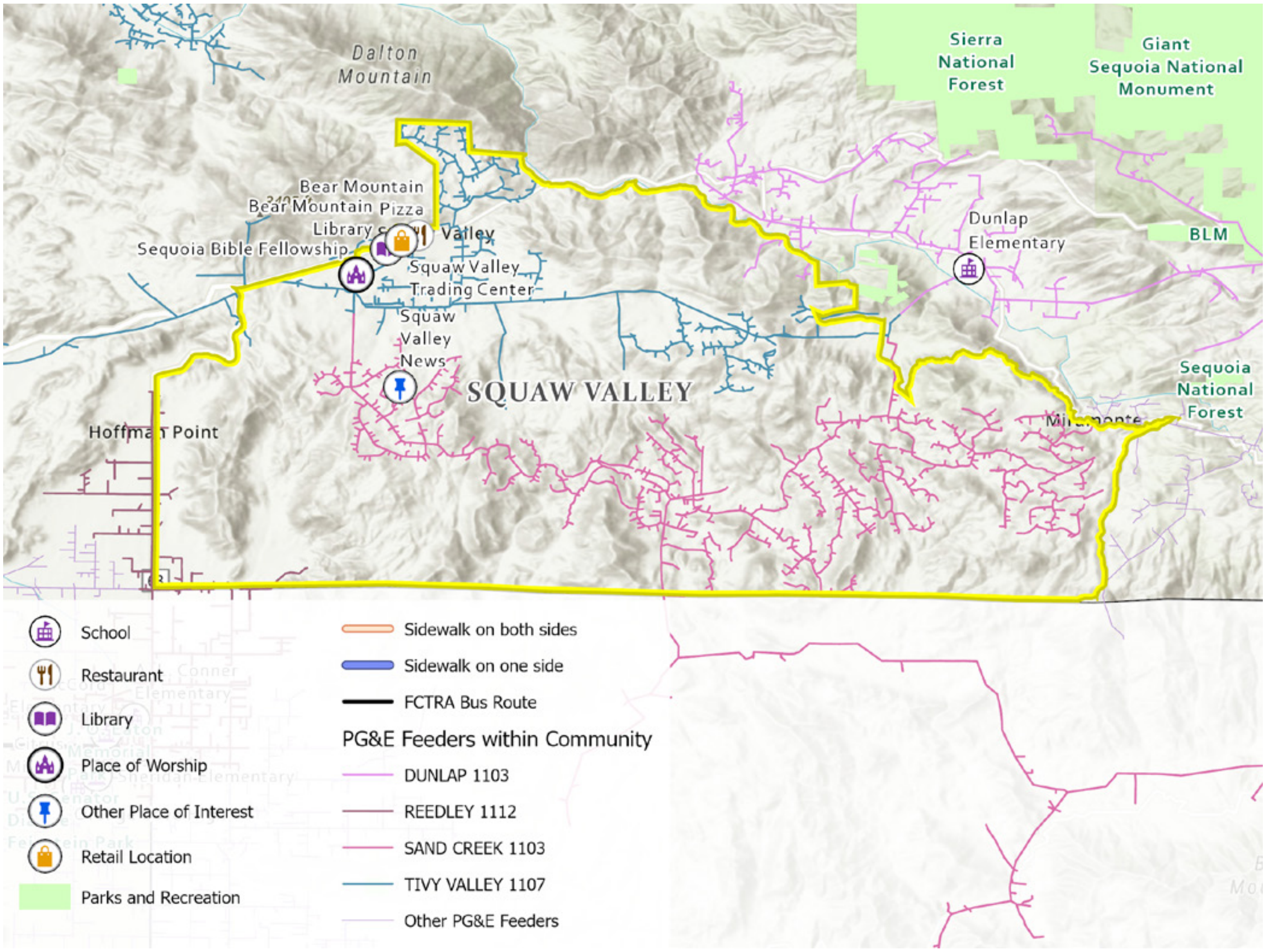
Figure 139: Aerial view of Tombstone with proposed solar array for Scenario A in the red box

Another scenario to consider when designing the resilience hub is the possibility of every household in Tombstone having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 52 households had a single EV, the total energy output per day would be 286 kWh/day. This would require a 66 kW solar system (211 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Tombstone installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

8.2.8 Squaw Valley

Squaw Valley is located in the southeastern region of Fresno County, along Kings Canyon Road. It has a population of about 3,600 as of 2019 Census data. Major landmarks in the community include Bear Mountain Library, Squaw Valley News, Sequoia Bible Fellowship, Squaw Valley Trading Center, and Bear Mountain Pizza as seen in Figure 140 below. Squaw Valley is located 9 miles north of Orange Cove, and 30 miles east of Fresno. There is currently no public transport beyond Orange Cove. There is no record online of Squaw Valley's Community Plan, despite its existence for multiple decades.

Figure 140: Squaw Valley Map

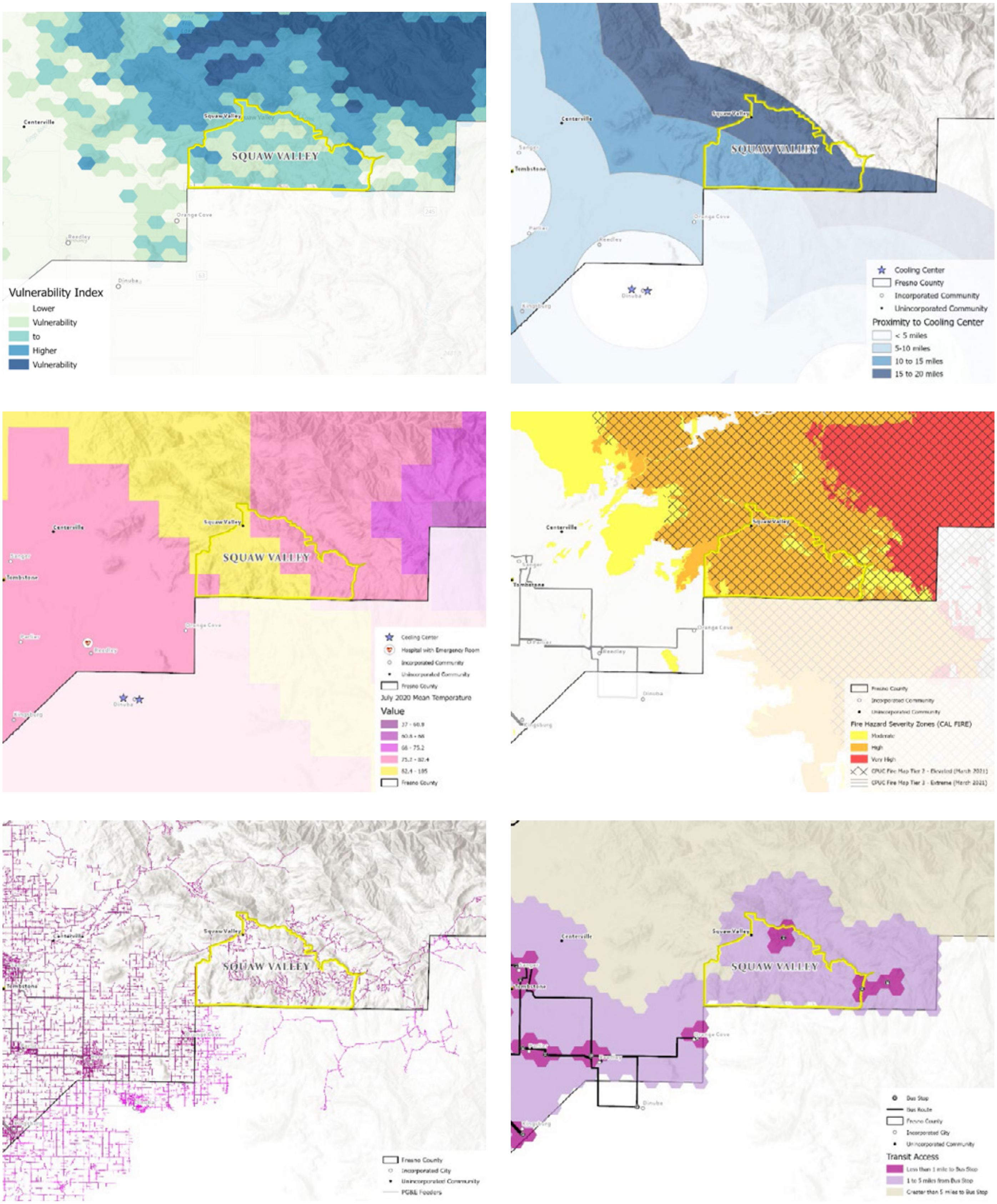


Squaw Valley faces high heat and is at a high fire risk. Additionally, the location is isolated from cooling centers and emergency rooms, has a high asthma rate, and a costly housing and transportation index as seen in Table 76 below. To alleviate such risks and factors, a fireproof resilience hub could serve as a cooling center that offers immediate medical care if needed before transferring to a main hospital facility.

Table 76. Squaw Valley Vulnerability Indicators that Exceed Threshold

Priority Level	Vulnerability Indicator	Indicator Threshold Exceeds
1	Fire Prone Areas	●
1	Mean Temperature	●
1	Proximity to Cooling Centers	●
1	PG&E Feeders	●
1	Access to Public Transit	●
2	Asthma Percentile	
2	Housing Burden	
2	Housing and Transportation Index	●
2	EJ Communities	
3	Proximity to Emergency Departments	●
3	Poverty	●
3	Linguistic Isolation	

Figure 141: Squaw Valley Priority 1 Vulnerability Indicators



Given the vulnerabilities experienced by Squaw Valley, the services detailed in Table 77 should be deployed at this location's resilience hub.

Table 77. Squaw Valley Resilience Hub Features

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Primary*	Transit	City/County bike program	Access to public transit, Housing and Transportation Index
Primary*	Transit	E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary*	Transit	Electric Vehicles (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals	Access to public transit, Housing and Transportation Index, Proximity to Emergency Departments
Primary	Facility	Air Conditioning	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Air filtration System	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Building Energy Efficiency features	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	Create a Fire Resistant Building and Fire Repellant Environment	Fire Prone Areas
Primary*	Energy	Local Microgrid	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Community Programming	Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	Fire Prone Areas, Mean Temperature, Proximity to Emergency Departments, Asthma Percentile
Primary	Community Programming	Community Resource Map	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Primary	Facility	ADA site compliance	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile
Secondary	Facility	Floodproofing and Stormwater Management	Housing Burden, Poverty
Secondary	Facility	Wi-Fi and Phone Charging Stations	Fire Prone Areas, Mean Temperature
Secondary	Facility	Trees and Greenspace	Proximity to Cooling Centers, Mean Temperature
Secondary	Facility	Kitchen + Food Storage	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Bathrooms, locker rooms, showers	Housing Burden, Poverty, Fire Prone Areas, Mean Temperature
Secondary	Facility	Video Chat with Medical Professionals	Asthma Percentile, Mean Temperature, Linguistic Isolation
Secondary	Community Programming	Jobs for Community Members	Housing Burden, Poverty
Secondary	Community Programming	Community Emergency Response Team(CERT) Trainings and Workshops (www.ready.gov)	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Programming	Community-led classes	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Proximity to Emergency Departments
Secondary	Community Programming	Workspace with computers	Housing Burden, Poverty
Secondary	Community Programming	Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	Fire Prone Areas, Mean Temperature, Proximity to Cooling Centers, Asthma Percentile, Poverty, Linguistic Isolation
Secondary	Community Programming	Event Room	Housing Burden, Poverty
Secondary	Community Programming	Online Forum or App to connect local resilience hubs	Fire Prone Areas, Mean Temperature, Asthma Percentile
Secondary	Community Programming	Create a Zello app group (https://zello.com/) and draw awareness.	Fire Prone Areas, Mean Temperature, Asthma Percentile, Proximity to Emergency Departments

Type	Category	Resilience Hub Features	Which Vulnerability indicators can be relieved?
Secondary	Facility	Greenhouse/Community Garden	Housing Burden, Poverty
Secondary	Facility	Water filtration system	Housing Burden, Poverty

An ideal resilience hub in these communities would have all the above features. To make more informed decisions about which features should be implemented, the below cost estimate in Table 78 summarizes the overall cost with assumptions included. Detailed cost breakdowns and assumptions can be found in Appendix 11.2.

Table 78. Squaw Valley Resilience Hub Cost Estimate

Equipment	Cost Estimate	Assumption
Bike Share Program Capital and Operating Costs	$62,600	The average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.
E-Scooter Share Program Capital	$1,700-$1,900	As a Bird Platform Partner, can purchase a minimum of 50 scooters between $600-700/vehicle. $1,600/Hub if there are 20 Hubs for 50 scooters ($32,500 total) $1,800/Hub for price of 3 individual scooters Supporting equipment ~$100
EVs and Charging Infrastructure	$40,00-$150,000	Includes the cost of the EV, EVSE, charging infrastructure, and installation for Level 1, Level 2, or DCFC options. See Appendix 11.2 for a breakdown of these costs.
Air Conditioning	$500-$37,000	On the low end is a window air conditioning unit (multiple will be needed for multiple rooms), on the high end is an entirely new HVAC system with new ductwork
Air Purification System	$200-$4,100	On the low end is a single air purifier (multiple will be needed for multiple rooms), on the high end is a whole-house air purification system
Building EE features	$450-$40,000	On the low end is hiring a home energy auditor, on the high end is installing a green roof or a greywater recycling system
Fire Resistant Building	$2,500-$40,000	On the low end is fireproofing lanscape on the high end is retrofitting exterior walls
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	Assuming 50 kits at $10,000
Community Resource Map	$50	Cost of materials
ADA Site Compliance	$100-$60,000	On the low end is adding grab bars/ hand railings and lowering thermostats, on the high end is converting to ADA compliant kitchens and bathrooms and installing elevators On average common upgrades are between $800-$8,000
Floodproofing	$9,000-$18,500	This could include heavy plastic sheeting along the exterior walls, cement and asphalt, or clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/12 year) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 for transplanting 10 trees. $300-$1,200 to transplant a single tree 8-12 ft
Kitchen Space/Appliances	$200-$125,000	On the low end is a portable plug-in stove, on the high end is installation of a new kitchen
Bathroom	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
CERT Trainings and Workshops (www.ready.gov)	$1,000-$5,000	Work with City of Fresno to provide CERT trainings to the wider rural communities

Within Squaw Valley, Bear Mountain Library was identified as a potential resilience hub location as seen in Figure 142. Bear Mountain Libraryis a branch of the Fresno County Public Library System and opened in 1994. Bear Mountain Library hosts "Tail

Wagging Tutors” events where community members can read to therapy dogs and partake in crafting sessions for grade-school children. The parking lot and curb by the building support the basic infrastructure needed for EV charging station installations. The large parking lot provides opportunities for carport solar installations as well.

Figure 142: Bear Mountain Library

The proposed cost for microgrid implementation at Bear Mountain Library would require the installation of solar and battery energy storage to power building and charging loads.

Scenario A proposes a new 169 kW solar array, which would be 421 panels (400 W each), and one 232 kWh battery bank. The solar array roughly equaling eighty-seven 9’ by 12’ car ports. The system would cover the entire building load (339 kWh/day) and fully recharge the battery bank of two EVs providing electricity for eight 120 V outlets throughout the day. It is assumed each EV has a 38.3 kWh battery, capable of being charged by a Level 2 charger for 8 hours, and each public outlet is connected to a 96 W load for 24 hours. The system can continue to support an extended outage assuming sufficient solar generation.

Scenario B proposes a single 232 kWh battery bank in addition to a new 37 kW solar array, roughly 92 panels equaling nineteen carports. This system is capable of providing energy to the two EVs and public outlet loads under the same assumptions as Scenario A. The cost breakdown and assumptions are defined in Table 79 below:

Table 79. Microgrid Cost Estimate for Bear Mountain Library

Scenario A: Microgrid is able to cover all building loads(including listed resilience hub features), charging loads for 2 electric vehicles, 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
169 kW new solar	$290,000	Assumed to cover the full load of 434 kWh/day
One 232 kWh batteries	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$450,000**	
Scenario B: Microgrid is able to cover all charging loads for 2 electric vehicles and 120 V public service for micromobility applications (E-bikes, E-scooters) for 1 day outage		
37 kW new solar	$60,000	Assumed to cover the full load of 95 kWh/day
One 232 kWh battery	$160,000	Assumed 12 hours of night load needs to be stored
Total	**$210,000**	

See Figure 143: For the proposed location of the proposed solar array at Bear Mountain Library for Scenario A that informed the cost estimate:

Figure 143: Aerial view of Bear Mountain Library with proposed solar array in the red boxes

Another scenario to consider when designing the resilience hub is the possibility of every household in Squaw Valley having an EV. Assuming an EV in Fresno County uses 5.5 kWh/day, and that all 1,488 households had a single EV, the total energy output per day would be 8,184 kWh/day. This would require a 1,875 kW solar system (6,049 solar panels) to be installed in a central location in the community to offset the energy use. If every household in Squaw Valley installed solar, it would require each home to install a 1.26 kW system (4 solar panels).

9. Funding Sources

Planning, management, and design of charging infrastructure and fleet replacement are critical components of successful municipal and school transportation electrification. Although many communities are committed to furthering their electrification goals, identifying and obtaining appropriate funding sources can be a significant barrier to robust implementation. As a result, a thorough understanding of available funding opportunities and/or incentives for EVs, charging infrastructure, and supportive DERs is vital to achieving transit electrification goals.

The focus of this section is on funding sources that are available to the public sector, including municipalities, transit agencies, school districts, and tribal entities. Funding for EVs, EVSE and DERs is available through local, state, and federal initiatives. Funding sources are intended to leverage public investment in EVs and EV-related infrastructure and develop partnerships with local governments to expand EVs and EV-related infrastructure adoption.

Each funding source is presented with a brief description, action to be taken by the applicant, funding amount available, and a web link with resources such as program information and application forms. It is important to note that the descriptions are not intended to be comprehensive and the presented programs may have additional requirements and restrictions that should be accounted for by applicants. Programs listed include those currently accepting applications and others that have recently provided funding but are not accepting applications as of the date of this report. Many of these programs have annual funding calls. It is suggested that applicants considering a specific funding source follow up directly with the sponsoring entity as they proceed with applications or detailed planning.

9.1 EV and EVSE Funding Sources

STATE AGENCIES AND PROGRAMS:

California Air Resources Board

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP):

Vouchers are provided directly through vehicle dealers for zero emission trucks and buses and applied at time of purchase. Vouchers are available on a first-come, first-serve basis and current funding availability can be found on the program website. The vouchers can be applied towards any vehicle model which is HVIP-approved. The list of approved ZEVs includes school buses, coach buses, transit buses, as well as vans and medium to heavy duty trucks. The catalog of approved vehicles can be found on the program website.

Applicant Action: Dealers must apply for certification through the program in order to offer vouchers. Any dealer or vendor affiliated with a manufacturer that produces HVIP-approved vehicles may become an HVIP-approved dealer. Purchasers must purchase the vehicle through an approved dealer. Dealers will process the HVIP voucher. Program opened temporarily in June 2021 to new voucher requests and will reopen again on August 10, 2021.

Amount: As seen in Table 80, incentives vary based on vehicle type and size with increased funding available for disadvantaged communities (DACs) (an additional $15,000 per bus). Up to $30,000 per vehicle is also available towards charging equipment. Average savings of 20% on delivered price.

Table 80. HVIP Vehicle Incentive Amounts

Vehicle Type	Per Vehicle Incentive
Shuttle Bus	$45-85.000 per vehicle
School Bus	$85-198.000 per vehicle
Trucks	$44-120.000 per vehicle

Eligible Entities: Any vehicle purchaser or fleet operator. Vehicles purchased through the program must be domiciled in California for at least three years. Increased incentive amounts are available for vehicles domiciled in disadvantaged communities.

Resource: https://www.californiahvip.org

Rural School Bus Pilot Project:

Through a partnership with CARB, the North Coast Air Quality Management District (NCUAQMD) administers funds from the California Climate Investments (CCI) Initiative for the. The goal of the program is to replace older diesel school buses in rural districts that may have less access to funding with cleaner technologies.

Applicant Action: The current application period is closed. The last selection list was released September 2020.

Amount: Applications ranked by size of air district, then age, then mileage. Funding priority given to small air districts.

Table 81. RSBPP Grant Amounts

Vehicle Type	Grants
Zero-Emission School Buses	$400,000
Electric School Bus Infrastructure	$5,000
Hybrid/Internal Combustion Engine School Busses	$165,000

Eligible Entities: Owners of transit, school, and shuttle buses. Eligible applicant types include public school districts, public charter schools, County Office of Education, and Joint Power Authorities. Private schools, private transportation companies, and non-profit agencies are not eligible. For the pilot, all California schools can apply (not just those in the NCUAQMD).

Resource:
https://www.ncuaqmd.org/index.php?page=rural.school.bus

California Volkswagen (VW) Mitigation Trust

Bus Replacement Grant:

The program offers grants for the purchase of zero-emission buses to replace old gasoline, diesel, CNG, or propane buses. The program is administered by CARB but is funded by the VW Mitigation Trust.

Applicant Action: Due to demand, zero-emission school bus funds under the VW Mitigation Trust are oversubscribed and no longer being accepted for Installment One. However, funds for transit and shuttle buses are still available. Applications are available and list of required documents available online.

Amount: Grants awarded on a first-come, first served basis.

Table 82. Bus Replacement Grant Program Incentive Amounts

Vehicle Type	Grants
Electric Transit Bus	$180,000
Fuel Cell Transit Bus	$400,000
Electric School Bus	$400,000
Electric School Bus (CARB non-compliant)	$380,000
Electric Shuttle Bus	$160,000

Eligible Entities: Owners of transit, school, and shuttle buses. Entities must own buses domiciled in California and operate primarily within the state of California.

Resources: https://afdc.energy.gov/laws/12513
http://vwbusmoney.valleyair.org/

Zero-Emission Class 8 Freight and Port Drayage Truck Program:

Provides funds to support expansion of zero-emission truck availability in the heaviest weight classes, those that typically rely on diesel. Provides Class 8 vehicle replacement with zero emission technologies. Class 8 includes freight trucks, waste haulers, dump trucks, and concrete mixers.

Applicant Action: The first solicitation of funds is now closed, and the next installment is anticipated to reopen in 2022-2023.

Amount: The funding cap per entity is 10% of the funding available ($2.7 million). The incentive's cap per vehicle is 100% of the cost of vehicle for government entities and 75% for non-government or a cap of $200,000 per equipment piece.

Eligible Entities: Public and private entities that own and operate eligible vehicles. New vehicle must be zero-emission, certified by CARB. Awardees must submit usage reports annually. Requires operation at least 75% of time in California and engine model years 1992 to 2012.

Resource: Volkswagen Environmental Mitigation Trust for California | California Air Resources Board (aqmd.gov)

Light-Duty Zero-Emission Electric Infrastructure Program:

A portion of the VW Mitigation Trust funding is available to purchase and install new charging stations.

Applicant Action: Application information is available online. Check website for funding announcements.

Amount: Maximum award amount is $4 million per applicant. The amount of eligible costs funded vary depending upon the ownership of the property where located and whether publicly accessible. A minimum 50% of funds go to disadvantaged and low-income communities.

Eligible Entities: Companies or public organizations with a record of overseeing procurement, installation and maintenance of DCFC and Level 2 chargers.

Resource: Light-Duty Zero-Emission Infrastructure, Electric (californiavwtrust.org)

California Department of Transportation

Sustainable Transportation Planning Grants:

The program provides grants annually to create plans that strengthen the connection between transportation and community goals. The program gives priority consideration to projects that integrate transportation programs with community preservation and environmental activities.

Applicant Action: The FY 2022-23 Sustainable Transportation Planning Grant awards will be announced in Spring 2022. Projects will commence in the Fall of 2022 and are expected to be completed in 2025. Applicants are encouraged to visit the California Grants Portal and subscribe to receive a notification when the next call-for-applications is released.

Amount: Grants received an average of $360,000 per project last cycle. Grant awards can be up to $500,000

Eligible Entities: Local transit agencies and municipalities may apply for sustainable community grants. Only Metropolitan Planning Organizations or Regional Transportation Planning Authorities are eligible for strategic partnership awards.

Resources: https://dot.ca.gov/programs/transportation-planning/regional-planning/sustainable-transportation-planning-grants

California Clean Mobility

Clean Mobility Options (CMO) Voucher Pilot Program:

CMO is funded by CCI, a statewide initiative funded by Cap-and-Trade dollars. This program is administered by CALSTART and Shared-Use Mobility Center in partnership with GRID Alternatives and the Local Government Commission. It provides voucher-based funding for zero-emission carsharing, innovative transit services, and ride-on-demand services in historically underserved communities. Program is funded by CCI.

Action: The application window is currently closed.

Amount: Each project can receive up to $1,000,000.

Eligible Entities: Government entities, nonprofit organizations, or California Native American Tribes.

Resources: https://www.cleanmobilityoptions.org/

California Energy Commission

San Joaquin Valley Incentive Project:

Rebates for installing DCFC or Level 2 chargers. DACs may qualify for additional funding and are required to receive 25% of total allocated funds. Chargers must be publicly available at all times; thus, they cannot be located behind a fence or in a gated parking lot. Eligible sites include parking lots, libraries, transit hubs, or curbsides. Design, engineering, and utility service request costs are eligible but are incurred at the applicant's risk prior to funds being reserved.

Applicant Action: At the time of the writing of this memo, all funding has been applied for and is currently being reviewed. The real-time funding dashboard will indicate if and when renewed funds become available.

Amount: Varies based on community, technology, and number of connectors.

Table 83. Incentives offered for various chargers, based on the community designation, provided through the EVSE Program.

Charger Type	DAC	Outside DAC
DCFC	$80,000 or 80% of project cost, whichever is less	$70,000 or 75% of project cost, whichever is less
Level 2	$4,000 per connector Additional $1,000 per connector in Multi-unit dwelling	$3,500 per connector Additional $1,000 per connector in Multi-unit dwelling

Eligible Entities: Public, government and on-profit entities, California Native American tribes, and businesses.

Resource: San Joaquin Valley Incentive Project | CALeVIP

School Bus Replacement Program:

CEC grant funds for replacement of oldest diesel school buses in the state with EVs with priority given to DACs. CEC hopes to help schools improve children's health by reducing exposure to transportation related air pollution.

Applicant Action: The application period is currently closed.

Amount: Availability of up to $78.7 million in grant funds.

Eligible Entities: Public school districts, county offices of education, and joint power authorities.

Resource: School Bus Replacement Program | California Energy Commission

Zero-Emission Drayage Truck and Infrastructure Pilot Program:
As part of CEC's Clean Transportation Program, the program provides funding to support large-scale deployment of zero-emission drayage and regional haul trucks as well as infrastructure needed to support them.

Applicant Action: The application period is currently closed.

Amount: $44 million in funds available. Competitive grant solicitation.

Eligible Entities: Public agency or non-profit organization. Regional haul truck, for the purpose of this solicitation, have daily ranges of 200 to 400 miles on a single charge or refueling event and are designed for day use and typically return to a home base each night.

Resource: GFO-20-606 - Zero-Emission Drayage Truck and Infrastructure Pilot Project (ca.gov)

Clean Transportation Program (Alternative Renewable Fuels and Vehicle Technology Program):
The program aims to support adoption of cleaner transportation, support innovation, and accelerate the development and deployment of advanced transportation and fuel technologies (EVs, hydrogen vehicles, natural gas vehicles, biofuels). Through the program, the CEC invests in a broad portfolio of transportation and fuel transportation projects throughout the state, leveraging public and private investments.

Applicant Action: In April 2021, CEC released its investment plan for 2021-2023 for the Clean Transportation Program, including ZEVs and supporting infrastructure, alternative fuel production and supply, and workforce training and development. Applications for grant funding opportunities are located at Solicitations (ca.gov).

Amount: Annual investments up to $100 million.

Eligible Entities: Dependent on specific grant opportunity.

Resource: https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program

UTILITY PROGRAMS:

Pacific Gas and Electric Company

EV Fleet:
Incentives are available for medium and heavy-duty vehicles and chargers within PG&E's service territory.

Applicant Action: Find out more information and apply for incentives through PG&Es Interactive Tool at PG&E's EV Fleet Program page. At least 2 vehicles must be acquired before 2024. The owner is required to provide charging data for at least 5 years and operate the chargers for at least 10 years.

Amount: Incentives are shown in Table 84. Vehicles are limited to 25 per site.

Table 84. Incentives offered for various vehicles and chargers through PG&E's EV Fleet Program

Vehicle Type	Per Vehicle Incentive Cap
Transit buses and Class 8 Vehicles	$9,000 per vehicle
Transportation refrigeration units, truck stop electrification, and forklifts	$3,000 per vehicle
School buses, local delivery trucks, and other vehicles	$4,000 per vehicle

Power Output	Rebate for Eligible Customers
Up to 50 W	50% of the charger cost, up to $15,000
50.1 to up to 150 W	50% of the charger cost, up to $25,000
150.1 kW and above	50% of the charger cost, up to $42,000

Eligible Entities: PG&E customers with the authority to install EVSE including public entities.

Resource: https://www.pge.com/en_US/large-business/solar-and-vehicles/clean-vehicles/ev-fleet-program/ev-fleet-program.page

EV Charge Schools Program:
This program provides charging infrastructure at school facilities. The utility owns, operates, and maintains EVSE and network fees up to 8 years or provides rebate to schools' charger and EVSE purchases as well as ongoing fees for 8 years. 40% of schools chosen are in DSACs.

Applicant Action: For application information contact the PG&E program manager by emailing EVSchoolsandParks@pge.com.

Amount: Up to $15,000 per charger.

Table 85. Incentives offered for various vehicles and chargers through PG&E's EV Fleet Program

Equipment Type	Equipment Rebate	Warranty	Maint. Rebate	Network Service	Total Rebate
L2 (Single)	$4,000	$1,150	$3,150	$2,500	$11,150
L2 (Dual)	$6,000	$1,150	$4,000	$4,000	$15,150

Resource: https://www.pge.com/pge_global/common/pdfs/small-medium-business/energy-alternatives/clean-vehicles/ev-charge-network/electric-vehicle-charging/EVChargeSchools_FactSheet.pdf

LOCAL AGENCIES AND PROGRAMS:

The San Joaquin Valley Air Pollution Control District

Alternative Fuel Mechanic Training:

Funding to provide education for mechanics on alternative fueled vehicles. Open to institutions that are currently using an alternative fuels program, servicing an alternative fuels system, or making the transition to alternative fuels technology in their fleet or infrastructure operations.

Applicant Action: Applications are available online.

Amount: Up to $15,000 per fiscal year for eligible education or training.

Eligible Entities: Public entities.

Resource: http://valleyair.org/grants/mechanictraining.htm

Public Benefit Grant Program:

The goal of the program is to provide the Valley's public institutions with funds to provide clean-air, public-benefit projects for the residents of the SJVAPCD. There are several subcomponents within the Public Benefit Grant Program. The New Alternative Fuel Vehicle Purchase Program provides funding to purchase new, eligible alternative fueled light duty vehicles. Applicants must be able to demonstrate that charging infrastructure will be available by time of vehicle purchase. Funding must be approved before the vehicle is purchased. Community improvement projects that reduce vehicle use and emissions can receive funding through the program. Alternative fuel infrastructure projects that provide benefits to residents and help the SJVAPCD meet its air quality goals are also eligible for funding.

Applicant Action: Apply online.

Amount: Up to $100,000 per agency ($20,000 per vehicle) for the New Alternative Fuel Vehicle Purchase Program. Up to $3,000,000 per project and per agency (up to 50% of project cost) is awarded for community improvement projects. This component of the program is currently closed. Funding details for alternative fuel infrastructure projects are not specified.

Eligible Entities: Public entities.

Resource: http://valleyair.org/grants/publicbenefit.htm

Electric School Bus Incentive Program:

Incentive to replace existing diesel school buses (at least 2 years old) with electric buses. Buses must service a public school and not yet have purchased the replacement bus.

Applicant Action: Apply online. The program is currently out of funding. Interest forms can be completed online and entities will be contacted as additional funding becomes available.

Amount: Up to $400,000.

Eligible Entities: Public schools.

Resource: http://valleyair.org/grants/electric-school-bus.htm

Truck Replacement Program:

Provides funding to replace on-road diesel truck fleets and purchase zero emission/hybrid/low NO_x vehicles, particularly for low income and disadvantaged communities. The program is not a rebate program; trucks are purchased after contract execution. Replacements, trade-ups, and fleet expansion (new purchase) are all acceptable methods to receive funding.

Applicant Action: Applications are currently being accepted on the website.

Amount: Incentives vary by weight class and fuel type. Up to 35% of cost of vehicle. Incentive caps range from $10,000 to $200,000.

Eligible Entities: Projects funded under this program must achieve emission reductions not required by law. Trucks must be domiciled with the SJVAPCD, operated at least 75% in California and 50% within in the SJVAPCD.

Resource: https://valleyair.org/grants/truck-replacement.htm

Emergency Vehicle Replacement Program:

The program provides incentive funds for replacement of in-use diesel emergency vehicles. The program is not a rebate program; emergency vehicles are purchased after contract execution.

Applicant Action: Applications are currently being accepted on the website.

Amount: Incentives vary by vehicles, miles traveled, fuel usage, and age. Funds are on a first come first served basis.

Eligible Entities: Eligible applicants include cities, counties, fire protection districts, or other public entities. Vehicles must be registered in California and within the boundaries of SJVAPCD, as well as operated at least 50% within in SJVAPCD boundaries and at least 75% within California.

Resource: https://valleyair.org/grants/emergency-vehicles.htm

Charge Up! EV Charger:

Voucher to install new EV chargers (Level 2 and DCFC). Additional funds up to $7,000 can be provided through the Fresno County Incentive Project (FCIP); however, no FCIP funding is available at this time.

Applicant Action: Apply through the online. Applications are currently being accepted. To receive the voucher, the applicant must file for the voucher before equipment is purchased.

Amount: Funding cap is $50,000 per applicant/site.

Table 86. Incentives offered for various chargers through the Chare Up! EV Charger Program

Charger Type	Maximum Amount per Unit	Minimum Cost Share
Level 2 Single Port	$5,500	None
Level 2 Dual Port	$6,000	None
DCFC	$25,000	30% of total cost

Eligible Entities: Public agencies (as well as business owners and developers of multi-unit dwellings).

Resource: http://valleyair.org/grants/chargeup.htm

Carl Moyer Program:

This CARB program administered by SJVAPCD authorizes funding of projects that enable the development of alternative, advanced, and cleaner technologies to support the State's air quality goals. The program funds a wide range of on-road project types including transit buses, urban buses, non-urban buses, and infrastructure. Infrastructure projects must be used to fuel or power a covered source and include, but are not limited to: battery charging station, alternative fueling station, stationary agricultural pump, shore power, and others that may be considered on a case-by-case basis.

Applicant Action: Fleet vehicles subject to the Fleet Rule for Transit Agencies and must be compliant with final regulatory requirements to be eligible for Carl Moyer Program funding. Applications are accepted until funds are exhausted. Eligible funding categories for SJVAPCD appear to only include heavy-duty on-road vehicles, off-road vehicles, and stationary agricultural irrigation pump engines at this time.

Amount: Funds are provided on a first come, first serve basis. The maximum percentage of eligible cost is shown in Table 87:

Table 87. Carl Moyer Program Maximum Percent of Eligible Cost

Projects	Maximum % of Eligible Cost
All Projects	50%
Publicly Accessible Projects	60%
Projects with Solar/Wind Power Systems*	65%
Publicly Accessible Projects with Solar/Wind Power Systems*	75%
Public School District – Battery Charging and Alternative Fueling Station	100%

*At least 50% of energy provided to covered sources by the project must be generated from solar or wind.

Eligible Entities: Public entities such as State, metropolitan, county, city, multi-county, school district, university, and federal agencies.

Resource: Carl Moyer Program: Infrastructure | California Air Resources Board

FEDERAL AGENCIES AND PROGRAMS:

Environmental Protection Agency (EPA)

Diesel Emission Reduction Act (DERA):

There are several projects under DERA including national grants, state grants, school bus rebates, and the American Rescue Plan. National grants include projects that achieve reductions in diesel emissions, particularly fleets in poor air quality areas. School bus grants reduce emissions from older diesel vehicles through replacements and retrofits. Rebates for electric school bus replacements will soon be available in underserved communities through the American Rescue Plan. EPA allocates DERA funds to U.S. states for the establishment of diesel emissions reduction programs.

Action: Applications currently closed for national grants. Applications for school bus grants are currently closed but open in the Fall.

Amount: $20,000 to $65,000 per bus depending on fuel type. Fleets up to 100 school buses may submit an application for up to 10 buses. Fleets with more than 100 school buses may submit two applications for 10 buses each. Maximum rebate per application is $300,000.

Table 88. DERA Reimbursement Amounts

Replacement Bus	Rebate Reimbursement
Diesel and Gasoline	$20,000
Propane	$25,000
CNG/Liquid Natural Gas	$30,000
Battery or Hydrogen Electric	$65,000

Eligible Entities: Regional, state, or tribal agencies that have jurisdiction over transportation and air quality (includes school districts and municipalities).

Resources: Diesel Emissions Reduction Act (DERA) Funding | US EPA

U.S. Department of Energy / Energy Efficiency and Renewable Energy

Vehicle Technologies Office (VTO):
The VTO is within the Office of Energy Efficiency and Renewable Energy and supports high impact projects to develop more energy efficient highway transportation technologies. Projects are generally related to research and design; however, may contain opportunities for public entities to work with partners to pilot technologies.

Action: New funding opportunity announcements (FOAs) are announced regularly.

Amount: Varies by grant.

Eligible Entities: Depending on application scope, many government agencies may apply.

Resources: Funding Opportunities | Department of Energy

U.S. DOT Federal Highway Administration (FHWA)

Congestion Mitigation and Air Quality Improvement (CMAQ) Program:
The CMAQ program has provided more than $30 billion in funding to over 30,000 transportation related environmental projects for State DOTs, metropolitan planning organizations, and other sponsors throughout the United States. Electric vehicle charging infrastructure and electric transit vehicles are eligible for funding. Locally, funds are administered through the Fresno Council of Governments (FCOG).

Action: Annually, FCOG approves guidelines, criteria, and application packets for the CMAQ program. Following a call for projects, applications are submitted by member agencies. Information regarding deadlines, required project match, funding categories and other information is available at the website below.

Amount: Approximately $30 million is available for 2021-2022.

Eligible Entities: Governmental entities including municipalities, transit agencies and schools.

Resources: https://www.fresnocog.org/project/congestion-mitigation-air-quality-cmaq-program/

National Highway Performance Program (NHPP):
The NHPP provides support for the condition and performance of the National Highway System (NHS) and for the construction of new facilities along the NHS - including EV charging stations.

Action: FCOG collaborates with Caltrans on implementing NHPP funds.

Amount: NHHP program funding for FY 20 is $24.2B.

Eligible Entities: Governmental entities.

Resources: https://www.fhwa.dot.gov/specialfunding/nhpp/160309.cfm#Funding

U.S. DOT Federal Transit Administration

Low or No Emission Vehicle Program:
This program provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required supporting facilities.

Action: Grant applications are expected to reopen under the next funding cycle.

Amount: Funding for FY 20 was $130M, 15% of cost to be shared by local or state government.

Eligible Entities: Governmental entities.

Resources: https://www.transit.dot.gov/funding/applying/notices-funding/low-or-no-emission-program-low-no-program-fy2020-notice-funding

Buses and Bus Facilities Program:
The purpose of the Grants for Buses and Bus Facilities Program is to assist in the financing of buses and bus facilities capital projects, including replacing, rehabilitating, purchasing or leasing buses or related equipment, and rehabilitating, purchasing, constructing or leasing bus-related facilities.

Action: Check for availability in the next funding cycle.

Amount: Up to $45M per project, 20% of cost covered by local or state government.

Eligible Entities: Governmental entities including public school districts.

Resources: https://www.transit.dot.gov/bus-program

9.2 DER Funding Sources

STATE AGENCIES AND PROGRAMS:

California Public Utilities Commision Self-Generation Incentive Program (SGIP):

This program is funded by the CPUC and administered by PG&E and supports existing, new, and emerging DERs. SGIP provides cash incentives that cover up to the full costs of a battery and its installation.

Action: Applications for incentives are through PG&E online.

Amount: The incentive depends on the performance of the battery storage and/or generation system, the GHG emissions, the energy capacity, and the power rating. A rebate can be between $250 and $1,000/kWh dependent on the category. On average, the rebate covers 15-20% of the average battery cost. Using California manufacturers provides an additional 20% incentive. Equity customers qualify for a higher rebate, which could cover up to 100% of the cost of the system.

Eligible Entities: Non-residential PG&E customers. Commercial, government, and non-profit groups can receive large-scale general market incentives.

Resources: Discover the Self-Generation Incentive Program for non-residential customers (pge.com)

Microgrid Incentive Program:

As a result of SB 1339, in 2021 CPUC ordered SCE, PG&E and San Diego Gas and Electric to jointly develop a statewide Microgrid Incentive Program with a $200 million budget to fund clean energy microgrids to support critical needs of vulnerable communities impacted by grid outages.

Action: The program has been approved but the details of the implementation have not been determined. In the meantime, public workshops will proceed to determine the best use of the funds. The program is anticipated to launch at the end of 2021.

Amount: $200 million program budget.

Eligible Entities: The program aims to target communities and facilities that may be at higher risk of electrical outages or rely on un-interrupted power, including fire stations, schools, nursing homes, low-income households, and individuals who utilize assistive and/or medical equipment.

Resources: Resiliency and Microgrids (ca.gov)

Califonia Energy Commission (CEC)

Energy Conservation Assistance Act (ECAA) – Loans:

The ECAA provides two loan programs for EE and energy generation projects, one is zero-interest rate for schools and the other is a low interest loan program.

Action: Applications accepted first-come, first-served on a rolling basis. There is no deadline.

Amount: The low interest loan program provides a 1% interest loan that can fund 100% of the project cost within a 17-year simple payback. Loan must be repaid from energy savings (including principal and interest) within a maximum of 20 years. Maximum loan is $3 million.

Eligible Entities: Cities, counties, special districts, public colleges, universities, care institutions, and hospitals. Residential, commercial, and private nonprofit institutions are not eligible.

Resources: Energy Conservation Assistance Act | California Energy Commission

Energy Partnership Program:

The program offers technical assistance to determine cost-effective EE measures for buildings. Some of the services that the program would fund include DER planning, conducting energy audits and preparing feasibility studies, reviewing existing proposals and designs, developing equipment performance specifications, reviewing equipment bid specifications, assisting with contractor selection, and reviewing commissioning plans.

Action: Applications are accepted on a rolling basis with no deadline.

Amount: The program typically services up to $20,000 of a consultant's cost but is project dependent.

Eligible Entities: Cities, counties, country Offices of Education, special districts, public hospitals, public care facilities, public Colleges or Universities.

Resources: Energy Partnership Program | California Energy Commission

Bright Schools Program:

The program offers a range of services to help identify the most cost-effective energy saving opportunities for schools. Some of the services that the program would fund include DER planning, conducting energy audits and preparing feasibility studies, reviewing existing proposals and designs, developing equipment performance specifications, reviewing equipment bid specifications, and reviewing commissioning plans.

Action: Applications are accepted on a rolling basis with no deadline.

Amount: The program typically services up to $20,000 of a consultant's cost but is project dependent.

Eligible Entities: K-12 Public Schools Districts, Charter Schools, State Special Schools

Resources: Bright Schools Program | California Energy Commission

California Clean Energy Jobs Act (Proposition 39):

Proposition 39, provides funding to local education agencies for eligible projects such as EE upgrades and clean energy generation. Projects have included switching to LED lighting, replacing inefficient HVAC, and installing solar panels.

Action: Funding for the program is not currently available.

Amount: Proposition 39 allocated $1.5 billion over five years to schools across California.

Eligible Entities: K-12 Public Schools Districts, Charter Schools, State Special Schools.

Resources: California Clean Energy Jobs Act K-12 Program - Prop 39 | California Energy Commission

California Infrastructure and Development Bank (IBANK)

Statewide Energy Efficiency Program (SWEEP): The program is run under IBanks's California Lending for Energy and Environmental Needs program. SWEEP issues loans to municipalities, universities, public schools, and hospitals for retrofits and clean energy projects that provide comprehensive efficiency improvements.

Action: Applications are accepted on a rolling basis online.

Amount: Financing can be through a direct loan from IBank between $500,000 and $30 million. The interest rate is set at the time the financing is approved.

Eligible Entities: Any subdivision of local government, cities, counties, special districts, assessment districts, joint powers authorities and non-profit corporations (as deemed eligible), municipalities, public universities, schools, and hospitals.

Resources: https://ibank.ca.gov/loans/cleen-programs/

FEDERAL AGENCIES AND PROGRAMS:

U.S. Department of Energy

Tribal Energy Loan Guarantee Program (TELGP): TELGP provides partial loan guarantees to federally recognized tribes to support economic development through energy development projects and activities including solar, wind, and energy storage.

Action: Interested parties should schedule a no-fee, pre-application consultation to review the project and basic eligibility requirements with TELGP@hq.doe.gov

Amount: Partial loan guarantee of private or state loans for larger scale ($25 million to $2 billion) energy projects. The program will guarantee up to 90% of the unpaid principal and interest due. Projects can be at a single site or at distributed locations.

Eligible Entities: Federally recognized tribes. The tribe or tribal energy development organization must have majority ownership and control of the project.

Resources: DOE-LPO-Tribal-Energy-Jan2020.pdf

Western Area Power Administration (WAPA): Transmission Infrastructure Program (TIP): TIP is a federal infrastructure financing program that provides funding and technical assistance to support the development of critical transmission and related infrastructure. TIP's aim is to expand and modernized the electric grid and facilitate the delivery of clean energy.

Action: Applicants should start by submitting a project proposal. If a full Business Plan proposal has not been developed, a partial application payment of $50,000 is required. Otherwise, the full payment of $250,000 is required with the proposal. Applicants are reviewed on a quarterly basis at the beginning of each fiscal quarter.

Amount: Typical loans range from $40 million to $1 billion dollars. Interest rates are based on U.S. Treasury rate, plus a credit-based spread. Shorter-term loans, primarily through construction and up to ten years are preferred.

Eligible Entities: Prospective utility-scale transmission and/or related projects must have at least one terminus in WAPA's 15-state service territory, demonstrate a reasonable expectation of repayment, facilitate the delivery of clean energy, not adversely impact system reliability or operations, and serve the public interest.

Resources: About TIP (wapa.gov)

Renewable Energy & EE Projects Loan Guarantees: The program provides loan guarantees for renewable energy generation, storage, and smart grid systems incorporating demand response, waste to energy projects, retrofitting existing renewable facilities with innovative technology. Eligible projects are generally large-scale projects or aggregated individual projects and incorporate innovative technology. The projects must have GHG benefits, be located in the U.S., and have a reasonable prospect of repayment.

Action: Potential applicants are encouraged to engage with the US Department of Energy's Loan Program Office for a no-fee, no-commitment consultation before applying through lgprogram@hq.doe.gov.

Amount: The program guarantees commercial loans of up to 30 years or 90% of the useful life of the financed asset. No maximum guarantee amount is stated. Application, facility, and maintenance fees are based upon the size of the loan. Application fees are $150,000 for loans up to $150 million and $400,000 for loans over $150,000.

Eligible Entities: Eligible entities, among others include local governments, non-profit entities, and schools.

Resources: RENEWABLE ENERGY & EFFICIENT ENERGY PROJECTS LOAN GUARANTEES | Department of Energy

U.S. Department of the Interior, Office of Indian Affairs

Tribal Climate Resilience Program, Annual Awards Program:
The program annually solicits for climate adaptation and preparedness planning for federally recognized tribes and tribal organizations. The program provides grants to support tribes as they prepare for the impacts of climate change, such as ocean/coastal management and planning.

Action: The 2021 Notice of Funding Opportunity closed in April. Applicants will be informed in August. Potential applicants should check the agency's website for future funding rounds.

Amount: The 2021 solicitation provided funding in a variety of categories including up to $150,000 for trainings and workshops, up to $150,000 for adaptation planning, up to $15,000 for travel to support adaptation planning, and up to $65,000 for capacity building for scoping efforts to support proposal development for adaptation planning.

Eligible Entities: Federally recognized tribes and tribal organizations.

Resources: Annual Awards Program | Indian Affairs

10. Conclusion & Next Steps

Rural Fresno County faces many challenges and opportunities with regard to maintaining and electrical grid system that can support the diverse needs of its 13 rural cities and numerous unincorporated communities. In addition to the existing vulnerabilities, rural Fresno County will need to undertake initiatives specific to maintaining resilient and sufficient grid infrastrucutre to maintain a system which can support both the impacts posed by climate change, including extreme heat and wildfire events, as well as changing services associated with fleet electrification and increased use of variable renewable energy sources.

For FCRTA, managing these changes will mean significant investments in redundant infrastructure for its existing bus depots to both manage anticipated grid impacts and ensure resilient transportation services. Additionally, FCRTA has opportunities to partner with the Rural Cities and Unincorporated Communities which it serves to promote climate resilience through transit, microtransit, energy, and related offerings. Such initiatives will promote climate resilience while addressing the vulnerabilities Fresno County currently experiences due to pollution, socioeconomic factors, and access to resources, particularly as such vulnerabilities have only been exacerbated by the COVID-19 pandemic.

To realize the benefits to FCRTA, the electric grid system, and rural Fresno County communities, the following next steps are recommended for implementation of this studies recommendations:

- Pursue grant and financing resources to design and implement the redundancy needs outlined in this study, prioritizing areas expected to experience future grid constraints
- Identify pilot locations and partners for micromobility and resilience hubs
- Seek opportunities for formalized partnerships to optimize shared charging model opportunities
- Continue to pursue integrated, long-term planning with regard to transportation electrification and grid needs in order to best meet the needs of rural communities

Appendices

11. Appendices

11.1 Methodology and Assumptions

This appendix summarizes the data and assumptions that underpin the final results, in order to provide maximum transparency.

The following table summarizes the key modeling inputs, along with the associated sources of information. PG&E and the CEC were the main sources. Where disaggregation was required (e.g., when applying California-wide data), pro-rata allocations based on actual Fresno County versus system historical adoption rates were applied where possible, with a population-based pro-rata used as a fallback.

Figure 144: Summary of Key Inputs and Sources

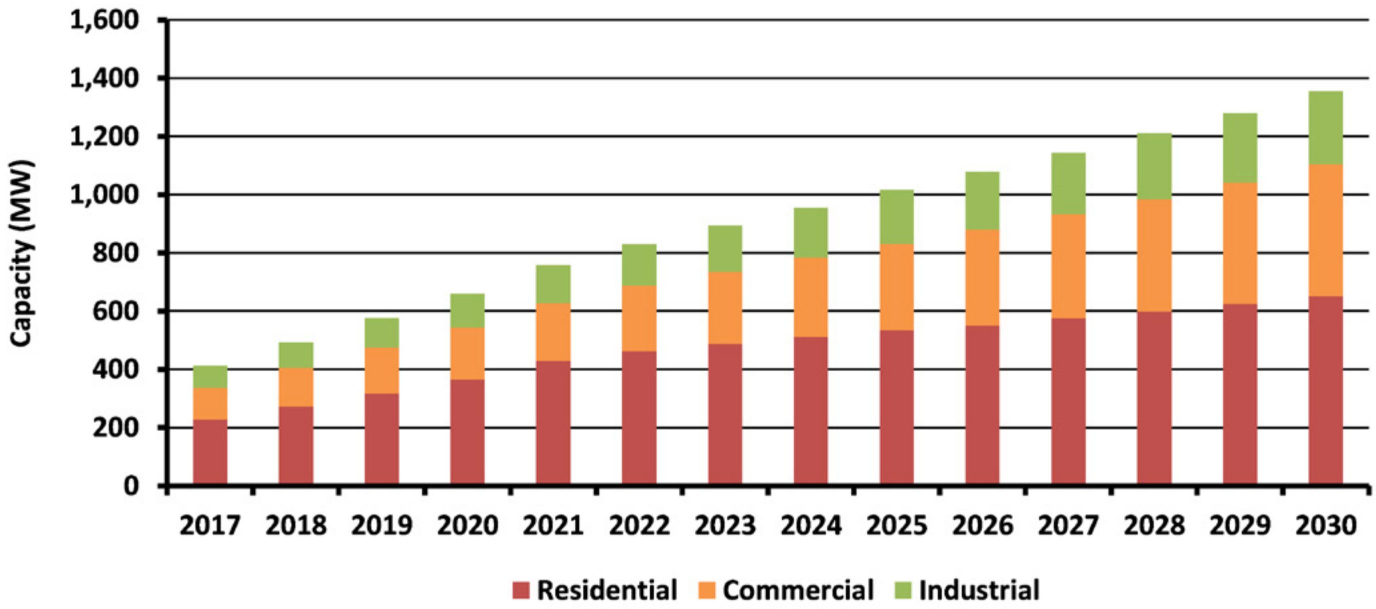
Key Input	Application	Source Name	Source Year	Source Title
Forecast EE Savings	Basis for EE Regional and Feeder Impacts Forecast and Load Shape	CEC	2019	Consolidated Electrical Distributors (CED) 2019 Hourly Results - PG&E - Mid-demand Case (MID), CED 2019 Hourly Results - PG&E
Historical Energy Efficiency Savings	Basis for Energy Efficiency Regional and Feeder Impacts Forecast	California Energy Data and Reporting System	2021	Quarterly Claims Data
PG&E Forecast BTM Solar Capacity by Sector	Basis for Solar Distributed Generation Regional and Feeder Impacts Forecast	CEC	2019	BTM PV Forecast - Statewide Self - Generation Forecast
Forecast Electric Vehicle Load	Basis for EV Regional and Feeder Impacts Forecast and Load Shape	CEC	2019	CED 2019 Hourly Results - PG&E - MID MID, CED 2019 Hourly Results - PG&E
Forecast Solar Load Shape	Basis for EV Regional and Feeder Impacts Forecast and Load Shape	CEC	2019	CED 2019 Hourly Results - PG&E - MID MID, CED 2019 Hourly Results - PG&E
Historical BTM Energy Storage Capacity	Basis for Distributed Energy Storage Regional and Feeder Impacts Forecast	California Distributed Generation Statistics	2021	Download Data - Distributed Generation Interconnection Program Data
Forecast Building Electrification	Basis for Building Electrification Regional and Feeder Impacts Forecast	Energeia Modelling	2020	Electrification Potential Model
GHG Emissions by Fuel	Basis for GHG Emissions Reduction	EPA	2011-20	Emission Factors
CO^2 Emissions by Fuel	Basis for GHG Emissions Reduction	Energy Information Agency	2016	CO^2 Emissions Coefficients
Locational Marginal Prices	Basis for Electricity Cost Estimates	California Independent System Operator	2020	Data Request to Application Programming Interface (API)
PG&E Feeder Load Profiles for High and Light Days and Feeder GIS	Basis for Individual Feeder Load Shape and Consumption	PG&E	2019	Integration Capacity Analysis (ICA)
PG&E Feeder Associated Asset Data (Rating)	Basis for Customer Count and Rating by Feeder	PG&E	2019	GNA
Parcel Data	Parcel to Feeder Mapping to Identify Customers per Sector	Fresno County	2019	GIS Shapefiles

Source: Energeia Research

11.1.1 Forecasts

The study's rooftop PV uptake forecast is based on historical actuals for Fresno County, PG&E-wide forecasts, and statewide forecasts available in the public domain.

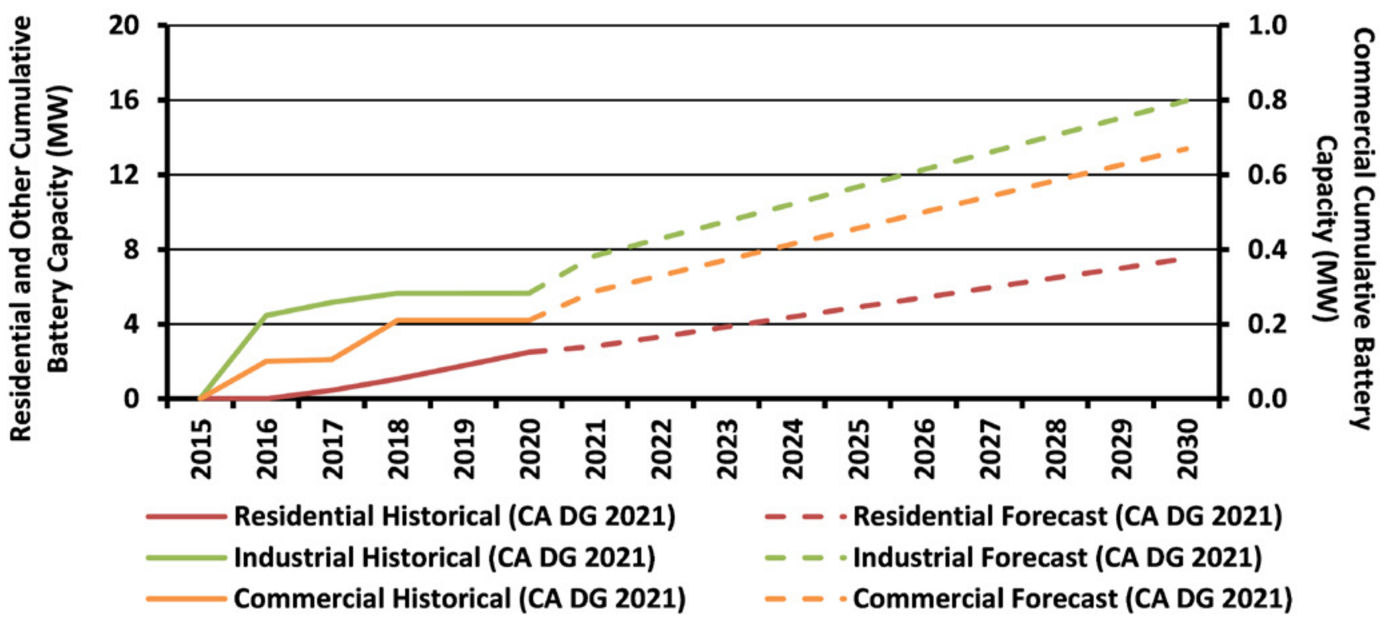
Figure 145: Rooftop Solar Uptake Forecast



Source: CEC (2019) BTM PV Forecast - Statewide Self - Generation Forecast, Energeia

BTM storage is also forecasted with a combination of top-level forecasts and historical actual adoption levels.

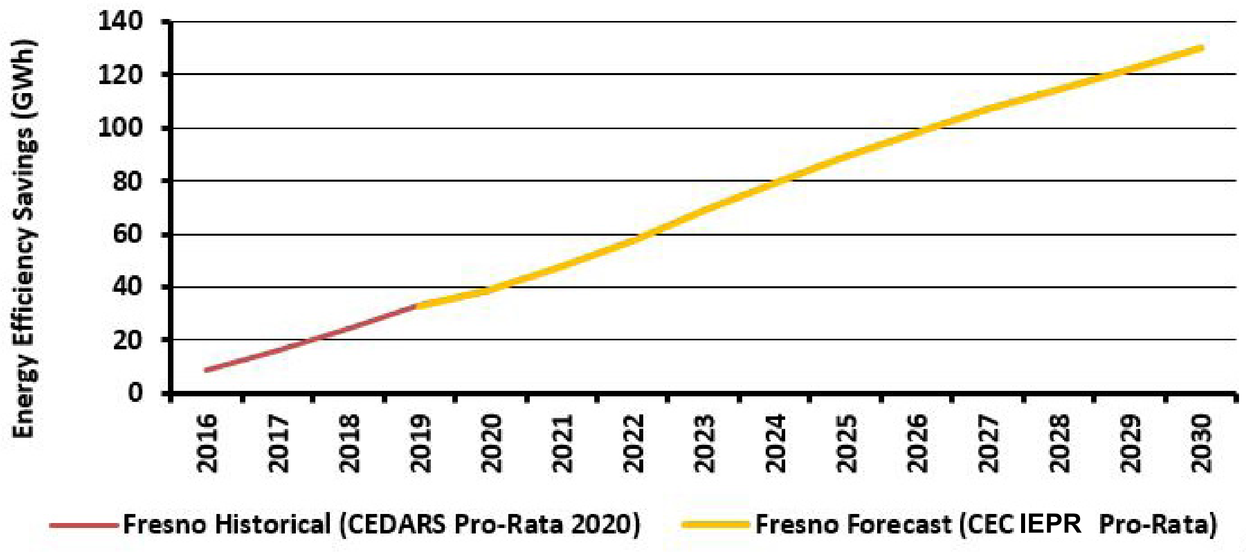
Figure 146: Behind-the-Meter Battery Storage Uptake Forecast



Source: CEC (2019) BTM PV Forecast - Statewide Self - Generation Forecast, Energeia

The EE forecast used is based on a pro-rata of the CEC Integrated Energy Policy Report (IEPR) forecast for PG&E. EE forecasts are not provided by customer segment, so the forecast is applied pro-rata on a per kilowatt-hour basis in the modeling.

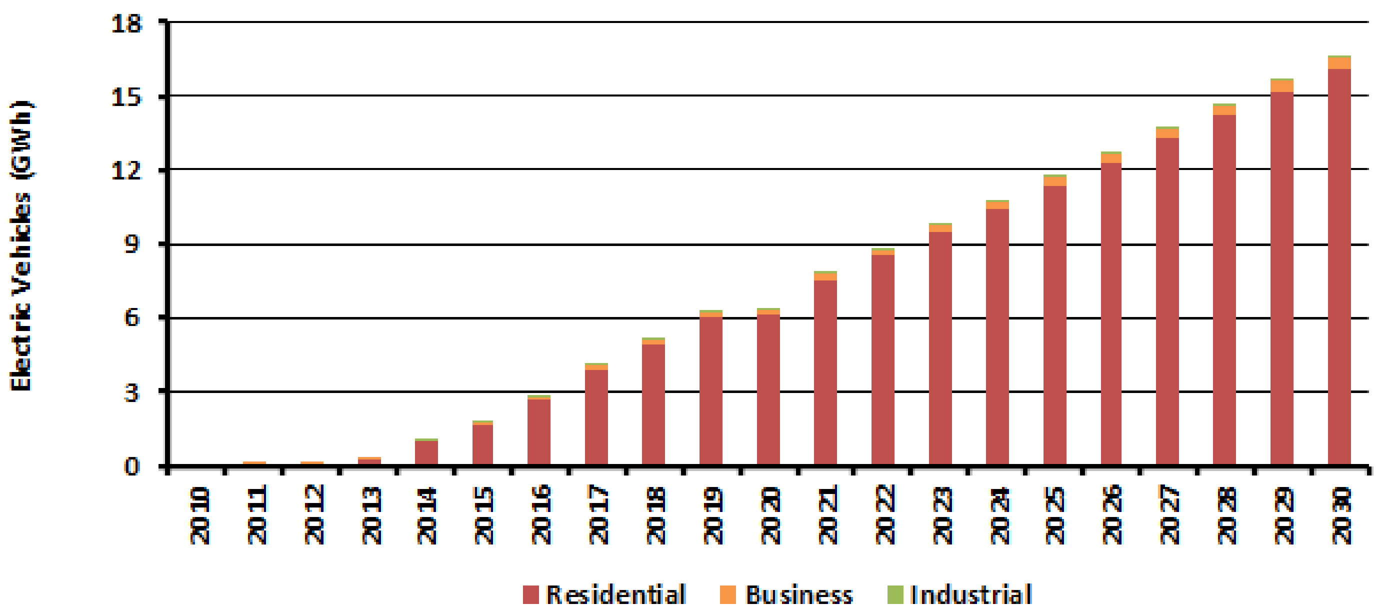
Figure 147: EE Forecast



Source: CEC (2019), CED 2019 Hourly Results - PG&E - MID, Energeia

The EV forecast used is based on a pro-rata of the CEC EIPER forecast for PG&E.

Figure 148: Electric Vehicle Uptake Forecast (Annual GWh Terms)

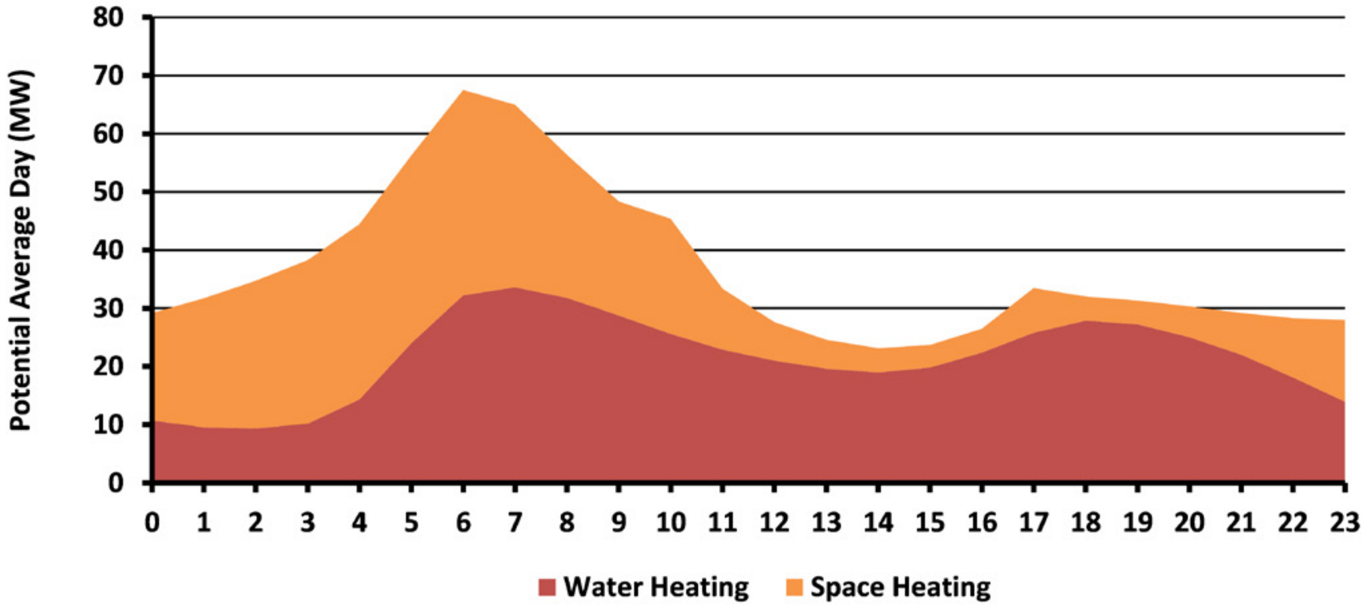


Source: CEC (2019), CED 2019 Hourly Results - PG&E - MID, Energeia

11.1.2 Load Shapes

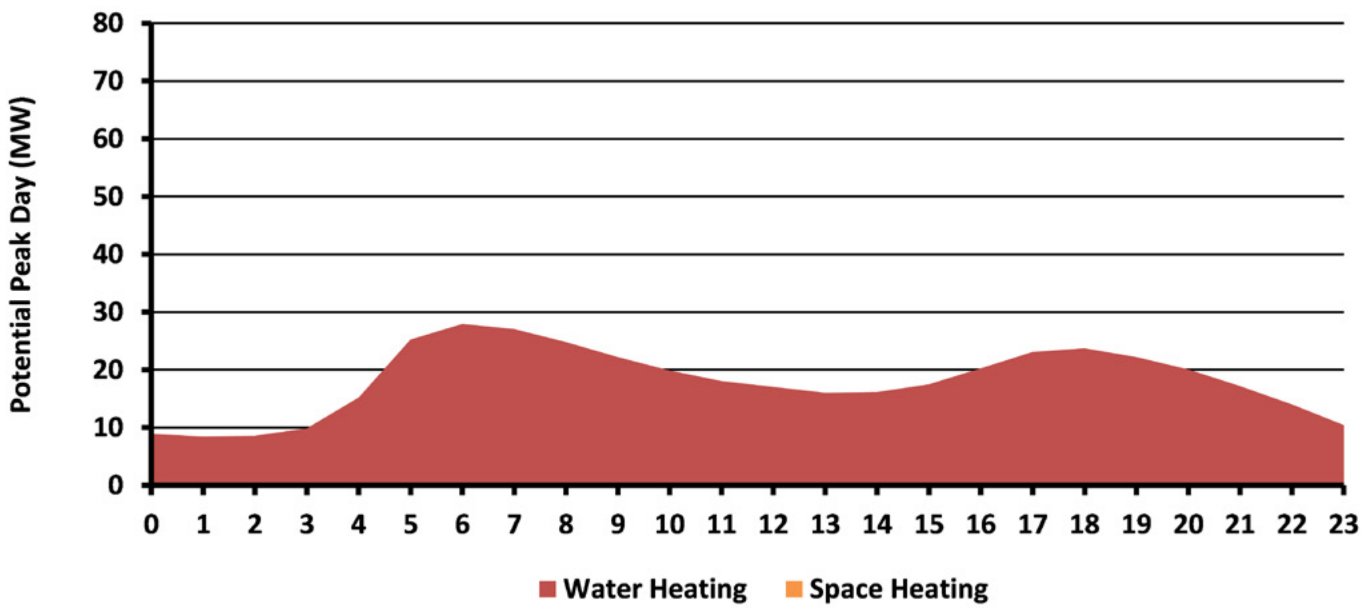
Part of the scope of the study was to determine the potential grid impacts of building electrification (e.g. water and space heating) in tandem with the electrification of FCRTA's fleet. As shown in the below figure, building electrification primarily impacts morning load from 6-7 am on the average day.

Figure 149: Potential Average Day Impact of Building Electrification



Source: CEC (2019), Open Energy Information (2013), PG&E n.d., Energeia Analysis

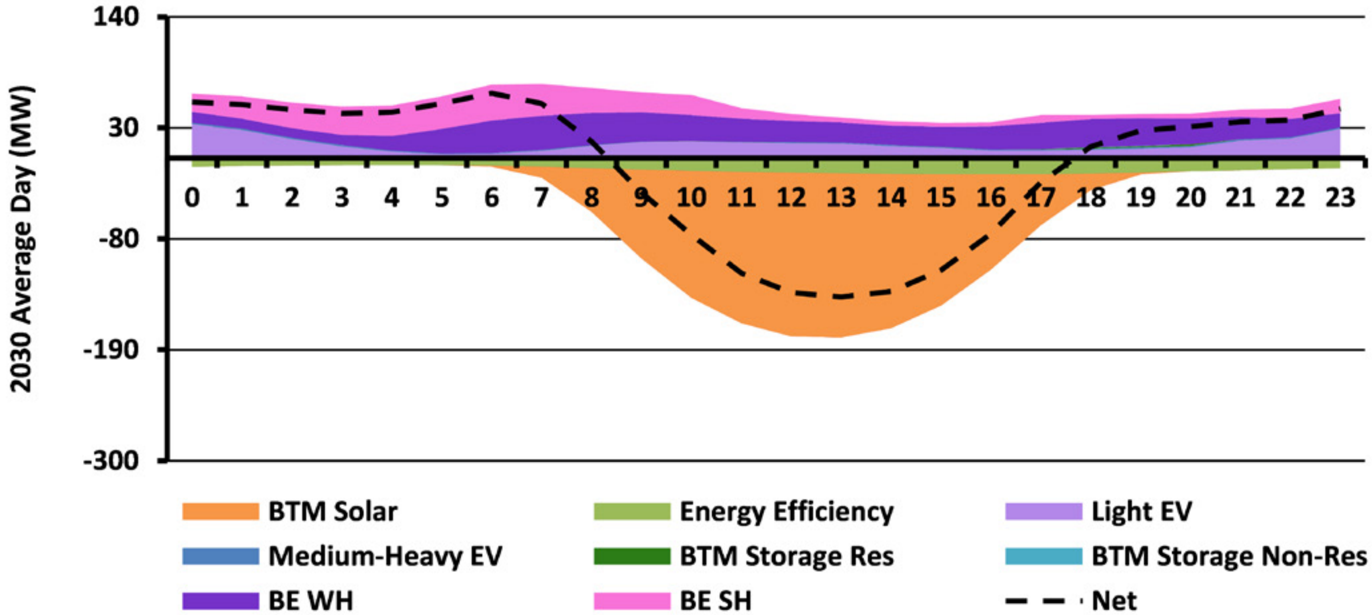
Figure 150: Potential Peak Day Impact of Building Electrification



Source: CEC (2019), Open Energy Information (2013), PG&E n.d., Energeia Analysis

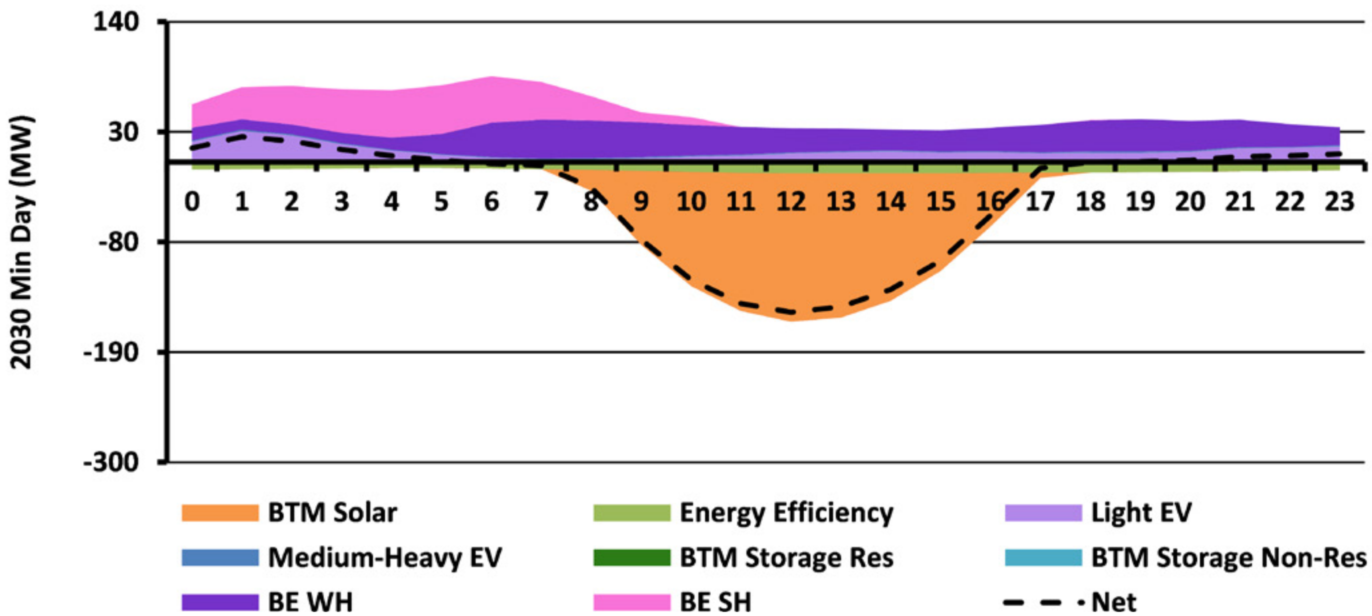
The below figure shows the overall impact of all in-scope DER load shapes, including EV, storage, solar, electrification, and EE, for the average day in 2030. Building electrification is the dominant contributor, and causes net load increases, particularly in the morning. EE has a modest impact, but solar causes a significant decrease in load during sunshine hours.

Figure 151: DER Cumulative Load Impacts at County Level – Average Day



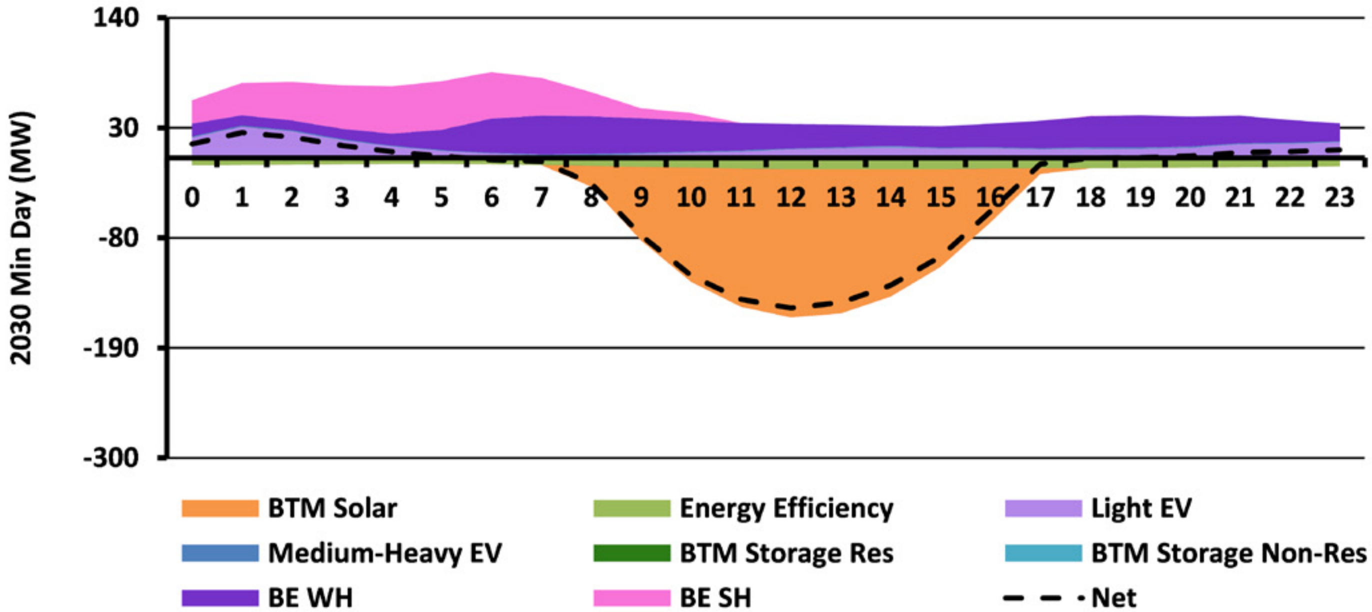
Source: FCOG (2017), U.S.Census n.d., Energeia

Figure 152: DER Cumulative Load Impacts at County Level – Peak Day



Source: FCOG (2017), Census n.d., Energeia

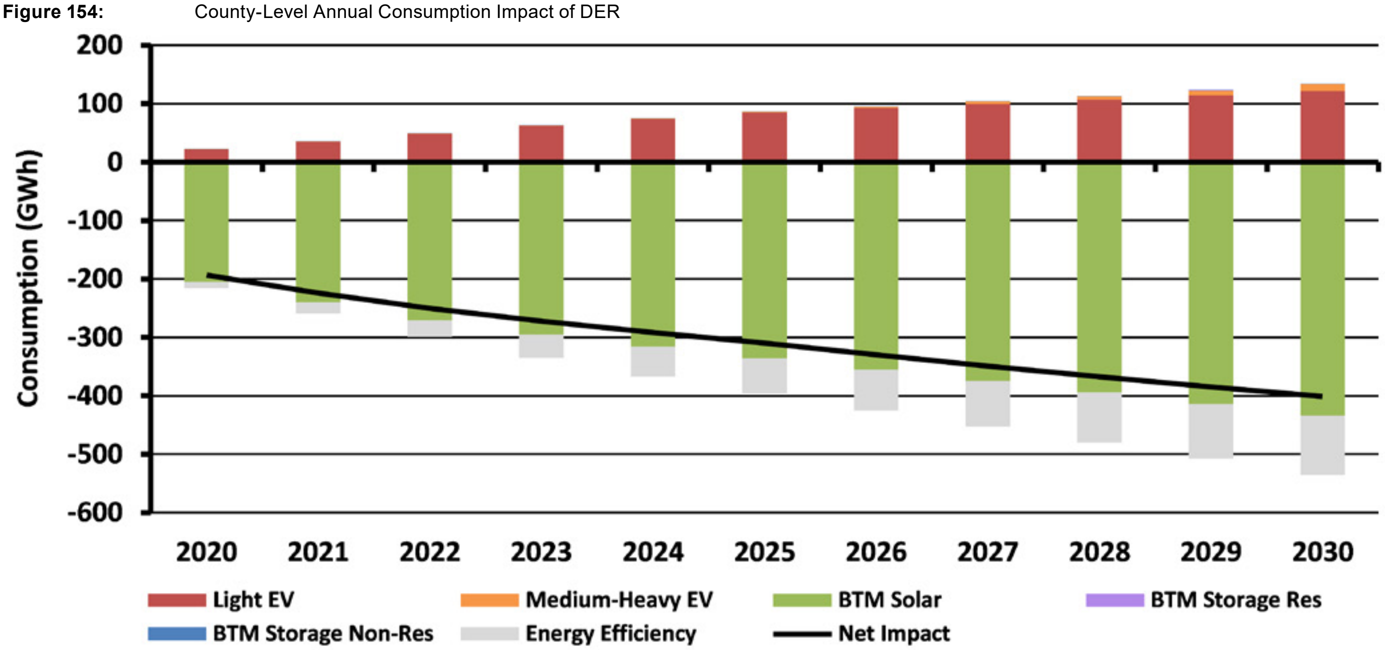
Figure 153: DDER Cumulative Load Impacts at County Level – Minimum Day



Source: FCOG (2017), U.S. Census n.d., Energeia

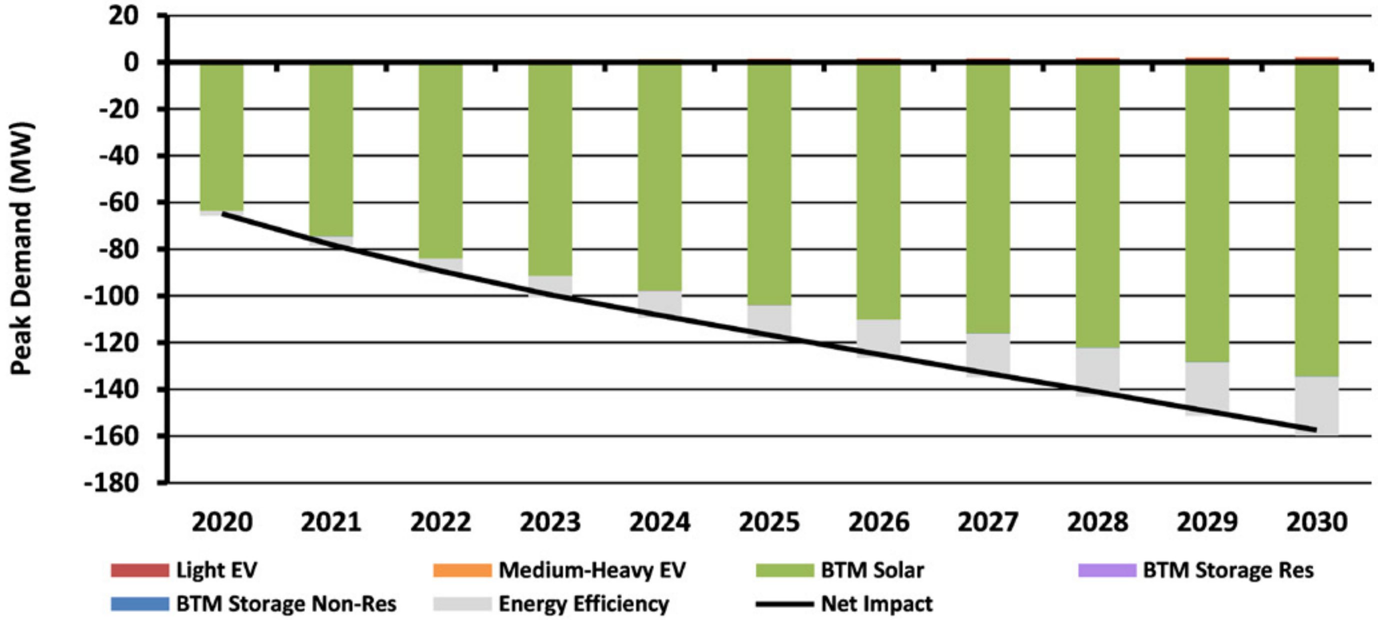
In the below two figures, CEC forecast impacts of DER on total consumption and peak demand on a pro-rata basis are shown for PG&E. Note that the CEC forecasts do not include building electrification, and that actual impacts on Fresno feeders vary significantly due to specific feeder peak timing.

Figure 154: County-Level Annual Consumption Impact of DER



Source: CEC (2019), CED 2019 Hourly Results - PG&E - MID, Energeia

Figure 155: County-Level Peak Demand Impact of DER



Source: CEC (2019), CED 2019 Hourly Results - PG&E - MID, Energeia

11.1.3 Grid Thermal Capacity and Solar PV Hosting Capacity

The table below shows the peak demand, rated capacity, and PV hosting capacity of each depot-connected feeder, according to PG&E's public GNA forecast. The Coalinga and Sanger feeders have been redacted by PG&E according to the aforementioned 15-100-15 rule. Notably, PG&E's ICA hosting capacity study found most depot feeders have no hosting capacity for new PV.

Figure 156: Table of 2020 Peak Demand, Rating, and PV Hosting Capacity by Depot-Connected Feeder

Depot	Feeder	Peak (MW)	Rating (MW)	PV Hosting Capacity (MW)
Coalinga	COALINGA NO 2 1105	N/A	8.92	-
Firebaugh	FIREBAUGH 1102	8.27	12.83	-
Fowler	MC CALL 1103	10.08	12.19	-
Huron	HURON 1112	5.50	10.69	-
Kerman	KERMAN 1102	11.95	12.83	0.63
Kingsburg	KINGSBURG 1102	8.76	12.19	-
Mendota	MENDOTA 1103	7.78	10.37	-
Orange Cove	REEDLEY 1112	9.70	12.19	-
Parlier	PARLIER 1104	9.59	10.69	-
Reedley	WAHTOKE 1106	10.99	12.19	-
San Joaquin	SAN JOAQUIN 1108	2.80	7.01	-
Sanger	RAINBOW 1105	N/A	12.83	0.59
Selma	MC CALL 1107	11.55	12.83	-

Source: PG&E (2020) ICA, GNA

The next table details peak demand and rated capacity for those feeders that serve unincorporated communities. In general, they have considerable headroom in 2020.

Figure 157: Table of 2020 Peak Demand and Rating by Unincorporated Community Feeder

Location	Feeder	Peak (MW)	Rating (MW)
Auberry	AUBERRY 1102	5.46	10.69
Big Sandy Rancheria	AUBERRY 1101	8.42	12.83
Biola	BIIOLA 1101	6.3	8.13
	BIOLA 1104	2.56	10.69
Bowles	BOWLES 1102	2.85	7.63
	MC CALL 1108	8.98	12.83
Cantua Creek	GIFFEN 1103	N/A	12.19
	SCHINDLER 1111	N/A	11.46
Caruthers	CARUTHERS 1101	9.32	11.67
Centerville	RAINBOW 1106	N/A	12.83.
	TIVY VALLEY 1106	2.54	8.13
	WAHTOKE 1108	N/A	12.19
Del Rey	MC CALL 1101	7.53	12.19
	SANGER 1110	N/A	9.26
Easton	BOWLES 1103	4.04	8.55
	KEARNEY 1104	5.45	10.69
	MALAGA 1108	N/A	11.55
	MC MULLIN 1106	N/A	0
	WEST FRESNO 1101	N/A	12.19
Lanare	CAMDEN 1104	7.05	12.19
	CARUTHERS 1102	8.4	12.83

Location	Feeder	Peak (MW)	Rating (MW)
Laton	CAMDEN 1103	10.23	12.19
	HARDWICK 1101	N/A	9.99
	HARDWICK 1102	6.98	10.46
Malanga	MALAGA 1106	N/A	12.19
Monmouth	BOWLES 1101	8.52	10.16
Riverdale	CAMDEN 1102	8.12	10.69
Squaw Valley	DUNLAP 1102	1.33	3.12
	SAND CREEK 1103	4.55	5.99
	TIVY VALLEY 1107	N/A	10.46
Table Mountain Rancheria	SHEPHERD 2111	N/A	22.22
	WOODWARD 2108	14.73	21.11
Tarpey Village	AIRWAYS 1108	9.12	12.83
	CLOVIS 1101	11.83	12.19
	CLOVIS 1104	8.27	12.19
	CLOVIS 1105	8.85	14.11
	CLOVIS 2110	12.59	20.96
Three Rocks	CANTUA 1103	N/A	7.12
Tombstone	MC CALL 1107	11.55	12.83

Location	Feeder	Peak (MW)	Rating (MW)
Tranquility	SAN JOAQUIN 1112	3.9	8.13
Unicorp	KERMAN 1102	11.95	12.83
	KINGSBURG 1102	8.76	0
West Park	KEARNEY 1114	N/A	10.46
	WEST FRESNO 1112	9.99	12.19

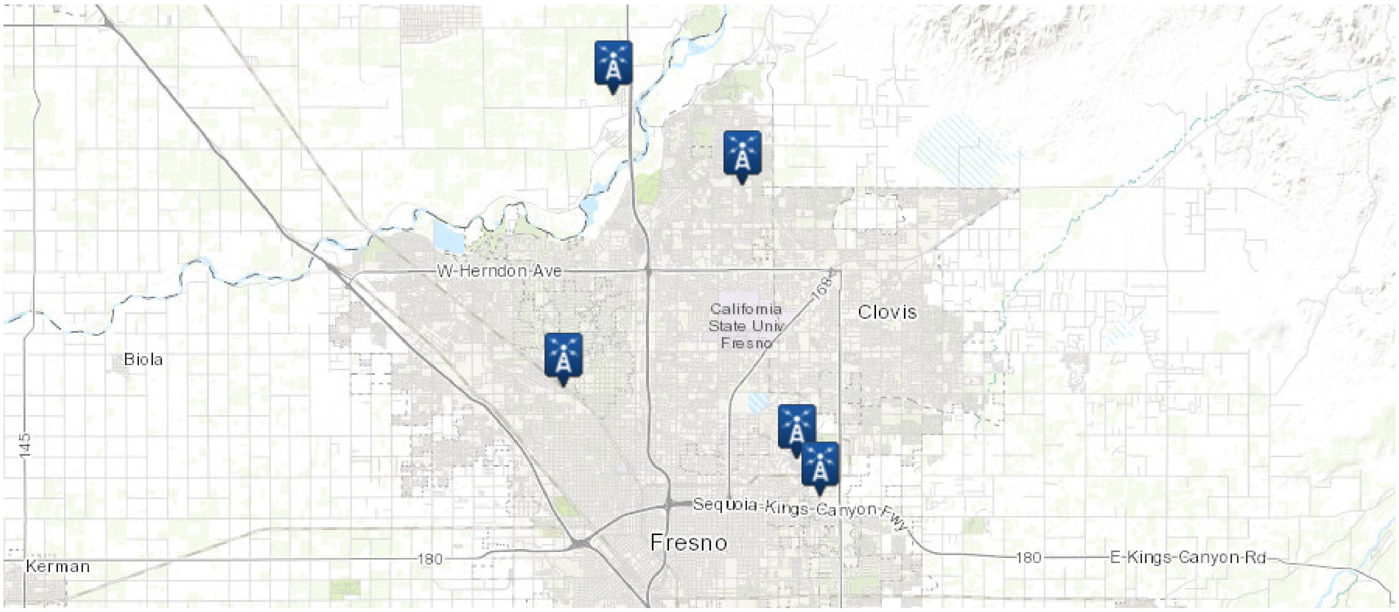
Location	Feeder	Peak (MW)	Rating (MW)
Laton	CAMDEN 1103	10.23	12.19
	HARDWICK 1101	N/A	9.99
	HARDWICK 1102	6.98	10.46
Malanga	MALAGA 1106	N/A	12.19
Monmouth	BOWLES 1101	8.52	10.16
Riverdale	CAMDEN 1102	8.12	10.69
Squaw Valley	DUNLAP 1102	1.33	3.12
	SAND CREEK 1103	4.55	5.99
	TIVY VALLEY 1107	N/A	10.46
Table Mountain Rancheria	SHEPHERD 2111	N/A	22.22
	WOODWARD 2108	14.73	21.11
Tarpey Village	AIRWAYS 1108	9.12	12.83
	CLOVIS 1101	11.83	12.19
	CLOVIS 1104	8.27	12.19
	CLOVIS 1105	8.85	14.11
	CLOVIS 2110	12.59	20.96
Three Rocks	CANTUA 1103	N/A	7.12
Tombstone	MC CALL 1107	11.55	12.83
Tranquility	SAN JOAQUIN 1112	3.9	8.13
Unicorp	KERMAN 1102	11.95	12.83
	KINGSBURG 1102	8.76	0
West Park	KEARNEY 1114	N/A	10.46
	WEST FRESNO 1112	9.99	12.19

Source: PG&E (2020) ICA, GNA

11.1.4 Weather History

There are five NOAA stations in Fresno, but the Fresno Yosemite International Airport station was the only station with a full year of data within Fresno. The Fresno Yosemite International Airport station is also the second closest to the region of study, so it was the best choice for this analysis. The map in the figure below illustrates the locations of the weather stations considered.

Figure 158: Location of Fresno Weather Stations



Source: NOAA (accessed 2021)

11.2 Resilience Hub Cost Estimates

Resilience Hub Features	Cost Estimate	Assumption
City/County bike program	$42,600	Capital Costs for 1 bike and 1 station According to the City of Santa Monica' Bicycle Sharing Analysis conducted by Economic & Planning Systems, Inc, which references several bike share case studies including the District of Columbia, Boulder, Denver, and Minneapolis, the average capital costs per bike is $4,600 and per station is $38,000. The average operating costs over 12 months per bike is $2,000 and per station is $18,000. Depending on the membership price (if any), there could be anywhere from 0-64% revenue made.[46] Studies have shown that bike programs are most successful if there is investment in bike lane expansion in parallel with bike station construction. Fresno County has spent about $200,000 annually on sidewalk and ADA improvements in recent years. Fresno county has about $400 million of planned bicycle and pedestrian expansion for unincorporated communities in particular as cited in Table 6-6 of the Fresno County Regional Active Transportation Plan.[47]
	$20,000	Operating costs/1year for 1 bike and 1 station

46 Economics & Planning Systems, Inc. (2012, October 25). City of Santa Monica Bicycle Sharing Analysis. The City of Santa Monica. https://www.smgov.net/uploadedFiles/Departments/PCD/Plans/Bike-Action-Plan/SantaMonicaBikeShare%20cost%20and%20revenue%20estimates.pdf

47 Fresno Council of Governments (2018, January). Chapter 7: County. Fresno County Regional Active Transportation Plan. https://2ave3l244ex63mgdyc1u2mfp-wpengine.netdna-ssl.com/wp-content/uploads/2016/01/6FresnoRegATPReport_County.pdf

Resilience Hub Features	Cost Estimate	Assumption
E-Scooter/E-Bike stations nearby for rent where available (Bird, Lime, Lyft)	32500 ($1600/ hub if there are 20 hubs)	50 Bird scooters/all Hubs Bird Platform Partner- Purchase a minimum of 50 scooters between $600-700/vehicle. 50 scooters could be placed at various hubs around Fresno County, with FCRTA as the owner. (if there are 18-20 Hubs this is more cost effective than buying individual scooters)[48]
	$1,800	3 high performance electric scooters/Hub (Segway Ninebot Kickscooter Max, Glion Dolly, etc.) Independent scooter vendors- $400-600/scooter
	$50-$100	Scooter charging supplies (power supply, cable) if not included in purchase. For 3 scooters
EVs (light and medium duty) + charging infrastructure to transport groups to nearest bus stop, train station, grocery stores, and hospitals[49]	$300-$4,500	EVSE Unit and Installation Costs- Level 1 charger EVSE Level 1 Single Unit: $300-$1,500 EVSE Level 1 Installation: $0-$3,000 According to a U.S. Department of Energy study, in order to minimize EVSE costs, a wall mounted EVSE unit should be used to eliminate the need for trenching or boring. Placing the EVSE close to the electrical service will also minimize the need for trenching/boring. A dual port EVSE should be chosen over two single port EVSE to reduce installation costs for each charging port as well. Additionally, the level of EVSE should be based off of available electrical capacity of the panel, and ideally the panel should have a dedicated circuit with available spaces so retrofits are not needed for installation.
	$1000-$19,200	EVSE Unit and Installation Costs- Level 2 charger EVSE Level 2 Single Unit: $400-$6,500 EVSE Level 2 Installation: $600-$12,700
	$14,000-$91,000	EVSE Unit and Installation Costs- DCFC charger EVSE DCFC Single Unit: $10,000-$40,000 EVSE Level 2 Installation: $4,000-$51,000
	$40,000 - $60,000	1 Medium sized EV/hub
Air Conditioning	$500	Window air conditioning unit (can cool 1-2 rooms)
	$3,800-$7,500	Central air conditioning unit for entire building
	$1,500 to $7,000	New ductwork (if needed)
	$7,000-$30,000	HVAC system
Air filtration System	$200	For a single air purifier system, multiple rooms in the hub will need multiple purifiers
	$500-$4,100	For whole-house air purifier
Building EE features	$1,200	Upgrade electrical panel (national average)
	$450	Hire Home Energy Auditor (national average)
	$810	Install home automation system (national average)
	$3,500	Install solar water heater
	$12,000-$40,000	Install green roof
	$700 - $20,000	Grey water system
	$2,570	Fireproofing near-home landscaping
Create a Fire Resistant Building and Fire Repellant Environment	$40,750	Retrofitting the exterior walls (including windows and doors)

48 Bird (n.d.). Bring a fleet of birds to your city. https://www.bird.co/platform/
49 New West Technologies, LLC (2015, November). Costs Associated with Non-Residential Electric Vehicle Supply Equipment: Factors to consider in the implementation of electric vehicle charging stations. U.S. Department of Energy. https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

Resilience Hub Features	Cost Estimate	Assumption
Emergency kits (including food and emergency water supply in droughts) + Emergency Planning Workshops	$10,000-$20,000	One kit is $200, 50 is $10,000
Community Resource Map	$50	Cost of materials
ADA site compliance	$800 - $8,000	Typical range for common upgrades
	$100-$1000	Adding grab bars and handrails (interior railings are $1000 on average)
	$1,500-$8,500	Lowering cabinets and sinks, installation costs vary
	$3-$22 per square foot	Adding non-slip flooring
	$1,500-$5,000	Installing chair or stair lifts
	$2,500-$60,000	Installing an elevator
	$75-$300 each	Lowering thermostats
	$9,000-$40,000	Converting to ADA compliant bathrooms and kitchens
Floodproofing and Stormwater Management	$9000 to 18500	May include -Heavy plastic sheeting along the exterior walls -Cement and asphalt -Clear coating
Wi-Fi and Phone Charging Stations	$500-$8,000	On the low end is typical Wi-Fi service ($360/12 months) with a modem and charging ports, on the high end is a solar powered Wi-Fi and smart charging station
Trees and Greenspace	$3,000-$12,000	$3,000-$12,000 Cost for transplanting 10 trees $300-$1,200 to transpolant a single tree 8-12 ft
Kitchen + Food Storage	$5,000-125,000	Install + develop entirely new kitchen space
	$1500-$4000	Add refrigerator to existing space
	$200	Add tabletop portable stove to existing space
	$700-$3,000	Add full size oven and stove to existing space
Bathrooms, locker rooms, showers	$18,000-$47,000	Cost of adding a bathroom to an existing space in a home, commercial bathroom with multiple stalls could exceed this range
Video Chat with Medical Professionals	$500-$2000	1 desktop setup (includes monitor, mouse, keyboard)
Jobs for Community Members	$90,000	3 full time personnel/Hub at rate of $14/hr, About $90k annually split between 3 people: -Admin/Event Coordinator -Security -Rotating teaching position
CERT Trainings and Workshops	$1000-$5000	Work with City of Fresno to provide CERT trainings to the wider rural communities
Community-led classes	See above for cost of 3 personnel in the hub	
Workspace with computers	$6,000	3 desktop computers for public use at $2000/ each
Monthly or Bimonthly meetings to discuss opportunities for growth, requested changes with community members	$0	No added cost, supported by full time staff/volunteers
Event Room	$0	No added cost, supported by full time staff/volunteers
Online Forum or App to connect local resilience hubs	$0	No added cost, supported by full time staff/volunteers

Resilience Hub Features	Cost Estimate	Assumption
Create a Zello app group (https://zello.com/) and draw awareness	$0	No added cost, supported by full time staff/volunteers
	$350	Small portable greenhouse 6’ by 8’ from Amazon
Greenhouse/ Community Garden	$5,000-$25,000	Large greenhouse construction 12’ by 12’
Smart Lighting System (Solar powered)	$100-$400	Motion sensor security lights outside the hub entrance
Water filtration system	$2,000	Average total price, will require additional research to determine best filter type to meet each community’s needs
	$50-$500	Carbon filter system: $50-$500
	$800-$2,000	UV disinfection system: $800-$2,000
	$1,000-$2,000	Ionization system: $1,000-$2,000
	$1,400-$1,500	Reverse osmosis system: $1,400-$1,500
	$100-$2,000	Filtration system installation

11.3 References

Alternative Fuels Data Center (n.d.). *Electric Vehicle Charging Station Locations.* https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC

Soulopoulos, N. (2017, April 12). *When Will Electric Vehicles by Cheaper than Conventional Vehicles?* Bloomberg New Energy Finance. https://data.bloomberglp.com/bnef/sites/14/2017/06/BNEF_2017_04_12_EV-Price-Parity-Report.pdf

County of Fresno (n.d.). *Fresno County GIS Portal.* https://gisportal.co.fresno.ca.us/portal/home/

Applied Development Economics, Inc. (2017, May 4). *Fresno County 2050 Growth Projections*. Fresno County Council of Governments. https://2ave3l244ex63mgdyc1u2mfp-wpengine.netdna-ssl.com/wp-content/uploads/publications/RTP/2018_RTP/Fresno_COG_2050_Projections_Final_Report_050417.pdf

Fresno Council of Governments (2018). Regional Transportation Plan: *Sustainable Communities Strategy 2018-2042*. https://www.fresnocog.org/project/regional-transportation-plan-rtp/

Long, J., Birkholzer, J., Mace, A., & Brady, S. (2018, February 5). *Long-term Viability of Underground Natural Gas Storage in California: an Independent Review of Scientific and Technical Information.* California Council on Science & Technology. https://ccst.us/wp-content/uploads/Full-Technical-Report-v2_max.pdf

Konala, S. (2019, November 21). *Behind-the-Meter PV Forecast: 2019 Revised Forecast.* California Energy Commission. https://www.energy.ca.gov/sites/default/files/2019-12/02a%20Konala_BTM%20PV%20Presentation%2011.21.19_0_0_ada.pdf

California Energy Commission (2021, January). *PG&E Planning Area: California Energy Demand Forecast Update, 2020-2030 Baseline Forecast – Mid Demand Case.* https://efiling.energy.ca.gov/GetDocument.aspx?tn=236312&DocumentContentId=69306

Marshall, L. (2020, August 26). *Electricity Rate Scenarios: Updating the CED 2019-2030 Demand Forecast.* California Energy Commission. https://efiling.energy.ca.gov/getdocument.aspx?tn=234488

California Energy Commission (2019). *California Energy Demand Hourly Results – PG&E Mid Demand Case.* https://efiling.energy.ca.gov/GetDocument.aspx?tn=231561&DocumentContentId=63377

Sathe, A., Maoz, K., Aquino, J., Pande, A., & Keneipp, F. (2020, May). *Fuel Substitution Forecasting Tools: Methods Supporting Senate Bill 350 Analysis.* California Energy Commission. https://efiling.energy.ca.gov/GetDocument.aspx?tn=233106&DocumentContentId=65590

Konala, S. (2020, December 3). *Photovoltaic and Battery Storage System Adoption.* California Energy Commission. https://efiling.energy.ca.gov/getdocument.aspx?tn=235835

California Independent System Operator (n.d.). *Market Price Maps.* http://www.caiso.com/PriceMap/Pages/default.aspx

California Public Utilities Commission (n.d.). *Historical Electric Cost Data.* https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/historical-electric-cost-data

California Public Utilities Commission (2020, July 7). *Natural Gas Reliability Standards*. https://www.cpuc.ca.gov/-/media/cpuc-website/industries-and-topics/documents/natural-gas-and-oil-pipeline-regulation/long-term-gas-planning-rulemaking/r2001007-track1a-july72020-staffworkshop-slides.pdf

California Department of Motor Vehicles (2018). *10/1/2018 Vehicle Fuel Type Count by Zip Code.* California Open Data. https://data.ca.gov/dataset/vehicle-fuel-type-count-by-zip-code/resource/d304108a-06c1-462f-a144-981dd0109900

Go Solar California (n.d.). *California Distributed Generation Statistics*. californiadgstats.ca.gov

National Renewable Energy Laboratory (2013). *2010-2012 California Household Travel Survey.* https://www.nrel.gov/transportation/secure-transportation-data/tsdc-california-travel-survey.html

Melaina, M., Bush, B., Eichman, J., Wood, E., Stright, D., Krishnan, V., Mai, T., & McLaren, J. (2016, December). *National Economic Value Assessment of Plug-in Electric Vehicles: Volume I.* National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy17osti/66980.pdf https://www.nrel.gov/docs/fy17osti/66980.pdf

OpenEI (2013). *Residential Hourly Load Profiles for Sacramento Executive Airport Typical Meteorological Year 3 (TMY3).* https://openei.org/datasets/files/961/pub/RESIDENTIAL_LOAD_DATA_E_PLUS_OUTPUT/BASE/USA_CA_Sacramento.Exec.AP.724830_TMY3_BASE.csv

OpenEI (2013). *Los Angeles Midrise Commercial Reference Building Hourly Load Profile for Sacramento Executive Airport Typical Meteorological Year 3 (TMY3).* https://urldefense.com/v3/__https:/openei.org/datasets/files/961/pub/COMMERCIAL_LOAD_DATA_E_PLUS_OUTPUT/USA_CA_Sacramento.Exec.AP.724830_TMY3/RefBldgMidriseApartmentNew2004_7.1_5.0_3B_USA_CA_LOS_ANGELES.csv__;!!ETWISUBM!lev7P2YijlrjLzVA4DimK3NNNi6m0TCtbkUWNDbegYO18OQ9O0o31KV-kuTy_Bx_uw$

OpenEI (2013). *Los Angeles Commercial Strip Mall Reference Building Hourly Load Profile for Sacramento Executive Airport Typical Meteorological Year 3 (TMY3).* https://urldefense.com/v3/__https:/openei.org/datasets/files/961/pub/COMMERCIAL_LOAD_DATA_E_PLUS_OUTPUT/USA_CA_Sacramento.Exec.AP.724830_TMY3/RefBldgStripMallNew2004_7.1_5.0_3B_USA_CA_LOS_ANGELES.csv__;!!ETWISUBM!lev7P2YijlrjLzVA4DimK3NNNi6m0TCtbkUWNDbegYO18OQ9O0o31KV-kuQ1C1ADTQ$

California Gas and Electric Utilities (2018). *2018 California Gas Report.* Pacific Gas & Electric. https://www.pge.com/pipeline_resources/pdf/library/regulatory/downloads/cgr18.pdf

Pacific Gas and Electric Company (2019, July 15). *2018 Annual Electric Reliability Report.* https://www.pge.com/pge_global/common/pdfs/outages/planning-and-preparedness/safety-and-preparedness/grid-reliability/electric-reliability-reports/AnnualElectricDistributionReliabilityReport2018.pdf

Pacific Gas and Electric (n.d). *EV Fleet program.* https://www.pge.com/en_US/large-business/solar-and-vehicles/clean-vehicles/ev-fleet-program/ev-fleet-program.page

Pacific Gas and Electric (n.d.). *Fleet Electrification* [Presentation]. https://calact.org/assets/Innovative%20Clean%20Transit%20Update%20-%20PGE%20Transportation%20Electrification%20-%20%20Sawaya.pptx

Pacific Gas and Electric (2020), Wildfire Safety Improvements Fall Progress Report

Proterra (n.d.). *Offering a Vehicle Configuration for Any Range.* https://www.proterra.com/vehicles/zx5-electric-bus/range/

Sia Partners (2016), *Public Charging Infrastructure Essential for the Mass Adoption of Electric Vehicles.* https://www.sia-partners.com/system/files/document_download/file/2020-06/20160831_sia_partners_ev_charging_infrastructure_insight_vf3_0.pdf

United States Census Bureau

New West Technologies, LLC (2015, November). *Costs Associated with Non-Residential Electric Vehicle Supply Equipment: Factors to consider in the implementation of electric vehicle charging stations.* U.S. Department of Energy. https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

United States Energy Information Agency (n.d.). *California All Grades All Formulations Retail Gasoline Prices.* https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMM_EPM0_PTE_SCA_DPG&f=M

United States Energy Information Agency (n.d.). *Weekly California No 2 Diesel Retail Prices.* https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_SCA_DPG&f=W

United States Energy Information Agency (2019) *Form EIA-860 detailed data with previous form data (EIA-860A/860B).* https://www.eia.gov/electricity/data/eia860/

United States Energy Information Agency (2019) *Form EIA-923 detailed data with previous form data (EIA-906/920).* https://www.eia.gov/electricity/data/eia923/

11.4 Stakeholder Engagement

11.4.1 Overview & Purpose

Community engagement throughout the FCRTA Study was designed to capture unique community unique goals throughout County and provide benefits for Study development. Benefits to the Study's development included opportunities to gain long-term, broad-based support and to increase the likelihood of successful implementation. Most importantly, however, outreach provided community education opportunities and increased the likelihood that project outcomes will positively impact and are closely aligned with community needs, especially those of vulnerable and hard-to-reach communities.

Community Outreach was designed to reflect the needs and goals of Fresno County's widespread and diverse population. Through six public-facing community workshops and two Community Connection Committee (CCC) meetings, the community and stakeholders had the opportunity to provide input, identify co-benefits, and provide feedback relating to the Study's scope. Outreach also included an online virtual engagement room with multiple educational opportunities relating to the Study.

Outreach and stakeholder engagement activities sought to advance the following goals:

Increased public awareness. The process provided enhanced educational awareness among community members, stakeholders, and decision makers about grid capacity and analysis, project milestones and progress, and opportunities for prioritization. Ample opportunities to learn about the electrical grid through innovative engagement methods were provided to alleviate the educational and awareness barrier that is common among electrification initiatives.

Project support. The FCRTA Study information was shared in a clear, concise, and accessible way to encourage early and continuous engagement throughout the Study development process. Engagement performed in this manner increases project support by key stakeholders and the community at large.

Establish communication channels. Outreach provided the public and stakeholders with Study updates and community workshop invitations throughout the Study's development processes. These communication channels can be used by the FCRTA for disseminating additional information about Study outcomes and FCRTA electrification efforts.

11.4.2 Key Engagement Findings

During the workshops, participants were polled to gather information about various topics. Polling indicated that:

- Nearly 80% of workshop participants had seen the way in which the grid was used change. These changes included increased utilization or renewable sources of energy, EE, and an increase in electrification including vehicles.
- Most workshop participants polled had experience with EVs. Only approximately 15% had no experience with EVs. More than 60% had ridden in an EV. In those workshops in which the question was asked, between 19% and 27% of the participants owned EVs, well above the EV adoption rate for Fresno County as a whole.
- The most important benefit of electrification to participants varied by workshop; however, a more reliable, resilient grid, as well as jobs and economic development opportunities were consistently the highest ranked options.

Discussions and questions asked by participants during each workshop also varied; however, the two areas brought up by participants most frequently were existing EV infrastructure use in rural communities and the need for collaboration to achieve EV goals. Grid reliability, affordability and renewables were also brought up by multiple participants, as were air quality and health, although the latter two not as frequently as the other topics. Other areas in which participants asked questions or made statements included climate change, community resilience, rural and disadvantaged areas, and economic development. Participants were knowledgeable about climate change and are concerned about its impacts on their communities.

It was clear that engagement participants were interested in both electrification and transit issues. Many understood how electrification could impact rural communities and is driving changes to the electric grid in ways that can both benefit and place rural communities at a disadvantage. They were proud of the efforts to date that rural communities and the FCRTA have made to ensure that EV charging infrastructure is available throughout County. Participants stressed that planning and funding collaboration have been vital to the success of those efforts and will be even more important as vehicle electrification progresses. They look forward to the results of the Study and using it as the basis for future collaboration for the benefit of rural communities and residents.

Participants were appreciative of FCRTA's leadership in commissioning a Study of rural Fresno County and that they were provided to provide feedback about community priorities. Favorable comments were also received about the transparency of the process.

11.4.3 Methodology

Outreach activities were designed to ensure that a diverse range of populations, and those that represent them, were included in the development of the Study and that they were empowered to meaningfully contribute so the Study.

The community outreach approach was based on four primary activities:

- Practicing Inclusive Engagement Strategies
- CCC Meetings
- Community Workshops
- Virtual Engagement Room

Prior to community outreach activities, the project team developed outreach materials that effectively communicated project goals and objectives, educated participants, and sparked conversations focused on the FCRTA's electrification efforts. Material content explained the technical components of the Study in an understandable and relatable way. Materials were updated throughout the outreach process as needed to reflect project progress, audience interests, and community feedback following completed engagements. By utilizing iterative materials that demonstrated project progress and responded to feedback from prior engagements, the project team ensured that community members and stakeholders were an integral part of the Study development process. Materials developed included:

- Technology platform instruction sheets
- Agendas
- Sign-in sheets
- Presentations
- Surveys
- Project overview materials
- Educational materials relating to the electrical grid, electrification, the benefits of grid enhancements for rural Fresno County, Fresno County's energy system, and EVs
- Community workshop video

Information dissemination channels utilized to announce outreach activities are listed below. The methods of dissemination were developed based on the input and insight of local organizations including those on the CCC. The project team used these channels to share project information, advertise community workshops, and disseminate information about the virtual meeting room. Information dissemination channels included:

- E-mails and invitations sent to interested community members and stakeholder organizations
- Social media platforms
- Local newspaper and TV community calendars
- FCRTA website
- Virtual fliers distributed to senior centers and healthcare facilities
- Online event calendars maintained by local business and advocacy organizations, Eventbrite, and municipalities
- Virtual fliers and email blasts made available for distribution by key community stakeholders and organizations including:
  - Municipalities and government agencies
  - Social service providers
  - Advocacy organizations
  - Community organizations (youth, social, business, labor, etc.)
  - Faith based organizations
  - Senior citizen centers

11.4.3.1 Inclusive Engagement Strategies

The project team utilized inclusive communication strategies throughout the outreach process. Engagement tools were inclusive, engaging, and accessible to empower community members of various populations, abilities, digital connection, and languages to contribute to the Study's development.

Engagement tools included:

- **Hybrid virtual/in person meeting**
- **Virtual meeting platforms:** Microsoft Teams and Zoom
- **Engagement tools:** PowerPoint presentation, facilitated discussions, whiteboarding sessions, voting and polling activities, follow-up information and surveys
- **Virtual engagement room:** A website with educational and engagement activities allowing participants to learn about the Study and electrification topics specific to rural Fresno County, watch a workshop video, and provide feedback

The project team also employed the following best practices for inclusive engagement:

Community Connection Committee: Leaders of local organizations with strong ties to various populations and interests in rural Fresno County were invited to join the Study's CCC. The project team worked closely with the CCC, described more fully below, to learn the most effective ways to reach the populations that these organizations represent or serve. The CCC helped identify opportunities to make outreach more meaningful and inclusive, and served as a key resource to disseminate engagement information to their networks.

Safety prioritization: The primary mode of engagement was virtual given restrictions and precautions necessary given COVID-19. The evolving COVID-19 situation and reopening stages listed on the County of Fresno's COVID-19 information page[50] were monitored and, when it was determined safe to do so, a hybrid in-person/virtual workshop was held utilizing social distancing and encouraging masking per local guidelines was held.

Accessible meeting times: Meetings were scheduled at various times to maximize community stakeholder participation. Meetings were held during the day, late afternoon, and evenings.

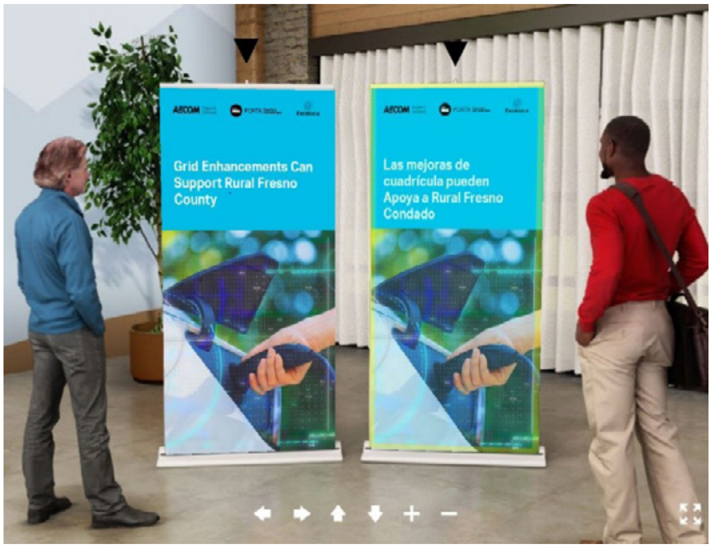
Workshop participation: Participants could participate in virtual workshops by computer or phone and the final workshop in person, by phone or by computer. This allowed community members to participate when internet connectivity was limited, or other technology barriers are present. The project team provided instructions for how to join the virtual meeting and start the session well in advance of the meeting to troubleshoot technology issues. The meeting agenda and objectives were shared with participants prior to all meetings, so they knew what to expect and felt comfortable participating.

English and Spanish resources: In an effort to be inclusive of Spanish speakers and reflect the diversity of the Fresno County populations, workshop meeting announcements, agendas, social media postings, web notices, and community and event calendar listings were posted and disseminated in both Spanish and English. The project team included a native Spanish speaker for engagements. Translation services were offered, and live, simultaneous Spanish translation was provided during four of the six workshops. During these events, information was provided both in Spanish and English instructing participants how to access the Spanish presentation. Participants were also able to ask questions and provide feedback during the sessions. One scheduled workshop was to be held entirely in Spanish with Spanish speaking presenters and all materials in Spanish. Unfortunately, after extensive promotion, no community members registered for the event, and the workshop was canceled.

50 County of Fresno (n.d.). *Covid-19 (Novel Coronavirus)*. https://www.co.fresno.ca.us/departments/public-health/covid-19

The Virtual Engagement Room allowed all visitors to access educational materials in Spanish or English. Upon entering the room, as shown in Figure 162, instructions were provided in Spanish and English on how to move about the room and access material.

Figure 159: Virtual Engagement Room Welcome Page



Visitors to the Virtual Engagement Room, were then able to explore a variety of topics with identical educational material provided in both Spanish and English. Figure 158 demonstrates how visitors were able to access materials by selecting the poster in the language of their preference.

11.4.4 Public Outreach Activities

Public outreach meetings consisted of two CCC meetings and six Community Workshops. The purposes of the public outreach process were focused on education, awareness, gaining project support, and soliciting relevant community feedback. Table 90 shows the schedule of engagement events.

Figure 160: Virtual Engagement Room Posters

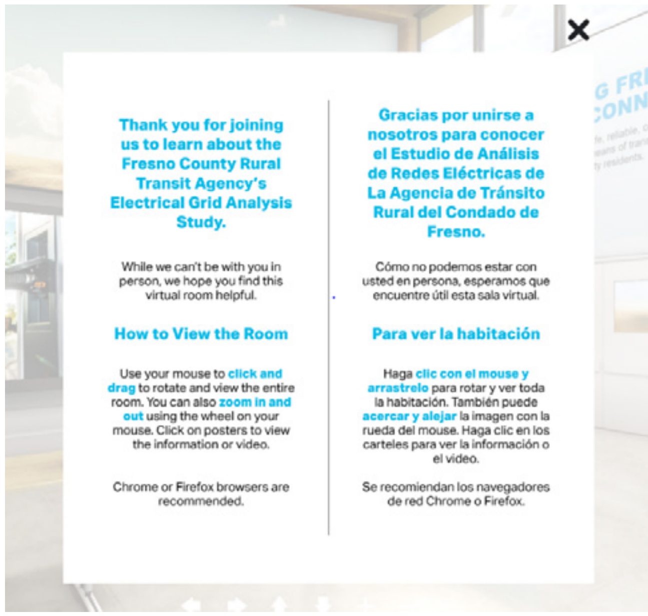


Table 89. Community Outreach Events

Community Workshop	Date
CCC #1	August 27, 2020
Community Workshop #1	September 30, 2020
Community Workshop #3	October 12, 2020
CCC #2	October 29, 2020
Community Workshop #4	November 19, 2020
Community Workshop #5	January 28, 2021
Community Workshop #6	August 18, 2021

Total attendance at engagement meetings was 120 participants. Eighty different individuals attended one or more of the workshops or CCC meetings. Attendance figures do not include FCRTA staff or project team members.

11.4.4.1 Community Connection Committee

To ensure that populations were provided the opportunity to participate in community outreach activities, a group of individuals representing organizations with deep ties to rural Fresno County was asked to serve on the CCC. The CCC functioned as a liaison between the project team and the community to help the project team effectively engage various populations. The CCC served the following functions:

- Shared best practices on how to share project information and advertise community outreach workshops and events to the populations that they represent; and

- Helped ensure that vulnerable and hard-to-reach populations are effectively engaged by assisting with the dissemination of materials.

The following organizations were invited to be members of the CCC:

- Adventist Health- Central Valley Network
- Agewell Fresno*
- Boys and Girls Club of Fresno County*
- California Rural Legal Assistance, Inc.
- CalTrans*
- Central California Environmental Justice Network*
- Center for Leadership, Equity, and Research
- Centro Binational Para El Desarrollo Indigene Pamaquine
- City of Coalinga
- City of Firebaugh
- City of Fowler
- City of Huron
- City of Kerman
- City of Kingsburg*
- City of Mendota
- City of Orange Cove
- City of Parlier
- City of Reedley*
- City of Sanger*
- City of San Joaquin
- City of Selma*
- County of Fresno*
- Every Neighborhood Partnership
- Faith in the Valley - Faith in Fresno
- Fresno Council of Governments*
- Fresno County Chamber of Commerce
- Fresno County Farm Bureau*
- Fresno County Office of Education*
- Fresno Housing Authority*
- Fresno Metro Ministry*
- Fresno PACE*
- Focus Forward
- Inspiration Transportation*
- PG&E
- Reedley College
- Self Help Enterprises*
- SoCal-Gas
- Southwest Transportation Agency
- United Health Centers*
- United Way of Fresno and Madera Counties*
- Valley Center for the Blind*
- Valley LEAP
- Veterans Affairs Medical Center

- West Hills College*

Twenty-six different individuals representing 24 Fresno County organizations attended CCC meetings. Organizations which participated in CCC meetings have an asterisk by their name in the list above.

11.4.4.2 Community Wokshops

The FCRTA hosted six public-facing workshops to provide educational awareness opportunities and solicit relevant feedback from rural Fresno County community members, rural communities, agencies, organizations, and other interested parties. Workshops were scheduled at a variety of times and days of the week, to allow for varied and wide-spread attendance. Workshops #1 through #5 were held virtually due to COVID-19 concerns while Workshop #6 allowed participants to participate in person, by computer, or by phone.

Workshops #1 through #5 were titled "*The FCRTA Grid Study, What it Could Mean for You and Your Rural Community*" followed the agenda shown in Figure 159.

Figure 161: Agenda: Workshops #1 - #5

The FCRTA Grid Study *What it Could Mean for You and Your Community*	
1	Welcome and Introductions
2	Safety Moment
3	Introduction to the Study
4	Electrification Overview
4a	Electrification
4b	The Electrification Grid
4c	Opportunities and Benefits
5	Study Review
6	Discussion

Two of the workshops provided additional emphasis on distinct focus areas. The same agenda was utilized; however additional information was provided relating to the focus area. Workshop #4 provided emphasis on information important to seniors and those that serve them. Workshop #5 included additional information of interest to rural communities such as how the Study could be used for their planning purposes and help identify funding opportunities. Additional efforts were made to invite those interested in these topics and encourage their attendance.

The final workshop was utilized to provide information regarding the Study's progress and key findings and describe next steps in the process. The agenda for Workshop #6 can be seen in Figure 160.

Figure 162: Agenda: Workshop #6

Electrical Grid Analysis Study *Progress and Key Findings*	
1	Welcome and Introductions
2	Safety Moment
3	Introduction to the Study
4	Study Progress & Key Findings to Date
5	Discussion
6	Wrap Up

Sixty-five different individuals, exclusive of FCRTA staff and project team members, attended at least one workshop. Seventeen of those attended more than one workshop. Workshop attendance ranged from one to 26 participants. The evening meeting had only one participant with daytime workshops having greater participation. The number of individual workshop participants can be seen in Table 90.

Table 90. Workshop Participation

	Workshop 1	Workshop 2	Workshop 3	Workshop 4	Workshop 5	Workshop 6	Total Participants
Total Participants	11	10	1	20	23	26	91

Representatives of governmental entities attended workshops at a higher rate than any other group, with rural Fresno County municipalities attending at a higher rate than other government segments. The breakout of attendance can be seen in Table 91.

Table 91. Workshop Participation by Interest Type

Interest	Workshop Attendance
Governmental Entity	
Rural Fresno County Municipality	14
Fresno County	13
State of California	10
Other	6
Social Service of Advocacy Organization	14
FCOG	10
Community Members	7
Transit Agency	7
School District	6
Other	4

11.4.4.3 Virtual Engagement Room

A virtual engagement room for the Study was available on the internet at https://aecomviz.com/FCRTA360/. The virtual room offered those visiting it an interactive, educational experience about the Study and topics relating to it. Upon entry, visitors were shown a community town hall setting in which several large posters, in both Spanish and English, allowed the visitor to access educational materials. By clicking on a poster, a separate internet tab opened with educational materials. Visitors were able to access information on the following:

- Electrical Grid Analysis Study Overview
- What is the Electrical Grid?
- Electrification: Restructuring How we Power Our Lives
- Grid Enhancements Can Support Rural Fresno County

- The Fresno County Energy System
- Electric Vehicles 101

Visitors also had access to a video of one of the workshops, the FCOG EVRP, and the FCRTA's Services Map and website. Figures 164 and 165 show images of the virtual room.

Figure 163: Virtual Engagement Room

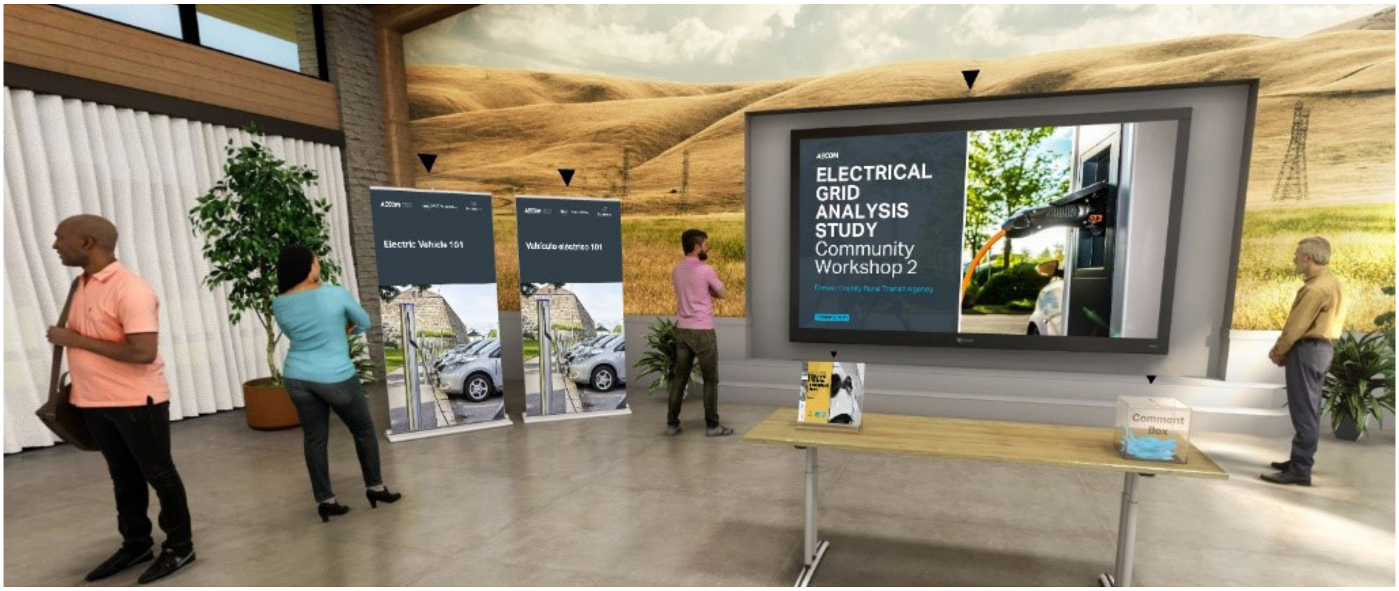


Figure 164: Virtual Engagement Room Kiosk and Route Map