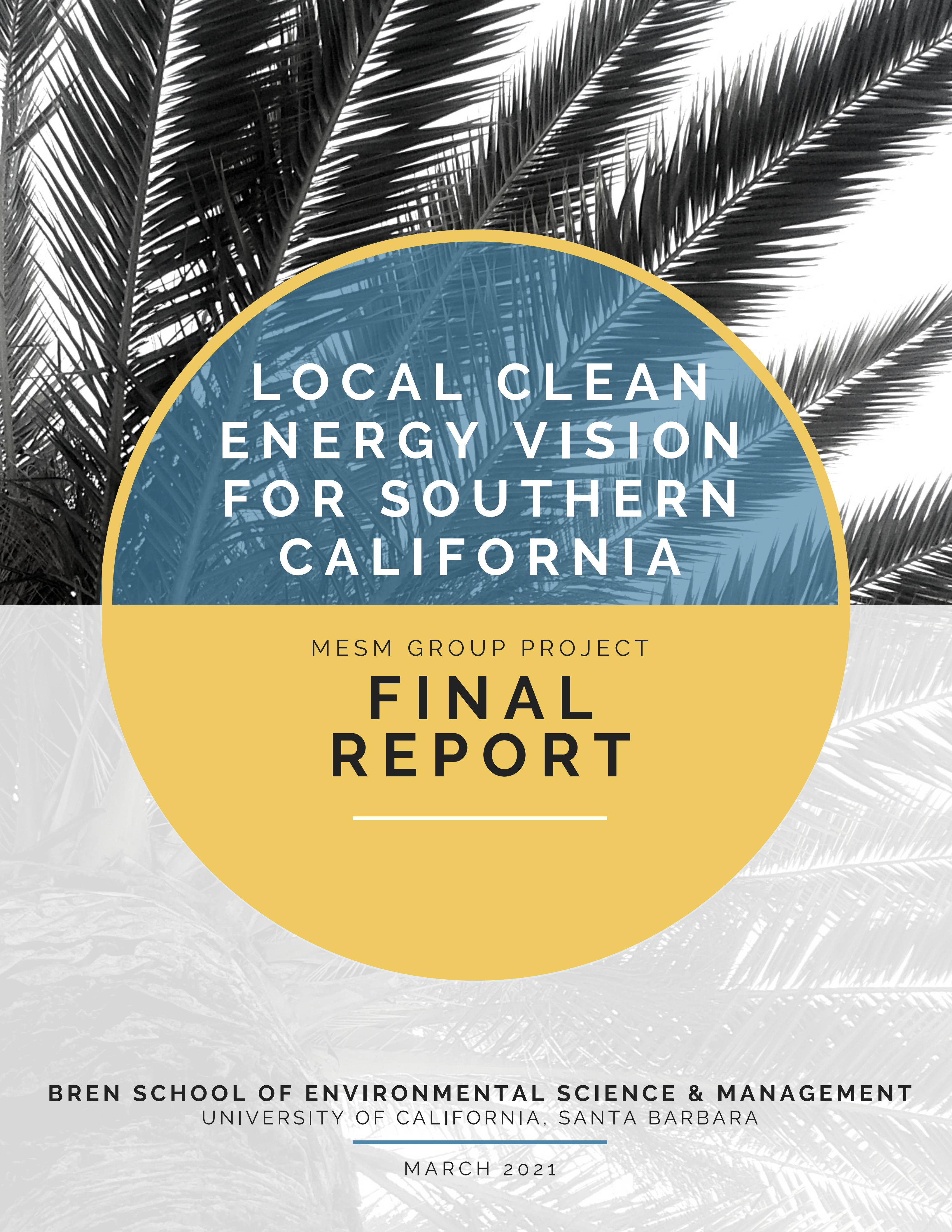

LOCAL CLEAN ENERGY VISION FOR SOUTHERN CALIFORNIA

MESM GROUP PROJECT

FINAL REPORT

BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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Local Clean Energy Vision for Southern California

Authors

Audrey Nolan
Keene Morrow

David Segan
Rich Viebrock

Jordan Isken

Faculty Advisors

Andrew Plantinga

Kyle Meng

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LOCAL CLEAN ENERGY VISION FOR SOUTHERN CALIFORNIA

As authors of this Group Project report, we archive this report on the Bren School's website such that the results of our research are available for all to read. Our signatures on this document signify our joint responsibility to fulfill the archiving standards set by the Bren School of Environmental Science & Management.

Audrey Nolan

David Segan

Jordan Isken

Keene Morrow

Rich Viebrock

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The Group Project is required of all students in the Master of Environmental Science and Management (MESM) Program. The project is a year-long activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Group Project Final Report is authored by MESM students and has been reviewed and approved by:

Dr. Kyle Meng

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Abstract

Decarbonization of the electricity sector plays a crucial role in reaching greenhouse gas reduction targets and avoiding climate change-related impacts. In California, organizations such as Community Choice Aggregators (CCAs) are increasing clean energy projects through long-term power purchase agreements. Most utility-scale clean energy projects are located remotely in large centralized developments but there are opportunities to develop local, smaller scale utility projects. Local projects are generally more expensive due to their smaller size but there is potential to capture additional benefits to offset capital costs. This project assessed three additional benefits that local clean energy can achieve through strategic siting: improved air quality from displacing natural gas power plants, lower-impact land use, and energy resilience, or power availability during an outage. We analyzed each benefit separately and reached three main conclusions: (1) the procurement of battery storage in the Western Los Angeles Basin reliability subarea can improve air quality in CPA's service territory; (2) environmental impact can be reduced by prioritizing development within the built environment where the development avoids competition with existing or potential greenspace and habitat; (3) the value provided by clean backup power systems is locationally dependent due to differing power outage rates. This information can be utilized to focus energy development in areas that capture benefits beyond reduced greenhouse gas emissions.

Key Words

Local Clean Energy, Resilience, Land Use Impacts, Habitat, Greenspace, Community Choice Aggregation, In-Front-of-the-Meter, Solar PV, Solar Photovoltaic, Battery Storage, Air Quality, Emissions Displacement, California

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Introduction and Significance

Electricity providers are expanding their portfolios of clean energy resources to meet California's Senate Bill 100 policy goal of having renewable energy and zero-carbon resources supply 100 percent of electric retail sales by 2045. Most utility scale clean energy projects are located remotely in large centralized developments, but there are opportunities to develop smaller utility scale projects locally, within and near load centers. Deploying more local clean energy resources may be the most beneficial path to achieving low carbon electricity goals. Local clean energy resources appear considerably more expensive, but the cost can be justified through strategic siting and design that help achieve additional benefits. Electricity providers need more information about the benefits of local development and how to adapt their siting strategy to achieve these benefits.

There are many criteria to consider when thinking about locating clean energy resources. In California, there are "local capacity" requirements mandating a certain amount of locally sited energy generation to ensure that sufficient energy is available if a critical transmission line goes down.[1] Many local natural gas plants will remain active if local clean energy generation does not meet local capacity requirements.[2] Apart from this explicit need for local generation, energy providers and policy makers see many co-benefits of local[1] clean energy that do not appear in project proposals. These include local job creation, targeted financial savings to disadvantaged communities[2], reduced need for transmission lines, ambient air quality improvements from displacing fossil fuel generation[3], greenspace and habitat benefits from lower impact development, and energy resilience, or power availability during an outage.

Given these potential benefits and the need for local capacity, electricity providers like Community Choice Aggregators (CCAs) are increasingly interested in investing in local clean energy resources like solar photovoltaics and battery storage (PV+S).[4] Policies around the world also tend to favor local generation,[5] which can add monetary incentives or legal requirements for CCAs to procure locally. Examples of CCA procured local generation included medium-scale PV systems that are ground mounted on undeveloped land within the service territory or installed on large customer rooftops. This is distinctly different from "behind-the-meter" customer owned rooftop solar or batteries, the most commonly talked about distributed energy resources.

Our clients are among the stakeholders interested in achieving multiple benefits from clean energy development. The Clean Power Alliance (CPA) is a CCA that is actively pursuing these opportunities but does not have the information to prioritize developments that maximize benefits. The Nature Conservancy (TNC) is working across the country to help private and public partners deliver clean, wildlife-friendly

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[1] Also known as decentralized, distributed, dispersed, or embedded generation. Clack et al. (2020) define local clean energy as resources administered below 69-kV substations. For this project, "local" is defined as within the service territory of the energy provider.

[2] See background section below titled "Disadvantaged Communities and CalEnviroScreen" for an explained definition of disadvantaged communities, per the California EPA.

renewable power to customers faster and cheaper. The Nature Conservancy has been informing CPA's effort to procure clean energy with lower development impacts.

This project will evaluate three specific co-benefits of local clean energy resources: improved air quality, energy resilience, or power availability during an outage, and low-impact project siting. The analysis will be for CPA's service territory, however, the methodology is relevant to other power purchasing entities that face similar challenges of assessing opportunities for developing new local clean energy resources.

Objectives

1. Define "multiple benefit, local clean energy"
2. Evaluate three benefits of multiple benefit local clean energy: improved air quality via displacement of natural gas power plants, greenspace and habitat benefits from lower impact development, and resilience against power outages for critical facilities
3. Develop spatial datasets to aid in identifying opportunities to advance multiple benefit local clean energy in CPA's service territory and provide procurement strategy recommendations

Methods

Conducting a complete cost-benefit analysis of local clean energy was beyond the scope of this project; therefore, we used distinct methods for each of our benefit categories: air quality, resilience, and land use.

Air Quality: Reliability regulation was evaluated to determine where natural gas power plants can be displaced with battery storage without disrupting federal reliability standards. Power market forces were then assessed to identify which natural gas power plants within or near CPAs service territory are most vulnerable to displacement. The information gathered from these analyses was used to develop battery storage procurement recommendations that maximize the possibility of displacing natural gas generating capacity. Lastly, a health impact assessment was conducted to determine the potential benefit of displacing the natural gas power plants that were identified as most vulnerable to displacement.

Resilience: A literature review on resilience evaluation was conducted to determine equations for the cost of an electrical outage and value of having a backup power system that provides resilience to that outage. Historical outage data at the community level was collected and analyzed to understand outage durations, frequency, and causes for the 32 communities that CPA serves. A benefit transfer method was used for determining a building's cost of unserved energy—a key parameter in the value of resilience calculation. The value of resilience was then calculated for a generic building in each community. Since the project was unable to obtain site-specific data, historical duration and frequency of outages in each community largely determine the value of resilience since a uniform average load value is used across communities, and the values for cost of unserved energy are very similar.

Greenspace and Habitat: A literature review was conducted to determine possible sources of land use impacts from photovoltaic and battery storage installations. An avoidance/attractor matrix for photovoltaics was developed to identify 7 levels of land use conflict for 12 categories indicating the intersection of higher, moderate, or lower greenspace and habitat need with four land use categories:

vacant land, disturbed land, parking lots greater than 2 acres, and building footprints greater than 2 acres. No land use impact was identified for battery storage installations. A spatial analysis examined 242,458 acres of development opportunities in Los Angeles and Ventura Counties to identify parcels, parking lots, and buildings within the CPA service territory that fall into the categories outlined in the matrix.

Findings

The findings presented in this report offer energy providers and stakeholders insight into the potential benefits of local clean energy resources and where those benefits can be achieved.

Definition of Multiple Benefit Local Clean Energy: *Energy generated near the end-user without on-site emissions of greenhouse gases or criteria air pollutants, that includes, but is not limited to, local air quality improvements, increased resilience against power outages, reduced development impact on greenspace and habitat, targeted financial savings to disadvantaged communities, and/or local job creation.*

This definition was developed to inform Clean Power Alliance's local procurement strategy. Benefits of multiple-benefit local clean energy are dependent on the stakeholder perspective, in this case, CPA.

Air Quality: Battery storage can displace natural gas generating capacity in the Los Angeles Basin reliability area, but not the Big Creek / Ventura reliability area. Results suggest that procurement of battery storage in the Western Los Angeles Basin reliability subarea is most likely to displace natural gas generating capacity located within or near CPA's service territory. It is believed that the Long Beach Generating Station is the least competitive natural gas power plant in the Western Los Angeles Basin reliability subarea, and thus most likely to be displaced. It is estimated that the Long Beach Generating station imposes roughly $590,000 of damage on communities exposed to its pollutant emissions every year.

Resilience: The resilience analysis provides ballpark estimates of the monetary value of resilience a backup storage system capable of islanding may provide to a facility in each of CPA's communities. The estimates range from $10,000 to over $70,000 over 10 years for a generic building with 50 kW of critical load. Communities vulnerable to wildfire generally have the highest value of resilience due to higher historical outage rates. The results are summarized in Figure 5.2.2.

Greenspace and Habitat: Spatial analysis informed by the avoidance/ attractor matrix identifies opportunities for investigation in 12 categories in Los Angeles Counties and 9 categories in Ventura County. Opportunities in the three lowest conflict groups totaled 103,742 acres (419 km^2) in Los Angeles County and 38,329 acres (155 km^2) in Ventura County.

Conclusions

Air Quality: Displacing natural gas power plants with battery storage is likely to reduce local pollutant emissions and improve local air quality. Procurement of battery storage should be focused on reliability subareas where battery storage can displace natural gas generating capacity without disrupting reliability standards. Doing so is likely to decrease the competitiveness of natural gas power plants located therein, therefore increasing the possibility of power plant displacement, reduced pollutant emissions, and improved local air quality. Further research is needed, however, to better understand the cause and effect relationship between displacing one natural gas power plant within a reliability subarea and power generation from other natural gas power plants within the same reliability subarea.

Resilience: There is significant value in backup energy and it is locationally dependent due to differing power outage risks. This value also largely depends on the value of the energy service being sustained during the outage, which this project does not analyze for specific critical facilities. The results reinforce the notion that CPA and other Community Choice Aggregators should consider the added benefit of resilience when comparing project proposals. Even within the local territory, there are significant differences in value provided by rooftop solar and storage systems. These results should not be used when making investment decisions, however, the methodology can be used utilizing site specific data.

Greenspace and Habitat: Land use impacts from photovoltaic development vary based on the land use of the existing space and the availability of habitat and greenspace near the area of interest. Vacant land, disturbed land, and parking lots that can be converted to greenspace or habitat in areas of high greenspace and habitat need present higher levels of land use conflict and should be avoided for photovoltaic development. Areas of lower habitat and greenspace need present lower levels of conflict, with lowest conflict for the roofs of existing buildings in these areas. These lower conflict opportunities are recommended for investigation for photovoltaic development.

Key Recommendations

- ***Focus capacity procurement efforts on the Western Los Angeles Basin reliability subarea*:** Focus procurement efforts on this region to maximize the possibility of displacing natural gas generating capacity located within or near CPA's service territory.
- ***Add the value of resilience to the benefits of critical facility solar + storage projects:*** Expand procurement of critical facility solar + storage systems when the value of resilience is greater than the cost of islanding and the net present value of the project as a whole is positive.
- ***Prioritize development within the built environment on building roofs and parking lots:*** Screen potential project locations against existing and potential habitat and greenspace, and avoid interference with those areas where habitat and greenspace are already limited.

1. Objectives

Objective 1 *Define "multiple-benefit, local clean energy"*

Through literature review, industry interviews, policy analysis, and the results discussed in this report, we will define "multiple-benefit local clean energy" for the clients use and for other relevant entities to adapt the definition for their clean energy efforts.

Objective 2 *Evaluate three benefits of multiple benefit local clean energy: improved air quality via emissions displacement, greenspace and habitat benefit from lower impact development, and resilience against power outages for critical facilities with solar and battery storage*

Air Quality: We explored opportunities to improve local air quality by displacing natural gas generating capacity with battery storage. To do so, we first analyzed local reliability regulation to identify where natural generating capacity can be displaced with battery storage without disrupting reliability standards. We then analyzed power market dynamics to identify which natural gas power plants located within or near CPA's service territory are most vulnerable to displacement. Lastly, we conducted a health impact assessment to determine the potential value of displacing any of the power plants that were identified as most vulnerable to displacement.

Resilience: The term resilience is used to mean backup power during an electrical outage, and the critical facilities of interest include community and municipal buildings that do not already have backup power. A literature review was conducted to determine equations for the cost of an outage and value of resilience. Historical outage data at the community level was then collected and analyzed to understand outage durations, frequency, and causes for the communities that CPA serves. The value of resilience could then be calculated for a generic building in each community. A benefit transfer method was used for the building's cost of unserved energy—a key parameter in the value of resilience calculation.

Greenspace and Habitat: We assessed potential land use conflicts caused by developing small-scale solar installations. To do so, we created a development impact matrix via The Nature Conservancy's methodology, industry interviews, and municipal zoning policy. We determined analysis inputs and criteria for the matrix by analyzing land use categories and also greenspace and habitat need. The results of this matrix were overlaid on Clean Power Alliance's service territory to highlight land use impact considerations when assessing potential project locations.

Objective 3 *Develop spatial datasets to aid in identifying opportunities to achieve multiple benefit local clean energy in CPA's service territory and provide procurement strategy recommendations.*

The evaluation of each benefit category, especially land use impacts, included spatial data analysis throughout the service territory. The results of the spatial analysis will be provided to CPA to further their procurement strategy.

2. Significance

Electricity load serving entities (LSEs) such as Community Choice Aggregators (CCAs) and Investor Owned Utilities (IOUs) are expanding their portfolios of clean energy resources through long-term power purchase agreements (PPAs) to meet California's Senate Bill 100 policy goal of having renewable energy and zero-carbon resources supply 100 percent of electric retail sales by 2045. Most utility scale renewable energy projects are located remotely in large centralized developments, but there are opportunities to develop smaller utility scale energy resources locally, within and near load centers. Procuring energy from local sources appears considerably more expensive. A recent request for offer (RFO) by CPA for local clean energy received bids that were three to five times more expensive than remote, utility scale projects outside of CPA's service territory. However, the additional cost can be justified through strategic siting and design that helps realize additional benefits. Among these benefits are improved air quality, enhanced energy resilience, and low-impact environmental design. Clean Power Alliance (CPA) and other LSEs need more information about the benefits of local development and how to adapt their siting strategy to achieve these benefits.

There are many criteria to consider when thinking about locating clean energy resources. For instance, in California, there is a "Local Capacity" requirement. This regulation requires a certain amount of locally sited energy generation to ensure that sufficient energy is available if a critical transmission line goes down.[6] Many local natural gas plants will remain active if local clean energy does not meet local capacity requirements.[7] Apart from this explicit need for local generation, energy providers and policy makers see many co-benefits of local[3] clean energy that do not appear in project proposals. These include local jobs, energy savings targeted to disadvantaged communities[4], increased stakeholder involvement in decision-making, reduced need for transmission lines, ambient air quality improvements and the associated health benefits from displacing fossil fuel generation[8], reduced environmental footprint, and resilience against electrical outages.

Given these potential benefits and the need for local capacity, power providers like Community Choice Aggregators are increasingly interested in investing in local clean energy resources like solar PV and battery storage.[9] Policies around the world also tend to favor local generation,[10] which can add monetary incentives or legal requirements for CCAs to procure locally. Medium-scale PV systems that are ground mounted on undeveloped land within the service territory, or installed on a large customer rooftops are examples of what CCA procured local generation might look like. This is distinctly different from "behind-the-meter" customer owned rooftop solar or batteries, the most commonly talked about distributed energy resources.

CCA's are actively pursuing these opportunities but do not have the information to maximize net benefits or prioritize developments within the local geography. This project will address that information gap and

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[3] Also known as decentralized, distributed, dispersed, or embedded generation. In this case, "local" is defined as within the service territory of the energy provider.

[4] See background section below titled "Disadvantaged communities and CalEnviroScreen" for an explained definition of disadvantaged communities, per the California EPA.

will also benefit other power purchasing entities that face similar challenges of assessing opportunities for developing new local clean energy resources.

3. Background

Before introducing the background for each of the three benefit categories, it is necessary to discuss the structure of Community Choice Aggregators along with the motivations and goals of Clean Power Alliance and The Nature Conservancy in the clean energy sector. The background section will then present relevant policies and legislation within the California energy sector followed by a brief review of the cost difference between the different scales of PV and storage developments. The discussion of cost trends and the higher cost of local development leads to an introduction of the benefits of local clean energy that may compensate for the higher face value cost. There are many additional considerations when assessing local clean energy including targeted savings to disadvantaged communities (DACs), electricity network capacity, and jobs. The discussion of other considerations then sets the stage for backgrounds specific to the analysis of air quality, critical facility resilience, and low-impact land use.

3.1 Community Choice Aggregation

Community choice aggregations (CCAs) allow municipal governments to procure their own energy mix on behalf of their residents while continuing to use the transmission and distribution infrastructure of the incumbent investor-owned utility.[11] CCAs form in the territory of Investor Owned Utilities (IOUs) and not in the territory of Publicly Owned Utilities (POUs), as ownership and management of power procurement is already local in POU territory.[12] This increased level of control over power procurement is attractive to communities looking for reduced electricity costs and/or cleaner energy sources and other community priorities. In California, CCAs have played a significant role in meeting the demand for clean energy beyond what is required by California's Renewable Portfolio Standard (RPS).[13] CCAs increase leverage when negotiating deals with power suppliers by aggregating demand from an entire municipality (Single Jurisdiction model), or multiple municipalities as is the case with Clean Power Alliance (Joint Powers Authority model). The increase in local autonomy over energy supply that CCAs provide spurs an interest in exploring the benefits local energy procurement can have for the community, apart from cleaner electricity supply or more affordable rates. In a National Renewable Energy Lab (NREL) study that conducted 12 interviews with CCAs and CCA stakeholders, all CCA interviewees reported high levels of interest from both the CCA and their customers in developing solar locally.[14]

3.2 Clean Power Alliance

The Clean Power Alliance aggregates demand across 32 member jurisdictions in Southern California.[15] This is done through a Joint Powers Agreement (JPA). CPA states in their JPA that it will offer an electricity portfolio that has greenhouse gas (GHG) emissions lower than that of Southern California Edison (SCE), the IOU in CPA's service territory. It also states other goals such as providing cost savings, promoting public health, providing economic benefits to the communities it serves, and ensuring that low-income communities are positively affected.[16] In June 2020, CPA released a Local Programs Strategic Plan that outlines CPA's efforts to bring the benefits of clean energy development locally[17]. CPA defines "local" to be within their service territory. There are several resilience and local procurement programs recommended in this plan that align with the objectives of our report. These include (1) "clean energy generation and storage at essential community facilities", (2) customer partnerships "to utilize storage systems for demand response, reliability, and/or resiliency" (6) community solar projects in disadvantaged communities resulting in bill discounts for qualifying customers.[18] CPA is recognized as an industry leader by incorporating environmental siting criteria in their Request for Offers (RFOs).[19]

3.3 The Nature Conservancy

The Nature Conservancy (TNC) is a global nonprofit organization working to create a world where people and nature thrive. TNC's mission is to conserve the lands and waters on which all life depends. To address climate change, TNC supports the deployment of renewable energy that provides communities with reliable, low-cost, low-carbon electricity while avoiding or minimizing environmental impacts. In California, TNC has partnered with a wide range of stakeholders to develop a collaborative and science-driven approach to the siting of renewable energy.

One of TNC's strategies involves working with energy purchasers to incorporate environmental stewardship principles and criteria into procurement. California Community Choice Aggregators (CCAs) emerged as natural partners in this process due to the environmental goals inherent in the CCA design[20]. CPA, the largest CCA in California, is rapidly expanding and thereby ramping up their energy purchases. Having already supported CPA on an approach to integrating conservation information into procurement decision-making, TNC is now exploring additional collaborative engagements with this electricity provider.

Recent reports from TNC have explored the pathways for renewable energy advancement in low-impact areas of California and determined the economic advantages of avoiding highly biodiverse lands for development. These reports focus on utility scale development in the California desert, where the solar resource is greatest and the largest PV plants are located[21]. As CPA wants to procure locally (within their service territory), the methods for identifying lower impact renewable energy development can still be applied using more urban-focused data. Advancements in energy technology and the transmission grid are creating opportunities for increasing deployment of DER. Furthermore, as detailed throughout this report, these local developments allow CPA to provide additional benefits to their customers. The Nature Conservancy is interested in providing recommendations for consideration of wildlife habitat, biodiversity, and other land use considerations within urban areas as they also recognize the contribution of nature to other public health benefits.

3.4 Relevant Legislation and Associated Programs

California Senate Bill 100 (SB 100) was approved in September of 2018 setting new mandates for the State's Renewables Portfolio Standard program (RPS).[22] SB 100 sets a target for California's renewable energy and zero-carbon resources to supply 100% of electric retail sales to end-use customers and 100% of the electricity procured to serving state agencies by December 31, 2045. The RPS program is continually increasing renewable energy procurement requirements for the State's load-serving entities and generation must be procured from RPS-certified facilities. As defined in the RPS Eligibility Guidebook[23], for facilities to earn certification to participate in the RPS program, they must meet eligibility requirements regarding the energy resource type used, location, metering techniques, and many other criteria to decrease GHG emissions. Community Choice Aggregators, such as Clean Power Alliance, have set ambitious clean energy procurement targets that will contribute to goals of SB 100 and invest in RPS-certified projects.

California Assembly Bill 1628 (AB 1628) addresses generations of environmental injustices towards people of color, low-income residences, tribal communities, and other marginalized populations throughout California's history.[24] Signed into Law in November of 2019, AB 1628 works to ensure that "populations and communities disproportionately impacted by pollution have equitable access to, and can meaningfully contribute to, environmental and land use decision making, and can enjoy the equitable distribution of environmental benefits." The Bill amends the Public Resources Code's definition for "Environmental Justice" to include the reduction and elimination of disproportionate pollution burdens. This report addresses the potential for DER to reduce air pollution burden, electricity bill-savings, and cost-reductions for development of DER in disadvantaged communities.

Assembly Bill 1550 was passed requiring a minimum of 25% of California's cap-and-trade funds be allocated to projects *located in* disadvantaged communities.[25] CPUC Decision 18-06-027 then created three programs to increase access to clean energy for DACs.[26] Of the programs, this report will focus on Community Solar Green Tariff (CGST)[27]. The CPUC Decision permits Community Choice Aggregators to develop and implement their own CSGT programs by filing a Tier 3 advice letter to the CPUC. Clean Power Alliance submitted an advice letter to CPUC that was approved in November of 2020.[28] Clean Power Alliance's Community Solar Green Tariff Program (CGST) program will be discussed in this report for its benefits to low-income and DAC households in CPA's service territory.

The CPUC's Community Solar Green Tariff Program (CGST) allows low-income customers in DACs to access clean energy with a 20% cost reduction on electricity bills.[29] The customers benefit from solar generation projects located *within* the communities where the power is used. Specifically, the subscribing residential DAC customer must be located within 5 miles of the generation project. CSGT requires participation of a community sponsor to host the project (a community based organization or local government entity). CPA has a 3.13 MW allocation for this program.[30] Of the Community Choice Aggregators in Southern California Edison's Service Territory, CPA serves the largest share of DAC residents.[31] This report will further address CPA's procurement decisions to capture these benefits for DACs.

3.5 Economies of Scale in Solar PV and Battery Storage

The per energy unit cost of solar photovoltaics and lithium-ion battery systems decreases with scale. This underlies the costs associated with procuring local energy resources. In theory, if the additional cost of a smaller system is greater than the additional benefits, then the net benefit is negative and the project should not be pursued. Research and resulting data give a sense of what the additional costs are for smaller systems. Examples are presented below.

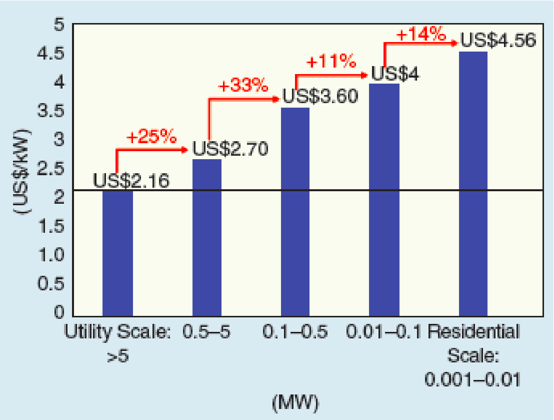


Figure 1: Incremental Cost of Solar Photovoltaic Systems (2018 US$/kW-ac)
Figure from Burger et al., 2019. Data from Feldman et al., 2018.[32]

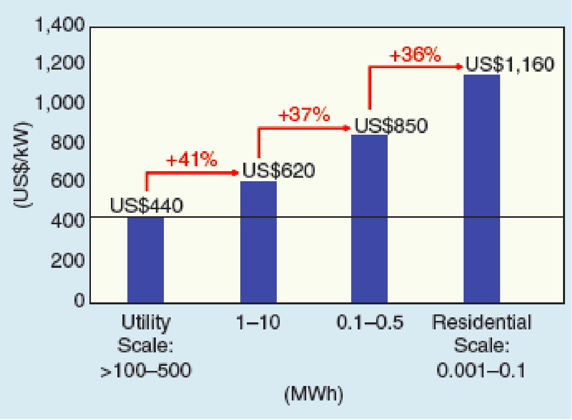


Figure 2: Incremental cost of lithium-ion battery systems (2017 US$/kwh)
Figure from Burger et al., 2019. Data from Lazard, 2017.[33]

Figure 1 and Figure 2 demonstrate the additional cost that might be expected as system size goes down. While economies of scale are substantial as the size moves to residential scale, it should be noted that economies of scale for solar PV asymptotes once the systems reach single digit MW capacity. Therefore, medium size systems (this project considers the scale of 250 kW - 10 MW) may approach the cost efficiency of much larger systems (100 MW+).

Lazard's annual levelized cost of energy and levelized cost of storage of 2020 provides an updated depiction of relevant cost comparisons. Comparing subsidized PV resources, the levelized cost of community PV ranges from 60-90 $/MWh and rooftop C&I PV ranges between 66-161 $/MWh. This is compared to the 24-35 $/MWh of utility scale PV.[34] Comparing unsubsidized storage resources, the levelized cost of residential Solar + storage ranges from 406-506 $/MWh and commercial and industrial solar + storage ranges from 247-319 $/MWh. This is compared to the 81-124 $/MWh of wholesale solar + storage .[35]

It is clear that the costs of developing small scale solar and storage are significantly greater than those of large scale. In October 2019, CPA launched a distributed energy request for offer (RFO). The request was "open to front of the meter renewable energy and storage projects less than 10 MW located in Los Angeles or Ventura counties"[36]. The projects that bid into the solicitation were three to five times more expensive than remote, utility scale projects outside of CPA's service territory. In response to these offers, CPA did not move forward with the projects submitted in this RFO. This serves as an example of the cost-disadvantage facing local clean energy development. However, development costs are not the full picture. The inclusion and valuation of co-benefits helps create a more complete understanding of the value of local clean energy development.

3.6 Other Benefits of Local Clean Energy Resources

This project's investigation of improved air quality via emissions displacement, lower-impact land use, and resilience against power outages covers only part of the picture. Other benefits of local clean energy resources include job creation, targeted savings to disadvantaged communities, reduced network losses, and deferred infrastructure upgrades.

Community Choice Aggregators are particularly interested in local job creation and economic development as differentiators from IOUs.[37] As such, CPA prioritizes projects that involve Project Labor Agreements. Size of the system aside, a high percentage of the jobs associated with solar PV are at the installation and maintenance phases, nearly 30% and 15% respectively according to one study.[38] This indicates that the location of installation determines where a substantial proportion of the jobs will be created. Comparing large centralized systems to smaller distributed systems, Clack et al. (2020) finds that distributed solar creates an average of 8.3 jobs per MW of electricity rate compared to utility scale solar's rate of 3.3 jobs per MW. These numbers are U.S. wide and "are tied to basic assumptions from NREL's JEDI and the IMPLAN modeling tools, adjusted further by actual jobs numbers provided in the Solar Foundation's annual solar jobs report."[39] Given that this report was funded by advocates of local solar, those employment numbers should be taken with caution. A comprehensive literature review of employment factors for wind and solar that was published in 2015 acknowledged that the installation labor requirements of small-scale solar is generally different from that of large-scale solar but found insufficient data to distinguish employment factors between the two.[40]

Targeted energy savings to disadvantaged communities are another component of economic development, in addition to jobs, that local clean energy resources may be able to provide. There is a widespread distributional energy justice issue on the consumption side of electricity with regard to the financial burden that low-income households bear in comparison to higher income brackets.[41] Targeting solar programs to disadvantaged communities have been shown to mitigate this issue in rooftop solar adoption.[42][43][44] Community solar can also provide targeted cost savings, with larger systems providing more opportunity for savings.[45] The California Center for Sustainable Communities developed a Solar Prioritization tool for Los Angeles County and found that disadvantaged communities tended to have higher potential for meeting all consumption with solar generation. However, they also found that those same communities are the most susceptible to export curtailments—likely the result of historically less grid infrastructure investments.[46] This means that circuit upgrades are an important factor for reaching penetration capacities in disadvantaged communities.

More important to utility operators than to Community Choice Aggregators, the locational value of energy can make Distributed Energy Resources (DERs) a priority over their more affordable per-unit counterpart, centralized resources. Locational value can be defined as the value of electricity services that changes with the location of the resource. Burger et al. (2019) identifies three electricity services that provide the bulk of locational value. These services include energy delivery—avoiding the network losses from generation to end-use; network capacity—deferring investment in upgrades to the grid by relieving line congestion; and reliability—energy resources that are available during a grid failure.[47] Initial penetration of DERs can reduce transmission losses if implemented in locations that experience times of high loading on the distribution grid. These are dense, urban locations where it is inefficient to connect less expensive energy resources[48] and at times of peak load.[49] This value can reach $96 per kW of line capacity added.[50] However, this marginal value decreases as penetration in that area increases and there is less strain on lines. To avoid new network capacity, PG&E found that on 10% of their feeders, solar PVs could defer new capacity at a value of $10-$60 per kW-year of solar capacity deployed.[51] However, similar to the marginal benefit of avoided delivery losses, these benefits fell by 50% after PV capacity reached 50% of peak demand at the feeder.[52] At the scale of the whole United States, a model introduced in Clack et al. (2020) finds that deploying more local solar and storage than business-as-usual projections is the most cost effective path to achieving net zero emissions.[53] This is largely driven by network system cost savings.

Cost savings in the electrical grid network, targeted savings to disadvantaged communities, and job creation are three benefits of local clean energy that were not analyzed as part of this project. The following sections provide background on the benefits analyzed.

3.7 Greenspace and Habitat Benefit from Lower Impact Development

The increase in low carbon energy development necessary to meet California's (CA) greenhouse gas reduction goals has been well studied from the perspective of technological feasibility[54] whereas the potential ecological impact and natural resource constraints have only recently been considered[55]. While low carbon energy generation presents environmental benefits in the form of greenhouse gas reduction and improved regional air quality, local effects from physical siting of facilities can negatively impact habitat, connectivity, wildlife, and water quality. These impacts arise from developing on undisturbed or lightly disturbed land and from the danger to wildlife presented by energy infrastructure[56]. Careful planning is necessary to avoid these impacts because renewable energy projects are more land intensive than fossil fuel generating projects, and are constrained to areas with natural resource availability and existing transmission infrastructure[57]. However, the effects are not entirely local as land cover conversion is also a major climate change concern[58]. Environmental impact trade-offs may be necessary to meet CA's energy demand using new renewable energy resources and some argue that changes to environmental policy that reduce environmental regulations might be necessary to fast track the development process[59].

The Nature Conservancy's *Power of Place* study is a spatial analysis that characterizes lower impact opportunities for renewable energy development in the Western U.S. This analysis determined that California can achieve decarbonization with renewable energy while also limiting land impacts and increasing cost-effectiveness. Developing renewable energy resources in areas of high biodiversity value is very costly due to habitat mitigation costs and environmental review and permitting costs.[60] Solar development is less constrained than wind due to natural resource availability and is likely to dominate the grid under a strictly low impact plan. Distributed solar has a lower impact due to its smaller scale but most energy demand scenarios forecast both distributed and utility scale developments will be necessary.

Local DER in the urbanized portions of Los Angeles County may be able to avoid major siting conflicts with biodiversity and habitat concerns. TNC recognizes the value of urban biodiversity and is working to inform decision-making to prioritize biodiversity conservation in urban areas, as urban biodiversity is traditionally overlooked and understudied. To address this problem, TNC developed a framework for assessing urban biogeography utilizing citizen science data that has the potential to inform the siting and design of future infrastructure projects.[61] In another recent study, TNC identified and mapped opportunities for expanding and adding habitat in Los Angeles County to inform stormwater management decisions[62]. Datasets from these efforts can be used to develop criteria for avoiding both existing habitat and potential locations for future habitat.

The urban and suburban context of the analysis in this report introduces multiple land use needs, and presents additional development considerations. In particular, TNC wants to support opportunities for expanding urban greenspace that can serve as habitat for wildlife, public recreation, and public health benefits. The Los Angeles County Parks and Recreation Department published the Los Angeles Countywide Comprehensive Parks and Recreation Needs Assessment in 2016[63], which identified the areas with the greatest park pressure, predominantly determined by surveying available park acreage per 1,000 people. By incorporating this park need metric, solar siting decisions can ensure that recreation and other park-related benefits to the community are preserved, and potentially enhanced, in the areas where those benefits are already the most confined[64]. Furthermore, conscious park design, and efforts to improve parks, can result in increased urban wildlife habitat specifically by utilizing native plants to support birds, pollinators, and other wildlife[65].

Environmental impact from renewable energy development is a feature of both development location and project design. Areas that are generally considered higher or lower environmental impact are summarized in the table below. These recommendations are mostly compiled from reports or mapping tools developed by TNC[66] [67] [68] [69] [70]:

Table 1: Features of Higher and Lower Environmental Impact Development Categories

Higher Environmental Impact	**Lower Environmental Impact**
❑ Areas of high environmental value including: (1) rare, important, or threatened and endangered species habitat, (2) wildlife corridors and migratory stopover sites, (3) intact natural habitats such as forests, grasslands, desert, or wetlands ❑ High value agricultural lands ❑ Lands with other social and cultural value ❑ Lands that overlap with areas of high habitat or greenspace need regardless of land quality	❑ Lands that have already been significantly altered for agriculture, infrastructure, and other development activities ❑ Previously disturbed lands such as pastures, roadways, and other degraded land that does not increase fragmentation ❑ In the built environment: Rooftops and parking lots or other paved surfaces ❑ Former mines or other industrial lands ❑ Transportation and utility corridors ❑ Low productivity agricultural lands ❑ Vacant lands in developed areas

The background review of renewable energy development impact is focused on solar photovoltaic systems. We chose this focus due to constraints within CPA's service territory. A vast majority of the opportunity space, Los Angeles County, prohibits utility scale wind development[71], and land use impacts from battery storage systems are considered immaterial. PV arrays generate roughly 8.1MW/acre[72] [73], and a majority of projects being considered for both the energy resiliency and Community Solar Green Tariff programs are around 250kW-500kW, requiring a footprint of 2-4 acres. In comparison Tesla mega pack batteries provide 250MW on a three-acre footprint[74].

Zoning

Zoning policies referring to renewable energy development vary throughout CPA's service territory. A review of municipal policies in CPA's member jurisdictions have very little guidance on renewable energy development, and guidelines, where they exist, tend to be geared toward project design aesthetics (Appendix C).

Los Angeles County considers all solar development over 2.5 acres to be utility scale, and utility scale solar development is allowed on a wide variety of zones with a conditional use permit[75]. Stricter guidelines, including environmental impact considerations, are mainly geared toward ground-mounted systems.

Ventura County provides fewer opportunities for renewable energy generation for offsite use. Planning commission approval is required in the five zones where renewable energy generation is permitted in Ventura County, though solar canopies over parking lots and other paved surfaces are encouraged and solar canopies are also listed as an acceptable substitute to tree shade in landscape designs[76].

Agriculture and open space zoning in most of Ventura County is controlled by Save Open Space & Agricultural Resources (SOAR)[77]. SOAR is a nonprofit organization that was established to deter development pressure from urban sprawl, which threatens Ventura County's scenic and valuable landscape. SOAR initiatives, which were adopted by the cities of Camarillo, Fillmore, Moorpark, Oxnard, Santa Paula, Simi Valley, Thousand Oaks and Ventura, prevent re-zoning on agricultural, rural, and open space designated areas without a countywide vote[78]. SOAR initiatives were renewed in 2016 and extended until 2050. It appears that these initiatives may prevent renewable energy development.

Location & Design

Ground mounted solar arrays on undisturbed land are generally regarded as the highest impact, and their impacts are comparable regardless of scale[79] [80]. However, the degree of impact is highly dependent on features of the individual site[81]. Impacts include clearing existing ground cover, releasing carbon via soil disturbance, augmenting run-off from grading and trenching which can influence surface water quality, habitat fragmentation, and potential PV heat island effects. These impacts can be mitigated by: prioritizing previously contaminated, disturbed, and degraded lands; reducing disturbance by preventing and minimizing grading, compaction, and topsoil removal; and utilizing a ground cover to improve soil carbon cycling, minimize water run-off, and reduce PV heat island effects. Contaminated and degraded lands within CPA's service territory may be valuable for renewable energy generation[82], but only where they do not hinder potential greenspace expansion that can support biodiversity and community benefits.

Development on rooftops and parking lots in the built environment poses fewer impacts and presents opportunities. Environmental conflicts in parking lots and rooftops are low and impacts on biodiversity are negligible[83]. While rooftop arrays show no impact on urban heat island effects[84] [85], solar canopies in parking lots can reduce ground temperatures[86]. There are more considerations with parking lot arrays than rooftop arrays, such as surface run-off and drainage on paved surfaces leading to complications if they aren't graded appropriately.

Environmental Stakeholder Review

When developing solar at a local scale, there are many stakeholders to consider such as the local government, solar industry, landowners, and communities. Support, or opposition, from these stakeholders is a factor in determining project siting suitability. Public opposition can present a major obstacle when siting energy development projects, and has even halted projects altogether[87] [88] [89]. Evidence for support of local renewable energy projects is mixed and generally follows the perceived community benefit. Support for solar is highest among CA residents that perceive positive impacts as both economic and social, including compensation for local development and increasing jobs [90] [91].

In general, the environmental benefit from renewable energy is viewed as providing both a public health benefit to consumers as well as reducing further threats to the environment at large[92]. US consumers mainly believe that the most important benefit of renewable energy is environmental[93], though there is a trade-off in environmental benefits as evidenced by concerns from within the environmental community. Renewable energy projects are expected to have environmental advocates' support because of the low carbon benefits, but this support varies, and in some cases environmental communities are the strongest opposition[94] [95]. This is because renewable energy projects are more land intensive than fossil fuel projects and are sited in wide open areas that can be seen from far distances.

Due to broad support of renewable energy development nationally, local opposition to renewable projects is often characterized as "not in my backyard" (NIMBY). However, energy development research on NIMBY is inconclusive because there is some debate about what counts as NIMBY [96]. In some cases, value and identity driven opposition has been mischaracterized as NIMBY, and that assumption had dismissed opportunities to engage legitimate viewpoints or uncover complex concerns[97]. NIMBY opposition is important to consider with any development, but is typically worse in response to large industrial sites[98]. Although, attitudes about renewable energy are typically positive within industrial areas[99]. These considerations taken together might signal that NIMBY concerns are less relevant for small-medium scale development in the urban context of Los Angeles, but may present more of an issue in agricultural portions of Ventura.

3.8 Resilience Benefit from Solar and Battery Storage at Critical Facilities

The value of an individual facility's energy resilience—having backup power during an electrical outage—is highly sought after as outages are lasting longer and occurring with more frequency due to global warming induced circumstances.[100][101] This is particularly true in California, where wildfire threats have led to long Public Safety Power Shutoff (PSPS) events. There is a significant cost of these outages due to our increasing reliance on electricity dependent technology.[102]

The ability to put a value on resilience makes projects that add resilience more economically viable.[103][104] There are many project opportunities, including backup power for a critical facility or upgrades to the electricity distribution system. Regardless of the project, the goal should be to achieve optimal resilience levels by equating the marginal cost of added resilience with the marginal benefit.[105] For the purpose of this study, utility investment in more resilient transmission and distribution infrastructure will not be discussed. Instead, the stakeholder is energy providers and the projects are clean backup energy such as solar plus battery storage systems. The goal is to present a clearer view of where these projects should be added. This is generally in locations where there are abnormally frequent and long outages and the provision of electricity during those outages is highly valued.

Methodology for calculating the value of resilience begins with calculating the cost of an outage. The cost of an outage is the upper bound value of resilience. An accepted equation for the cost of an outage is multiplying the duration without power (hours) by power lost (kW) by the value of the unserved kWh ($/kWh).[106] The value of unserved kWh is also called the value of lost load (VoLL) and is the most difficult value of this equation to obtain. Key parameters that determine the value of lost load include the duration, frequency of outages, the time of day, the day of the week, the season of the year, presence of advance warning, customer type, the criticality of the energy lost, and the ability to substitute for the electricity service.[107] For example, an unexpected six hour outage on a summer Saturday will have different effects on a fire station, an office building, and a grocery store with existing backup power. How each building values the lost load is likely to change if it were a weekday and advance notice was given.

There are several methods for determining the VoLL for a given facility or jurisdiction.[108] Notable methods can be bucketed into three broad categories: the stated preference method, the revealed preference method, and the top-down economy wide approach.[109] The stated preference method uses surveys or interviews to derive values directly from electricity customers. For example, different types of electricity customers may be asked their willingness to pay for electricity in a variety of outage scenarios. This might also take the form of a customer damage function, converting the damage incurred during an outage into monetary terms. The stated preference method is considered to be one of the more effective methods. The revealed preference method uses existing data to infer valuations. An example of revealed preference would be using the cost of diesel generators to supply electricity in an outage as a proxy for the value of resiliency. Finally, the economy wide approach method uses macroeconomic indicators. An example of this would be the lost economic production during an extended outage. In non-market evaluation there is also a technique called the benefits transfer method, which involves the application of valuation results or data derived in one study to estimate the value for unstudied sites.

A benefit transfer method is utilized for our research to attain the value of lost load. This makes it less accurate than directly surveying customers of interest, but more practical for a high level analysis. Research by Nexant Inc. for the Lawrence Berkeley National Laboratory (LBNL) built a model from a meta-analysis of 34 different utility surveys conducted between 1989 to 2012 across the United States.[110] The surveys used a standard approach to gauge customer willingness to pay and therefore could be brought together to form a single model. The model outputs are presented by customer class and outage duration in a table called Table ES-1, seen in Appendix G. This model also led to the creation of the user-friendly Interruption Cost Estimator (ICE) calculator. Inputs for the ICE calculator include Customer Average Interruption Duration Index (CAIDI), System Average Interruption Duration Index (SAIFI), number of customers, type of customer, location (U.S. State), average energy usage (MWh), industry, backup capabilities, and the distribution of outages by time of day. The ICE tool was created with grid infrastructure improvements in mind[111], but has been utilized by organizations such as the National Renewable Energy Laboratory to estimate outage costs for individual facilities.[112] The majority of studies informing the LBNL meta-analysis do not regard outages longer than 16 hours and none consider outages longer than 24 hours (only 2% to 3% of all observations are more than 12 hours).[113] This shortcoming means that the estimates in the report should not be used for long duration power outages that last more than 24 hours. It is nevertheless the source of VoLL in the United States whenever a stated preference method is not used.

The National Renewable Energy Laboratory (NREL) has published several reports demonstrating how valuing resilience for critical facilities changes the economics of adding solar plus storage (PV+S). Two such studies, discussed below, use VoLL data from the LBNL report discussed in the prior paragraph and use NREL's Renewable Energy Optimization (REOpt) tool to determine optimal system sizes to maximize net present value (NPV). These studies point out how incorporating a VoLL number into new solar + storage system cost-benefit analyses adds additional monetary benefit and will make more projects economically viable and may encourage constructing larger system sizes.

NREL's New York Smart DG Hub-Resilient Solar Project focused on guiding an optimal solar + storage system for three specific critical facilities.[114] The NPV of different systems was analyzed under different scenarios such as economic savings alone or meeting resiliency needs. In depth building characteristics are used to customize the system size to meet the facility's needs. The authors also determine the exact critical loads of two of the three buildings analyzed (for the fire station they simply assumed 65% of average load) which provides useful context for critical facility resilience evaluations. First, the Senior Center is a facility that can be a cooling shelter for up to 70 people. The critical loads, which include air conditioning, lighting, and a computer, draw approximately 100 kWh/day with almost all of the load occurring during the day, assuming no AC is used at night. This amounts to an average ~10 kW critical load from 7am-5pm and an ~4 kW critical load average overall, with a peak of ~12.9 kW. Second, the School is another facility that can be used as a shelter. The critical loads of the school, which include room lighting, room AC units, and boiler room equipment, draw approximately 352 kWh/day in the summer and 432 kWh/day in the winter. This amounts to ~14.6 kW of average critical load in the summer and 18kW of average critical load in the winter. During the summer day from 7am-5pm the average kW jumps to ~21.7 kW and if every critical load is on at the same time, it hits a peak of 39 kW. These critical load values, along with building characteristics, system outage and frequency data, and other variables are input into DOE's ICE Calculator to generate a VoR.

A separate NREL study by Laws et al. quantified the effects of valuing resilience on cost-optimal solar + storage systems on a primary school, a large office building, and a large hotel in Anaheim, California.[115] This study also used VoLL values from the LBNL report. The study then determined system costs, benefits, and optimal system sizes for each customer scenario by using the ReOpt tool to balance the costs of the system, cost of electricity from the utility, and the costs of outages. Since the different customer types have different critical loads, the value of resilience differs among the three analyses. Unlike in the New York study, the critical loads of the facilities were not determined through surveys and were assumed to be 50% of average load. This study also introduces a simplified equation for the value of resilience (VoR) that is distinct from our equation of the cost of an outage introduced earlier. This equation provides a simplified alternative to using the ICE Calculator. It is more conducive to calculations that are not for an entire jurisdiction or a few specific facilities and is the methodology used in this analysis. The VoLL variables are still taken from the LNBL report, presented in Table ES-1. The VoR equation is the VoLL ($/kWh) multiplied by the annual mean load (kW) multiplied by the hours provided by the solar + storage system.

The costs of islanding a solar + storage system for critical facility resiliency must be considered when determining whether a resilient system[116] is the most economical solution. Islanding refers to an energy system that can operate independently of the grid and generate or transmit electricity when the main grid is down. Laws et al. call the added cost the “islandable premium” and present it as a percentage of the costs of the non-islandable system. Since a wide capital cost range exists for islanding a system, the authors defined a maximum cost to island that would yield a NPV greater than the non-islandable system. This is any scenario where the cost of islanding capability is less than the added savings from resiliency. The authors concluded that the islandable premium ranges from 3-21% of the costs of the non-islandable system. This premium varies greatly between sites and therefore requires site specific data when assessing if an islandable system is the best choice.

Critical facilities traditionally use diesel generators for backup power generation during an outage. Placing a value on resilience is relevant for any backup power supply, however, diesel generators are not an ideal solution for several reasons. First, they produce harmful local air pollutants and greenhouse gases. Second, they are not used for the majority of their lifetime. Third, the large upfront costs of diesel generators, combined with maintenance and fuel costs, can be a financial burden and thus they are only installed by facilities such as hospitals that have particularly high load criticality. solar + storage systems are expensive but they are clean and can provide value even when there is no outage with load management.[117] Power providers can use an aggregation of solar + storage systems as virtual power plants during normal operations to balance load and thus provide value beyond their ability to serve as backup power.

Community Choice Aggregators are among the entities that can take advantage of the dual benefits of PV+S. Critical facilities that do not already have backup generators are of particular interest for CCAs given the public service benefits. This is an important distinction when considering a CCA’s provision of backup storage because the value only goes to the facility where it is located. Therefore, to avoid CCA expenditures going to private customers, the facility should provide a public service. Examples of critical facilities identified are waste-water treatment facilities, first-responder buildings, and community centers. CPA is implementing a Clean Back-up Power for Essential Facilities Program (Power Ready) to provide one critical facility in each of the 32 member organizations clean backup power. CPA is currently conducting a feasibility study with a 3rd party engineering consultancy to assess which critical facilities within each member jurisdiction would reap the most benefits from installing PV+S.[118][119] These backup systems will be distinct from those incentivized by California’s Self Generation Incentive Program.[120] They will be owned by CPA and operated as a grid connected load service during normal operation. In the event of an outage, the battery will be capable of islanding and serve as clean backup power for the critical facility. In this application, local solar + storage provides multiple benefits. It can displace emissions at the grid scale by using stored renewable energy during peak hours, and it can provide critical power without any harmful emissions during outages.[121]

3.9 Air Quality Benefits from Natural Gas Power Plant Displacement

Health Impact of Natural Gas Generators

In 2019, natural gas power plants accounted for nearly 43% of California's in-state electricity generation and over 99% of all in-state fossil-fuel based electricity generation[122]. Natural gas power plants are relied on so heavily in California because they are inexpensive to operate and emit low quantities of pollutants and greenhouse gases, relative to other fossil fuel-based power plant-s[123]. Natural gas power plants are also firm and dispatchable resources that are much needed by grid operators to smooth out differences in electricity supply and demand and maximize grid reliability[124] Nevertheless, there are negative impacts associated with natural gas power plants that raise concerns about their prevalence in California.

While natural gas power plants have low environmental impact relative to power generation from oil and coal, they still emit harmful pollutants when generating electricity. Natural gas power plants emit sulfur dioxide (S2O), nitrogen oxides (NOx), and particulate matter 2.5 (PM 2.5), among other pollutants when generating electricity[125]. Unlike greenhouse gases, which have a global impact, pollutants emitted from a natural gas power plant impose damage on the local environments and populations that are exposed to them. This exposure translates into health impacts that include, but are not limited to, increased rates of acute coronary events, asthma-related hospital visits among children, and overall negative health impacts on the elderly.[126] Studies that have converted such impacts into monetary damages have concluded that the average natural gas power plant in the United States imposes an annual cost of roughly $1.49 million on communities that are exposed to its pollutant emissions[127].

While it is challenging to pin-point exactly who is exposed to pollutant emissions from a single smokestack, research has shown that there is a correlation between living in proximity to power plants and experiencing some of the negative health impacts listed above. Specifically, research has shown a correlation between living near power plants and increased hospital visits among the elderly, asthma related hospital visits, and preterm births[128] [129] [130]. These findings have strong implications for natural gas power plants located in high-density areas, such as those in downtown Los Angeles, as they are likely imposing such damage on very many people. These findings are also especially concerning given research that has concluded that "California's power plants are disproportionately located near communities with high cumulative socioeconomic and environmental burdens."[131] Specifically, 42% of peaker plants in California are located in the most disadvantaged 30% of communities.[132] For these reasons, the Clean Power Alliance is interested in finding ways to displace natural gas power plants with clean alternatives.

Displacing Gas-Fired Generation with Battery Storage

The Clean Power Alliance has a unique opportunity to displace natural gas power plants with battery storage and improve air quality in Southern California. Contrary to natural gas power plants, battery storage does not emit greenhouse gases or pollutant emissions when generating electricity. For this reason, battery storage is a favorable alternative to natural gas power generation in high-density areas, where pollutant emissions are especially damaging. So long as the electricity that is used to charge a battery comes from remote or clean energy resources, battery storage offers high-density areas a clean alternative to natural gas power generation.

CPA can leverage its wholesale electricity purchasing power to procure battery storage in strategic locations so that it displaces natural gas generating capacity located within or near its service territory. Understanding how this mechanism works requires an understanding of reliability regulation and the California power market. Reliability regulation that governs the California power market by-and-large dictates where natural gas generating capacity can and cannot be displaced with battery storage. Similarly, as a sole participant within a competitive power market, CPA's ability to displace a natural gas power plant is limited by greater market forces. The following sections provide a brief overview of the way that reliability regulation and the California power market influence the displacement of natural gas generating capacity with battery storage.

California Reliability Regulation

The California power sector is governed by strict federal regulation, much of which is intended to maximize the reliability of the electric grid. The Department of Energy formally defines reliability as the ability "to meet the electricity needs of end-use customers even when unexpected equipment failures or other factors reduce the amount of available electricity."[133] While there are many standards that govern the reliability of the power sector, the Department of Energy has distilled them down into four informal "reliability rules" that broadly capture all federal requirements[134]:

1. Power generation and transmission capacity must be sufficient to meet peak demand for electricity
2. Power systems must have adequate flexibility to address variability and uncertainty in demand (load) and generation resources
3. Power system must be able to maintain steady frequency
4. Power systems must be able to maintain voltage within an acceptable range

The integration of new power generation resources such as photovoltaic solar panels and battery storage on the electric grid pose a challenge to these rules[135]. If new resources are not integrated carefully when deployed at mass, they will likely threaten grid reliability by breaking one, if not all four of the rules listed above. Thus, these four rules have significant influence over whether clean energy resources such as photovoltaic solar panels and battery storage can displace traditional power generating resources like natural gas power plants.

While these rules are set at the federal level via regulation and standards, they are uniquely implemented and monitored by a variety of regional organizations across the United States. For the vast majority of California, including the entirety of CPA's service territory, the California Independent System Operator assumes this responsibility. The California Independent System Operator, formally known as the CAISO, is a non-profit organization that "manages the flow of electricity on high-voltage power lines, operates a wholesale energy market, and oversees infrastructure planning."[136] While coordinating these activities, the CAISO is bound to statutory obligation to ensure that the four reliability rules listed above are upheld[137].

Transmission Constraints & Load Pockets

The CAISO's obligation to maintain grid reliability often manifests in regulatory requirements, some of which influence how clean energy resources are integrated into the electric grid. One such requirement is born out of transmission constraints that limit the amount of electricity that can flow into highly populated areas from remote power plants[138]. In such areas, which are commonly referred to as load pockets, electricity demand occasionally exceeds the amount of electricity that transmission lines can bring in. If left unaltered, load pockets would frequently experience a supply deficiency, resulting in significant disturbance to grid operations and violation of federal reliability regulation.

When large scale transmission projects are too expensive to remediate the reliability challenges posed by load pockets, grid operators turn to local power generating resources to do so. Power generating resources located within a load pocket can connect directly to local distribution lines, bypassing the transmission constraints that cause reliability concerns. This allows them to contribute electricity supply to the load pocket even when transmission lines leading therein are at full capacity. Grid operators utilize these power generating resources to account for the difference between electricity demand within a load pocket and transmission capacity leading therein[139]. This creates an effective distinction between power plants located within and outside of a load pocket. Whereas the former can mitigate supply deficiency concerns within a load pocket, the latter cannot. For this reason, local power generation is an essential component of a reliable electric grid.

The CAISO & Local Capacity Requirements

Within its jurisdiction, the CAISO has identified two separate tiers of load pockets: reliability areas and reliability subareas. The distinction between the two is largely a matter of size; the footprint of a reliability area is much larger than that of a reliability subarea, and the latter is generally a subset of the former. While both are relevant for this study, reliability subareas present greater opportunity to pin-point power plant displacement within or near CPA's service territory, and thus are the focus of this analysis. Figure 3 below depicts reliability subareas located within or near CPA's service territory.

Figure 3: Reliability Subareas In or Near CPA's Service Territory

By the very nature of being load pockets, reliability subareas are transmission constrained and thus require power generating capacity located therein to mitigate reliability concerns. The CAISO conducts significant modeling to ensure that all reliability subareas have sufficient power generating capacity located therein. In its annual *Local Capacity Technical Report (LCTR)*, the CAISO reports the minimum amount of power generating capacity needed within each reliability subarea to ensure grid reliability. This value, which the CAISO refers to as a “local capacity requirement,” serves as authority for each reliability subarea. A reliability subarea must have at least as much power generating capacity located therein as its local capacity requirement.[140]

While there are coordinated market mechanisms that regulatory bodies use to ensure that all local capacity requirements are met, they are not foolproof. For this reason, the CAISO reserves the right to force power plants to stay online through what is known as a “Reliability Must Run” contract.[141] As the name implies, the CAISO uses such contracts to force a power plant to stay online to mitigate any reliability concerns that would arise if it didn’t. The CAISO typically deploys this mechanism when a power plant is needed to meet local capacity requirements but has requested to go offline, often because it has been pushed out of the power market. In this sense, local capacity requirements serve as the backbone of a regulatory mechanism (RMR) that dictates whether a power plant can be decommissioned.

In response to statewide interest in decarbonizing the electricity sector, the CAISO’s most recent LCTR also provides guidance on where battery storage can displace natural gas generating capacity without disrupting reliability standards. For each reliability subarea, the CAISO explicitly reports the maximum amount of natural gas generating capacity that can be displaced with battery storage. This value, which is determined based on battery charging limitations that are detailed in the report, dictates whether natural gas generating capacity can be displaced with battery storage in any given reliability subarea. Like local capacity requirements, displacing more natural gas generating capacity with battery storage than the CAISO has deemed suitable would trigger a RMR.

California Power Market

The California power market is a deregulated market that is managed by the CAISO[142]. The term "deregulated" is used here because, unlike regulated markets, California's power market is infused with market principles that allow for competition in electricity generation, transmission, and retail sales. Despite what the name implies, deregulated power markets require significant oversight to ensure that supply and demand are within a small margin of error at all times and that power generating resources are deployed in an economically optimal manner. For 80% of California, the CAISO provides this oversight by coordinating the wholesale electricity market and centrally dispatching power plants[143].

In each of the markets that exist for electricity generators, location and cost of electricity production largely determine whether the CAISO will ultimately dispatch a power plant to generate and sell electricity.[144] This allows the CAISO to maximize grid reliability and minimize electricity prices, respectively. Due to transmission constraints, location is an especially important consideration when dispatching power plants to meet electricity demand within reliability subareas. As mentioned above, only power plants located within a reliability subarea can satisfy demand when it exceeds transmission capacity leading therein. In terms of the power market, this means that only power plants located within a reliability subarea are eligible to compete for electricity demand therein when it exceeds transmission capacity. It is believed that this dynamic effectively creates local power markets within reliability subareas, where competition is generally limited to only those power plants that are located therein.

When power generation is demanded within a transmission-constrained area, such as a reliability subarea, the CAISO generally dispatches power plants located therein in order of ascending marginal cost of electricity production[145]. Power plants with the lowest marginal cost of electricity production are dispatched first, whereas power plants with the highest marginal cost of electricity production are dispatched last.[146] The CAISO dispatches power plants in this order until the local market equilibrium is achieved (supply is equal to demand). Power plants with costs of electricity production above the local market equilibrium are not dispatched.

Understanding this market mechanism provides insight into how adding battery storage to a reliability subarea can displace power generation from natural gas power plants located within the same reliability subarea. Adding battery storage to a reliability subarea increases the total amount of power generating supply that the CAISO can dispatch to satisfy local electricity demand, when needed. So long as the battery storage system can outcompete some of the natural gas power plants within the reliability subarea, it would push some natural gas generating capacity above the average market equilibrium. If a natural gas generator is consistently kept above the average market equilibrium, it can be thought of as being pushed out of the local power market, as it is no longer competitive therein.

CPA's Displacement Mechanism

As is described above, regulatory and economic forces have significant influence over whether a natural gas power plant can be displaced with battery storage. A natural gas power plant is only likely to be displaced if it is located within a reliability subarea that can forgo natural gas generating capacity without disrupting reliability standards. Similarly, a natural gas power plant is only likely to be displaced if it has a high cost of electricity production relative to the power plants that it competes against. It is believed that transmission-constrained, reliability subareas effectively create local power markets, in which competition is generally limited to only power plants located therein. If this assumption holds true, CPA can leverage its wholesale electricity purchasing power to push natural gas generating capacity out of local power markets.

CPA can displace a natural gas power plant by siting battery storage in a reliability subarea where (1) natural gas generating capacity can be displaced without disrupting reliability standards and (2) some power plants have a high relative cost of electricity production. In doing so, CPA would increase the supply of power generating capacity located within the reliability subarea and effectively push the higher-cost power generating resource away from the average market equilibrium. While this is not guaranteed to displace a natural gas power plant, it is likely to have a negative financial impact on the higher-cost power generating resources located within the reliability subarea. At the very least, being pushed further above the average market equilibrium is likely to reduce emissions from the power plant, as it would be dispatched by the CAISO less frequently.

3.10 Disadvantaged Communities & CalEnviroScreen

As introduced in the legislation background section of this report, California Senate Bill 535 defines disadvantaged communities (DACs) as “disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation” *or* “areas with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment.”[147] Since 2018, CalEPA has used the CalEnviroScreen 3.0 algorithm to score communities on the aforementioned criteria and identify the 25% highest scoring census tracts to designate as DACs[148]. The results of the CalEnviroScreen algorithm were used to create mapping layers and generate an interactive map that includes specific details for each census tract in California. CPA has identified that “34% of the 294 zip codes in CPA service territory either entirely or partially contain census tracts identified as Disadvantaged Communities.”[149] Solar energy installations in DACs have the potential to benefit the community in both economic welfare and public health. Distributed renewable energy production and battery storage provides communities the opportunity to displace fossil fuel power plants in those areas. By replacing these plants with solar installations, the community can gain the benefit of approximately 1.4 cents per kilowatt hour in environmental and public health benefits.[150] These benefits may be greater in DACs as the negative impacts of air pollution are higher than the average and these areas are often located near pollution-producing operations. Within CPA’s territory, gas-fueled power plants in or near DACs have been retired or have requested retirement in recent years. Without ensuring that there are energy resources in place to meet the demand for electricity, such as solar + storage, these plants could be restarted and again contribute to the pollution burden in these DACs. Alternatively, if these plans are retired and there are not adequate replacements in place, there would be a lack of resilience in the communities that tend to be at the highest risk if they lose power. The air quality and emissions displacement discussion of this report will further address increasing solar + storage by using CalEnviroScreen 3.0 map layer to strategically site energy resources that benefit census tracts with the highest CalEnviroScreen 3.0 Scores.

4. Methods

Conducting a complete cost-benefit analysis of local clean energy would be the ideal methodology, however, covering all the costs and benefits is out of this project's scope. Instead, the analysis is focused on the three benefit categories of air quality, resilience, and land use. These benefits were analyzed separately from one another given their distinctness.

4.1 Air Quality

This study aims to identify opportunities for CPA to displace natural gas power plants within or near its service territory, reduce pollutant emissions, and improve local air quality. As is referenced in the background section above, this requires consideration of reliability regulation and power market forces. A natural gas power plant is only likely to be displaced with battery storage if it is located within a reliability subarea that can forgo natural gas generating capacity without disrupting reliability standards. Further, a natural gas power plant is only likely to be displaced if it has a high cost of electricity production relative to all other power plants located within its respective reliability subarea. In this sense, the goal of this analysis is to identify power plants within or near CPA's service territory that are also located in a favorable reliability subarea and have a high relative cost of electricity production.

Identifying opportunities to displace natural gas power plants located within or near CPA's service territory thus requires both a regulatory and economic analysis. First, a regulatory analysis is conducted to identify which of the reliability subareas that intersect with CPA's service territory can forgo natural gas generating capacity. Reliability subareas that can forgo natural gas generating capacity are considered further, whereas those that cannot are removed from the analysis. For each reliability subarea that can forgo natural gas generating capacity, an economic analysis is conducted to determine the relative competitiveness of all natural gas power plants located therein. The least competitive power plant within each reliability subarea is speculated to be the most vulnerable to displacement. Lastly, a health impact assessment is conducted to determine the potential value of displacing the power plants that are speculated to be the most vulnerable to displacement.

Key Assumptions

- Every power plant located within a reliability subarea was assumed to provide the same value to that reliability subarea, regardless of its location therein. This assumption is born out of the structure of the CAISO's LCTR, which suggests that this is, at least generally, the case. Nevertheless, further investigation may be warranted, given the complexity of power flow and possibility that location within a reliability subarea is more influential than this study assumes.

- Due to limited capacity, this analysis focuses exclusively on market dynamics within transmission constrained areas. Inherently, this assumes that market dynamics outside of the transmission constrained area have no influence on power plants located therein. Given expected demand for natural gas power generating capacity for the broader CAISO system, it is very possible that "external" market demand will influence local resources.

- As is discussed below, relative competitiveness of power plants located within a reliability subarea is determined by each power plant's average annual heat rate. This assumes that a power plant's heat rate, and thus fuel costs, dictate relative competitiveness. This neglects variables like fixed costs and non-operating variable costs that likely influence relative competitiveness. For this reason, results from the economic feasibility assessment are considered speculative, rather than factual.

- This analysis did not address the cause and effect relationship between displacing one natural gas power plant within a reliability subarea and power generation from other natural gas power plants within the same reliability subarea. It is possible that the displacement of natural gas power generating capacity with battery storage may result in increased emissions from other natural gas power plants to satisfy battery charging demand. Furthermore, it is possible that displacing one power plant could force others to spend more time in a "ramping" phase, when pollutant emissions are generally higher. While these considerations were deemed beyond the scope of this analysis, further consideration should be given to them to ensure that efforts to reduce pollutant emissions in one location doesn't have a negative impact on air quality in another.

- Atmospheric transport of pollutants was not analyzed in this study. Rather, a power plant's location was used to determine whether it is likely to have a negative impact on communities within CPA's service territory. Analysis of pollution transport and time-specific emissions data would help to understand exactly where pollution from individual sources is going and the true damage of their emissions, respectively.

4.1.1 Power Plant Database

Prior to analyzing which power plants are most vulnerable to displacement, they need to be identified. Datasets from the Energy Information Administration and the California Energy Commission were used to develop a combined dataset that identifies all power plants relevant to this analysis. The Energy Information Administration's Form EIA-860 dataset was used to identify all natural gas power plants in California that "have a nameplate capacity greater than 1 MW, are connected to the local or regional electricity power grid, and have the ability to draw power or deliver power to the grid[151]". Table 2 lists the plant-specific attributes that were pulled from the 2019 version of this dataset[152].

Table 2: Form EIA-860 Data

Field Name	**Description**
Plant Code (EIA Plant ID)	EIA-assigned plant code
Plant Name	Name of power plant
Street Address	Street address of power plant
City	City that power plant is located in
County	County that power plant is located in

State	State that power plant is located in
Latitude	The latitude of power plant's coordinates
Longitude	The longitude of power plant’s coordinates
Sector Name	Plant-level sector name, designated by the primary purpose, regulatory status and plant-level combined heat and power status
Grid Voltage (kv)	Plant's grid voltage at point of interconnection to transmission or distribution facilities

Plant-specific attributes were pulled from the California Energy Commission’s Critical Infrastructure database and matched to all power plants identified on the Energy Information Administration’s Form EIA-860 dataset[153]. The database was downloaded from the California Energy Commission’s website and was last updated on November 18th, 2020 at the time of download. Table 3 lists the attributes pulled from the California Energy Commission Critical Infrastructure database[154].

Table 3: CEC Critical Infrastructure Data

Field Name	**Description**
Plant ID (CEC Plant ID)	CEC-assigned plant code
Generator Count	Number of electricity generators located at the power plant
General Fuel	General fuel type: Biomass, Coal, Digester Gas, Gas, Geothermal, Hydro, Landfill Gas, MSW, Nuclear, Solar (PV), Solar Thermal, Wind, & Other.
Online Year	Year that power plant first began operations
Peaker	If power plant is a peaker. 0 = No, 1 = Yes.
Local Reliability Area	Local reliability area that power plant is located within (assigned by Electricity Assessments Division)
Local Reliability Subarea	Local reliability subarea that power plant is located within (assigned by Electricity Assessments Division)
Senate District	Senate district that power plant is located within
Assembly District	Assembly district that power plant is located within
Congressional District	Congressional district that power plant is located within
Ces30 Percentile	CalEnviroScreen 3.0 percentile
Project Location	Designation of “Low Income” or “Disadvantaged Community” based on CalEnviroScreen Percentile

Power Plants were matched across the Energy Information Administration’s Form EIA-860 dataset and California Energy Commission Critical Infrastructure database using the California Energy Commission’s

"Energy Commission Power Plant ID Cross Reference Table 2020 – XLSX.[155]" This cross-reference table provides a crosswalk between each power plant's unique California Energy Commission Plant ID and Energy Information Administration Plant ID. The resulting dataset was used in the regulatory, economic, and health-impact assessments.

4.1.2 Regulatory Feasibility of Emissions Displacement

The CAISO's 2025 LCTR was used to determine whether natural gas power plants could be displaced with battery storage without disrupting reliability standards[156]. The 2025 LCTR was chosen over the 2021 LCTR because it provides a longer term vision of reliability concerns in the CAISO balancing authority area. The maximum quantity of battery storage that can displace natural gas power plants in the Los Angeles Basin and Big Creek / Ventura reliability areas, and all subareas located therein, was identified in this report. For the Big Creek / Ventura reliability area, and all subareas located therein, maximum displacement values were pulled from table 3.2-66 on page 116 of the report.

For the Los Angeles Basin reliability area, and all subareas located therein, maximum displacement values were calculated using two separate tables in the report. First, the maximum amount of energy storage capacity for each reliability area and subarea was identified in table 3.2-74 on page 128 of the report. Second, the total quantity of battery storage capacity located in each reliability area and subarea was calculated by summing up the capacity of all battery storage resources listed in Attachment A of the report. Maximum displacement values were then calculated by subtracting the total capacity of battery storage in each local capacity area found in Attachment A from the maximum amount of energy storage capacity found in table 3.2-74.

The California Energy Commission Critical Infrastructure database identifies the reliability area and subarea that each power plant is located within. This dataset was used to identify which power plants are located within each reliability subarea. This data was then cross-referenced with the 2025 LCTR to ensure that this study only includes power plants that the CAISO expects to be online in 2025.

4.1.3 Economic Feasibility of Emissions Displacement

Natural gas power plants require a fuel input (natural gas) to generate and sell electricity. A natural gas power plant's operational costs are largely driven by its fuel costs. Power plants with more efficient generators are cheaper to operate because they use less fuel, and are thus more competitive than a power plant with less efficient generators. This analysis used each power plant's average annual heat rate, which is the amount of heat required to generate one kwh of electricity, to determine relative competitiveness.

Combined heat and power (CHP) and industrial power plants were excluded from this analysis, leaving only non-CHP independent power providers and electric utilities. These power plants were excluded because power generation from such facilities is not exclusively a function of electricity demand. Since there are reasons for these facilities to generate power other than electricity demand, it was reasoned that it is not economically feasible to displace them with power market mechanisms alone.

The data used to calculate each power plant's average annual heat rate was drawn from the California Energy Commission's Quarterly Fuel and Energy Report (QFER CEC-1304)[157]. This data includes detailed information about power plants "with a total nameplate capacity of 1 MW or more that are located within California or within a control area with end users inside California."[158]

Annual, plant-specific heat rates from 2014 – 2019 were downloaded from the California Energy Commission's website. For each year and facility, the data includes a California Energy Commission Plant ID, Net MWh Produced, MMBTU Consumed, and Heat Rate, among other miscellaneous data that was not used for this study. To calculate each power plant's average annual heat rate, the annual heat rates from 2014 – 2019 were averaged across all years. The resulting annual average heat rate for each plant was then converted from MMBtu / MWh to Btu / kWh by multiplying the average heat rate by 1,000. The average annual heat rate for each power plant located within a reliability subarea that can forgo natural gas generating capacity was then compared. Power plants with the highest annual average heat rate relative to all others within a reliability subarea was determined to be the least competitive power plant located therein.

4.1.4 Health-Impact of Power Plant Emissions

A health impact assessment was conducted for every power plant on the power plant database with a nameplate capacity greater than 25 MW. The relative health impact of each power plant was determined using average annual social costs and the OEHHA's CalEnviroScreen tool. A power plant's average annual social cost represents the monetary damage associated with a power plant's average annual pollutant emissions. This value can be thought of as the annual monetary damage that each power plant has historically imposed on communities exposed to its pollutant emissions. For each power plant, its average annual social cost of its pollutant emissions was calculated by multiplying average annual pollutant emissions by county-specific marginal damages.

$$\text{Avg. Annual Social Cost} \left(\frac{\$}{\text{Year}}\right) = \text{Avg. Annual Emissions} \left(\frac{\text{Mass}}{\text{Year}}\right) \times \text{Marginal Damage} \left(\frac{\$}{\text{Mass}}\right)$$

Average Annual Emissions

Data for individual power plant emissions was drawn from the Environmental Protection Agency's 2014, 2016, and 2018 Emissions & Generation Resource Integrated Database (eGRID) to calculate average annual pollutant emissions[159]. For all three data years, the database includes mass emissions of SO2 and NOx for every power plant that has a nameplate capacity greater than 25 MW and produces electricity for sale[160]. The 2018 database is the only one that includes plant-specific mass emissions of PM 2.5.

For each of the three data years, the databases were filtered to include only power plants located in California. Plant-specific mass emissions of SO2 and NOx were averaged across each of the three data years (2014, 2016, 2018) to calculate each power plant's average annual emissions. Values that were not available in the data set for any of the three given years were excluded from the average calculation. Because PM 2.5 data is limited with this database, 2018 mass emissions of PM 2.5 were assumed to be each plant's annual average.

Marginal Damage Estimates

Plant-specific annual average mass emissions of SO2, NOx, and PM 2.5 were multiplied by county-specific marginal damages to generate each power plant's average annual social cost of emissions.

$$\frac{Pollutant\ Emissions\ (Mass)}{Year} \times \frac{US\ Dollar}{Pollutant\ (Mass)} = \frac{US\ Dollar}{Year}$$

For the three pollutants listed above, county-specific marginal damages were drawn from the most recent version of the Air Pollution Emission Experiments and Policy analysis model, AP3[161]. County-specific marginal damages for each of these three pollutants were first extracted from the model and inflated from 2014 USD to 2019 USD using the bureau of labor statistics inflation calculator. Table 4 below shows the marginal damages associated with each pollutant that were used in this analysis. These county-specific marginal damages were then matched to individual power plants using county FIPS code. Average annual social cost of SO2, NOx, and PM 2.5 emissions were then calculated by multiplying each power plant's average annual emissions of a pollutant by its respective marginal damage. Plant-specific social costs associated with SO2, NOx, and PM 2.5 emissions were then summed to calculate each power plant's social cost of pollutant emissions.

Table 4: APEEP Marginal Damages (Medium Stack; 2019 USD / Ton)

County	**SO2**	**NOx**	**PM 2.5**
Los Angeles	$ 122,736	$ 40,578	$ 257,268
Ventura	$ 42,855	$ 12,188	$ 61,460

CalEnviroScreen Percentile & Community Designation

The OEHHA's CalEnviroScreen tool (CES) was used to get a more holistic understanding of the overall pollution burden that communities within California face. The CES percentile and community designation was identified for the census tract that each power plant is located within. The CES percentile indicates the cumulative pollution burden that any given census tract experiences relative to all other census tracts in California. The higher the percentile, the greater the pollution burden.

4.2 Resilience

A two-part approach was utilized to analyze the value of resilience for critical facilities in CPA's member jurisdictions and guide the prioritization of locations. First, historical outage data for each member jurisdiction was collected and analyzed. Second, the value of resilience for a generic building in each jurisdiction was calculated using the data collected in part one.

4.2.1 Historical Power Outage Data Analysis

The duration of the outage is one of the key factors that affect the value of resilience. Southern California Edison (SCE) owns and operates the electricity transmission and distribution infrastructure for all of CPA's member jurisdictions. California Public Utility Commission (CPUC) Decision 96-09-045 requires SCE to publicly disclose system wide outage information, and Electric Reliability Reporting Rulemaking (R. 14-12-014) at the end of 2014 revised this to be at the more granular district level. Circuit level data must be released upon request.[162] Jurisdiction level data is therefore publicly available back to 2016[163], while SCE service territory level data is available back to 2012. This jurisdiction level data is available in PDF format in the "Back-up Slides" section of the presentations for each individual city/county. It was manually copied into excel jurisdiction by jurisdiction. Table 5 lists the fields collected and calculated from this data.

Table 5: SCE Jurisdiction Level Outage Data

Field Name	**Description**
SAIDI (minutes)	System Average Interruption Duration Index. The cumulative amount of time the average customer is interrupted by "sustained" (longer than 5 minutes) outages.
SAIFI (interruptions)	System Average Interruption Frequency Index. The number of times the average customer is interrupted by "sustained" outages.
CAIDI (minutes)	Customer Average Interruption Duration Index. Equals SAIDI/SAIFI. The average amount of time it takes to restore power after an unexpected interruption.
MAIFI (interruptions)	Momentary Average Interruption Frequency Index. The number of times the average customer is interrupted by "momentary " (lasting 5 minutes or less) outages
Year	The calendar year outages occurred.
Jurisdiction	The city or county that SCE reported data for.
Percentage of SAIDI and % of SAIFI by cause of outage	There are 7 categories of outage causes: 1) 3rd Party, 2) Equipment Failure, 3) Operation, 4) Other, 5) Vegetation/Animal, 6) Weather/Fire/Earthquake, and 7) PSPS. These data provide the percentage of outage time (SAIDI) by cause and the percentage of outages by cause for each year.

[164]

An analysis of this data reveals how power outages compare across jurisdictions and within jurisdictions year by year. The data was imported into R to create visualizations and new parameters to evaluate such as the CAIDI value (SAIDI/SAIFI) and total outage hours (total customers x SAIDI). The visualizations are presented in Appendix F.

4.2.2 Value of Resilience (VoR)

The Value of Resilience is not only dependent on the outage duration, but also on the value of lost load (VoLL), the season and time of day of the outage, the critical load that the backup system should be sized for, and more. As discussed in the background section, the VoLL, or the cost of the outage, is the most important variable in the VoR equation and is also the most difficult to assess. For this analysis, a benefit transfer method was used with values from Table ES-1: Medium and Large C&I (Over 50,000 Annual kWh) on page xii of Sullivan et al. (2015)[165] seen in Appendix G. These values are the best available estimates for the VoLL without access to building specific information. The values in this table are dependent on the length of the outage. To translate the values in this table to a value specifically for the estimated outage duration in a given jurisdiction, interpolation was used. The equation for this interpolation is the following:

Equation 1: Interpolated Outage Duration

$$y = y_1 + (x - x_1) \times (\frac{y_2 - y_1}{x_2 - x_1})$$

x values	Outage Hours
x	Average CAIDI for jurisdiction (hours)
x_1	The hours in Table ES-1 that were the closest length of outage less the jurisdiction's mean CAIDI (hours)
x_2	The hours n Table ES-1 that were the closest length of outage greater than the jurisdiction's mean CAIDI (hours)
y values	Cost per Unserved kWh
y	Cost per unserved kWh for the jurisdiction CAIDI value ($/kWh)
y_1	Cost per unserved kWh for x1 hours ($/kWh)
y_2	Cost per unserved kWh for x2 hours ($/kWh)

Equations from Laws et. al. (2018)[166] were used to turn outage length and VoLL into a value of resilience for a critical facility. These equations are as follows:

Equation 2: Cost of an Outage

$$Cost\ of\ an\ outage\ (C) = VoLL\ (\$/kWh) \times Annual\ Mean\ Load\ (kW) \times CAIDI\ (hours)$$

Equation 3: Value of Resilience

$$\boxed{\begin{gathered} Value\ of\ Resilience\ (VoR)\ =\ VoLL\ (\$/kWh)\ \times \\ Annual\ Mean\ Load\ (kW)\ \times\ Hours\ provided\ by\ PV + S\ system \end{gathered}}$$

The annual mean load is a data point provided by the site where the PV + S system will be located. The average critical load that will be sustained by the PV + S system should be used for the VoR calculation. Laws et. al. (2018) arbitrary chose 50% of annual mean load as an assumption for critical load. The hours provided by the solar + storage system are consequently the amount of time the system can meet the critical load. For actual implementation, different scenarios should be run considering that the size of the system determines the VoR but it is also a function of the VoR.

For our calculation of value of resilience over the lifetime of the system and discounted to present value, we tweak the equation slightly as follows:

Equation 4: Lifetime Present Value of Resilience

$$\boxed{\begin{gathered} Lifetime\ present\ value\ of\ resilience\ (VoR)\ = \\ VoLL\ (\$/kWh)\ \times\ Annual\ Mean\ Load\ (kW)\ \times \\ Hours\ provided\ by\ PV + S\ system \times \\ Expected\ Annual\ Number\ of\ Outages\ (SAIFI) \times \\ System\ Lifetime\ \times\ Discount\ Function \end{gathered}}$$

4.3 Greenspace and Habitat

The framework for characterizing lower-impact features is adapted from a land use matrix developed for a previous analysis by TNC[167]. In the prior study the matrix was used to define avoidance and attractor criteria for utility scale solar development in the West Mojave Desert. The study area for this analysis presents numerous unique opportunities for development not found in the West Mojave study area and consequently the matrix has been modified to accommodate land use categories that were not under consideration in the desert report. The new matrix includes features of the urban environment that are potential sites for solar development including building roofs, parking lots, vacant land, and disturbed land use parcels.

4.3.1 Avoidance/Attractor Matrix

The avoidance/attractor matrix (Table 6) presents the intersection of four land use categories with three greenspace & habitat need categories as varying levels of land use conflict (Table 7).

Greenspace & Habitat Need

Greenspace need encapsulates the level of access to parks and other outdoor recreation opportunities for people. Habitat need describes the availability of these spaces to non-human actors.

The variable availability of robust data for these metrics resulted in different methods in Los Angeles and Ventura Counties.

Land Use Categories

Land use was defined using Southern California Association of Governments (SCAG) land use designation categories[168]. Only categories that Clean Power Alliance identified[169] as targets for solar development were included in the analysis categories. Since battery storage installations are co-located with existing buildings in need of backup power, the land use impact of battery storage development was not considered.

Vacant Land

Parcels categorized as Vacant Land are generally those without extant structures on them.

Vacant Land presents an exceptional opportunity to expand greenspace and habitat in areas of high need. As such, it represents the highest conflict category and should be avoided for solar development in favor of improving greenspace and habitat access. This conflict is less in areas of Moderate need and even less in areas of Low need, but all solar development on vacant parcels presents higher levels of conflict.

Disturbed Land

Parcels designated as Disturbed Land are generally those that have been developed in some way and are within land use categories that CPA has identified as being more opportune for development. Thus, this category includes Commercial, Industrial, and Manufacturing land uses as well as non-vacant brownfields, but excludes Residential and Protected land uses.

Such parcels have the opportunity for conversion to expand greenspace and habitat in areas of Higher need and thus present the second highest level of conflict in these places. Areas of Moderate need represent lower conflict whereas areas of Lower need are categorized into the third lowest conflict category.

Parking Lots

Based on guidelines from CPA[170], the typical density achieved for solar installations is 8 acres per MW. CPA is seeking to develop solar installations with capacities between 250 kW and 10 MW and thus parking lots of at least 2 acres were isolated for analysis as a land use category.

Parking lot footprints are only available for Los Angeles County, thus this category does not factor into the impact analysis for Ventura County.

In areas of higher greenspace and habitat need, the conversion of parking lots to land uses that can reduce need represents a valuable opportunity for expanding greenspace and habitat. However, if conversion is not possible, installing a solar array on the site may be beneficial to the area. As such, parking lots in areas of higher need are categorized as "Dependent on Project design."

Parking Lots in Moderate and Lower need areas present opportunities for lower impact solar development.

Buildings

Buildings with footprints of at least 2 acres, large enough to support a minimum 250 kW solar array, were isolated for analysis.

In Lower need areas, existing buildings are categorized as the lowest conflict category and are recommended for development investigation. In Moderate and Higher need areas, buildings represent opportunities for solar development with lower conflict, but may still present opportunities to improve habitat and greenspace availability.

Impact Categories

The avoidance/attractor matrix (Table 6) results in twelve impact categories, categorized into a range of seven levels of conflict, ranging from very high impact to very low impact (Table 7). Higher conflict categories should be avoided for development while lower conflict categories should be prioritized for investigation. Category 7, Parking Lots in Higher need areas, is described as "dependent on project design" due to the opportunity to convert parking lots to land uses that relieve greenspace and habitat need.

Table 6: Avoidance/Attractor Impact Matrix

Land Use	**Greenspace/Habitat Need**		
	Higher Need	**Medium Need**	**Lower Need**
Vacant Land	Very High Conflict, Avoid (1)	2	3
Disturbed Land	4	5	6
Parking Lots (>2 acres)	Dependent on project design (7)	8	9
Building Roofs (>2 acres)	10	11	Very Low Conflict, Investigate (12)

Table 7: Land Use Impact Levels & Categories

Conflict Level	**Impact Categories**
Very High	1
	4
	2
	3, 5
	6
	8, 9, 10, 11
Very Low	12
Dependent on project design	7

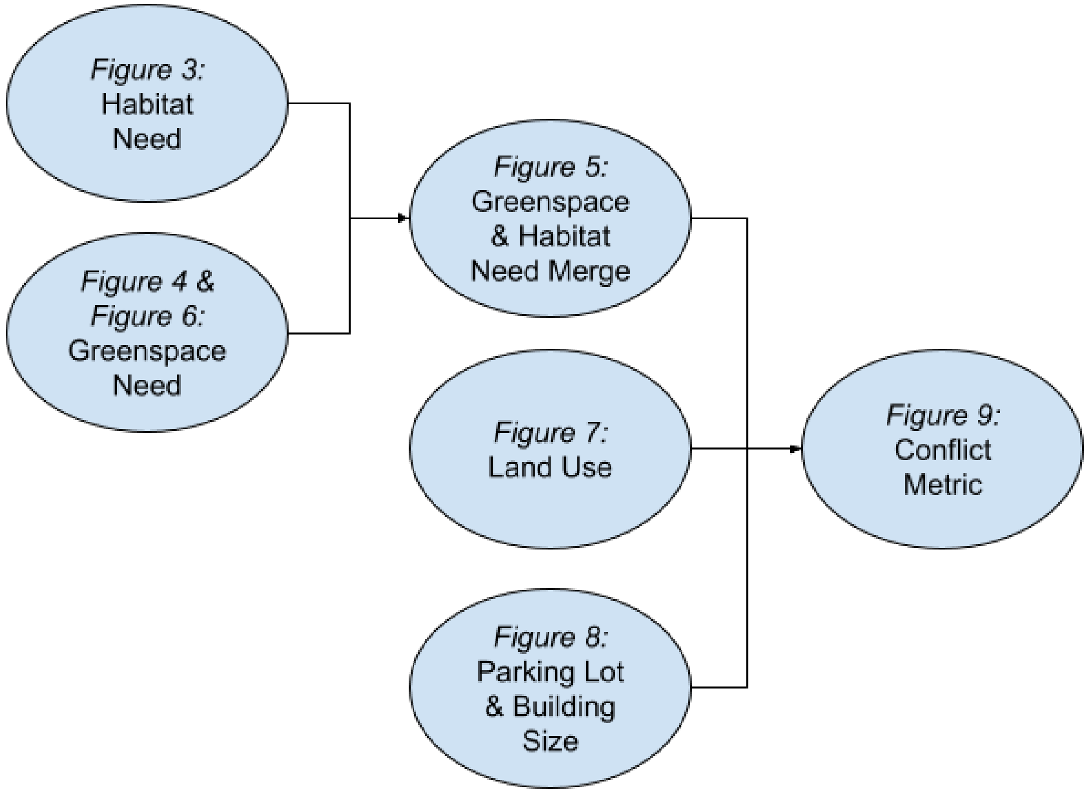
4.3.2 Mapping

All spatial analysis used the EPSG:3310: NAD 1983 California Teale Albers coordinate system. All input data was projected to EPSG:3310 as needed.

The overall workflow for land use impact mapping is shown in Figure 4. Each bubble in the flow represents an individual sequence of processes that result in the indicated metric or metrics and is described in more detail in the indicated process flow diagram. The entire process assigns the highest level of greenspace and habitat need to intersected parcels, parking lots, and buildings to determine the conflict level for that parcel per the avoidance/attractor matric (Table 6)

Mapping parameters are described in further detail in Appendix I: Mapping Parameters.

Figure 4: Overall Greenspace & Habitat Mapping Workflow



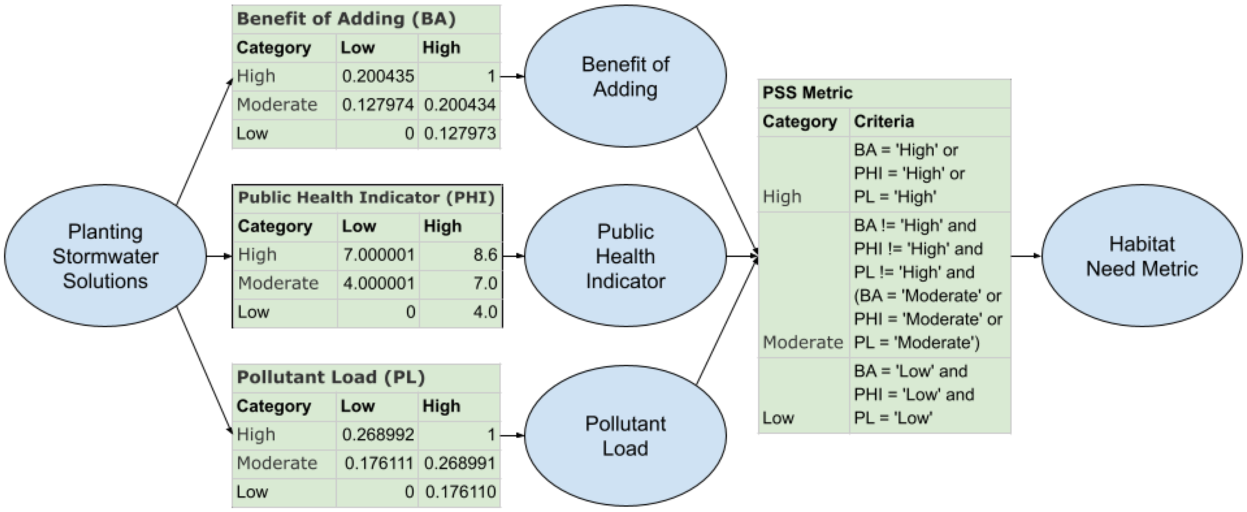
Greenspace & Habitat Need

A unified metric for greenspace and habitat need was implemented for the horizontal axis of the avoidance/attractor matrix. The methodology for this metric varies between counties in the service territory due to data availability.

Los Angeles County

In Los Angeles County, habitat need was determined using TNC's Planting Stormwater Solutions[171] data for Benefit of Adding, Pollutant Load, and Public Health Indicator. Each metric was divided into three levels, as shown in Figure 4.3.2b. Benefit of Adding and Pollutant Load values were divided into terciles while Public Health Indicator values were divided into levels based on advice from The Nature Conservancy[172]. The resulting higher, moderate, and lower levels were unified into a Habitat Need Metric such that higher levels in any of the indicators took precedence in the final metric, so that if any indicator was high, the unified metric would be high but all indicators must be low for the unified metric to be low (Figure 5).

Figure 5: Habitat Need Workflow



Benefit of Adding (BA)

Category	Low	High
High	0.200435	1
Moderate	0.127974	0.200434
Low	0	0.127973

Public Health Indicator (PHI)

Category	Low	High
High	7.000001	8.6
Moderate	4.000001	7.0
Low	0	4.0

Pollutant Load (PL)

Category	Low	High
High	0.268992	1
Moderate	0.176111	0.268991
Low	0	0.176110

PSS Metric

Category	Criteria
High	BA = 'High' or PHI = 'High' or PL = 'High'
Moderate	BA != 'High' and PHI != 'High' and PL != 'High' and (BA = 'Moderate' or PHI = 'Moderate' or PL = 'Moderate')
Low	BA = 'Low' and PHI = 'Low' and PL = 'Low'

Greenspace need was identified using the Los Angeles County Parks Needs Assessment[173]. This data categorizes 1 acre hexagons covering all of the county into Very Low, Low, Moderate, High, and Very High need categories. These categories were simplified into three levels of park need: Low, Moderate, and High as well as into numerical need categories for the purposes of the matrix analysis, as shown in Table 8 and Figure 6.

Table 8: Los Angeles County Parks Need Levels Categorized for Analysis

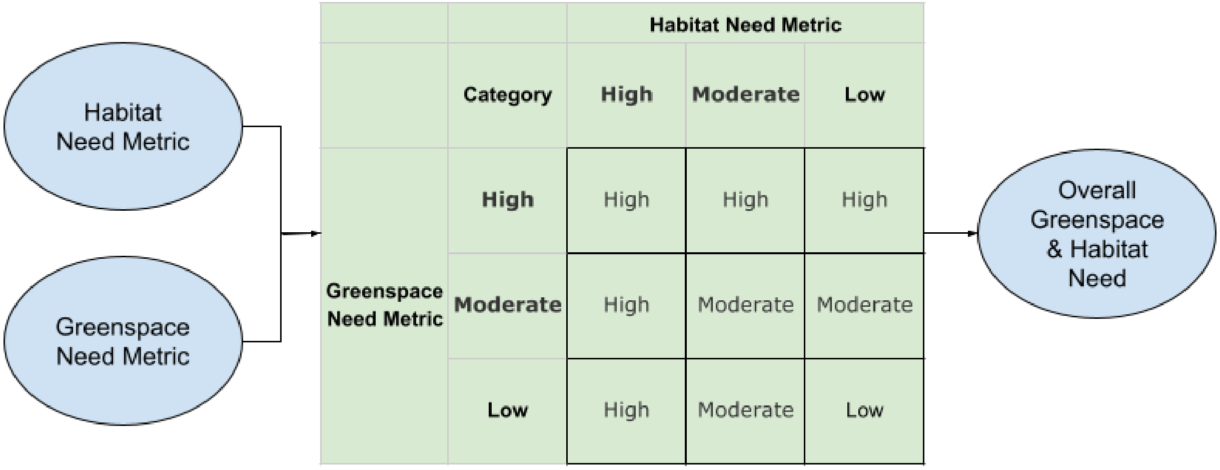
LA County Park Need	Analysis Park Need	Numerical Need Category
Very Low	Low	1
Low		2
Moderate	Moderate	3
High	High	4
Very High		5

Figure 6: Greenspace Need Workflow for Los Angeles County

Park Need	
Category	**Metric**
Very High	High
High	
Moderate	Moderate
Low	Low
Very Low	

To derive a unified Greenspace & Habitat Need metric for Los Angeles County, the independent Greenspace Need and Habitat Need metrics were compared for each parcel so that high need in either metric result in high overall need, while lower overall need only appeared where there was lower need in both categories (Figure 7).

Figure 7: Los Angeles County Greenspace & Habitat Need Workflow

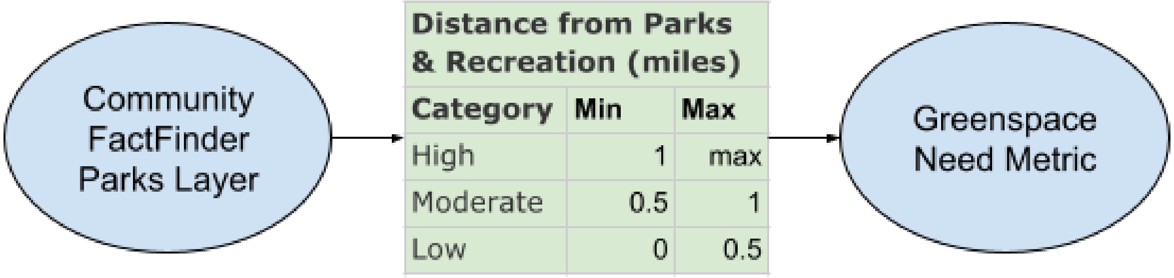


		Habitat Need Metric		
	Category	**High**	**Moderate**	**Low**
Greenspace Need Metric	**High**	High	High	High
	Moderate	High	Moderate	Moderate
	Low	High	Moderate	Low

Ventura County

In the absence of comprehensive habitat need data for Ventura County, park need was used as a proxy for habitat need based on advice from The Nature Conservancy[174] and the methods recorded in the Los Angeles County Parks Needs Assessment[175]. Statewide Community FactFinder data for parks[176] was used to identify greenspace need in Ventura County, allowing for more accurate assessment of areas at the edge of Ventura County that would not have been fully captured by the land use data constrained to the county. Parcels were categorized into need levels based as shown in Figure 8.

Figure 8: Greenspace Need Workflow for Ventura County

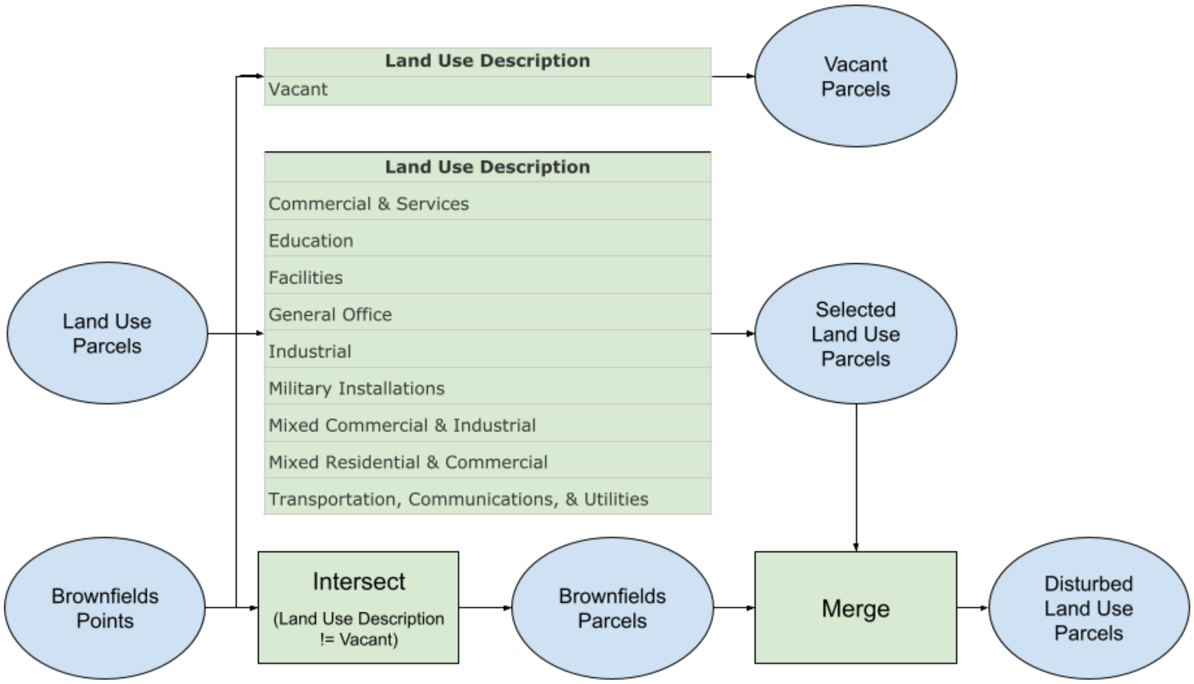


Land Use Categories

Vacant Land & Disturbed Land

SCAG land use data[177] [178] was used to identify parcels in the Vacant Land and Disturbed Land land use categories. Parcels fully or partially within the CPA service territory were categorized based on the land use description. (Figure 9)

Figure 9: Land Use Category Workflow



Vacant Land includes the six categories of land use SCAG designates as vacant land (Table 9). These categories were isolated for analysis as Vacant Land. The vacant land designation took precedence over any proximity to a brownfield designated on the Department of Toxic Substance Control (DTSC) Hazardous Waste and Substances (HWS) Site List due to the higher level of conflict.

Table 9: Vacant Land Designations

Code	**Description**
3000	Vacant
3100	Vacant Undifferentiated
3200	Abandoned Orchards and Vineyards
3300	Vacant With Limited Improvements
3400	Beaches (Vacant)
1900	Urban Vacant

Disturbed Land incorporates nine broad land use designation categories (Table 10), totaling 84 specific designations (see Appendix D: : Land Use Designations & Associated Analysis Categories) and parcels identified as brownfields that did not fall in Vacant Land parcels.

Table 10: Disturbed Land Designations

Description	**Number of Designations in Description Category**
Commercial and Services	9
Education	7
Facilities	12
General Office	4
Industrial	16
Military Installations	7
Mixed Commercial and Industrial	1
Mixed Residential and Commercial	3
Transportation, Communications, and Utilities	25
Total	**84**

Brownfield parcels were identified using point data of Department of Toxic Substance Control (DTSC) Hazardous Waste and Substances (HWS) Site List[179]. Any parcel in the SCAG land use data set that fell within 100 feet of a point in the DTSC HWA data set and was designated as a brownfield for the purpose of analysis. Only parcels that were not previously identified as Vacant Land category were designated as Disturbed Land. A 100-foot radius was chosen based on the assumption that any HWS site is at least 200 feet across or otherwise impacts the area around it in at least that radius.

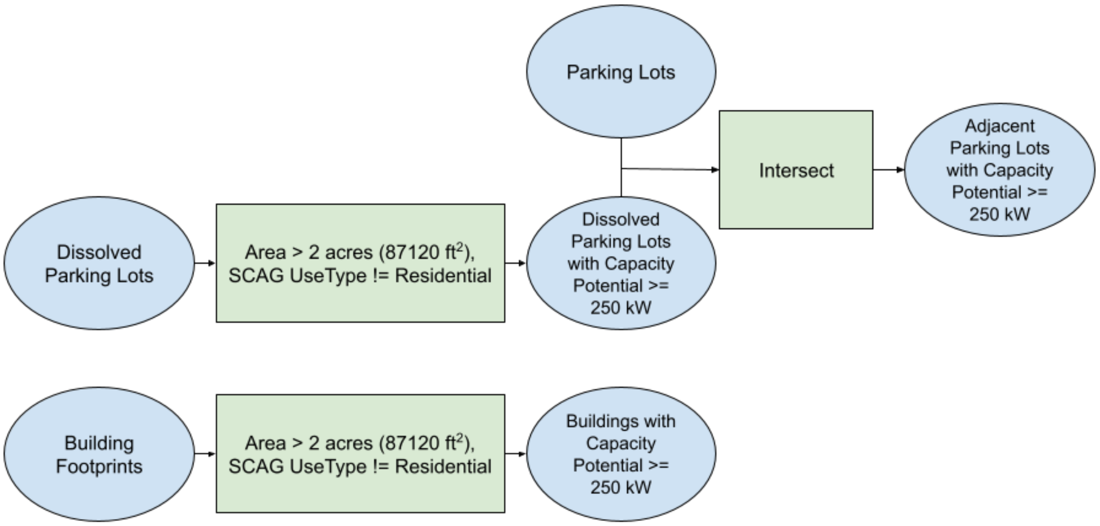
Spatial joins were used to assign the highest intersecting Greenspace & Habitat Need category to each parcel polygon, from which the conflict category was identified based on the avoidance/attractor matrix. (Table 6)

Parking Lots

Parking Lot footprints[180] were only available for Los Angeles County. Parking lots that were not designated as residential were isolated then dissolved to identify adjacent parking lots prior to being filtered to only dissolved lots greater than or equal to 2 acres. Undissolved parking lots that intersected these dissolved parking lots were then isolated and used for further analysis. (Figure 10)

A spatial join was used to assign the highest intersecting greenspace and habitat need category to each parking lot polygon, from which the conflict category was identified based on the avoidance/attractor matrix. (Table 6)

Figure 10: Parking Lot & Building Workflows



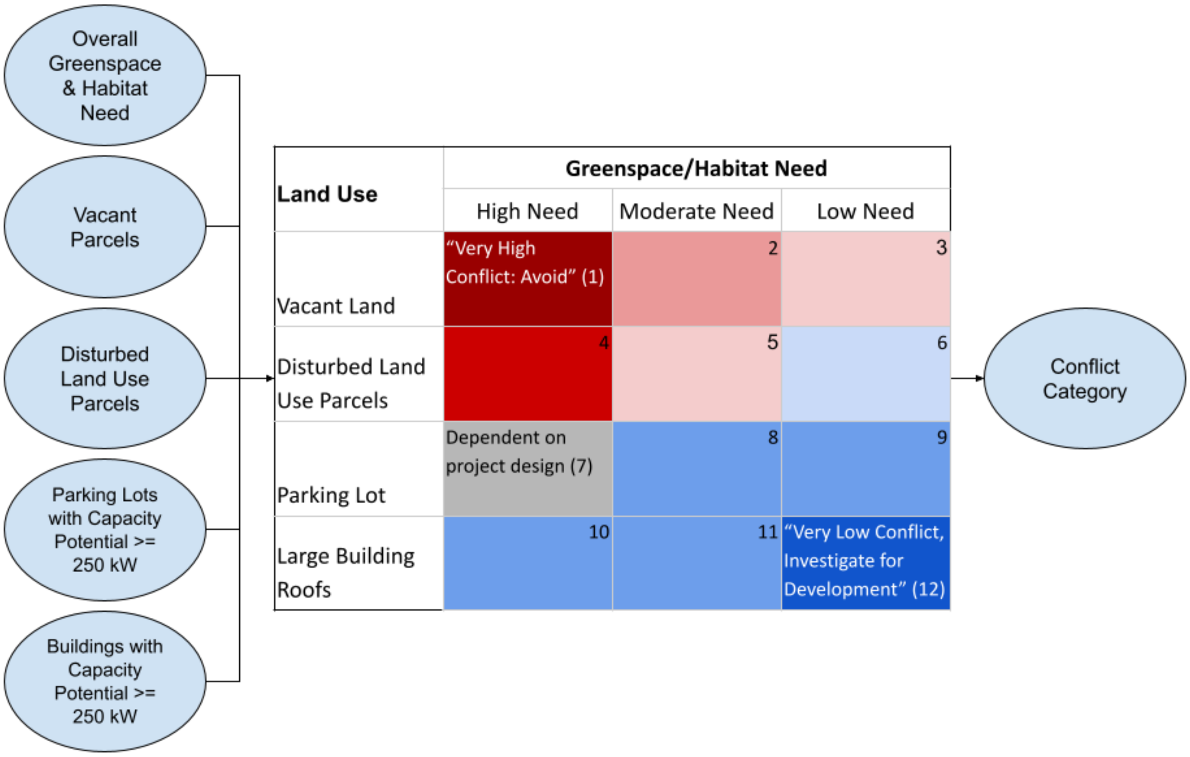
Buildings

Building footprints[181] greater than or equal to 2 acres that were not designated as residential were isolated for analysis. (Figure 10) A spatial join was used to assign the highest intersecting greenspace and habitat need category to each building polygon, from which the conflict category was identified based on the avoidance/attractor matrix (Table 6).

Impact Characterization

Parcels, parking lots, and building footprints were assigned an impact category based on the highest greenspace and habitat need identified for their location and the avoidance/attractor matrix (Figure 11).

Figure 11: Impact Categorization Workflow



Land Use	**Greenspace/Habitat Need**		
	High Need	Moderate Need	Low Need
Vacant Land	“Very High Conflict: Avoid” (1)	2	3
Disturbed Land Use Parcels	4	5	6
Parking Lot	Dependent on project design (7)	8	9
Large Building Roofs	10	11	“Very Low Conflict, Investigate for Development” (12)

Refer to Appendix I: Mapping Parameters for more details on the tools and parameters used for all mapping methodologies.

5. Findings

5.1 Definition of multiple benefit local clean energy

Energy generated near the end-user without on-site emissions of greenhouse gases or criteria air pollutants, that includes, but is not limited to, local air quality improvements, increased resilience against power outages, reduced development impact on greenspace and habitat, targeted financial savings to disadvantaged communities, and/or local job creation.

This definition was developed to inform Clean Power Alliance's local procurement strategy. Benefits of multiple-benefit, low-impact land use local clean energy are dependent on the stakeholder perspective, in this case, CPA.

5.2 Evaluation of the identified multiple benefits

5.2.1 Local Air Quality Benefits

As is referenced above, three distinct analyses were conducted to identify opportunities to displace natural gas power plants with battery storage within or near CPA's service territory. First, reliability regulation was assessed to identify which reliability subareas can forgo natural gas generating capacity without disrupting federal reliability standards. Second, power plants within favorable reliability subareas were ranked in order of their average annual heat rate to speculate relative competitiveness. Lastly, health impact indicators were evaluated to understand the potential benefit of displacing any of the targeted power plants with battery storage. The results from each of these three analyses, which ultimately inform procurement recommendations, are as follows:

Regulatory Feasibility of Displacement

Whether or not a natural gas power plant can be displaced with battery storage was determined via an analysis of the CAISO's 2025 LCTR. Each of the reliability subareas that intersect with CPA's service territory were assessed to identify which can forgo natural gas generating capacity without disrupting federal reliability standards. The following sections report which reliability subareas within the Big Creek / Ventura and Los Angeles Basin reliability areas are favorable for displacement.

Big Creek / Ventura Reliability Area

It is not possible to displace natural gas generating capacity with battery storage in any reliability subarea located within the Big Creek / Ventura reliability area without disrupting reliability standards. As is referenced in the CAISO's LCTR, "adding storage for Rector, Vestal, Goleta, Santa Clara, or Moorpark (reliability) sub-areas will not enable displacing gas-fired generation…" This is due to a number of reasons that include, but are not limited to, the absence of local capacity requirements, battery storage saturation (Santa Clara), and expected transmission projects that eliminate local capacity requirements. Table 11 below, which reports information pulled directly from the CAISO's LCTR, depicts this information in slightly more detail.[182]

Table 11: Big Creek / Ventura Estimated Energy Storage Maximum Capacity & Energy

Area	**Local Capacity Requirement**	**Maximum energy storage that can be added to replace gas-fired local capacity**	
		Capacity (MW)	**Energy (MWh)**
Rector	0	0	0
Vestal	310	0	0
Goleta	0	0	0
Santa Clara	225	0	0
Moorpark	0	0	0
Big Creek-Ventura	1,002	0	0

These results mean that CPA cannot displace natural gas generating capacity with battery storage in any reliability subarea that is located within the Big Creek / Ventura reliability area. If any natural gas power plants located therein were to be pushed out of power markets, the CAISO would likely use a RMR contract to force it to stay online. These expectations are validated by RMR contracts that were issued to the CSU Channel Islands and E.F. Oxnard power plants in the past year for this exact reason. This has special implications for CPA, as there are several power plants located within the Big Creek / Ventura reliability area that are likely imposing damage on communities within CPA's service territory (McGrath Peaker, CSU Channel Islands and E.F. Oxnard). Barring transmission upgrades, it is not believed that any of these power plants can be displaced with battery storage.

Los Angeles Basin Reliability Area

Analysis of the CAISO's 2025 LCTR revealed that natural gas generating capacity can be displaced with battery storage within the Los Angeles Basin reliability area and each reliability subarea located therein. Specifically, natural gas power plants can be displaced within the El Nido and Western Los Angeles Basin reliability subareas, both of which intersect with CPAs service territory. Table 12below lists the exact amount of natural gas power generating capacity that can be displaced with battery storage within each of these reliability subareas without disrupting reliability standards.[183]

Table 12: Los Angeles Basin Estimated Energy Storage Maximum Capacity & Energy

Area/Sub-area	**Estimated Energy Storage Maximum Capacity (MW)**	**Estimated Energy Storage Maximum Energy (MWh)**
El Nido sub-area	250	2,000
Western LA Basin sub-area	2,700	27,000

These results mean that CPA can displace natural gas generating capacity located within the El Nido and Western Los Angeles Basin reliability subareas up to the limits listed in Table 5.2.1b. This has special implications for CPA, as many of the power plants located within the Western Los Angeles Basin reliability subarea are located within or near CPA's service territory.

Economic Feasibility of Displacement

Average annual heat rate was used to gauge the relative competitiveness of natural gas power plants located within the El Nido and Western Los Angeles Basin reliability subareas. As mentioned in the method's section above, a power plant's heat rate is the amount of heat that a generator requires in order to produce one kwh of electricity. The higher the heat rate, the more expensive it is to operate the power plant. Thus, the power plant with the highest heat rate within each respective reliability subarea is speculated to be the least competitive power plant located therein.

It is important to note two things about the power plants that were included in this analysis. First, combined heat and power (CHP) and industrial power plants were excluded from this analysis, leaving only non-CHP independent power providers and electric utilities. The reasons for this are detailed in the methods section above. Second, this list contains only those power plants that the CAISO expects to be online in 2025. The CAISO lists these power plants in Attachment A of the 2025 LCTR.

Table 13 and Table 14 below list each of the natural gas power plants located within the Big Creek / Ventura and Western Los Angeles Basin reliability subareas, respectively, in order of descending average annual heat rate.

Table 13: El Nido Reliability Subarea - Average Annual Heat Rate

Plant Name	**City**	**Sector**	**Capacity (MW)**	**Heat Rate**
El Segundo Energy Center	El Segundo	IPP Non-CHP	526	8443

Table 14: Western Los Angeles Basin Reliability Subarea – Average Annual Heat Rate

Plant Name	**City**	**Sector**	**Capacity (MW)**	**Heat rate**
Long Beach Generation LLC	Long Beach	IPP Non-CHP	260	16797
Vernon	Vernon	Electric Utility	42	16271
AES Alamitos LLC*	Long Beach	IPP Non-CHP	1970	12489
AES Huntington Beach LLC*	Huntington Beach	IPP Non-CHP	430	11315
Glenarm	Pasadena	Electric Utility	227	11193
Center Hybrid	Norwalk	Electric Utility	49	10910
Canyon Power Plant	Anaheim	Electric Utility	200	10693
Barre Peaker	Stanton	Electric Utility	49	10269
Walnut Creek Energy Park	Industry	IPP Non-CHP	501	9840
Anaheim	Anaheim	Electric Utility	49	9576
El Segundo Energy Center	El Segundo	IPP Non-CHP	526	8443
Malburg	Vernon	IPP Non-CHP	159	7484

*AES Alamitos and AES Huntington Beach were included in this analysis because they are expected to be repowered by 2025.

These results suggest that the Long Beach Generating Station and El Segundo Power are the least competitive natural gas power plants located within the Western Los Angeles Basin and El Nido reliability subareas, respectively. Based on this metric, it is speculated that these two facilities would be the first natural gas power plants to be displaced if sufficient battery storage capacity were added to their respective reliability subareas. Note, however, that while heat rates are believed to be a good indicator of relative competitiveness, they are not perfect. Heat rates account only for variable operational costs and neglect non-variable operational costs and fixed costs, among other things factors. For this reason, these results are considered speculative rather than factual.

Health-Impact Assessment

Annual average social costs and CalEnviroScreen (CES) data were used to gauge the health impact of every natural gas power plant located in the El Nido and Western Los Angeles Basin reliability subareas. Tables Table 15 and Table 16 below list the (1) CES percentile of the census tract that each power plant is located within, (2) the CES community designation of the census tract that each power plant is located within, (3) and the estimated annual average social cost of pollutant emissions for each power plant. For the CES percentile, the higher the percentile, the more pollution burden a census tract experiences. Again, power plants are listed in order of descending annual average heat rate.

Table 15: El Nido Reliability Subarea – Health Impact Indicators

Plant Name	**Annual Average Social Cost (2019 USD)**	**CES Percentile**	**Community Designation**
El Segundo Energy Center	$3,417,272	NA	NA

Table 16: Western Los Angeles Basin Reliability Subarea – Health Impact Indicators

Plant Name	**Annual Average Social Cost (2019 USD)**	**CES Percentile**	**Community Designation**
Long Beach Generation	$589,999	NA	NA
Vernon	NA	NA	NA
AES Alamitos LLC	$16,956,895	NA	NA
AES Huntington Beach	$3,729,058	4	Neither Low Income or DAC
Glenarm	$1,658,840	19	Neither Low Income or DAC
Center Hybrid	$248,826	85	Disadvantaged Community
Canyon Power Plant	$1,578,843	76	Disadvantaged Community
Barre Peaker	$298,517	81	Disadvantaged Community
Walnut Creek Energy Park	$2,380,787	87	Disadvantaged Community
Anaheim GT	$422,818	76	Disadvantaged Community
El Segundo Energy Center	$3,417,272	NA	NA
Malburg	$3,137,547	NA	NA

Unfortunately, data is missing for several power plants listed in Table 15 and Table 16. Emissions data is not available for the Vernon Power Plant because it is smaller than 25MW, which is the threshold for reporting for the eGrid database. Power plants with missing values for the CES percentile and community designation do not have CES data attributed to them because they are located in census tracts that are labelled “High Pollution, Low Population.” The damage associated with pollutant emissions from these power plants should not be overlooked, however, as several are located adjacent to census tracts that are in the highest CES percentile.

5.2.2 Resilience

Results for the resilience analysis can be broken down into two parts. First, the analysis of historical outage data for each of CPA's 32 member jurisdictions, and second, a high level look at the value of resilience across these jurisdictions using the framework discussed in methods. This information can be used by CPA to prioritize solar + storage projects in regions where outages are more common. The visualizations in Appendix F provide further insight into the causes of outages in CPA service territory. Figure 12 below illustrates the resilience valuation across communities without taking into account any other differences between communities apart from historical outage frequencies and durations.

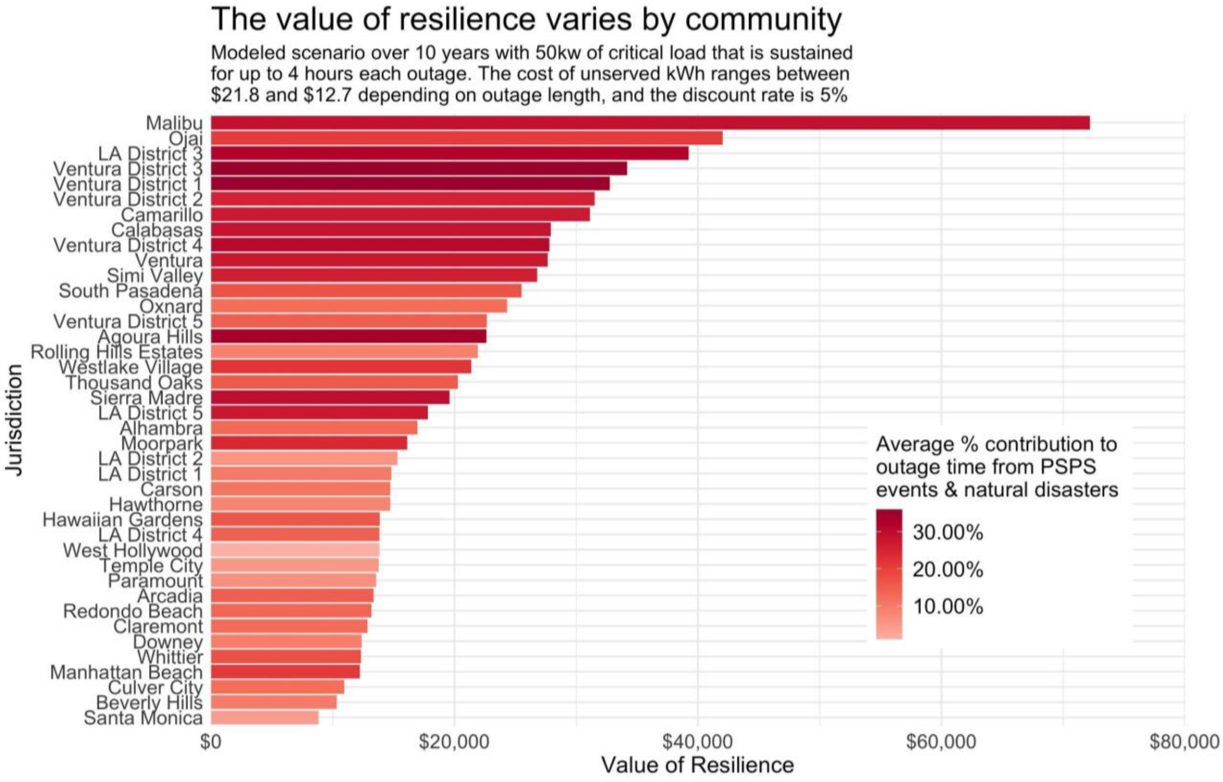


Figure 12: Modeled value of resilience for Clean Power Alliance's member jurisdictions.
Each bar indicates the value of resilience per outage event multiplied by the expected number of outage events over 10 years. The present value of resilience is calculated using a discount rate of 5%. These values are modeled for a building with 50 kw of critical load and a system that can meet the critical load for 4 hours. The average outage length and frequency are jurisdiction specific and are based off of historical averages. The value of lost load used is the same across jurisdictions—these values are adapted from the Medium/Large C&I section of Table ES-1 of LBNL's Updated Value of Resilience paper. The surveyed customers in Medium/Large C&I had an average annual usage of 7,140,501 kWh. Dividing by 8760 hours/year, this amounts to an average load of 815 kW. A 50 kW critical load was chosen arbitrarily, it amounts to approximately 6% of average load. The darker shades indicate that Public Service Power Shutoff events and natural disasters have historically had a larger contribution to outage hours.

5.2.3 Greenspace and Habitat

Preliminary research established the Avoidance/Attractor Impact Matrix (Table 6, reproduced here as Table 17) for land use, providing twelve impact categories, seven levels of conflict, and one category acknowledging design dependent impact (Table 7, reproduced here as Table 18) for use in spatial analysis of low land use impact opportunities.

Table 17: Avoidance/Attractor Impact Matrix

Land Use	**Greenspace/Habitat Need**		
	Higher Need	**Medium Need**	**Lower Need**
Vacant Land	Very High Conflict, Avoid (1)	2	3
Disturbed Land	4	5	6
Parking Lots (>2 acres)	Dependent on project design (7)	8	9
Building Roofs (>2 acres)	10	11	Very Low Conflict, Investigate (12)

Table 18: Land Use Impact Levels & Categories

Conflict Level	**Impact Categories**
Very High	1
	4
	2
	3, 5
	6
	8, 9, 10, 11
Very Low	12
Dependent on project design	7

Los Angeles County

Analysis of the southern county in the Clean Power Alliance Service Territory assessed 51,400 (166,588.89 acres) parcels, parking lots, and building footprints in land use categories identified as having a potential for solar developments with capacities between 250 kW and 10 MW. Some parking lots and buildings are co-located with parcels assessed as disturbed land but represent distinct opportunities for solar development with different conflict levels. The total acreage assessed may include overlap of these features.

We identified 103,742.75 acres of lower impact (8,671 features in categories 6, 8, 9, 10, 11, and 12) development opportunities and 55,542.25 acres of higher impact (35,919 features in categories 1, 2, 3, 4, and 5) areas where development should be avoided. The remaining 7,303.90 acres of assessed area are parking lots in high need areas (category 7), whose level of land use conflict is dependent on project design. (Table 19)

Table 19: Service Territory in Los Angeles County Land Use

Land Use	Need Level	Impact Category	Number of Objects	Average Area (acres)	Total Area (acres)
Vacant Land	High	1	0	0	0
Vacant Land	Moderate	2	5	15.0388	75.19388
Vacant Land	Low	3	28	240.8994	6745.183
Disturbed Land	High	4	32187	1.3763	44298.25
Disturbed Land	Moderate	5	3699	1.1959	4423.621
Disturbed Land	Low	6	7076	14.1466	100101.6
Parking Lots	High	7	6810	1.0725	7303.896
Parking Lots	Moderate	8	320	0.8447	270.3042
Parking Lots	Low	9	624	1.642	1024.619
Buildings	High	10	88	4.1476	364.989
Buildings	Moderate	11	248	3.5546	881.5412
Buildings	Low	12	315	3.4911	1099.697

Ventura County

In Clean Power Alliance's northern county of operation, 24,535 parcels and building footprints totaling 75,869.92 acres were analyzed for their land use impact. Parking lot footprint data was unavailable for Ventura County.

The assessment identified 10,330 parcels and building footprints totaling 37.540.28 acres of higher impact (categories 1, 2, 3, 4, and 5) areas where development should be avoided and 14,205 parcels and building footprints totaling 38,329.65 acres of lower impact (categories 6, 10, 11, and 12) development opportunities. As parking lots were not analyzed, impact categories 7, 8, and 9 are excluded from the results for Ventura County. (Table 20)

Table 20: Service Territory in Ventura County Land Use

Land Use	Need Level	Impact Category	Number of Objects	Average Area (acres)	Total Area (acres)
Vacant Land	High	1	346	6.8175	2358.855
Vacant Land	Moderate	2	809	4.5474	3678.819
Vacant Land	Low	3	5836	1.1593	6765.813
Disturbed Land	High	4	803	18.113	14544.71
Disturbed Land	Moderate	5	2536	4.019	10192.08
Disturbed Land	Low	6	10140	2.2075	22383.83
Parking Lots	High	7	No data available for parking lots in Ventura County.		
Parking Lots	Moderate	8			
Parking Lots	Low	9			
Buildings	High	10	476	5.5041	2619.963
Buildings	Moderate	11	1600	3.9235	6277.599
Buildings	Low	12	1989	3.5436	7048.255

Lower Conflict Opportunities

Lower conflict areas represent places that are expected to minimize land use conflict if secured for solar development, but each feature represents a unique situation in the context of its locality and further analysis of site specific factors is necessary to provide a full picture of the impact of developing in a given location.

6. Discussion and Recommendations

6.1 Local Air Quality Benefits Discussion

Together, the results from the regulatory, economic, and health-impact assessments can be used to inform CPA's strategic procurement efforts. The results of the regulatory assessment provide guidance on where CPA should site local battery storage to maximize the possibility of displacing natural gas power plants located within or near its service territory. The results of the economic assessment suggest which power plants within targeted reliability subareas are most vulnerable to displacement. Lastly, the health-impact assessment gauges the potential benefits of displacing any of the natural gas power plants located within targeted reliability subareas.

While the results from the regulatory feasibility assessment are favorable for power plant displacement within the El Nido reliability subarea, the results from the economic feasibility assessment are not. As is seen in Table 5.2.1c, only the El Segundo Energy Center is expected to provide local capacity to the El Nido reliability subarea in 2025. The EL Segundo Energy Center is relatively young and has an average annual heat rate that suggests that it would be difficult to displace. For this reason, it is not recommended that CPA pursue efforts to displace natural gas power plants in the El Nido reliability subarea.

This leaves just one reliability subarea remaining: Western Los Angeles Basin. Based on the results of the regulatory feasibility assessment, we recommend that CPA focus local storage procurement efforts on the Western Los Angeles Basin reliability subarea. While it is not guaranteed that doing so will displace a natural gas power plant located therein, there is regulatory room to displace natural gas generating capacity with battery storage in the Western Los Angeles Basin reliability subarea. We believe that battery storage procurement within the Western Los Angeles Basin reliability subarea can decrease the competitiveness of natural gas power plants located therein, and thus increase the possibility of displacement.

Results suggest that the Long Beach Generating Station is the least competitive natural gas power plant located within the Western Los Angeles Basin reliability subarea, and thus most likely to be displaced. While the Long Beach Generating Station is not located within CPA's service territory, it is believed that it's pollutant emissions negatively impact communities within CPA's service territory, given their proximity. Even if this assumption proves to be false, there is good reason to believe that its pollutant emissions have a negative impact on the broader Southern California area, given its location in Long Beach.

Air Quality / Health Benefits Recommendations

- Focus local storage procurement efforts on the Western Los Angeles Basin reliability subarea to maximize the possibility of displacing natural gas generating capacity located within or near CPA's service territory. While it is challenging to state what the exact effects of doing so would be, we believe that this is the most likely way for CPA to displace natural gas generating capacity located within or near its service territory via power procurement efforts alone.

- Leverage existing relationships with natural gas power plants located within the Western Los Angeles Basin reliability subarea to see if there is interest in hybridization or conversion from natural gas to battery storage. Partnership with existing natural gas power plants would allow CPA to have a more targeted approach to displacement. This approach would also eliminate any uncertainty that arises when leveraging market mechanisms to displace natural gas generating capacity.

6.2 Resilience Discussion

The calculated values of resilience (VoR) in this report demonstrate that there is significant value in backup energy and that it varies greatly based on location due to differing power outage risks. In this high level analysis, duration and frequency of outages mostly determine the VoR. This is because a uniform average load value is used, and the values of lost load (VoLL), or cost per unserved kWh, are very similar. The VoLL values only differ in that they decrease on a per kWh basis as the outage length increases—causing the VoR gap between communities to be narrower than if the VoLL was the same for all outage lengths. The results do not show how the VoR is highly dependent on a number of factors that are uncertain. Of the variables that determine the VoR, the most uncertain are the future duration and frequency of outages and the VoLL for the critical facility being considered.

The duration and frequency of outages were not modeled into the future due to the uncertainty of climate change and public safety power shutoffs (PSPS). Figure F.1 in Appendix F illustrates how total annual outage duration per customer has steadily increased from 2013-2019 across SCE service territory. This suggests that future durations would be longer than historical durations. However, as the average annual durations get longer, the marginal benefit of reducing outage time eventually becomes greater than the marginal cost of upgrades for the utility. Utilities like Southern California Edison are under pressure from the California Public Utilities Commission to balance the risk of causing wildfires with avoiding PSPS events. Given this uncertain landscape, and that no discernible trends were seen in the 4 years' worth of data for each jurisdiction, a simple historical average was used. If the SCE service territory trend continues, the VoR will be greater than presented. Another uncertainty is the frequency of severe outages lasting more than 24 hours. These may become more common due to the increased frequency of natural disasters. The VoLL values used in this analysis are not applicable in these scenarios given that the survey data that informs the VoLL does not address outages lasting longer than 24 hours. The VoLL may be much higher for a long duration outage if there are increasing marginal damages past 24 hours.

The VoLL used in this analysis may also not accurately represent critical facility VoLL. The VoLL values used from Table ES-1 in the LBNL Updated Value of Service Reliability Report are not specific to any facility type. The willingness to pay for energy during an outage may be significantly higher for a critical facility than for the average facility type surveyed. In that report, the data is bucketed into Medium/Large C&I (with an average annual usage of 7,140,501 kWh), Small C&I (with an average annual usage of 19,214 kWh), and residential. Critical facility usage is likely in between Small C&I and Medium/Large C&I building sizes. Since the VoLL ($/kWh) is significantly lower for Medium/Large C&I than it is for Small C&I (see Appendix G), it is conservative to use the Medium/Large value. In this study, a critical load was somewhat arbitrarily chosen as 50 kW. This may be on the higher end for a typical critical facility and would have the opposite effect of the more conservative VoLL choice.

The VoLL will be different across critical facilities and across scenarios. The service provided by the critical facility that relies on electricity, and the population that benefits from that service, determine this variance. A low income senior center with a large population of vulnerable elders may have a higher value for a solar + storage system that can provide cooling during a summer outage than a police station in a low crime wealthy community. The timing and presence of advance warning is another variable that is likely to change the VoLL. Lastly, the typical time, day of week, and season of outages are other variables that affect the VoLL. A more robust VoLL evaluation would take these factors into account.

Despite the broadness of these calculations, there are several reasons that it is worthwhile to include the value of resilience in project economics. First, when adding up the costs and benefits of local energy resources compared to remote generation, resiliency benefits should be included if the system has islanding capability. In this case, valuing resilience lowers the cost gap between local and remote PV+S. Second, when considering a solar + storage system for a specific facility, the VoR may make a previously unviable project viable, or increase the optimal size of the system. In general, if the present value of resilience is greater than the cost to island the system, then the capital cost of islanding is worthwhile. The additional present value of resilience can be added to the NPV of the project.

This project is not the only effort to quantify the resilience benefit of local clean energy for CCAs and prioritize projects. The NavigaDER tool developed by TerraVerde and MCE, with funding from the California Energy Commission, was developed specifically to help CCAs prioritize distributed energy resources. The tool takes customer data as inputs and generates the costs and benefits of implementing a selected DER program—such as battery storage.[184] This tool may be an alternative to using the methodology presented in this report.

Resilience Recommendations

- Add the value of resilience to the benefits of critical facility solar + storage projects. Expand procurement of critical facility solar + storage systems if the value of resilience is greater than the cost of islanding and the net present value of the project as a whole is positive.
- Target critical facilities for backup storage based on the risk of outages and the public value of the service that the facility provides.
- Once a facility is being evaluated:
  - Determine the critical load of the facility and plug that load value into the VoR equation.
  - Utilize the Medium/Large C&I VoLL from the 2015 LBNL report in the VoR equation if a more in-depth evaluation of VoLL for the critical facility is not practical. This will assign a conservative $/kWh value.

Resilience Policy Recommendations

- In-front-of-the-meter energy storage that provides ancillary grid services in addition to providing backup power for critical facilities that serve low-income communities should be adequately subsidized. California currently incentivizes behind-the-meter energy storage projects through the

Self Generation Incentive Program (SGIP). Per CPUC Rulemaking 12-11-005, the majority of funds are set aside for critical facilities and low-income customers, however, $60 million is set aside for residential customer battery storage installations from 2020-2025. The benefits for the grid and a transition to clean energy of household behind-the-meter systems are still not completely understood and should further be investigated. The benefits can be predominantly private and reduce tax revenue, CCA revenue, and utility revenue. In-front-of-the-meter battery storage systems that are owned by an electricity provider and can be used as a grid resource during normal operation, while being capable of islanding during an outage and providing value to critical facilities that serve low-income communities, should also be adequately subsidized.

- Policy requiring IOUs to disclose more transparent outage data can help CCA procurement efforts. Electric Reliability Reporting Rulemaking (R. 14-12-014) can be revised to require utilities to not only disclose outage data but to disclose the data in useful formats. For example, comma separated value spreadsheets in addition to the PDF presentations. This data, and all outage related data should be made readily available to Community Choice Aggregators whose customers are affected.

6.3 Greenspace and Habitat Discussion & Recommendations

The methods that we utilized for analyzing land use/environmental impact were designed in consideration of CPA's service territory. There is a parallel effort, undertaken in the background and literature review, to frame a definition of low-impact development that can be used to inform conservation-minded development in other geographic areas. While the general definition would ideally be universal. it is important to discuss how the area under study in this report differs from low-impact recommendations made elsewhere in California. Additionally, overlap or competition from TNC's other program areas may influence recommendations. We recognize that all lands under consideration have multiple opportunities and it is important to recognize those other opportunities. Our analysis does not capture all of them.

Previously contaminated lands, including some brownfields and landfills, are highlighted as an important renewable energy opportunity space in publications by TNC[185], EPA[186], and others[187]. Across the United States these lands represent millions of acres and revitalizing/remediating those areas through renewable energy development can draw community support and can reduce project costs and benefit from streamlined permitting. According to EPA's Re-Powering Mapper Tool, there are 2,960 potential solar development locations in contaminated areas of Los Angeles and Ventura counties[188]. However, these broad recommendations tend to be in the scope of utility scale developments and our limited stakeholder outreach indicated that the smaller degraded and/or contaminated areas in the urban context may have competing uses that don't often appear in settings outside urban areas.

Making an informed recommendation for developing renewable energy on vacant lots or previously contaminated areas must consider alternative uses such as parks and open space. This can be challenging because of the clear overlap between (1) the areas of high pollution and poor air quality (CalEnviroScreen), and (2) the areas of high park and open space needs. On the one hand, we want to identify areas where renewable energy development can displace emissions from fossil fuel energy generation and utilize state programs for development in disadvantaged communities, but, on the other hand, those development opportunities should limit their interference with vital greenspace opportunities.

Community based organizations in Los Angeles that advocate for increased recreational opportunities in disadvantaged communities have expressed that, in some areas, contaminated lands represent critical open space opportunities[189] [190]. However, other site indicators like the proximity to residential areas or the context within larger recreation networks can influence the desirability. Ground truthing locations is essential to uncover those other site features, after they have been evaluated through our initial environmental screening. Determining the site-specific park and greenspace desirability criteria highlights the need for a community-centric development process including collaboration with local community based organizations, and may even create an opportunity for co-location. Guidelines for engaging community based organizations, and advancing energy equity, were recently outlined by the California Environmental Justice Alliance[191].

Our results exclude agricultural areas as an opportunity space due to restrictions set by SOAR initiatives. However, we investigated the potential for renewable energy development in poor quality agricultural areas of Ventura County, and concluded that conversion of agricultural zoning was not advisable. We developed our guidance for Ventura County agricultural land from an examination of TNC recommendations elsewhere in California. TNC has made recommendations for conversion of low-productivity agricultural areas to renewable energy development[192] and for habitat restoration[193]. In each case the geographic context is an important factor.

Two main themes emerged from our consideration of agriculture conversion. First, agricultural areas in Ventura County are mainly constrained to floodplains and flatlands that are desirable for urbanization. Development of these areas will have a greater impact on watershed hydrology. These areas also have higher ecological value and TNC has partnered with agriculture land owners in Ventura's Santa Clara River watershed to protect floodplain habitat[194]. Second, opposition to SOAR initiatives include a host of stakeholders who want to develop in agriculture and open space areas. Development pressure in Ventura County is high given its location next to Los Angeles County, the second most populous metropolitan area in the United States. Aligning with SOAR opposition to encourage even small changes to SOAR initiatives may entirely diminish the open space protections they afford. Moreover, a collapse of SOAR could result in sprawling development that renders the Ventura County agriculture industry unstable[195]. Therefore, CPA should not explore development opportunities in SOAR controlled zones if they require re-zoning.

We also researched opportunities for co-location of renewable energy development with greenspace and agriculture. The benefits of co-location have been studied[196] but few projects involving in-front-of-the-meter generation exist. The co-location design varies based on the goal of the project, ranging on a spectrum from energy-focused to vegetation-focused. There is a trade-off between maximizing production of either vegetation or renewable energy, however synergies can simultaneously enhance the productivity of both systems. In general, a hybrid/integrated approach would involve elevating and spacing out solar infrastructure to allow for either natural or managed vegetation to exist within the project site[197]. Though an integrated design might alternatively avoid prominent groupings of natural vegetation and valuable natural features of the landscape, or, in the case of agriculture, utilize unplanted boundaries. Agrivoltaic systems have been shown to increase soil moisture thereby reducing drought stress, and reduced daytime PV panel temperature resulting in increased renewable energy production[198]. Opportunities for utilizing energy infrastructure for additional environmental benefits have also been explored, like planting pollinator habitat in transmission corridors[199].

6.4 Other Discussion & Recommendations

Criteria for renewable energy development proposals should incorporate principles of energy perceptions that are locally important. For instance, if communities worry about the aesthetics of projects, as we uncovered in the municipal policy review, then an effort can be made to incentivize projects that are not easily visible or incorporate aesthetically desirable features. If instead communities are worried about energy resilience, then guidelines can be created requiring a portion of the project budget to be dedicated to battery storage. Additionally, local opposition can present itself at various points in the siting and development process and is often associated with mistrust when project decisions are not made in a public process[200]. Best practices for intentional community involvement in project planning focus on transparency, outreach, coordination with local organizations, accountability, and local program design[201].

Public awareness of energy generation is typically low because it is invisible to the average consumer, and, in general, energy salience for Americans is highest during energy disruptions[202]. Timing of messaging for resiliency benefits from DER development in response to power shut offs (PSPS events) can be effective for gaining public support. Similarly, “peer effects” on a micro scale influence the adoption of residential solar from both word of mouth advertisement and visibility[203]. It is possible that this pattern of adoption could also operate at a macro scale, or the community level. Pilot projects have the potential to influence nearby districts upon completion.

Public understanding of DER and effective framing of the co-benefits has not been studied. A survey of impacted communities will serve to better understand the dominant perceptions about renewable energy projects and their key indicator variables in the project areas. This would help craft the appropriate framing for key decision makers and politicians to help garner public support.

7. Further Research

The following topics were beyond the scope of this project deliverable but should be considered moving forward with multiple benefit local clean energy research:

- ***Defining the status quo of CCA procurement:*** If CCAs do not strategically procure multiple benefit local clean energy, then what would the alternative be?
- ***Assessing the effects of increased clean energy resources:*** How does increased local clean energy change other generation source’s output? Will this affect resource adequacy?
- ***Informing other CCA efforts:*** How can the analysis and results of this project be refined to inform local clean energy procurement strategies by other entities?
- ***Creating policy to overcome barriers to achieving benefits:*** How can local and state policy incentivize load serving entities to account for the social and environmental benefits of local clean energy? What tools, such as NavigaDER, can be created to incentivize in-front-of-the-meter local clean energy resources?
- ***Comparing benefits:*** How can decision makers compare the value provided by these benefits and consequently choose the best procurement options? What additional benefits should be assessed

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Appendices

Appendix A: Acronyms and Abbreviations

Acronym	Meaning
BESS	Battery Energy Storage System
CAIDI	Customer Average Interruption Duration Index
CCA	Community Choice Aggregator
CES	CalEnviroScreen
CIC	Customer Interruption Cost
CPA	Clean Power Alliance
DER	Distributed Energy Resource
IOU	Investor Owned Utility
kW	Kilowatt
LCTR	Local Capacity Technical Report
LSE	Load Serving Entity
LU	Land Use
MAIFI	Momentary Average Interruption Frequency Index
MW	Megawatt
NIMBY	Not In My Backyard
PCF	Potential Critical Facility
PPA	Power Purchase Agreement
PSPS	Public Safety Power Shutoff
PV+S	Photovoltaic plus Storage
RMR	Reliability Must Run

Appendix B: Definitions

Behind-the-meter	An energy resource that provides power on-site without passing through a utility meter. (See also in-front-of-the-meter)
Critical Facility	Community and municipal buildings or operations that do not have existing backup power.
Customer Average Interruption Duration Index (CAIDI)	Equal to SAIDI/SAIFI. The average amount of time it takes to restore power after an unexpected interruption.
Distributed Energy Resource (DER)	A generator or energy-storage device connected at distribution voltage levels. May also include communication enabled technologies that can provide demand response services. In general, DERs are characterized by relatively small capacities.
In-front-of-the-meter	An energy resource that provides power into the grid before being used by an end-user. The energy must pass through a customer's utility meter before being utilized. (See also behind-the-meter)
Islanding	The wiring of an energy system such that it can operate independently of the grid and generate or transmit electricity when the main grid is down.
Jurisdiction / Community	The member agencies that are signed on to Clean Power Alliance's community choice aggregation program through a Joint Powers Authority.
Large Scale Solar	10 MW - 1,000+ MW. Typically ground-mounted in remote locations.
Load Serving Entity (LSE)	An entity that supplies electricity to customers, such as a utility or CCA.
Medium Scale Solar	15 kW - 10 MW of capacity. Typically on commercial rooftops or ground mounted arrays. This project considers the scale of 250 kW - 10 MW
Momentary Average Interruption Frequency Index (MAIFI)	The number of times the average customer is interrupted by "momentary" (lasting 5 minutes or less) outages.

Appendix C: Renewable Energy Municipal Policy

Jurisdiction	Municipal Policy Overview
Agoura Hills	Reduced fees for solar permitting. No additional mention of solar development in city ordinances.[1]
Alhambra	Has a municipal solar leasing program. No additional mention of solar development in city ordinances.[2]
Arcadia	A General Plan policy of exploring solar opportunities on municipal buildings.[3] Ground- mounted solar must comply with the setback requirements of the main structure, but solar must be roof-mounted where practical. Solar panels must comply with zoning height requirements.[4]
Beverly Hills	Electrical and Community Development Department permits required for all solar panels.[5] No additional requirements in the city ordinances.
Calabasas	Roof-mounted solar must be placed in the least visible location without significantly reducing operating efficiency. Ground-mounted solar shall be screened from the public right of way.[6]
Camarillo	No mention of non-residential solar development in city ordinances.[7]
Carson	No mention of non-residential solar development in city ordinances.[8]
Claremont	City ordinances explicitly allow solar development in all zones.[9]
Culver City	On non-residential zoned parcels, parking lot solar is allowed up to a maximum of 13’ 6” above the allowable height of a building.[10]
Downey	No mention of non-residential solar development in city ordinances.[11]
Hawaiian Gardens	Only addresses solar attached to a building, but allowed with conditional use permit in non-residential zones and with a minor use permit in residential zones. Developments of new solar shall obtain easements from adjacent properties ensuring solar resources will not be blocked.[12]
Hawthorne	Solar development must be blocked from public view by a 6’-8’ fence. All other references only apply to solar for on-site use.[13]

Malibu	No mention of non-residential solar as large as CPA local solar projects.[14],[15]
Manhattan Beach	No additional restrictions for non-residential solar. Rooftop solar may exceed district height limits by 12".[16]
Moorpark	City has 1.1MW solar development at a wastewater treatment plant. Renewable energy development allowed pending conditional use permit in O-S (open space), A-E(agriculture exclusive), and R-A (residential agriculture).[17]
Ojai	No mention of non-residential solar as large as CPA local solar projects.[18]
Oxnard	No mention of non-residential solar development in city ordinances.[19]
Paramount	No mention of non-residential solar development in city ordinances.[20]
Redondo Beach	Adopted portions of the California Fire Code, which requires certain layouts on rooftop solar to allow for firefighting access.[21]
Rolling Hills Estates	No mention of non-residential solar development in city ordinances. [22]
Santa Monica	Non-residential rooftop solar must have a minimum total wattage of 2.0 watts per square foot and be placed in the least visible location unless energy production is significantly decreased as defined in the city ordinances. Rooftop non-residential solar may extend 5' above the rooftop even if it exceeds height allowances. Must be set back 2' from the property line.[23]; Has a municipal solar leasing program.
Sierra Madre	Ground-mounted solar requires a minor conditional use permit.[24]
Simi Valley	No mention of non-residential solar development in city ordinances.[25]
South Pasadena	Rooftop solar is exempt from zoning requirements as long as it does not exceed height limits.[26]
Temple City	No mention of non-residential solar development in city ordinances.[27]
Thousand Oaks	No mention of non-residential solar development in city ordinances.[28]
Ventura	No mention of non-residential solar development in city ordinances.[29]
West Hollywood	Rooftop solar may be 12' above the height limit. Zone clearance required as a part of construction permit.[30]
Whittier	No additional restrictions in municipal code.[31]

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[1] Municipal Code City of Agoura Hills, CA. https://library.municode.com/ca/agoura_hills/codes/code_of_ordinances?nodeId=11934

[2] City of Alhambra, California Code of Ordinances. https://codelibrary.amlegal.com/codes/alhambra/latest/alhambra_ca/0-0-0-88163

[3] Arcadia General Plan. *Chapter 6:Resource Sustainability Element.* November 2010. https://www.arcadiaca.gov/Shape%20Arcadia/Development%20Services/general%20plan/Resource%20Sustainability.pdf

[4] City of Arcadia Development Code. *Division 3: Site Planning and General Development Standards.* https://www.arcadiaca.gov/Shape%20Arcadia/Development%20Services/development%20code/3.Arcadia%20DevCodeDivision%203%20Site%20Planning%20and%20Gen%20Standards_FINAL.pdf

[5] City of Beverly Hills. *Building Permit FAQs and Resources.* http://www.beverlyhills.org/departments/communitydevelopment/permits/

[6] City of Calabasas Municipal Code. https://library.municode.com/ca/city_of_calabasas/codes/code_of_ordinances?nodeId=CICAMUCO

[7] City of Camarillo Municipal Code. https://library.municode.com/ca/camarillo/codes/code_of_ordinances?nodeId=CAMARILLOMUCO

[8] City of Carson Municipal Code. https://www.codepublishing.com/CA/Carson/#!/CarsonNT.html

[9] Claremont Municipal Code. http://www.qcode.us/codes/claremont/view.php?topic=16-16_145&frames=on

[10] Municipal Code of the City of Culver City. http://library.amlegal.com/nxt/gateway.dll/California/culver/themunicipalcodeofthecityofculvercitycal?f=templates$fn=default.htm$3.0$vid=amlegal:culvercity_ca

[11] City of Downey Municipal Code. https://qcode.us/codes/downey/

[12] City of Hawaiian Gardens Municipal Code. https://library.municode.com/ca/hawaiian_gardens/codes/municipal_code?nodeId=15728

[13] City of Hawthorne Municipal Code. http://www.qcode.us/codes/hawthorne/

[14] Malibu Municipal Code. https://qcode.us/codes/malibu/

[15] City of Malibu Photovoltaic Systems Plan Checklist. https://www.malibucity.org/DocumentCenter/View/207/Photovoltaic-Systems-Plan-Check-Guide

[16] Manhattan Beach Code of Ordinances. https://library.municode.com/ca/manhattan_beach/codes/code_of_ordinances

[17] City of Moorpark Municipal Code. https://qcode.us/codes/moorpark/

[18] City of Ojai Municipal Code. http://www.qcode.us/codes/ojai/

[19] City of Oxnard Code of Ordinances. https://codelibrary.amlegal.com/codes/oxnard/latest/overview

[20] City of Paramount Municipal Code. http://www.paramountcity.com/residents/community-development/municipal-code

[21] Redondo Beach Municipal Code. https://qcode.us/codes/redondobeach/

[22] City of Rolling Hills Estates Municipal Code. https://library.municode.com/ca/rolling_hills_estates/codes/code_of_ordinances

[23] City of Santa Monica Municipal Code. https://www.qcode.us/codes/santamonica/

[24] Sierra Madre Code of Ordinances. https://library.municode.com/ca/sierra_madre/codes/code_of_ordinances?nodeId=16627

[25] Simi Valley Municipal Code. https://library.municode.com/ca/simi_valley/codes/code_of_ordinances?nodeId=16629

[26] South Pasadena City Code. https://www.codepublishing.com/CA/SouthPasadena/

[27] Temple City City Code. https://codelibrary.amlegal.com/codes/templecityca/latest/overview

[28] The City of Thousand Oaks Municipal Code. https://codelibrary.amlegal.com/codes/thousandoaks/latest/thousandoaks_ca/0-0-0-1

[29] The City of Thousand Oaks Municipal Code. https://codelibrary.amlegal.com/codes/thousandoaks/latest/thousandoaks_ca/0-0-0-1

[30] West Hollywood Municipal Code. https://qcode.us/codes/westhollywood/

[31] Whittier Municipal Code https://library.municode.com/ca/whittier/codes/code_of_ordinances

Appendix D: Land Use Designations & Associated Analysis Categories

SCAG			Analysis Category
Category	Land Use Code	Description	
Single Family Residential	1110	Single Family Residential	Exclude
	1111	High Density Single Family Residential (9 or more DUs/ac)	Exclude
	1112	Medium Density Single Family Residential (3-8 DUs/ac)	Exclude
	1113	Low Density Single Family Residential (2 or less DUs/ac)	Exclude
Multi-Family Residential	1120	Multi-Family Residential	Exclude
	1121	Mixed Multi-Family Residential	Exclude
	1122	Duplexes, Triplexes and 2- or 3-Unit Condominiums and Townhouses	Exclude
	1123	Low-Rise Apartments, Condominiums, and Townhouses	Exclude
	1124	Medium-Rise Apartments and Condominiums	Exclude
	1125	High-Rise Apartments and Condominiums	Exclude
Mobile Homes and Trailer Parks	1130	Mobile Homes and Trailer Parks	Exclude
	1131	Trailer Parks and Mobile Home Courts, High-Density	Exclude
	1132	Mobile Home Courts and Subdivisions, Low-Density	Exclude
Mixed Residential	1140	Mixed Residential	Exclude
	1100	Residential	Exclude

Rural Residential	1150	Rural Residential	Exclude
General Office	1210	General Office Use	Disturbed
	1211	Low- and Medium-Rise Major Office Use	Disturbed
	1212	High-Rise Major Office Use	Disturbed
	1213	Skyscrapers	Disturbed
Commercial and Services	1200	Commercial and Services	Disturbed
	1220	Retail Stores and Commercial Services	Disturbed
	1221	Regional Shopping Center	Disturbed
	1222	Retail Centers (Non-Strip With Contiguous Interconnected Off-Street Parking)	Disturbed
	1223	Retail Strip Development	Disturbed
	1230	Other Commercial	Disturbed
	1231	Commercial Storage	Disturbed
	1232	Commercial Recreation	Disturbed
	1233	Hotels and Motels	Disturbed
Facilities	1240	Public Facilities	Disturbed
	1241	Government Offices	Disturbed
	1242	Police and Sheriff Stations	Disturbed
	1243	Fire Stations	Disturbed
	1244	Major Medical Health Care Facilities	Disturbed
	1245	Religious Facilities	Disturbed
	1246	Other Public Facilities	Disturbed
	1247	Public Parking Facilities	Disturbed
	1250	Special Use Facilities	Disturbed

	1251	Correctional Facilities	Disturbed
	1252	Special Care Facilities	Disturbed
	1253	Other Special Use Facilities	Disturbed
Education	1260	Educational Institutions	Disturbed
	1261	Pre-Schools/Day Care Centers	Disturbed
	1262	Elementary Schools	Disturbed
	1263	Junior or Intermediate High Schools	Disturbed
	1264	Senior High Schools	Disturbed
	1265	Colleges and Universities	Disturbed
	1266	Trade Schools and Professional Training Facilities	Disturbed
Military Installations	1270	Military Installations	Disturbed
	1271	Base (Built-up Area)	Disturbed
	1272	Vacant Area	Disturbed
	1273	Air Field	Disturbed
	1274	Former Base (Built-up Area)	Disturbed
	1275	Former Base Vacant Area	Disturbed
	1276	Former Base Air Field	Disturbed
Industrial	1300	Industrial	Disturbed
	1310	Light Industrial	Disturbed
	1311	Manufacturing, Assembly, and Industrial Services	Disturbed
	1312	Motion Picture and Television Studio Lots	Disturbed
	1313	Packing Houses and Grain Elevators	Disturbed

	1314	Research and Development	Disturbed
	1320	Heavy Industrial	Disturbed
	1321	Manufacturing	Disturbed
	1322	Petroleum Refining and Processing	Disturbed
	1323	Open Storage	Disturbed
	1324	Major Metal Processing	Disturbed
	1325	Chemical Processing	Disturbed
	1330	Extraction	Disturbed
	1331	Mineral Extraction - Other Than Oil and Gas	Disturbed
	1332	Mineral Extraction - Oil and Gas	Disturbed
	1340	Wholesaling and Warehousing	Disturbed
Transportation, Communications, and Utilities	1400	Transportation, Communications, and Utilities	Disturbed
	1410	Transportation	Disturbed
	1411	Airports	Disturbed
	1412	Railroads	Disturbed
	1413	Freeways and Major Roads	Disturbed
	1414	Park-and-Ride Lots	Disturbed
	1415	Bus Terminals and Yards	Disturbed
	1416	Truck Terminals	Disturbed
	1417	Harbor Facilities	Disturbed
	1418	Navigation Aids	Disturbed
	1420	Communication Facilities	Disturbed
	1430	Utility Facilities	Disturbed

	1431	Electrical Power Facilities	Disturbed
	1432	Solid Waste Disposal Facilities	Disturbed
	1433	Liquid Waste Disposal Facilities	Disturbed
	1434	Water Storage Facilities	Disturbed
	1435	Natural Gas and Petroleum Facilities	Disturbed
	1436	Water Transfer Facilities	Disturbed
	1437	Improved Flood Waterways and Structures	Disturbed
	1438	Mixed Utilities	Disturbed
	1440	Maintenance Yards	Disturbed
	1441	Bus Yards	Disturbed
	1442	Rail Yards	Disturbed
	1450	Mixed Transportation	Disturbed
	1460	Mixed Transportation and Utility	Disturbed
Mixed Commercial and Industrial	1500	Mixed Commercial and Industrial	Disturbed
Mixed Residential and Commercial	1600	Mixed Residential and Commercial	Disturbed
	1610	Residential-Oriented Residential/Commercial Mixed Use	Disturbed
	1620	Commercial-Oriented Residential/Commercial Mixed Use	Disturbed
Open Space and Recreation	1800	Open Space and Recreation	Exclude
	1810	Golf Courses	Exclude
	1820	Local Parks and Recreation	Exclude
	1830	Regional Parks and Recreation	Exclude

	1840	Cemeteries	Exclude
	1850	Wildlife Preserves and Sanctuaries	Exclude
	1860	Specimen Gardens and Arboreta	Exclude
	1870	Beach Parks	Exclude
	1880	Other Open Space and Recreation	Exclude
	1890	Off-Street Trails	Exclude
Agriculture	2000	Agriculture	Exclude
	2100	Cropland and Improved Pasture Land	Exclude
	2110	Irrigated Cropland and Improved Pasture Land	Exclude
	2120	Non-Irrigated Cropland and Improved Pasture Land	Exclude
	2200	Orchards and Vineyards	Exclude
	2300	Nurseries	Exclude
	2400	Dairy, Intensive Livestock, and Associated Facilities	Exclude
	2500	Poultry Operations	Exclude
	2600	Other Agriculture	Exclude
	2700	Horse Ranches	Exclude
Vacant	3000	Vacant	Vacant
	3100	Vacant Undifferentiated	Vacant
	3200	Abandoned Orchards and Vineyards	Vacant
	3300	Vacant With Limited Improvements	Vacant
	3400	Beaches (Vacant)	Vacant

	1900	Urban Vacant	Vacant
Water	4000	Water	Exclude
	4100	Water, Undifferentiated	Exclude
	4200	Harbor Water Facilities	Exclude
	4300	Marina Water Facilities	Exclude
	4400	Water Within a Military Installation	Exclude
	4500	Area of Inundation (High Water)	Exclude
Specific Plan	7777	Specific Plan	Exclude
Under Construction	1700	Under Construction	Exclude
Undevelopable or Protected Land	8888	Undevelopable or Protected Land	Exclude
Unknown	9999	Unknown	Exclude

Appendix E: Land Use Designations Identified as Potential Critical Facilities

SCAG		Category
Land Use Code	Description	
1240	Public Facilities	Facilities
1241	Government Offices	Facilities
1242	Police & Sheriff Stations	Facilities
1243	Fire Stations	Facilities
1244	Major Medical Health Care Facilities	Facilities
1245	Religious Facilities	Facilities
1246	Other Public Facilities	Facilities
1247	Public Parking Facilities	Facilities
1250	Special Use Facilities	Facilities
1251	Correctional Facilities	Facilities
1252	Special Care Facilities	Facilities
1253	Other Special Use Facilities	Facilities
1260	Educational Institutions	Education
1261	Pre-Schools/Day Care Centers	Education
1262	Elementary Schools	Education
1263	Junior or Intermediate High Schools	Education
1264	Senior High Schools	Education
1265	Colleges & Universities	Education
1266	Trade Schools & Professional Training Facilities	Education
1270	Military Installations	Military Installations
1271	Base (Built-up Area)	Military Installations
1272	Vacant Area	Military Installations
1273	Air Field	Military Installations

1274	Former Base (Built-up Area)	Military Installations
1275	Former Base Vacant Area	Military Installations
1276	Former Base Air Field	Military Installations
1400	Transportation, Communications, & Utilities	Transportation, Communications, & Utilities
1410	Transportation	Transportation, Communications, & Utilities
1411	Airports	Transportation, Communications, & Utilities
1412	Railroads	Transportation, Communications, & Utilities
1413	Freeways & Major Roads	Transportation, Communications, & Utilities
1414	Park-and-Ride Lots	Transportation, Communications, & Utilities
1415	Bus Terminals & Yards	Transportation, Communications, & Utilities
1416	Truck Terminals	Transportation, Communications, & Utilities
1417	Harbor Facilities	Transportation, Communications, & Utilities
1418	Navigation Aids	Transportation, Communications, & Utilities
1420	Communication Facilities	Transportation, Communications, & Utilities
1430	Utility Facilities	Transportation, Communications, & Utilities
1431	Electrical Power Facilities	Transportation, Communications, & Utilities
1432	Solid Waste Disposal Facilities	Transportation, Communications, & Utilities
1433	Liquid Waste Disposal Facilities	Transportation, Communications, & Utilities
1434	Water Storage Facilities	Transportation, Communications, & Utilities
1435	Natural Gas & Petroleum Facilities	Transportation, Communications, & Utilities
1436	Water Transfer Facilities	Transportation, Communications, & Utilities
1437	Improved Flood Waterways & Structures	Transportation, Communications, & Utilities
1438	Mixed Utilities	Transportation, Communications, & Utilities
1440	Maintenance Yards	Transportation, Communications, & Utilities
1441	Bus Yards	Transportation, Communications, & Utilities
1442	Rail Yards	Transportation, Communications, & Utilities
1450	Mixed Transportation	Transportation, Communications, & Utilities
1460	Mixed Transportation & Utility	Transportation, Communications, & Utilities

Appendix F: Historical Outage Analysis Visualizations

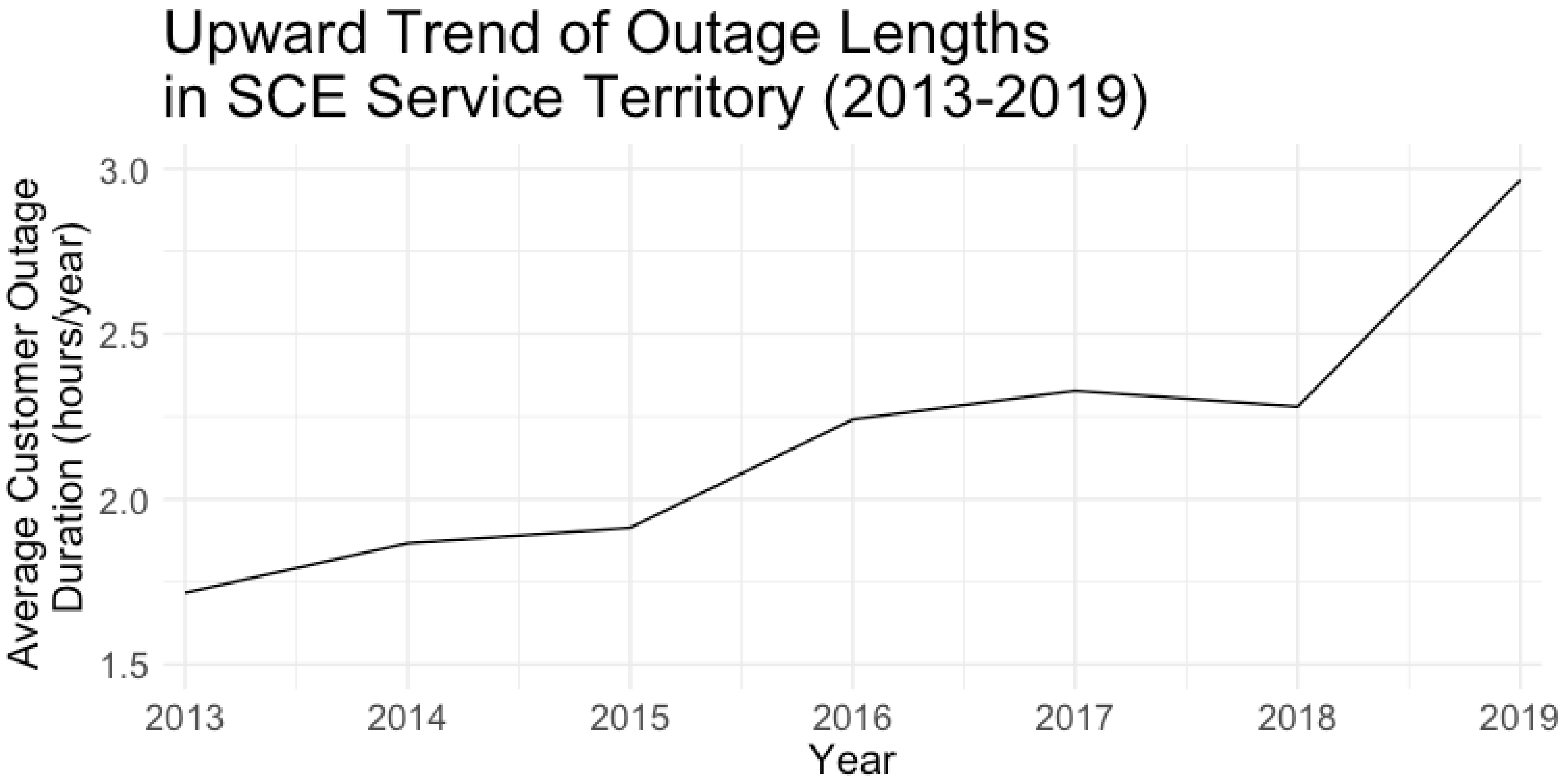

Figure F.1: Outage time across SCE service territory has been trending upward. Data source: EIA Utility Reliability Datatable, 2020.

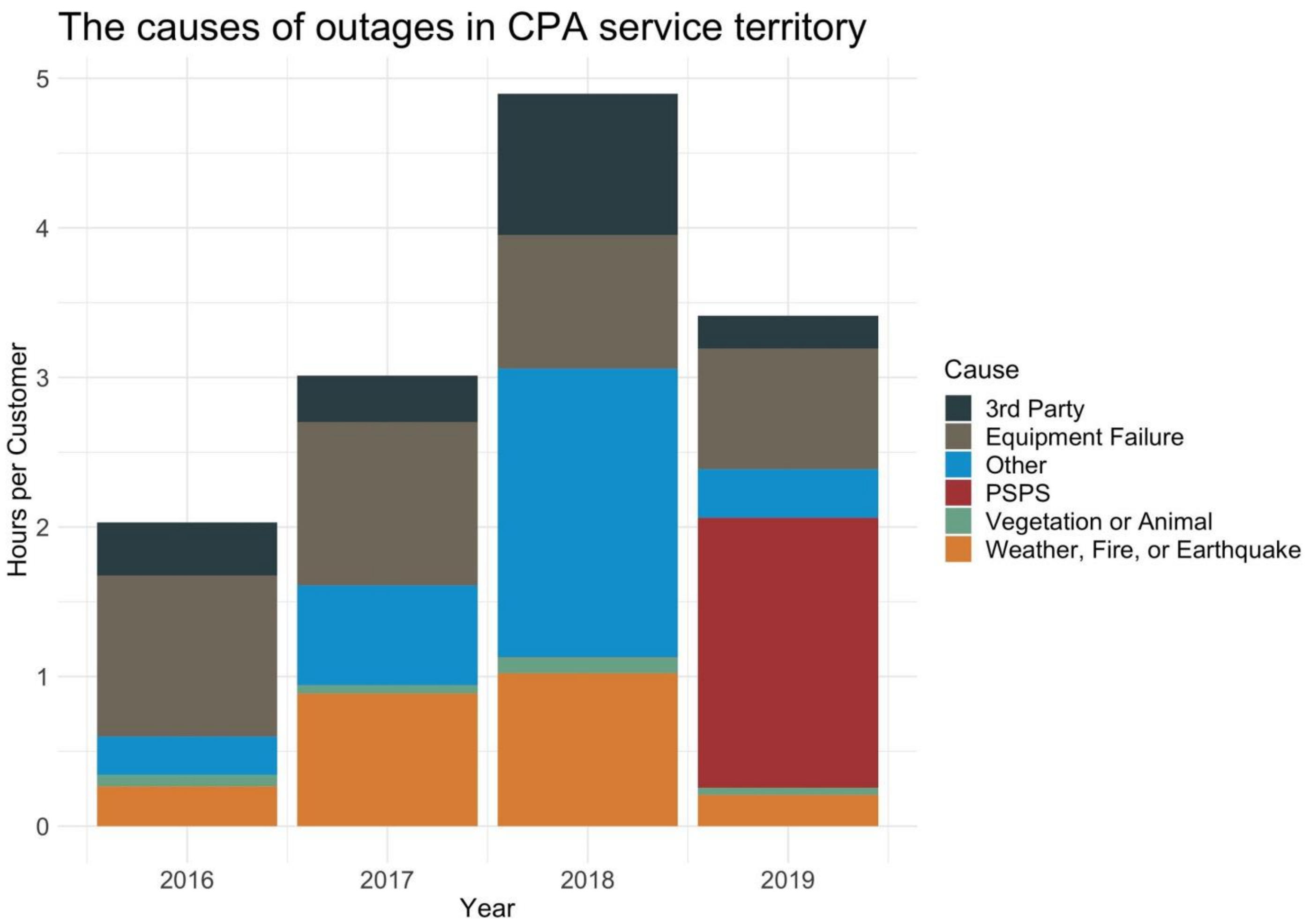

Figure F.2:The x-axis represents the year and the y-axis represents the number of hours an average customer in CPA's service territory was without power that year. The color represents the contribution of outage hours by cause. This was calculated by multiplying the number of SCE customers in each jurisdiction by the average annual outage hours (SAIDI) a customer experienced in that jurisdiction. The result is total outage hours per jurisdiction. Total outage hours were then multiplied by the % contribution to SAIDI of each cause for each community. The result is outage hours by cause per year. The color represents the contribution of outage hours by cause. Data source: SCE Annual Reliability Reports, 2020.

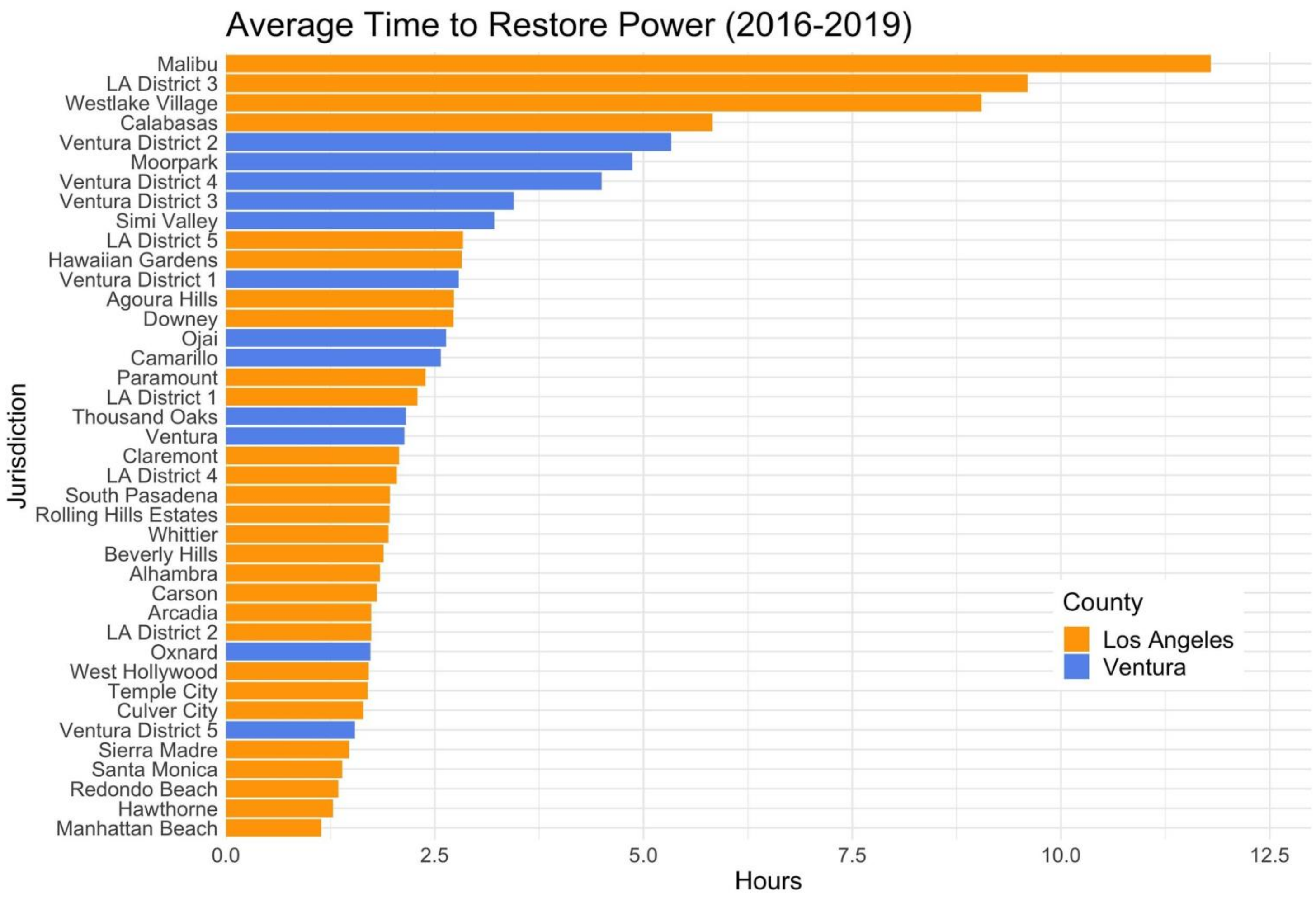

Figure F.3:Average time to restore power in Clean Power Alliance member jurisdictions. The y-axis is the jurisdiction name as labeled by SCE. The word "unincorporated" has been removed in front of Ventura and Los Angeles districts. The x-axis is the average number of hours across 2016-2019 that it took SCE to restore power after an unexpected outage. This is the CAIDI statistics and is calculated by dividing SAIDI by SAIFI (cumulative annual duration by number of outages) The colors distinguish between Ventura and Los Angeles counties.

Appendix G: Value of Lost Load

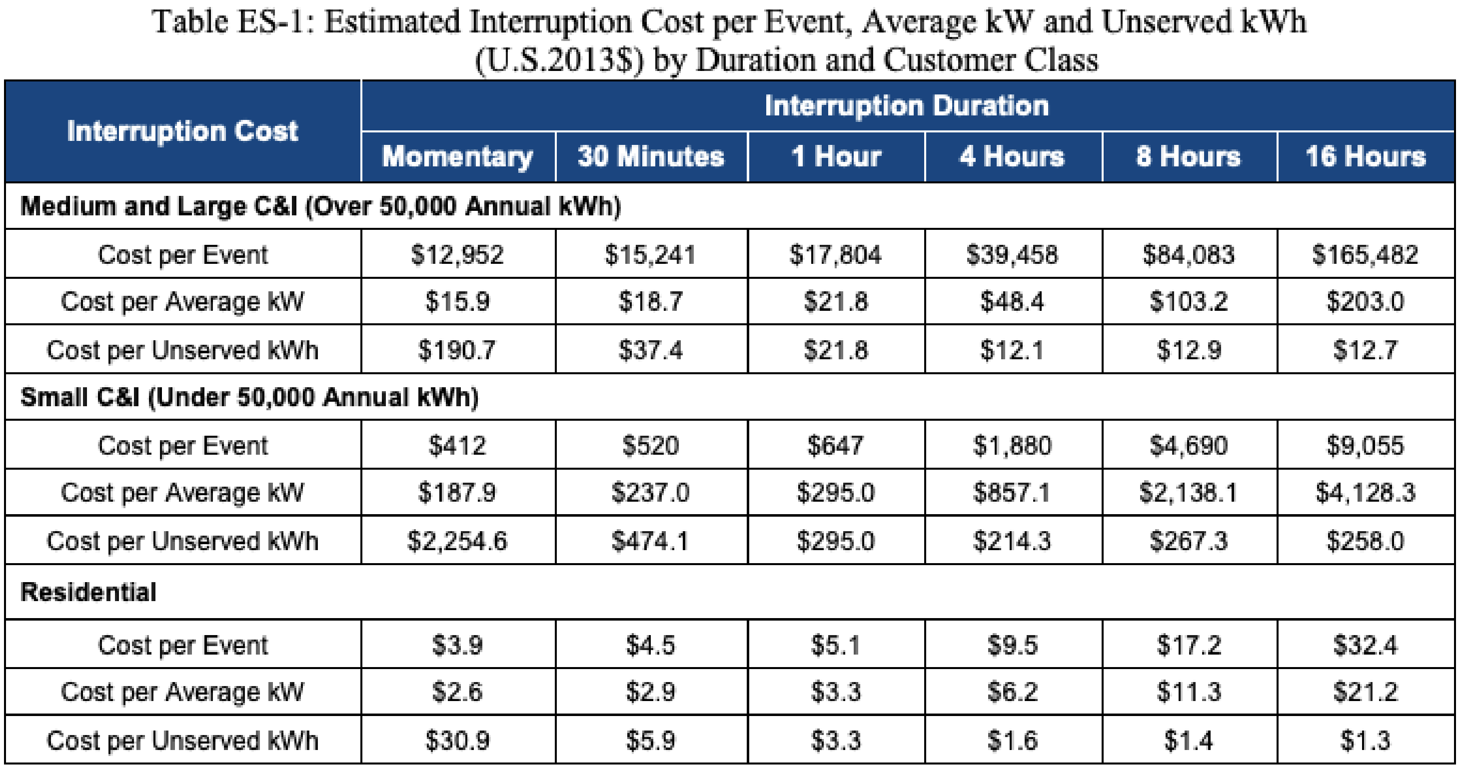

Table ES-1: Estimated Interruption Cost per Event, Average kW and Unserved kWh (U.S.2013$) by Duration and Customer Class

Interruption Cost	Interruption Duration					
	Momentary	30 Minutes	1 Hour	4 Hours	8 Hours	16 Hours
Medium and Large C&I (Over 50,000 Annual kWh)						
Cost per Event	$12,952	$15,241	$17,804	$39,458	$84,083	$165,482
Cost per Average kW	$15.9	$18.7	$21.8	$48.4	$103.2	$203.0
Cost per Unserved kWh	$190.7	$37.4	$21.8	$12.1	$12.9	$12.7
Small C&I (Under 50,000 Annual kWh)						
Cost per Event	$412	$520	$647	$1,880	$4,690	$9,055
Cost per Average kW	$187.9	$237.0	$295.0	$857.1	$2,138.1	$4,128.3
Cost per Unserved kWh	$2,254.6	$474.1	$295.0	$214.3	$267.3	$258.0
Residential						
Cost per Event	$3.9	$4.5	$5.1	$9.5	$17.2	$32.4
Cost per Average kW	$2.6	$2.9	$3.3	$6.2	$11.3	$21.2
Cost per Unserved kWh	$30.9	$5.9	$3.3	$1.6	$1.4	$1.3

Table ES-1 from Sullivan, M., Schellenberg, J., & Blundell, M. (2015).[1] The interruption costs in Table ES- 1 are for the average-sized customer in the meta-database. The average annual kWh usages for the respondents in the meta-database are 7,140,501 kWh for medium and large C&I customers, 19,214 kWh for small C&I customers and 13,351 kWh for residential customers.

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[1] Sullivan, M., Schellenberg, J., & Blundell, M. (2015). Updated Value of Service Reliability Estimates for Electric Utility Customers in the United States (LBNL--6941E, 1172643; p. LBNL--6941E, 1172643). https://doi.org/10.2172/1172643

Appendix H: Potential Critical Facilities (PCF) by CPA Member Jurisdiction

Jurisdiction	County	Number of PCFs
Unincorporated Los Angeles County	Los Angeles	3646
Unincorporated Ventura County	Ventura	1989
Thousand Oaks	Ventura	598
Simi Valley	Ventura	552
Oxnard	Ventura	531
Ventura	Ventura	328
Moorpark	Ventura	289
Camarillo	Ventura	236
Claremont	Los Angeles	212
Paramount	Los Angeles	166
Redondo Beach	Los Angeles	153
Ojai	Ventura	138
Santa Monica	Los Angeles	120
Alhambra	Los Angeles	116
Carson	Los Angeles	97
Arcadia	Los Angeles	75
Temple City	Los Angeles	68
Whittier	Los Angeles	51
Hawthorne	Los Angeles	49
South Pasadena	Los Angeles	49
Calabasas	Los Angeles	47
Manhattan Beach	Los Angeles	46
Downey	Los Angeles	45
Beverly Hills	Los Angeles	41
Hawaiian Gardens	Los Angeles	41
Malibu	Los Angeles	37
Rolling Hills Estates	Los Angeles	19
West Hollywood	Los Angeles	16
Westlake Village	Los Angeles	14
Culver City	Los Angeles	12
Agoura Hills	Los Angeles	7

Appendix I: Mapping Parameters

Data

Table I.1 : Mapping Data Sources

Data Layer	Type	Source	Year
DTSC Hazardous Waste and Substances Site List (Cortese List)	Point	Department of Toxic Substances Control	2020
Planting Stormwater Solutions	Polygon	The Nature Conservancy	2020
LA Parks Needs Assessment HEX	Polygon	County of Los Angeles	2014
LARIAC4 Buildings - Countywide Building Outlines	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4	2014
LARIAC4 Parking Lots	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4	2014
US Building Footprints	Polygon	Microsoft	2019
General Plan Land Use - Ventura	Polygon	Southern California Association of Governments (SCAG)	2020
General Plan Land Use - Los Angeles	Polygon	Southern California Association of Governments (SCAG)	2016
City and County Boundaries	Polygon	California Board of Equalization	2020
California Parks	Polygon	Community FactFinder	2020
Critical Infrastructure GIS Data: Power Plant	Point	California Energy Commission	2020
Local Reliability Subareas	Polygon	California Energy Commission	2016
Local Reliability Areas	Polygon	California Energy Commission	2016

Spatial Extent

Analysis was constrained to the Clean Power Alliance Service territory except for where assessing the edges of the territory depended on additional data, as in the park need analysis for Ventura County.

Greenspace & Habitat Mapping Parameters

General

Data: Clean Power Alliance (CPA) Service Territory		
Data Layer	**Type**	**Source**
City and County Boundaries	Polygon	California Board of Equalization
CPA Member Jurisdictions	Table	Clean Power Alliance

Methods: Clean Power Alliance Service Territory			
Step	**Tool**	**Parameters**	**Result**
1	Select by Attributes	Layer:	City and County Boundaries
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"City" IN (CPA Member Jurisdictions)
2	Extract		CPA Service Territory

Land Use

The fields recorded in Table I.1were added to the SCAG Land Use parcel datasets for both Ventura County and Los Angeles County.

Table I.1: Fields Added to SCAG Land Use Parcels for Analysis

Field Name	Alias	Type	Precision / Length	Purpose
Acreage		Float	0	Record parcel area in acres
BoA	Benefit of Adding	Float	0	Record the maximum Planting Stormwater Solution: Benefit of Adding value that intersects the parcel
BoA_Rank		String	10	Translate Benefit of Adding value to a rank of Low, Moderate, or High
Brownfield		Long	5	Record whether or not a DTSC Hazardous Waste and Substances Site List (Cortese List) point lies 100 feet or less from the parcels
Conflict		Long	5	Record the impact category determination
Critical		Long	5	Record whether or not the parcel has a land use identified as a potential critical facility
GH_Need		String	10	Record the final greenspace and habitat need of Low, Moderate, or High

Habitat		String	10	Record the overall habitat need rank of the parcel based on Benefit of Adding, Public Health Indicator, and Pollutant Load values
NEED_CODE		Long	5	Record the maximum Park Need value that intersects the parcel as a numeric rank
Park_Need	Park Need	String	10	Record the maximum Park Need value that intersects the parcel as Very Low, Low, Moderate, High, or Very High
PHI	Public Health Indicator	Float	0	Record the maximum Planting Stormwater Solution: Public Health Indicator value that intersects the parcel
PHI_Rank		String	10	Translate Public Health Indicator value to a rank of Low, Moderate, or High
PL	Pollutant Load	Float	0	Record the maximum Planting Stormwater Solution: Pollutant Load value that intersects the parcel
PL_Rank		String	10	Translate Pollutant Load value to a rank of Low, Moderate, or High

Vacant Land

Data: Vacant Land Identification

Data Layer	**Type**	**Source**
General Plan Land Use - Ventura	Polygon	Southern California Association of Governments (SCAG)
General Plan Land Use - Los Angeles	Polygon	Southern California Association of Governments (SCAG)

Methods: Identifying Vacant Land

Step	**Tool**	**Parameters**	**Result**
1	Select by Attributes	Layer:	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"SCAG_ID" IN ('3000', '3100', '3200', '3300', '3400', '1900')
2	Field Calculator	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles	!SCAG_ID! = "Vacant"

Disturbed Land

Data: Disturbed Land Identification

Data Layer	**Type**	**Source**

DTSC Hazardous Waste and Substances Site List (Cortese List)	Point	Department of Toxic Substances Control
General Plan Land Use - Ventura	Polygon	Southern California Association of Governments (SCAG)
General Plan Land Use - Los Angeles	Polygon	Southern California Association of Governments (SCAG)

Methods: Brownfield Identification			
Step	**Tool**	**Parameters**	**Result**
1	Select By Location	Selection method:	Select features from
		Target layer(s):	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles
		Source layer:	DTSC Hazardous Waste and Substances Site List (Cortese List)
		Spatial selection method for target layer feature(s):	are within a distance of the source layer feature
		Apply a search distance:	100 feet
2	Field Calculator	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles	!Brownfield! = 1

Methods: Identifying Disturbed Land

Step	Tool	Parameters	Result
1	Select by Attributes	Layer:	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"SCAG_ID" IN ('1210', '1211', '1212' , '1213' , '1200' , '1220' , '1221' , '1222' , '1223' , '1230' , '1231' , '1232' , '1233', '1240' , '1241' , '1242' , '1243' , '1244' , '1245' , '1246' , '1247' , '1250' , '1251' , '1252' , '1253' , '1260', '1261' , '1262' , '1263' , '1264' , '1265' , '1266' , '1270' , '1271' , '1272' , '1273' , '1274' , '1275' , '1276', '1300' , '1310' , '1311' , '1312' , '1313' , '1314' , '1320' , '1321' , '1322' , '1323' , '1324' , '1325' , '1330', '1331' , '1332' , '1340' , '1400' , '1410' , '1411' , '1412' , '1413' , '1414' , '1415' , '1416' , '1417' , '1418', '1420' , '1430' , '1431' , '1432' , '1433' , '1434' , '1435' , '1436' , '1437' , '1438' , '1440' , '1441' , '1442', '1450' , '1460' , '1500' , '1600' , '1610' , '1620')
2	Field Calculator	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles	!SCAG_ID! = "Disturbed"
3	Select by Attributes	Layer:	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"Brownfield" = 1
4	Select by Attributes	Layer:	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles
		Method:	Remove from selection
		SELECT * FROM layer WHERE:	!SCAG_ID! = "Vacant"
5	Field Calculator	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles	!SCAG_ID! = "Disturbed"

Parking Lots

Data: Parking Lot Capacity Identification - Los Angeles County		
Data Layer	**Type**	**Source**
LARIAC4 Parking Lots	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4

Methods: Parking Lot Capacity Identification - Los Angeles County			
Step	**Tool**	**Parameters**	**Result**
1	Select by Attributes	Layer:	LARIAC4 Parking Lots
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"UseType" <> 'Residential'
2	Extract		LARIAC4 Parking Lots - Non-Residential
3	Dissolve	Input Features	LARIAC4 Parking Lots - Non-Residential
		Output Feature Class	LARIAC4 Parking Lots - Non-Residential - Dissolve
		Dissolve Field(s) (optional)	
		Create multipart features	No
4	Calculate Geometry	Field:	Acreage
		Property:	Area
		Coordinate system:	Use coordinate system of the data source (NAD 1983 California Teale Albers)
		Units:	Acres
5	Select by Attributes	Layer:	LARIAC4 Parking Lots - Non-Res - Dissolve
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"Acreage" >= 2
6	Extract		LARIAC4 Parking Lots - Non-Res - Dissolve 2ac
7	Select By Location	Selection method:	Select features from
		Target layer(s):	LARIAC4 Parking Lots - Non-Res
		Source layer:	LARIAC4 Parking Lots - Non-Res- Dissolve 2ac
		Spatial selection method for target layer feature(s):	intersect the source layer feature
8	Extract		LARIAC4 Parking Lots - Non-Res - 2ac

Buildings

Data: Building Rooftop Capacity Identification		
Data Layer	**Type**	**Source**
LARIAC4 Buildings - Countywide Building Outlines	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4
US Building Footprints	Polygon	Microsoft

Methods: Building Rooftop Capacity Identification			
Step	**Tool**	**Parameters**	**Result**
1	Select by Attributes	Layer:	LARIAC4 Buildings - Countywide Building Outlines; US Building Footprints
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"UseType" <> 'Residential'
2	Extract		Buildings - Non-Residential
3	Calculate Geometry	Field:	Acreage
		Property:	Area
		Coordinate system:	Use coordinate system of the data source (NAD 1983 California Teale Albers)
		Units:	Acres
4	Select by Attributes	Layer:	Buildings - Non-Residential
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"Acreage" >= 2
5	Extract		Buildings - Non-Residential - 2ac

Greenspace & Habitat Need

Los Angeles County

Data: Park Need - Los Angeles County

Data Layer	Type	Source
LA Parks Needs Assessment HEX	Polygon	County of Los Angeles
LARIAC4 Buildings - Countywide Building Outlines	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4
LARIAC4 Parking Lots	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4
General Plan Land Use - Los Angeles	Polygon	Southern California Association of Governments (SCAG)

Methods: Parcel Park Need - Los Angeles County

Step	Tool	Parameters	Result
1	Dissolve	Input Features	LA Parks Needs Assessment HEX
		Output Feature Class	LA Parks Needs Assessment HEX - Dissolve
		Dissolve Field(s) (optional)	
		Create multipart features	No

2	Field Calculator	LA Parks Needs Assessment HEX - Dissolve	!NEED_CODE! =
			if (!Park_Need! = <NULL>):
			return 0
			elif (!Park_Need! = “Very Low”):
			return 1
			elif (!Park_Need! = “Low”):
			return 2
			elif (!Park_Need! = “Moderate”):
			return 3
			elif (!Park_Need! = “High”):
			return 4
			elif (!Park_Need! = “Very High”):
			return 5

3	Spatial Join	Target Features	General Plan Land Use - Los Angeles
		Join Features	LA Parks Needs Assessment HEX - Dissolve
		Output Feature Class	General Plan Land Use - Los Angeles - Park Need Joined
		Join Operation (optional)	

		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	NEED_CODE (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

4	Field Calculator	General Plan Land Use - Los Angeles - Park Need Joined	!Park_Need! =
			if (!NEED_CODE! = 0):
			return “”
			elif (!NEED_CODE! != 1):
			return “Very Low”
			elif (!NEED_CODE! != 2):
			return “Low”
			elif (!NEED_CODE! != 3):
			return “Moderate”
			elif (!NEED_CODE! != 4):
			return “High”
			elif (!NEED_CODE! != 5):
			return “Very High”

Methods: Parking Lot Park Need - Los Angeles County

Step	Tool	Parameters	Result
1	Spatial Join	Target Features	LARIAC4 Parking Lots
		Join Features	LA Parks Needs Assessment HEX - Dissolve
		Output Feature Class	LARIAC4 Parking Lots - Park Need Joined
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	NEED_CODE (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	
2	Field Calculator	LARIAC4 Parking Lots - Park	!Park_Need! =

		Need Joined	if (!NEED_CODE! = 0):
			return “”
			elif (!NEED_CODE! != 1):
			return “Very Low”
			elif (!NEED_CODE! != 2):
			return “Low”
			elif (!NEED_CODE! != 3):
			return “Moderate”
			elif (!NEED_CODE! != 4):
			return “High”
			elif (!NEED_CODE! != 5):
			return “Very High”

Methods: Building Rooftop Park Need - Los Angeles County

Step	Tool	Parameters	Result
1	Spatial Join	Target Features	LARIAC4 Buildings - Los Angeles
		Join Features	LA Parks Needs Assessment HEX - Dissolve
		Output Feature Class	LARIAC4 Buildings - Los Angeles - Park Need Joined
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	NEED_CODE (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

2	Field Calculator	LARIAC4 Buildings - Los Angeles - Park Need Joined	!Park_Need! =
			if (!NEED_CODE! = 0):
			return “”
			elif (!NEED_CODE! != 1):
			return “Very Low”
			elif (!NEED_CODE! != 2):
			return “Low”
			elif (!NEED_CODE! != 3):
			return “Moderate”
			elif (!NEED_CODE! != 4):
			return “High”

			elif (!NEED_CODE! != 5): return “Very High”

Data: Habitat Need - Los Angeles County		
Data Layer	**Type**	**Source**
Planting Stormwater Solutions	Polygon	The Nature Conservancy
LARIAC4 Buildings - Countywide Building Outlines	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4
LARIAC4 Parking Lots	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4
General Plan Land Use - Los Angeles	Polygon	Southern California Association of Governments (SCAG)

Methods: Parcel Habitat Need - Los Angeles County			
Step	**Tool**	**Parameters**	**Result**
1	Spatial Join	Target Features	General Plan Land Use - Los Angeles
		Join Features	Planting Stormwater Solutions
		Output Feature Class	General Plan Land Use - Los Angeles - PSS
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	Benefit_of_Adding (maximum) Pollutant Load (maximum) Public Health Indicator (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

2	Field Calculator	General Plan Land Use - Los Angeles - PSS	!BoA_Rank! =
			if (!BoA! <= 0.127973):
			return 'Low'
			elif (!BoA! > 0.127973 AND !BoA! <= 0.200434):
			return 'Moderate'
			elif (!BoA! > 0.200434):
			return 'High'

3	Field Calculator	General Plan Land Use - Los	!PL_Rank! =

		Angeles - PSS	if (!PL! <= 0.176110):
			return 'Low'
			elif (!PL! > 0.176110 AND !PL! <= 0.268991):
			return 'Moderate'
			elif (!PL! > 0.268991):
			return 'High'

4	Field Calculator	General Plan Land Use - Los Angeles - PSS	!PHI_Rank! =
			if (!PHI! < 4):
			return 'Low'
			elif (!PHI! >= 4 AND !PHI! <= 7):
			return 'Moderate'
			elif (!PHI! > 7):
			return 'High'

5	Field Calculator	General Plan Land Use - Los Angeles - PSS	!Habitat! =
			if (!BoA_Rank! = 'High' or !PL_Rank! = 'High' or !PHI_Rank! = 'High'):
			return 'High'
			elif (!BoA_Rank! = 'Low' and !PL_Rank! = 'Low' and !PHI__Rank! = 'Low'):
			return 'Low

6	Field Calculator	General Plan Land Use - Los Angeles - PSS	!Habitat! =
			if (!BoA_Rank! != 'High' and !PL_Rank! != 'High' and !PHI_Rank! = 'Moderate'):
			return 'Moderate'
			elif (!BoA_Rank! != 'High' and !PL_Rank! = 'Moderate' and !PHI_Rank! != 'High'):
			return 'Moderate’
			elif (!BoA_Rank! = 'Moderate' and !PL_Rank! != 'High’ and !PHI_Rank! != 'High'):
			return 'Moderate’

Methods: Parking Lot Habitat Need - Los Angeles County

Step	Tool	Parameters	Result
1	Spatial Join	Target Features	LARIAC4 Parking Lots
		Join Features	Planting Stormwater Solutions
		Output Feature Class	LARIAC4 Parking Lots - PSS
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	Benefit_of_Adding (maximum) Pollutant Load (maximum) Public Health Indicator (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

2	Field Calculator	LARIAC4 Parking Lots - PSS	!BoA_Rank! =
			if (!BoA! <= 0.127973):
			return 'Low'
			elif (!BoA! > 0.127973 AND !BoA! <= 0.200434):
			return 'Moderate'
			elif (!BoA! > 0.200434):
			return 'High'

3	Field Calculator	LARIAC4 Parking Lots - PSS	!PL_Rank! =
			if (!PL! <= 0.176110):
			return 'Low'
			elif (!PL! > 0.176110 AND !PL! <= 0.268991):
			return 'Moderate'
			elif (!PL! > 0.268991):
			return 'High'

4	Field Calculator	LARIAC4 Parking Lots - PSS	!PHI_Rank! =
			if (!PHI! < 4):
			return 'Low'
			elif (!PHI! >= 4 AND !PHI! <= 7):
			return 'Moderate'
			elif (!PHI! > 7):
			return 'High'

5	Field Calculator	LARIAC4 Parking Lots - PSS	!Habitat! =
			if (!BoA_Rank! = 'High' or !PL_Rank! = 'High' or !PHI_Rank! = 'High'):
			return 'High'
			elif (!BoA_Rank! = 'Low' and !PL_Rank! = 'Low' and !PHI__Rank! = 'Low'):
			return 'Low

6	Field Calculator	LARIAC4 Parking Lots - PSS	!Habitat! =

			if (!BoA_Rank! != 'High' and !PL_Rank! != 'High' and !PHI_Rank! = 'Moderate'):
			return 'Moderate'
			elif (!BoA_Rank! != 'High' and !PL_Rank! = 'Moderate' and !PHI_Rank! != 'High'):
			return 'Moderate’
			elif (!BoA_Rank! = 'Moderate' and !PL_Rank! != 'High’ and !PHI_Rank! != 'High'):
			return 'Moderate’

Methods: Building Rooftop Habitat Need - Los Angeles County

Step	Tool	Parameters	Result
1	Spatial Join	Target Features	LARIAC4 Buildings - Los Angeles
		Join Features	Planting Stormwater Solutions
		Output Feature Class	LARIAC4 Buildings - Los Angeles - Park Need Joined - PSS
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	Benefit_of_Adding (maximum) Pollutant Load (maximum) Public Health Indicator (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

2	Field Calculator	LARIAC4 Buildings - Los Angeles - Park Need Joined - PSS	!BoA_Rank! =
			if (!BoA! <= 0.127973):
			return 'Low'
			elif (!BoA! > 0.127973 AND !BoA! <= 0.200434):
			return 'Moderate'
			elif (!BoA! > 0.200434):
			return 'High'

3	Field Calculator	LARIAC4 Buildings - Los Angeles - Park Need Joined - PSS	!PL_Rank! =
			if (!PL! <= 0.176110):
			return 'Low'
			elif (!PL! > 0.176110 AND !PL! <= 0.268991):
			return 'Moderate'
			elif (!PL! > 0.268991):
			return 'High'

4	Field Calculator	LARIAC4 Buildings - Los Angeles - Park Need Joined - PSS	!PHI_Rank! =
			if (!PHI! < 4):
			return 'Low'
			elif (!PHI! >= 4 AND !PHI! <= 7):
			return 'Moderate'
			elif (!PHI! > 7):
			return 'High'

5	Field Calculator	LARIAC4 Buildings - Los Angeles - Park Need Joined - PSS	!Habitat! =
			if (!BoA_Rank! = 'High' or !PL_Rank! = 'High' or !PHI_Rank! = 'High'):
			return 'High'
			elif (!BoA_Rank! = 'Low' and !PL_Rank! = 'Low' and !PHI__Rank! = 'Low'):
			return 'Low

6	Field Calculator	LARIAC4 Buildings - Los Angeles - Park Need Joined - PSS	!Habitat! =
			if (!BoA_Rank! != 'High' and !PL_Rank! != 'High' and !PHI_Rank! = 'Moderate'):
			return 'Moderate'
			elif (!BoA_Rank! != 'High' and !PL_Rank! = 'Moderate' and !PHI_Rank! != 'High'):
			return 'Moderate’
			elif (!BoA_Rank! = 'Moderate' and !PL_Rank! != 'High’ and !PHI_Rank! != 'High'):
			return 'Moderate’

Methods: Greenspace & Habitat Need - Los Angeles County			
Step	**Tool**	**Parameters**	**Result**

1	Field Calculator	General Plan Land Use - Los Angeles,
		LARIAC4 Parking Lots - PSS,
			!GH_Need! =
			if (!Park_Need! = “High” or !Habitat! = “High”):
			return “High”
			elif (!Park_Need! = “Low” and !Habitat! = “Low”):
			return “Low”
			elif (!Park_Need! != “High” and !Habitat! = “Moderate”):
			return “Moderate”
			elif (!Park_Need! = “Moderate” and !Habitat! != “High”):
			return “Moderate”

Ventura County

Data: Park Need - Ventura County		
Data Layer	**Type**	**Source**
California Parks	Polygon	Community FactFinder
CPA Service Territory	Polygon	
LARIAC4 Buildings - Countywide Building Outlines	Polygon	County of Los Angeles Region Imagery Acquisition Consortium (LARIAC) 4
General Plan Land Use - Ventura	Polygon	Southern California Association of Governments (SCAG)

Methods: Parcel Park Need - Ventura County			
Step	**Tool**	**Parameters**	**Result**
1	Select By Location	Selection method:	Select features from
		Target layer(s):	California Parks
		Source layer:	CPA Service Territory
		Spatial selection method for target layer feature(s):	are within a distance of the source layer feature
		Apply a search distance:	5 miles
2	Extract		CPAST Parks - 5 mi
3	Multiple Ring Buffer	Input Features	California Parks
		Output Feature Class	California Parks - Distance

		Distances	0.5, 1, 10
		Buffer Unit (optional)	Miles
		Field Name (optional)	Park_Distance
		Dissolve Option (optional)	All
		Outside Polygons Only (optional)	Full

4	Field Calculator	California Parks - Distance	!NEED_CODE! =
			if (!Park_Distance! = 0.5):
			return 2
			elif (!Park_Distance! != 1):
			return 3
			elif (!Park_Distance! != 10):
			return 4

5	Spatial Join	Target Features	General Plan Land Use - Ventura
		Join Features	California Parks - Distance
		Output Feature Class	General Plan Land Use - Ventura - Park Need Joined
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	NEED_CODE (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

6	Field Calculator	General Plan Land Use - Ventura - Park Need Joined	!Park_Need! =
			if (!NEED_CODE! = 0):
			return “”
			elif (!NEED_CODE! != 2):
			return “Low”
			elif (!NEED_CODE! != 3):
			return “Moderate”
			elif (!NEED_CODE! != 4):
			return “High”

Methods: Building Rooftop Park Need - Ventura County			
Step	**Tool**	**Parameters**	**Result**
1	Spatial Join	Target Features	LARIAC4 Buildings - Countywide Building Outlines; US Building Footprints
		Join Features	California Parks - Distance
		Output Feature Class	LARIAC4 Buildings - Countywide Building Outlines; US Building Footprints - Ventura Park Need Joined
		Join Operation (optional)	
		Keep All Target Features (optional)	
		Field Map of Join Features (optional)	NEED_CODE (maximum)
		Match Option (optional)	
		Search Radius (optional)	
		Distance Field Name (optional)	

2	Field Calculator	LARIAC4 Buildings - Countywide Building Outlines; US Building Footprints - Ventura Park Need Joined	!Park_Need! =
			if (!NEED_CODE! = 0):
			return “”
			elif (!NEED_CODE! != 2):
			return “Low”
			elif (!NEED_CODE! != 3):
			return “Moderate”
			elif (!NEED_CODE! != 4):
			return “High”

Impact Category

Methods: Impact Category - Los Angeles County			
Step	**Tool**	**Parameters**	**Result**

1	Field Calculator	General Plan Land Use - Los Angeles - GH_Need Calculated	!Conflict! = if (!GH_Need! = “High” and Vacant = 1):
			return 1
			elif (!GH_Need! = “Moderate” and Vacant = 1):
			return 2
			elif (!GH_Need! = “Low” and Vacant = 1):
			return 3
			elif (!GH_Need! = “High” and Disturbed = 1):
			return 4
			elif (!GH_Need! = “Moderate” and Disturbed = 1):
			return 5
			elif (!GH_Need! = “Low” and Disturbed = 1):
			return 6

2	Field Calculator	LARIAC4 Parking Lots - GH_Need Calculated	if (!GH_Need! = “High”):
			return 7
			elif (!GH_Need! = “Moderate”):
			return 8
			elif (!GH_Need! = “Low”):
			return 9

3	Field Calculator	LARIAC4 Building Footprints - GH_Need Calculated	if (!GH_Need! = “High”):
			return 7
			elif (!GH_Need! = “Moderate”):
			return 8
			elif (!GH_Need! = “Low”):
			return 9

Methods: Impact Category - Ventura County			
Step	**Tool**	**Parameters**	**Result**

1	Field Calculator	General Plan Land Use - Ventura - Park_Need Calculated	!Conflict! =
			if (!Park_Need! = “High” and Vacant = 1):
			return 1
			elif (!Park_Need! = “Moderate” and Vacant = 1):
			return 2
			elif (!Park_Need! = “Low” and Vacant = 1):
			return 3
			elif (!Park_Need! = “High” and Disturbed = 1):
			return 4
			elif (!Park_Need! = “Moderate” and Disturbed = 1):
			return 5
			elif (!Park_Need! = “Low” and Disturbed = 1):
			return 6

2	Field Calculator	LARIAC4 Building Footprints - Park_Need Calculated	if (!Park_Need! = “High”):
			return 7
			elif (!Park_Need! = “Moderate”):
			return 8
			elif (!Park_Need! = “Low”):
			return 9

Resilience Mapping Parameters

Data: Potential Critical Facility Identification		
Data Layer	**Type**	**Source**
General Plan Land Use - Ventura	Polygon	Southern California Association of Governments (SCAG)
General Plan Land Use - Los Angeles	Polygon	Southern California Association of Governments (SCAG)

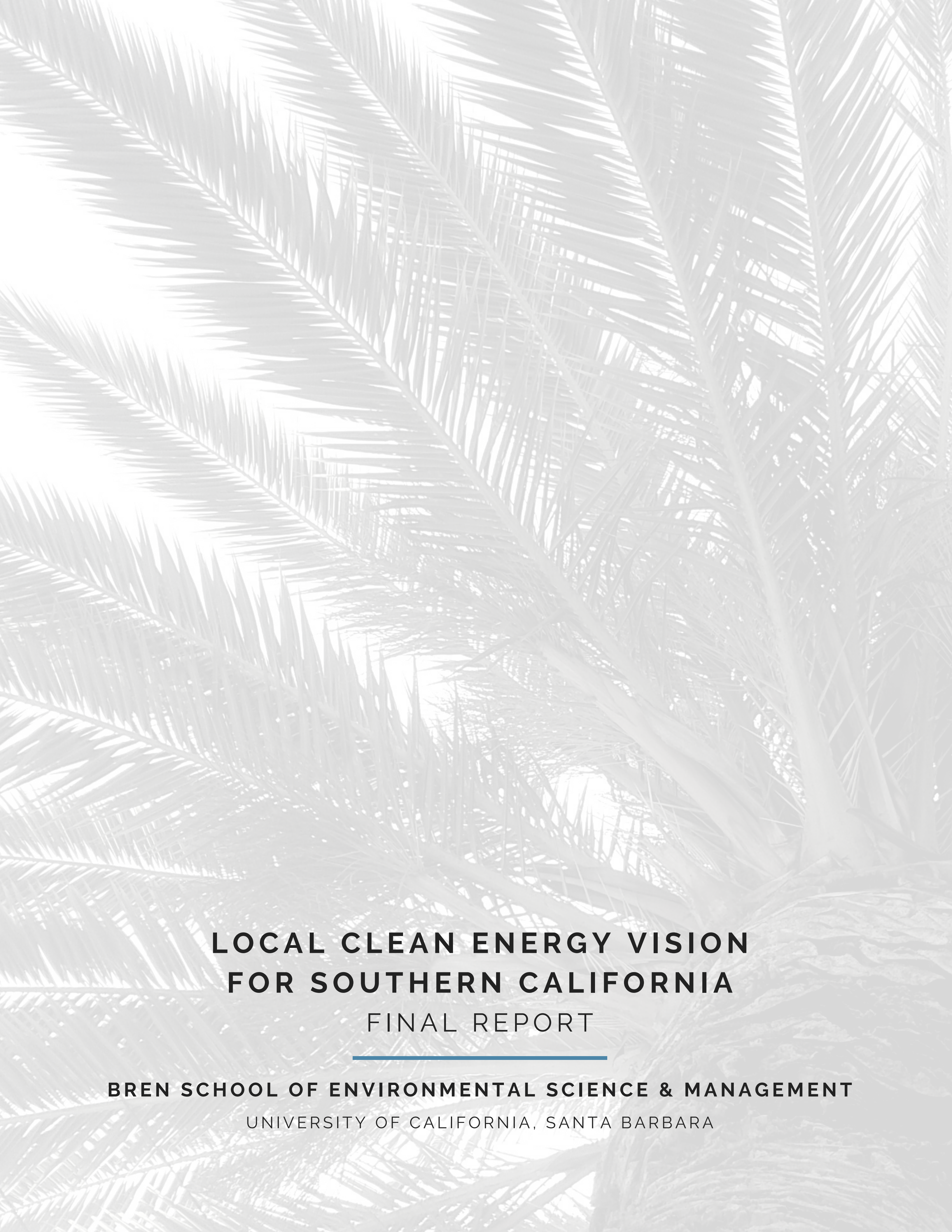
Methods: Potential Critical Facility Identification			
Step	**Tool**	**Parameters**	**Result**
1	Select by Attributes	Layer:	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles
		Method:	Create a new selection
		SELECT * FROM layer WHERE:	"SCAG_ID" IN ('1240', '1241', '1242', '1243', '1244', '1245', '1246', '1247', '1250', '1251', '1252', '1253', '1260', '1261', '1262', '1263', '1264', '1265', '1266', '1270', '1271', '1272', '1273', '1274', '1275', '1276', '1400', '1410', '1411', '1412', '1413', '1414', '1415', '1416', '1417', '1418', '1420', '1430', '1431', '1432', '1433', '1434', '1435', '1436', '1437', '1438', '1440', '1441', '1442', '1450', '1460')
2	Field Calculator	General Plan Land Use - Ventura; General Plan Land Use - Los Angeles	!Critical! = 1

Air Quality Mapping Parameters

Data: Power Plant Analysis		
Data Layer	**Type**	**Source**
Clean Power Alliance Service Territory	Polygon	Solsite
Critical Infrastructure GIS Data: Power Plant	Point	California Energy Commission
Local Reliability Subareas	Polygon	California Energy Commission
Local Reliability Areas	Polygon	California Energy Commission

Methods: CPA Service Territory Power Plants			
Step	**Tool**	**Parameters**	**Result**
1	Select By Location	Selection method:	Select features from
		Target layer(s):	Local Reliability Areas
		Source layer:	Clean Power Alliance Service Territory
		Spatial selection method for target layer feature(s):	intersect the source layer feature
2	Extract		CPAST_Power_Gen
3	Export Attribute Table		CPAST_Power_Gen.dbf
4	Convert Attribute Table		CPAST_Power_Gen.csv

Methods: Power Plant Attribute Update			
Step	**Tool**	**Parameters**	**Result**
1	Join	Layer	CPAST_Power_Gen
		What do you want to join to this layer?	Join attributes from a table
		Choose the field in this layer that the join will be based on:	Plant_ID
		Choose the table to join to this layer...:	CPAST_Power_Gen_Updated.csv
		Choose the field in the table to base the join on:	Plant_ID
		Join Options	Keep all records
2	Extract		CPAST_Power_Gen_Updated



LOCAL CLEAN ENERGY VISION FOR SOUTHERN CALIFORNIA

FINAL REPORT

BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT

UNIVERSITY OF CALIFORNIA, SANTA BARBARA