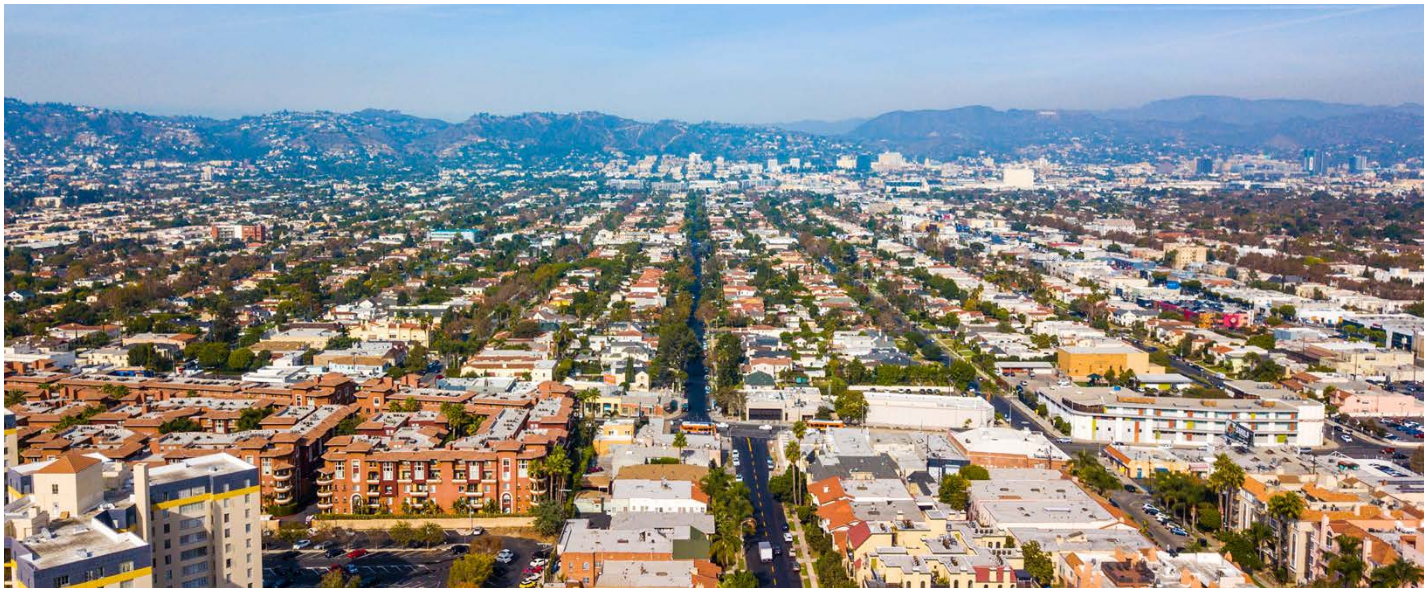

Chapter 1: Justice as Recognition

FINAL REPORT: LA100 Equity Strategies

Patricia Romero-Lankao, Nicole Rosner, Jane Lockshin, Daniel Zimny-Schmitt, and Lis Blanco

LA100 EQUITY STRATEGIES

Chapter 1: Justice as Recognition

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Preface

The Los Angeles 100% Renewable Energy Study, or LA100, revealed that although all communities in Los Angeles will share in the air quality and public health benefits of the clean energy transition, increasing equity in participation and outcomes will require intentionally designed policies and programs. The LA100 Equity Strategies project was specifically designed to help Los Angeles identify pathways to such policies and programs in the form of equity strategies. The project aimed to do this by incorporating research and analysis to chart a course toward specific, community-prioritized, and equitable outcomes from the clean energy transition outlined in the LA100 study.

The Project Partners

The Los Angeles Department of Water and Power (LADWP), the National Renewable Energy Laboratory (NREL), and the University of California Los Angeles (UCLA) partnered on the LA100 Equity Strategies project to develop strategies for engaging communities, funding equitable technology and infrastructure investments, expanding existing programs, and designing new programs and policies to improve equity by incorporating what community members themselves know is needed to achieve a more equitable energy future.

The Project Approach

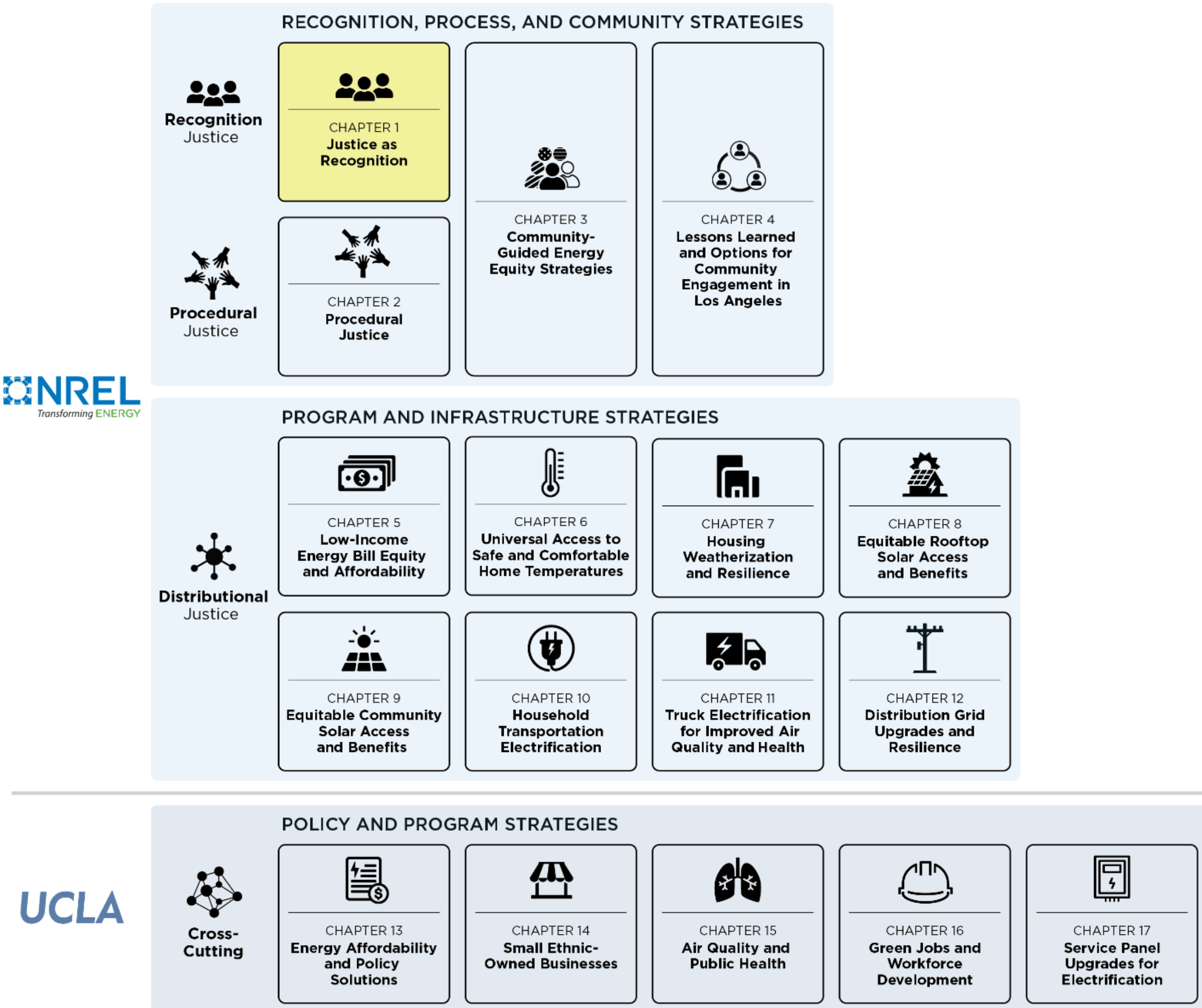
LA100 Equity Strategies employs a unique mixed-methodological approach utilizing three distinct—but connected—research efforts. Through these efforts, NREL and UCLA developed a range of strategy options for increasing equity in LA's transition to 100% clean energy.

A Project Summary

To get a high-level overview of the project, you can dive into the executive summary, interactive data visualizations, and more on the LA100 Equity Strategies website at maps.nrel.gov/la100/equity-strategies.

The Full Report

NREL's final full report for the LA100 Equity Strategies project encompasses seventeen chapters. The first twelve chapters, authored by NREL, are organized around the three tenets of justice. Chapters 1–4 address recognition and procedural justice, while Chapters 5–12 address distributional justice. The final five chapters, authored by UCLA, provide crosscutting policy and program strategies. Each chapter provides data, methods, insights, and strategies to help LADWP make data-driven, community-informed decisions for equitable investments and program development.



NREL Chapters

Chapter 1: Justice as Recognition

Chapter 2: Procedural Justice

Chapter 3: Community-Guided Energy Equity Strategies

Chapter 4: Lessons Learned and Options for Community Engagement in Los Angeles

Chapter 5: Low-Income Energy Bill Equity and Affordability

Chapter 6: Universal Access to Safe and Comfortable Home Temperatures

Chapter 7: Housing Weatherization and Resilience

Chapter 8: Equitable Rooftop Solar Access and Benefits

Chapter 9: Equitable Community Solar Access and Benefits

Chapter 10: Household Transportation Electrification

Chapter 11: Truck Electrification for Improved Air Quality and Health

Chapter 12: Distribution Grid Upgrades for Equitable Resilience and Solar, Storage, and Electric Vehicle Access

UCLA Chapters

Chapter 13: Energy Affordability and Policy Solutions Analysis

Chapter 14: Small Ethnic-Owned Businesses Study

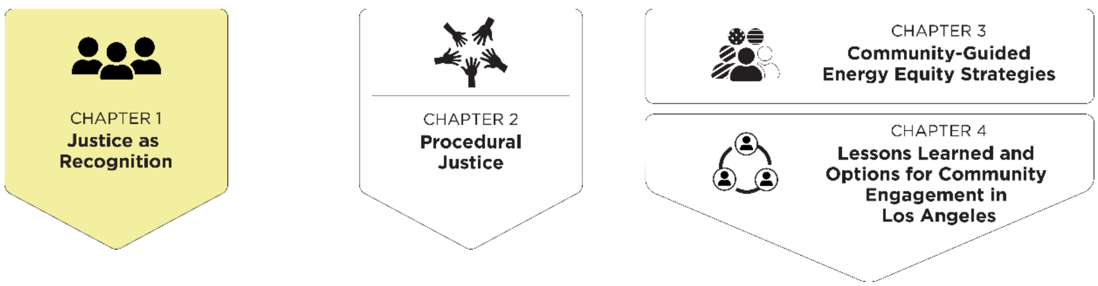
Chapter 15: Air Quality and Public Health

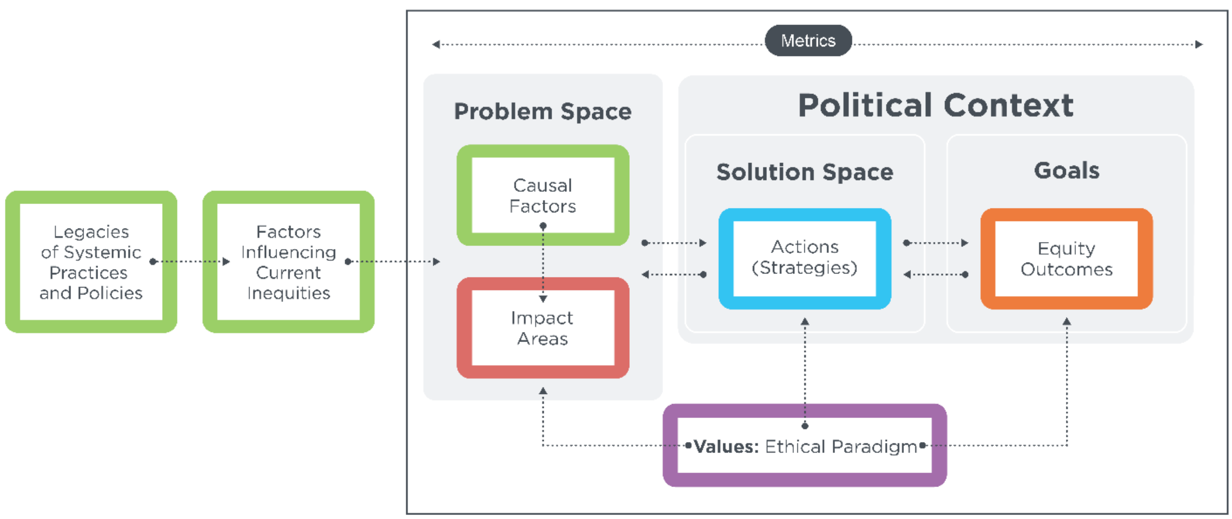
Chapter 16: Green Jobs Workforce Development

Chapter 17: Service Panel Upgrade Needs for Future Residential Electrification

About Chapters 1–4

In Chapters 1–4, NREL presents community-grounded research and analysis results on recognition justice and procedural justice, community-guided equity strategies and future options for community engagement by LADWP. Across these chapters, a mixed-methodological approach is applied, including a systematic literature review, statistical analysis of access to LADWP programs, and qualitative research with communities and community-based organizations to examine understandings of energy transition needs, barriers, and priorities. This work informs modeling and development of equity strategies by analyzing (1) the distribution of benefits of LADWP programs and strategies in the city and (2) historical and current factors contributing to this distribution and other energy inequities in the city.





List of Abbreviations and Acronyms

CalEPA	California Environmental Protection Agency
CBO	community-based organization
DAC	disadvantaged community
DER	distributed energy resources
ESAP	Energy Savings Assistance Program
EV	electric vehicle
FPL	federal poverty level
GHG	greenhouse gas
HECA	High Efficiency Cabin Air
HEIP	Home Energy Improvement Program
HOLC	Home Owners' Loan Corporation
HVAC	heating, ventilation, and air conditioning
LADWP	Los Angeles Department of Water and Power
NEM	net energy metering
NIMBY	not in my back yard
NREL	National Renewable Energy Laboratory
OEHHA	Office of Environmental Health Hazard Assessment
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
UPCT	Utility Pre-Craft Training

Executive Summary

The Challenge

The LA100 Equity Strategies project synthesizes community guidance with robust research, modeling, and analysis to identify strategy options that can increase equitable outcomes in Los Angeles' clean energy transition. Grounded in the analysis of past and ongoing energy inequities and engagement with underserved communities, the project presents community-guided and community-tailored strategies that aim to operationalize recognition and procedural justice. This chapter focuses on recognition justice, identifying and analyzing past and present social, cultural, and institutional barriers to affordable and clean energy for LA communities, as well as disparities in the distribution of energy system burdens and benefits. Acknowledging historical and structural factors behind current energy inequities is a first step in developing energy equity strategies for the Los Angeles Department of Water and Power (LADWP) to achieve distributional justice—the just and equitable distribution of energy benefits and burdens in LA's energy transition. Recognition, procedural, and distributional justice are the three tenets of energy justice around which the LA100 Equity Strategies project is organized (see the Glossary).

In the United States, theory and practice around justice have historically focused on unequal distribution of environmental benefits and burdens. The historical siting of hazardous infrastructure such as power plants and transportation corridors in communities of color and low-income communities has disproportionately concentrated negative environmental impacts in their neighborhoods. Those inequities are reproduced via programs, policies, and other efforts (e.g., zoning and regulations, rebates and incentives, lending, investment, and financing) that directly affect people's lives and livelihoods. In recent decades, energy justice scholars and activists broadened their analysis to examine how environmental inequities intersect with other forms of social difference in the distribution of energy benefits and burdens. This approach investigates how differences in class, race, gender, age, and abilities, among others, intersect to understand the social, cultural, and institutional processes that create and perpetuate energy inequities.

The LA100 Equity Strategies project embraces this approach to developing a more just clean energy future for LA. Because recognizing and understanding past and existing inequities is vital to addressing them in ways that ensure an equitable energy transition for all Angelenos, this chapter focuses on identifying and analyzing the challenges and inequities of LA's past and existing energy system, including LADWP programs.

Goal and Approach

Chapter 1 uses energy justice as a conceptual tool to identify and analyze past and existing inequities as barriers to recognition justice. NREL social scientists closely examined historical inequities in Los Angeles, along with the corresponding causal factors, to understand how these inequities became embedded in policies, processes, and finally, in community members' experiences and livelihoods. NREL social scientists worked with communities that have been historically underserved and overburdened by the energy system in Los Angeles to analyze the broader structural factors determining energy inequities and to co-design a solution space for more equitable policy action.

As shown in Figure ES-1, we analyzed the legacies of systemic practices and policies as underlying factors influencing current inequities that we organized into four prioritized areas:

1. Affordability and burdens
2. Access and use
3. Health, safety, and resilience
4. Jobs and workforce development.

This analysis led to the identification of building blocks for community-guided equity strategies that LADWP could use on the pathway to equitable outcomes in the clean energy transition (Chapters 3 and 4). The goal is to utilize a recognition justice approach to draw insights for the development of strategies (Chapter 3) and procedures (Chapter 4) that more equitably distribute the benefits and burdens of the 100% clean energy transition.

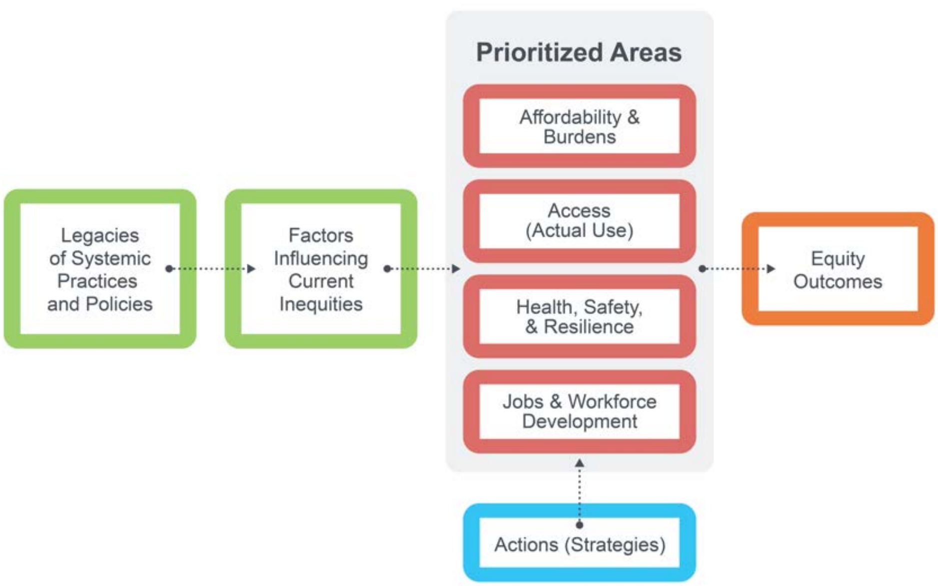


Figure ES-1. Analytic approach to recognition justice

Grounding Community Engagement

Listening to, learning from, and partnering with communities and community-based organizations (CBOs) in Los Angeles formed the foundation of our research, analysis, and engagement process. The historical and statistical analysis of energy inequities in Los Angeles presented in this chapter forms the baseline conditions for LA100 Equity Strategies' community engagement. Complementing this baseline understanding, engagement with community members in listening sessions, CBOs on the Steering Committee, and institutional actors on the Advisory Committee informed our analysis and identification of priority areas (Chapter 2) and helped to illuminate the steps LADWP can take to improve equity outcomes for their ratepayers.

Key Findings: Past and Current Energy Inequities

Here we provide the results of a qualitative and quantitative overview of critical processes determining inequities in education, employment, income, housing, and transportation relevant to the current energy transition. We focus on the causal factors affecting current inequities in priority areas such as (1) energy affordability, (2) energy access, (3) health, and (4) jobs (Figure ES-1), finding that:

- LADWP's programs such as solar installation benefit, non-low-income-targeted energy efficiency programs, and electric vehicle incentives are not equitably distributed across communities. Higher-income mostly homeowner and White populations benefit more.
- Underserved communities such as low-income families, renters, and people of color face higher energy and transportation burdens, unsafe temperatures, and higher impact from extreme heat events, and other negative impacts of historical legacies that are still present in current policies and practices. Our analysis concentrated on underserved communities located in South LA, East LA, San Fernando Valley, and the Harbor area (i.e., Wilmington and San Pedro).

These inequities are evidenced in the everyday experiences of underserved community members, who reported:

- Poor quality and maintenance of infrastructure and housing due to decades of disinvestment and neglect
- A lack of affordable housing for renters and owners
- Barriers to making energy decisions for themselves and their communities (that we term *self-determination*)
- A lack of access to financial capital for energy access, affordability, and decision-making
- Mistrust and grievances related to the government agencies and policies, and
- A lack of accessible and useful information about resources and programs.

Factors Influencing Energy Inequity in Health, Safety and Community Resilience

With a focus on health, safety, and community resilience one of the prioritized areas, Table ES-1 presents a series of structural and intersecting factors that influence energy inequities. Table 4 (page 20) through Table 7 (page 27) discuss how these factors can impact inequities in affordability and access in the other prioritized areas analyzed and modeled in Chapters 2–12. As can be seen in Table ES-1, communities and CBOs referred to built-environment factors, such as "addressing habitability with energy retrofits" (Steering Committee Members 2022a) and associated "space concerns with electrification technologies" (Steering Committee Members 2022a). In Los Angeles, the "biggest health danger [is] from transportation" (Steering Committee Members 2022a) rather than peaker plants; thus, "electrifying transportation will reduce GHGs" and result in public health benefits in their communities (Steering Committee Members 2022a). Yet, there is still a "need to address pollutants produced by peaker plants" (Steering Committee Members 2022a). A recurrent socioeconomic concern relates to the fracturing and displacement of low-income communities of color, and how to "avoid eviction and affordable housing loss" (Steering Committee Members 2022a). Such forms of displacement relate to affordability, but also to community resilience, as a loss of community members—whether due to utility disconnection, infrastructure-related displacement, eviction, and/or loss of affordable housing options—fractures social safety nets and professional networks that are key determinants of a household's capacity to deal with burdens and stressors.

Table ES-1. Examples of Factors that Can Impact Inequalities in Health, Safety, and Community Resilience in Relation to Home Temperatures and Housing Weatherization

Dimension	Structural Factors
Built environment	Appliances lighting: efficiency of dishwashers Building age and envelope: maintenance and insulation Heating and cooling system: system type, fuel type, and fuel cost
Economic dimension	Sudden or chronic economic hardship due to unstable or persistent low income Difficulty affording up-front costs of energy investments and technologies
Policy and political context	Building codes Inadequate policies, programs, and investments
Sociocultural and behavioral dimension	Awareness of time-of-use rate, changes to net metering policies

Participants also considered how to redress inequities through cultural and behavioral change in the way government entities engage with communities and procedural justice. Part of community resilience includes defining what engagement and accountability look like after the LA100 Equity Strategies project and recognizing the importance of including "often-marginalized equity communities in the decision process for LA100 policies and timeline." Finally, participants pointed to a need for "more direct install programs" (Steering Committee Members 2022a) as well as LADWP programs designed with "incentives rather than rebates" to support resilience in their communities.

Envisioning Equitable LADWP Programs

In this chapter, we analyze critical processes that have historically determined inequities in education, employment, income, housing, and transportation in Los Angeles. This historical groundwork orients proposed building blocks for LADWP to operationalize recognition justice, as Chapters 3 and 4 demonstrate. Across this report, we use our findings to develop strategies that will more equitably distribute the benefits and burdens of the LA clean energy transition.

Linking our analysis of LADWP customer-facing programs to the experiences LA community members shared, our research findings revealed that the benefits of LADWP programs are not equitably distributed across communities (Figure ES-2). NREL analyzed address-level data on LADWP program beneficiaries, including the amount of benefit received. Customer discount programs benefit disadvantaged communities, but programs subsidizing electric vehicles and solar installations disproportionately benefited non-disadvantaged, mostly White, mostly non-Hispanic, mostly home owning, and above median income communities (Figure ES-2).

LADWP RESIDENTIAL INVESTMENTS 1999–2022

Category	Program	Number of Years	Total Amount Spent	Avgerage Amount per Customer DAC/Non-DAC	% of Incentives (Normalized by number of customers) DAC/Non-DAC	Which Communities Disproportionately Benefited from Programs? DAC/Non-DAC	Mostly Non-White/White	Mostly Hispanic/Non-Hispanic	Mostly Renters/Owners	Below/Above Median Income
SOLAR INSTALLATION (1999–2022)	Net Energy Metering Programs	22	$340,604,541	0.25 kW / 0.41 kW	38% / 62%	Non-DAC	White	Non-Hispanic	Owners	Above
ENERGY EFFICIENCY (2013–2021)	Home Energy Improvement Program	3	$3,378,869	$3 / $2	61% / 39%	DAC		Hispanic	Owners	
	Refrigerator Turn-In and Recycle Program	5	$2,667,307	0.010 refrigerators / 0.014 refrigerators	42% / 58%	Non-DAC	White	Non-Hispanic	Owners	Above
	Consumer Rebate Program	6	$93,248,144	$64 / $74	46% / 54%	Non-DAC	White	Non-Hispanic	Owners	Above
	Other Non-Low-Income-Targeted Programs	15	$36,343,548	$178 / $196	35% / 65%	Non-DAC	White	Non-Hispanic	Owners	Above
	Energy Savings Assistance Program*	5	$7,897,260	$11 / $1	92% / 8%	DAC	Non-White	Hispanic	Renters	Below
ELECTRIC VEHICLES (2013–2021)	Incentive Programs	8	$5,361,426	$41 / $64	23% / 77%	Non-DAC	White	Non-Hispanic	Owners	Above
CUSTOMER DISCOUNTS (2006–2021)	Low-Income Program*	15	$173,633,204	$195 / $64	73% / 27%	DAC	Non-White	Hispanic	Renters	Below
	Lifeline Program*	15	$313,424,782	$302 / $164	65% / 35%	DAC	Non-White	Hispanic	Renters	Below

* Low-Income Targeted

Figure ES-2. Statistical analysis of access to the benefits of LADWP programs and investments

Chapter 1 maps how unequal access to LADWP programs relates to the legacy of trends and practices in education, jobs, housing, transportation, and energy infrastructure. While energy assistance policies and programs are widely considered best practices in the clean energy transition, inequities have become entrenched in these programs across energy utilities in the United States (analyzed in Chapter 4). We present actionable solutions and strategies in Chapters 3 and 4 that LADWP can use to ensure that going forward, their programs will be more accessible and equitable for LA communities.

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1 Introduction

From its inception, environmental justice theory and practice in the United States have focused on the unequal distribution of benefits and burdens. Understanding the historical development of these inequities through programs, policies, infrastructure, and other efforts has also been a part of this theory and practice (Morello-Frosch and Jesdale 2006; Morello-Frosch et al. 2011; Cushing et al. 2015). Early environmental justice research and advocacy included documenting how the location of hazardous sites has disproportionately affected communities of color and low-income communities. This approach also examined how transportation corridors have disproportionately affected communities of color and low-income communities, and the ways in which environmental impacts have become entrenched in these neighborhoods where community members live their day-to-day lives (Section 3.1).

In the last two decades, however, scholarly and environmental approaches to environmental justice were broadened to examine how environmental inequities intersect with other forms of social difference—e.g., class, race, gender, age, and abilities—to understand the social, cultural, and institutional processes of exclusion through which these inequities are (re)produced (Bulkeley et al. 2013; Agyeman et al. 2016; Schlosberg and Collins 2014; Walker 2009a). These processes, policies, and practices of structural exclusion include infrastructure siting and investment, zoning and regulations, rebates and incentives, lending, and financing (i.e., redlining), and other strategies and practices through which inequalities arise in the distribution of benefits and costs. Benefits include energy access, affordability, and reliable public health and safety. Regarding costs, the negative social and environmental impacts disproportionately affect predominantly underserved groups.

Over the past decade, energy justice has become a conceptual, analytical, and decision-making tool for unifying diverse justice considerations (Sovacool and Dworkin 2015). The LA100 Equity Strategies report employs three energy justice tools developed by Sovacool and Dworkin (2015) to inform context, engagement processes, and overall findings. This chapter uses energy justice as a *conceptual tool* to analyze how the legacy of past and ongoing policies and practices impact current energy inequities in Los Angeles. These findings inform Chapter 2, which focuses on procedural justice. Chapter 2 employs energy justice as an *analytical tool* to examine how values and decision-making shape energy inequities. Chapters 3–12 use energy justice as a *decision-making tool* to support the Los Angeles Department of Water and Power (LADWP), city officials, ratepayers, and community-based organizations (CBOs) in developing more informed and grounded energy equity strategies. Chapters 5–12 specifically address distributional justice, focused on the distribution of energy-related benefits (e.g., energy access, affordability, and reliability), as well as the distribution of negative consequences (e.g., public health, safety, jobs, and financial burdens).

LA100 Equity Strategies follows forward-looking and groundbreaking scholarship (Walker 2009b; Schlosberg and Collins 2014; McCauley and Heffron 2018) and practice (e.g., Initiative for Energy Justice) by moving beyond an examination of only the distributional aspects of benefits, burdens, and disadvantages (i.e., distributional justice) to analyze three critical tenets of energy justice: recognition, procedural, and distributional justice (see the Glossary). The goal of this first chapter is to present an analytic approach to recognition justice, aiming to understand and address past and current energy inequities (Figure 1, page 3) and to examine the legacies and causal factors influencing energy inequities in Los Angeles (Walker 2009b; Carley and Konisky 2020; Carley, Engle, and Konisky 2021; Schlosberg and Collins 2014; McCauley and Heffron 2018). The results of this analysis are the baseline for the following chapters, which present the analysis and findings from a collaborative community engagement process led by the National Renewable Energy Laboratory (NREL), LADWP, and CBO partners. Through this engagement process, we worked with communities that have been historically underserved and negatively affected by the current energy system to identify energy problems and co-design a solution space for more equitable decision-making and effective policy action. The engagement process, as a critical component of procedural justice, entails forming partnerships with community members and local institutions to co-identify barriers and opportunities for designing and implementing more equitable energy outcomes. Thus, the focus on procedural justice in Chapter 2 grounds the historical findings from this chapter in the lived experience of local Angelenos.

In the following sections, we define key terms and develop an analytic approach to the just transition to clean energy in Los Angeles that guides Chapters 2–4 (Section 2.1). We present the mixed methods used to understand the barriers to justice as recognition, including a literature review, community engagement process, and statistical analysis of LADWP programs (Section 2.2). We then examine the processes influencing energy inequalities in education, employment, income, housing, and transportation (Section 3.1). We also analyze the causal factors affecting current inequities in four areas: energy affordability, energy access, health, and jobs (Section 4). These findings inform energy equity strategies and options for community engagement to address those causal factors (Chapters 3 and 4).

Analytic Approach

Our conceptual approach to energy justice emphasizes the legacy of historical policies and practices (e.g., mortgage lending) on ongoing causal factors of energy inequities in Los Angeles (Figure 1). In this framework, the *causal factors* refer to historical and current structural processes, policies, and practices that have led to current inequities in the energy system (Agyeman et al. 2016; Álvarez and Coolsaet 2020). Causal factors directly and indirectly affect the energy system and the energy transition in Los Angeles. Equity strategies seek to address these effects or *impact areas* to engender more equitable *energy outcomes*. An impact area can include an energy sub-sector, such as housing, or a crosscutting prioritized area, such as energy affordability and health.

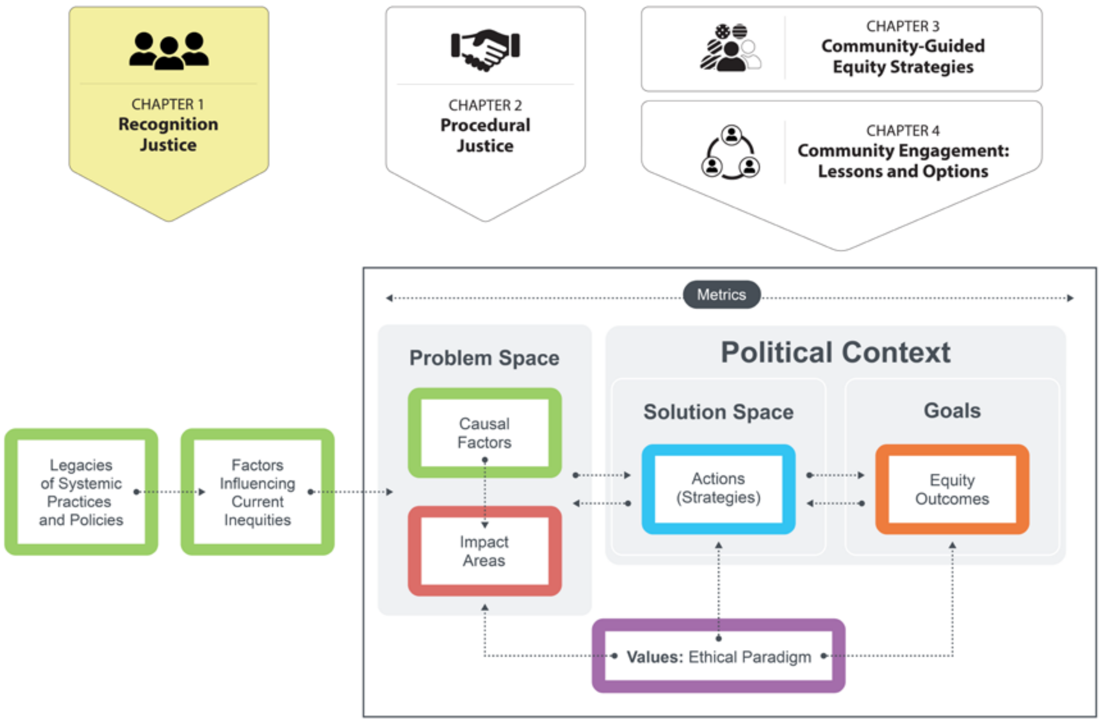

Figure 1. Overarching framework of LA100 Equity Strategies Chapters 1–4

An energy transition entails changes in sociotechnical energy systems and systems of policy action or strategy (*solution space*, see Figure 1), including regulations, subsidies, and investments and how they are designed, implemented, and evaluated. In turn, these strategies are the means to achieve more equitable energy outcomes as the City of LA transitions to clean energy (Arent et al. 2017; McCauley and Heffron 2018; Carley and Konisky 2020). The *political context* includes any institutional element (e.g., LADWP internal organizational structure or City of Los Angeles regulations) that might impact how LADWP and other city officials can approach a problem and the strategies to target that problem. We analyze the political context in Chapters 3 and 4.

Underlying this framework is the *value system*, or the ethical paradigm that structures the sociocultural norms, beliefs, and practices guiding how a group of people prioritize and relate to the current energy transition (see definition in the Glossary, page 37). Our framework assumes that just energy transitions can be more effectively and inclusively achieved by a systematic effort to explicitly understand and address community and stakeholder values.

The analysis in this chapter emphasizes the legacy of historical policies and practices (e.g., mortgage lending) on ongoing causal factors of energy inequities in Los Angeles (Figure 2). Causal factors include the processes, policies, and practices influencing current inequities in participation, protection from burdens, and fair treatment in access to benefits, in four crosscutting priority areas. These areas were *prioritized* by Steering Committee members in 1:1

meetings, supported by an energy justice literature review presented at the National Academies (Romero-Lankao 2022), and aligned with U.S. policymaking (e.g., Justice40[1]):

- Affordability and burdens
- Access to energy technologies, infrastructure, and LADWP programs
- Public health, safety, and community resilience
- Jobs and workforce development (Figure 2 and Chapter 2).

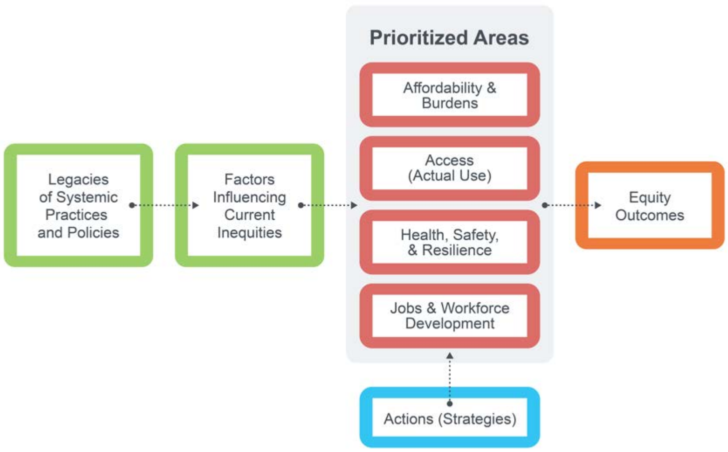

Figure 2. Analytic approach to recognition justice

[1] www.whitehouse.gov/environmentaljustice/justice40

2 Methods

To identify and examine the most relevant causal factors impacting equity in Los Angeles' energy transition, we employ both quantitative and qualitative methods. Our mixed methodological approach includes a literature review, statistical and qualitative analysis, and a tiered community engagement process, as shown in and described in detail in Chapter 2. Causal factors and impacts were identified through a review of academic literature, government reports, LA City Council policy documents, and direct stakeholder engagement. Thus, the analysis and findings below also reflect causal factors as perceived, understood, and experienced by LA residents and energy system actors. This analysis has informed technical strategy development in the LA100 Equity Strategies study moving forward.

Figure 3 depicts the overall approach and timeline for each of the primary research and engagement efforts we used to develop a community-guided approach to (a) agree on goals, metrics, methods, and data sources, and (b) refine a detailed plan for modeling, analysis, and evaluation of implementation-ready strategies for Los Angeles' just energy transition. The team created a continuous feedback loop through engagement efforts, such as neighborhood-specific community listening sessions, Steering Committee meetings, and Advisory Committee meetings (for details, see Chapter 2).

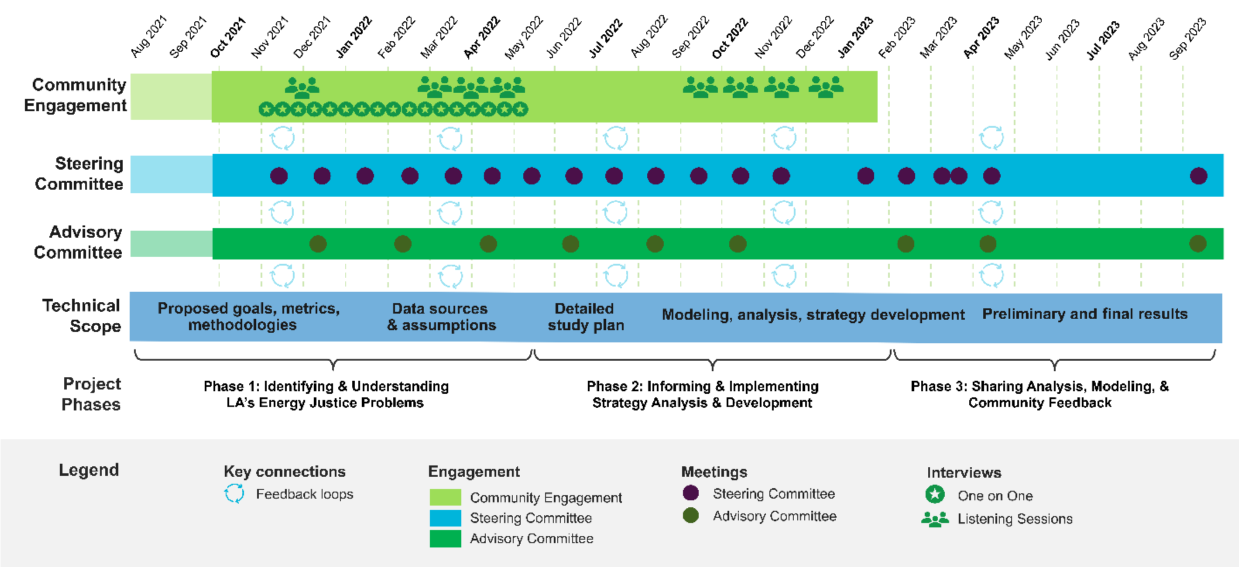

Figure 3. LA100 Equity Strategies framework and timeline

2.1 Literature Review

We conducted a systematic literature review to ground LA100 Equity Strategies analysis and engagement efforts in prior research (Romero-Lankao, Qin, and Dickinson 2012). This literature review relies on the analysis of secondary data, such as academic scholarship, research reports, policy documents, newspaper articles, local CBO publications, and press releases. We conducted a literature search of available academic databases (e.g., Web of Science, BioOne, and Google

Scholar), official documents, policy databases, and additional references selected from these sources. Given that just energy transitions are a relatively new area in energy research and practice (Carley and Konisky 2020), we focused our review on studies published over the past 22 years (2000–2022). The following search terms were selected to help guide our literature search:

- Procedural justice terms included procedural justice, community driven, energy solutions, and inclusive urban energy strategies.
- Recognition justice terms included recognition justice, policy, built environment, political, and cultural determinants of energy equity.
- Distributional justice terms included distributional justice, attributes and socio-spatial distribution of energy affordability, access, security, poverty, and disadvantage.

As a result, more than 130 sources were reviewed and analyzed for Chapters 1–4. Additionally, we reviewed policies, reports, public comments, and community impact statements associated with more than 20 separate Los Angeles City Council motions relevant to energy, equity, and environmental issues affecting the LADWP service territory to (1) inform understandings of causal factors contributing to existing inequities, and (2) anticipate potential barriers to energy equity strategies (Chapter 3). These council files were primarily identified through an advanced search of the Los Angeles City Clerk Council File Management System[2], references made by LA100 Equity Strategies Steering Committee and Advisory Committee members from 2021–2023, and a thorough review of LA100 Advisory Group meeting summaries from 2017–2021. Finally, we reviewed notes, summaries, presentations, and other relevant documents from all LA100 Steering and Advisory Group meetings held during the duration of this project (Chapter 2).

2.2 Statistical Methods

We conducted a mapping of socioeconomic and demographic differentiation in access to LADWP program and infrastructure investments and electricity reliability (LADWP 2021). A statistical analysis was performed to measure how LADWP incentives and benefits have been distributed across sociodemographic groups and identify any disproportionate outcomes. Using address-level customer data provided by LADWP, we analyzed 16 programs. Of these, six programs provide energy incentives, six provide electric vehicle (EV) incentives, and two programs provide customer discounts (Table 1, page 7; details are provided in Table A-1 in Appendix A).

Customer data from each program were geocoded by address and aggregated by census tract to determine the total number of households receiving benefits as well as the total dollar value of the investment from LADWP for each census tract within Los Angeles. These data were then merged with information from CalEnviroScreen (August et al. 2021) to identify tracts that are in disadvantaged communities (DACs).[3] Using American Community Survey data (U.S. Census

[2] cityclerk.lacity.org/lacityclerkconnect

[3] In this chapter and in chapters 2-4, we use the terms "disadvantaged communities" to refer to statistical analysis that utilizes census data and CalEnviroScreen data. The qualitative analysis uses the term "underserved communities". Both terms are defined in the Glossary.

Bureau 2019), we integrated census tract-level data on sociodemographic indicators of race, ethnicity, income, and homeownership (see an in-depth explanation in Appendix B).

Causal factors and impacts were identified through a review of academic literature, government reports, LA City Council policy documents, and direct stakeholder engagement. Therefore, the analysis and findings below also reflect causal factors as perceived, understood, and experienced by LA residents and energy system actors. This analysis has informed technical strategy development in the LA100 Equity Strategies study.

Table 1. LADWP Programs and Services for which Statistical Analysis was Conducted (1999–2022)

Program Type	Program Name
Energy efficiency incentive programs	Commercial Direct Install (CDI)
	Home Energy Improvement Program (HEIP)
	Refrigerator Turn In and Recycle Program (RETIRE)
	Consumer Rebate Program (CRP)
	Other non-low-income-targeted programs
	Energy Savings Assistance Program (ESAP) (low-income-targeted)
Solar installation programs	Net Energy Metering (NEM)
	Solar Incentive Program (SIP)
EV incentive programs	Feed-in Tariff (FiT)
	Solar Rooftops Lease Agreement (SRP)
	New Commercial/Residential Chargers/Sub-Meters
	Used Residential Vehicles
	Direct Current Fast Charging (DCFC)
	Medium-Duty and Heavy-Duty (MDHD)
Customer discount programs	Low-Income Program
	Lifeline Program
Power infrastructure reliability metrics	System Average Interruption Duration Index (SAIDI)
	System Average Interruption Frequency Index (SAIFI)
Other programs	Tree Canopy Program (CITY – “City Plants”)

Next, we calculated the total amount of dollars spent per program, year, and community. We compared the number of benefits (adjusted by population) from each program to determine if communities receive benefits proportional to their population (see Appendix B). Lastly, we mapped program information by tract to determine which areas receive the most and least number of incentives proportional to their population.

3 Analysis of Historical Factors Influencing Current Inequities

This section provides a qualitative and quantitative overview of critical processes determining inequalities in education, employment, income, housing, and transportation. The section also targets the causal factors affecting current inequities in four areas: energy affordability, energy access, health, and jobs. The goal is twofold: (1) to utilize a recognition justice approach that allows us to (2) draw insights that can be used to develop strategies that more equitably distribute the benefits and burdens of the 100% clean energy transition.

3.1 Determinants of Historical Urban Inequities

This subsection focuses on the historical context that led to present-day energy inequities in five key sectors of urban development: education, workforce development, housing, transportation, and energy infrastructure. Particular attention is paid to the legacy of historical mortgage lending practices in the United States and their ongoing influence in Los Angeles today. This lending legacy is not only visible in the housing sector and related energy burdens, but also correlates with the siting of energy system and transportation infrastructure and related environmental impacts.

3.1.1 Education and Workforce Development

Access to education and educational attainment are crucial factors influencing Angelenos' employment, income, and poverty status. Over the past 40 years, existing educational and socioeconomic inequities have been exacerbated by the changing structure of the city's economy, producing important impacts on access to jobs and career opportunities. During the 1980s–1990s, Los Angeles witnessed a de- and reindustrialization process that resulted in the decline of postwar manufacturing jobs, affecting new-immigrant neighborhoods where the garment industry had been a major employer. Although gains were made in aerospace and light manufacturing, underserved communities were only able to access a limited spectrum of service sector jobs in restaurants, hotels, offices, theme parks, and private homes (Davis 2006).

As a result of these trends, the relative prevalence of jobs in different sectors in Los Angeles County has changed significantly in the past two decades (Figure 4). Using the Longitudinal Employer-Household Dynamics data set, which links employment records to employees, trends in the 10-largest employment sectors can be observed. Manufacturing has seen the largest decline in employment, with wholesale and retail trades also declining. Health care and social assistance have seen the largest growth in employment, followed closely by information, professional and scientific services, and accommodation and food services. Transportation and warehousing, educational services, and administrative and support services have fluctuated some but have remained relatively constant (Figure 4; for details, see Chapter 16).

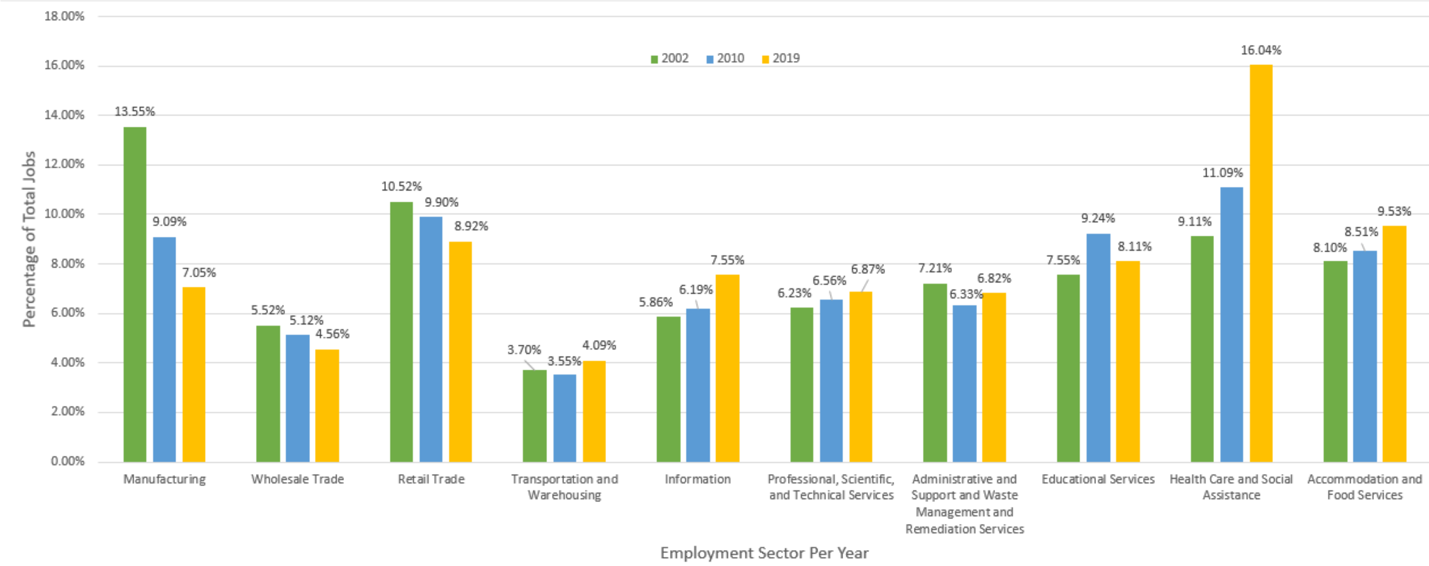

Figure 4. Percentage of total jobs in Los Angeles County by employment sector (North American Industry Classification System sectors)

Source: Longitudinal Employer-Household Dynamics Residence Area Characteristics data set ("Longitudinal Employer-Household Dynamics," U.S. Census Bureau, https://lehd.ces.census.gov/data/)

For many Angelenos who do not own a home, earnings from employment represent the most significant—and frequently the only—portion of all income. Over the last three decades, the median wage earned per hour of work has differed substantially between racial and ethnic groups in Los Angeles. As shown in Figure 5, earnings by White Angelenos have increased slightly and are roughly double earnings by Latino Angelenos. Black and Asian Angelenos have earned a median wage roughly halfway between wages of Whites and Latinos, although over the past two decades, wages earned by Asians have increased and wages earned by Black people have decreased.

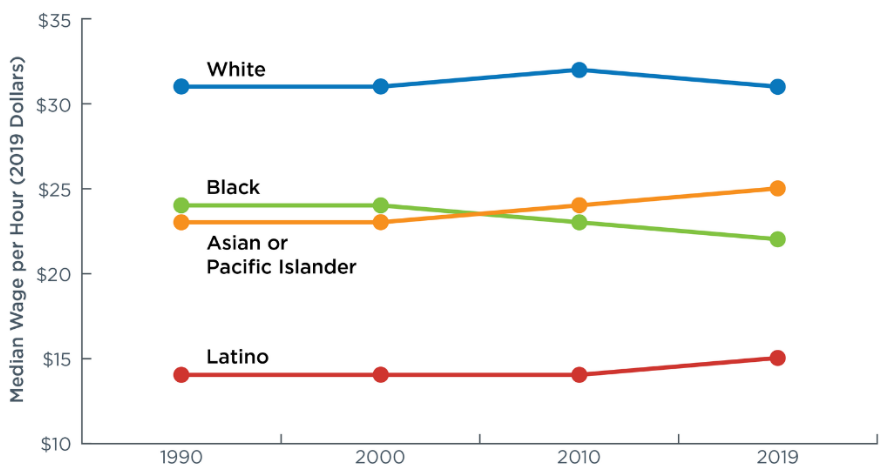

Figure 5. Median wage earned per hour by race/ethnicity in Los Angeles (2019 dollars)

Source: National Equity Atlas

Increase of low-wage work is a key structural contributor to economic inequality in Los Angeles. Wages have not kept up with home prices; 64.1% of Angelenos are renters, and 55% of renters are rent burdened (Rosen et al. 2020). This growing economic inequity leads to growing energy inequity by impacting households' abilities to pay energy bills, live in energy efficient housing, and afford transportation. As shown in Table 2, energy burdens for low-income multifamily households are higher than the national average. However, for all other groups, energy burdens in Los Angeles are lower than the national average.

Table 2. Median Energy Burdens in Metropolitan Areas for All Households and Highly Impacted Groups[a]

Metro Areas	All Households	Low-Income (≤200 FPL[b])	Black	Hispanic	Older Adults (65+)	Renters	Low-Income Multifamily[c]	Built Before 1980
National	3.1%	8.1%	4.2%	3.5%	4.2%	3.4%	3.1%	3.4%
LA	2.2%	6.0%	3.6%	2.6%	3.2%	2.4%	4.8%	2.3%
Phoenix	3.0%	7.0%	3.2%	3.6%	4.0%	2.8%	4.6%	3.6%
San Jose	1.5%	6.5%	1.8%	1.9%	2.4%	1.5%	4.7%	1.6%
San Francisco	1.4%	6.1%	2.4%	1.2%	2.4%	1.4%	4.9%	1.4%

Source: Drehobl, Ross, and Ayala (2020)

[a] Highly Impacted Groups include low-income, Black, Hispanic, older adult (65+), renters, low-income multifamily residents, and those residing in buildings built before 1980.

[b] FPL refers to the federal poverty level.

[c] Low-income multifamily households are below 200% FPL and in a building with five or more units.

3.1.2 Housing and Development

Historical and ongoing mechanisms of institutionalized exclusion and discrimination in the housing sector have direct and indirect impacts on current energy inequalities.[4] These mechanisms include:

- Restrictive covenants[5]
- Zoning ordinances[6]
- Real estate and lending practices, such as redlining[7]
- Federal Housing Administration lending policies[8]
- Rental practices, such as price gouging, volatile rents, and illegal landlord actions (e.g., "cash for keys" and absentee landlords)[9]
- Legislation (i.e., Article 34 and Proposition 14).[10]

Using redlining as an example, we analyze how these mechanisms have interacted to create energy inequity impacts such as residential segregation;[11] poor construction quality, unsafe and inefficient housing stock (related to the need for constant maintenance and general noncompliance with required code upgrades);[12] displacement, disinvestment, and neglect[13, 14].

The practice of discriminatory mortgage lending is one example of the historical mechanisms that continue to entrench structural inequity in present-day urban development. Discriminatory lending practices—such as redlining—limited investment in certain areas of the city, affecting residents living in those areas by creating or supporting residential segregation. Such practices resulted in communities of color living in neighborhoods that have poor-quality construction and unsafe and inefficient housing stock. These policies limited residents' access to credit to improve those conditions, resulting in increased maintenance costs, high energy bills given inefficiencies, and against-code upgrades. Without access to structurally sound housing stock related to conditions like asbestos, lead, mold, and/or legal upgrading options, these households also become ineligible for available energy efficiency programs, such as publicly accessible solar installation programs.

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[4] Ong, Comandon, and González 2019; Covington et al. 2019; Tijerina 2019; Kun and Pulido 2014; Massey and Denton 1993; Jackson 1985; 1980; Hillier 2003; Katznelson 2005; Rothstein 2017; Redford 2017; Stephens and Pastor 2020; Pulido, Sidawi, and Vos 1996; Pulido 2010; Michney and Winling 2019

[5] Ong, Comandon, and González 2019; Massey and Denton 1993; Jackson 1985; Katznelson 2005; Rothstein 2017; Redford 2017

[6] Massey and Denton 1993; Jackson 1985; Katznelson 2005; Rothstein 2017; Redford 2017

[7] Tijerina 2019; Massey and Denton 1993; Jackson 1985; Hillier 2003; Katznelson 2005; Rothstein 2017; Redford 2017; Jackson 1980; Michney and Winling 2019

[8] Massey and Denton 1993; Jackson 1985; Hillier 2003; Katznelson 2005; Rothstein 2017; Redford 2017

[9] Tijerina 2019; Kun and Pulido 2014; Massey and Denton 1993; Jackson 1985; Rothstein 2017

[10] Ong, Comandon, and González 2019; Tijerina 2019; Rothstein 2017

[11] Ong, Comandon, and González 2019; Covington et al. 2019; Tijerina 2019; Kun and Pulido 2014; Massey and Denton 1993; Jackson 1985; 1980; Hillier 2003; Katznelson 2005; Rothstein 2017; Redford 2017; Stephens and Pastor 2020; Pulido, Sidawi, and Vos 1996; Pulido 2010; Michney and Winling 2019

[12] Covington et al. 2019; Kun and Pulido 2014; Jackson 1985

[13] Covington et al. 2019; Kun and Pulido 2014; Massey and Denton 1993; Jackson 1985; Rothstein 2017; Redford 2017; Stephens and Pastor 2020

[14] Kun and Pulido 2014; Massey and Denton 1993; Pulido, Sidawi, and Vos 1996; Pulido 2010

3.1.2.1 Redlining: The History

Redlining "refers to lending (or insurance) discrimination that bases credit decisions on the location of a property to the exclusion of characteristics of the borrower or property. Usually, it means that lenders will not make loans to areas with African Americans or other perceived risks to real estate investments" (Hillier 2003). In the 1930s, the federal government's new Home Owners' Loan Corporation (HOLC) began developing "Residential Security Maps" of U.S. cities to calculate perceived mortgage lending risk (Jackson 1985). The rating system evaluated neighborhoods based on racial/ethnic composition, occupation, income, physical quality and age of housing stock, and economic demand, using the A, B, C, and D color-coded system illustrated in Table 3 (Jackson 1985). The fourth ranked category—Category D—was color-coded red, generating the name redlining. These maps effectively endorsed and institutionalized existing discriminatory practices of lenders and bankers.

While redlining was a practice of lending discrimination against an *area,* not individuals, it impacted individual lives when their homes and communities were marked as lending risks and systemically refused access to credit, loans, and the opportunities associated with those benefits. Benefits that were denied to certain individuals and communities include equal access to opportunities to buy, maintain, and repair their homes as well as equal ability to leverage the wealth from homeownership (Massey and Denton 1993; Jackson 1985). The HOLC, designed to support borrowers in homeownership, compounded a racial wealth gap by restricting loan access to Black borrowers, most frequently living in "D" coded areas (Michney and Winling 2019).

Understanding how this source of systemic inequity functioned in the past will help LADWP and the City of Los Angeles redress present inequities for the future as they design more equitable energy strategies.

Table 3. HOLC "Residential Security Maps" Lending Risk Categories

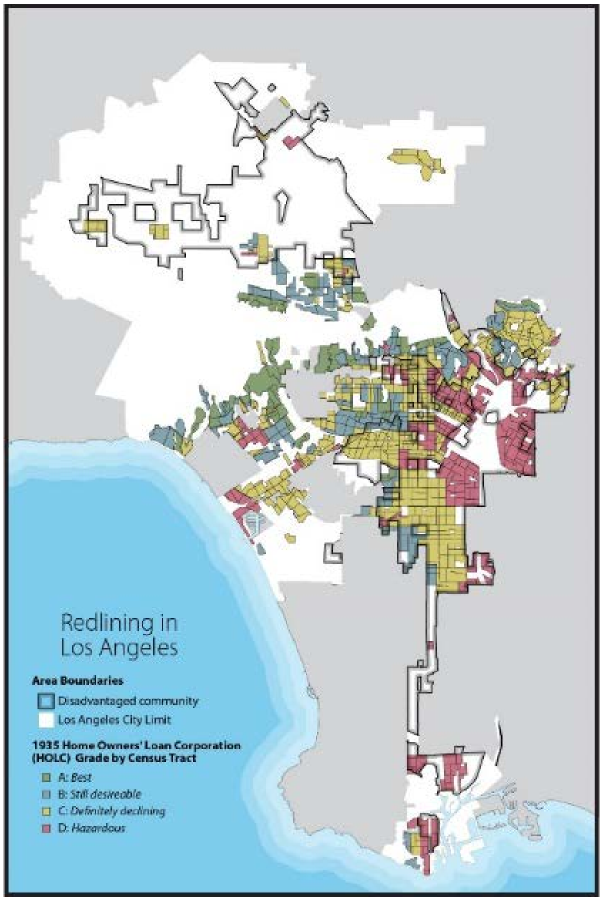
Mortgage Lending Risk	"Grade"	Description
Low	**A** **"Best"**	"The First and best grade, i.e., green, areas were described as new, homogenous, and 'in demand as residential locations in good times or bad.' Homogeneous meant 'Americans of the better class,' and not Jewish, Black, or immigrant sections" (Jackson 1980, 431–432).
	B **"Still Desirable"**	"The Second security grade (blue) went to 'still desirable' areas that had 'reached their peak,' but were expected to remain stable for many years" (Jackson 1980, 431–432).
	C **"Definitely Declining"**	"The Third grade (yellow) or 'C' neighborhoods were 'definitely declining' because of age, obsolescence, or change of style. 'Having seen their better days,' such yellow-colored sections were 'within such a low price or rent range as to attract an undesirable element'" (Jackson 1980, 431–432).
High	**D** **"Hazardous"**	"The Fourth grade (red) or 'hazardous' areas were those 'in which the things taking place in C areas have already happened.' Black neighborhoods were invariably rated 'D' as were any areas characterized by poor maintenance, poverty, or vandalism" (Jackson 1980, 431–432).

3.1.2.2 Redlining: The Legacy

A robust body of scholarship has found that the housing and lending practices of the past influence the present-day distribution of DACs' income and capacity to buy, maintain, repair, and leverage wealth from private property (i.e., home ownership) in Los Angeles. These forms of discrimination directly and indirectly affect the ongoing wealth gap and the socio-spatial distribution of energy inequity in the city.[15] As Table 3 and the map in Figure 6 show, 92.25% of tracts with HOLC Grades C and D are currently in DAC tracts. The median income of households currently in tracts graded by HOLC in 1935 as A is *229.4% higher* than households currently in tracts graded as D[16].

[15] Tijerina 2019; Massey and Denton 1993; Jackson 1985; Hillier 2003; Katznelson 2005; Rothstein 2017; Redford 2017; Jackson 1980; Michney and Winling 2019; Hoffman, Shandas, and Pendleton 2020.

[16] It is also important to note here that the income data is **capped** at $250,000, thus likely underreporting what the actual income gap is.



"Grade"	Percent of DAC Tracts in HOLC Grades	2019 Demographics in 1935 HOLC-Graded Tracts:				Median Household Income ($/year)*
		White*	Non-White*	Hispanic*	Home-Owners*	
Low — A "Best"	0.25	8.77	3.12	1.43	11.06	127,581
B "Still desirable"	3.96	14.54	10.09	5.18	18.39	82,448
C "Definitely Declining"	47.03	45.18	50.65	48.19	45.89	54,889
High — D "Hazardous"	48.76	31.50	36.14	45.20	24.67	48,560

"Mortgage Risk"

Figure 6. Redlining and current demographics in Los Angeles

The legacy of redlining can also be seen in the siting of major freeway construction in Los Angeles in the decades following the 1930s (Figure 7, page 16). Most major freeway construction was sited in low-income communities of color living in neighborhoods formerly graded D and C by the HOLC. Such projects have significant impacts on these communities—resulting in displaced residents, fractured social and professional networks, and increased pollution as a result of freeway traffic. For example, the 1993 Century Freeway (Interstate 105) alone displaced 25,000 residents over a 15-year period. Interstate 105 plans predominantly affected African American and low-income neighborhoods, which had been mapped as Grades C and D (Hughes 2021), and have faced higher health impacts (see Figure 8).

Finally, recent research demonstrates that the effects of climate change, such as extreme heat, can be felt more acutely in formerly redlined neighborhoods, leading to increased health risks and higher energy costs. This can lead to higher mortality risk during heat waves and higher cooling loads. On the date (i.e., 2017) measured by Hoffman, Shandas, and Pendleton (2020), redlined neighborhoods (Grade D) in Los Angeles were, on average, 4.2°C (7.6°F) hotter than those neighborhoods deemed "Best" (Grade A) by the HOLC in the 1930s (Figure 8). These trends are partly attributable to urban disinvestment practices and land use patterns that result in a lower relative amount of tree canopy and greenspace (cools and reflects heat) as compared to asphalt (absorbs heat) in "D" neighborhoods (Hoffman, Shandas, and Pendleton 2020). Other causal factors, such as inefficient and poorly maintained air conditioning and poorly insulated homes, may compound these differences.[17]

1939 HOLC "Residential Security Map"

Map of Perceived Mortgage Lending Risk in

LA Neighborhoods

Color-Coded Categories:

Category 1: **"Best"** = Grade A

Category 2: "**Still Desirable**" = Grade B

Category 3: "**Definitely Declining**" = Grade C

Category 4: "**Hazardous**" = Grade D

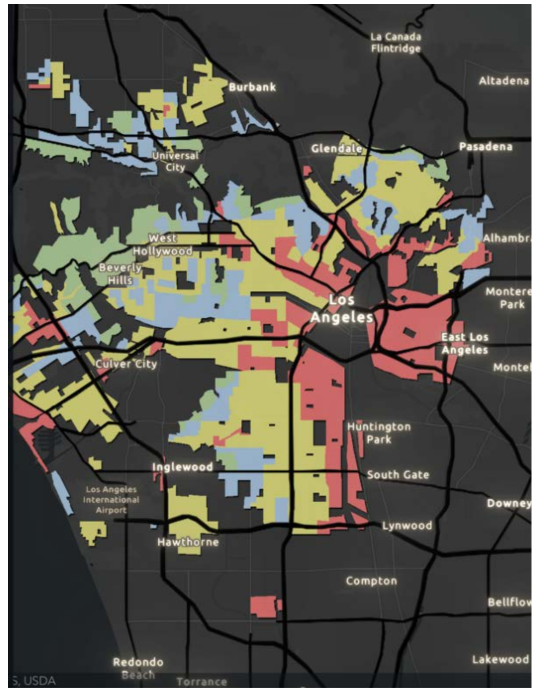


Figure 7. The correlation between the legacy of redlining and major freeway projects in Los Angeles, where thick black lines represent freeways

Source: Hughes 2021

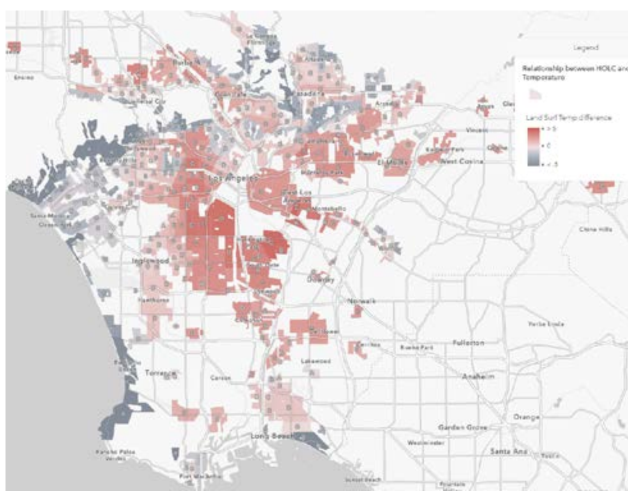


Figure 8. Effects of historical housing policies on resident exposure to intra-urban heat in LA

Source: Hoffman, Shandas, and Pendleton (2020)

[17] Note that zoning in Los Angeles (https://zimas.lacity.org/) loosely follows DAC boundaries. In other words, renters likely residing in DACs are the very same segment that are most vulnerable to heat, air pollution, and other hazards (Romero-Lankao, Qin, and Dickinson 2012; Romero-Lankao, Wilhelmi, and Chester 2018; Harlan et al. 2013a).

3.1.3 Transportation Development

As shown in Figure 7 and discussed above, a web of freeways was built through Los Angeles since the 1950s, particularly in East LA and South LA. The construction of this infrastructure required demolition of thousands of homes and businesses (Meares 2020), disproportionately displacing residents of historically redlined or racially diverse neighborhoods (Fleischer 2020). This fractured communities and exacerbated segregation (Stermon and Lukinbeal 2021), the wealth gap, and the health gap (Nardone, Chiang, and Corburn 2020), because neighborhoods in close proximity to freeways are exposed to higher levels of pollution (including air pollution and noise pollution). This pollution has a long-term impact of suppressing property values for homeowners (Li and Saphores 2012; Cervero and Duncan 2002). At the same time, an additional inequitable impact is created that keeps the cost of housing relatively lower—and therefore more accessible to lower-income households—due to the hazards of pollution.

This pattern of development also embedded a dependency on the automobile, with its associated public health impacts, its connection to economic opportunities and inherent costs, and greenhouse gas emissions. For individuals and households without access to an automobile, economic opportunity is typically harder to access; and, even when controlling for many other influential variables (e.g., levels of education, race, age, gender, employment status, and household size), incomes of carless households in Los Angeles are significantly lower than those of car-owning households (King, Smart, and Manville 2019). At the same time, the cost of owning and maintaining a personal vehicle is proportionately higher as a share of a household's budget, the lower a household's income.

In terms of accessing employment, Angelenos commute 8.8 miles on average each way to work (Kneebone and Holmes 2015). Since 2000, the proximity to employment for residents living in neighborhoods with high poverty rates and/or majority-minority populations has notably decreased, leading these residents to travel further for livable-wage jobs. Thus, disadvantaged populations are suffering longer commutes (Kneebone and Holmes 2015; Tijerina 2019), which effectively lowers the value of their labor per hour as the time and cost of travel to work increases.[18] Although many factors are intervening, this distance can contribute to increased emissions and health and quality of life impacts.

These issues disproportionately negatively impact low-income residents, people of color, and immigrants. Negative impacts, such as increases in the cost of transportation and the distance from livable-wage jobs and other services, are exacerbated by limited transportation options. These residents contend with limited access to reliable and frequent public transportation options, while access to private transportation—a norm in Los Angeles given the city's auto-centric geography—is limited by economic barriers. Furthermore, the transportation options available to these residents place them at a higher risk of incidents and crashes that compromise traffic safety. This has translated to more than 250 traffic fatalities per year in recent years, with almost one-half of those being pedestrians or bicyclists (Fonseca 2022). These victims are disproportionately residents of underserved communities, with Black residents especially impacted (Brozen and Yahata Ekman 2020).

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[18] LA100 Equity Strategies Listening Sessions, 2022

3.1.4 Energy System Infrastructure

Analysis in this section does not include aging distribution, which may potentially impact underserved communities as illustrated by the recent death due to downed powerlines[19]. LADWP's 8 GW of electrical generating capacity comes from power plants in five different states using seven different energy sources: coal, geothermal, hydropower, natural gas, nuclear, solar, and wind (Furnaro and Kay 2021). Of these power plants, the Harbor Generating Station and the Valley Generating Station are located within the LA city limits. Both are natural gas-fired power plants located in two disadvantaged areas: the Harbor Generating Station in LA's Wilmington neighborhood and the Valley Generating Station in the Sun Valley neighborhood of LA's San Fernando Valley. The communities around these power plants bear a larger burden of the air pollution they generate (Ramirez 2020). An example concerning the siting and systems surrounding existing fossil fuel infrastructure in Los Angeles is instructive here. Jill Johnston, Assistant Professor of Preventive Medicine at the University of Southern California, notes:

> "In working class communities of color in South Los Angeles, for instance, oil and gas operations occur within close proximity of where people live or go to school, but few policy protections are enforced to limit the migration of various chemicals from oil well sites in these communities. In contrast, when you look at sort of White and wealthier parts of the county, like near Beverly Hills, you do see those oil facilities tend to be completely enclosed. There tends to be noise barriers and a lot more systems in place to try to prevent the release of chemicals or other harmful effects upon the nearby communities." (Ramirez 2020)

Aware of this situation, an LA100 Equity Strategies listening session participant also noted that:

> "[W]hile I appreciate raising the concern about addressing current infrastructure, shoring up that infrastructure, I also wonder if there is a plan to remediate some of the infrastructure that currently exists in South LA that is problematic, in terms of known adverse health outcomes. So, I think one thing is capacity. Does our infrastructure have the capacity to deal with these things. But I also think, just in terms of—from what I understand from the community—there is a sense of neglect. In terms of the outdated infrastructure that needs remediation…"

In 2020, regulators voted to allow four Southern California natural gas plants to remain online potentially till 2026,[20] indicating that the state does not yet have sufficient clean energy resources or storage and reliability provisions to close fossil fuel plants. In the meantime, Angelenos living close to these generating facilities will continue to breathe the accompanying hazardous air pollutants (Roth 2020).

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[19] For details, see Chapter 12 and the following sources: "LADWP Launches Website to Share Locations and Daily Progress of Priority Pole Replacement Work," LADWP, May 4, 2023, https://www.ladwpnews.com/ladwp-launches-website-to-share-locations-and-daily-progress-of-priority-pole-replacement-work/ and "L.A. to Pay $38 Million Over Downed Power Line that Electrocuted Father and Daughter," David Zahniser and Dakota Smith, *Los Angeles Times*, April 24, 2023, https://www.latimes.com/california/story/2023-04-24/dwp-will-settle-downed-power-line-lawsuit-for-38-million.

[20] See "California just can't kick its coastal gas plant addiction," Sammy Roth, *Los Angeles Times*, June 22, 2023, https://www.latimes.com/environment/newsletter/2023-06-22/california-just-cant-kick-its-coastal-gas-plant-addiction-boiling-point.

3.2 Causal Factors of Current Energy Inequities in Crosscutting Prioritized Areas

In this section, we analyze the legacies and causal factors influencing energy inequalities in four crosscutting prioritized areas identified through a literature review and one-on-one meetings with CBOs that were in LA100 Equity Strategies Steering Committee (Figure 1, page 3):

1. Energy affordability and burdens (Chapter 5)
2. Access to and use of energy technologies, infrastructure, and LADWP programs
3. Jobs and workforce development
4. Public health, safety, and community resilience.

Table 4 (page 20), Table 5 (page 22), Table 6 (page 25), and Table 7 (page 27)—which correspond to the prioritized areas of energy affordability and burdens; access and use; jobs and workforce development; and public health, safety, and community resilience respectively—illustrate causal factors that have contributed to present-day inequities in the following areas modeled in this report:[21]

- Safe home temperatures and housing weatherization (Chapters 6 and 7)
- Transportation electrification and truck electrification for air quality (Chapters 10 and 11)
- Rooftop solar and storage, and community solar (Chapters 8 and 9)
- Grid upgrades (Chapter 12).

3.2.1 Affordability and Burdens

Although the LA100 study (Cochran and Denholm 2021) found that the goal of achieving 100% renewable energy by 2035 is feasible and essential, there must be a concentrated effort to remediate existing and future inequities in energy affordability and burdens. This includes the potential future burden of higher electricity rates that become unaffordable for low- and moderate-income ratepayers in Los Angeles (Brown et al. 2020a and Chapter 5). To achieve equity goals in the clean energy transition and remediate past inequities in Los Angeles, Chapter 5 examines strategies that could address energy burdens, particularly for underserved Angelenos. Currently, Los Angeles has energy incentive programs that often disproportionately benefit wealthier populations (see Section 4), rather than enhancing energy affordability or reducing burdens that can lead to achieving energy justice. Energy burden is "the percent of a household's income spent on utilities for heating, cooling, and other energy services" (Brown et al. 2020b; Drehobl, Ross, and Ayala 2020; Hernández and Bird 2010). However, calculating the energy burden, while important for understanding inequities, is not enough. Many other burdens (e.g., rent, health care, childcare) lower the funds available to individuals and families, and utility bills must be paid.

Energy justice scholars and practitioners are increasingly calling for a more holistic approach to energy burdens that (a) considers energy inequalities embedded in housing, transportation, infrastructural investments, and program development, and (b) examines tradeoffs households

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[21] For further information on how these causal factors relate to present-day energy equity impacts, see Appendix C.

may make to pay for rent, mobility, and other needs while avoiding disconnection, displacement, and other disruptions (Hernández and Bird 2010; Gonzalez et al. 2021). The ultimate purpose is to develop strategies that more effectively foster affordability. As already described in Section 3.1.1 and Table 2 (page 11), high energy burdens—set in the United States at more than 6% of a household's income (Drehobl, Ross, and Ayala 2020)—result from a series of intersecting factors, barriers, and challenges that Angelenos face. By analyzing the qualitative findings from engagement with community members and CBOs, as well as our ongoing literature review, we identified examples of these factors in Table 4.

In Steering Committee meetings, affordability and energy burdens have been a primary area of concern for member CBOs. Comments have ranged from built-environment concerns, such as how "new building standards may affect housing affordability" (Steering Committee Members 2022a), to socioeconomic concerns, such as "funding assistance for low-income folks" (Steering Committee Members 2022a) and the "need for fully funded technical assistance" (Steering Committee Members 2022a) in low-income homes to redress costly energy inefficiencies. Members have also considered how to redress inequities through cultural and behavioral change, such as providing "better real-time information about peak energy use rates to nudge behavior and save money on energy bills" (Steering Committee Members 2022b). Finally, members have pointed to programmatic- and policy-related opportunities, such as developing a pathway to initiate "automatic enrollment in low-income rate subsidy programs" (Steering Committee Members 2022b).

After qualitatively coding CBO data into priority areas, we created subcategories to map the types of causal factors and energy impact areas to each form of feedback and literature review referred to in Chapter 2, and in Section 2 of this chapter. Table 4 integrates this qualitative coding. For a more detailed illustration, please see Table C-1 in Appendix C.

Table 4. Examples of Factors That Can Impact Energy Affordability and Burdens

Modeled Areas	Dimension	Causal Factors
Safe Home Temperatures, Housing Weatherization	Built Environment	Cost of upgrading and energy retrofits
		Cost of introducing heat pumps in single-family, multifamily, commercial, manufactured, municipal buildings
		Cost of local infrastructure (e.g., physical accessibility, maintenance, accessibility for people with mobility challenges)
	Policy / Political context	LADWP conservation and efficiency-promoting programs to reduce home / community energy bills (e.g., accessibility of information)
		Incentives vs. rebates for building energy upgrades (e.g., impact of up-front investment requirements) and reducing energy bills
	Sociocultural / Behavioral	Awareness of time-of-use rates, changes to net metering policies (e.g., information access for informed decision-making)
		Cultural / language barriers to understanding tariffs

Modeled Areas	Dimension	Causal Factors
		Time poverty (e.g., ability to participate in appliance programs)
Rooftop Solar and Storage, Community Solar,	Built Environment	Cost of overcoming barriers to solar installation (building and roof upgrades)
		Constraints on *where* and *when* distributed generation and local solar is deemed economically feasible
		Cost of installing solar on public facilities
	Policy / Political Context	Cost of communication of plans and studies with appropriate language, materials, transparency in assumptions and process, etc.
	Sociocultural / Behavioral	Cost of introducing discount programs
		Cost of introducing neighborhood-level pilots and neighbor or peer effects shaping community uptake of solar and storage
Transportation and Truck Electrification	Built Environment	Cost of introducing workplace / public EV charging
	Policy / Political Context	Cost of developing community outreach and engagement activities
	Sociocultural / Behavioral	Cost of communicating technical plans and studies to communities
Grid Upgrades	Built Environment	Cost and technical feasibility of upgrading distribution infrastructure (e.g., distributed generation and rooftop solar)
	Policy / Political Context	Technical and financial resources to improve existing LADWP policies and develop new ones
	Sociocultural / Behavioral	Cost of communication of plans and studies with appropriate language, materials, transparency in assumptions and process, etc.

3.2.2 Access to Energy Technologies, Infrastructure, and Programs

LA100 Equity Strategies involves co-developing energy equity strategies that achieve a more equitable and just energy transition. A key means to achieving this goal is to holistically examine how different communities can access or use energy transition technologies and services such as energy efficient air conditioners, heat pumps, solar, and electric mobility to fulfill their everyday needs of heating, cooking, power, transportation, and telecommunications. No single definition is used to define energy access (IEA 2020), but access typically refers to a household's *actual use* of: (a) a minimum level of reliable electricity; (b) safer and more sustainable energy for cooking, AC, and heating and stoves; (c) a grid that enables productive economic activity and public services; and (d) heat pumps, AC, electric mobility, rooftop solar, and other transition technologies, devices, and services.

Energy access can be constrained by a suite of intersecting factors, barriers, and challenges that communities face. Beyond physical access, energy access includes the means to take advantage of utilizing existing technologies—whether constraints be economic (i.e., budget), knowledge-based (i.e., information, training), or sociocultural (i.e., behavioral norms). As with affordability, qualitative methods employed during community engagement and a literature review have been used to identify examples of these factors (see Table 5). For a more detailed illustration of how these causal factors relate to energy equity impacts related to access, see Table C-2 in Appendix C.

In Steering Committee meetings, member CBOs have consistently called attention to the question of access—e.g., to energy technologies, infrastructure, and programs—as a critical equity-opportunity space. Comments have ranged from built-environment concerns, such as how to "incentivize upgrades in older rental properties" (Steering Committee Members 2022a), to socioeconomic concerns, such as access to information that can "help small businesses understand affordable options" and developing "new financing models to ameliorate [their] up-front cost concerns" (Steering Committee Members 2022a). Members have also considered how providing access to "real-time information on energy sources to lower-income households" (Steering Committee Members 2022a) can bolster cultural and behavioral change for both LADWP and their customers, emphasizing the need to "keep cost increases transparent and clear before introducing a technology" (Steering Committee Members 2022b). As LADWP increases transparency with their customers, Angelenos are given the tools to calculate how their everyday actions directly relate to changes in the environment and utility costs (Steering Committee Members 2022a; 2022b). Finally, members have pointed to the need for more program and policy actions to increase all Angelenos' access to career-advancing opportunities, such as developing "paid apprenticeship training programs and intentional gender inclusivity," providing educational "training in key communities," and opening job training access to underserved populations such as "non-college bound high schoolers" and the "prison population" (Steering Committee Members 2022a; 2022b).

After qualitatively coding CBO data into primary areas of concern regarding access, we created subcategories to map out the types of causal factors and energy impact areas to which each form of feedback referred. Table 5 integrates this qualitative coding system into our ongoing literature review to provide a more robust analysis of the factors limiting access to energy equity.

Table 5. Examples of Causal Factors That Can Impact Access and Use

Modeled Areas	Dimension	Causal Factors
Safe Home Temperatures, Housing Weatherization	Built Environment	Building age (e.g., technical barriers to electrification and energy retrofits)
		Building type (e.g., feasibility of technologies in single-family, multifamily buildings)
		Local infrastructure (e.g., physical accessibility, maintenance, accessibility for people with mobility challenges)
	Policy / Political context	DWP conservation and efficiency-promoting programs to reduce home and community energy demand (e.g., accessibility of information)

Modeled Areas	Dimension	Causal Factors
		Incentives vs. subsidies or rebates for building energy upgrades (e.g., impact of up-front investment requirements)
	Sociocultural / Behavioral	Awareness of time-of-use rates, changes to net metering policies (e.g., information access for informed decision-making)
		Cultural and language barriers to information (e.g., accessibility of information related to existing assistance programs or technical guidance)
		Time poverty (e.g., ability to participate in community engagement activities and/or education and outreach programs)
Rooftop Solar and Storage, Community Solar	Built Environment	Building and roof age (e.g., technical barriers to solar installation)
		Constraints on distributed generation and rooftop solar technical feasibility (e.g., *where* and *when* distributed generation and local solar is deemed economically and technically feasible)
		Land use patterns and development density (e.g., density impacts on solar potential and feasibility)
		Solar on public facilities (e.g., access to resilient energy and educational co-benefits of visible solar)
	Sociocultural / Behavioral	Ability of partners to communicate technical plans and studies to their communities with appropriate language, materials, transparency in assumptions and process, etc.
		Barriers to participation in community outreach and engagement activities
		Neighborhood-level uptake of solar and storage (e.g., peer effects help solar adoption feel accessible)
Transportation and Truck Electrification	Built Environment	Availability of workplace / public EV charging
	Sociocultural / Behavioral	Ability of partners to communicate technical plans and studies to their communities with appropriate language, materials, transparency in assumptions and process, etc.
		Barriers to participation in community outreach and engagement activities
		Mode-shifting policies and trends affecting social and cultural acceptability and perceived accessibility and safety of alternative transportation options
		Time poverty (e.g., ability to shift transportation behaviors or modes, ability to take advantage of off-peak hours EV charging incentives)
Grid Upgrades	Built Environment	Age of existing distribution infrastructure (and timeline for future upgrades) constraining technical feasibility of distributed generation and rooftop solar
	Policy / Political Context	LADWP policies prioritizing energy efficiency vs. new generation (e.g., access to energy efficiency programs, technical and financial resources)

Modeled Areas	Dimension	Causal Factors
	Sociocultural / Behavioral	Ability of partners to communicate technical plans and studies to their communities with appropriate language, materials, transparency in assumptions and process, etc.
		Barriers to participation in community outreach and engagement activities

3.2.3 Jobs and Workforce Development Opportunities

LA100 showed the potential for a 100% renewable energy target by 2035 to require an average of more than 10,000 jobs annually to build and operate power generation-related infrastructure (Cochran et al., n.d., 100). Existing scholarship has found that as they expand, clean energy industries can create more job opportunities than fossil fuel industries (Cameron and Van Der Zwaan 2015; Pollin and Callaci 2019). However, underserved communities, who are often already excluded from equitable workforce participation, are particularly likely to face challenges from labor disruptions associated with the energy transition, even if a low-carbon economy creates more job opportunities than fossil fuel industries (Carley and Konisky 2020; Furnaro and Kay 2021). A series of causal factors and best practices could be considered to avoid detrimental job impacts and foster workforce development opportunities during the transition away from fossil fuels in Los Angeles. To identify these factors and practices, qualitative methods employed during community engagement and an ongoing literature review have been used (see Table 6, page 25). For a detailed illustration of how these causal factors relate to energy equity impacts related to jobs and workforce development, please see Table C-3 in Appendix C.

In Steering Committee meetings, providing career-advancing jobs and workforce development opportunities has been a crosscutting issue for member CBOs. Comments have ranged from geographic and built-environment concerns, such as how to develop "targeted job training for communities near LADWP properties" (Steering Committee Members 2022a), to socioeconomic concerns, such as identifying "who will finance an equitable workforce transition" (Steering Committee Members 2022a). Members have also considered how to redress inequities through cultural and behavioral change on the employer side, suggesting LADWP "support funders [employers] with strong labor standards & practices" (Steering Committee Members 2022a). Finally, members emphasized a need to develop a "Jobs Plan for LA100" (Steering Committee Members 2022b) that includes expanding successful existing LADWP programs that increase career-advancing jobs for underserved populations, such as the Utility Pre-Craft Training (UPCT) program (Steering Committee Members 2022a; 2022b; 2021).

After qualitatively coding CBO data into primary areas of concern related to jobs and workforce development, we created subcategories to map the types of causal factors and energy impact areas to which each form of feedback referred. Table 6 integrates this qualitative coding system into our ongoing literature review to provide a more robust analysis of the factors influencing energy-related jobs and workforce development in Los Angeles today.

Table 6. Examples of Causal Factors That Can Impact Jobs and Workforce Development Opportunities

Modeled Areas	Dimension	Causal Factors
Safe Home Temperatures, Housing Weatherization	Policy / Political Context	Building codes (e.g., impact of new building codes on quantity, quality of construction jobs)
		City contracting standards (e.g., impact of hiring and labor standards on ensuring quality jobs for local residents)
		Collective bargaining agreements and workforce development and training in relation to the energy transition
		LADWP conservation and efficiency-promoting programs to reduce home and community energy demand (e.g., impact of programs on employment and training for clean energy trades in local communities)
Rooftop Solar and Storage, Community Solar	Built Environment	Interrelated dependencies of transmission upgrades, distributed generation, and small-scale residential solar (e.g., long-term job potential and security in these different sectors)
	Policy / Political Context	City contracting standards (e.g., impact of bid requirements on ability for small local businesses to bid for and win City contracts)
		Hiring practices for construction, operation, and maintenance of solar and related infrastructure
		Workforce training programs and opportunities for construction, operation, and maintenance of solar technology and infrastructure
Transportation and Truck Electrification	Policy / Political Context	City contracting standards (e.g., impact of hiring and labor standards on ensuring quality jobs for local residents)
		Hiring practices for construction, operation, and maintenance of transportation systems and infrastructure
		Workforce training programs and opportunities for construction, operation, and maintenance of panels and charging infrastructure
Grid Upgrades	Built Environment	Existing natural gas units and associated infrastructure (e.g., economic dependence on fossil-fired generation for jobs and tax revenue)
	Economic	Rate structures (e.g., impacts on ability for small businesses to hire and raise wages)
		Revenue losses from closure of fossil-fired generation (e.g., impacts on long-term household- and community-level economic stability)
	Policy / Political Context	City contracting standards (e.g., impact of hiring and labor standards on ensuring quality jobs for local residents)

3.2.4 Public Health, Safety, and Community Resilience

LA100 found that DACs located near LADWP in-basin power plants, the Ports of Los Angeles and Long Beach, and major roadways, as well as those living or working in buildings with space-heating or other appliances, could expect different types of benefits from the transition to a 100% renewable future. The benefits include improved public health from reduced use of indoor combustion equipment replaced with electric appliances, as well as reductions in air pollution and in concentrations of more local pollutants (Hettinger et al. 2021).

Energy justice scholars emphasize that the effect of indoor and outdoor air pollution, extreme heat, and other climatic and environmental impacts on communities is determined by socioeconomic and spatial inequalities, driven by the already referred to socio-institutional dynamics shaping urban development. Scholars emphasize that in many cities, a series of factors springing from social inequality result from legacies of past practices and policies (Section 1.4.1). These factors prevent DACs from reaping the rewards of local environmental amenities such as tree shade, open space, good-quality housing and building envelopes, and cleaner air (Morello-Frosch et al. 2011; Lucas 2012; Church, Frost, and Sullivan 2000). These factors relate to higher exposure and lower community resilience, defined as the capacity to draw on income, education, and other resources to adapt to the health impacts of pollution, heat, energy outages, and other disruptions and stressors (Harlan et al. 2013b; Romero-Lankao, Qin, and Dickinson 2012; Qin et al. 2015; Hayden, Brenkert-Smith, and Wilhelmi 2011).

In this section, we summarize preliminary results from qualitative methods employed during community engagement and a literature review to identify examples of these factors (see Table 7). For a detailed illustration of how these causal factors relate to energy equity impacts related to public health, safety, and community resilience, please see Table C-4 in Appendix C.

In Steering Committee meetings, public health, safety, and community resilience have surfaced as primary areas of concern for member CBOs. Comments include built-environment concerns, such as “addressing habitability with energy retrofits” (Steering Committee Members 2022a) and associated “space concerns with electrification technologies” (Steering Committee Members 2022a). Members have also emphasized that in Los Angeles, the “biggest health danger [is] from transportation” (Steering Committee Members 2022a) rather than peaker plants; thus, “electrifying transportation will reduce GHGs” (Steering Committee Members 2022a) and significantly contribute to public health benefits in their communities. Yet, there is still a “need to address pollutants produced by peaker plants” (Steering Committee Members 2022a). A recurrent socioeconomic concern is related to the fracturing and displacement of low-income communities of color, and how to “avoid eviction and affordable housing loss” (Steering Committee Members 2022a). Such forms of displacement relate to affordability, but also to community resilience, as a loss of community members—whether a result of utility disconnection, infrastructure-related displacement, eviction, and/or loss of affordable housing options—fractures social safety nets and professional networks that are key determinants of a household’s capacity to deal with burdens. Members have also considered how to redress inequities through cultural and behavioral change in the way government entities engage in community engagement and procedural justice. Community resilience includes defining what engagement and accountability look like after the LA100 Equity Strategies project and recognizing the importance of including “often-marginalized equity communities in the decision process for LA100 policies and timeline” (Steering Committee Members 2022b). Finally, members have pointed to a need for "more direct install programs" (Steering Committee Members 2022a; 2021) as well as LADWP programs designed with "incentives rather than rebates" (Steering Committee Members 2022a; 2021) to support resilience in their communities.

After qualitatively coding CBO data into primary areas of concern, we created subcategories to map out the types of causal factors and energy impact areas each form of feedback referred to. Table 7 integrates this qualitative coding system into our ongoing literature review to provide a more robust analysis of the factors influencing public health, safety, and community resilience in Los Angeles today.

Table 7. Examples of Causal Factors That Can Impact Public Health, Safety, and Community Resilience

Modeled Areas	Dimension	Causal Factors
Safe Home Temperatures, Housing Weatherization	Built Environment	Indoor air pollution and emissions from building systems and appliances (e.g., refrigerants, air toxins, methane)
		Building age (e.g., affecting structural stability and health risks)
		Building exposure to climate hazards / adaptability to climate extremes
		Local microclimatic and infrastructural characteristics associated with ability to maintain thermal comfort, exposure to energy infrastructure-related hazards, etc.
	Economic	Sudden or chronic economic hardship due to persistent low (or unstable) income affecting ability to maintain safe and healthy home or work environment (e.g., thermal comfort, routine maintenance, addressing sources of indoor air pollution)
		Rent burden affects ability to maintain safe and healthy housing
	Sociocultural / Behavioral	Baseline vulnerability of building occupants to indoor air pollution, extreme heat, and health multiplier problems affecting resilience to acute health threats (e.g., heat waves and respiratory viruses)
	Policy / Political Context	City contracting standards (e.g., impacts of pollution related to contractors hired for City building projects)
		Zoning ordinances to fund HVAC upgrades for homes, schools, and community facilities in polluted areas
Community Solar, Rooftop Solar and Storage	Built Environment	Backup for remote and local resources (e.g., affecting energy reliability during outages)
		Life cycle costs and emissions of distributed energy technology and infrastructure (e.g., related health impacts across geographic and temporal/intergenerational scales)
		Solar on public facilities providing access to resilient energy
	Economic	Land acquisition costs for solar farms (e.g., siting decisions and associated environmental impacts)

Modeled Areas	Dimension	Causal Factors
		Long-term funding for infrastructure maintenance and intergenerational impacts of allowing energy generation infrastructure to fall into disrepair or fail
	Policy / Political Context	City contracting standards for distributed energy installation and infrastructure projects influencing life cycle impacts of City activities, including pollution related to work performed by contractors
		Tax credits for solar and storage enabling broad adoption of resilient energy systems
	Sociocultural / Behavioral	Baseline individual vulnerability to air pollution from power generation creating individual- and community-level disparities in health benefits (and burdens) associated with distributed energy systems
		Not in my back yard (NIMBY) -ism (e.g., siting polluting or undesirable infrastructure in disadvantaged areas)
		Failure to prioritize health and resilience of outlying communities when analyzing impacts of clean energy facilities and infrastructure
Transportation and Truck Electrification	Built Environment	Infrastructure enabling electrification of trains, heavy-duty transport beyond buses (including freight) affecting feasibility of reducing emissions near warehouses, port, other heavy transportation corridors
		Electrification of private medium-duty vehicles, delivery truck fleets to reduce health impacts of air pollution
	Economic	Electricity rates relative to cost of gasoline affecting speed of electrification and mitigation tradeoffs between emissions from transportation and emissions from power generation
	Policy / Political Context	City contracting standards (e.g., pollution related to contractors hired for transportation infrastructure projects)
		Fossil fuel subsidies affecting speed of transition to clean energy and resulting health benefits
		Reduction policies and trends for vehicle miles traveled (e.g., changes in *sources* and *distribution* of emissions and air quality impacts over time)
		Rollback of Corporate Average Fuel Economy standards and resulting emissions and health impacts
	Sociocultural / Behavioral	Baseline vulnerability to transportation-related air pollution, health multiplier problems
		Behavior changes in response to COVID-19 (e.g., ability to shift to new transportation modes and resulting emissions and health impacts)
		Mode-shifting (e.g., from transit to private vehicles and resulting emissions and health impacts)

Modeled Areas	Dimension	Causal Factors
Grid upgrades	Built Environment	Age of existing 4.8 kV distribution infrastructure affecting current operating performance of existing feeders and impacts on customer energy reliability and resilience
		Exposure to pollution from existing natural gas units and associated infrastructure
		Increasing frequency / severity of extreme weather, wildfires due to climate change
		Life cycle costs and emissions of distributed energy technology and infrastructure affecting the timing and distribution of different types of emissions and impacts
		Siting of current and planned transmission infrastructure enabling or constraining transition to clean energy systems in communities economically dependent on (and exploited by) extractive fossil energy systems
	Economic	Revenue losses from closure of fossil-fired generation affecting long-term household- and community-level economic stability, tax base, and ability to maintain critical public services
	Policy / Political Context	City contracting standards (e.g., pollution related to contractors hired for City building projects)
		Fossil fuel subsidies affecting speed of transition to clean energy and resulting health benefits
	Sociocultural / Behavioral	Adoption of demand response and load flexibility programs and behaviors affecting system-wide resilience
		Baseline individual vulnerability to air pollution from power generation
		Customer adoption of distributed energy systems affecting system-wide resilience
		Social and political acceptability of generation fuels, battery storage facilities for resilience

4 Access to the Benefits of LADWP Programs

Our recognition justice efforts included mapping current access to the benefits of LADWP programs ("LADWP Investments" in 30), to identify and measure inequities. Here, we compare the *number of benefits* distributed as well as the *total dollars* spent per program across communities (Figure 11, page 32).

We described in Section 2.2 the Statistical Methods used to analyze each program. We calculated the total amount of dollars spent (in the column "Total Amount Spent") as well as the total amount spent per customer in DAC and non-DAC communities (in the column "Avg. Amount per Customer") in Figure 9. Likewise, we adjusted the number of benefits received according to population to compare the percentage of benefits distributed across communities (represented in the column titled "% of Incentives" in Figure 9). Additionally, we performed a statistical analysis to determine if these percentages are statistically significant; in other words, the communities identified in the column titled "Which Communities Disproportionately Benefited from Programs?" in Figure 9 determine the communities that received a disproportionate amount of program benefits. Lastly, we identified if certain communities experienced more and/or longer power interruptions according to the System Average Interruption Duration and Frequency Indices (SAIDI and SAIFI; Figure 10). These analyses of utility-offered programs, services, and power infrastructure reliability contribute to recognition justice by identifying the communities that have historically benefited from programs and services in which LADWP has invested.

LADWP RESIDENTIAL INVESTMENTS 1999–2022		NUMBER OF YEARS	TOTAL AMOUNT SPENT	AVGERAGE AMOUNT PER CUSTOMER DAC/Non-DAC	% OF INCENTIVES Normalized by number of customers DAC/Non-DAC	WHICH COMMUNITIES DISPROPORTIONATELY BENEFITED FROM PROGRAMS? DAC/Non-DAC	Mostly Non-White/White	Mostly Hispanic/Non-Hispanic	Mostly Renters/Owners	Below/Above Median Income
SOLAR INSTALLATION (1999–2022)	Net Energy Metering Programs	22	$340,604,541	0.25 kW / 0.41 kW	38% / 62%	Non-DAC	White	Non-Hispanic	Owners	Above
ENERGY EFFICIENCY (2013–2021)	Home Energy Improvement Program	3	$3,378,869	$3 / $2	61% / 39%	DAC		Hispanic	Owners	
	Refrigerator Turn-In and Recycle Program	5	$2,667,307	0.010 refrigerators / 0.014 refrigerators	42% / 58%	Non-DAC	White	Non-Hispanic	Owners	Above
	Consumer Rebate Program	6	$93,248,144	$64 / $74	46% / 54%	Non-DAC	White	Non-Hispanic	Owners	Above
	Other Non-Low-Income-Targeted Programs	15	$36,343,548	$178 / $196	35% / 65%	Non-DAC	White	Non-Hispanic	Owners	Above
	Energy Savings Assistance Program*	5	$7,897,260	$11 / $1	92% / 8%	DAC	Non-White	Hispanic	Renters	Below
ELECTRIC VEHICLES (2013–2021)	Incentive Programs	8	$5,361,426	$41 / $64	23% / 77%	Non-DAC	White	Non-Hispanic	Owners	Above
CUSTOMER DISCOUNTS (2006–2021)	Low-Income Program*	15	$173,633,204	$195 / $64	73% / 27%	DAC	Non-White	Hispanic	Renters	Below
	Lifeline Program*	15	$313,424,782	$302 / $164	65% / 35%	DAC	Non-White	Hispanic	Renters	Below

* Low-Income Targeted

Figure 9. Analysis of LADWP investments in programs and services

Figure 10. Analysis of the benefits of LADWP programs and investments

Overall, the key findings (by program type) reveal that:

- The net energy metering (NEM) *solar installation programs* disproportionately served more installed solar capacity (kW) in non-disadvantaged, mostly White, mostly non-Hispanic, owner-occupied, and affluent tracts (Figure 9). Given the financial capital required for customers to be able to install rooftop solar and participate in these NEM programs, these findings are consistent with the trends of customer-adopted solar explored throughout the nation (Sigrin and Mooney 2018).
- *Energy efficiency incentive programs* (except the low-income-targeted program, otherwise known as the Energy Savings Assistance Program) disproportionately benefited households in non-disadvantaged communities as well as communities with mostly White, mostly non-Hispanic, owner-occupied, and affluent households (Figure 9).
- LADWP *EV incentive programs* disproportionately benefited non-disadvantaged communities and communities with mostly White, mostly non-Hispanic, owner-occupied, affluent households. However, there is no statistical difference between disadvantaged communities and non-disadvantaged communities in the distribution of *all* EV charging stations that are available to the public (Chapter 10), although our findings indicate that communities with mostly non-Hispanic households have more EV charging stations than communities with mostly Hispanic households.
- The Low-Income and Lifeline *customer discount programs* benefited disadvantaged communities as designed.
- Disadvantaged and mostly Hispanic communities have, on average, marginally more *power interruptions* per year than non-disadvantaged communities (0.93 in disadvantaged communities compared to 0.78 in non-disadvantaged communities; Figure 9*)*. However, there was no statistical significance between communities regarding the *duration* of the experienced power interruptions.

Lastly, we mapped program information to spatially identify census tracts that receive incentives proportional to their population. Our results indicate that most tracts that received disproportionate amounts of non-low-income-targeted residential energy efficiency incentives are located outside of DAC boundaries and conversely, residential energy efficiency programs that targeted low-income customers *appropriately* served households in DACs (Figure 12). Likewise, NEM solar installation programs (Figure 13) and residential EV incentives (Figure 9) disproportionately served census tracts located outside of DACs.

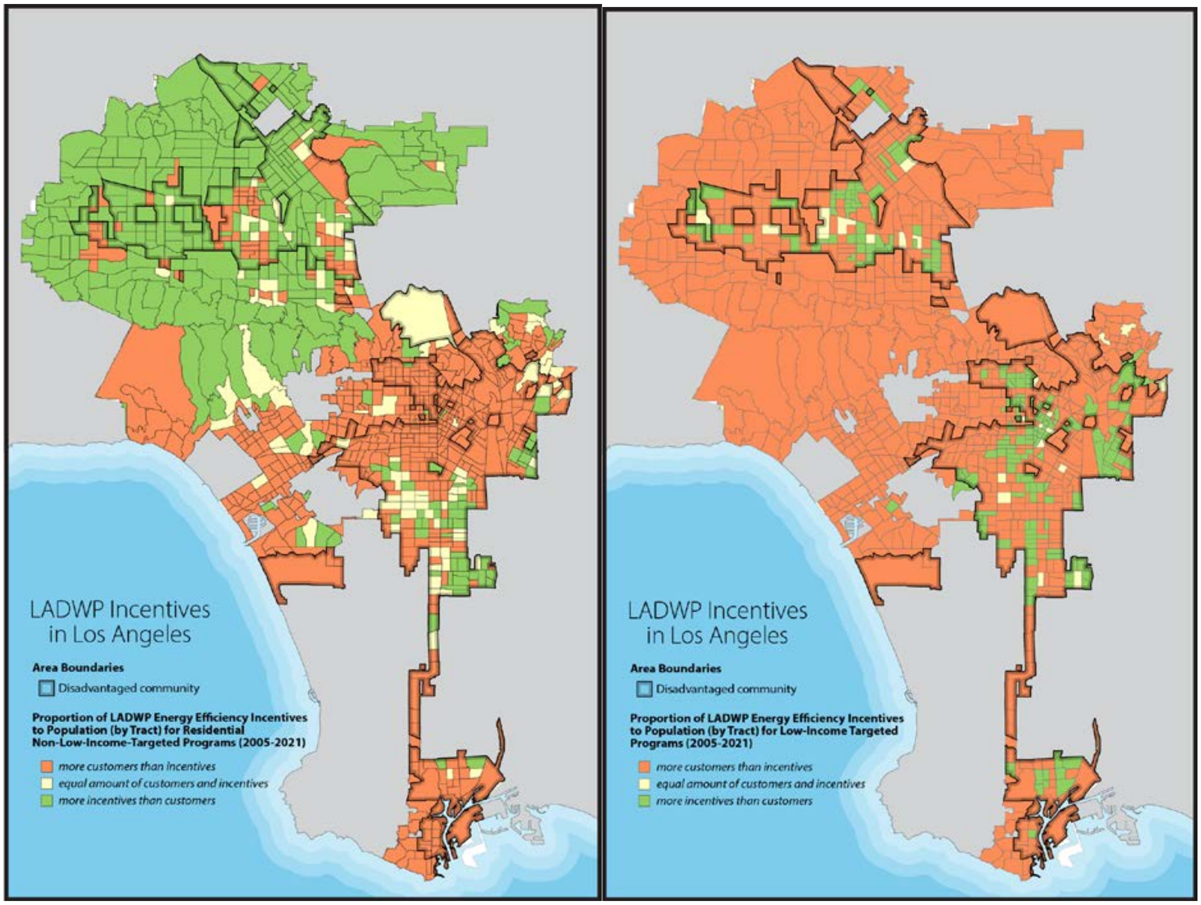

Figure 11. Proportion of residential energy efficiency incentives to population by census tract for programs *not* targeting low-income households (left) and programs targeting low-income households (right)

Orange tracts indicate the percentage of households in each tract is greater than the percentage of benefits received, green tracts indicate the percentage of incentives received is greater than the percentage of households in each tract, and yellow tracts represent areas where the percentage of incentives is proportional to the *population*.

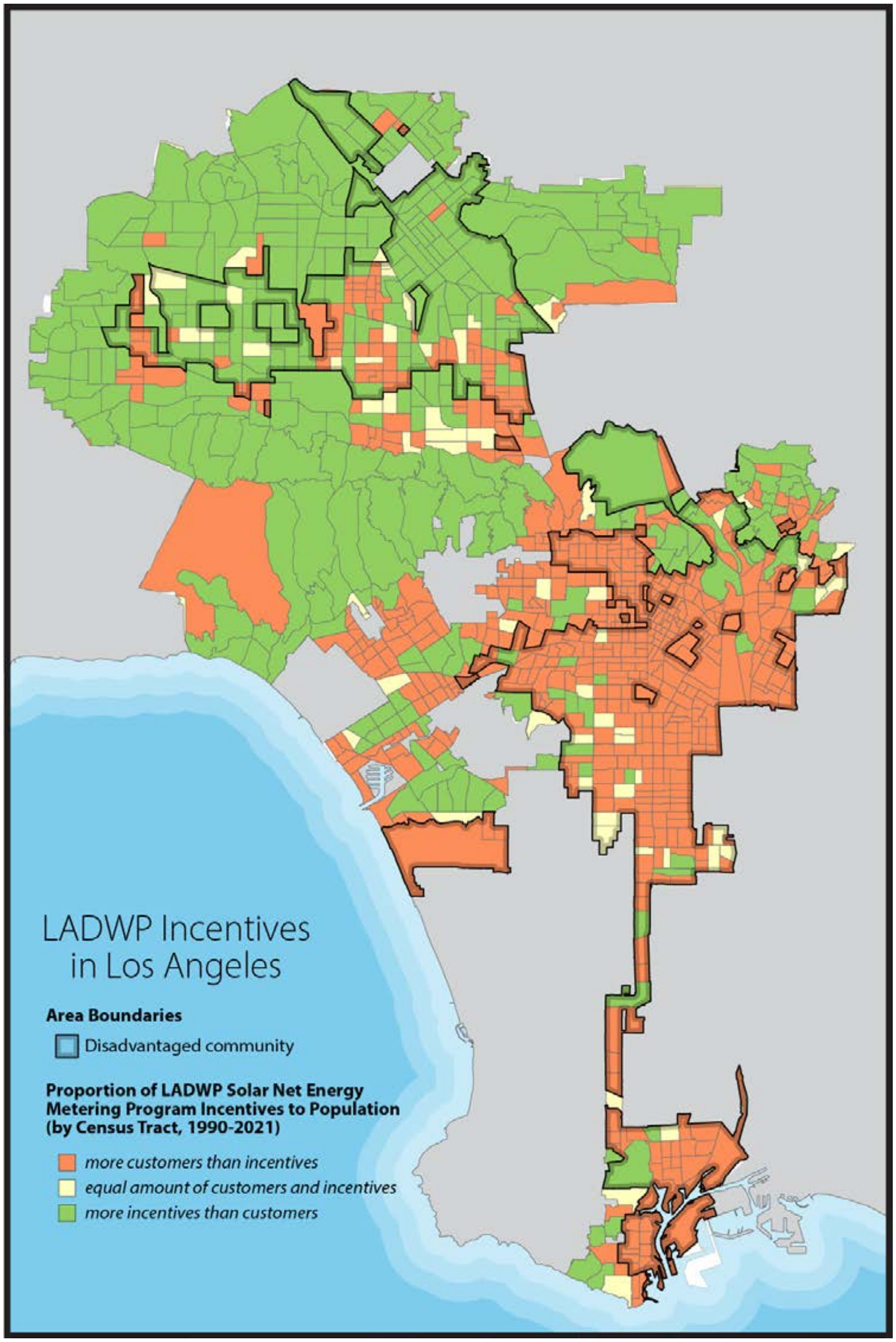

Figure 12. Proportion of residential incentives to population by census tract for solar NEM programs

Orange tracts indicate the percentage of households in each tract is greater than the percentage of benefits received, green tracts indicate the percentage of incentives received is greater than the percentage of households in each tract, and yellow tracts represent areas where the percentage of incentives is proportional to the *population*.

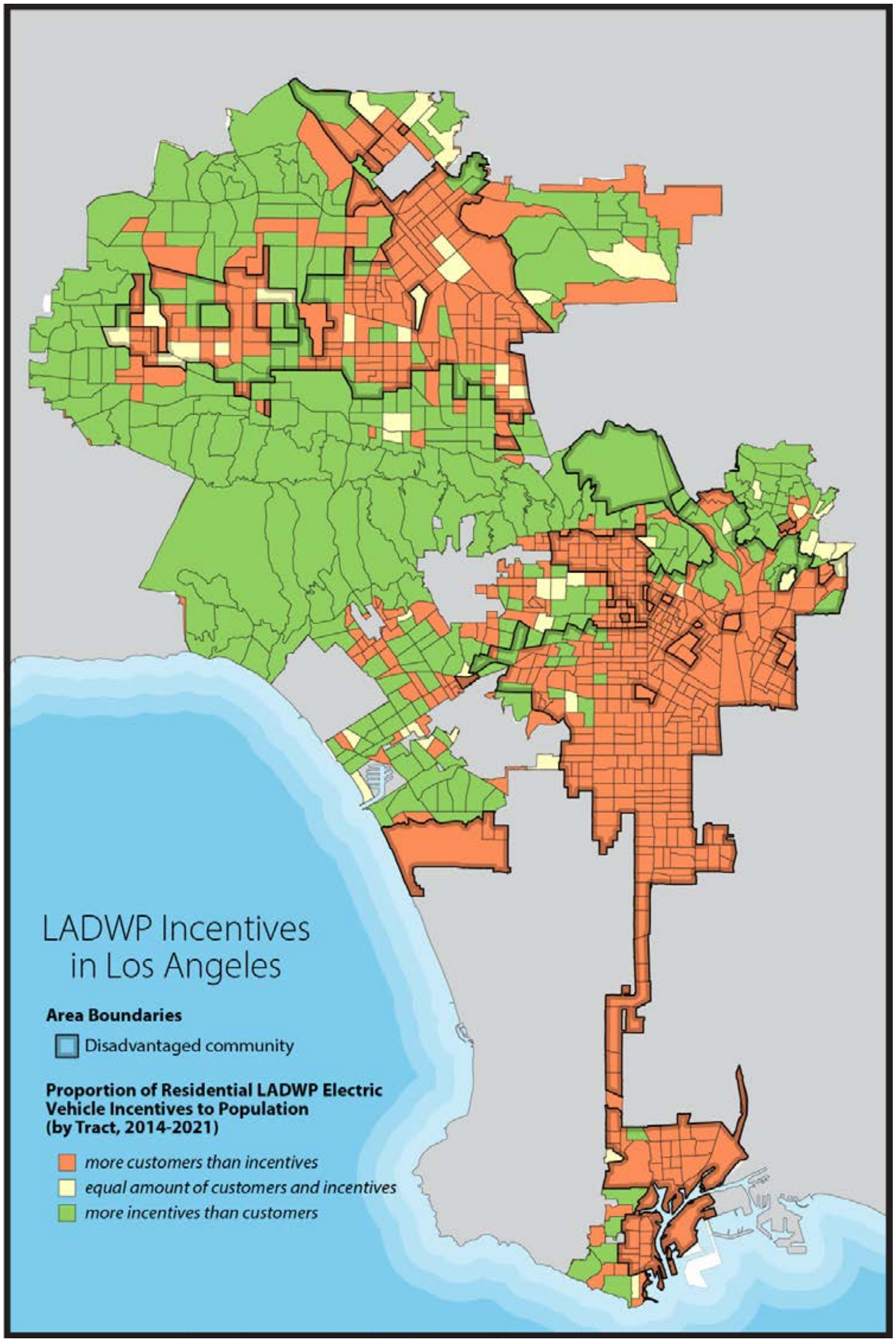

Figure 13. Proportion of residential EV incentives to population by census tract

Orange tracts indicate the percentage of households in each tract is greater than the percentage of benefits received, green tracts indicate the percentage of incentives received is greater than the percentage of households in each tract, and yellow tracts represent areas where the percentage of incentives is proportional to the *population*.

5 Conclusion

In this chapter, we presented results of analysis on *recognition justice.* We used a mixed methodological approach, including a systematic literature review and statistical analysis of LADWP programs and investments. Our aim was to inform modeling and development of equity strategies by analyzing (a) the distribution of benefits of LADWP programs and investments in the city and (b) historical and current factors contributing to this distribution and other energy inequities in the city. We provided the results of a qualitative and quantitative overview of critical processes determining inequities in education, employment, income, housing, and transportation relevant to the current energy transition. We focused on the causal factors affecting current inequities in four areas: (1) energy affordability, (2) energy access, (3) health, and (4) jobs (Figure ES-1), finding that:

- The benefits of LADWP's programs such as solar installation benefits, non-low-income-targeted energy efficiency programs, and EV incentives are not equitably distributed across communities.
- Underserved communities such as low-income families, renters, people of color face higher energy and transportation burdens, unsafe temperatures, and higher impact from extreme heat events, and other negative impacts of historical legacies that are still present in current policies and practices. At the same time, those who benefit include higher-income families, White Angelenos, and homeowners.

Redlining and infrastructure investment and siting belong to a set of historical and ongoing processes of institutionalized exclusion that have direct and indirect implications on current energy inequities in Los Angeles. For instance, the legacies of redlining negatively affect populations living in poor-quality buildings and unsafe and inefficient housing stock; they also constrain people's access to credit to improve those conditions, and force families to pay high energy bills. These inequities are evidenced in the everyday experiences of underserved community members, who reported:

- Poor quality and maintenance of infrastructure and housing due to decades of disinvestment and neglect
- A lack of affordable housing for renters and owners
- Barriers to making energy decisions for themselves and their communities (that we term *self-determination*)
- A lack of access to financial capital for energy access, affordability, and decision-making
- Mistrust and grievances related to the government agencies and policies
- A lack of accessible and useful information about resources and programs.

Without access to structurally sound housing stock or to legal upgrading options, these households also become ineligible for available energy efficiency programs, such as publicly accessible solar installation programs.

We identified a series of structural, intersecting factors currently influencing energy inequalities. For example, chronic economic hardship due to persistent low income intersects with factors such an inefficient housing stock to impact households' ability to afford electricity. Building type and age intersect with ownership status to influence a household's capacity to benefit from solar incentive, Feed-in Tariff, and Feed-in Tariff Plus programs. Analysis of these factors informs the modeling and strategy development described in subsequent chapters that effectively redresses current inequities for the future as LADWP and their partners design just transition strategies.

We mapped how unequal access to LADWP programs relates to the legacy of trends and practices in education, jobs, housing, transportation, and energy infrastructure. While energy assistance policies and programs are widely considered best practices in the clean energy transition, inequities have become entrenched in these programs across energy utilities in the United States (analyzed in Chapter 4). We present actionable solutions and strategies in Chapters 3 and 4 that LADWP can use to ensure that going forward, their programs will be more accessible and equitable for LA communities.

6 Glossary

Actions/Strategies: the means used to solve identified problems in an impact area; actions and strategies involve programs such as bills, regulations, rates, subsidies, and investments and how they are designed, implemented, and evaluated (Dubash et al. 2022)

Causal Factors: "Events, incidents, happenings that lead to the occurrence or development of a phenomenon" (Buckley and Waring 2013, 156).

Climate Justice: the remediation of the impacts of climate change on poor people and people of color, and compensation for harms suffered by such communities due to climate change (Burkett 2008)

Co-Creation: "a process through which two or more public and private actors attempt to solve a shared problem, challenge, or task through a constructive exchange of different kinds of knowledge, resources, competences, and ideas that enhance the production of public value in terms of visions, plans, policies, strategies, regulatory frameworks, or services, either through a continuous improvement of outputs or outcomes or through innovative step-changes that transform the understanding of the problem or task at hand and lead to new ways of solving it" (Torfing et al. 2019, 802)

Community Engagement: Often entails public participation through an ongoing, two-way or multidirectional process, ideally with an emphasis on relationships and trust-building rather than instrumental decisions. The latter are processes where engagement becomes the instrument to achieve social acceptance (Stober et al. 2021).

Disadvantaged Community: "Disadvantaged communities refers to the areas which most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, presence of hazardous wastes as well as high incidence of asthma and heart disease. One way that the state identifies these areas is by collecting and analyzing information from communities all over the state. CalEnviroScreen, an analytical tool created by the California Environmental Protection Agency (CalEPA), combines different types of census tract-specific information into a score to determine which communities are the most burdened or "disadvantaged"" (California Public Utilities Commission 2023).

Energy Equity: the equitable distribution of social, economic, and health benefits and burdens of energy across all segments of society (Jenkins 2017)

Energy Justice: the provision of safe, affordable, and sustainable energy to all individuals, across all areas (Jenkins 2017); this is done with a framework informed by justice movements, including attention to three core tenets:

- *Distributional justice* seeks to ensure a just and equitable distribution of benefits and negative impacts of the clean energy transition.
- *Justice as recognition* seeks to understand and address past and current energy inequities by analyzing structural causes of exclusion and vulnerability and specific needs associated with energy services among social groups.

- *Procedural justice* aims to actively engage partners and communities throughout the project, to co-design the analysis and shape the resulting equity strategies (Energy Equity Project 2022).

Energy Transition: a large-scale or deep societal change in the production, distribution, and use of energy; this transition can entail transformations in social-technical systems and systems of policy and governance intended to substantially improve the outcomes out of unsustainable pathways, such as fossil fuel use (Carley and Konisky 2020)

Environmental Justice: the distribution of environmental hazards and access to all natural resources; it includes equal protection from burdens, meaningful involvement in decisions, and fair treatment in access to benefits (U.S. EPA 2023)

Equity Outputs: immediate, easily measurable effects of an action aimed at achieving equity (Dubash et al. 2022).

Equity Outcomes: ultimate changes that a policy will yield (Dubash et al. 2022).

Equity: a measurement of fairness and justice. Unlike equality, which refers to the provision of the same to all, equity aims to recognize the historical and ongoing differences in experiences and outcomes between people, groups, and communities to redress those imbalances.

Frontline Community: a community, frequently a low-income community of color, that experiences the first and worst consequences of environmental and climate change including floods, heat waves, and other climate extremes as well as the impacts of facilities that are used to extract, produce, process, and transport energy resources.

Impact Areas: particular sectors and subsectors of the energy system impacted by causal factors

Just Energy Transition: a deep societal change in the energy system that fulfills at minimum three of the tenets of justice: recognition justice, procedural justice, and distributional justice (McCauley and Heffron 2018)

Justice: involves removing barriers that prevent equity through energy actions (strategies) that offer individuals and communities equal access to energy resources and options to self-determine their energy goals (Romero-Lankao and Nobler 2021).

Participation: relates to the involvement of the public in infrastructure siting and other clean energy decisions and policies (Stober et al. 2021). Participation is an umbrella concept that includes processes of community engagement and public decision-making (Stober et al. 2021). Participatory decision-making denotes inclusion of actors such as underserved communities in an energy project as a decision-maker. Direct participation refers to the level of economic and/or political involvement of a local community or municipality in an energy project.

Underserved Community: a community, frequently a low-income community of color, that (a) does not benefit from energy programs, investments, and technologies, and (b) is not recognized, considered, or able to participate in energy decision-making (Klinsky et al. 2017)

Values: the ethical paradigm that structures the sociocultural norms, beliefs, and practices guiding how a group of people prioritize and relate to the current energy transition (Jenkins 2017)

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Appendix A. Detailed Classification of LADWP Investment Programs and Services

Table A-1. Detailed Classification of LADWP Investment Programs and Services

Program	Years	Unique Locations	Number of Records	Total Dollars	Description
System Average Interruption Duration Index (SAIDI)	2015–2020	158 (DS-level)	872	no data	Average number of minutes a customer's power is out in a year for the system
System Average Interruption Frequency Index (SAIFI)	2015–2020	158 (DS-level)	872	no data	Average number of interruptions per year for the system
Tree Canopy Program (CITY)	2014–2021	12,450	17,594	$13,782,835	"City Plants": Tree planting to address the low tree canopy cover in LA
Commercial Direct Install Program (CDI)	2013–2021	17,187	41,151	$220,352,003	Energy- and water-saving equipment is installed at the business at no cost to the owner for qualifying businesses.
Home Energy Improvement Program (HEIP)	2017–2020	5,844	7,038	$3,378,869	The direct install whole-house program offers LADWP residential customers free lighting and water efficiency upgrades to improve the home's envelope and core systems.
Refrigerator Turn In and Recycle (RETIRE)	2016–2021	12,230	16,057	$2,667,307	A free service to pick up and recycle refrigerators
Consumer Rebate Program (CRP)	2015–2021	30,846	84,580	$93,248,144	Educate and encourage LADWP residential customers to purchase and install qualifying energy efficient products in their home
EV Incentives	2013–2021	6,910	987	$63,647,945	Commercial New Charger

Program	Years	Unique Locations	Number of Records	Total Dollars	Description
			339	no data	Commercial New Sub-Meter
			6	$430,000	Medium-Duty Heavy-Duty (MDHD)
			14	$1,800,000	Direct Current Fast Charge (DCFC)
			5,678	$3,017,576	Residential New Charger
			374	$92,500	Residential New Sub-Meter
			1,967	$2,251,350	Residential Used Vehicle
Solar Incentive Programs	2013–2021	100	137	$90,096,630	Feed-in Tariff Interconnection Agreement (FiT)
	1999–2021	21,344	34,551	$340,604,541	NEM (up to 1 MW) (SIP)
	2016–2021	16,068	24,763		Net Energy Metering (up to 1 MW) (NEM)
	2017–2020	32	32	$28,920	Solar Rooftops Program Lease Agreement (SRP)
Energy Efficiency Incentive Programs	2018–2019	74	74	$145,574	Energy Upgrade California (EUCA)
	2013–2017	60	60	$5,206,681	California Advanced Home Program (CAHP)
	2018–2021	17,939	30,651	$2,220,823	Efficient Product Marketplace (EPM)
	2017–2021	13,998	39,766	$22,561,827	HVAC Optimization Program (ACOPT)
	2007–2021	1,089	1,948	$85,361,268	Custom Performance-Based Efficiency Program (CPP)
	2005–2021	5,721	10,252	$116,752,703	Commercial Lighting Incentive Program / Commercial Lighting Efficiency (CLIP)
	no data	199	207	$229,455	Food Service Program (FSP)

Program	Years	Unique Locations	Number of Records	Total Dollars	Description
	2016–2021	924	2,327	$21,500,939	Upstream HVAC (UHVAC)
	2020–2021	6	6	no data	Multifamily Whole Building (MFWB)
	2007–2016	35	35	$1,442,410	New Construction (NC)
	2010–2012	39	64	$4,213,033	Chiller Efficiency Program (CEP)
	2012	46	51	$751,682	Nonprofit Program (NP)
	2006–2016	1,186	1,541	$1,995,610	Refrigeration (REF)
	no data	1,624	6,318	$7,897,259	Energy Savings Assistance Program (ESAP) (*Low-Income Targeted*)
	no data	no data	25	$3,611,156	Savings By Design / Zero By Design (SBD)
Low Income Discount Program (now EZ-SAVE)	2006–2021	43,561	598,542	$173,633,204	Customers may qualify to have a discount applied to their electric and/or water bills based on their income and household size.
Lifeline Discount Program	2006–2021	40,854	308,824	$313,424,782	Customers 62 years of age or older or permanently disabled may qualify, based on their income, to have a discount applied to their electric and/or water bills.

Appendix B. T-Tests: Methodology and Results

We evaluated the distribution of incentives by sociodemographic group using statistical analysis (t-tests) to identify areas of uneven distribution. Using this tract-level data as input, unequal variance independent t-tests were performed. These tests assume that data from two groups of the population both follow a normal distribution (i.e., data near the mean are more frequent than data far from the mean). However, unequal variance independent t-tests do not assume that data from two groups of the population have the same mean or variance (Welsh 1947). This means that the average values from two data sets (each representing a group of the population), as well as the dispersion of data points to their average value from each data set, are not assumed to be the same.

T-tests produce inferential statistics that evaluate hypotheses regarding differences between two groups of the population. In this analysis, we hypothesize that incentives *are not* evenly distributed among different households. T-tests provide two outputs: t-values and p-values. The significance of the t-values is determined by *p-values*, or the probability of an observed outcome when we assume the null hypothesis is true. A null hypothesis claims that there is no difference in data represented by two groups of the population. In this case, our null hypothesis is that incentives *are* evenly distributed among different households. If a *p-value* is smaller than a *pre-defined alpha*, the results of the *t-test* are statistically significant. In this analysis, we used an alpha of 0.025, which is the standard for two-tailed tests (Welsh 1947). Therefore, p-values smaller than 0.025 are interpreted in our results as: given our input data, the probability of receiving data points that are distributed evenly among all households is so low that we must reject our null hypothesis. Therefore, we can claim that incentives are unevenly distributed to one group of households compared to another.

The following tables identify communities according to sociodemographic indicators that disproportionately benefited from programs (blank entries indicate that no statistical significances between households and incentives existed) as well as the corresponding p- and t-values according to the number of benefits distributed and the total dollar amount spent for each program for the following types of investments: (1) energy efficiency programs, (2), solar installation programs, (3) EV incentive programs, (4) customer discount programs, and (5) power infrastructure reliability metrics.

B.1 Energy Efficiency Programs

Table B-1. Number of Households Receiving Benefits from Residential Energy Efficiency Investments

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
California Advanced Home Program (CAHP)	no statistically significant difference				
Chiller Efficiency Program (CEP)	no statistically significant difference				
Consumer Rebate Program (CRP)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Efficient Product Marketplace (EPM)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Energy Savings Assistance Program (ESAP)[a]	DAC	Mostly Non-White	Mostly Hispanic	Mostly Renters	Below Median Income
Energy Upgrade California (EUCA)	no statistically significant difference				
Home Energy Improvement Program (HEIP)	DAC		Mostly Hispanic	Mostly Owners	
HVAC Optimization Program (ACOPT)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Refrigeration Program (REF)	Non-DAC	Mostly White	Mostly Non-Hispanic		Above Median Income
Refrigerator Turn In and Recycle Program (RETIRE)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income

[a] Low-Income Targeted

Table B-2. Number of Households Receiving Benefits from Residential Energy Efficiency Investments (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
California Advanced Home Program (CAHP)	0.264	0.836	0.247	0.062	0.202
Chiller Efficiency Program (CEP)	0.113	0.647	0.107	0.543	0.938
Consumer Rebate Program (CRP)	<0.001	<0.001	0.003	<0.001	<0.001
Efficient Product Marketplace (EPM)	<0.001	<0.001	<0.001	<0.001	<0.001
Energy Savings Assistance Program (ESAP)[a]	<0.001	0.001	<0.001	<0.001	<0.001
Energy Upgrade California (EUCA)	0.048	0.080	0.178	0.051	0.102
Home Energy Improvement Program (HEIP)	<0.001	0.141	0.005	<0.001	0.906
HVAC Optimization Program (ACOPT)	<0.001	<0.001	<0.001	<0.001	<0.001
Refrigeration Program (REF)	<0.001	0.001	<0.001	0.079	<0.001
Refrigerator Turn In and Recycle Program (RETIRE)	<0.001	<0.001	<0.001	<0.001	<0.001

[a] Low-Income Targeted

Table B-3. Number of Households Receiving Benefits from Residential Energy Efficiency Investments (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
California Advanced Home Program (CAHP)	1.131	0.209	1.180	-1.936	1.328
Chiller Efficiency Program (CEP)	1.608	0.463	1.772	-0.624	0.079
Consumer Rebate Program (CRP)	6.596	7.984	2.950	13.246	8.877
Efficient Product Marketplace (EPM)	33.693	14.659	20.939	14.000	23.393
Energy Savings Assistance Program (ESAP)[a]	-8.781	-3.236	-5.763	-5.951	-6.986
Energy Upgrade California (EUCA)	1.994	1.783	1.362	1.999	1.659
Home Energy Improvement Program (HEIP)	-8.143	-1.473	-2.832	7.497	0.118
HVAC Optimization Program (ACOPT)	10.121	6.594	6.933	5.510	7.645
Refrigeration Program (REF)	1.131	0.209	1.180	-1.936	1.328
Refrigerator Turn In and Recycle Program (RETIRE)	1.608	0.463	1.772	-0.624	0.079

[a] Low-Income Targeted

Table B-4. Amount of Investment Dollars Spent on Residential Energy Efficiency Investments

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
California Advanced Home Program (CAHP)	Mostly Non-Hispanic				
Chiller Efficiency Program (CEP)	no statistically significant difference				
Consumer Rebate Program (CRP)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Efficient Product Marketplace (EPM)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Energy Savings Assistance Program (ESAP)[a]	DAC		Mostly Hispanic	Mostly Renters	Below Median Income
Energy Upgrade California (EUCA)	Non-DAC				
Home Energy Improvement Program (HEIP)	DAC			Mostly Owners	
HVAC Optimization Program (ACOPT)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Refrigeration Program (REF)	Non-DAC		Mostly Non-Hispanic	Mostly Owners	Above Median Income
Refrigerator Turn In and Recycle Program (RETIRE)	no data				

[a] Low-Income Targeted

Table B-5. Amount of Investment Dollars Spent on Residential Energy Efficiency Investments (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
California Advanced Home Program (CAHP)	0.229	0.770	0.024	0.058	0.133
Chiller Efficiency Program (CEP)	0.346	0.725	0.174	0.648	0.584
Consumer Rebate Program (CRP)	<0.001	<0.001	<0.001	<0.001	<0.001
Efficient Product Marketplace (EPM)	<0.001	<0.001	<0.001	<0.001	<0.001
Energy Savings Assistance Program (ESAP)[a]	<0.001	0.033	<0.001	<0.001	<0.001
Energy Upgrade California (EUCA)	0.002	0.080	0.288	0.305	0.461
Home Energy Improvement Program (HEIP)	<0.001	0.124	0.765	<0.001	0.187
HVAC Optimization Program (ACOPT)	<0.001	<0.001	<0.001	<0.001	<0.001
Refrigeration Program (REF)	<0.001	0.318	0.001	0.021	0.001
Refrigerator Turn In and Recycle Program (RETIRE)	no data				

[a] Low-Income Targeted

Table B-6. Amount of Investment Dollars Spent on Residential Energy Efficiency Investments (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
California Advanced Home Program (CAHP)	1.220	0.295	2.390	-1.948	1.576
Chiller Efficiency Program (CEP)	0.950	0.355	1.442	0.472	0.555
Consumer Rebate Program (CRP)	6.593	7.628	3.998	14.796	9.548
Efficient Product Marketplace (EPM)	33.613	14.598	20.657	13.756	23.014
Energy Savings Assistance Program (ESAP)[a]	-4.245	-2.139	-3.675	-4.479	-6.152
Energy Upgrade California (EUCA)	3.182	1.804	1.075	1.035	0.742
Home Energy Improvement Program (HEIP)	-5.652	-1.541	0.298	7.368	1.322
HVAC Optimization Program (ACOPT)	12.138	8.229	8.356	7.399	9.340
Refrigeration Program (REF)	4.860	0.999	3.363	2.327	3.306
Refrigerator Turn In and Recycle Program (RETIRE)	no data				

[a] Low-Income Targeted

Table B-7. Number of Entities Receiving Benefits from Commercial Energy Efficiency Investments

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Commercial Direct Install (CDI)	DAC			Mostly Renters	Below Median Income
Commercial Lighting Incentive Program (CLIP)	DAC			Mostly Renters	
Custom Performance-Based Efficiency Program (CPP)	Non-DAC		Mostly Non-Hispanic		
Food Service Program (FSP)	Non-DAC				
New Construction Program (NC)	no statistically significant difference				
Nonprofit Program (NP)	no statistically significant difference				

Table B-8. Number of Entities Receiving Benefits from Commercial Energy Efficiency Investments (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Commercial Direct Install (CDI)	<0.001	0.076	0.312	<0.001	0.007
Commercial Lighting Incentive Program (CLIP)	0.005	0.027	0.080	<0.001	0.585
Custom Performance-Based Efficiency Program (CPP)	0.002	0.205	0.001	0.089	0.063
Food Service Program (FSP)	0.003	0.364	0.071	0.812	0.053
New Construction Program (NC)	0.693	0.947	0.385	0.043	0.739
Nonprofit Program (NP)	0.259	0.975	0.453	0.223	0.425

Table B-9. Number of Entities Receiving Benefits from Commercial Energy Efficiency Investments (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Commercial Direct Install (CDI)	-7.469	-1.776	-1.012	-3.495	-2.693
Commercial Lighting Incentive Program (CLIP)	-2.833	-2.222	1.756	-3.802	-0.547
Custom Performance-Based Efficiency Program (CPP)	3.131	-1.272	3.504	-1.705	1.865
Food Service Program (FSP)	3.040	0.910	1.819	-0.238	1.955
New Construction Program (NC)	0.397	0.067	0.882	-2.152	-0.338
Nonprofit Program (NP)	1.155	-0.032	-0.759	1.246	-0.817

Table B-10. Amount of Investment Dollars Spent on Commercial Energy Efficiency Investments

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Commercial Direct Install (CDI)	DAC				
Commercial Lighting Incentive Program (CLIP)			Mostly Non-Hispanic		
Custom Performance-Based Efficiency Program (CPP)	no statistically significant difference				
Food Service Program (FSP)	no statistically significant difference				
New Construction Program (NC)	no statistically significant difference				
Nonprofit Program (NP)	no statistically significant difference				

Table B-11. Amount of Investment Dollars Spent on Commercial Energy Efficiency Investments (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Commercial Direct Install (CDI)	<0.001	0.220	0.977	0.472	0.782
Commercial Lighting Incentive Program (CLIP)	0.730	0.268	0.001	0.038	0.301
Custom Performance-Based Efficiency Program (CPP)	0.058	0.063	0.060	0.150	0.080
Food Service Program (FSP)	0.143	0.708	0.071	0.160	0.327
New Construction Program (NC)	0.534	0.692	0.339	0.194	0.359
Nonprofit Program (NP)	0.315	0.169	0.059	0.043	0.426

Table B-12. Amount of Investment Dollars Spent on Commercial Energy Efficiency Investments (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Commercial Direct Install (CDI)	-6.394	-1.228	-0.029	-0.720	-0.277
Commercial Lighting Incentive Program (CLIP)	0.345	-1.108	3.340	-2.082	1.036
Custom Performance-Based Efficiency Program (CPP)	1.899	-1.872	1.886	-1.442	1.762
Food Service Program (FSP)	-1.471	0.376	1.822	1.423	0.983
New Construction Program (NC)	0.629	0.403	0.983	-1.329	0.964
Nonprofit Program (NP)	1.022	1.406	1.969	2.104	0.809

B.2 Solar Installation Programs

Table B-13. Number of Households Receiving Benefits from Solar Installation Programs

Program	Non-DAC/DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Feed-In Tariff Program (FiT)	no statistically significant difference				
Net Metering Programs (NEM and SIP)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income

Table B-14. Number of Households Receiving Benefits from Solar Installation Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Feed-In Tariff Program (FiT)	0.258	0.776	0.200	0.339	0.341
Net Metering Programs (NEM and SIP)	<0.001	<0.001	<0.001	<0.001	<0.001

Table B-15. Number of Households Receiving Benefits from Solar Installation Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Feed-In Tariff Program (FiT)	-1.131	-0.284	-1.283	-0.956	-0.953
Net Metering Programs (NEM and SIP)	15.809	10.879	7.547	16.311	14.203

Table B-16. Amount of Installed Capacity from Solar Installation Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Feed-In Tariff Program (FiT)	no statistically significant difference				
Net Metering Programs (NEM and SIP)	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income

Table B-17. Amount of Installed Capacity from Solar Installation Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Feed-In Tariff Program (FiT)	0.163	0.846	0.791	0.685	0.737
Net Metering Programs (NEM and SIP)	<0.001	<0.001	<0.001	<0.001	<0.001

Table B-18. Amount of Installed Capacity from Solar Installation Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Feed-In Tariff Program (FiT)	-1.406	-0.195	-0.267	-0.408	-0.338
Net Metering Programs (NEM and SIP)	16.565	9.429	9.840	13.804	13.748

B.3 EV Incentive Programs

Table B-19. Number of Households Receiving Benefits from Residential EV Investment Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
New Sub-Meter	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Used Vehicle	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income

Table B-20. Number of Households Receiving Benefits from Residential EV Investment Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	<0.001	<0.001	<0.001	<0.001	<0.001
New Sub-Meter	<0.001	<0.001	<0.001	<0.001	<0.001
Used Vehicle	<0.001	<0.001	<0.001	<0.001	<0.001

Table B-21. Number of Households Receiving Benefits from Residential EV Investment Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	25.978	8.968	15.102	11.068	16.199
New Sub-Meter	6.773	7.650	3.964	3.857	5.590
Used Vehicle	14.446	5.909	11.376	7.943	10.275

Table B-22. Amount of Investment Dollars Spent on Residential EV Investment Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
New Sub-Meter	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income
Used Vehicle	Non-DAC	Mostly White	Mostly Non-Hispanic	Mostly Owners	Above Median Income

Table B-23. Amount of Investment Dollars Spent on Residential EV Investment Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	<0.001	<0.001	<0.001	<0.001	<0.001
New Sub-Meter	<0.001	<0.001	<0.001	<0.001	<0.001
Used Vehicle	<0.001	<0.001	<0.001	<0.001	<0.001

Table B-24. Amount of Investment Dollars Spent on Residential EV Investment Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	26.019	9.067	15.096	11.039	16.249
New Sub-Meter	6.709	7.573	3.944	3.762	5.579
Used Vehicle	11.345	4.201	10.045	6.554	8.330

Table B-25. Number of Entities Receiving Benefits from Commercial EV Investment Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	Non-DAC		Mostly Non-Hispanic	Mostly Renters	Above Median Income
New Sub-Meter			Mostly Non-Hispanic		

Table B-26. Number of Entities Receiving Benefits from Commercial EV Investment Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	<0.001	0.170	<0.001	0.024	0.011
New Sub-Meter	0.546	1.000	<0.001	0.979	0.222

Table B-27. Number of Entities Receiving Benefits from Commercial EV Investment Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	3.827	1.377	8.103	-2.281	2.561
New Sub-Meter	0.604	-0.001	4.108	0.026	1.228

Table B-28. Amount of Investment Dollars Spent on Commercial EV Investment Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	Non-DAC		Mostly Non-Hispanic	Mostly Renters	Above Median Income
New Sub-Meter	no data				

Table B-29. Amount of Investment Dollars Spent on Commercial EV Investment Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	<0.001	0.709	<0.001	0.016	0.024
New Sub-Meter	no data				

Table B-30. Amount of Investment Dollars Spent on Commercial EV Investment Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
New Charger	3.595	0.374	7.147	-2.429	2.272
New Sub-Meter	no data				

B.4 Customer Discount Programs

Table B-31. Number of Households Receiving Benefits from Customer Discount Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
EZ-SAVE[a]	DAC	Mostly Non-White	Mostly Hispanic	Mostly Renters	Below Median Income
Lifeline[a]	DAC	Mostly Non-White	Mostly Hispanic	Mostly Renters	Below Median Income

[a] Low-Income Targeted

Table B-32. Number of Households Receiving Benefits from Customer Discount Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
EZ-SAVE[a]	<0.001	<0.001	<0.001	<0.001	<0.001
Lifeline[a]	<0.001	<0.001	0.006	<0.001	<0.001

[a] Low-Income Targeted

Table B-33. Number of Households Receiving Benefits from Customer Discount Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
EZ-SAVE[a]	-30.547	-9.795	-14.590	-14.319	-20.062
Lifeline[a]	-14.924	-4.925	-2.731	-5.735	-9.663

[a] Low-Income Targeted

Table B-34. Amount of Customer Savings from Customer Discount Programs

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
EZ-SAVE[a]	DAC	Mostly Non-White	Mostly Hispanic	Mostly Renters	Below Median Income
Lifeline[a]	DAC	Mostly Non-White			Below Median Income

[a] Low-Income Targeted

Table B-35. Amount of Customer Savings from Customer Discount Programs (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
EZ-SAVE[a]	<0.001	<0.001	<0.001	<0.001	<0.001
Lifeline[a]	<0.001	<0.001	0.434	0.051	<0.001

[a] Low-Income Targeted

Table B-36. Amount of Customer Savings from Customer Discount Programs (t-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
EZ-SAVE[a]	-37.227	-10.243	-19.145	-9.852	-21.251
Lifeline[a]	-13.834	-3.828	-0.783	-1.956	-7.380

[a] Low-Income Targeted

B.5 Power Infrastructure Reliability

Table B-37. Average Indexes from Power Reliability Metrics

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Frequency of Power Interruptions (SAIFI)	DAC		Mostly Hispanic		
Duration of Power Interruptions (SAIDI)	no statistically significant difference				

Table B-38. Average Indexes from Power Reliability Metrics (p-value)

Program	Non-DAC/ DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Frequency of Power Interruptions (SAIFI)	<0.001	0.834	0.015	0.231	0.606
Duration of Power Interruptions (SAIDI)	0.195	0.979	0.181	0.302	0.883

Table B-39. Average Indexes from Power Reliability Metrics (t-value)

Program	Non-DAC/DAC	Mostly White/ Mostly Non-White	Mostly Non-Hispanic/ Mostly Hispanic	Mostly Owners/ Mostly Renters	Mostly Above Median Income/ Mostly Below Median Income
Frequency of Power Interruptions (SAIFI)	-4.248	-0.210	-2.470	1.207	-0.517
Duration of Power Interruptions (SAIDI)	-1.298	-0.026	-1.347	1.038	0.147

Appendix C. Structural Factors and Present-Day Equity Impacts in Los Angeles

Table C-1. Examples of Factors That Can Impact Energy Affordability and Burdens in Buildings, Transportation, Distributed Energy Resources, and Utility-Scale Infrastructure

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Buildings	Built Environment	Appliances and lighting (type, efficiency)	Energy burden due to wasted energy / inefficiency (Steering Committee Members 2021)
		Building age	Technical feasibility of (barriers to) electrification / energy retrofits to reduce energy burden (Steering Committee Members 2022a; Advisory Group Members 2018c; Harris-Dawson et al. 2022)
			Effort / investment / time required to upgrade / decarbonize (Harris-Dawson et al. 2022)
		Building efficiency (envelope, HVAC)	Energy burden due to wasted energy / inefficiency (Steering Committee Members 2021)
		Exposure to climate change-related hazards / adaptability to climate extremes	Financial burden of evacuation, displacement, repairs
			Energy burden associated with coping measures (e.g., air conditioning) (Advisory Group Members 2019a; 2019c; 2021)
			Water cost burden associated with drought (Rodriguez 2021)
		Local microclimatic / infrastructural characteristics	Energy burden associated with cooling to mitigate urban heat island effects (Steering Committee Members 2021)
			Technical feasibility of onsite energy generation: construction density, shading, rooftop space, etc. (Steering Committee Members 2022a)
	Economic	Building occupancy / ownership status (owner-occupied vs. renter-occupied)	Split incentives for building energy upgrades (renters' ability to invest in cost-saving energy upgrades vs. owners' ability to recover costs of investment) (Steering Committee Members 2022b)
			Ability to participate in solar incentive, Feed-in Tariff, and Feed-in Tariff Plus programs (Krekorian and O'Farrell 2021b)
		Sudden or chronic economic hardship due to unstable / persistent low income	Chronic high energy burden
			Affordability of building repairs / maintenance (Advisory Group Members 2021; Steering Committee Members 2022a)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		Rent burden	(Lack of) Discretionary income to invest in building repairs / maintenance (Harris-Dawson et al. 2022)
		Up-front EE/RE technology costs	Affordability of transition to weatherization / electrification technologies (Advisory Group Members 2019c; 2021)
		Use of public funding vs. private funding for technology and infrastructure upgrades	Distribution of costs related to the transition among different customer types (Advisory Group Members 2021)
	Policy / Institutional	Building codes	Impact of enhanced building codes on housing affordability, minimum building efficiency (Steering Committee Members 2022a; Harris-Dawson et al. 2022)
		Policies / programs / investments for energy efficiency vs. new generation	Ability for customers to control energy use and costs (existence of programs and customer knowledge / trust of programs and benefits) (Advisory Group Members 2017a; 2019b; 2020d; 2021)
		Incentives vs. rebates for building energy upgrades	Up-front costs and magnitude of financial burden on building owners / renters (Steering Committee Members 2022a; 2022b; Advisory Group Members 2021)
	Sociocultural / Behavioral	Awareness of time-of-use rates, changes to net metering policies	Ability to apply knowledge to control bill costs / make informed energy decisions (Residents of Los Angeles 2022a; Advisory Group Members 2017b; 2020c)
		Changing electricity use patterns in response to behavior changes driven by COVID-19	Impact of rate increases on total energy bills for different sectors / building types
			Redistribution of energy costs / burden among commercial and residential sectors (Advisory Group Members 2017a; 2020b; Lou et al. 2021)
		Household energy demands related to occupant characteristics	Disparities in how, when, and how much energy is needed by different households / building occupants (Advisory Group Members 2020b; 2021)
			Impact of transition on total energy bills for median and lifeline customers, neighborhood-level disparities in energy bill impacts (Advisory Group Members 2020b; 2020c; 2021)
		Time poverty	Ability to implement and participate in load shifting / demand response programs and behavior changes (Advisory Group Members 2020b)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Distributed Energy Resources	Built Environment	Interrelated dependencies of transmission upgrades, distributed generation, and rooftop solar	Distribution of cost of new transmission / distribution infrastructure, and who pays costs of new transmission (Advisory Group Members 2018a; 2018b; 2018c; 2018d; 2019b; 2019c; 2020a; 2020c; 2020d)
		Need to transition land use patterns with higher densities	Higher adoption rates for rooftop solar photovoltaics in lower-density residential areas (Advisory Group Members 2018d; 2020a)
	Economic	Economic impacts of COVID-19 pandemic (income loss, rising costs)	Affordability of customer-owned DERs (Advisory Group Members 2019c; 2020a)
		Housing market fluctuations	Financial tools (e.g., mortgage refinance) available to afford customer-owned DERs
			Ability to repay debts incurred to purchase DERs (Advisory Group Members 2019a)
		Up-front cost of customer-owned DERs	Affordability of DERs (Advisory Group Members 2020b)
			Opportunity to realize long-term savings from reduced power bills / energy burden (Advisory Group Members 2019c)
	Policy / Institutional	Design of incentives, credits, subsidies for rooftop solar (magnitude, change over time)	Economic feasibility, ROI for customer-owned DERs (Advisory Group Members 2019a; 2019b; 2019c; 2020a; 2020b; 2020c; Lou et al. 2021)
			Magnitude of financial benefits to early adopters vs. late adopters (Advisory Group Members 2020a; O'Shaughnessy 2022)
		Feed-in tariffs, net billing, net metering policies and rates	Distribution of costs and economic benefits for excess customer generation (Advisory Group Members 2019b; 2019c; 2020a; 2020b; Krekorian and O'Farrell 2021b)
		LADWP programs to support ratepayer adoption of DERs	Efforts to lower economic barriers to DER adoption for low-income customers (Advisory Group Members 2018d)
Mobility / Transportation	Built Environment	Availability of workplace / public EV charging	Access to free and public EV charging, energy burden for businesses vs. drivers (Advisory Group Members 2019a)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Mobility / Transportation	Economic	Electricity rates vs. cost of gasoline	Affordability, feasibility, and speed of transition to electric vehicles (Advisory Group Members 2018b; 2018d; 2019c; 2020b)
		Funding mechanisms for installation and maintenance of EV supply equipment	Distribution of installation costs for fast-charging stations
			Who pays / collects fees for use of fast charging
		Up-front vehicle costs	Affordability of personal gasoline / electric vehicles (Advisory Group Members 2019c)
	Sociocultural / Behavioral	Behavior changes in response to COVID-19 pandemic	Changing mobility / commuting needs, ability to shift transportation mode to reduce risk / transportation energy burden (Advisory Group Members 2020a; Williams, Blair-Loy, and Berdahl 2013; Kossek, Lautsch, and Eaton 2006)
		Consumer sensitivity to electricity rates	Acceptability / willingness to transition to new technologies to reduce transportation energy burden (Advisory Group Members 2018b; 2020b)
		Time poverty	Ability to take advantage of incentives for charging personal EVs during off-peak hours to reduce transportation energy burden (Advisory Group Members 2020b; Williams, Blair-Loy, and Berdahl 2013; Kossek, Lautsch, and Eaton 2006; Lambert 2008; Hyde, Greene, and Darmstadt 2020)
Utility-Scale Infrastructure	Built Environment	Age of existing 4.8 kV distribution infrastructure	Geographic disparities in technical feasibility of distributed generation (Advisory Group Members 2019c)
		Increasing frequency / severity of extreme weather, wildfires due to climate change	(Distribution of) Costs for system hardening, undergrounding lines (Advisory Group Members 2019a; 2019b; 2019c; 2020b; 2020c)
		Seasonal environmental variation / drought	Higher water costs for households and small businesses with limited financial / technical ability to adopt conservation measures (Advisory Group Members 2018c; 2019c; Koretz and O'Farrell 2021; Rodriguez 2021)
	Economic	Cost-benefit optimization models for analyzing decentralization strategies and storage investments	Mechanisms to value / prioritize investments with multiple / indirect benefits for decision-making, including social cost of carbon, methods for assigning monetary value to human health and well-being (Advisory Group Members 2018d; 2019a; 2019b)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		Rate structures	Impact of rates on other sectors of the economy (Advisory Group Members 2019b)
			Energy burden (Advisory Group Members 2019b)
			Greater impact of rate increases on household and community health / well-being for low-income households (Advisory Group Members 2020b)
	Policy / Institutional	Prioritization of energy efficiency vs. new generation	Availability of energy efficiency programs and incentives
			Magnitude of financial and technical assistance, incentives (Advisory Group Members 2019b)
		Real-time pricing, time-of-use rates	Burden on customers with limited ability to reduce or shift consumption (Advisory Group Members 2018b; 2020a)
	Sociocultural / Behavioral	Adoption of demand response and load flexibility programs and behaviors	Opportunity to realize long-term savings from reduced power bills (Advisory Group Members 2019b)
		Customer adoption of DERs	Impacts on system reliability, need for infrastructure upgrades / expansion (Advisory Group Members 2020a)

Table C-2. Examples of Factors That Can Limit Access in Buildings, Transportation, Distributed Energy Resources, and Utility-Scale Infrastructure

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Buildings	Built Environment	Building age	Technical feasibility of (barriers to) electrification / energy retrofits (Steering Committee Members 2022a; Advisory Group Members 2018c; Harris-Dawson et al. 2022)
		Building type (e.g., single-family, multifamily, commercial, manufactured, municipal)	Technical feasibility of onsite energy systems for single-family vs. multifamily vs. manufactured homes (Krekorian and O'Farrell 2021b)
		Local infrastructure (maintenance, ADA accessibility, etc.)	Physical accessibility of buildings and facilities (and the services they provide) (Llewellyn 2019)
	Policy / Institutional	DWP conservation and efficiency-promoting programs to reduce home	Accessibility of information through targeted outreach (Advisory Group Members 2017a; 2020d; 2021)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		/ community energy demand	Contracting opportunities for local grassroots organizations to assist in dissemination of information (Advisory Group Members 2017a; 2021)
		Incentives vs. rebates for building energy upgrades	Ability to take advantage of economic assistance policies that require up-front investment (Steering Committee Members 2022a; 2022b)
	Sociocultural / Behavioral	Awareness of time-of-use rates, changes to net metering policies	Ability to provide comment /input on proposed policy changes (Residents of Los Angeles 2022a; Advisory Group Members 2017b; 2020c)
			Access to information to make informed energy decision (Residents of Los Angeles 2022a)
		Cultural / language barriers to information	Access to information on bill assistance, energy efficiency, energy conservation, and demand response programs (Residents of Los Angeles 2022a; 2022b; Advisory Group Members 2020c)
			Accessibility of technical information for non-technical audiences (Residents of Los Angeles 2022b; Advisory Group Members 2018c; 2020b; 2020d)
		Time poverty	Ability to participate in education / outreach programs (Residents of Los Angeles 2022a; 2022b)
			Ability to provide comment, attend public hearings, and/or participate in community engagement activities related to zoning, building codes, homeowner / neighborhood associations, etc.
			Ability to implement and participate in load shifting / demand response programs and behavior changes
Distributed Energy Resources	Built Environment	Building and roof age	Technical feasibility of customer-owned / community solar (Advisory Group Members 2019b)
		Interrelated dependencies of transmission upgrades, distributed generation, and small-scale residential solar	Where and when distributed generation and local solar are deemed economically and technically feasible (Advisory Group Members 2018a; 2018b; 2018c; 2018d; 2019b; 2019c; 2020b; 2020d)
		Land use patterns and development density	Impact of construction density on solar technical potential and feasibility (Advisory Group Members 2018d; 2019b)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		Solar on public facilities	Access to resilient energy (Advisory Group Members 2019b)
			Access to educational co-benefits of visible renewable energy (Advisory Group Members 2019b)
		Transmission-related bottlenecks in deployment of solar and storage	Technical feasibility / access to distributed energy (Advisory Group Members 2020b)
	Sociocultural / Behavioral	Ability of partners to communicate technical plans and studies to their communities with appropriate language, materials, transparency in assumptions and process, etc.	Accessibility of information necessary to participate (Residents of Los Angeles 2022b; Advisory Group Members 2019c; 2020b; 2020c)
		Barriers to participation in community outreach and engagement activities	Ability to participate (Advisory Group Members 2020c)
		Neighborhood-level uptake of solar and storage	Peer effects on solar adoption (Advisory Group Members 2020a)
Transportation	Built Environment	Availability of workplace / public EV charging	Access to free and public EV charging (Advisory Group Members 2019a)
	Sociocultural / Behavioral	Ability of partners to communicate technical plans and studies to their communities with appropriate language, materials, transparency in assumptions and process, etc.	Accessibility of information necessary to participate (Advisory Group Members 2019c; 2020b; 2020c)
		Barriers to participation in community outreach and engagement activities	Ability to participate (Advisory Group Members 2020c)
		Mode-shifting policies and trends	Perceived accessibility / acceptability of different mobility options (Williams, Blair-Loy, and Berdahl 2013; Kossek, Lautsch, and Eaton 2006)
		Time poverty	Ability to shift transportation behaviors / modes

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
			Ability to participate in planning / outreach / education activities and programs (Williams, Blair-Loy, and Berdahl 2013; Kossek, Lautsch, and Eaton 2006; Lambert 2008; Hyde, Greene, and Darmstadt 2020)
			Ability to take advantage of incentives for charging personal EVs during off-peak hours
Utility-Scale Infrastructure	Built Environment	Age of existing 4.8 kV distribution infrastructure	Upgrade timeline enabling / constraining technical feasibility of distributed generation, larger system changes (Advisory Group Members 2019c; 2020b)
		DWP regional stormwater capture projects in the North Valley	Accessibility of LADWP nature-based projects designed to improve water quality and supply, other community benefits (Krekorian, Martinez, and Rodriguez 2021b)
	Policy / Institutional	Prioritization of energy efficiency vs. new generation	Availability of / access to energy efficiency programs and incentives, financial and technical assistance (Advisory Group Members 2019b)
	Sociocultural / Behavioral	Ability of partners to communicate technical plans and studies to their communities with appropriate language, materials, transparency in assumptions and process, etc.	Accessibility of information necessary to participate (Advisory Group Members 2019c; 2020b; 2020c)
		Barriers to participation in community outreach and engagement activities	Ability to participate (Advisory Group Members 2020c)

Table C-3. Examples of Factors that Can Limit Access to Jobs and Workforce Development Opportunities in Housing, Transportation, Distributed Energy Resources, and Utility-Scale Infrastructure

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Buildings	Policy / Institutional	Building codes	Impact of new building codes on quantity, quality of construction jobs (Harris-Dawson et al. 2022)
		City contracting standards	Impact of hiring and labor standards on ensuring quality jobs for residents (Koretz and Krekorian 2021; Krekorian and O’Farrell 2021a)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
			Impact of bid requirements on ability for some small and local businesses to bid for / win City contracts (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)
		Collective bargaining agreements and workforce development / training in relation to the renewable energy transition	Empowerment of organized labor to participate and take ownership of the transition (Advisory Group Members 2019b)
		DWP conservation and efficiency-promoting programs to reduce home / community energy demand	Contracting opportunities for local grassroots organizations to assist in dissemination of information (Advisory Group Members 2017a; 2021)
			Impact of conservation and weatherization programs on employment and training for clean energy trades in local communities (Residents of Los Angeles 2022a; Advisory Group Members 2017a; 2020b)
Distributed Energy Resources Distributed Energy Resources	Built Environment	Interrelated dependencies of transmission upgrades, distributed generation, and small-scale residential solar	Long-term job potential / job security in different energy generation sectors and infrastructure construction (Advisory Group Members 2020b; 2021)
	Policy / Institutional	City contracting standards	Impact of hiring and labor standards on ensuring quality jobs for local residents (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)
			Impact of bid requirements on ability for some small and local businesses to bid for / win City contracts (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)
		Hiring practices for construction, operation, and maintenance of DER systems and related infrastructure	Impact of past / current transitions on quantity, quality, and distribution of jobs (Advisory Group Members 2019b; 2020b)
		Workforce training programs / opportunities for construction, operation, and maintenance of technology and infrastructure	Access to knowledge / skills / opportunities to transition professionally (Advisory Group Members 2019b; 2020b)
			Economic mobility through past energy technology expansions / transitions

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Mobility / Transportation	Policy / Institutional	City contracting standards	Impact of hiring and labor standards on ensuring quality jobs for local residents (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)
			Impact of bid requirements on ability for some small and local businesses to bid for / win City contracts (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)
		Hiring practices for construction, operation, and maintenance of transportation systems and infrastructure	Impact of electrification on quantity, quality, and distribution of jobs (Advisory Group Members 2019b; 2020b)
		Workforce training programs / opportunities for construction, operation, and maintenance of infrastructure	Access to knowledge / skills / opportunities to transition professionally (Advisory Group Members 2019b; 2020b)
			Economic mobility through past transportation system expansions / transitions (Advisory Group Members 2019b; 2020b)
Utility-Scale Infrastructure	Built Environment	Existing natural gas units and associated infrastructure	Economic dependence on fossil-fired generation for jobs, tax revenue, community budget (Navajo Nation) (O'Farrell 2020)
	Economic	Rate structures	Impact of rates on other sectors of the economy (e.g., small business' ability to hire / raise wages) (Advisory Group Members 2019b)
		Revenue losses from closure of fossil-fired generation	Long-term community-level economic stability (O'Farrell 2020)
	Policy / Institutional	City contracting standards	Impact of hiring and labor standards on ensuring quality jobs for residents (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)
			Impact of bid requirements on ability for some small and local businesses to bid for / win City contracts (Koretz and Krekorian 2021; Krekorian and O'Farrell 2021a)

Table C-4. Examples of Factors Contributing to Inequities in Public Health, Safety, and Community Resilience

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
Buildings	Built Environment	Building / appliance efficiency, type	Other energy-related emissions (besides carbon dioxide, e.g., methane, refrigerants, air toxics) (Advisory Group Members 2018c; 2021; 2020c; 2020b)
			Indoor air quality, thermal comfort, occupant health (Steering Committee Members 2022a; 2022b; Advisory Group Members 2021; Harris-Dawson et al. 2022)
		Building age	Structural stability / safety risks (e.g., earthquakes) (Harris-Dawson et al. 2022)
		Exposure to climate hazards / adaptability to climate extremes	Occupant health / habitability, morbidity and mortality, climate resilience (Advisory Group Members 2019c; 2020b)
		Local microclimatic / infrastructural characteristics	Neighborhood-level disparities in exposure to energy infrastructure-related hazards (Advisory Group Members 2020b; 2020c; 2020d)
	Economic	Sudden or chronic economic hardship due to persistent low (or unstable) income	Lack of resources to maintain safe and healthy home / work environment (e.g., thermal comfort, addressing sources of mold / leaks, routine maintenance) (Steering Committee Members 2022a; Lou et al. 2021; Drehobl and Ross 2016)
		Rent burden	Unstable access to safe, healthy, and affordable housing (Steering Committee Members 2022a; Harris-Dawson et al. 2022)
			Loss of community services (grocery stores, pharmacies, etc.) due to eviction / displacement of small businesses
	Sociocultural / Behavioral	Baseline vulnerability to indoor air pollution, health multiplier problems	Occupant health / resilience to acute health threats (e.g., COVID-19, heat waves) (Advisory Group Members 2020b)
	Policy / Institutional	City contracting standards	Life cycle impacts of City activities, including pollution related to contractors hired for building projects (Koretz and Krekorian 2021)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		DWP conservation and efficiency-promoting programs to reduce home / community energy demand	Reduced demand /need for construction of additional generation and infrastructure (and associated impacts) (Advisory Group Members 2017a)
		Zoning: Ordinances to fund HVAC upgrades for homes, schools, and community facilities in polluted areas	Access to resources to ameliorate health impacts of power generation and pollution (Krekorian, Martinez, and Rodriguez 2021b)
Distributed Energy Resources	Built Environment	Backup for remote and local resources	Customer energy reliability during outages (Advisory Group Members 2018d)
		Life cycle costs and emissions of distributed energy technology and infrastructure	Displaced timing and location of different types of emissions and impacts across geographic and intergenerational scales (Advisory Group Members 2020c)
		Solar on public facilities	Access to resilient energy (Advisory Group Members 2019b)
	Economic	Land acquisition costs for solar farms	Siting decisions for large solar projects (and associated environmental impacts) (Advisory Group Members 2019b)
			Conflicting / competing land uses serving other community needs (Advisory Group Members 2019b)
		Long-term funding for infrastructure maintenance	Intergenerational impacts of allowing energy generation infrastructure to fall into disrepair / fail (Advisory Group Members 2017b)
	Policy / Institutional	City contracting standards	Life cycle impacts of City activities, including pollution related to contractors hired for DER installation / infrastructure projects (Koretz and Krekorian 2021)
		Tax credits for solar and storage	System-wide reliability / resilience benefits of customer DERs, reduction in peak demand and distribution stress (Advisory Group Members 2020a)
	Sociocultural / Behavioral	Baseline vulnerability to air pollution from power generation	Distribution of health benefits from customer adoption of clean and distributed energy (Advisory Group Members 2020b)
		NIMBY-ism	Siting polluting / undesirable infrastructure and facilities (including batteries, large solar farms) in / near communities with less social / political capital to mount political opposition (Advisory Group Members 2018b; 2019b; 2020a)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		Treatment of outlying communities in analysis of renewable energy development impacts	Prioritization of urban / interior communities vs. rural / outlying communities (Advisory Group Members 2019a)
Mobility / Transportation	Built Environment	Infrastructure for electrification of trains, heavy-duty transport beyond buses (including freight)	Feasibility of reducing criteria emissions associated with transportation, especially near warehouses, ports, other heavy transportation corridors (Steering Committee Members 2022a; 2022b; Advisory Group Members 2019c)
	Economic	Electricity rates vs. cost of gasoline	Tradeoffs between emissions reductions in power and transportation sectors (Advisory Group Members 2018b; 2018d; 2019c; 2020b)
	Policy / Institutional	City contracting standards	Life cycle impacts of City activities, including pollution related to contractors hired for transportation infrastructure projects (Koretz and Krekorian 2021)
		Fossil fuel subsidies	Investment in fossil fuel-dependent technology and infrastructure (Advisory Group Members 2019c)
		Childhood exposure to diesel pollution while riding in school buses	Loss of funding for schools with high absence rates (Advisory Group Members 2019c; Muñoz et al. 2019; Lee, Fung, and Zhu 2015)
			Impacts to learning from chronic / repeated school absences due to asthma (Advisory Group Members 2019c; Muñoz et al. 2019; Lee, Fung, and Zhu 2015)
		Rollback of Corporate Average Fuel Economy standards	Delayed realization of health benefits from implementation of emission-reducing technologies (Advisory Group Members 2019b)
	Sociocultural / Behavioral	Baseline vulnerability to transportation-related air pollution, health multiplier problems	Health impacts of exposure / vulnerability to transportation-related air pollution (Advisory Group Members 2020b)
		Behavior changes in response to COVID-19	Changing mobility needs / ability to shift to new transportation modes (i.e., ability to stay at home or use personal vehicle to avoid exposure) (Advisory Group Members 2020a; Williams, Blair-Loy, and Berdahl 2013; Kossek, Lautsch, and Eaton 2006)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
		Electrification of private medium-duty vehicles, delivery truck fleets	Significant impact on air quality and public health, exposure to tailpipe emissions (especially among children) (Advisory Group Members 2019b; Muñoz et al. 2019; Lee, Fung, and Zhu 2015)
		Mode-shifting policies and trends	Reductions in total number of vehicles on the road (and traffic, collisions, etc.) (Advisory Group Members 2019c)
		VMT reduction policies and trends	Changes in sources and distribution of emissions and air quality impacts over time (Advisory Group Members 2019b; 2019c)
Utility-Scale Infrastructure	Built Environment	Age of existing 4.8 kV distribution infrastructure	Current operating performance of existing feeders, impact on customer energy reliability and resilience (Advisory Group Members 2019c)
		DWP regional stormwater capture projects in the North Valley	Spatial distribution of LADWP nature-based projects designed to improve water quality and supply, and accessibility of community and environmental benefits (Krekorian, Martinez, and Rodriguez 2021b)
		Existing natural gas units and associated infrastructure	Local exposure to pollution associated with combustion (Advisory Group Members 2020a; 2020c)
			Economic dependence on fossil-fired generation for jobs, community budgets and services (Navajo Nation) (Steering Committee Members 2022b; O'Farrell 2020)
		Increasing frequency / severity of extreme weather, wildfires due to climate change	Health impacts of public safety power shutoffs (Advisory Group Members 2019a)
		Life cycle costs and emissions of distributed energy technology and infrastructure	Timing and location of different types of emissions and impacts (Advisory Group Members 2020c)
		Seasonal environmental variation / drought	Increasing need for / reliance on different seasonal storage technologies to maintain system reliability (Advisory Group Members 2018c; 2019c; Koretz and O'Farrell 2021)
		Siting of current and planned transmission infrastructure	Reliability of current transmission infrastructure / frequency of extended transmission outages (Advisory Group Members 2019c; 2020b; 2020c)

Sector	Dimension	Structural Factors	Present-Day Equity Impacts
			Legacy infrastructure from extractive fossil energy systems (Advisory Group Members 2018b; 2019a; 2020a; 2020b; Krekorian, Martinez, and Rodriguez 2021a)
	Economic	Revenue losses from closure of fossil-fired generation	Long-term community-level economic stability, tax base, and ability to maintain public services (Navajo Nation) (O'Farrell 2020)
	Policy / Institutional	City contracting standards	Life cycle impacts of City activities, including pollution related to contractors hired for building projects (Koretz and Krekorian 2021)
		Colorado River Compact	Governance of water allocation across states, Native Tribes, and jurisdictions in the Southwest (Koretz and O'Farrell 2021)
		Fossil fuel subsidies	Investment in fossil fuel-dependent technology and infrastructure, externalizing social cost of carbon (Advisory Group Members 2019c)
	Sociocultural / Behavioral	Adoption of demand response and load flexibility programs and behaviors	Overall system demand, reliability, resilience (Advisory Group Members 2019b)
			(Avoided) emissions from fossil-fired peaker plants
		Baseline vulnerability to air pollution from power generation	Health impacts of exposure to air pollution from power generation (Advisory Group Members 2020b)
		Customer adoption of DERs	Impacts on system reliability, need for infrastructure upgrades / expansion and associated environmental impacts (Advisory Group Members 2020a)
		Social / political acceptability of generation fuels, battery storage facilities	Which technologies, risks, impacts have been / will be allowed (Advisory Group Members 2019b; 2019c; 2020a; 2020b)

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