Phasing Out Fossil Fuel Infrastructure in Los Angeles

Challenges for a Just Transition

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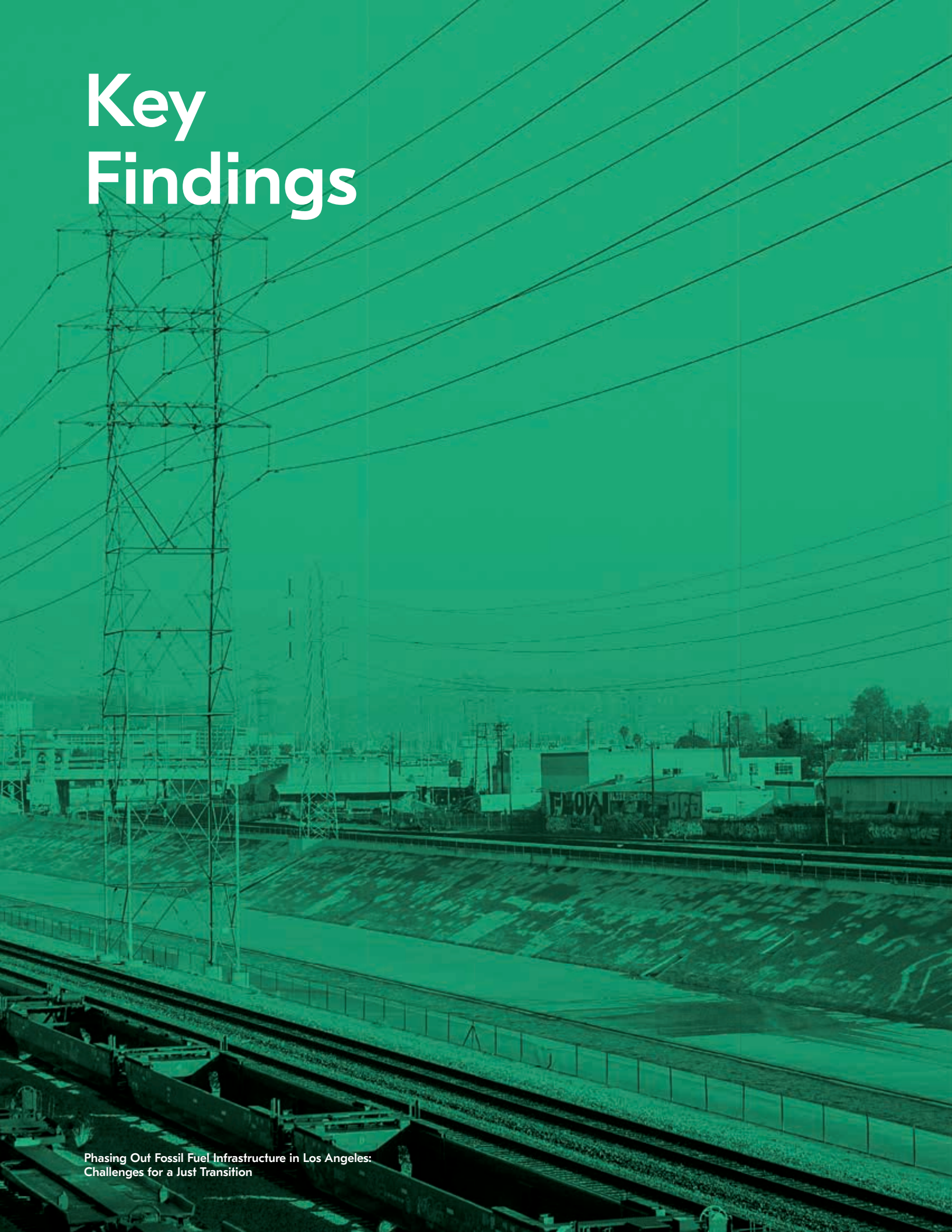
Table of Contents

List of Acronyms

CPUC	California Public Utility Commission
DWP	Los Angeles Department of Water and Power
EV	Electric Vehicle
GND	Green New Deal
IBEW 18	International Brotherhood of Electrical Workers Local 18
IPP	Intermountain Power Plant
JT	Just Transition
LAGND	Los Angeles Green New Deal
OPA	Office of Public Accountability
OTC	Once-Through Cooling System
PV	Photovoltaic
RPS	Renewable Portfolio Standard
SB	Senate Bill

Key Findings



Despite the concept's mixed reception from organized labor, we center our understanding of decarbonization of the energy system in Los Angeles around the need for a **"just transition."** We use this concept because it originated in the labor movement and because union labor has been one of the greatest opponents of the Los Angeles Green New Deal plan. Simply put, "the principle of just transition is that a healthy economy and a clean environment can and should co-exist. **The process for achieving this vision should be a fair one that should not cost workers or community residents their health, environment, jobs, or economic assets.** Any losses should be fairly compensated. And the practice of just transition means that the people who are most affected by pollution—the frontline workers and the fenceline communities—should be in the leadership of crafting policy solutions" (Just Transitions Alliance, n.d.).

With an awareness of the need to ensure both distributional justice and procedural justice, we put forward four dimensions that are critical for just energy transitions in large cities like Los Angeles: **public participation, social acceptance, job security and planning, and environmental justice and redress.** We discuss each dimension in the depth in the main body of the report.

Drawing from an extensive review of best practices in fossil fuel infrastructure phase-out from around the world, we also provide a summary of considerations that are relevant to the phase-out of natural gas and other fossil fuel infrastructure in Los Angeles.

The process for achieving this vision should be a fair one that should not cost workers or community residents their health, environment, jobs, or economic assets.

First, alternative future uses for the infrastructure and sites should be identified early on, and the public should be involved in early and constant participation surrounding the phase-out. In the case of Haynes, Harbor, and Scattergood, for example, two early options under consideration (battery storage and repowering for green hydrogen) would have very different trajectories and potential risks. Second, it should be acknowledged that retired or decommissioned power plants or other infrastructure can be converted or reused in a variety of ways (many of which require extensive planning and consultation), and that conversion or decommissioning can be more expensive than the construction of the facilities themselves, and may present health and environmental risks to neighboring communities and alter surrounding land values. All of these risks and challenges should be taken into account early on, and key stakeholders should be consulted as decisions are made about which risks are and are not acceptable.

We conclude with twelve recommendations for designing socially and environmentally just municipal decarbonization plans for Los Angeles and beyond:

1. The need for early and constant public participation
2. The need to address discrepancies in information and key definitions
3. The need to create more permanent and diverse stakeholder forums
4. The need for more concrete planning around transitioning workers and the need to support existing organizations and coalitions doing this work
5. Compensation for historically affected communities
6. The need to include communities located outside Los Angeles who are part of its energy systems in environmental justice assessments
7. Inclusion of both quantitative and qualitative analyses of household energy practices and experiences to work toward distributive justice
8. The need to strike a balance between innovation and reliability
9. The need for more attention given to the specific demands and challenges of decommissioning
10. Recognition that decommissioning could be a source of green jobs and other value creation
11. Recognition that—given the newness of large-scale urban decarbonization agendas—cities will have to draw knowledge from other cases from around the world, rather than just their own experiences
12. Acknowledgment that Los Angeles is on the cutting edge, and should work to create knowledge that will be useful for other cities in the future

Introduction

Among US cities, Los Angeles has adopted some of the country's most aggressive decarbonization and renewable energy targets. One major example is their most recent sustainability plan, the Los Angeles Green New Deal (LAGND), launched in 2019.

The goal of the LAGND is, among other things, to achieve a zero-carbon electricity grid by 2045 and carbon-free sources of energy by 2050. To meet these goals, the city will phase out coal from its power mix by 2025 and natural gas by 2045. These commitments are in line with SB 100, a California regulation signed in 2018, which mandates that utilities in the state procure 100% of their electricity from zero-emission sources by 2045. The city's power system—which will need to be radically transformed to meet these goals—is owned and managed by the Los Angeles Department of Water and Power (DWP), the largest municipal utility in the United States, which serves 3.1 million residential customers across the Los Angeles Basin.

Moreover, Los Angeles has some of the highest solar photovoltaic (PV) capacity in the United States (Pforzheimer et al. 2020), a renewable energy industry that has become an important source of local jobs. According to the E2 group, 50 cities in the United States were home to more than 320,000 renewable energy jobs in 2018. Los Angeles (41,000 jobs) led the list, followed by New York City (21,000 jobs) (E2 2018). Moreover, between 2005 and 2015, new California Renewable Portfolio Standard (RPS)-compliant generation capacity created an estimated 2,465 good quality union jobs in the construction of renewables in Los Angeles County, which represents 7.5% of the union construction jobs created in California during the same period (Jones et al. 2016). This trend is expected to further continue over the coming years, as the LAGND plan estimates that the transition towards renewable electric power will create more than 300,000 jobs in the city of Los Angeles by 2035 and 400,000 by 2050 (LAGND 2019).

Despite the estimates for job creation laid out in the LAGND, local workers have been some of the main opponents of the plan. This is particularly the case for union workers in the utility and fossil fuel sectors, who have expressed concerns over the loss of jobs that could stem from the phase-out of fossil fuel energy production and consumption in Los Angeles. Local business and ratepayer advocates have also opposed key aspects of this decarbonization agenda, arguing that it will be costly for ratepayers.

Given that oil and natural gas are not only intensively consumed but also extracted and refined in Los Angeles, decarbonization will be a complex and multifaceted process. Any plans for making the energy system greener will have to take into consideration not just electricity production, but also the health of residents living around drilling sites, oil and gas storage and transportation infrastructure, and refinery facilities (Shamasunder et al., 2018). Moreover, most of the neighborhoods where fossil fuel extraction and refining occur disproportionately contain Latinx and Black populations (SCOPE 2017). This is also the case for communities living around the four gas-fired power plants located within Los Angeles County, namely the Haynes, Harbor, Scattergood, and Valley Generating Stations, of which only the first three have planned phase-out timelines. At the time of writing, plans for the Valley Generating Station are not firm, though there is a new expediency around closing the plant after it was discovered that the facility had been leaking methane into the Latinx-majority community of Sun Valley for several years (Chou 2020).

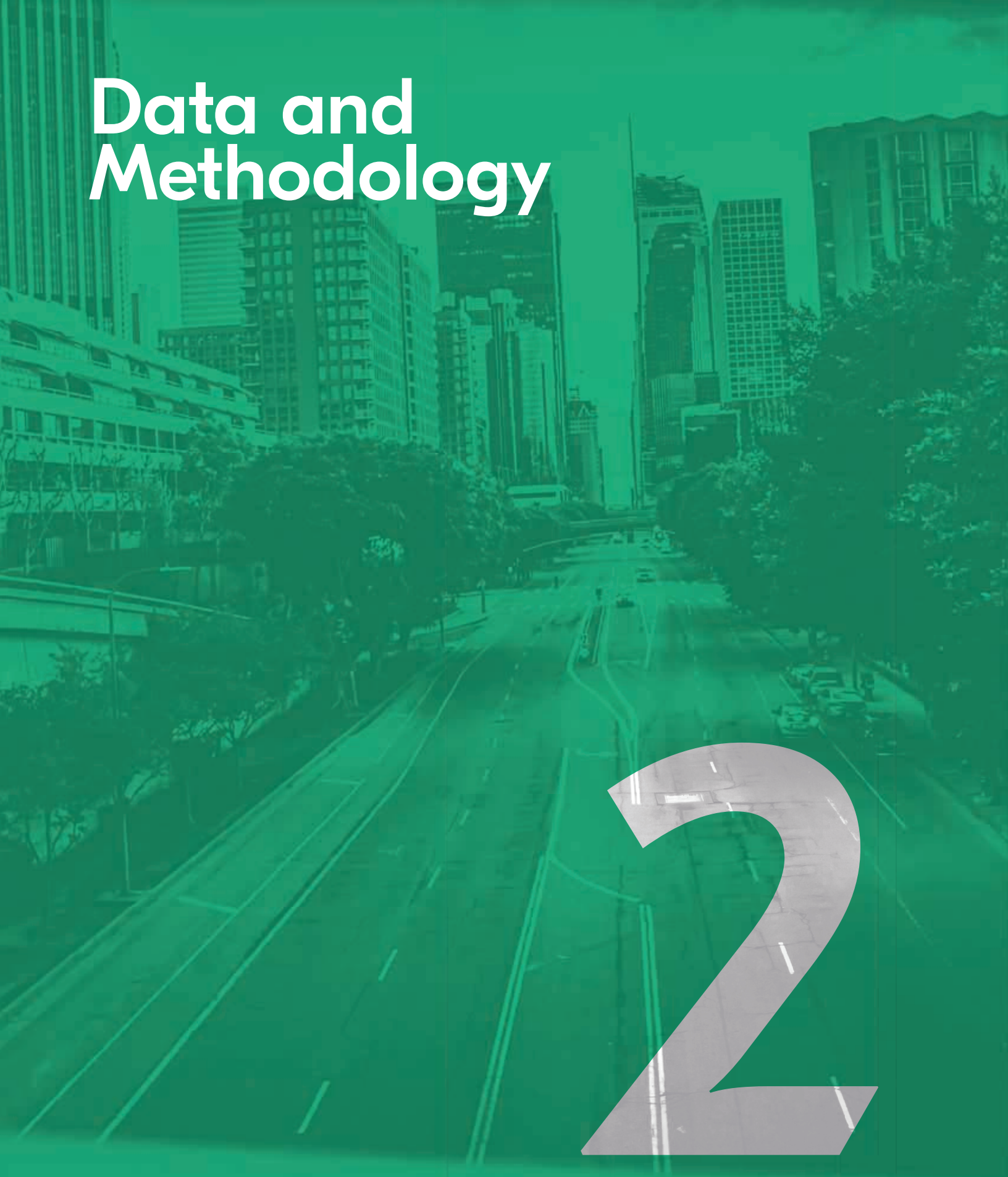
The challenge of ensuring equitable decarbonization outcomes is not unique to the city of Los Angeles. As societies move away from fossil fuels, similar challenges and controversies are taking place across the world. The possible negative impacts of low-carbon energy transitions represent a growing concern for policymakers, scholars, and environmental and labor organizations (ILO 2015; Raimi et al. 2020). As a response, the concept of just transitions (JT)—which acknowledges the need to ensure socially and environmentally just outcomes for workers and communities exposed to the negative effects of low-carbon energy transitions (Blue Green Alliance 2020)—has gained prominence since the late 2000s.

With the aim of contributing to the design and assessment of more effective and just decarbonization policies, this report presents an analysis of the main social and environmental challenges that the city of Los Angeles faces to advance towards a just energy transition. This report seeks to complement studies conducted in recent years to assess the city's capacity to transition toward cleaner energy sources, which have focused on the technical feasibility and economic costs of decarbonization plans (Navigant 2019; Knight et al., 2018; Powers 2019; Cochran and Denholm 2021).

We examine four key dimensions of a just transition that are particularly relevant to the case of Los Angeles and to large cities more generally: (1) public participation; (2) social acceptance; (3) job security and planning; and (4) environmental justice and redress.

The remainder of this report is organized as follows. Section 2 lays out the methodology of the study. Section 3 presents an historical overview of the phase-out of fossil fuels in Los Angeles. Section 4 introduces the concept of JT and defines its use in this report. Section 5 describes the main findings of the study and the challenges for a JT in Los Angeles. Section 6 summarizes some of the national and international best practices for reducing negative social and environmental impacts associated with the retirement and decommissioning of gas-fired power plants and other types of fossil fuel infrastructure. Section 7 presents the main conclusions of this study and recommendations for policymakers.

Data and Methodology



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Primary data used in this report includes 22 semi-structured interviews conducted with local stakeholders between July 2020 and April 2021. The list of informants includes scholars, energy experts and consultants, activists, utility workers, and representatives from environmental organizations, the city government and DWP, the Office of Public Accountability, and the Southern California Public Power Authority. All the interviews lasted between 40 and 80 minutes. All interview informants were promised anonymity when they consented to participating. For this reason, interview data will be referenced in this report as "personal communication," followed by the date of the interview when relevant—no names or affiliations will be included.

This study also relies on the analysis of secondary data, such as academic journal articles, research reports, policy documents, and press releases. Around 300 newspaper articles published in the *Los Angeles Times* from the 1980s to 2020 were analyzed, focusing on DWP as well as energy, climate, and decarbonization policies in California and Los Angeles. An extensive review of official documents published by DWP was also conducted, including annual, financial, and environmental reports. Finally, presentations and relevant documents from all the meetings held by the Renewable Energy Advisory Group (23 meetings between June 2017 and December 2020) were also reviewed.

All interviews were transcribed and then analyzed along with the secondary data by coding the information thematically according to four key dimensions of a JT; the dimensions were identified through a comprehensive review of the literature of the topic (see Section 4).

This deductive analytical process was complemented by inductive analysis, in which specific themes and categories associated with each of these four dimensions emerged from the interviews and secondary data. Coding of all primary and secondary data occurred during and after the process of data collection, and new interviews were conducted to fill gaps in information and clarify key issues. Moreover, additional secondary data was selectively gathered based on existing gaps in information and was analyzed using the same coding methods. This recursive process of collecting and analyzing data continued until saturation was reached (Given 2008).

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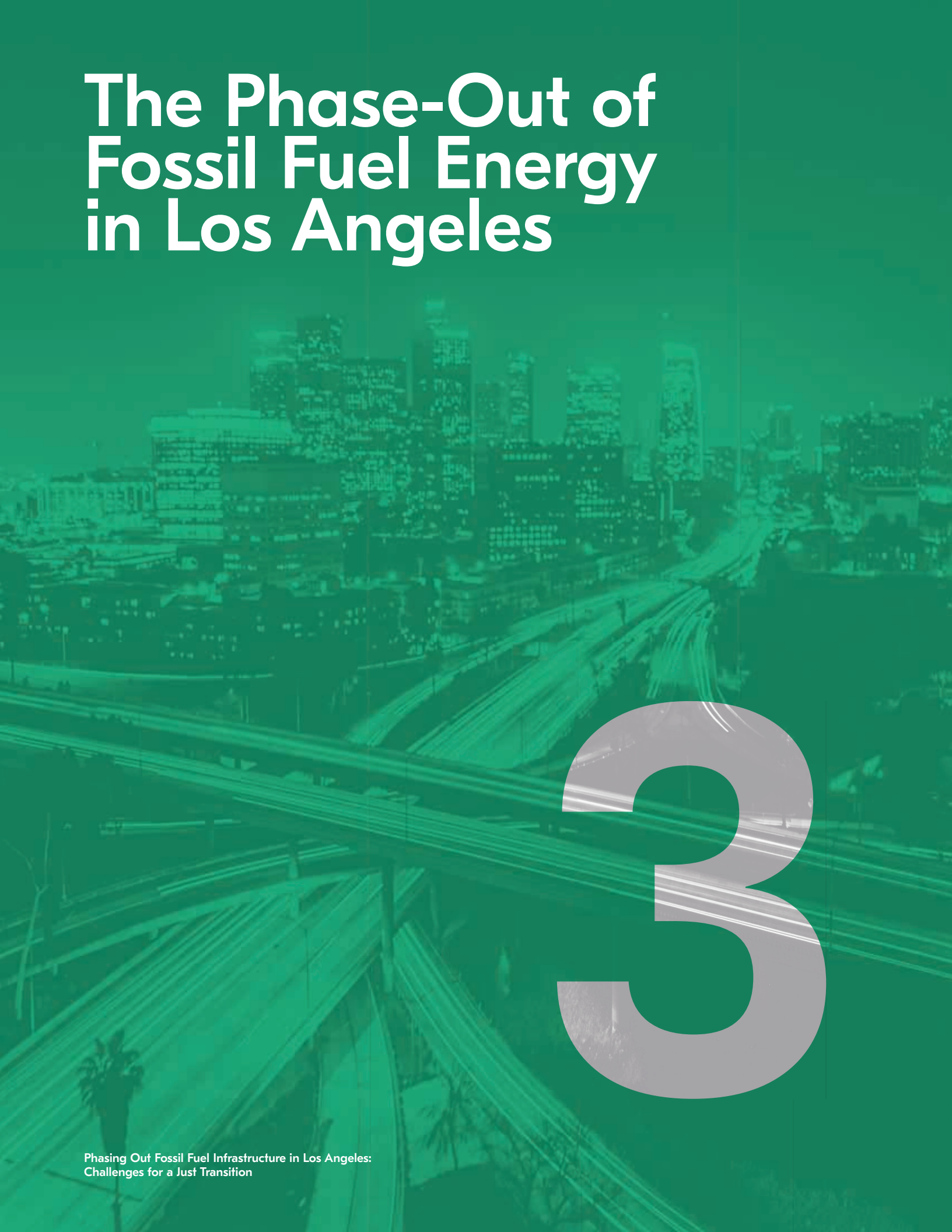
The Phase-Out of Fossil Fuel Energy in Los Angeles



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3.1. Power decarbonization targets

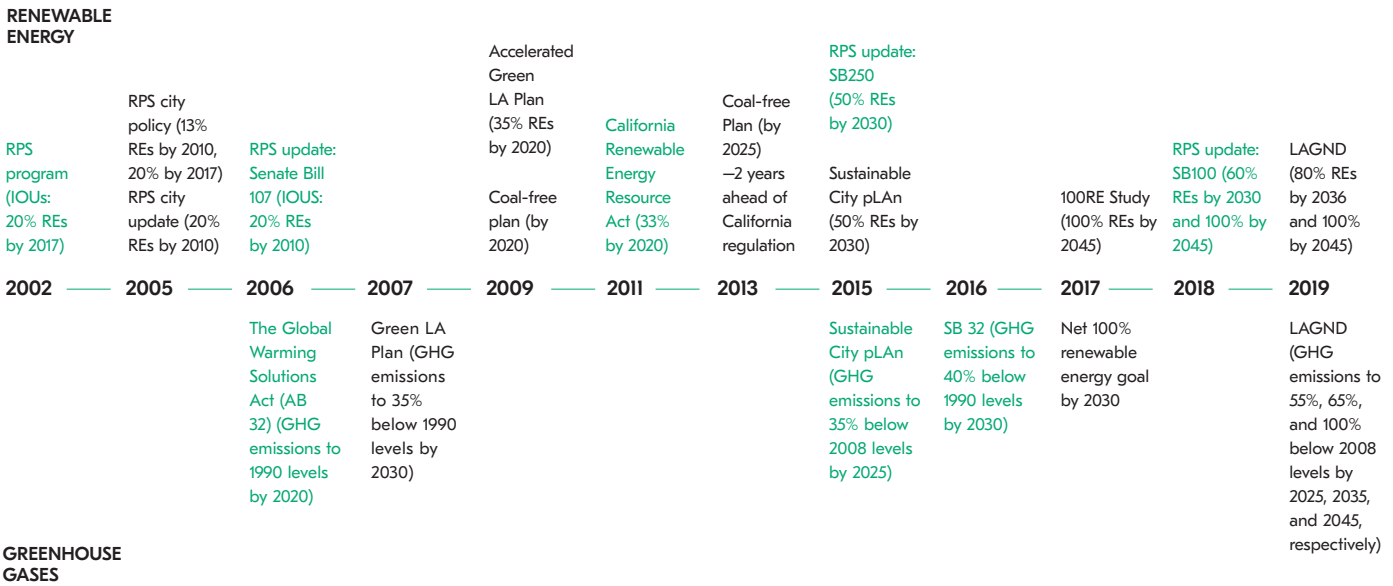
Over the past two decades, decarbonization initiatives by DWP have been deeply influenced by State of California laws and policies surrounding, the promotion of renewable energy, and the phase-out of fossil fuel power generation. However, some of the targets defined by the City of Los Angeles have also surpassed state goals. Figure 1 presents a timeline showing the main city and state power decarbonization targets. The sections that follow describe these targets in more detail.

3.1.1. State targets

California's first major decarbonization goal was established in 2002, when SB 1078 created the state's Renewable Portfolio Standard (RPS) program, which required investor-owned utilities to produce 20% of their electricity from qualified renewable sources by 2017 (CPUC n.d.). In 2006, California Assembly Bill 32 (AB 32), also known as "The Global Warming Solutions Act," established more comprehensive climate regulations, including decarbonization obligations for both investor-owned and municipally-owned utilities with the aim of reducing greenhouse gas emissions to 1990 levels by 2020 and to 80% below 1990 levels by 2050 (CARB 2018). SB 107 was also passed in 2006, which accelerated the RPS 20% target to 2010, as was the Emissions Performance Standard (EPS)—established by SB 1368—which prohibited signing or extending long-term contracts with coal-fired power plants (Petek 2020).

In 2011, the California Renewable Energy Resource Act established the following targets: 20% of a utility's retail sales were required to come from renewable energy resources by 2013, 25% by 2016, and 33% by 2020. In 2015, SB 350 increased the RPS targets to 40% by 2024, 45% by 2027, and 50% by 2030.

Figure 1
Major Decarbonization Targets for California and Los Angeles
(California Targets in Green, Los Angles in Black)



Moreover, in 2016, SB 32 extended the limit of greenhouse gas emissions to 40% below 1990 levels by 2030 (Petek, 2020). In 2018, SB 100 increased the RPS targets again, requiring that all the state's utilities, including municipally-owned ones, achieve 44% renewable energy by 2024, 52% by 2027, and 60% by 2030. The bill also required all the state's electricity to come from "zero-carbon" sources by 2045 (CPUC n.d.).

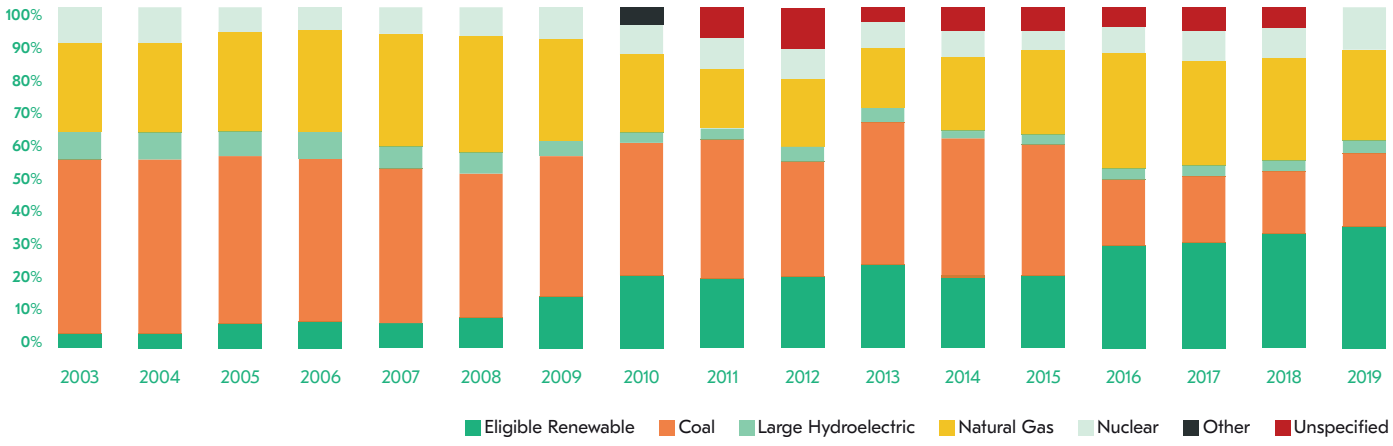
The State of California also implemented a number of policies and programs to help meet these goals, including but not limited to: the California Solar Initiative, the Net Energy Metering program for energy self-producers, and the Cap-and-Trade program (DWP 2019a; Petek 2020).

3.1.2. City targets

Power decarbonization in Los Angeles started in 1991 with the decision to shift power plants from oil to natural gas. This move was mostly driven by increasing concerns and regulations around air pollution in the Los Angeles Basin (Levin 1991; Larrubia 2006). One of the first initiatives created to explicitly promote decarbonization at DWP was the "Green Power for a Green LA Program," launched in 1999, which allowed consumers to buy a portion of their electricity from renewable sources for an extra monthly fee (LA Times 1999). This program followed trends among major investor-owned utilities in California—such as Southern California Edison and Pacific Gas and Electric, both of whom also launched green pricing programs during 1997-98. However, the success of the DWP program was marginal and, as Figure 2 shows, by 2003, only 3% of DWP capacity came from renewable sources.

Another important moment for decarbonization in Los Angeles occurred in 2000, when pressure from environmental groups and local communities, as well as new environmental regulations, led to the decision to sell DWP's 20% stake in the Mohave Generating Station in Southern Nevada (Kondo 2000), a coal-fired plant that relied on coal slurry piped in from Arizona.

Figure 2
LADWP Power Mix



Source: Los Angeles Department of Water and Power

Los Angeles Department of Water and Power's 7,880 MW of generating capacity comes from power plants located in five different states and connected through 3,600 miles of transmission lines and 10,400 miles of distribution lines.

Although the 2002 RPS exempted municipally-owned utilities, they were still required to develop their own local standards. In 2005, the City of Los Angeles adopted an RPS policy that required DWP to generate 13% of its power from renewable sources by 2010, and 20% by 2017 (DWP 2014). Since this policy was adopted, DWP has invested more aggressively in renewable power. This was particularly evident under Mayor Antonio Villaraigosa (in office from 2005 to 2013), who accelerated many of the city's decarbonization targets. In 2005, he moved up the 20% RPS goal from 2017 to 2010, in line with discussions happening at the state level. In 2007, Los Angeles' first climate action plan was published. The plan, called "Green LA: An Action Plan to Lead the Nation in Fighting Global Warming," set a new target of 35% of total electricity coming from renewable sources by 2020, a target that Villaraigosa raised to 40% soon after. The plan also set forth a goal of reducing the city's greenhouse gas emissions to 35% below 1990 levels by 2030 (LA 2007). In 2008, Villaraigosa announced the Solar LA Plan, which aimed to generate 10% of peak summer electricity demand from solar power by 2020 (Kho 2009). In 2009, Villaraigosa announced a plan to retire the use of coal at DWP by 2020, a target that had to be postponed in 2013 until 2025, given contractual obligations and financial constraints (Levin 1991; Linthicum 2012; Linthicum 2013c).

In line with SB 1386, DWP sold its 21.2% ownership in the coal-fired Navajo Generating Station in Arizona in 2016, three years before the end of the contract (Cassell 2013; Cassell 2015). This plant was built in the 1970s and was adjacent to the Kayenta coal mine in the Navajo Nation, which operated from 1972 to 2019. In 2016, Navajo (477 MW) was retired from DWP's power system (DWP News 2016), and in 2019, the plant stopped providing electricity to its other consumers in Arizona, Nevada, and California, and was finally decommissioned.

As Figure 3 shows, DWP's 7,880 MW of generating capacity comes from power plants located in five different states and connected through 3,600 miles of transmission lines and 10,400 miles of distribution lines. This power system includes only one coal-fired power station, the Intermountain Power Plant (IPP) in Utah, which accounts for 18% of DWP's capacity. The power system also relies heavily on four natural gas-fired stations within Los Angeles County, and one in Nevada, which in total account for 31% of DWP's capacity. There is only one nuclear plant in the system, located in Arizona and accounting for 10% of DWP's capacity. Renewable energy (wind, solar, geothermal, and small hydro) account for 34% of DWP's capacity (in 2019) and are drawn from smaller and more distributed power plants located in four different states (DataLA 2019).

Figure 3
Map of the DWP Power System
(as of 2020)

Data sources: LADWP, City of LA Geohub, U. S. Census Bureau

Since the decision to phase-out coal-fired power production was announced by Mayor Villaraigosa in 2009, different options have been discussed for the future of the Intermountain Power Plant (IPP), which is owned by the Intermountain Power Agency and operated by DWP. While it is operated by DWP, several California utilities purchase power from this plant. In 2013, DWP announced a plan to convert the IPP to run on natural gas. This allowed the city to accelerate its target of a 100% coal-free grid from the state-imposed deadline of 2027 (also defined by the end of the contract with IPP) to 2025 (Linthicum 2013a). The repowering of IPP was approved in 2015 (DWP 2018a). In December 2019, Mayor Eric Garcetti (in office from 2013 until present) announced an updated plan for the plant, which will now run on a mix of natural gas and hydrogen, with the eventual plan of converting it to run on hydrogen alone by 2045 (IEEFA 2020). Utility-scale green hydrogen power is a novel technology, and the repowering of IPP to run exclusively on hydrogen would make it one of the first such facilities in the world. There is also a plan to utilize a nearby two-mile wide salt dome for hydrogen storage, where renewable hydrogen will be "stored in caverns, each the size of the Empire State Building" (Tucker n.d.).

In 2015, Mayor Garcetti released the Sustainable City pLAn, the first comprehensive sustainability plan for the city of Los Angeles, which proposed strong commitments in terms of new investments in solar capacity, energy storage, and efficiency. The main decarbonization targets in this plan are: the complete divestment from coal-fired power plants by 2025; 50% of DWP's electricity coming from renewable sources by 2030; and greenhouse gas emissions reduction by 35% from 2008 levels by 2025 (LA 2015).

In September 2016, the Los Angeles City Council directed DWP to incorporate a goal of net 100% renewable energy by 2030 into its Integrated Resource Plan and to implement the "100% Renewable Energy Study" (or LA100). This $10-million study was developed in partnership with the National Renewable Energy Laboratory (NREL), a federally-funded energy research organization, which produced complex simulations to model different scenarios to achieve the city's goal (Cochran and Denholm 2021). In 2018, when SB100 was passed, LA100 added the goal of 100% zero-carbon energy by 2045 into their models (DWP 2018e). Inputs from LA100 would be used in DWP's next Strategic Long-Term Resource Plan, which was put on hold until the completion of the study. Moreover, a second project called "Clean Grid LA" was established in 2019, which uses the LA100 results as well as inputs from the city council, the mayor, and ratepayers to turn the options discussed into an actionable plan (DWP 2018f).

The LA100 study was also developed in dialogue with the "100% Renewable Advisory Group," where energy experts, environmental organizations, local universities, business associations, and DWP came together to discuss the design and results of the RE100 study (DWP 2020c; NREL 2020; Office of LA Mayor 2019). This group met quarterly from 2017 until the end of 2020.

Figure 4
LA 100 Study: Scenarios

SB100
Evaluated Under Moderate, High and Stress Load Electrification
- 100% clean energy by 2045
- Only scenario with a target based on retail sales, not generation
- Only scenario that allows up to 10% of the target to be natural gas offset by renewalbe electricity credits
- Allows existing nuclear and upgrades to transmission

EARLY & NO BIOFUELS
Evaluated Under Moderate and High Load Electrification
- 100% clean energy by 2035, 10 years sooner than other scenarios
- No natural gas generation or biofuels
- Allows existing nuclear and upgrades to transmission

TRANSMISSION FOCUS
Evaluated Under Moderate and High Load Electrification
- 100% clean energy by 2045
- Only scenario that builds new transmission corridors
- No natural gas or nuclear generation

LIMITED NEW TRANSMISSION
Evaluated Under Moderate and High Load Electrification
- 100% clean energy by 2045
- Only scenario that does not allow upgrades to transmission beyond currently planned projects
- No natural gas or nuclear generation

The results of the LA100 study were released in March 2021 as an executive summary and 12-chapter report (Cochran and Denholm 2021). One key outcome of the report was the identification of four reference scenarios that can be used to evaluate the technical feasibility, reliability impacts (including vulnerabilities to events such as heat waves, fires, earthquakes, and other natural disasters and occurrences), economic costs, and job impacts of different pathways to achieve the 100% renewable energy goal (see Figure 4). As of the publication of this report, discussions are still ongoing over which of the technological options presented in the scenarios is preferable.

In 2019, Mayor Garcetti launched the LAGND plan, an update of the Sustainable City pLAn, which committed to an accelerated goal of 80% renewable energy by 2036, as a stepping-stone to achieve California's mandate of 100% renewables by 2045. Moreover, the LAGND seeks to reduce greenhouse gas emissions to 55%, 65%, and 100% below 2008 levels by 2025, 2035, and 2045, respectively (LA 2019).

As Figure 5 shows, decarbonization initiatives implemented by the State of California and the City of Los Angeles have been successful in decreasing CO2 emissions by approximately 20% below 1990 levels during the 2000s and 2010s, and by more than 40% in 2016 and 2017. Moreover, the 2015 goal from the Sustainable City pLAn of reducing Los Angeles' greenhouse gas emissions by 2025 was accomplished in 2017, eight years ahead of schedule.

3.2. Once-through cooling gas-fired power plants

In February 2019, Mayor Garcetti announced the decision to phase out three of the four natural gas-fired power plants operated by DWP: Haynes (1,739.14 MW), Scattergood (876 MW), and Harbor (549.18 MW), all of which have units that use ocean water for cooling (once-through

cooling systems, or OTC). These units account for a total of approximately 2,900 MW, 83% of DWP's total in-basin capacity (3,415 MW) (DWP 2017a).

The decision to phase out these units is in line with Section 316(b), a statewide policy to minimize OTC impacts on marine life. The California State Water Resources Control Board (SWRCB) adopted the policy in 2010 as a new addition to California's Clean Water Act. The policy affected over 1,065 existing facilities in California (DWP 2017a), and originally mandated that DWP stop using OTC units by 2020. However, in 2010, an extension to 2029 was granted by the SWRCB, after negotiations where DWP sought an extension to 2045 (Navigant 2015). The schedule to phase out these power plants is described in Table 1.

DWP has already spent $1.3 billion replacing older generating units at the Haynes and Harbor Generating Stations. In 2015, Unit 3 of Scattergood was replaced by Units 4 through 7, and Unit 3 was decommissioned (DWP 2017a). Units 1 and 2 were originally expected to be repowered by 2020 and over thirteen additional units were planned to be repowered across all three stations by 2029 (Food and Water Watch 2018). However, those plans were paused in 2017 to analyze whether the stations should be repowered or retired and replaced with renewables. A DWP-commissioned OTC study was convened in this context, which assessed the reliability of various combinations of repowering and retirement scenarios for each facility (DWP 2017c; LADWP 2019). Consultants hired by DWP in 2018 suggested two options: (1) rebuilding all the gas-fired units of the three stations for $2.2 billion, or (2) rebuilding some units and replacing the remaining ones with solar energy and battery storage for $3.4. billion (Energy Mix 2019).

These OTC power stations have increasingly operated as "peaker plants"—meaning that they run only when there is high ("peak") demand for electricity. Scattergood 1 and 2 as well as Haynes 1, 2, 5, and 8 have had very low usage rates in recent years, with 2017 capacity factors between 1.9% and 5.3% (averaging 3.2%).

Figure 5
CO2 Emissions by DWP (Metric Tons) 1990-2017

Percentages are relative to emissions levels in 1990, which act as a baseline. The year 2000, for example, has 102% of the 1990 levels of emissions, while 2016 has 59% of 1990 levels.

Source: https://data.lacity.org/resource/2qdj-cyiz.json

However, one large OTC combined cycle unit, Haynes Unit 8, had a capacity factor of 39.6% (Powers 2019).

The phase-out of gas-fired power plants in Los Angeles has been a major focus of environmental NGOs and activists, including the Los Angeles Clean Energy Coalition, all of whom have put pressure on the mayor and other elected officials. Organizing and political pressure was ultimately effective, and, in February 2019, Mayor Garcetti announced that the three plants would be phased out rather than repowered and that public spending would be redirected toward energy storage and at least 3 gigawatts of clean energy (Boyer 2019). According to this new plan, the two OTC units in Scattergood (Units 1 and 2) would be phased out by 2024 (rather than repowered by 2020), and Harbor and Haynes would be phased out by 2029 (rather than repowered by 2026 and 2029, respectively). For this new plan, DWP was granted an additional nine-year extension from the SWRCB to continue using Scattergood. In exchange, the utility will phase out natural gas rather than repowering all its OTC units by 2029.

Decisions surrounding the future of these generating stations and the sites on which they are located are still being discussed. According to the final meetings of the Renewable Energy Advisory Group, possibilities under consideration include building storage capacity in these facilities and repowering some of the units to run on hydrogen so they can maintain their role as in-basin "peaker" units (DWP 2020b; Powers 2019).

The three OTC generating stations are located in some of Los Angeles' and California's most polluted communities. The pollution burden of the communities surrounding Harbor, Haynes, and Scattergood is reflected in the CalEnviroScreen (see Figure 6), a screening tool

Table 1
OTC Compliance Schedule

			ANNUAL CAPACITY FACTORS				
UNITS	SWRCB COMPLIANCE	UNIT CAPACITY	2014	2015	2016	2017	2018
Harbor 5	12/31/2029	75	3.30%	2.40%	2.90%	2.00%	1.00%
Haynes Unit 1	12/31/2029	230	12.70%	6.50%	12.80%	3.40%	1.60%
Haynes Unit 2	12/31/2029	230	13.10%	8.00%	12.70%	5.30%	1.10%
Haynes Unit 8	12/31/2029	264	34.20%	38.00%	39%	39.60%	45.40%
Haynes Unit 1, 2, 8	12/31/2029	724	20.70%	18.50%	22.30%	17.20%	16.10%
Scattergood Unit 1	12/31/2024	163	22.20%	7.60%	21.50%	4.80%	4.50%
Scattergood Unit 2	12/31/2024	163	5.80%	18.90%	4.00%	1.90%	2.40%
Scattergood Units 1, 2	12/31/2024	326	14.00%	13.30%	12.70%	3.30%	3.40%

Source: California Energy Commission 2019

developed by the California Office of Environmental Health Hazard Assessment (OEHHA) (Rodriguez and Zeise 2017).

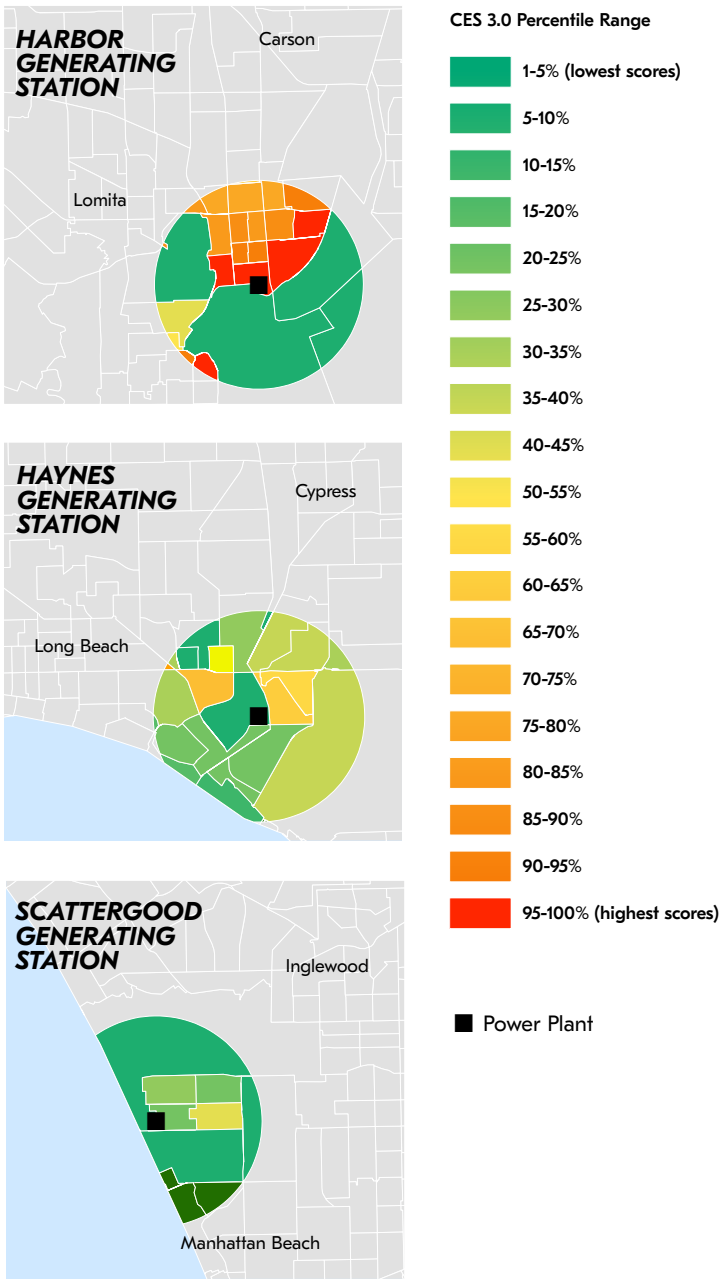
Communities surrounding the Harbor Generating Station in Wilmington are assigned to the 95-100 percentile range, which indicates heavy pollution compounded with increased vulnerability to pollutants. Wilmington's pollution burden includes high diesel emissions, toxic chemical releases, toxic cleanups, and hazardous threats. Exposure and pollution threats there are higher than 90% of all other census tracts in California. The communities surrounding the Harbor Generating Station are recognized to be some of the most polluted areas in Los Angeles. They have a CES pollution score between 8 and 10, which means they are heavily impacted by air pollutants, drinking water pollutants, and toxic releases from facilities including the power plant.

Populations surrounding the Haynes Generating Station, located in Long Beach, face varying degrees of pollution exposure. The CES score for census tracts in the two-mile radius surrounding the station is between 65% and 70%. In that two-mile radius, the communities closest to the station experience higher levels of PM2.5,[1] toxic releases, and hazardous waste than over 80% of California's census tracts (OEHHA 2018).

For Scattergood Generating Station, located in El Segundo, nearby communities have a low CalEnviroScreen percentile of 20-25%, and a pollution burden higher than 80% of all California's census tracts. Communities near

1. PM2.5 are microscopic solids (at 2.5 microns in diameter) or droplets which pose serious health effects if inhaled (US EPA, 2016).

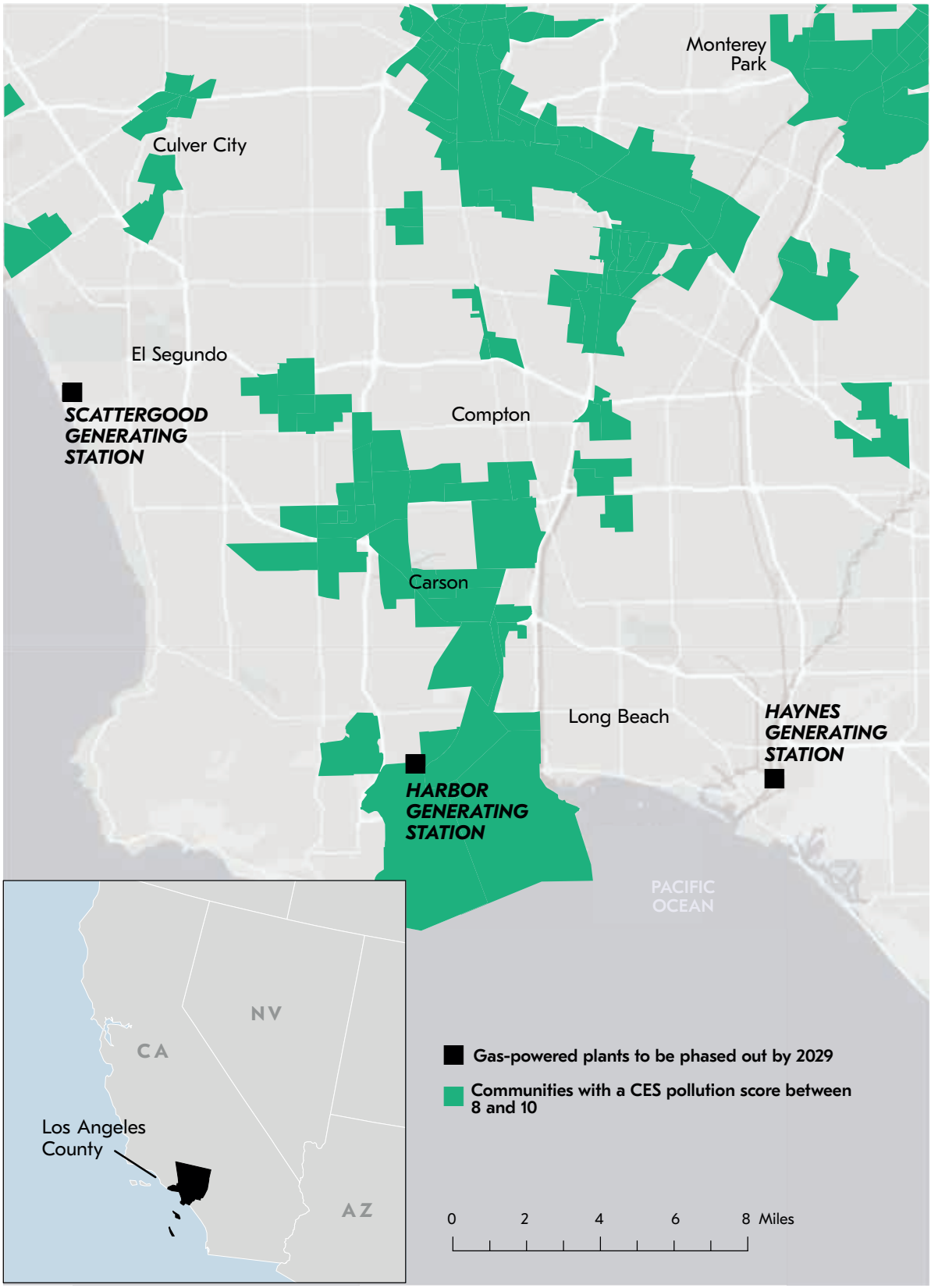
Figure 6.1
CalEnviroScreen and Air Pollution Around the OTC Power Plants



Source: LADWP, CalEnviroScreen 3.0

The overall community CalEnviroScreen scores are calculated from two major components, each consisting of two indicators: pollution burden (exposure to pollutants and harmful substances from local emitters), and population characteristics (sensitive population and socioeconomic factors). A lower score indicates lower pollutant impact compounded by pollution sensitivity and socioeconomic factors. Each census tract is then assigned a percentile according to the ordered CES score. Each tract's percentile ranks its relative position to other tracts (Rodriguez and Zeise 2017).

Figure 6.2
CalEnviroScreen and Air Pollution Around the OTC Power Plants



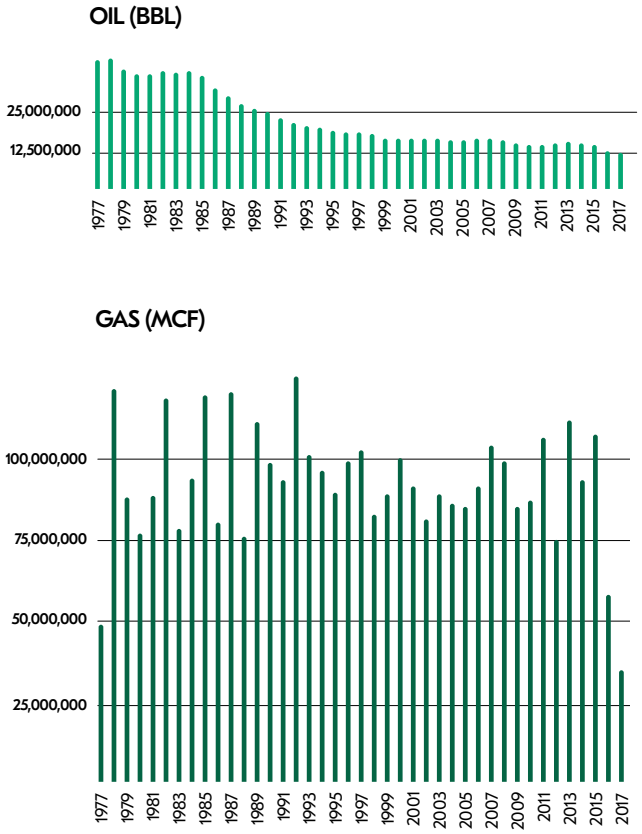
Scattergood experience high levels of PM2.5, and exposure to diesel and hazardous waste at rates higher than 80% of California census tracts (Rodriguez and Zeise 2017).

3.3. Oil and natural gas production

As one of the largest urban oil fields in the United States, Los Angeles has faced serious challenges with environmental justice. Currently, there are more than 2,000 active oil wells in Los Angeles County, which produced over 108 million barrels of oil (BBL) between 2010 and 2017, around 7% of California's total production in that period (California Department of Conservation 2020; EIA 2020). During the same period, active wells in Los Angeles County extracted 674 million cubic feet (MCF) of natural gas (USC 2020). In 2016, Los Angeles County produced 11.8 million BBL and 58 million MCF of natural gas, which accounted for 16.5% and 6.3% of California's production, respectively. The same year, the city of Los Angeles produced 2.6 million BBL and 10.5 million MCF of natural gas. The five largest oil and gas well operators in the city of Los Angeles are ExxonMobil (711 wells), Chevron USA (482 wells), Warren E&P (421 wells), Tidelands Oil Production (335 wells), and Union Pacific Resources (328 wells) (Rigby and Shin 2017).

While active production of oil and natural gas has decreased in recent years, Los Angeles County is still an important and active oil field (see Figure 7). Thus, abandoned and underutilized wells continue to present health and safety concerns for surrounding communities even as production decreases. Of the 5,198 active and idle oil and gas wells in the county, 1,974 are located less than 2,500 feet from homes, schools, and other sensitive receptors (USC 2020). In 2015, there were 508 active wells in the city of Los Angeles, 429 of which were located within 2,500 feet of sensitive receptors.[2] This industry generated output valued at $182 million in 2015, which accounts for about 0.1% of the city's gross domestic product. Moreover, the same year, oil and natural gas extraction provided around 345 jobs for directly-employed workers and independent contractors in

Figure 7
Oil and Natural Gas Extraction in Los Angeles County (1977-2017)



Source: https://secure.conservation.ca.gov

2. According to the EPA, sensitive receptors include, but are not limited to, hospitals, schools, daycares, elderly housing, and convalescent facilities. These are places where the occupants are more susceptible to the adverse effects of toxic substances and pollutants.

Table 2
Main Oil Refineries in Los Angeles County

NAME / OWNER	PRODUCTION (BBPD)	LOCATION	EMPLOYEES
Los Angeles Refinery / Marathon Petroleum	363,000	Carson, CA	1,620 full-time employees
El Segundo / Chevron	290,000	El Segundo, CA	Over 1,100 people and 500 independent contractors
Torrance / PBF Energy	155,000	Torrance, CA	Over 600 people and 300 to 500 onsite contractors
Wilmington Refinery / Phillips 66	165,000	Carson and Wilmington, CA	875 people (including onsite contractors)
Wilmington / Valero Energy	135,000	Wilmington, CA	430 people
South Gate Refinery / World Oil Corporation	8,500	South Gate, CA	33 people

Sources: MP 2020; Chevron El Segundo 2021; Torrance Refining Company 2021; Philipp 66 2021; Valero 2021

the city of Los Angeles (out of a total city-wide workforce of just under two million). In the case of Los Angeles County, this number was higher, with 3,201 jobs (Rigby and Shin 2017).

Moreover, there are seven oil refineries in Los Angeles County, which produce nearly 1.031 million BBL per day. The two largest refineries are in Carson (owned by Marathon Petroleum) and El Segundo (owned by Chevron). In total, these refineries employ over 4,600 people across the Los Angeles Basin. Table 2 shows the level of production and location of the refineries operating in Los Angeles County.

There are two natural gas storage facilities in Los Angeles County: Playa Del Rey and Aliso Canyon, which are owned and operated by SoCalGas, a subsidiary of Sempra Energy. SoCalGas does not release the numbers of employees for either facility.[3] The Playa Del Rey facility provides natural gas to neighboring power stations (i.e., Scattergood, Harbor, Haynes, Southern California Edison South Bay, and AES Redondo Beach LLC). Aliso Canyon provides natural gas to 17 gas-fired power plants in Southern California and is one of the largest natural gas storage facilities in DWP's network (SoCalGas 2020). In October 2015, an underground gas leak forced thousands of residents to evacuate. Within a year, over 109,000 metric tons of methane was released into the atmosphere, and Aliso Canyon was temporarily closed by the State of California (McNary

3. SoCalGas employs 8,196 people in Southern California (Dun & Bradstreet 2020).

2019), eventually resuming operations in 2017 (Agrawal 2017). The facility was estimated to be worth over $769 million in 2019, a number that continues to rise as its use ramps up to near pre-leak levels (Roth 2020b).

Environmental organizations in Los Angeles have denounced the disproportionate impacts that oil drilling and refining have had on Latinx and Black communities (SCOPE 2017; California Department of Conservation 2020). To address this problem, the LAGND commits to "reduce oil production by 40% below 2013 levels," (LA 2019:26) and to "create an annual oil well and facilities compliance inspection program, prioritizing communities in closest proximity to facilities" (LA 2019:30). Despite the fact that the decarbonization goals of the city specified an end date for the use of fossil fuels in power production, the end date of oil and natural gas extraction, storage, and refining is still unknown. In this context, environmental groups have argued that the measures included in the LAGND are insufficient to protect the health of local communities and to remediate the damages caused by these industries (Sunrise LA 2019). Discussions for a phase-out of urban oil drilling, driven by local organizations and their campaigns, are currently taking place (STAND LA 2020), as are discussions at the state and county levels about increasing setbacks and implementing other buffers between wells and buildings like homes and schools (Herr 2020). The formation of a new task force to discuss just transitions for oil well workers in Los Angeles County could generate novel solutions or even serve as a model for other industries, but it is not currently a formal element of the LAGND plan itself (Sierra Club 2020).

3.4. Oil and natural gas demand

SoCalGas is the primary distributor of natural gas in Southern California, supplying both retail and wholesale customers. With over 21.8 million consumers, SoCalGas is one of the nation's largest natural gas distribution utilities. Statewide natural gas demand is projected to decrease at an average rate of 1.7% each year in the residential sector, 1.5% in the electric generation and commercial sectors, and 0.2% in the industrial sector. SoCalGas also estimates that total natural gas demand will decline at an annual rate of 1% from 2020-2035. This entails a decrease from an around 850 billion cubic foot demand in 2019 to around 750 billion cubic feet in 2035. This decrease can be explained by modest rates of economic growth, mandates by the California Public Utility Commission (CPUC) on energy efficiency, and the growth of renewable power production and electrification in line with the SB 350 goals (California Gas and Electric Utilities 2020).

Among California cities, Los Angeles has the highest gasoline consumption, with 551 million gallons in 2019, a number that has continuously increased since 2014 (California Energy Commission 2021). Los Angeles has over 7.7 million registered vehicles (automobiles, trucks, and motorcycles) (LA Almanac 2017), and 19% of the city's yearly greenhouse gas emissions, including from both the residential and industrial sectors, originate from transportation (LA 2019: 70). The LAGND seeks to reduce 5 million vehicle miles traveled per day while cutting traffic times by 15%. Some of the ways that the plan aims to do this is by incentivizing the public to walk more (through, for example, the installation of cool corridors and crosswalk repairs and improvements), and by expanding

public transportation (including a 30% increase in the county's bus network and Metro rail lines). LA Metro, the public agency tasked with managing the transportation system, has also reduced its gasoline consumption by having its entire bus fleet run on compressed natural gas (SoCalGas 2021). The LAGND also includes plans to distribute electric vehicle (EV) rebates, install over 10,000 public EV chargers by 2022, and electrify 100% of Metro and LA Department of Transport (LADOT) buses by 2030 (LA 2019: 83). The electrification of the transportation sector will be expedited by an executive order from California Governor Gavin Newsom, which bans the sale of gasoline-powered automobiles by 2035. While the order only impacts passenger vehicles, the California Air Resources Board will require medium- and heavy-duty vehicles to be zero-emission by 2045 (Ohnsman 2020). There are expectations for legal challenges against the executive order, but thus far five automakers (BMW, Ford, Honda, Volkswagen, and Volvo) are supporting it.

3.5. Comparing Los Angeles to other cities

Of the 100 most populated cities in the US, Los Angeles is among the 45 that have a greenhouse gas reduction target and a baseline measurement of their emissions (Markolf et al. 2020). Of the 32 cities that have inventoried their emissions since 2010, Los Angeles has experienced the largest decrease in emissions (around 47% below 1990 levels), followed by San Francisco and Washington, DC (each 30% below 1990 levels). Los Angeles also leads the nation in total installed solar PV capacity and is ranked number 15 in terms of per capita solar PV capacity among the 57 cities surveyed by the 2020 Shining Cities report (Pforzheimer et al. 2020). While the potential capacity is high, the time required to receive approval and install rooftop solar panels by DWP amounts to at least 12 to 13 weeks, which is significantly longer than that of other California cities like San Diego and Sacramento (Li 2014).

While the three main investor-owned utilities of California (Southern California Edison, San Diego Gas and Electric, and Pacific Gas and Electric) have already divested from coal, DWP has been slower in this regard and has only recently decided to repower IPP (Knight et al. 2018). Moreover, in 2019, 34.1% of DWP's power mix was produced by renewables, which is 1.1% higher than the overall state target, but lower than most investor-owned utilities in Southern California.

In 2019, New York City also devised a Green New Deal plan, but with climate goals slightly more ambitious than the LAGND. It is aiming to adopt 100% clean electricity by 2040 (in comparison to 100% renewable electricity in 2045 in Los Angeles) and become carbon neutral by 2050 (identical to Los Angeles) (City of New York n.d.).

Just Transitions

4

The concept of "just transitions" (JT) emerged in the 1970s from the global labor movement and was first mobilized in the US in the 1990s around the closure of chemical plants (Stevis and Felli 2014). As we work to make our economy greener, we also transform it; just transitions place workers and other impacted communities in the center of conversations about those economic transformations, in order to ensure that they are not left behind. Simply put: "the principle of just transition is that a healthy economy and a clean environment can and should co-exist. The process for achieving this vision should be a fair one that should not cost workers or community residents their health, environment, jobs, or economic assets. Any losses should be fairly compensated. And the practice of just transition means that the people who are most affected by pollution—the frontline workers and the fenceline communities—should be in the leadership of crafting policy solutions" (Just Transitions Alliance, n.d.).

The concept has since made its way into the mainstream, particularly as part of the national dialogue around the challenges and possibilities of a Green New Deal. The greening of the energy system, including the phase-out of fossil fuel infrastructures, is going to result in the loss of jobs in power plants and in the extraction, transportion, and refining of oil and gas—a just transition framework aims to mitigate the effects on impacted constituencies and communities. Two distinct dimensions, or conceptions, of justice are critical for transitions: procedural justice and distributional justice. Distributional justice ensures the fair allocation of the costs and benefits of a transition, while procedural justice requires the consideration of whose interests and which issues are taken into account in decision-making, and who gets to participate and hold power in making decisions (Piggot et al. 2019).

As we work to make our economy greener, we also transform it; just transitions place workers and other impacted communities in the center of conversations about those economic transformations, in order to ensure that they are not left behind.

Despite JT's origins in the labor movement, unions have had mixed reactions to the concept. A report by the Labor Network for Sustainability, as one example, captures the reticence of unions to embrace the idea, characterizing transition as it is currently being practiced as workers being asked to "attend their own funerals." To substantiate this sentiment, they quote Brad Markell of the AFL-CIO Industrial Union Council, who explains "it's very important to us that we build an understanding of the experience working people have had for the last 40 years. People's gut feeling is that if this transition happens in the current political economy, they're going to be left out" (quoted in Labor Network for Sustainability 2016).

Despite tensions around the term, we find it a useful framework for capturing the range of issues that must be taken into account in decarbonization plans, especially ones like the LAGND that involve the phase-out of facilities that employ large numbers of union workers.

4.1. Key dimensions

In our analysis of the phase-out of infrastructure and the economic restructuring that will occur as part of the LAGND, we focus on four key dimensions of a JT in this report. They are discussed in depth and with reference to LA-specific conditions in Section 5.2. These four factors were drawn from the extensive scholarly and activist literature on JT and are being highlighted because we see them as particularly important for energy transitions at the city or municipal level. Other dimensions may be more relevant at other scales (national, international) or for systems and infrastructures unrelated to energy, which will be important for researchers to keep in mind when studying JT and phase-out in other contexts.

(1) Public participation. Policymakers and scholars have highlighted the importance of public participation in the design of JT policies, especially for the fair allocation of costs and benefits (Piggot et al. 2019). A participatory process involves the early inclusion of local communities, workers, and environmental organizations in dialogue with private companies and government representatives. Participatory and inclusive governance structures are also key to ensuring the broader legitimacy of decarbonization policies (Cowell et al. 2017).

(2) Social acceptance. Consensus-building is needed to accelerate energy transitions and ensure fairness for different actors (UNFCCC 2018). Participation of local stakeholders in the planning of transition policies as well as the creation of potential community benefits are fundamental to reducing resistance and building trust (Lennon et al. 2019). One important challenge for advancing towards greater social acceptance is what researchers have termed "energy controversies," i.e., social disputes and conflicts associated with the management of energy systems and the implementation of energy policies, including decarbonization policies (Cuppen 2018). Social and policy research on energy controversies has shown that rather than trying to avoid or eliminate controversies, energy transition plans need to offer more democratic governance over them, ensuring that they evolve in a setting where spaces for encounter, discussion, reflection, and potential consensus-building are properly created (Pesch et al. 2017).

(3) Job security and planning. A well-planned transition is key to ensuring a future and a clear path forward for workers currently employed in the fossil fuel sector, broadly defined. Job security—even if it doesn't necessarily mean doing the exact same job—is essential. Creating realistic prospects for high-quality jobs, programs for relocation (if there is a mismatch between the locations of old and new jobs), and options for early retirement are among the range of possible ways to provide security to

workers. Reliable plans will also need to be based on legal certainty and binding collective agreements (ILO 2015; Vogl et al. 2019).

(4) Environmental justice and redress. Prioritizing communities that have disproportionately faced the health and environmental impacts associated with living around fossil fuel infrastructures (broadly understood) is an important aspect of a JT. Examples include stricter environmental monitoring and an earlier phase-out of polluting operations in these areas. A JT also needs to repair past damages, including making efforts to recognize past impacts, improve social relations, and restore trust (Tsosie 2015; Beckett and Keeling 2019). A careful process of environmental remediation needs to take place around former sites of fossil fuel production, and opportunities need to be created for the redevelopment of land in ways that are economically and socially beneficial for local communities.

4.2. Key actors and challenges

Centering just transitions underscores the economic and social impacts of transitioning away from fossil fuels and toward cleaner renewable energy systems (Blue Green Alliance 2020). Across contexts, scholars and policymakers who study JTs have focused on two groups that are disproportionately affected: local communities, and workers economically dependent upon the extraction, processing, and combustion of coal, oil, and natural gas. While workers in the fossil fuel energy industry have been found to

The nature of the DWP system has linked the fates of communities in Arizona and Utah with the City of Los Angeles, and decarbonization will impact them in profound ways.

be facing lower salaries, worsening working conditions, and unemployment, scholars have found that local communities are experiencing the effects of declining economic activity and lower public revenues (Raimi et al. 2020; Evans and Phelan 2016). Moreover, local communities living around former sites of coal, oil, and gas extraction and power production, are often exposed to pollution and overall environmental degradation from inadequate and costly environmental remediation (Beckett and Keeling 2019).

While many studies of just transitions tend to be localized in particular places, the nature of energy systems and commodity chains means that distant actors are sometimes impacted as much as proximate ones (Mulvaney 2013; Sovacool 2016). Considering these communities is especially important when studying JTs in large cities, whose energy systems depend on complex networks of local and extra-local sites of powerproduction and distribution. This view is summarized in Figure 8.

This report focuses on the challenges for a JT in the city of Los Angeles, with particular emphasis on three populations that

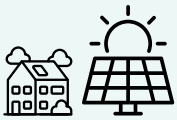
will be impacted: workers in the fossil fuel energy sector, communities living around natural gas-fired power stations, and energy consumers. However, these are not the only communities that are impacted, and so it is critical for future research to be extended to consider other affected communities. We lay out three areas of study that we cannot cover here but where we see a need for future research:

(1) We do not cover the just transition challenges associated with decreasing coal-fired and other non-renewable power production in regions outside of Los Angeles, which have historically produced power consumed within the city. The nature of the DWP system has linked the fates of communities in Arizona and Utah with the city of Los Angeles, and decarbonization will impact them in profound ways that are not possible to fully consider within the scope of this report. This is certainly the case for communities both within and outside the Navajo Nation in Arizona who were economically dependent on the Navajo Power Station (Kutz 2021), as well as local communities in Utah that are economically dependent on the Intermountain Power Plant (O'Donoghue 2017).

(2) We do not cover the ecological impacts of solar and wind investments, or the new transmission lines needed for DWP's energy transition. This is important given that environmental groups and local communities have expressed concerns about problems of waste disposal, land use, and habitat and landscape impacts associated with these developments, particularly with regards to utility-scale projects and transmission lines (Dickinson 2007; Bryce 2019; Gross 2020; Roth 2021).

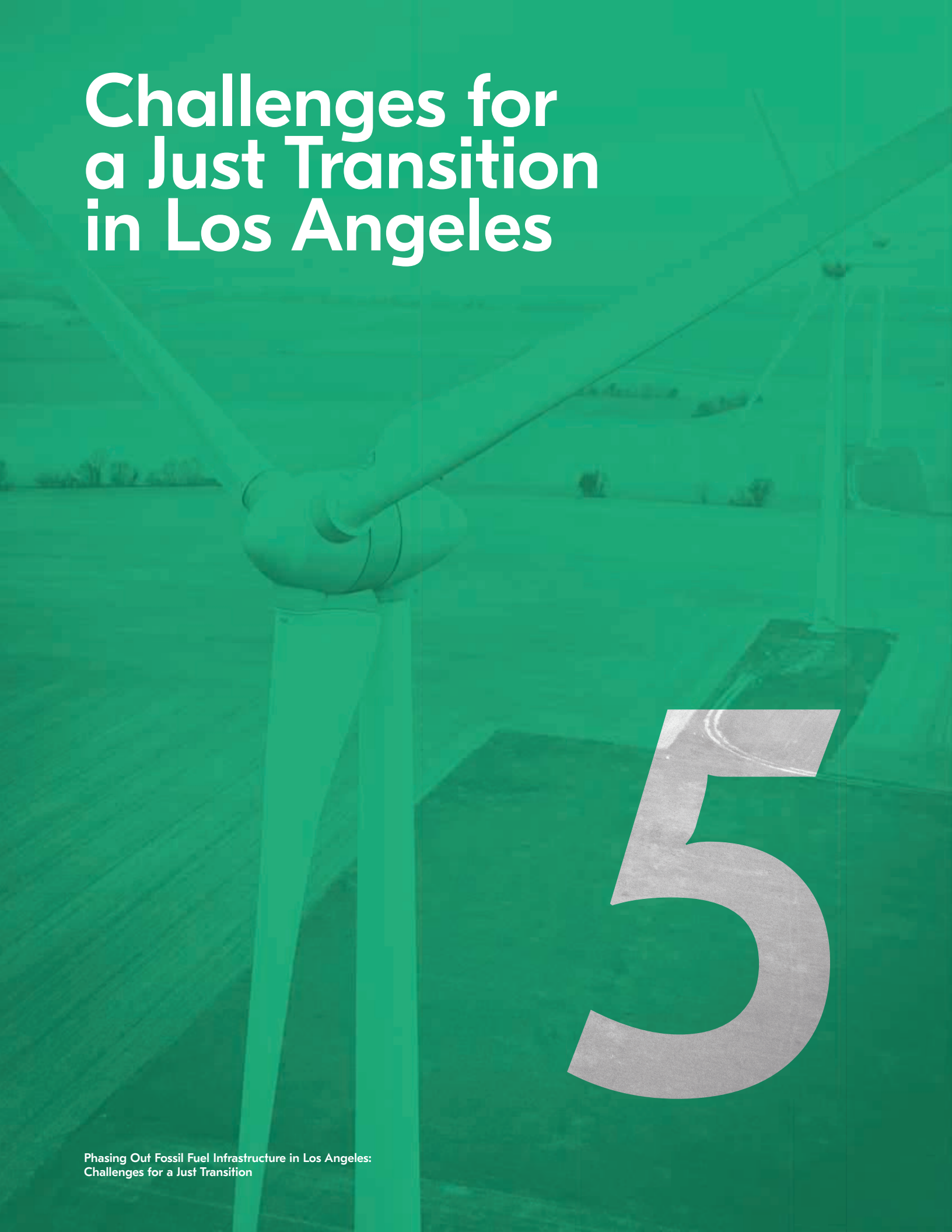
(3) We do not cover the challenges faced by communities living around oil and gas drilling, refineries, storage sites, and transportation hubs. These communities are affected not only by the lack of a clear phase-out date for these facilities in current city policies, but also by the environmental and health impacts and risks associated with fossil fuel infrastructure left idle, as well as its inadequate remediation. More work can and should be done to understand how to ensure a just transition away from oil and gas for these communities—the recent establishment of a county-level JT task force on oil well remediation is one step in this direction (Sierra Club 2020).

Figure 8
Key Actors and Challenges for Just Transitions

AFFECTED AGENTS/GROUPS	CHALLENGES	TRANSITION POLICY OPTIONS (EXAMPLES)
Workers in the fossil fuel energy sector 	Layoffs; reskilling for new jobs	Early retirement and unemployment benefits Worker transfer schemes Training and retraining programs
Communities dependent on fossil fuel energy production 	Economic decline and migration due to loss of economic activity	Investment in community-level public goods (e.g. strategic infrastructure; civil facilities) Regional and local development programs
Communities living around fossil fuel infrastructure 	Environmental liabilities; health impacts	Decommissioning and environmental remediation funds and programs
Communities living around low-carbon energy infrastructure 	Impacts caused by large scale wind turbines, industrial solar plants, transmission lines, etc.	Improve local participation in the decision making around the location of renewable energy investments Compensation schemes
Energy consumers 	Rising energy costs; loss of power reliability	Income tax reductions Cash transfers and compensation schemes Subsidized low-carbon goods
Other regions and actors in the energy commodity chain 	Export of emissions in less environmentally regulated regions; impacts associated with the renewable energy commodity chain	Carbon border taxes Traceability programs for raw materials used in batteries and electrification

Source: Created by the authors, based on Green and Gambhir (2020), and Atteridge and Strambo (2020).

Challenges for a Just Transition in Los Angeles



5

5.1. Concerns by key actors

5.1.1. Workers

Utility workers represent some of the strongest opposition to decarbonization plans in Los Angeles, particularly the LAGND. This is especially true for the International Brotherhood of Electrical Workers Local 18 (IBEW 18), the union that represents nearly all employees at DWP. IBEW 18 has over 8,000 members, who work for different public sector institutions. They include utility, electrical and clerical workers, engineers, custodians, and tree trimmers. There is a strong perception among local stakeholders that IBEW 18, and particularly the union's business manager Bryan D'Arcy, are powerful actors in local energy politics. IBEW has expressed dissatisfaction with recent city sustainability policies at several junctures, including through the formation of Working Californians, a nonprofit research and advocacy organization operated by IBEW 18, that has mounted opposition to the LAGND and Mayor Eric Garcetti.

IBEW 18 has employed different tools to oppose city decarbonization policies, the following of which are especially important:

Financing campaigns against policies and local politicians with decarbonization agendas, and in support of politicians against these plans. Some examples include the campaign against Garcetti during his run for mayor in 2013 and in support of his challenger Wendy Greuel, financial contributions to the campaign of John Lee during elections for a City Council seat in the northwest San Fernando Valley in 2019, and a TV and radio advertisement campaign launched in 2019 against the LAGND and against Mayor Garcetti.

Organizing demonstrations against decarbonization policies. Some examples include protests outside of DWP headquarters and Mayor Garcetti's home by union members against the decision to phase out the three OTC stations.

Campaigns and lobbying to block decarbonization projects. An important example is the opposition to non-unionized solar projects in 2008, which led to the controversial Measure B, a solar power ballot measure proposed by then-Mayor Villaraigosa in consultation with workers and which proposed to have unionized DWP workers install solar panels on rooftops and parking lots, but which was ultimately rejected in the polls in 2009 (Zahniser 2008). Another example is the opposition from IBEW 18 workers in 2019 to the Eland project, a combined solar and energy storage project that will be built in the Mojave Desert of eastern Kern County, about two hours north of Los Angeles. IBEW 18's objection was predicated on the argument that the project was not in compliance with the union's contracts with DWP. While their opposition was not able to stop the project, it did delay implementation (Roth 2019d; The Times Editorial Board 2019).

With regard to the LAGND plan and the decision to phase out the OTC gas-fired power plants, the main concerns expressed by organized labor are potential job losses, especially

good quality union jobs. IBEW 18 has argued that renewable energy investments will replace jobs in coal and gas-fired power stations, will employ less people and for shorter terms (e.g. for construction rather than daily maintenance), often require workers to be less skilled, will employ workers outside the city of Los Angeles (given that most renewable investments are located outside the city borders), and that many jobs that are currently being created within the city and county (rooftop solar, for example) are being done by contractors, not union workers (McGreevy 2005, personal communication 3/21/21). Working Californians has also argued that the LAGND will be costly and that those costs will be borne by local citizens, increasing power rates on local families, driving up the price of gasoline, and making traffic worse (WCA 2019). These views are in line with other workers, organizations in the state of California (Marinucci and Kahn 2019) and within the United States (Irfan 2019) that have recently opposed Green New Deal policy proposals.

5.1.2. Energy consumers

Groups of ratepayers—directly represented by their Neighborhood Councils—have also expressed concerns about the LAGND and previous decarbonization policies implemented by the LA city government. In order to take consumer concerns into account, in 2012 a Ratepayer Advocate was appointed to direct the Office of Public Accountability (OPA), a department within the City that serves as a quasi-independent watchdog of DWP's operations and finances (OPA 2020a). In the past, the OPA has criticized coal phase-out plans and renewable energy investments for being too expensive (Linthicum 2013b). Although the OPA has not published any specific commentaries or reports on the LAGND, its director has expressed the need to be cautious about the role of hydrogen, a technology that has not yet been incorporated at a large scale by other utilities in the country and which will be used to repower the IPP, a key piece of the plan to transition the DWP system to 100% renewables by 2045 (Roth 2019g). With regard to the decision to phase out the OTC gas-fired power plants, the OPA recommended that DWP and the city "avoid irrevocable actions," and called for studies of alternative options to continue, including the need for "consideration of more agile fossil generation mixed with dispatchable renewable resources before, during, or after the OTC plants cease to use ocean cooling" (OPA 2019:1).

Some business organizations have also opposed the LAGND and other city and county decarbonization plans. This includes the Los Angeles Area Chamber of Commerce (Roth 2019a) and the Valley Industry and Commerce Association (Mantle 2019). In particular, their concerns were focused around the impacts on power rates and system reliability that could stem from the phase-out of the OTC generating units. In contrast, the Los Angeles Business Council, another important business advocacy organization, which includes among its membership representatives from the renewable energy sector, has supported different initiatives that promote the decarbonization of Los Angeles.

5.1.3. Communities living around fossil fuel infrastructure and environmental organizations

Community and environmental organizations have played a key role in promoting and

designing decarbonization policies in Los Angeles. Important players organizing to accelerate the energy transition include:

Sierra Club (Los Angeles Chapter): nationwide grassroots environmental organization.

STAND LA (Stand Together Against Neighborhood Drilling Los Angeles): environmental justice coalition of community groups that seeks to end neighborhood drilling in Los Angeles. Founded in 2013.

CBE (Communities for a Better Environment): environmental justice organization that focuses on California's low-income communities and communities of color. Founded in 1978.

Pacoima Beautiful: environmental justice organization that focuses on communities in the San Fernando Valley. Founded in 1996.

Food and Water Watch: nationwide grassroots environmental organization. Founded in 2005.

Sunrise Movement LA: city hub of the Sunrise Movement, nationwide environmental organization with a focus on climate change and environmental justice.

Moreover, some of these organizations have worked together in strategic alliances:

The Los Angeles Clean Energy Coalition: this coalition includes Communities for a Better Environment, Pacoima Beautiful, Sierra Club, Grid Alternatives, and the Los Angeles Business Council. The main goal of this coalition is to improve the lives of the residents of Los Angeles by advocating for commitments to 100% renewable energy by 2040.

Clean Power Campaign: coalition of environmental groups and renewable energy companies formed to lobby and advocate for the use of clean energy in the city and for the transition away from fossil fuels.

Repower LA: citywide coalition of community groups, environmentalists, and small businesses anchored by Los Angeles Alliance for a New Economy (LAANE), Strategic Concepts in Organizing and Policy Education (SCOPE), and IBEW Local 18. Formed in 2011, it advocates for equitable environmental programs and career-path jobs at DWP. Repower LA, however, does not support the 100% by 2040 campaign.

Some of the main concerns for local residents living around fossil fuel infrastructure, who are predominantly part of lower-income communities of color, are health impacts. Establishing a 2,500-foot buffer zone or "setback" between oil and gas facilities and residential buildings, schools, hospitals, among other public infrastructure, has been one of the main demands of activists and environmental justice groups (Hensleigh and Haake 2021).

Moreover, environmental groups have raised concerns about the fact that in current decarbonization plans, it is still unclear if the non-OTC natural gas units owned and managed by DWP (approximately 2.4 GW of capacity) will remain online through 2045 (DWP 2020b:30). Residents of Sun Valley and Pacoima, in alliance with environmental organizations, have also protested against the Valley Generation Station, the only non-OTC gas-fired power plant operated by DWP. In October 2020, DWP revealed that this station had been leaking methane for over three years, further increasing the concerns of local residents (Roth 2020d).

Environmental groups have also pointed out that some of Los Angles' energy system transitions were late in comparison with their peer utilities—the delay in phasing coal out of the system when compared to other California investor-owned utilities is one example of this. Similarly, environmental activists have argued that, despite the fact that the targets in the LAGND are in line with California's mandate, the goals included are not in line with the Paris Agreement. On this point, representatives from the Sunrise Movement LA have said: "with Mayor Garcetti's current plan for net-zero emissions by 2050, Los Angeles is on track to be twenty years too late. That is not a GND" (Sunrise LA 2019).

Finally, with regard to the phase-out of the OTC generating units, a central challenge for a JT for communities living around these and other fossil fuel infrastructures in Los Angeles is the need for appropriate and safe retirement and eventual decommissioning of these sites (see section 6).

5.2. Considerations for a just transition in Los Angeles

5.2.1. Public participation

Given that the city was previously criticized for the lack of public participation in its sustainability and decarbonization agendas, the LAGND included a range of stakeholders in its design process. For example, the Los Angeles Clean Energy Coalition was invited to participate in designing the energy section of the plan. However, environmental organizations have mostly achieved their influence over policies through lobbying and campaigning. One clear example is the key role that the Los Angeles Clean Energy Coalition played in Mayor Garcetti's last-minute announcement—as a key aspect of the GND—that he would phase out, rather than repower, the OTC plants. This last-minute decision ultimately stemmed from personal negotiations, lobbying, and public pressure, rather than an open and participatory stakeholder engagement process, a fact that has had an impact on how it has been received by union workers (personal communication 9/2/2020; personal communication 10/2/2020).

IBEW 18 also has a long history of participating in decision-making around energy issues in Los Angeles and has influenced important decarbonization policies through lobbying and internal pressures. However, their participation in formal processes of decision-making for a JT seems to have been more limited. The municipally-owned nature of DWP means that decisions related to the decarbonization of its power system are linked with the public governance structure of the city government

and are subject to public scrutiny, often eliciting immediate reactions from local stakeholders and the media. However, multiple interviewees for this project agreed that decision-making at DWP is not based on strong public participation. An important issue challenging public participation in DWP's energy transitions has to do with transparency, particularly with regard to accessing data and information from the utility. The DWP website allows open access to some annual reports, general financial data, rates information, and recent strategic resource plans—however, more detailed and historical information about, for example, power plant operations and the financial status of different assets and infrastructures is not easily accessible. While conducting research for this report, we found that personnel at DWP were very guarded about sharing this type of data, particularly when it was considered politically sensitive, such as information about the phase-out of the OTC generating stations.

Interviewees also expressed concern about the lack of public participation in decision-making around the future uses of the OTC power plants and sites. Currently, DWP is considering different possibilities, such as hydrogen repowering and battery storage in these sites. However, it is our understanding that neither environmental groups nor local communities have been included in these discussions thus far.

In 2017, DWP created the LA100 Advisory Group (see Section 2.1), an important initiative to incorporate public participation in the utility's decarbonization strategies. Despite our project interviewees stating that they valued this multi-stakeholder initiative for the possibility of providing input and feedback to the scenarios and analyses included in the LA100 study, they also highlighted some critiques about the advisory group that could be useful to consider for similar participatory initiatives in the future:

(1) Most of the participants and presenters were experts on the technological and financial aspects of decarbonizing the grid, and thus they were not able to speak fully about the social and ecological implications of such transitions.

(2) Beyond commenting on the LA100 study, it is unclear how relevant the activities of this group were, as discussions did not directly result in decisions or binding agreements. Interview informants noted that the lack of clarity around the ways that their feedback would ultimately shape outcomes led to decreased engagement by some participants.

(3) The group provided a good networking space for energy consulting firms interested in participating in future studies and projects with DWP. However, it missed the opportunity to create a space for dialogue among stakeholders with opposing views on the decarbonization plan, which could have helped to achieve consensual decisions that would increase social acceptance.

(4) There was a lack of representation from actors outside Los Angeles who are potentially affected by the plan, such as communities living around the IPP and other utility-scale renewable energy projects and facilities. While it

would have, admittedly, been difficult to include them, a truly just transition requires us to understand how cities are linked to other sites through commodity chains and durable infrastructure like transmission lines. Finally, informants also mentioned that indigenous stakeholders with an interest in Los Angles land use decisions, such as the Tongva peoples, were consulted only in passing.

5.2.2. Social acceptance

5.2.2.1. Discrepancies in assessments

Scholars have argued that one of the central conditions for achieving greater social acceptance of decarbonization processes is the development of shared assessments of the main risks and benefits of transitioning away from fossil fuels (e.g., Pesch et al. 2017). While a range of reports and assessments have been completed by relevant actors, including environmental groups, the city government, and consultants, there are discrepancies around a number of key concerns. In particular, there is not a clear consensus on the technical feasibility of a 100% renewable power system, on the implications of various decarbonization scenarios and pathways for workers, or on the cost- effectiveness of the plans.

Technical feasibility. As a municipally-owned utility which is also its own balancing authority, DWP is particularly autonomous in terms of determining the technical feasibility of its investment and divestment decisions. The lack of an external authority assessing and approving these decisions, such as the CPUC that regulates most of the utilities of California, makes questions about the technical feasibility of DWP's decarbonization plans particularly open to customer complaints and public scrutiny (Mills 2018). In this context, despite the fact that DWP developed and commissioned several technical studies to support and justify their decisions, this has not fully stemmed dissent or public concern.

Understandings of the technical feasibility of energy portfolios vary between actors and over time. New research and technological developments, as well as changes in market conditions and in the social perception of energy technologies, are all important factors and, therefore, feasibility studies need to be updated accordingly. For example, until very recently, the plan of completely phasing out coal from the DWP power system was seen by several local actors as not technically feasible (Linthicum 2012). Today, there is a much broader consensus that phasing out coal is not only technically feasible but also cost-effective.

Currently, local stakeholders and scholars are divided about the technical feasibility of a total phase-out of fossil fuels, including natural gas, from the power system by 2045. The decision to phase out the OTC stations was particularly controversial in this regard because only two months before, consultants hired by DWP advised that this would not be a sound decision. Some managers at DWP supported this view as well as the possibility of replacing some of the OTC units with more efficient infrastructure equipped with dry-cooling technology, arguing that the phase-out of these facilities would generate reliability problems (Roth 2018; Roth 2019b). The view that a complete phase-out of natural gas-fired

power generation is not technically feasible is supported by different actors, such as IBEW 18 and Working Californians (Reyes et al. 2019), business organizations such as the Los Angeles Area Chamber of Commerce (Roth 2019a) and the Valley Industry Association (Mantle 2019), and some energy consultants (Russo 2019).

The question of reliability is gaining greater relevance as Los Angeles experiences longer and hotter summers, which have increased power demand. This in turn has increased the need to use diesel—a much more polluting fossil fuel—as a backup fuel by some stations and backup generators during emergencies, given shortages in the natural gas reserve capacity, which has been described as a key problem and risk associated with a rapid phase-out of gas power infrastructure (Barboza 2016; Dooley 2020).

The possible need to expand natural gas capacity to accelerate decarbonization has been debated by energy consultants and scholars in California (Roth 2019d). Data showing that there is power overcapacity in the state is viewed by some actors as a reason to discredit the real need to keep burning and investing in gas capacity by DWP rather than creating better inter-state coordination (Food and Water 2018; Penn 2017).

According to an energy consultant who supports the idea of natural gas as the best "bridge fuel" for a low-carbon energy transition, gas-fired stations running low-capacity factors should be seen as a strategy to ensure the reliability needed to accelerate the expansion of renewable energy production, and therefore the phase-out of natural gas, in the near future (personal communication, 9/3/2020). From this perspective, rather than phasing out all existing natural gas-fired power stations, a more effective decarbonization strategy would be to avoid building new ones and incorporate renewable sources as fast as possible. This resonates with the "difficult last 10%" argument, which asserts that the most difficult (or even impossible) phase for achieving 100% renewable energy is the last 10%. This 10% is commonly composed of "peaker" power plants, such as the OTC units, which run at a very low capacity but are needed to ensure that the system is responsive to peak demands. According to one of the meetings of the Renewable Energy Advisory Group, "although the last 10% will be a long-term achievement, methods chosen to reach the first 90% will impact options for achieving the final 10%, especially considering once-through cooling units and other peaking capacity" (DWP 2020a:9). Other local energy experts and representatives from the renewable energy sector suggest that a combination of solutions such as energy storage, renewables, energy efficiency, and demand response, are already available and cost-effective for a rapid transition without the need for more investments or ongoing reliance on natural gas (personal communication, 8/12/2020; Knight et al. 2018).

More recently, the incorporation of green hydrogen as a key technology in DWP's decarbonization plan has opened up new possibilities, as well as a new set of critiques about its technical feasibility (Meeker et al. 2019). If DWP converts IPP or any of the in-basin OTC plants

to run partially or fully on green hydrogen, this would be the first utility-scale application of hydrogen in the United States, making it difficult to evaluate the feasibility or potential challenges of relying on this emerging technology (Roth 2019g), particularly with regards to storage, which requires very cold temperatures and very high pressure, and can present risks to local populations. As one renewable energy analyst and green hydrogen skeptic said of the risks, "its storage requires compression to 700 times atmospheric pressure, refrigeration to 253 degrees Celsius... It carries one quarter the energy per unit volume of natural gas... It can embrittle metal; it escapes through the tiniest leaks and yes, it really is explosive" (Robbins 2020).

The LA100 study, conducted by some of the country's leading renewable energy experts, and aimed at understanding the viability and reliability of a range of decarbonization and renewable energy pathways for Los Angeles, represents an important effort to address discrepancies in interpretations around the technical feasibility of transitioning towards 100% renewables. The results of this study emphasize that Los Angeles is technically capable of achieving 98% clean energy within the next decade and the 100% goal by 2035, which includes the total phase-out of natural gas (Cochran and Denholm, 2021). The DWP Renewable Energy Advisory Group also represented a key opportunity to create more shared assessments of different technological scenarios from a broader range of stakeholders. However, some participants have argued that the technical vocabulary used in most of the meetings limited more engaged participation and comprehension from stakeholders with less knowledge of the engineering and financial aspects of the energy system (*personal communication, 10/2/2020*). While the participants in the advisory group raised the fact that the language used there was very technical, the report produced from the study is written in very clear and approachable language. We also found that it demonstrates a level of nuance that avoids some of the generalizations of other related studies, and that it captures and acknowledges gaps that need to be addressed by future research (Cochran and Denholm, 2021).

Job impacts. Another important source of disagreement is on the impacts that transitioning away from fossil fuels will have for local jobs, particularly among workers trained to operate and maintain—and who are currently employed operating and maintaining—fossil fuel infrastructure. While some workers' organizations have argued that this transition will negatively impact the labor market, local politicians supporting decarbonization policies, as well as a number of different publications, have shown the opposite.

For example, the LAGND estimates that 300,000 "green jobs" will be created by 2035 and 400,000 by 2050. These numbers surpass the total workers employed in the fossil fuel sector in the city and will add to the over 35,000 green jobs that, according to estimates by the city government, have been created since Mayor Garcetti took office in 2013 (Holman 2019). With regard to energy decarbonization, the LAGND estimates that local solar installations will support 6,500 jobs by 2025, while clean grid infrastructure investment will support 45,000 jobs by 2022. Moreover, DWP's energy efficiency programs will support 1,600 jobs annually, the zero-carbon building initiative will support 175,000 jobs by 2050,

expanding publicly available EV charging infrastructure by 2025 will support 1,500 jobs, and electrifying 100% of buses by 2030 will support an additional 10,000 jobs (LA 2019).

According to Rigby and Shin (2017), implementing a required 2,500 foot setback distance for oil and gas wells operating in the city of Los Angeles would lead to an estimated 532 jobs lost, including workers directly employed with affected facilities and infrastructure, as well as related jobs. This loss would be partially offset by the remediation of the wells affected by this policy, which would generate around 356 jobs (including indirect jobs).

One of the main components of the LA100 study is an analysis of the job impacts of transitioning to 100% renewable power by DWP, including a comparison of the different scenarios contained within the study. The study estimates that net job impact within the city—which reflects combined positive and negative impacts from 2026 to 2045—ranges from a low of 3,600 fewer jobs annually under the Early & No Biofuels scenario, to a high of 4,700 additional jobs under the SB100—Stress scenario, changes that are described as "small" in relation to the millions of jobs existing in Los Angeles, despite the fact that the impacts could be quite significant in specific industries such as natural gas (Keyser et al. 2021). However, in all scenarios, jobs at DWP are expected to increase between "an average of 7,900 jobs per year in SB100—Moderate to 13,200 jobs per year in Early & No Biofuels—High" (Cochran and Denholm, 2021:14). Moreover, this study only considers jobs associated with the construction, installation, and operation of electricity generation infrastructure, and "ripple effects" (i.e. associated activities), not jobs associated with energy efficiency and demand managment.

Some estimates have exaggerated the number of jobs that the clean energy sector can generate and excluded job losses associated with the phase-out of the fossil fuel economy (Kahn 2019). Other accounts, at the same time, have overestimated the negative job impacts of decarbonizing Los Angeles, without fully considering how labor efficiency measures (e.g., mechanization) and market competition (e.g., cheaper gas and renewable energy technologies) have also reduced jobs. In this context, it is critical to consider both current jobs and a "business as usual" benchmark of job reductions in fossil fuel-based industries in order to best estimate the job effects of the energy transition.

Scholars have argued that large cities like Los Angeles tend to be more economically diverse than remote regions singularly or heavily dependent upon the production of fossil fuels (Brown et al. 2017). Therefore, there are more possibilities for related alternative employment, potentially making a JT for workers more manageable. However, according to Zabin (2020), framing new jobs in the renewable energy sector as "greening" existing jobs rather than as creating new "green" jobs is key, given that workers employed in the fossil fuel energy sector possess skills that can be transferable to the renewable energy sector. Accompanied by correct labor protection measures, greening existing jobs would also create more worker buy-in around potential positive job effects of transitioning towards low-carbon energy.

The perception that workers at DWP are better paid and receive higher benefits than other city agencies and utilities has been shared by a range of local stakeholders in Los Angeles over the last two decades, if not longer (Dolan 2014; Lopez 2017; Zahniser and Smith 2017). Recent studies published by the OPA show that while DWP has greater numbers of unionized workers and more use of internal labor than other public and investor-owned utilities in the country, "executives' total pay is well below median compared to peers" (OPA 2020b:86). The OPA also concluded that "DWP's salaries at the lower end (e.g., employees making <$100K), which represent the bulk of employees, are well above peers," and that "this structure aligns with the City's general equity goals" (OPA 2020b: 58). However, after including bonus/incentive pay, DWP falls just below the median among utility peers (Pickel 2018: 9). Some informants in this study noted that, because of the perception of high pay and good benefits among DWP employees, there is a feeling that IBEW 18's opposition to decarbonization plans—including the LAGND—is a way to retain their existing privileges, rather than a legitimate concern that its workers will not experience a just transition. Other critical views suggest that a possible loss in membership—as a result of the expansion of privately-owned renewable energy projects, relying on workers associated with other unions or non-unionized workers—could be another reason for IBEW 18's strong opposition (personal communication, 8/19/2020). Finally, consumer groups, as well as Mayor Garcetti, have expressed the opinion that the high costs of salaries and benefits for the workers at DWP are among the reasons for expensive electric bills (Zahniser and Smith 2017; Finnegan and Linthicum, 2013; LA Times 2012; LA Times 2010).

The costs of decarbonization. In contrast to investor-owned utilities, rate changes at DWP are not subject to the CPUC. Rather, DWP has to report to local entities, such as the mayor and the City Council, to raise rates to compensate for investments needed for an energy transition. As Mills (2018) observes: "this degree of public accountability may increase the barriers to financing stranded asset compensation" (39-40). Moreover, as a municipal utility that does not respond to shareholders, but rather to local citizens, changes in energy rates are very controversial and create opposition from energy consumers (Villaraigosa et al. 2013). However, in comparison to investor-owned utilities, DWP revenue goes towards recovering costs and updating infrastructure rather than shareholder returns (Mills 2018), giving DWP greater latitude to ensure low rates for consumers. Additionally, given the relationship between the city and the utility, there is also a strong desire to prevent stranded assets and ensure that existing assets live out their productive lives as fully as possible. This is at least in part because DWP is a net contributor to the city's general fund, meaning that keeping costs low for the utility allows them to subsidize other parts of the city budget (personal communication 8/4/2020).

The OPA has produced various studies that assess the possible costs that different decarbonization policies would have for ratepayers in Los Angeles, such as the repowering of IPP with natural gas (supported by OPA [OPA 2018]), the roof-top utility community solar pilot program (with respect to which OPA was "neutral" [OPA 2016]), and the sale agreement to divest from the Navajo Station (considered "reasonable" and "fair" [OPA 2014]). More recently, OPA has suggested that increases in

renewable power generation will challenge DWP to continue offering competitive electricity rates (OPA 2020b). DPW's ownership and/or direct control of these generating stations has been important for keeping rates consistent and relatively low. This represents a challenge in terms of incorporating contracts with renewable energy providers, which could limit control over cost structures. A potential increase in costs associated with privatizing a portion of DWP's power capacity through the incorporation of renewable power produced by facilities not owned or managed by DWP has been crucial in local discussions of how to decarbonize the grid since the 2000s (LA Times 2009).

The LA100 study also analyzes the net economic impacts of transitioning toward 100% renewable energy, with a comparison of different scenarios. The study concludes that while there may be slight positive or negative economic impacts associated with achieving the LA100 scenarios, they will only have a small effect on Los Angeles' overall economy (Keyser et al. 2021:1). Despite the study not analyzing the specific impacts that different scenarios could have in terms of raising residential electric bills, it does estimate their cost range, which could be used as a reference for rate designs. These costs range between $57 billion and $87 billion (2019$), depending on the scenario and load projection (Cochran and Denholm, 2021:29).

Finally, ongoing discussions around residential electrification have ignited debates about the costs for consumers of moving away from natural gas. SoCalGas, the local gas provider, has promoted the argument that electrification would increase bills for homes that continue to use natural gas, given that the costs of operating and maintaining natural gas storage and conveyance infrastructure would fall on a smaller group of people, likely some of the city's lower-income populations (Roth 2019b).

5.2.2.2. Discrepancies in key concepts

Another major challenge for building consensus around decarbonization plans and strategies is that key terms are often used differently, or similar terms are used by different stakeholders to convey different aims and outcomes. This creates problems in the communication of decarbonization plans. We identify five main discrepancies around key concepts used in decarbonization discussions and plans in Los Angeles.

(1) Demand-side vs. broader decarbonization. Los Angeles' decarbonization plans have targeted the power, transportation, and construction sectors. However, this demand-side approach has left oil fields as outliers (Tuttle 2020). This limited definition of decarbonization, which is also present in most regulations established by the State of California, has been criticized by environmental organizations that argue that a broader understanding of decarbonization which also includes the supply-side is needed, especially in order to promote stronger regulations to phase out oil and natural gas extraction and processing (STAND LA 2017; Oil Change International 2018).

(2) Zero-carbon vs. renewable energies. Discussions around what resources should count toward the RPS have been constant in California since the inception of this policy at

the beginning of the 2000s and have involved complex legal and scientific debates. These discussions are also common with the incorporation of nuclear energy, natural gas, and large hydropower into zero-carbon goals. Under current law, California's RPS mandates 100% "zero-carbon" (or "carbon-free") energy by 2045, which includes among its qualifying resources, solar, wind, biomass, geothermal, and small hydropower (Petek 2020). DWP has been involved in legal proceedings against the California Energy Commission related to the eligibility of biomethane contracts and out-of-state hydropower (Morris 2018). The distinction between zero-carbon and renewable energies was also part of the discussions held by the Renewable Energy Advisory Group, where these different concepts were considered in outlining scenarios without total agreement around the benefits of either (DWP 2018b).

(3) Carbon-free vs. low-carbon.

Different reports, studies, and policies conflate the notion of carbon-free and low-carbon energy systems. Low-carbon energy, as a concept, has been used strategically to emphasize the environmentally friendly character of initiatives that may still produce carbon emissions. In particular, in the case of Los Angeles, the notion of low-carbon energy can conceal the role that natural gas plays in various projects and initiatives. For example, the American Public Gas Association recently switched its vocabulary, so that it was no longer referring to a "carbon-free" economy or "net-zero" buildings, but instead a "low-carbon" economy and "lower carbon footprint" for buildings (Roth 2019f). This change in vocabulary was part of the natural gas sector's strategy to promote the use of natural gas as a climate friendly fuel.

(4) Carbon-free vs. carbon neutral.

The differences between "carbon-free" and "carbon neutral" energy goals are another source of conceptual vagueness that make it difficult to compare specific targets across studies. In Los Angeles, the net 100% renewable energy goal set by the city government in 2016—which defined the goals and parameters of the LA100 study—was based on the notion of carbon neutrality, which included the offsetting of emissions through the purchase of Renewable Energy Credits (RECs) or the export of excess renewable energy generated by DWP to neighboring balancing areas (DWP 2018f:4). When SB100 was passed, the LA100 study included the carbon-free goal of 100% renewable energy at all hours in only one of its scenarios. Different renewable energy plans by the city and DWP include these concepts without clearly stating their environmental limits, opening the door to accusations of greenwashing (LA 2015; LA 2019). This problem was expressed during the meetings of the Renewable Energy Advisory Group, where the concept of carbon neutrality—despite being included in different scenarios considered by the group—was seen as problematic, and the use of RECs was criticized for not addressing the need to phase out local

fossil fuel use and for not creating enough jobs and other economic benefits associated with renewable energy investments locally (DWP 2017b; DWP 2018b).

(5) Green vs. environmentally damaging natural gas. The coexistence of a negative and positive environmental image of natural gas is common in the United States and internationally (Scheer et al. 2017). In Los Angeles, while some actors argue that natural gas is a green fuel because it is less polluting and carbon-intensive than coal and petroleum products, environmental groups claim that given its high methane emissions, it should not be seen as green. Moreover, natural gas exploration, drilling, and production generates other environmental impacts beyond emissions (EIA 2020). The discrepancy is seen in the tension between actors that view natural gas as a transition fuel versus anti-natural gas environmental views (see 5.2.2.1). This discrepancy was also reflected in the Renewable Energy Advisory Group, where natural gas was sometimes framed as green, sometimes not. The use of natural gas was included in two of the eight models analyzed in the Advisory Group (DWP 2018).

This view of natural gas as a green fuel has been actively promoted by the industry. The natural gas industry has also worked hard to maintain a positive reputation locally. For example, a report published by the Los Angeles Times in 2019 showed that SoCalGas donates heavily to local organizations, such as charities and business groups that promote pro-gas and anti-electrification solutions (Roth 2019e). SoCalGas has also financed advertisements and campaigns that promote the virtues of natural gas as an affordable and green fuel (Roth 2019f). Furthermore, the utility has provided funding for Californians for Balanced Energy Solutions (or C4BES), a pro-gas advocacy group (Roth 2020b). While SoCalGas promotes a clean energy future in Southern California based around natural gas, the main power utilities in the region (DWP and SoCal Edison) promote building electrification and the expanded use of electric cars. However, these utilities, which still rely on natural gas, tend to be more silent about the role of gas in power production. The idea that electrification is needed to decarbonize Los Angeles also means breaking with a previous idea of natural gas as a more modern, clean, and efficient technology. The superiority of natural gas as a fuel for home cooking and heating was promoted in the 2000s as a response to a previous wave of electrification during the 1950s-1970s (Wedner 2001). Therefore, the challenge of (re)promoting electrification today involves reshaping local imaginaries and cultural attachments to gas built up during the past three decades.

5.2.3. Job security and planning

One critique against the LAGND shared by a number of individuals interviewed for this

Table 3
Green Jobs in the LAGND - Milestones

2021 **OPEN GREEN CAREER PATHWAYS THROUGH THE FOLLOWING INITIATIVES**	**2025** **CREATE 100,000 GREEN JOBS**
Collaborate with Los Angeles Community College District to develop pipelines for employment in green construction industry professional services	Create a Jobs Cabinet to convene City departments to identify job growth opportunities
Offer Green Jobs courses at L.A. Trade Technical College for 250 students and place them in internships	Work with the private sector to grow green jobs within the companies
Work with local trade and technical schools to create an EV workforce pipeline	Create private sector partnerships to establish business apprenticeships
Establish workforce training programs for landscape managers on the installation and care of native plants	Collaborate with stakeholders on a just transition for workers into the green jobs of the future
Prepare workers who have jobs that will become automated with retraining	Ensure contracts for City construction projects and provide opportunities for local hiring and disadvantaged worker employment
Add sustainability curriculum to WorkSource Development Center training	Track the number of people trained and placed through the WorkSource Development Centers
Offer two free years of community college for eligible high school graduates, which will expose students to hundreds of courses in sustainability	Expand targeted local hire positions to more city departments
Launch the Advanced Prototyping Center Fellowship at the Los Angeles Cleantech Incubator (LACI) to place 50 people in jobs per cohort	

Adapted from LAGND Plan, 2019.

report is the fact that it lacks a clear plan and pathway toward a just transition for workers, both union and non-union. The LAGND contained one section that outlined targets and milestones for increasing green jobs in Los Angeles, which focused on creating new employment programs and attracting cleantech investments from the private sector. Most of these jobs are expected to be created from public and private investments resulting from policies to decarbonize the city, expand renewable energy, and other environmental initiatives. The LAGND also includes different milestones in terms of green jobs creation, which are detailed in Table 3.

However, despite establishing the intention to advance in this direction, the LAGND does not include specific initiatives to provide job security for workers that are directly or indirectly

employed in fossil fuel-powered facilities. While the creation of a collaborative process to outline a just transition is part of the milestones for 2025, making this process central to the drafting of the LAGND—rather than an ancillary step to be taken up later—could have helped to achieve earlier and stronger buy-in from local workers who will be impacted.

Much of the current work taking place to plan for a JT is happening in the non-profit sector. One important organization that is addressing the need to create a stronger alliance between workers and environmental organizations is LAANE (Los Angeles Alliance for a New Economy). LAANE was created by union representatives and has been highlighted as a particularly successful organization in terms of implementing environmental plans that also improve workers' conditions (Greenhouse 2019). In recent years, LAANE has developed several projects in collaboration with unions, local communities, and environmental groups. Currently, LAANE is working on a plan for a just transition for workers affected by the phase-out of the OTC power plants by DWP.

Another initiative that has contributed to the development of job skills for a just transition is the Utility Pre-Craft Trainee Program (UPCT), launched in 2011. This program is jointly operated by DWP and IBEW 18 and "is an earn and-learn, pre-apprenticeship training program in which entry-level trainees work full time weatherizing homes and small businesses while learning skills and preparing for civil service exams and career opportunities in the utility" (Zabin et al. 2020: 3). Trainees participating in the UPCT are members of IBEW 18 and receive $16 per hour plus health and retirement benefits. This program is supported by LAANE, RepowerLA, and SCOPE. UPCT's trainees have assisted with the installation of solar technologies on properties owned by DWP and the implementation of energy efficiency measures for DWP's Home Energy Improvement and Small Business Direct Install programs. According to Zabin et al. (2016), UPCT has been successful in recruiting trainees from disadvantaged communities in Los Angeles County. UPCT has also been important for IBEW Local 18, "which faces an aging workforce (40% of DWP union employees were at or near retirement age at the time of the UPCT program's launch)." In this context, "the UPCT program is building a new generation of union workers that better reflects the Los Angeles workforce demographics, helping IBEW 18 to gain allies and adherents from the city's low-income communities" (Zabin et al. 2016:66).

Other promising initiatives to provide job security to workers affected by energy transitions are being developed as this report is being written. One notable example is the Just Transitions Taskforce, created at the end of 2020 by Los Angeles County, and which is in charge of creating jobs for the remediation of abandoned and nonproductive oil wells (Sierra Club 2020). This taskforce includes the participation of the Sierra Club, Los Angeles and Orange County Building Trades, and United Steelworkers Local 675 (Embrey 2020).

5.2.4. Environmental justice and redress

One of the objectives of the City of Los Angeles' decarbonization agenda, as mandated by the City Council, is to incorporate distributional justice by prioritizing disadvantaged neighborhoods as the first beneficiaries of environmental improvements (LA 2019). This dimension was incorporated into the LA100 study through the use of the CalEnviroScreen tool, which was used to locate

disadvantaged communities in order to target them for energy efficiency and renewable energy investments (DWP 2018d). The study concludes that there is significant potential for new rooftop solar installations in disadvantaged communities (Hettinger et al. 2021). However, lack of data to differentiate between disadvantaged and non-disadvantaged households and household energy uses within these communities limited this study's capacity to provide more specific projections in terms of potential clean energy developments. This issue is recognized by the report's authors, who observe that "a full environmental justice analysis of not just customer-solar adoption, but also adoption of building energy efficiency and electrification of electric appliances and vehicles, among others, would require details on policy and program implementation, which were beyond the scope of this study" (Cochran and Denholm 2021:51). The authors also observe that policies and initiatives will need to be intentionally crafted to prioritize these communities (Cochran and Denholm 2021:54).

The LA100 study also analyzed how environmental justice communities would be impacted by the different scenarios in terms of changes in air pollution and public health outcomes. Some of the main conclusions were that air pollution-related health effects would decrease citywide under all the considered scenarios, with greater change in health outcomes for disadvantaged communities (Cochran and Denholm 2021:51). In terms of the contribution of different sectors, the authors observe that increased levels of electrification, in commercial buildings and transportation, for example, would create the greatest overall improvements to health. Moreover, it is expected that residents of disadvantaged communities living near the LADWP in-basin power plants will experience additional health benefits to those quantified by the study (Hettinger et al. 2021:3).

Participants in the Renewable Energy Advisory Group noted that an important limitation to the LA100 study's ability to identify ways to maximize benefits to communities who experience environmental injustice is the fact that "value judgments and subjective elements" cannot be easily modeled (DWP 2018:10). Given that considering broader social and normative aspects was not the focus of the methodologies and approaches used by the LA100 study, this remains an important aspect that future projects need to address.

Generally speaking, environmental justice has not been the primary driver or reason for phasing out or creating clean infrastructure in Los Angeles. Rather, regulatory requirements, economic efficiency, or technological change and obsolescence have driven environmental decision-making, with environmental justice then included as a factor to be modeled or as a positive or negative externality created by plans. An exception was the decision to phase out rather than repower the OTC stations, particularly Scattergood. In this case, lobbying from environmental and local organizations was a key driver. However, relying on this type of pressure creates the risk of leaving behind communities with less resources for organizing and lobbying.

Finally, a plan for redress and restitution for communities in Los Angeles that have lived for decades around fossil fuel infrastructure has not been included in current city plans.

The Phase-Out Process: Best Practices

6

This section lays out best practices from other studies and from the scholarly literature for undertaking the phase-out of fossil fuel infrastructure. While there are ample studies, including LA100, that consider how capacity can be ramped up to replace carbon-intensive infrastructure, much less attention has been paid to the processes associated with taking that infrastructure offline or repowering it in greener ways.

First, there are two main processes associated with the phase-out of fossil fuel infrastructure that are important to distinguish.

(1) Retirement: This entails the shutdown of power units and the removal of their capacity from the power grid. When retired, units are withdrawn from operation and the operational permits of infrastructure used in the production, transformation, and consumption of fossil fuel energy are terminated. Infrastructure that is not in operation and has not been decommissioned is commonly referred to as idle (Malley 2016).

(2) Decommissioning: This includes the dismantling of infrastructure, the removal of components, and their recycling, storage, and/or disposal (Invernizzi et al. 2020). A complete decommissioning process also includes the decontamination, environmental remediation, and rehabilitation of the sites (EPA 2016).

Distinguishing these processes is important given that they are associated with different environmental and social challenges. Most of the studies conducted in Los Angeles have focused on the technical and economic challenges related to the retirement of infrastructure. However, less has been said about the social and environmental impacts of retirement as well as with the decommissioning process. In this section, we focus specifically on the decommissioning of gas-fired power plants. Some of the elements included in this review also apply to other types of fossil fuel infrastructure. However, specific assessments for different types of infrastructures are needed, considering the challenges associated with their material compositions, structures of ownership, and regulatory frameworks.

In recent years, some units of the OTC power plants have already been repowered and decommissioned (see Section 2.2.). However, if a complete decommissioning of these power stations is considered a viable alternative, it would pose specific challenges. These challenges vary substantially according to the different future uses for these sites. While there is still uncertainty with respect to the full range of future uses, decommissioning examples from other contexts can provide useful information about some key risks and the best practices related to this process.

Early identification of future uses. There are multiple possibilities for the reconversion of retired power plants, which are associated with different regulations for an adequate decommissioning process. Weighing these options is important for calculating the possible costs of decommissioning. Normally, sites that are repowered or repurposed for industrial use have to be remediated to brownfield conditions, while sites that are repurposed for residential, commercial, and mixed uses have to be remediated to greenfield (pre-project)

conditions (Raimi 2017:8). Moreover, when power plants are retired and left idle, rather than properly decommissioned, they become more degraded and create more contamination, increasing mitigation costs (Raimi 2017). For all these reasons, future uses should be identified early on and the viability of specific options should be evaluated regularly.

To take advantage of already existing transmission infrastructure, converting power plants to renewable energy projects and battery storage can be a convenient option. This reconversion can also lower the possibilities of lob josses. Although generating power from renewable energy such as solar is less labor-intensive than coal or gas-fired power plants, these projects can keep a portion of the plant's original workers employed through at least the construction process (O'Donnell 2019).

To encourage this type of reconversion, in 2016, the EPA launched the RE-Powering America's Land Initiative, which provides technical assistance for the development of renewable energy projects on contaminated sites (EPA 2016) (for an overview of similar public incentives, see Raimi 2017). As Raimi (2017) suggests, despite the fact that most power plant owners lack expertise in real estate and property development, analysis of the potentials for redevelopment is essential to determine opportunities and liabilities in each case.

Partial decommissioning provides an in-between solution for power plant owners. Partial decommissioning, colloquially known as going "cold and dark," is the process by which power plants are retired from the system and some operational materials are removed from the premises. By doing this, partial decommissioning maintains infrastructure but suspends operation and electricity generation (Brown et al. 2017: 30). Partial decommissioning affords the owners flexibility if the economic environment does not incentivize complete decommissioning (Raimi 2017:12). However, this partial process creates concerns regarding the management of idle infrastructure and environmental degradation.

Early and constant public participation. Decommissioning power plants involves long planning processes and compliance with complex environmental regulations (Brown et al. 2017). According to the literature, successful decommissioning processes—meaning those that avoid unnecessary social and ecological impacts and legal claims—generally include participatory mechanisms and disclosure of information from the outset (Bond et al. 2004). Taking into account the different economic, social, and ecological impacts and risks of decommissioning is fundamental to better understanding who the stakeholders that need to be included in the different phases of the planning process. Remediating to brownfield or greenfield conditions, selling to developers or environmental liability transfer firms, and converting sites to parks or other civil services are all decisions that need to be made in dialogue with local communities. Timely communication of project plans, knowing possible risks and impacts, and steps to be taken to mitigate them are all fundamental for a successful decommissioning process (Hope 2014).

In some cases, plant owners have convened community advisory boards in which different local stakeholders participate, in order to keep the stakeholders abreast of plans,

developments, and potential risks, as well as to gather their opinions, feedback, and address their concerns (Electric Power Research Institute 2010a, b; Malley 2016). It should be noted, however, that these types of consultative processes should not act as a replacement for more robust participatory governance structures, which should be convened to work together with stakeholders through the design, planning, implementation, and monitoring of decommissioning processes.

Transparency of decommissioning costs. According to the literature on decommissioning power stations, costs of decommissioning are high and difficult to predict, especially given that many of the costs are not fully known until the work has begun. Moreover, there is a shortage of well-documented and publicly available studies on the financial aspects of decommissioning, which are not normally disclosed by companies (Brown et al. 2017; Abdo et al. 2017). Therefore, creating public information on the costs and challenges associated with this process could represent an important source of knowledge, not only for local stakeholders, but also for promoting more efficient and informed decommissioning processes elsewhere.

The costs of decommissioning power plants are typically borne by the generating companies or transferred to electricity consumers. In the United States, when power plants are located on public land and the costs of environmental remediation are high, local taxpayers normally bear the costs of clean-up (Raimi 2017). Therefore, disclosing decommissioning costs during the planning process, as well as changes during implementation, is important for increasing social acceptance of phase-out processes among ratepayers and taxpayers, as well as social accountability.

While there are ample studies, including LA100, that consider how capacity can be ramped up to replace carbon-intensive infrastructure, much less attention has been paid to the processes associated with taking that infrastructure offline or repowering it in greener ways.

Creating local jobs and expertise. Decommissioning projects are more efficient when workers who know the plants participate in the process. Long-term employees have better knowledge of the history of the facilities, their functioning, and their problems (Hope 2014:4). However, decommissioning also requires specialized knowledge that external contractors can provide. As Brown et al. (2017:72) suggest: "it may be easier to strike a balance between using contractors for decommissioning activities and using current employees to prepare for decommissioning. This could create a gradual decrease of plant workforce rather than a simultaneous widespread laying off of employees."

There are many opportunities to generate jobs and expertise through the decommissioning process. Hiring local workers, engaging with local labor organizations, and subcontracting with local businesses are all good alternatives (Raimi 2017). In addition to hiring engineering and construction workers, the decommissioning of fossil fuel infrastructure requires many other specialized workers to deal with, for example, permits, regulations, and community relations. Cultivating these novel and specialized forms of work can help in the development of local expertise that can be utilized in other decommissioning projects, including other types of infrastructure and in other regions.

Given that decommissioning jobs are temporary and are generally not capable of replacing the number of jobs lost through the retirement of power plants (Brown et al. 2017), local workers that oppose the shutdown of fossil fuel infrastructure do not normally see decommissioning as a valuable job-generating activity. However, looking at successful national and international examples can provide ideas of how to move towards good-quality decommissioning jobs. For example, in Scotland, the oil and gas sector has been able to frame decommissioning activities not as sunk costs and short-term jobs, but as economic opportunities for the development of a domestic industry (McCauley 2018).

Adequate management of hazardous materials. One of the main risks of decommissioning processes is related to the inappropriate identification, management, abatement, and disposal of hazardous materials (Hope 2014). In general, the decommissioning of natural gas-fired plants (which tend to be

Table 4
Hazardous Materials Present in Gas-Fired Power Plants and their Impacts

IN-PLANT HAZARDOUS WASTE		IMPACTS
Emission by-products	CO2, NOx, SO2, PM2.5, PM10	Respiratory diseases, cancer, heart failure
DECOMMISSIONING WASTE		**IMPACTS**
Chemical Waste	NORM (naturally-occurring radioactive material) waste and radioactive sludge	Cancer, but relatively unknown
Electronic Toxic Waste	Polychlorinated Biphenyls (PCBs), tin-lead, brominated fire retardants, cadmium	Neurovascular disease

Source: Brown et al. 2017; CARB 2020

newer) poses fewer risks in comparison to the decommissioning of coal plants, which require the management of coal ash and more dangerous asbestos (Raimi 2017). However, when gas-fired power plants have been repowered from former coal or petroleum-fired stations, more environmental risks are present and a more complex environmental remediation is needed.

The decommissioning of natural gas and oil-fired power plants faces similar challenges in terms of waste management. Solid waste concerns for these types of plants include bioproducts from air pollution controls and chemical waste, some of which may contain radioactive elements (Brown et al. 2017). High voltage power electronics (e.g., switches, inverters, converters, and controllers) and other power devices can contain materials such as lead, brominated fire retardants, and cadmium, which can cause environmental and health impacts if not disposed of properly. Therefore, the impacts of inadequate management of hazardous materials can affect not only local communities surrounding power plants, but also the environment and health of the broader population.

Another equally important consideration is the adequate retirement of pipelines and storage infrastructure, which poses risks such as explosions and various liquid and gas leaks. These risks can be minimized by ensuring these types of infrastructure are correctly sealed and disassembled, where relevant (Raimi 2017).

Table 5
Other Environmental Risks from the Decommissioning of Power Plants

AIR, SOLID WASTE AND WATER POLLUTION	Water quality can be affected by: activities that cause soil erosion, weathering of newly exposed soils resulting in leaching and oxidation that could release chemicals into the water, presence of dissolved salts from untreated groundwater used to control dust, and pesticide applications. After decommissioning is complete, disturbed areas need to be contoured and replanted to minimize impacts related to water quality.
IMPACTS ON GEOLOGICAL RESOURCES	Removal of access and on-site roads, buildings, and other structures, and heavy vehicle traffic may impact soil and geological resources. Surface disturbance, heavy equipment traffic, and changes to surface runoff patterns can cause soil erosion, resulting in nutrient loss and reduced water quality in nearby surface water bodies. After decommissioning is complete, disturbed areas need to be contoured and replanted to minimize the potential for soil erosion and impacts to geological resources.
WATER QUALITY	Water quality can be affected by: activities that cause soil erosion, weathering of newly exposed soils resulting in leaching and oxidation that could release chemicals into the water, presence of dissolved salts from untreated groundwater used to control dust, and pesticide applications. After decommissioning is complete, disturbed areas need to be contoured and replanted to minimize impacts related to water quality.

Source: Brown et al. 2017

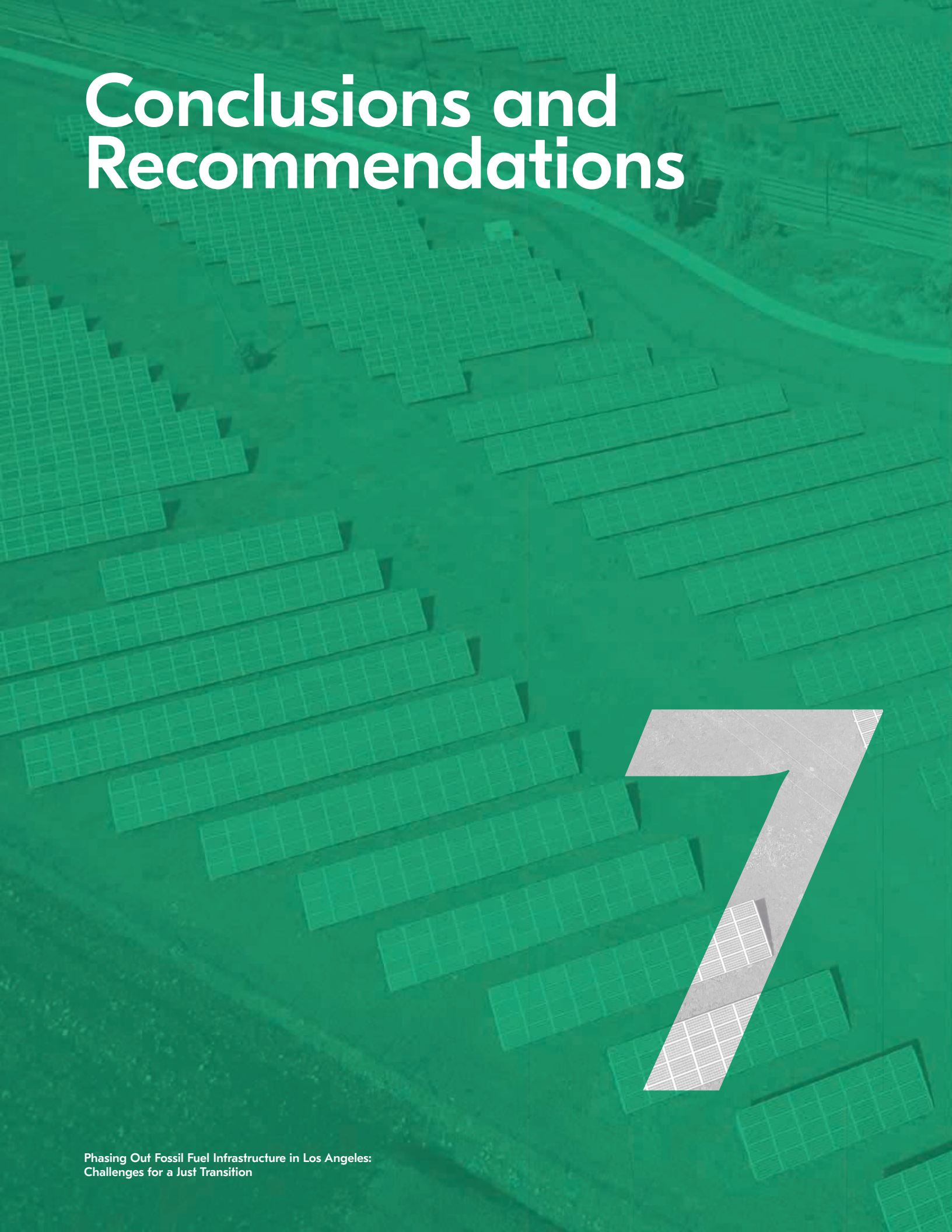
Adequate prevention of other environmental risks. Table 5 summarizes other environmental risks that can be created during the decommissioning of power plants and that need proper management and monitoring.

Appropriate recycling and reuse of materials. In the decommissioning process, it is common for owners of power plants to try to sell some components and materials (such as compressors, generators, engines, and pumps) on the metal scrap market or to other generator companies for their reuse. This process can create problems of liability when "the owner/seller of equipment is uninvolved in determining the appropriateness of planned reuse" (Hope 2014:3). Ensuring that the materials sold are not reused for the production of fossil fuel energy elsewhere and that they are properly recycled are important aspects of a JT that utilities phasing out infrastructure need to consider and that environmental organizations need to monitor (Jacobson and Delucchi 2011).

Impacts on local land values. The retirement and decommissioning of fossil fuel infrastructure can have important impacts on surrounding land values. If the sites of retired power plants are considered damaged, surrounding lands may become devalued. However, appropriate restoration of the sites and potential reconversion possibilities may also increase their value (Brown et al. 2017). This will vary from site to site and project to project but should be taken into account in all situations.

Other community concerns. The dismantling and demolition of power plants in dense urban areas tends to be costlier than in rural or less populated areas. These costs are tied (at least in part) to: the need to remove and transport hazardous materials, typically by truck, through populated neighborhoods; stricter regulations; and higher risks of neighbors' expressing concerns regarding dust and other irritants (Raimi 2017). Other concerns include noise (e.g., trucks and use of construction machinery) and visual impacts (e.g., road development, removal of buried structures and equipment, and disturbed soils) during decommissioning activities.

Conclusions and Recommendations



7

Following our review of a just transitions framework, analysis of the major considerations for a JT in Los Angeles, and best practices for fossil fuel infrastructure phase-out, we offer the following recommendations. These recommendations take a range of social and ecological dimensions into account and will help design city/municipal decarbonization plans that rapidly reduce carbon emissions and transform the energy system while placing workers and local communities in the center of the discussion. Recommendations stem from our review of best practices in the academic and policy literature, as well as our own extensive process of data collection and analysis in Los Angeles.

An early and ongoing participatory process. Workers, local communities living around fossil fuel infrastructure, environmental groups, ratepayers' organizations, and other relevant stakeholders need to actively participate in the different phases of the decarbonization process. The Renewable Energy Advisory Group represented a positive example in this regard. However, new tools and venues for participation, with broader reach and which do not cover just the technological and financial aspects of decarbonizing DWP and Los Angeles, need to be created. A more institutionalized participatory process for workers, where they take direct responsibilities in planning and collaborating with other stakeholders, is urgently needed. Looking at other national and international examples of multi-stakeholder governance structures to plan low-carbon energy transitions in contexts with high levels of "energy controversies" (Cuppen 2018) can be illustrative. Additionally, more local participation is needed in decision-making around the future of the OTC stations, which should consider not only the challenges associated with the system's technical needs (e.g., reliability, stability, balance, etc.), but also different possible decommissioning activities and future land uses. More active participation of local communities outside Los Angeles that are part of DWP's power system is also needed for a genuine JT that avoids hiding the extra-local impacts of the city's energy-intensive consumption.

Addressing discrepancies in information and key definitions. It is necessary to reach a minimum level of social consensus around key aspects of decarbonization plans in order to generate broader acceptance. In order to do so, it is necessary to work to avoid vagueness in the use of key concepts, such as decarbonization, clean energies, zero-carbon, and renewable energies. This involves explicitly addressing—while not necessarily resolving—discrepancies in interpretations around the technical feasibility, jobs impacts, and economic costs of the city's decarbonization plans. More accessible language needs to be developed to communicate the technical and economic aspects of the transition to the broader public and to engage non-energy experts in the discussion. Emphasizing the city's and DWP's achievements and successes with regard to decarbonization is important to show the effectiveness of previous policies. Additionally, more explicit consideration of the environmental limitations of specific plans and initiatives, especially in relation to national and international standards, can improve transparency, accountability, and social acceptance.

Creating permanent and diverse stakeholder forums. The creation of more permanent public forums with the participation of different stakeholders, including consultants

and scholars from local universities, can help to promote social acceptance. Using the governance structure of the Renewable Energy Advisory Group could be a good starting point in this regard. Including more diffusion activities and the development of multi-stakeholder and consensus-based studies around controversial topics is also important. Given that the LA100 study includes public outreach and workshops, it is important to organize these activities in a way that ensures information is not unilaterally communicated, that issues that create controversy are explicitly addressed, technical topics are translated into more accessible and engaging vocabulary, and an open and safe space for dialogue and dissent is created.

Concrete planning and strengthening coalitions for a planned transition for workers. Despite the fact that the LAGND emphasizes the creation of green jobs, the lack of direct initiatives to support workers who risk losing their jobs is an important gap in this plan, which has only been partially addressed by recent initiatives that have emerged after the release of the plan. Given that workers whose employment is entwined with fossil fuel energy production are one of the main groups opposing the decarbonization policies of the city, a more structured transition process for them would likely improve acceptance and create new opportunities for productive coalitions. Local decarbonization policies need to incorporate some of the multiple policy alternatives that national and international cases suggest to address this issue, such as relocation programs, compensation payments, and early retirement schemes, or explore new alternatives suitable to local conditions. Strengthening support for existing coalitions of workers, environmental organizations, the city government, DWP, and industrial actors (e.g., LAANE, RepowerLA, and the new LA County Just Transitions task force) is also an important for advancing towards a more just and timely transition.

Building the path for a just transition for the near-term and longer-range future cannot take place without addressing the social impacts created by current and past systems of energy production and consumption. This requires prioritizing communities whose health and wellbeing have been historically affected.

Compensating historically affected communities. Building the path for a JT for the near-term and longer-range future cannot take place without addressing the social impacts created by current and past systems of energy production and consumption. This requires prioritizing communities whose health and wellbeing have been historically affected by the local production, storage, and distribution of fossil fuel energies. This can be done by, for example, providing environmental remediation first in prioritized communities as well as targeting these areas for clean job

opportunities. Other forms of direct compensation need to be considered in dialogue with affected residents, as well as retroactive compensation schemes for historically affected communities within and outside Los Angeles.

Including extra-local communities in environmental justice assessments. Given the central role that communities living outside Los Angeles have historically played in the production of electricity consumed in the city, it is a major oversight of current studies and policies (including this one) that they lack close consideration and engagement with how the energy transition is impacting and will impact these communities. This does not only involve an explicit assessment of the effects that decarbonizing the Los Angeles grid is playing in communities in places like Arizona and Utah, but also new local communities being incorporated into the DWP's power system through the development of low-carbon energy technologies, and others involved in the natural gas and oil commodity chains.

Creating quantitative and qualitative analyses to inform distributive justice. The LA100 study recognizes the importance of future studies for creating new data to understanding household energy uses (e.g., differences in household size, appliance age, mobility options, access to smart energy devices, etc.) in order to better inform the design of programs that prioritize communities that suffer from environmental injustices (Hettinger et al. 2021:4). Equally important is the need to incorporate more qualitative analysis of energy uses, experiences, and beliefs. Several studies from the social sciences have shown the importance of qualitative methodologies such as interviews, focus groups, ethnography, and participatory mapping to inform policymaking in energy transitions (Broto et al. 2018; Groves et al. 2017; Rinkinen et al. 2021; Rinkinen et al. 2019). Future studies on the distributive justice elements of decarbonizing Los Angeles should use insights from these perspectives in dialogue with quantitative analysis and modeling.

Striking a balance between technological innovation and reliability. Local policymakers have emphasized the leadership role that Los Angeles has played in incorporating innovative decarbonization technologies. Emphasizing this leadership is important to demonstrate the broader positive environmental impacts that Los Angeles can have by influencing other cities to follow similar policies. However, given local concerns around the feasibility of using newer technologies like hydrogen, emphasizing other more mundane experiences and successes will be equally important to improving social acceptance to the decarbonization process.

Taking the decommissioning fossil fuel infrastructure seriously. Most of the reports and other research on the city's renewable energy and decarbonization targets has focused on assessing what new investments are needed to achieve these goals. However, the costs and other environmental and social impacts associated with the decommissioning of operating and idle fossil fuel infrastructure in Los Angeles need more empirical examination. This will contribute to filling current gaps in knowledge around decommissioning activities, which is fundamental to better assessing the economic and environmental challenges and opportunities associated with these processes.

Creating value around decommissioning and cleanup activities. Despite the fact that decommissioning is likely to be a huge facet of future decarbonization efforts in Los Angeles and beyond, these processes have not been a focus for green jobs planning. Promoting the creation of economic activities and expertise around these processes is an important step to accelerate a Just Transistion.

Gaining knowledge from other cases. Despite the fact that there is a shortage of comprehensive studies on the social, economic, and ecological impacts of phasing out gas-fired power stations, the amount of natural gas infrastructure that has been decommissioned in recent years or is in the process of being decommissioned in the United States—particularly in California—is growing. Case studies of decommissioning projects will be helpful to better understand best practices and risks that DWP and other utilities and power producers should consider and mitigate. Expanding local knowledge and awareness of these topics is an important step to improve the capacity of local actors to demand stronger accountability around decommissioning and participate in the decision-making around these processes.

Creating knowledge for other cases. The experience of decarbonizing Los Angeles can serve as an important case study for other cities in the United States and internationally. DWP and the City of Los Angeles' government should work to gather and systematize information about this experience to share with policymakers and environmental organizations who are considering undertaking similar processes. Documenting the results of the experience will be a vital way that Los Angeles can contribute to promoting just transitions elsewhere. Additionally, the public nature of DWP, as a municipally-owned utility, presents an opportunity for sharing technical and accounting data that could be used to improve public understanding of phase out and decommissioning processes. As a key member of the C40 network, Los Angeles should be documenting its knowledge and sharing whatever information it is able to be transparent about, in order to help other cities to transition in socially and environmentally just ways.

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