LA100 EQUITY STRATEGIES

Chapter 16. Green Jobs Workforce Development

FINAL REPORT: LA100 Equity Strategies

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LA DWP UCLA

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Introduction

This report focuses on creating an equitable workforce development strategy that should accompany a "Justice Transition" to 100% renewable energy generation by the City of Los Angeles Department of Water and Power (LADWP) in the context of the new emerging green jobs economy for L.A. City and L.A. County. The report has two major parts. The first presents a LA100 Public Access Data Analysis Platform and Calculator that allows for multiple community stakeholders (including ratepayers) to engage in environmental and energy justice planning. The second part presents a Community Case Study of Wilmington and a Community Engagement Approach to identify multiple pathways to community engagement and planning for energy, ecological, and environmental Justice Transitions with a primary focus on jobs and workforce development connected to LADWP investments, policies, and existing programs.

For our case study deliverable, we conducted research in Wilmington, California, located in the City of Los Angeles, City Council District 15. The City of Los Angeles and LADWP are planning to rapidly transition to renewable energy with zero emissions and carbon neutrality. According to the C40 agreements established in the Paris Agreement, which was signed by the United Nations in December 2015, Los Angeles and 93 other densely populated cities pledged to take actions to combat climate change by creating sustainable, low-carbon cities. The C40 cities aim to raise climate ambition, influence the global agenda, build a movement, and scale up climate action. Los Angeles has an urgent need to allocate funds effectively while transitioning to a just, sustainable, and equitable distribution for green jobs, to build environmentally friendly green infrastructure, and to move towards 100% renewable energy investment with zero emissions.

President Biden's Justice40 Initiative, established in 2022 via Executive Order 14008, allocates 40% of the environmental infrastructure and of the Inflation Reduction Act, Bipartisan Infrastructure Law, and American Rescue Plan budgets specifically to low-income, pollution-burdened, and disadvantaged frontline communities.[1] The Initiative's goals are to reverse disinvestment in marginalized communities, reverse pollution trends, develop affordable sustainable housing and better public transit, and create clean water infrastructure. Wilmington qualifies as a disadvantaged community based on several criteria, including high levels of air pollution, low levels of green space, proximity to hazardous waste and industrial facilities, low income, high housing costs, high levels of poverty, and low educational attainment. As a result, Wilmington is eligible to receive Justice40 funds, which could be used to address all of these issues.

In addition to international and federal goals, in 2019 Mayor Garcetti set ambitious targets for the City of Los Angeles under the Los Angeles City Green New Deal (GND). These targets include supplying 100% renewable energy and reducing energy consumption, sourcing

[1] "Justice40: A Whole-of-Government Initiative," The White House, https://www.whitehouse.gov/environmentaljustice/justice40/; see also "Biden-Harris Administration Launches Version 1.0 of Climate and Economic Justice Screening Tool, Key Step in Implementing President Biden's Justice40 Initiative," The White House (November 22, 2022), https://www.whitehouse.gov/ceq/news-updates/2022/11/22/biden-harris-administration-launches-version-1-0-of-climate-and-economic-justice-screening-tool-key-step-in-implementing-president-bidens-justice40-initiative/

most of the City's water locally and capturing more stormwater, reducing the amount of driving and using only zero-emission vehicles, building more housing next to transit, creating hundreds of thousands of green jobs, and achieving overall carbon neutrality by 2045.

We chose to focus on the community of Wilmington for this case study because it is located near five oil refineries, making it a disadvantaged, pollution-burdened, fence line community. Wilmington is surrounded by the Port of Los Angeles and is a predominantly Latinx community that is underrepresented, low-income, and heavily burdened by various sources of pollution, particularly from energy use and transportation. Environmental justice advocates and activists view Wilmington as ground zero for environmental racism due to the high levels of pollution in the community.

Measuring and Creating New Green Jobs: Race, Equity and Community Engagement

LA100 Public Access Data Analysis Platform and Calculator

The LA100 Public Access Data Analysis Platform and Calculator was created to allow stakeholders to explore multiple policy questions, with respect to historical employment equity of LADWP and green jobs as well as to potential future scenarios for greater employment equity for LADWP and green jobs in Los Angeles. The Data Analysis Platform and Calculator is based on input-output analysis and SAM (Social Accounting Matrix) methodology applied to data for the City of Los Angeles and LADWP and is presented in a public access GIS (Geographic Information System) web platform. This report provides summary information for Los Angeles County and the City of Los Angeles using the SAM data analysis platform to estimate direct, indirect, and induced[2] green jobs and equity over the period from 2011 to 2019 and to project potential future scenarios to 2025 for greater employment equity for LADWP and green jobs in Los Angeles (see Methodological Appendix).

Part One of this chapter has six sections, with the first three addressing questions on the history of green job growth and equity in Los Angeles between 2011 and 2019, including findings on the multiplier-like impact of green job creation on non-green jobs by race, gender, and geography. The following three sections focus on questions concerning the potential future scenarios to 2035 for greater employment equity for LADWP and green jobs in Los Angeles based on LA100 projections.

Below, we summarize some of the guiding questions in our work and their preliminary findings:

(1) What has been the historical growth of green and non-green jobs in Los Angeles City and County between 2011 and 2019, as well as the direct as well as indirect employment impact of green job creation on green and non-green jobs?

- Our findings show that total green jobs have been growing more rapidly compared to total non-green jobs in L.A. City between 2011 and 2019. Green jobs grew 8.2%, while non-green jobs grew 4.6%. While direct green jobs are growing at a rapid pace, non-green jobs are also growing due to green job linkages with other sectors that are not considered green, creating a multiplier growth in non-green jobs.

(2) What is the equity composition of employment by race and gender (Latinx, African American, White, Asian, and other workers) for all green jobs by ZIP Codes and Disadvantaged Communities (DACs)?

- Latinx people represent nearly 48% of the workers holding green jobs, while Whites hold 32% of the green job's positions in the City of L.A. The most underrepresented race in

[2] Direct jobs are those required for the operation and maintenance of a project as a result of an investment in a company or enterprise; indirect jobs are those jobs created on the upstream and downstream supply chain of the project as a result of the investment. Induced jobs are those jobs that are generated as a result of the project's workers' disposable income increase due to the operation of the project.

green jobs are American Indian or Alaska Native people, with 0.1% of total green jobs.

(3) What is the race and gender of LADWP workers by industry and occupation, inside and out of the L.A. Basin, by work location and residency as well as by ZIP Codes and DACs?

- Most DWP workers, who are relatively well paid, do not live in DACs. However, Latinx and African American workers make up the largest share of DWP employees living in DACs, and they earn the lowest wages of DWP workers living in both DACs and non-DACs. Latinx and African American workers are more concentrated in lower wage occupations and activities, yet they earn comparable wages in both higher- and lower-paid occupations.

(4) What are the likely future scenarios for green jobs in L.A. City and County (direct, indirect, and induced), taking into account future changing ethnic demographic projections to identify gaps needed to be filled in order to achieve future equitable green employment?

- Total green jobs in L.A. County are expected to grow 20% from 2019 to 2035, while non-green jobs are expected to grow 30%. The gap analysis shows that Latinx green jobs workers will have to grow faster to keep up with higher demographic growth.

(5) What are the potential future employment scenarios for LADWP by industry and occupation based on LA100 modeling of alternative technology investment options, including employment gap projections by race and gender categories and by geography?

- Future LADWP employment scenarios indicate important growth in large LADWP industry sub-sectors and occupations, which will require more rapid recruitment and targeted training of Latinx and African American workers.

(6) Based on estimating green jobs and LADWP scenarios for workforce development training needs by industry and occupations, what are the best future equitable employment transition strategies that could be implemented?

- LADWP will need to manageably invest in and implement new Green Jobs Workforce Development pilot projects designed to expand training in particular projected occupations and to specifically recruit workers from growing race and gender groups in DACs.

Wilmington Case Study and Community Engagement

In Part Two of this chapter, we present the findings of our case study in Wilmington, CA, which gathered direct input from typically excluded community members to complement findings from our Public Access Data Platform. This case study involved monthly meetings over a period of six months, with two main goals in mind: (1) educating about green jobs and DWP, and (2) understanding the obstacles in accessing such jobs. The feedback we received is invaluable in informing the development of an effective green jobs workforce development plan that addresses the specific needs and challenges faced by the community.

Wilmington, CA is known as ground zero for pollution exposure, both locally and nationally. Our Wilmington Case Study approach was based on leading DACs indicators that revealed the environmental racism inflicted on a population approximately 90% Latinx, subjected to high

levels of emissions from the oil industry and the Port of Los Angeles. In our community engagement meetings, we developed a survey to measure the before and after levels of knowledge on environmental racism, green jobs, workforce development, and LADWP.

Recommendations and Next Steps

This report shows that the City of Los Angeles can achieve a just transition to clean energy and a green jobs future, requiring DWP Green Jobs Workforce community engagements for closing the inequality gaps in gender and race with respect to employment. Expanding and maintaining stakeholder access to a Green Jobs Calculator like the one we've developed can help direct investments in green jobs workforce development centers in communities that are usually marginalized, such as Wilmington.

A future just transition for LADWP and green jobs will require a skilled and prepared workforce, and a higher paying workforce development pipeline that can cost-effectively be directed to DACs to create a fair distribution of jobs in the new green economy. Our Wilmington Case Study and Community Engagement approach shows that the community is ready to participate in developing the new training pipeline for green jobs and workforce development pilot projects. More such projects can be created by accessing Justice 40 environmental justice funds through G2G financing that require community-based organization (CBO) partnerships to invest in more DACs/Green Jobs LADWP Workforce Development partnerships.

1. Green Jobs Historical Trends in Los Angeles City and Los Angeles County

We begin with the historical growth of green and non-green jobs in Los Angeles City and County between 2011 and 2019, as well as the direct and indirect employment impacts of green job creation on green and non-green jobs.

1.1 Green Job Growth Outpaces L.A. Non-Green Job Growth

Figure 1 shows that total green jobs have been growing more rapidly compared to total non-green jobs in L.A. City since 2011. Green jobs have grown 8.2% on average from 2011 to 2019 (with 2011 as the base year), and total non-green jobs grew 4.6% on average. On the other hand, in L.A. County, green jobs grew 6.7% on average over 2011 to 2019, while total non-green jobs grew 8.9% on average.

Table 1 shows that green jobs represent only 5.4% of total jobs in L.A. County, and 3% in L.A. City. However, green jobs in the sectors prioritized by the L.A. City (core green jobs) are growing faster than green jobs and total non-green jobs. While L.A. City green jobs grew 1.8% and non-green jobs grew 1.1% yearly on average from 2011 to 2019, core green jobs grew 2.8% over the same period. In L.A. County, green jobs and total non-green jobs grew 1.4% and 1.9% respectively, while green core jobs grew 2.1%.

Figure 1: L.A. City and L.A. County, Green and Total Non-Green Jobs Growth Index, 2011 = 100

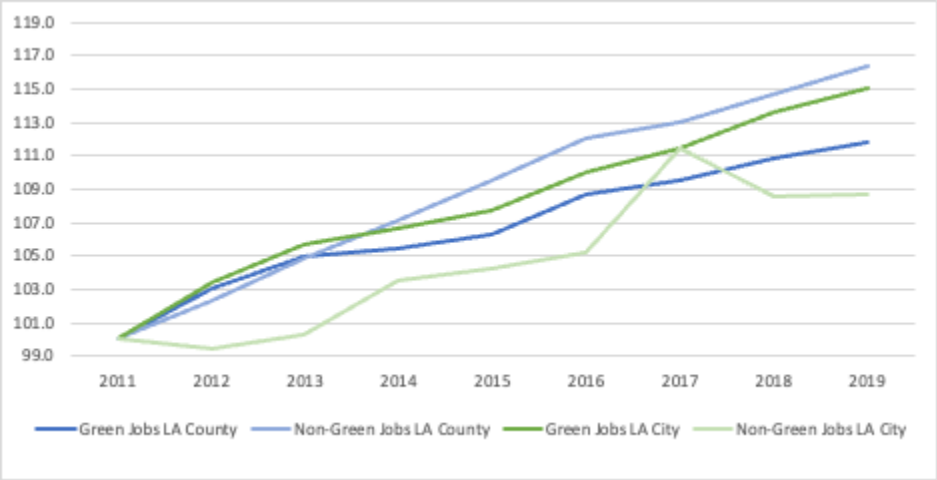


Table 1: L.A. City and L.A. County, Green, Core Green, and Total Non-Green Jobs[3]

Year	L.A. County			L.A. City		
	Non-Green Jobs	Green Jobs	Core Green Jobs	Non-Green Jobs	Green Jobs	Core Green Jobs
2011	3,879,577	215,655	20,465	1,925,598	57,921	6,106
2012	3,973,354	222,213	21,000	1,914,574	59,875	6,327
2013	4,069,979	226,380	21,508	1,931,101	61,186	6,578
2014	4,151,260	227,336	21,674	1,992,821	61,776	6,615
2015	4,241,293	229,306	22,047	2,007,560	62,413	6,773
2016	4,340,821	234,501	21,866	2,025,396	63,706	6,646
2017	4,378,516	236,259	22,149	2,147,074	64,522	6,936
2018	4,442,390	238,965	23,347	2,091,550	65,775	7,236
2019	4,506,450	241,081	24,198	2,092,621	66,635	7,574

1.2 L.A. Core Green Jobs Growing Fastest

Core green jobs are defined as those jobs in sectors directly related to 100% renewable energy transition, such as: electricity transmission, utility scale renewables, batteries, and wind; distributed energy resources, solar installers, battery manufacturing (power or transportation); buildings design, construction, electrification, energy efficiency, water efficiency, on-site renewable energy installation, energy management; fossil fuel decommissioning, zero emission vehicle charger installation and maintenance, rail and transit, environmental consulting, and environmental non-profits. Figure 2 shows that core green jobs have become an important growth driver for green jobs both in L.A. City and L.A. County, especially since 2016, when in

[3] Total Jobs in L.A. City is data from American Community Survey; Total Jobs in L.A. County is data from the Quarterly Census of Employment and Wages, BLS.

both the City and County Core, green jobs started to grow at a more rapid pace, substantially overpassing growth rates of both green and non-green jobs.

Figure 2: L.A. City and L.A. County Core Green, Green and Total Non-Green Jobs Growth Index, 2011 = 100

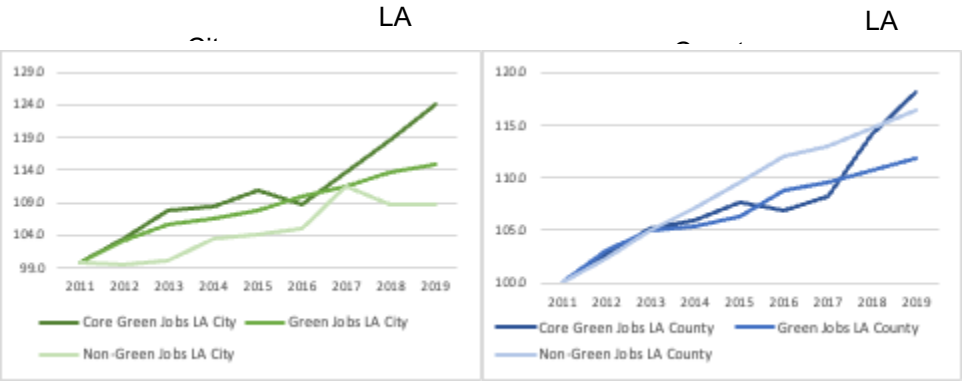
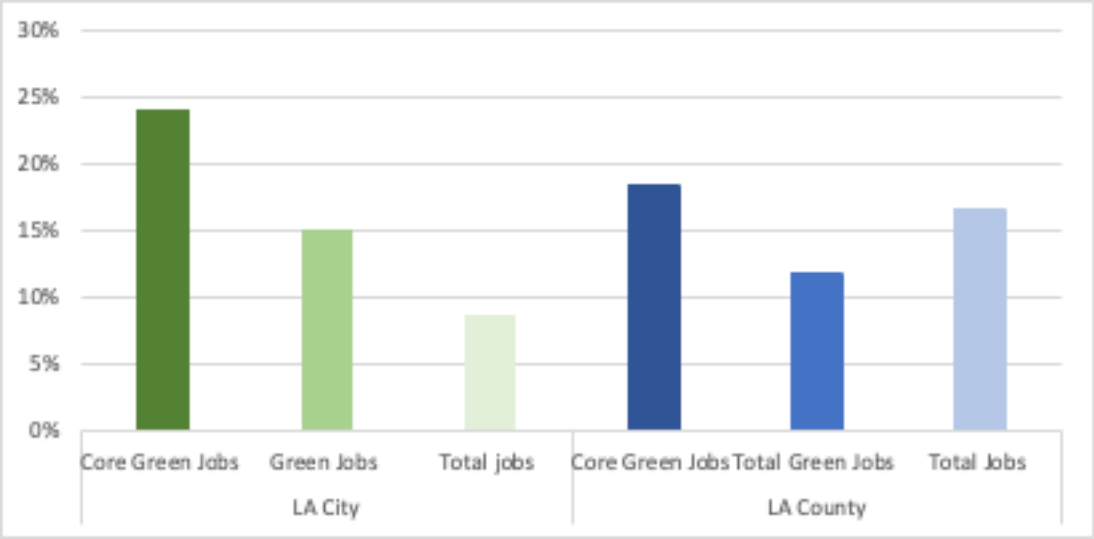


Figure 3 shows that there is a transition between jobs in green and non-green sectors in both L.A. County and L.A. City, especially among those sectors prioritized by L.A. City and considered to be core green jobs. The inter-annual growth rate in core green jobs between 2011 and 2019 was 24% for L.A. City and 18% for L.A. County, which is higher than the inter-annual growth rates for green and non-green jobs over the same period in both regions.

Figure 3: Transitioning Jobs by Green and Non-Green Sectors. Inter-annual Growth Over 2011 – 2019

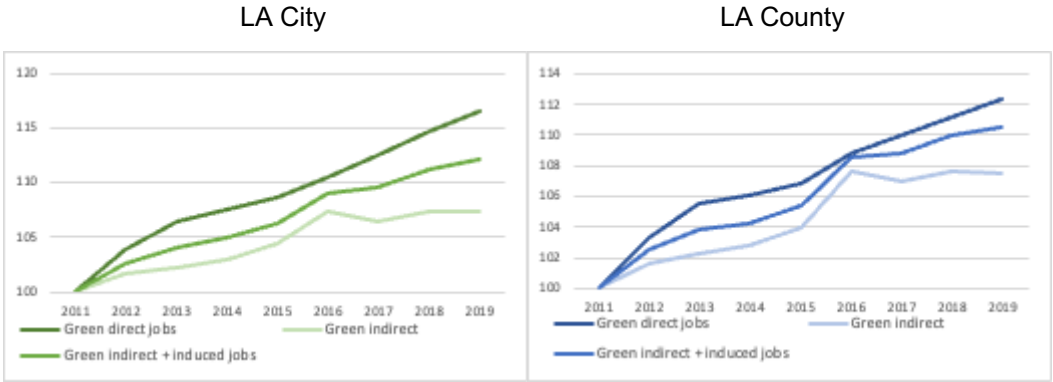


1.3 Direct Green Jobs Create Indirect and Induced Green and Non-Green Jobs

We begin by defining direct, indirect, and induced jobs, as well as upstream and downstream jobs (see Methodological Appendix for detailed explanation). As defined in footnote 2, direct jobs are those generated as a result of an investment in a company, indirect jobs are those created along the project's supply chain as a result of the investment, while induced jobs are those generated as a result of workers' disposable income changes due the project. In supply chains, upstream jobs are created by the suppliers to fulfill the demand needs of the project, while downstream jobs are those external jobs needed to deliver goods and services generated by the project and demanded by other projects or final customers.

While direct green jobs are growing at a rapid pace, non-green jobs are also growing due to green job linkages with other sectors that are not considered green, creating a multiplier growth in non-green jobs. The gap between the growth rates in direct jobs and indirect jobs (via inter-industries linkages) is relatively high (see Figure 4). The gap in growth rates is lower between direct and indirect + induced jobs (inter-industries and final consumption linkages). This means that the growth in direct green jobs generates a higher final consumption linkage due to increases in workers' disposable income that result in the creation of non-green induced jobs.

Figure 4: L.A. City and L.A. County, Green Direct, Indirect + Induced Green and Non-Green Jobs Growth Index, 2011 = 100



1.4 Direct Green Jobs Create Indirect and Induced Green-Only Jobs

We can also measure the creation of green-only jobs as a result of the economic linkages between industries (indirect effects), and expenditure patterns due to the increase in disposable income (induced effects). As shown in Figure 5, compared to Figure 4, the gap between green direct jobs and green indirect + induced jobs growth rates is lower when green only jobs are considered, which means that green direct jobs drive higher green indirect + induced jobs than non-green indirect + induced jobs.

Figure 5: L.A. City and L.A. County, Green Direct, Indirect + Induced Green Jobs (Green Only) Growth Index, 2011 = 100

1.5 Equity Composition of Green Job Employment by Race and Geography

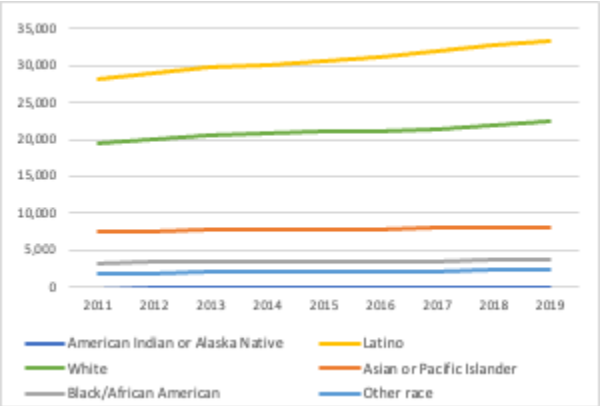
We now turn to the equity composition of employment by race and gender (Latinx, African American, White, Asian, and other workers) for all green jobs by ZIP Codes and Disadvantaged Communities (DACs).

1.5.1 Latinx people are the largest green job holders.

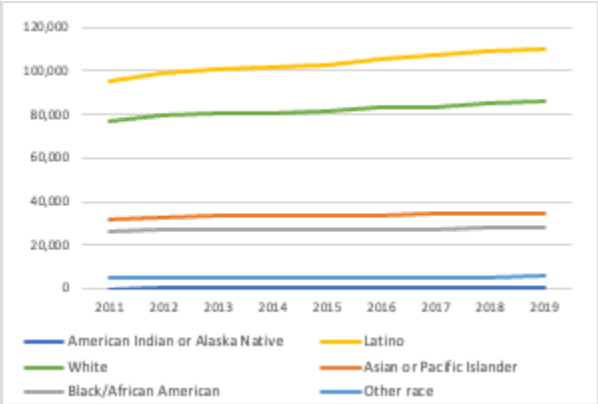
Figure 6 shows that Hispanics represent nearly 48% of the workers holding green jobs, while Whites hold 32% of the green jobs positions in L.A. City. The most underrepresented race in green jobs is American Indian or Alaska Native, with 0.1% of total green jobs in L.A. City. In L.A. County, Latinx people represent 41% of green jobs workers, while Whites are 33%. Also, American Indian or Alaska Native are the most underrepresented, accounting for 0.3% of the total green jobs in L.A. County.

Figure 6: L.A. City and L.A. County, Green Jobs by Race

LA City



LA County



1.5.2 Latinos are the largest growing, but others are growing faster.

Figure 7 shows that in L.A. City, the race group that is growing most rapidly is "Other race," followed by Latinx people, and third African American. On the other hand, in L.A. County the labor category that is growing most rapidly is Latinx, followed by "Other race" and Whites. Contrary to L.A. City, in L.A. County African American employment is the least rapid in growth.

Figure 7: L.A. City and L.A. County, Green Jobs Growth Index by Race, 2011 = 100

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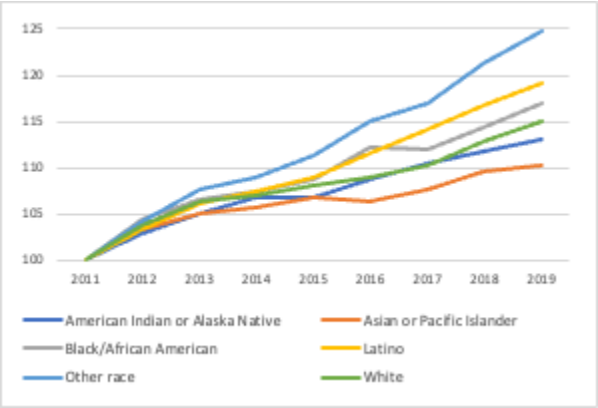

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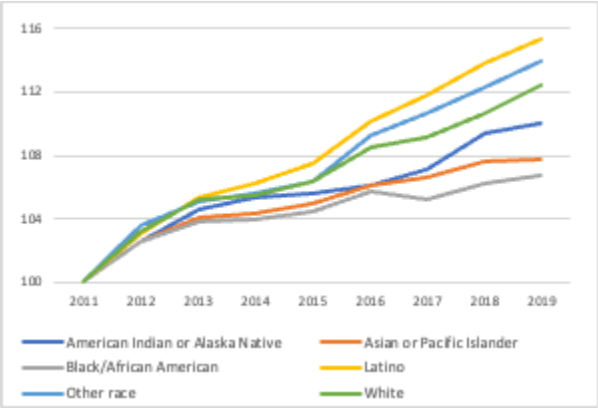


1.5.3 The growth of Latinx green jobs is very beneficial to White and African American green and non-green workers.

Figure 8A and Table 2A show that, though Latinx workers are the largest group with direct green jobs, the indirect + induced green jobs effects over other races is higher than their own direct jobs effects. In this sense, indirect + induced green jobs were 1.26 times higher than direct green jobs for Latinx people, while the indirect + induced green jobs were 1.67 times higher than the direct green jobs for African Americans, 1.58 times higher for Asian or Pacific Islander, and 1.3times higher for Whites. All of these groups benefit from the indirect and induced linkages of Latinx workers' direct green jobs.

On the other hand, as shown in Figure 8B. and Table 2B, African American workers in L.A. County benefit the least due to indirect + induced linkages; the rate of indirect + induced over direct jobs for this group of workers is 1.22. For Latinx workers, it is 1.23, for Whites 1.36, and for Asian or Pacific Islander 1.43, which means that the latter groups benefit the most from the indirect and induced linkages.

Figure 8: L.A. City and L.A. County, Green Direct, Indirect and Induced Green Jobs by Race, Number of Jobs

A. LA City

B. LA County

Table 2. L.A. City and L.A. County, Direct, Indirect, and Indirect + Induced Green Jobs by Race Category

A. LA City

Year	Direct						Indirect						Indirect + Induced					
	American Indian or Alaska Native	Asian or Pacific Islander	Black/African American	Hispanic	Other race	White	American Indian or Alaska Native	Asian or Pacific Islander	Black/African American	Hispanic	Other race	White	American Indian or Alaska Native	Asian or Pacific Islander	Black/African American	Hispanic	Other race	White
2011	33	2,865	1,191	12,355	991	8,263	4	893	397	2,043	171	2,120	46	4,569	2,024	15,701	887	11,181
2012	34	2,980	1,255	12,782	1,035	8,624	4	905	404	2,067	174	2,136	47	4,702	2,104	16,187	921	11,534
2013	34	3,045	1,285	13,159	1,081	8,898	4	908	406	2,076	176	2,144	48	4,772	2,138	16,591	943	11,763
2014	35	3,060	1,296	13,330	1,098	8,974	4	913	410	2,088	177	2,154	49	4,803	2,160	16,801	950	11,843
2015	34	3,074	1,303	13,521	1,129	9,063	4	932	420	2,105	181	2,184	49	4,863	2,191	17,028	961	11,936
2016	35	3,023	1,333	13,817	1,156	9,074	4	955	448	2,161	196	2,262	51	4,880	2,274	17,456	1,004	12,103
2017	35	3,089	1,352	14,169	1,192	9,295	4	943	424	2,193	187	2,204	52	4,915	2,252	17,853	1,005	12,158
2018	35	3,152	1,387	14,490	1,242	9,559	4	955	427	2,221	190	2,223	53	4,998	2,290	18,276	1,035	12,388
2019	36	3,190	1,420	14,811	1,282	9,787	4	950	436	2,245	194	2,250	53	5,009	2,339	18,588	1,063	12,595
2020	34	3,021	1,331	13,999	1,241	9,331	4	896	395	2,142	180	2,114	51	4,722	2,163	17,568	1,006	11,879

B. LA County

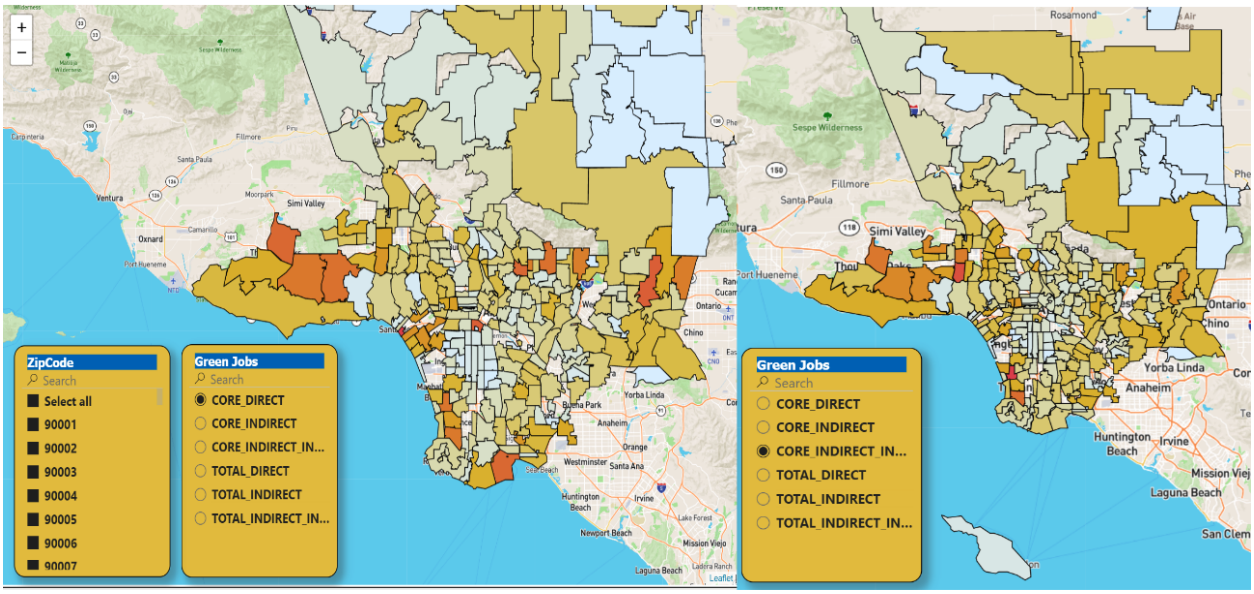
Year	Direct						Indirect						Indirect + Induced					
	American Indian or Alaska Native	Asian or Pacific Islander	Black/African American	Hispanic	Other race	White	American Indian or Alaska Native	Asian or Pacific Islander	Black/African American	Hispanic	Other race	White	American Indian or Alaska Native	Asian or Pacific Islander	Black/African American	Hispanic	Other race	White
2011	312	13,073	11,759	42,852	2,042	31,859	30	3,321	1,405	6,697	458	7,996	358	18,875	14,262	52,941	2,809	44,969
2012	319	13,478	12,073	44,206	2,125	33,038	30	3,338	1,425	6,827	462	8,052	367	19,306	14,632	54,531	2,898	46,230
2013	326	13,717	12,224	45,310	2,165	33,827	30	3,335	1,430	6,878	462	8,090	375	19,526	14,805	55,649	2,932	47,025
2014	328	13,759	12,220	45,703	2,175	33,909	31	3,347	1,438	6,911	464	8,100	377	19,591	14,818	56,069	2,946	47,114
2015	330	13,816	12,272	46,316	2,189	34,144	31	3,388	1,463	6,995	469	8,225	378	19,730	14,924	56,731	2,970	47,547
2016	331	13,846	12,363	47,357	2,226	34,535	31	3,506	1,534	7,248	496	8,636	381	20,049	15,159	58,204	3,073	48,835
2017	333	13,961	12,300	48,056	2,270	35,003	32	3,469	1,509	7,315	491	8,417	385	20,085	15,090	59,007	3,101	48,809
2018	341	14,122	12,429	49,042	2,308	35,581	33	3,488	1,533	7,411	495	8,463	393	20,255	15,226	60,064	3,140	49,402
2019	343	14,202	12,467	49,810	2,348	36,265	32	3,452	1,551	7,420	498	8,553	394	20,211	15,305	60,661	3,177	50,086
2020	321	13,496	11,747	47,220	2,253	34,720	30	3,256	1,460	7,001	474	8,065	368	19,071	14,379	57,212	3,029	47,526

1.5.4 Geographic green jobs tracking.

We have developed a Geographic Information System (GIS) platform that allows us to identify the ZIP Codes where green jobs workers are concentrated, both by place of residence and work, and to identify whether these ZIP Codes have a high or low concentration of Disadvantaged Communities (DACs).

Our GIS platform is a valuable online portal that gives information for future public policy, since it is capable of identifying whether the green direct, indirect, and induced jobs that are being created are correlated to low- or high-income geographies, which can have big implications in terms of equity strategies for the future.

Figure 9: UCLA GIS Mapping: Green Jobs by Location of Work, Direct, Indirect + Induced



1.6 LADWP Current Employment Equity Composition

Using administrative data from LADWP, we have assessed the state-of-the-art equity composition for LADWP workers in the Power division, considering different categories such as gender, race, and place of residence. We focus on the race and gender of LADWP workers by industry and occupation, inside and out of the L.A. Basin, by work location and residency, as well as by ZIP Codes and DACs. Generally speaking, most DWP workers, who are relatively well paid, do not live in DACs. However, Latinx and African American workers make up the largest share of DWP employees living in DACs and earn the lowest wages of DWP workers living in both DACs and non-DACs. Latinx and African American workers are more concentrated in lower wage occupations and activities, yet they earn comparable wages in both higher and lower paid occupations.

1.6.1 Gender Composition

The most concerning finding with respect to gender composition is that in the Power division of LADWP, there is an underrepresentation of women. According to the internal data, only 9% of the Power workforce are women, while 91% are men. Also, women are concentrated mostly in three broad occupation categories: Office and Administrative Support, Life, Physical, and Social Science, and Management (see Table 3).

Table 3: Gender Representation in LADWP Power Division by Total and Occupation

Occupations	Female	Male
Architecture and Engineering	14%	86%
Building and Grounds Cleaning and Maintenance	0%	100%
Construction and Extraction	3%	97%
Installation, Maintenance, and Repair	1%	99%

Life, Physical, and Social Science	42%	58%
Management	34%	66%
Office and Administrative Support	71%	29%
Production	4%	96%
Transportation and Material Moving	1%	99%
Total	9%	91%

When we analyzed the average age of women and men in LADWP's Power division by occupation, we found that there are no significant differences in the ages of men and women (Table 4), shedding light on another significant concern: wage gaps between men and women. On average, women earn 9% less than men, and this is not because of their underrepresentation in many of the occupational categories, but because of a systemic inequality, since they earn less in all occupational categories. Even in those occupation categories where there is a relatively high female representation, they still make much less than men; for example, in Office and Administrative Support, women earn 6% less than men, in Life, Physical, and Social Science women earn 9% less than men. By contrast, in Management, women earn 33% less than men on average (Table 5).

Table 4: Gender Composition Average Age by Occupational Category in LADWP Power Division

Occupation	Female	Male
Architecture and Engineering	37	39
Building and Grounds Cleaning and Maintenance		48
Construction and Extraction	42	48
Installation, Maintenance, and Repair	43	47
Life, Physical, and Social Science	44	46
Management	45	50
Office and Administrative Support	47	48
Production	43	45
Transportation and Material Moving	62	53
Total	43	46

Advancing gender equity for LADWP Power workers could be achieved via a review of the skill profile by worker regardless of gender, and to adjust their earnings based on skill parameters.

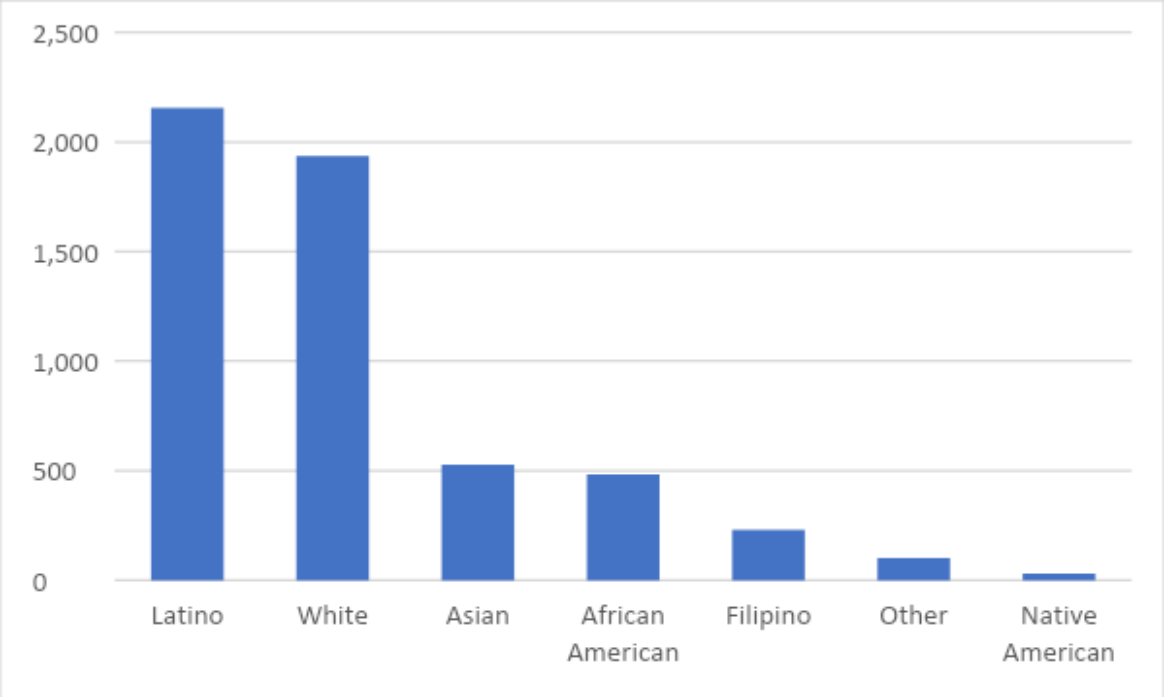
Table 5: Gender Composition Average Wage by Occupational Category in LADWP's Power Division

Occupations	Female	Male
Architecture and Engineering	121,378	129,711
Building and Grounds Cleaning and Maintenance		99,393
Construction and Extraction	93,753	100,630
Installation, Maintenance, and Repair	104,226	106,337
Life, Physical, and Social Science	118,463	130,168
Management	153,430	228,303
Office and Administrative Support	86,986	93,010
Production	87,614	121,731
Transportation and Material Moving	59,863	143,408
Total	106,365	116,875

1.6.2 Racial Composition

According to human resources data for the LADWP's Power division, the two most represented races among workers are Latinx (39%) and Whites (35%), followed by Asians (10%) (Figure 10).

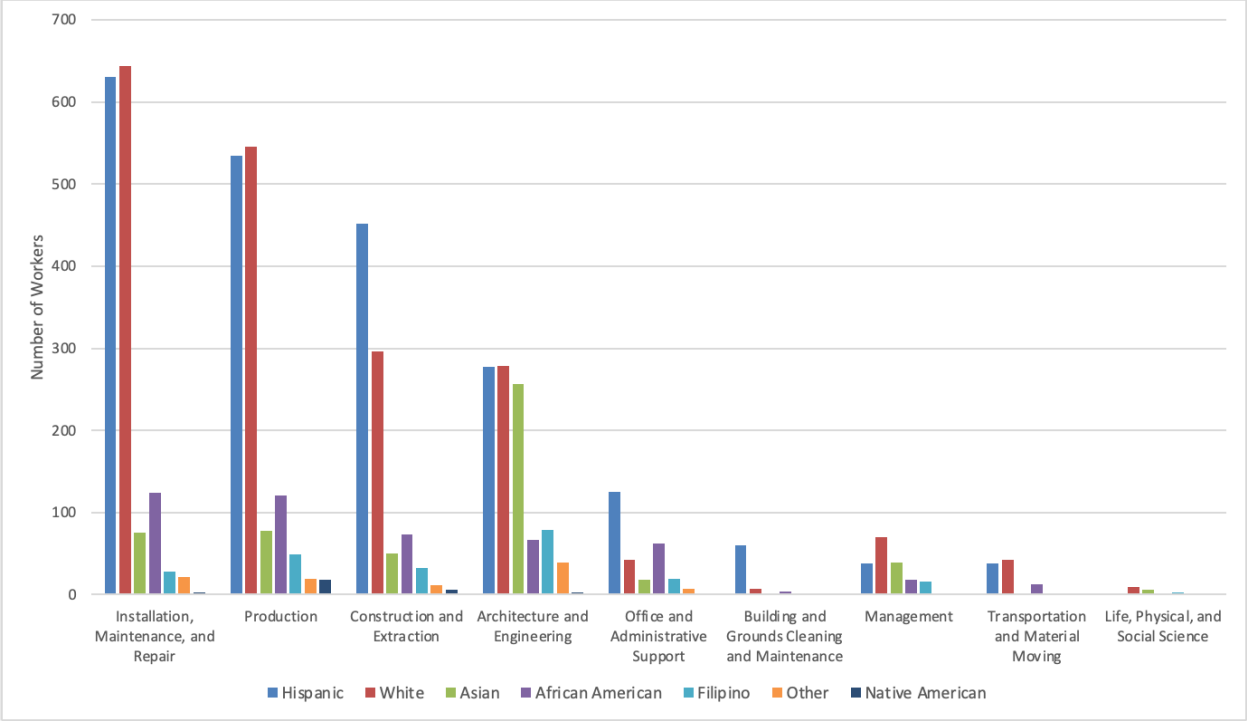
Figure 10: **Race Composition of LADWP's Power Division Workers (Number of Workers)**



However, there are significant gaps between workers by race when they are analyzed by occupational category. In this sense, in occupations like Installation, Maintenance, and Repair; Production; and Architecture and Engineering, the gap between Latinx workers and Whites is relatively tiny, while in Construction and Extraction occupations, the gap is relatively high in favor of Latinx workers. For Management occupations, the gap is relatively high in favor of Whites (Figure 11).

Latinx, White, and African American workers make up the largest share of employees in the LADWP Power division's construction occupations. White, Latinx, and African American workers are also concentrated in the Power Production sector, projected to be transitioned from in-basin carbon to non-carbon production.

Figure 11: LADWP Total Workers in Power Sector by Occupation and Ethnicity



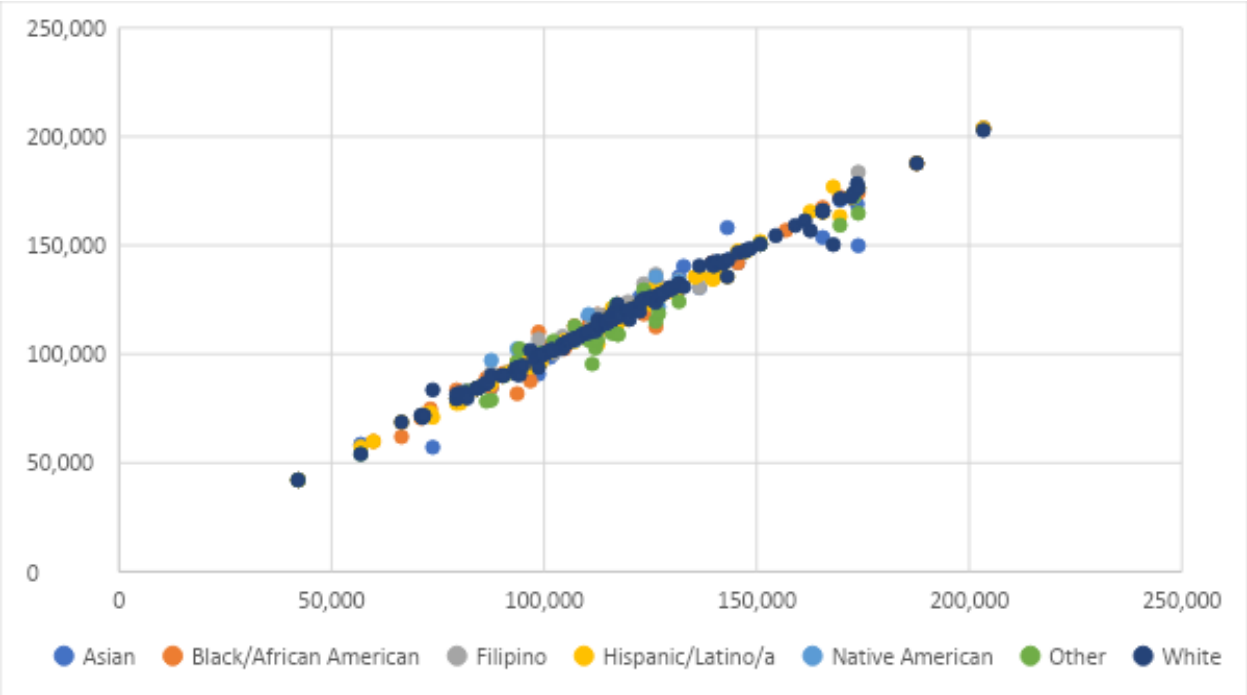
When we analyze average wages by race, it is possible to identify negative and positive gaps. In this sense, "Other races" earn 9% less than the average, African American earn 7% less, and Latinx earn 6% less. On the other hand, Native American earn 10% more than the average, Asians earn 9% more, and Whites earn 6% more (Table 6).

Table 6: Average Wage by Race

Race	Average wage
African American	108,127
Asian	126,184
Caucasian	122,431
Filipino	119,228
Hispanic	109,282
Native American	126,957
Other	105,198
Total	115,909

Although there is a gap in total average wages by race, it is important to note that when the analysis is controlled by occupation, the gaps tend to decrease, which means that the dispersion of wages from the mean wages by occupation and ethnicity tends to be low. This might seem positive in terms of current equity (see Figure 12). However, we should be cautious with this analysis and go deeper.

Figure 12: Dispersion from the Mean Wages by Occupation and Ethnicity



When we compare the total average wage by occupation with the average wage by occupation and ethnicity, we find intriguing results, such as that in those occupations where Latinx and African American workers are most represented (Installation, Maintenance, and Repair; Production; and Construction and Extraction), they make less than the total average, while

Whites and Asians tend to earn more than the total average in the same occupations (Table 7), a factor which sheds light on the results of the section below.

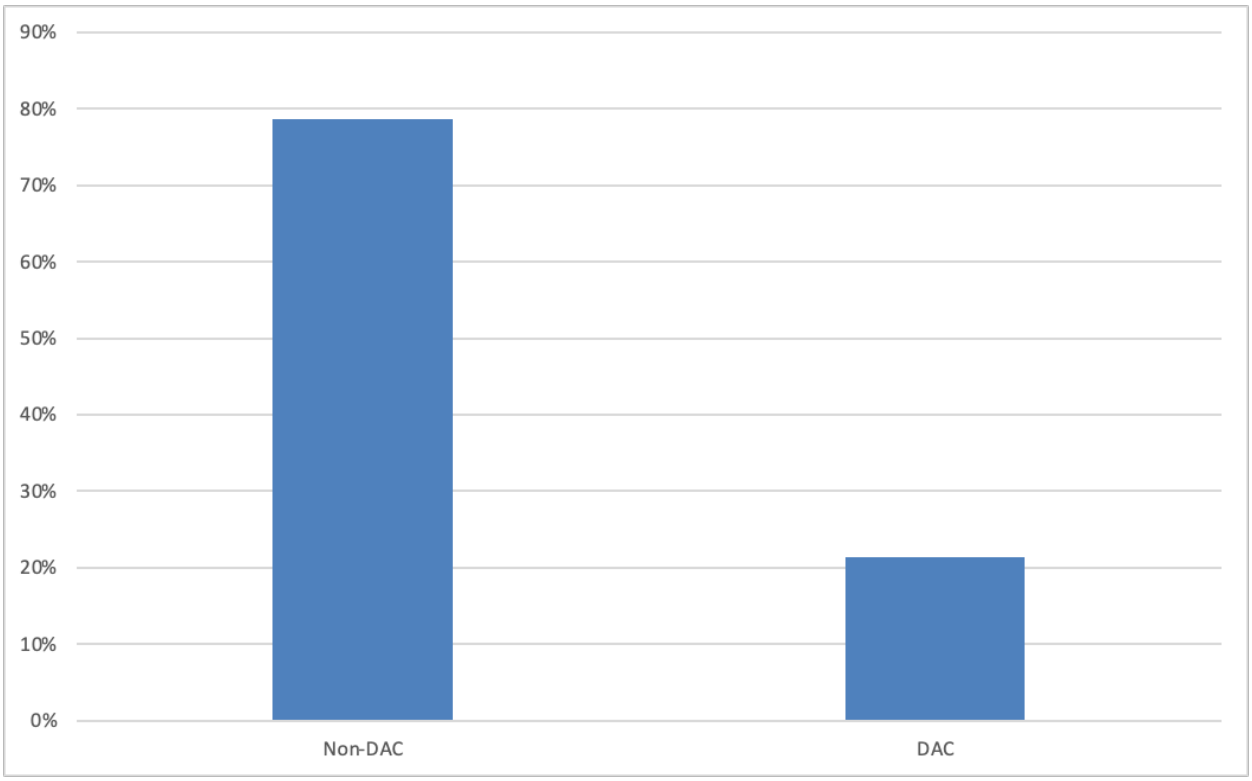
Table 7: Comparison of Total Average Wages by Occupation and Average Wages by Occupation and Ethnicity

	Total		Latinx		White		Asian		African American		Filipino		Native American		Other	
Occupation	# of workers	Wage	# of workers	Wage	# of workers	Wage	# of workers	Wage	# of workers	Wage	# of workers	Wage	# of workers	Wage	# of workers	Wage
Installation, Maintenance, and Repair	1,527	106,314	630	103,488	644	108,225	76	117,210	124	104,184	28	112,553	3	122,127	22	95,531
Production	1,365	120,481	535	115,417	545	130,141	78	122,348	121	99,915	49	118,563	18	128,396	19	106,744
Construction and Extraction	922	100,436	452	97,701	296	104,871	50	97,584	73	99,761	33	103,582	6	132,484	12	85,349
Architecture and Engineering	1,001	128,529	277	127,843	279	129,305	257	128,907	67	134,104	79	126,771	3	119,872	39	120,005
Office and Administrative Support	275	88,716	125	89,191	43	87,491	18	87,407	62	87,410	19	94,164	1	103,648	7	85,784
Building and Grounds Cleaning and Maintenance	72	99,393	60	98,777	7	101,587	0	0	4	104,609	1	100,078	0	0	0	0
Management	183	202,936	38	196,630	70	233,074	39	186,359	18	191,593	16	151,749	0	0	2	102,761
Transportation and Material Moving	98	142,555	38	116,761	43	171,365	2	156,099	13	118,547	1	221,495	0	0	1	89,993
Life, Physical, and Social Science	19	125,239	0	0	9	125,303	6	126,655	1	121,626	3	123,422	0	0	0	0

1.6.3 LADWP Power Division Workers' Place of Residence by DAC

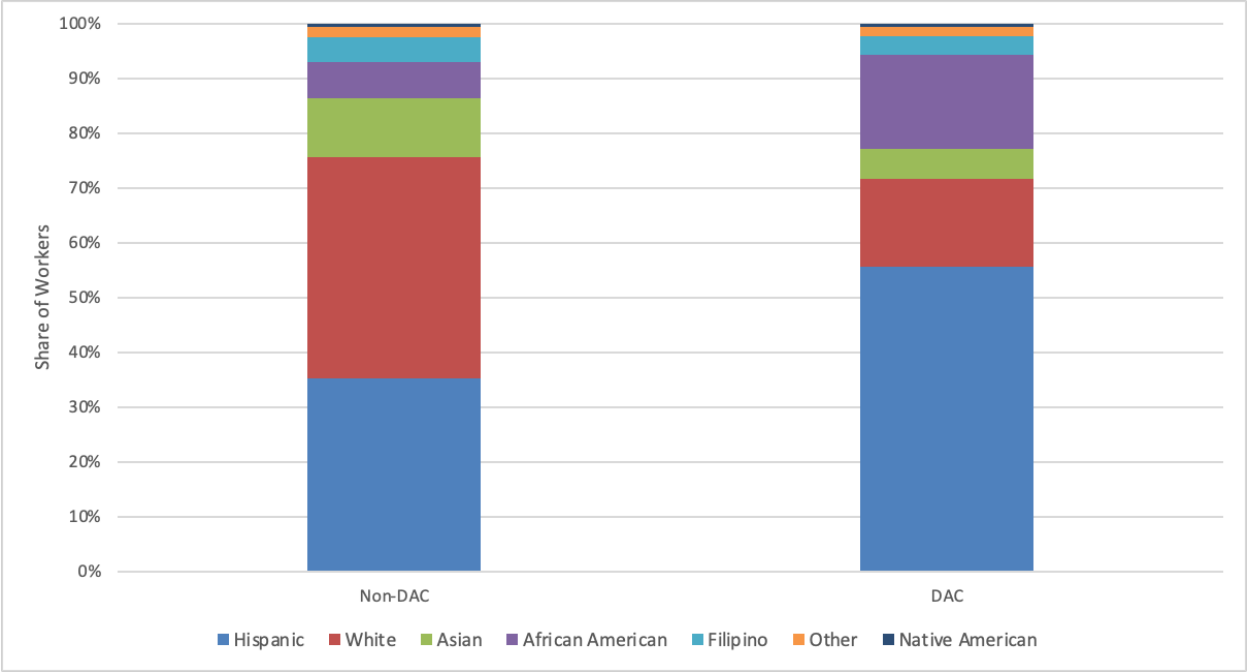
Most DWP workers do not live in DACs, which might be explained by the relatively high wages that they earn (Figure 13).

Figure 13: Share of LADWP Workers Living in ZIP Codes with High and Low DAC Density



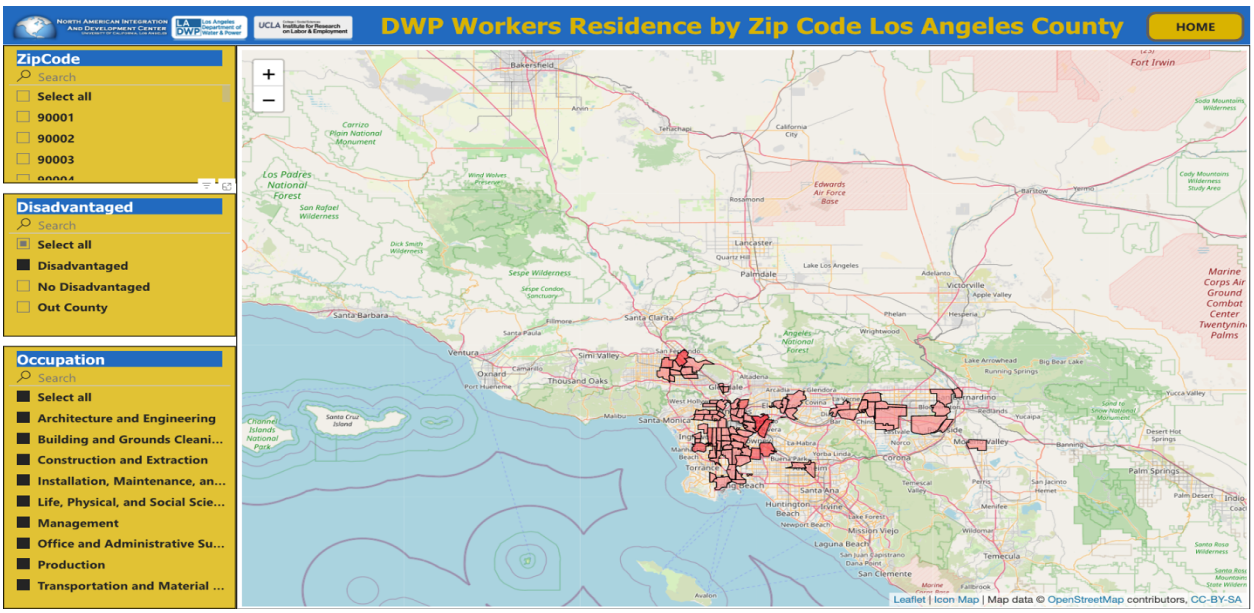
However, Latinx and African American workers make up the largest share of LADWP employees living in ZIP Codes with high density of DACs (Figure 14) and earn the lowest wages of LADWP workers living in both DACs and non-DACs; this finding might be related to the fact that Latinx and African American workers are more concentrated in lower wage occupations and activities, yet they earn comparable wages in both higher and lower occupations.

Figure 14: Share of LADWP Workers in Power Division Living in Zip Codes with High DACs Density, by ZIP Code



We also built a GIS system capable of identifying the ZIP Codes where LADWP workers live based on ZIP Codes with high and low concentration of DACs, as well as by occupations (Figure 15). Once again, this is a powerful platform that gives relevant information not just for future public policy, but also for corporate decisions for LADWP on how to increase the well-being of their employees and society. The GIS system is hosted at https://naid.center/gis-maps.

Figure 15: LADWP Workers Living in ZIP Codes with High Concentration of DACs

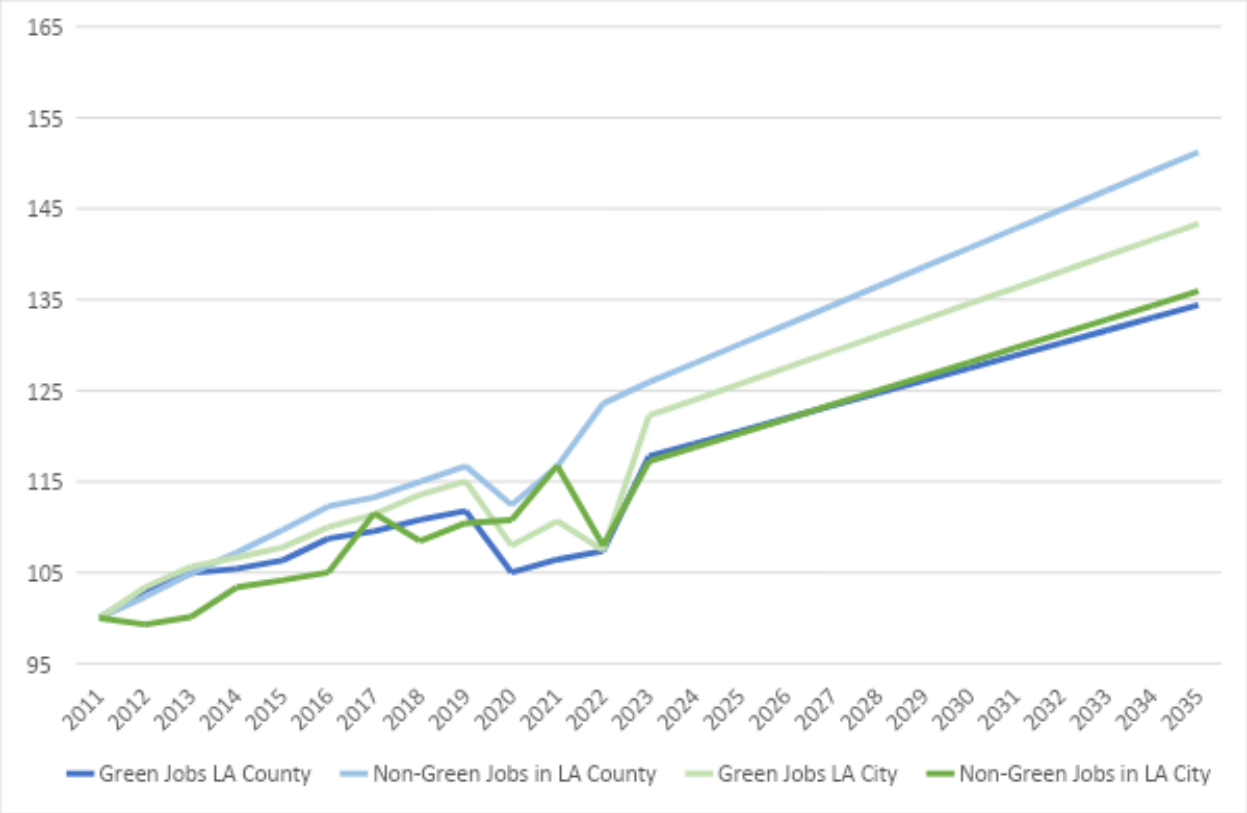


1.7 Likely Future Scenarios for Green Jobs in L.A. City and County and Gaps Analysis

We next turn to the likely future scenarios for green jobs in L.A. City and County (comprising direct, indirect, and induced), taking into account future changing ethnic demographic projections to identify the gaps that need to be filled in order to achieve future equitable green employment. Total green jobs in L.A. County are expected to grow 20% from 2019 to 2035, while non-green jobs are expected to grow 30%. The gap analysis shows that Latinx green jobs workers will have to grow faster to keep up with higher demographic growth.

Transitioning to a greener economy requires more green projects that generate green jobs. According to our time series regression analysis, in L.A. County green jobs are projected to grow 20% from 2019 to 2035, while non-green jobs are expected to grow 30%. On the other hand, between 2019 and 2035, total green jobs in L.A. City are expected to grow 25%, while non-green jobs are expected to grow 23% in the same period (Figure 16). When we compare these results to the growth registered between 2011 and 2019, though green jobs are expected to grow at a faster rate, the gap in growth between green and non-green jobs is shortening, meaning that non-green jobs might be leading the labor market growth over the next few years.

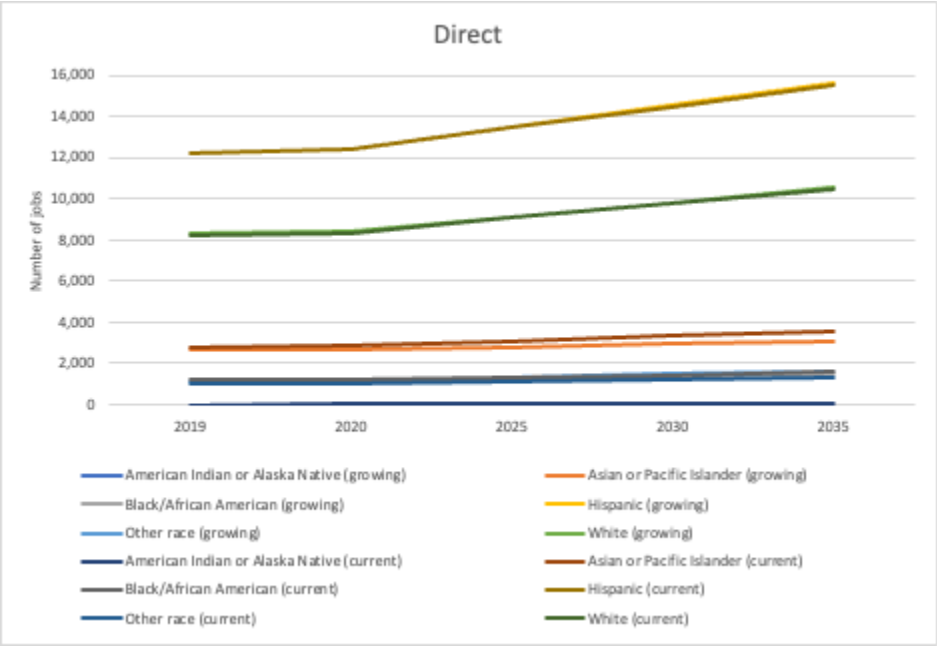
Figure 16: Green and Non-Green Jobs Growth Index in L.A. County and L.A. City, 2011 = 100

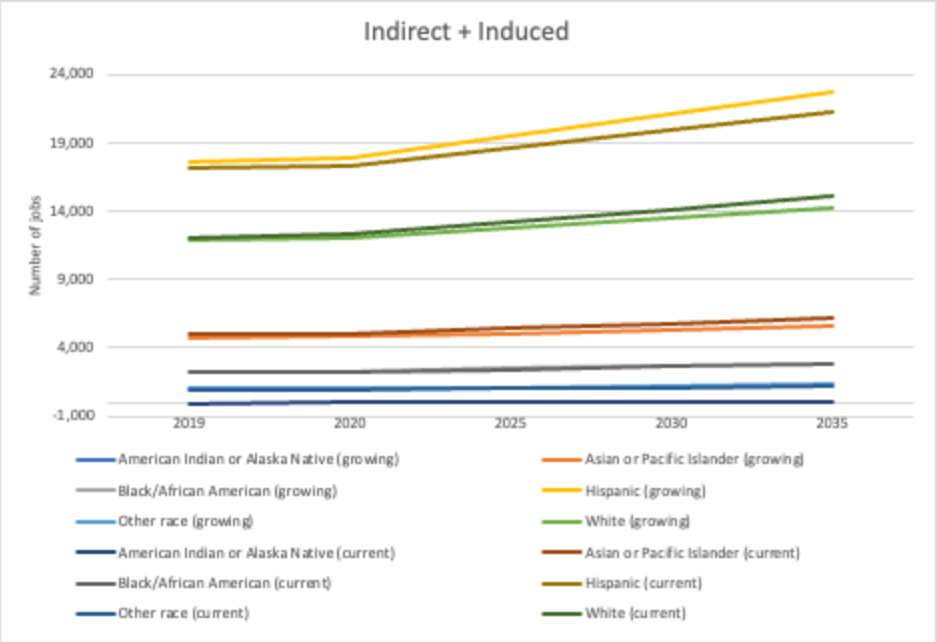


When we ask the question of how equity might help to maintain or increase the growth of green jobs and a greener economy, we take into account future changing ethnic demographic projections to identify gaps that need to be filled in order to achieve future equitable green employment.

In this sense, we projected green jobs by direct and indirect + induced categories, considering the projected demographic changes based on historical trends. As a result, we find that if we distribute the projected green jobs by comparing the current race structure and the projected (growing) demographic structure, there are no significant gaps in direct green jobs. However, keeping the current racial employment structure might worsen the growth of green jobs through the linkages to indirect + induced green jobs creation. Thus, the gap analysis shows that Latinx green jobs workers will have to grow faster to keep up with higher demographic growth, and to lead the creation of new green jobs (Figure 17).

Figure 17: Gap Analysis of Projected Green Jobs in L.A. City (Growing vs Current Ethno-occupational Structure), Direct and Indirect + Induced





On the gaps side, when we compare the projection of green jobs by race and the current racial structure, if the hiring for direct jobs remains with the same current structure, there will be a negative gap for Other Races and Latinx (341 and 120 positions, respectively), while Asian or Pacific Islander will face a positive gap (surplus) of 510 workers. However, this negative gap is higher for Latinx workers in indirect and induced green jobs (1,413 positions), while it is positive for Whites and Asian or Pacific Islander (898 and 642 surplus positions), which might increase inequalities.

1.8 Potential Future Employment Scenarios for LADWP Based on LA100 Strategies

We now turn to the potential future employment scenarios for LADWP by industry and occupations based on LA100 modeling of alternative technology investment options, including employment gap projections by race and gender category and by geography.

Future LADWP employment scenarios indicate important growth in large LADWP industry sub-sectors and occupations, which will require more rapid recruitment and targeted training of Latinx and African American workers; those occupations where we have identified as mostly represented are the ones that are expected to grow with the execution of the different scenarios presented in LA100 report.

1.8.1 LA100 Scenarios Workforce Needs

Chapter 11 of the LA100 report describes the economic impacts and the jobs for the Los Angeles 100% Renewable Energy Study. The authors estimate the total number of jobs that will be

generated due to investments in the transition to 100% renewable energy, and they break down this number of jobs in two:

a. Installation and Construction: number of jobs due to the required infrastructure installation and construction.
b. Operations and Maintenance: number of jobs due to the operations and maintenance of infrastructure, and generation/transmission of energy.

For each of these two categories, they do an analysis of the nine scenarios given in chapter 6 of the LA100 report, which are:

a. Early and no biofuels – High
b. Early and no biofuels – Moderate
c. Limited New Transmission – High
d. Limited New Transmission – Moderate
e. Transmission Focus – High
f. Transmission Focus – Moderate
g. SB100 – Stress
h. SB100 – High
i. SB100 – Moderate

They also estimated the Los Angeles in-basin and out-of-basin jobs for each of the scenarios and categories. As they state in the chapter, "Jobs analysis can be thought of as identifying overall jobs needed to support construction and operations (including supply chain and induced employment), but the study does not identify how these results could translate to specific occupations" (Keyser et al., 2021).

Based on the data presented in that report, we estimated the annual average number of jobs required for each scenario and category, including in-basin and out-of-basin. Then, using the projected occupational structure for the sectors Power and Communication Line and Related Structures Construction (NAICS: 237130) and Electric Power Generation, Transmission, and Distribution (NAICS: 221100) from the Bureau of Labor Statistics, we projected the number of jobs required for each scenario by specific occupations. For Operation and Maintenance jobs, we identified a total of 91 occupations, while for Installation and Construction, we identified a total of 57 occupations.

1.8.2 Current and Future Scenarios for equitable employment composition

With historical data on employment from the Current Population Survey and the American Community Survey, we have projected the aggregate number of jobs in the utility sector and in energy-related occupations, under various scenarios of racial-ethnic distribution. Using historical and projected data, we conducted an equity gap analysis for L.A. County through which we compare the future distribution of employment assuming that the current labor structure by race-ethnic category remains the same over time, compared to how the distribution of employment would have to change by adjusting to the projected demographic shifts in ethnic racial categories. This equity gap analysis thus allows us to project how many workers in different

race-ethnic categories would have to be trained to perform those occupations in order to enhance the chances for improved racial-ethnic employment equity into the future.

Future LADWP employment scenarios indicate important growth in large LADWP industry sub-sectors and occupations, a factor which will require more rapid recruitment and targeted training of Latinx and African American workers. Those occupations where we have identified that those groups of workers are represented most highly are the ones that are expected to grow with the execution of the different scenarios presented in the LA100 report.

1.8.3 Results for the LA 100 scenarios with most and least jobs growth[4]

Chapter 11 of the LA100 report, "Economic Impacts and Jobs," does an input-output analysis of the different potential scenarios for 100% renewable energy in Los Angeles. However, as they report, these are aggregate numbers and do not reflect the specific occupations that are going to be required, since more information is needed. Thus, we used those results and Bureau of Labor Statistics projections for the labor markets by occupation and industry by scenario to estimate the number of workers needed by occupation at different aggregation levels.

In this section, we report the top occupations for the scenarios with most and least total job creation. When we compare these results with the current ethno-occupational structure of LADWP, we shed light on how the hiring strategy for future LADWP labor needs should meet higher equity standards.

Considering results from the LA100 report, the yearly average number of jobs for the Construction and Installation category by scenarios is 4,300 for Limited New Transmission – High scenario, and 11,000 for the Early & No Biofuels – High scenario. However, these results do not show the number of jobs by occupation required; we have identified that for Limited New Transmission – High and Early & No Biofuels – High scenarios, the top occupations are Construction and Extraction occupations, with a range from 1,700 to 4,200 jobs, and Educational Instruction and Library occupations, ranging from 1,600 to 4,000 jobs (Table 8).

[4] In this section, we present the most and least job growth scenarios; however, a dashboard including all scenarios with a higher level of disaggregation in occupations can be found on the NAID Center website: https://naid.center/gis-maps.

Table 8: Early & No Biofuels – High and Limited New Transmission – High Scenarios by Average Yearly Jobs Needed in Construction and Installation Category

	Early & NoBiofuels-High			Limited New Transmission-High		
Occupations	In-Basin	Out-of-Basin	Total	In-Basin	Out-of-Basin	Total
Architecture and engineering occupations	153	48	200	33	46	80
Arts, design, entertainment, sports, and media occupations	3	1	5	1	1	2
Building and grounds cleaning and maintenance occupations	17	5	23	4	5	9
Business and financial operations occupations	364	114	478	80	111	190
Computer and mathematical occupations	42	13	55	9	13	22
Construction and extraction occupations	3,238	1,012	4,250	707	983	1,690
Educational instruction and library occupations	3,082	963	4,045	673	936	1,609
Healthcare practitioners and technical occupations	10	3	14	2	3	5
Installation, maintenance, and repair occupations	42	13	55	9	13	22
Legal occupations	614	192	805	134	186	320
Life, physical, and social science occupations	471	147	619	103	143	246
Management occupations	66	21	86	14	20	34
Office and administrative support occupations	17	5	23	4	5	9
Production occupations	38	12	50	8	12	20
Protective service occupations	239	75	314	52	73	125
Total	8,397	2,624	11,020	1,834	2,549	4,383

For the Operations and Maintenance (O&M) category, the yearly average range of jobs is 1,500 for SB100 – Moderate scenarios and 2,200 jobs for both Transmission Focus – High and SB100 – Stress scenarios. Thus, for the SB100 – Moderate and Transmission Focus – High, the top occupations are Installation, Maintenance, and Repair occupations, ranging from 600 to 800 jobs, and Office and Administrative Support occupations, ranging from 200 to 300 jobs (Table 9). We have estimated these results for different occupational aggregation levels.

Table 9: SB100 – Moderate and Transmission Focus – High Scenarios by Average Yearly Jobs Needed in Operations and Maintenance (O&M) Category

	SB100-Moderate			Transmission Focus-High		
Occupations	In-Basin	Out-of-Basin	Total	In-Basin	Out-of-Basin	Total
Architecture and engineering occupations	51	111	162	80	154	234
Arts, design, entertainment, sports, and media occupations	2	5	7	4	7	11
Building and grounds cleaning and maintenance occupations	3	6	9	4	9	13
Business and financial operations occupations	42	92	135	66	128	194
Computer and mathematical occupations	20	43	62	30	59	89
Construction and extraction occupations	23	49	72	35	69	104
Educational instruction and library occupations	0	0	0	0	0	0
Healthcare practitioners and technical occupations	0	0	0	0	0	1
Installation, maintenance, and repair occupations	173	376	550	269	521	791
Legal occupations	1	3	5	2	4	7
Life, physical, and social science occupations	10	22	32	16	31	47
Management occupations	38	83	121	59	115	174
Office and administrative support occupations	64	138	202	99	191	290
Production occupations	50	109	159	78	151	229

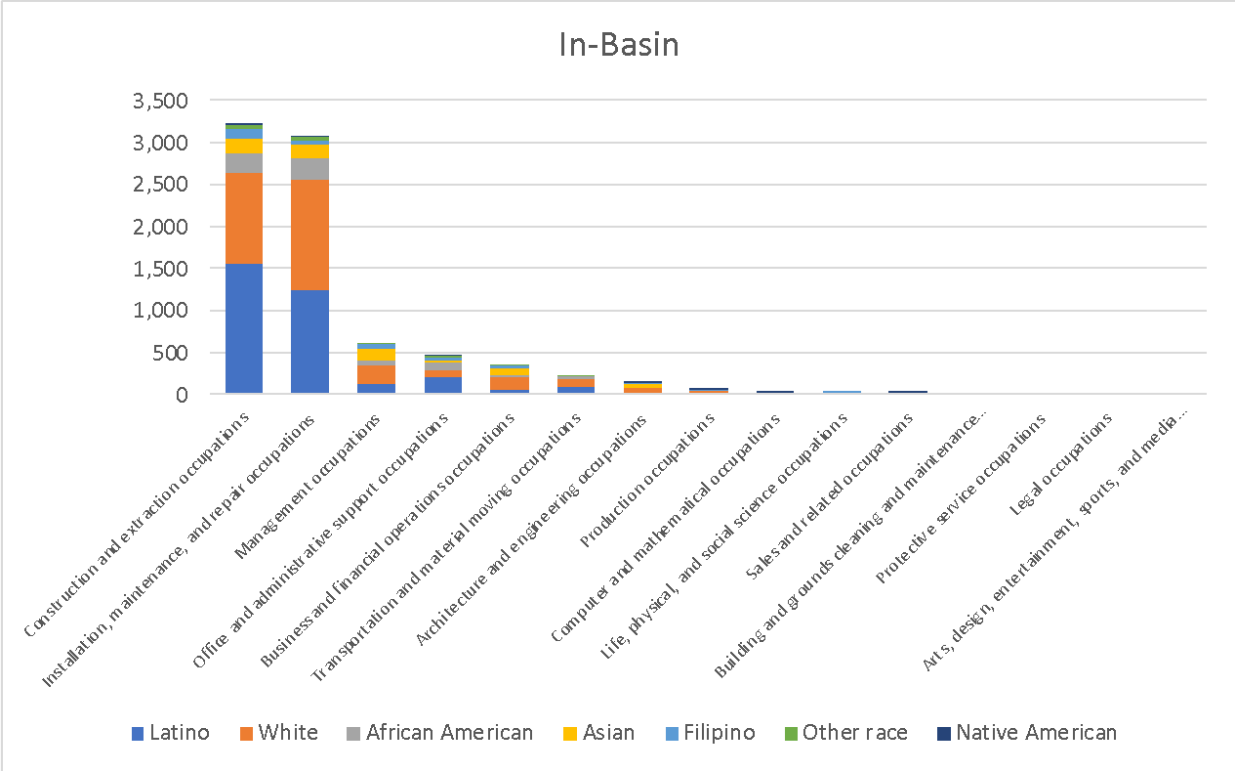
Protective service occupations	5	11	16	8	16	24
Sales and related occupations	6	13	19	9	18	27
Transportation and material moving occupations	9	20	30	15	28	43
Total	498	1,083	1,581	775	1500	2,276

We also analyzed the LA100 scenarios jobs creation by occupation and racial composition, considering current LADWP racial composition and future demographic changes. This analysis allows us to estimate the total number of workers required by occupation and race categories for each of the scenarios presented in the LA100 report.

Continuing with the most and least jobs growth scenarios presented above, we have found that in the Early & No Biofuels – High scenario (the most job growth in the Construction and Installation category) Latinx and Whites are the most represented workers in Construction and Extraction occupations, and Installation, Maintenance, and Repair occupations, both in-basin and out-of-basin. A total of 3,700 Latinx workers, 3,100 White workers, and 653 African American workers are required in this scenario to meet the occupational needs in the categories previously mentioned (Figure 18).

In the case of the Limited New Transmission – High, the least job growth scenario for the Construction and Installation category, 3,200 Latinx workers, 2,700 White workers, and 560 African American workers are required (in-basin and out-of-basin) to fulfill the scenario demand in occupations like Construction and Extraction and, Installation, Maintenance, and Repair. These are also the occupational categories with the most jobs growth in these scenarios (Figure 19).

Figure 18: Early & No Biofuels – High Scenario Average Yearly Jobs Needed in Construction and Installation Category by Occupation and Race (Number of Jobs)



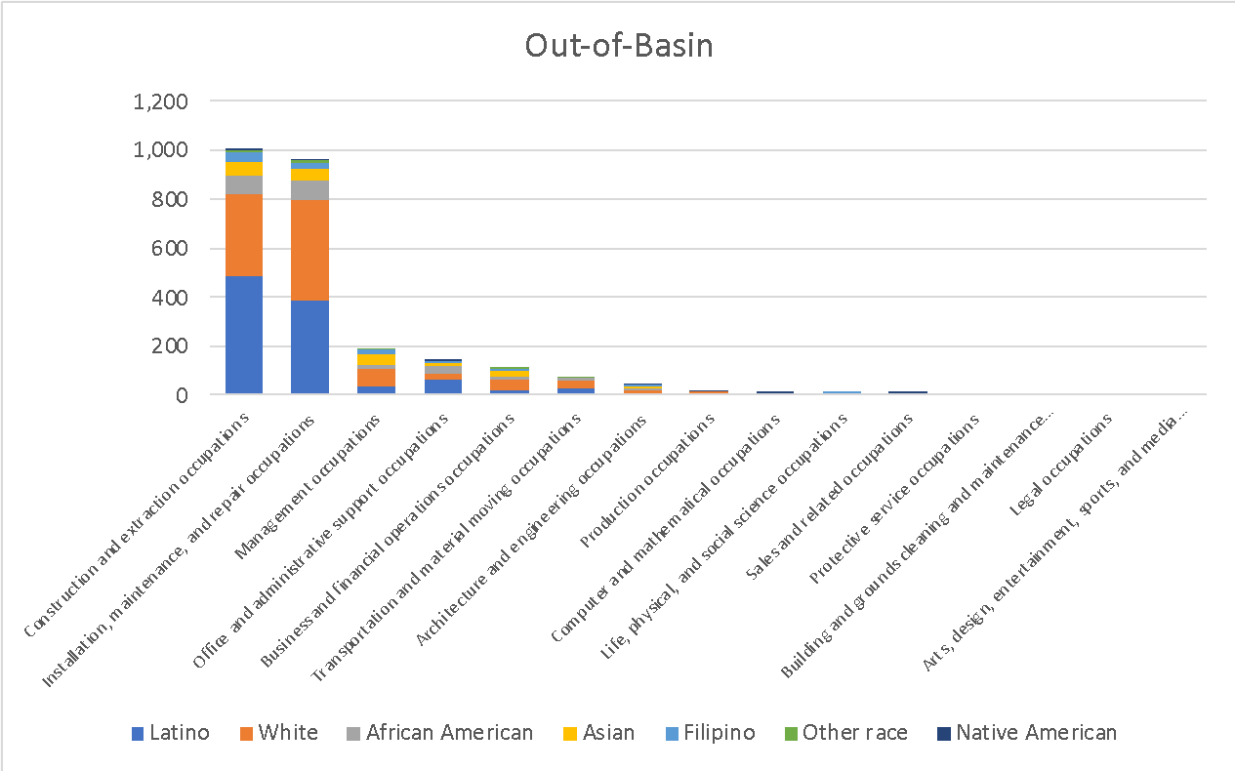
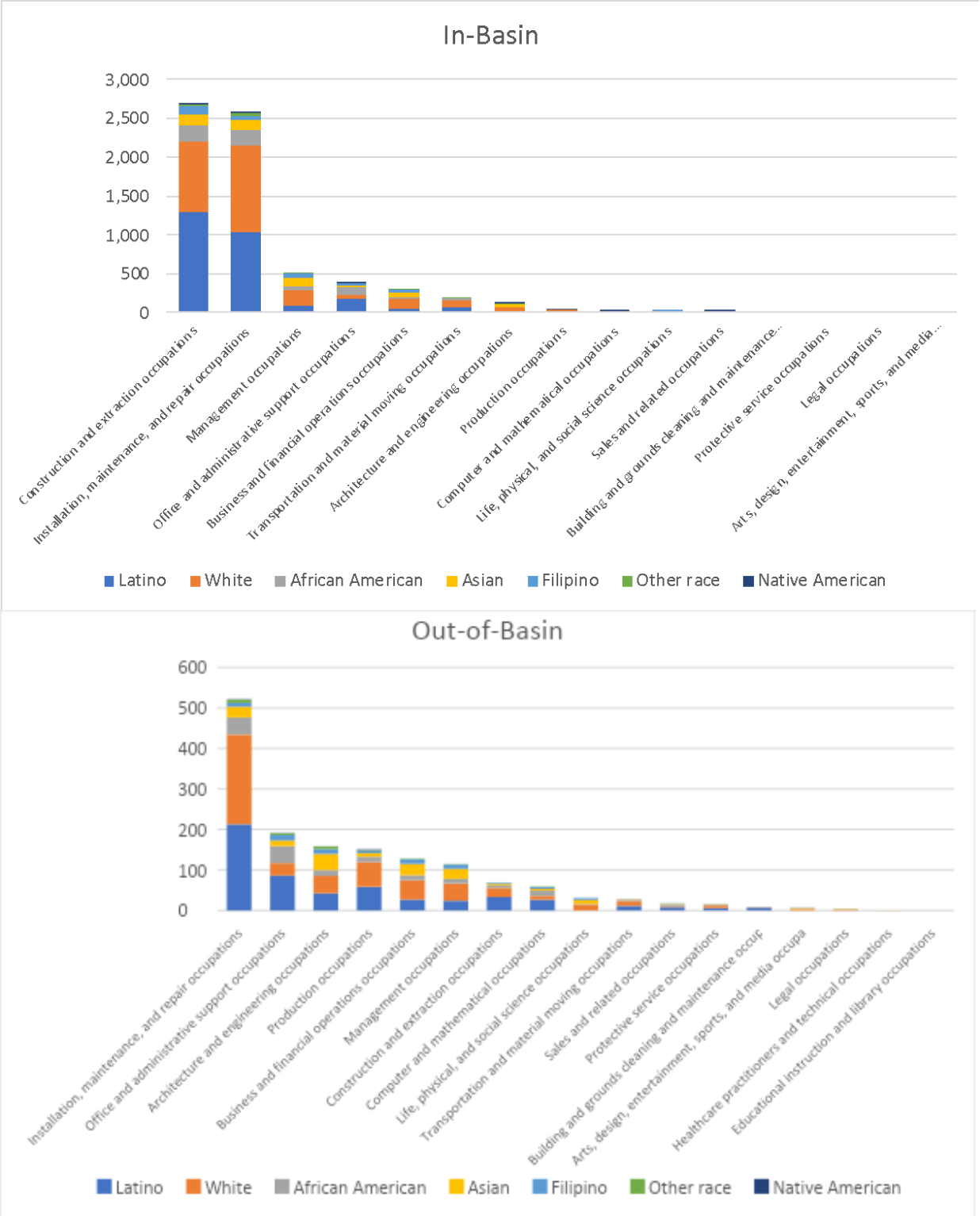


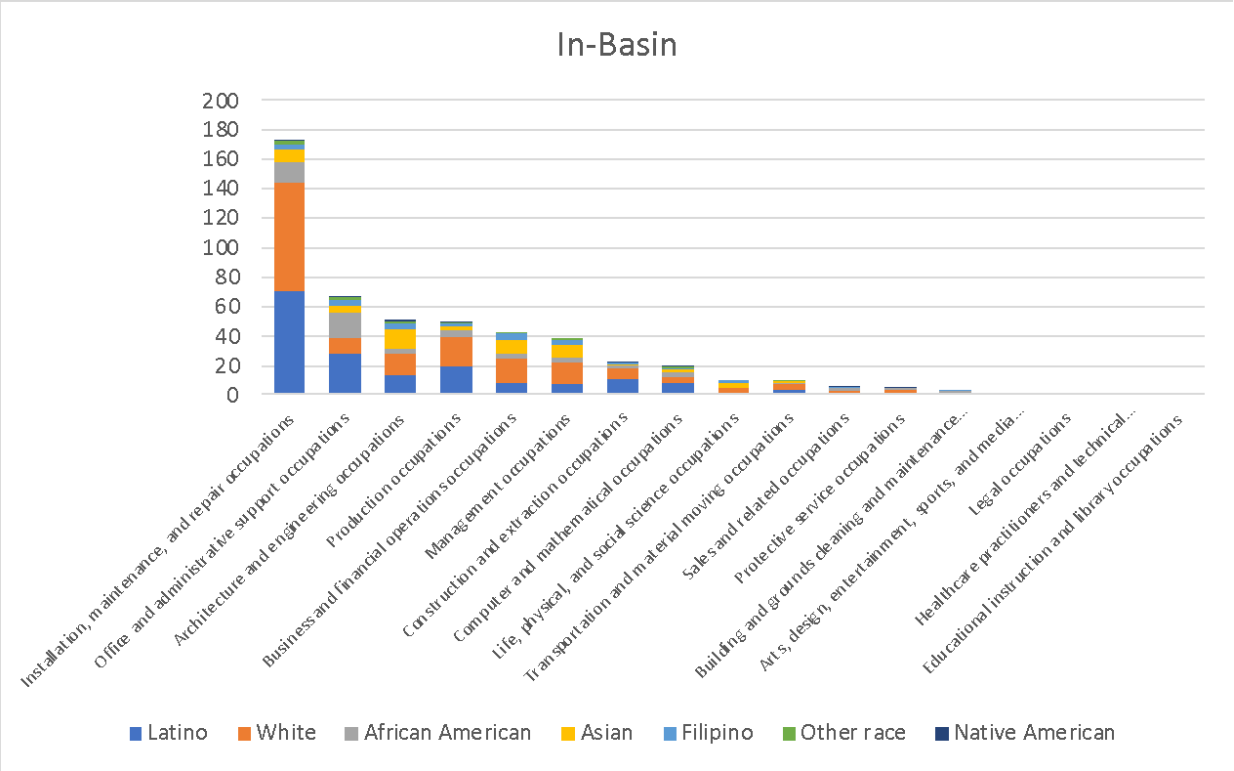
Figure 19: Limited New Transmission - High Scenario Average Yearly Jobs Needed in Construction and Installation Category by Occupations and Race (Number of Jobs)



In the Operations and Maintenance category, the least and most jobs growth scenarios are SB100 – Moderate, and Transmission Focus – High. For the SB100 – Moderate scenario, the most demanded occupations are Installation, Maintenance, and Repair occupations, Office and Administrative Support occupations, Architecture and Engineering occupations, and Production occupations; the number of Latinx workers required to fulfill those occupations (in-basin and out-of-basin) is 400, along with 370 Whites and 120 African Americans (Figure 20).

For Transmission Focus – High, the highest jobs growth scenario in the Operations and Maintenance category, the number of Latinx workers (in-basin and out-of-basin) is 600, 540 Whites, and 170 African American for the following occupational categories: Installation, Maintenance, and Repair; Office and Administrative Support; Architecture and Engineering; and Production occupations (Figure 21).

Figure 20: SB100 – Moderate Scenario Average Yearly Jobs Needed in Operations and Maintenance (O&M) Category by Occupation and Race (Number of Jobs)



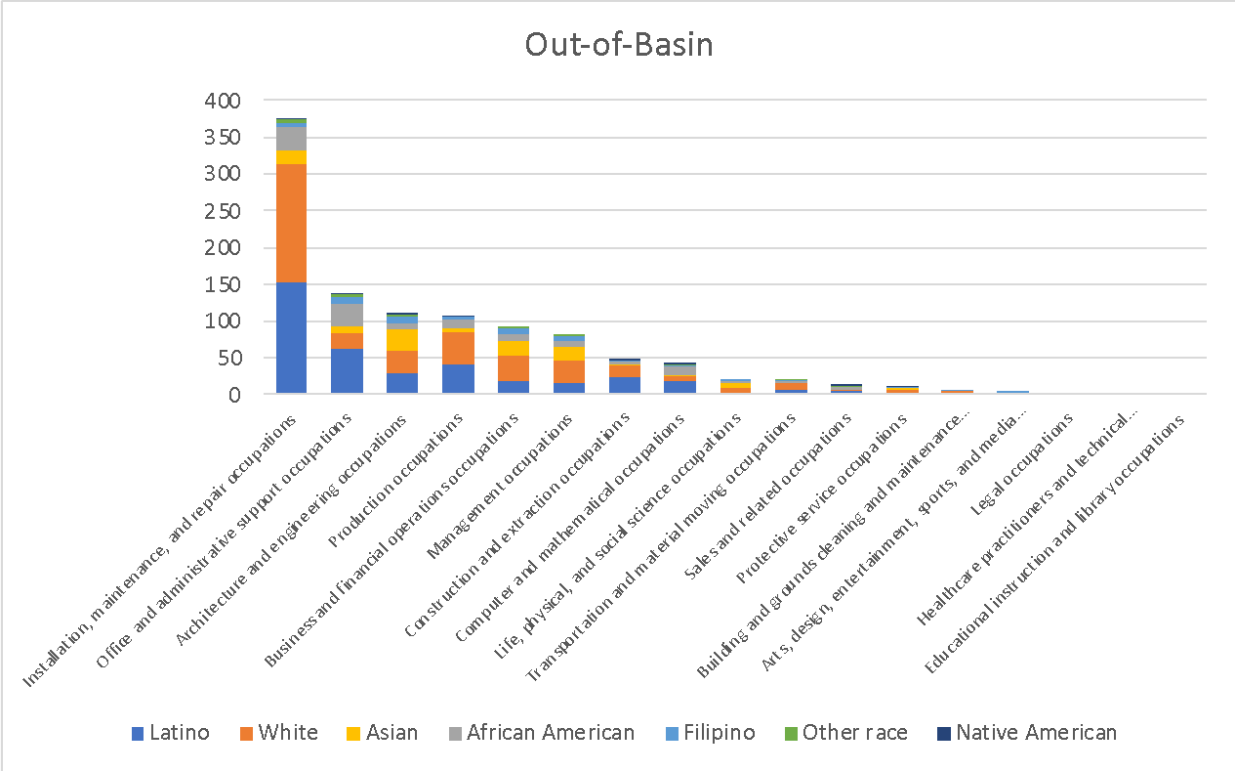
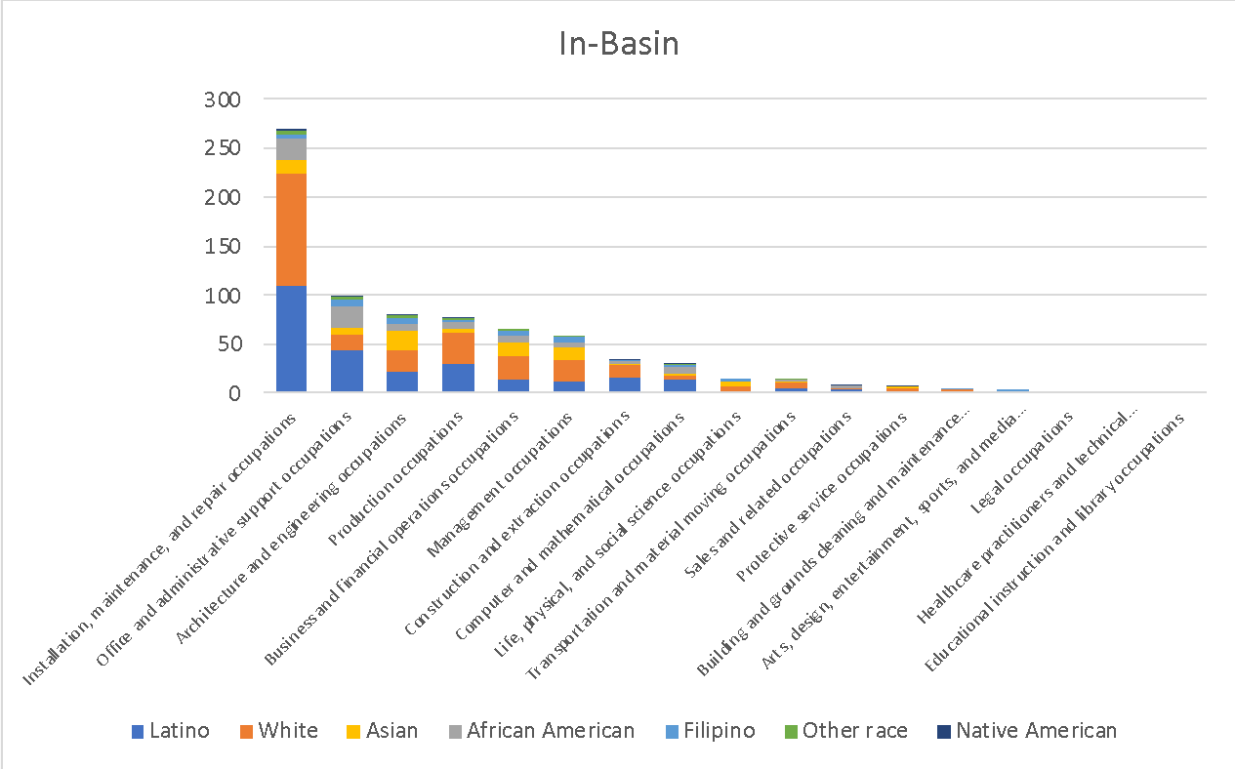
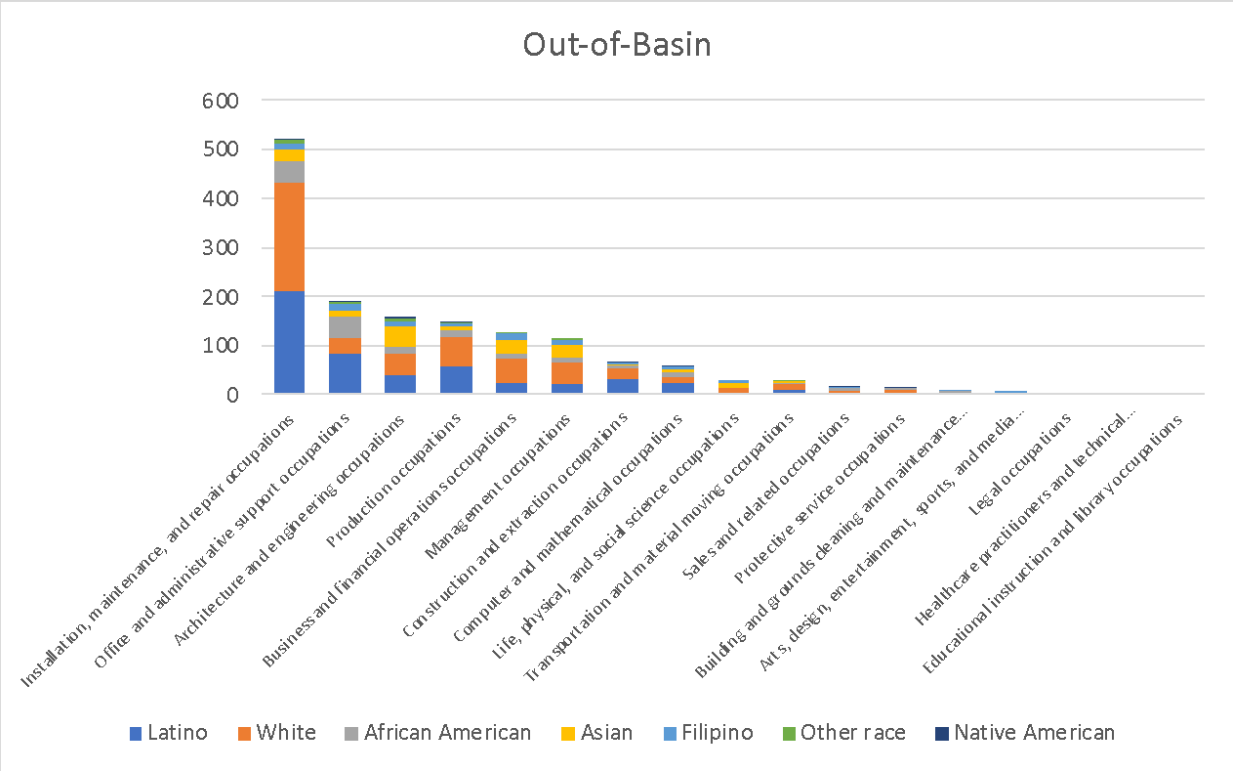


Figure 21: Transmission Focus – High Scenario Average Yearly Job Needed in Operations and Maintenance (O&M) Category by Occupations and Race (Number of Jobs)





Execution of the proposed LA100 scenarios for a transition to a 100% renewable energy system will require the recruitment and targeted training of Latinx, White, and African American workers, since as we have demonstrated, the occupations where they have the most representation are the ones that are expected to increase because of these projects. On the other hand, as has been demonstrated in the previous section, green jobs are expected to be led by Latinx and African American workers.

1.9 Future Equitable Employment Transition Strategies

Based on estimating green jobs and LADWP scenarios for workforce development training needs by industry and occupations, we explore the best future equitable employment transition strategies that could be implemented.

We use an estimate of $10,000 per capita on training for the workforce development in DACs communities and we have estimated the total costs for the scenario with the most and least job growth for the Construction and Installation category (presented in Table 9). However, it is important to take into consideration that here, we are aggregating the total costs for the Construction and Installation and Operations and Maintenance categories, and we have broken it down by in-basin and out-of-basin training costs.

For the Early & No Biofuels – High scenario, in-basin, we estimate a cost of nearly $84 million to train the workers dedicated for Construction and Installation, and an additional $3 million to train those workers dedicated for Operations and Maintenance (Table 10A.).

Out-of-basin workers training might cost $26.24 million for the Construction and Installation workers and $18.76 million for Operations and Maintenance workers, adding a total of $45 million for all the out-of-basin workers under the Early & No Biofuels – High scenario (Table 10B.). Adding both in-basin and out-of-basin, the estimated cost might be nearly $132 million.

Table 10: Cost of Training for Early & No Biofuels – High Scenario, by Occupation and Race, In Basin and Out-of-Basin (in Millions of $)

10A. In-Basin Workers

Occupation	Latinx	White	African American	Asian	Filipino	Other race	Native American	Total
Construction and extraction occupations	15.76	10.74	2.49	1.71	1.19	0.41	0.22	32.52
Installation, maintenance, and repair occupations	13.01	13.54	2.58	1.61	0.59	0.47	0.06	31.86
Management occupations	1.34	2.37	0.62	1.38	0.58	0.07	0.00	6.37
Office and administrative support occupations	2.30	0.82	1.12	0.36	0.36	0.11	0.02	5.10
Business and financial operations occupations	0.82	1.45	0.38	0.84	0.36	0.04	0.00	3.90
Transportation and material moving occupations	0.99	1.04	0.32	0.05	0.02	0.02	0.00	2.45
Architecture and engineering occupations	0.51	0.51	0.12	0.47	0.14	0.07	0.01	1.83
Production occupations	0.37	0.39	0.08	0.05	0.03	0.01	0.01	0.96
Computer and mathematical occupations	0.24	0.09	0.12	0.04	0.04	0.01	0.00	0.53
Life, physical, and social science occupations	0.00	0.23	0.03	0.15	0.08	0.00	0.00	0.48
Sales and related occupations	0.19	0.07	0.09	0.03	0.03	0.01	0.00	0.42
Protective service occupations	0.08	0.08	0.02	0.01	0.01	0.00	0.00	0.20
Building and grounds cleaning and maintenance occupations	0.16	0.02	0.01	0.00	0.00	0.00	0.00	0.19

Legal occupations	0.00	0.05	0.01	0.04	0.02	0.00	0.00	0.11
Arts, design, entertainment, sports, and media occupations	0.00	0.02	0.00	0.02	0.01	0.00	0.00	0.05
Healthcare practitioners and technical occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Educational instruction and library occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	35.77	31.42	7.98	6.76	3.47	1.23	0.33	86.97

10B. Out-of-Basin Workers

Occupation	Latinx	White	African American	Asian	Filipino	Other race	Native American	Total
Installation, maintenance, and repair occupations	6.59	6.86	1.31	0.81	0.30	0.24	0.03	16.15
Construction and extraction occupations	5.32	3.63	0.84	0.58	0.40	0.14	0.08	10.98
Office and administrative support occupations	1.74	0.62	0.85	0.27	0.27	0.09	0.01	3.86
Management occupations	0.71	1.25	0.33	0.72	0.31	0.04	0.00	3.35
Business and financial operations occupations	0.58	1.02	0.27	0.59	0.25	0.03	0.00	2.74
Architecture and engineering occupations	0.66	0.67	0.16	0.62	0.19	0.09	0.01	2.40
Production occupations	0.81	0.85	0.18	0.12	0.08	0.03	0.03	2.09
Transportation and material moving occupations	0.45	0.47	0.14	0.02	0.01	0.01	0.00	1.10
Computer and mathematical occupations	0.39	0.14	0.19	0.06	0.06	0.02	0.00	0.87
Life, physical, and social science occupations	0.00	0.24	0.03	0.16	0.08	0.00	0.00	0.51

Sales and related occupations	0.15	0.05	0.08	0.02	0.02	0.01	0.00	0.34
Protective service occupations	0.10	0.10	0.02	0.01	0.01	0.00	0.00	0.25
Building and grounds cleaning and maintenance occupations	0.14	0.02	0.01	0.00	0.00	0.00	0.00	0.16
Arts, design, entertainment, sports, and media occupations	0.00	0.05	0.01	0.03	0.02	0.00	0.00	0.10
Legal occupations	0.00	0.04	0.00	0.03	0.01	0.00	0.00	0.09
Healthcare practitioners and technical occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Educational instruction and library occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	17.64	16.00	4.41	4.07	2.02	0.69	0.16	44.99

For the Limited New Transmission – High scenario, we estimate that the cost of training for the Construction and Installation category of in-basin workers might be $70.22 million, and an additional $5.75 million for the workers in the Operations and Maintenance category, adding a total of nearly $76 million on training for in-basin workers under this scenario (Table 11A).

Considering the out-of-basin workers in this scenario, this adds up to nearly $25.5 million for the Construction and Installation category of workers, and $13.50 million for the Operations and Maintenance workers, adding nearly $39 million for out-of-basin worker training (Table 11B). Adding both in-basin and out-of-basin workers, the cost of training for this scenario might sum nearly $115 million.

Table 11: Cost of Training for Limited New Transmission – High Scenario, by Occupation and Race, In Basin and Out-of-Basin (in Millions of $)

11A. In-Basin Workers

Occupations	Latinx	White	African American	Asian	Filipino	Other race	Native American	Total
Installation, maintenance, and repair occupations	11.34	11.80	2.25	1.40	0.52	0.41	0.06	27.7
Construction and extraction occupations	13.25	9.03	2.09	1.44	1.00	0.34	0.19	27.3
Management occupations	1.17	2.08	0.54	1.20	0.51	0.06	0.00	5.57
Office and administrative support occupations	2.11	0.75	1.03	0.33	0.33	0.10	0.02	4.68
Business and financial operations occupations	0.75	1.32	0.34	0.76	0.32	0.04	0.00	3.53
Transportation and material moving occupations	0.86	0.90	0.27	0.04	0.02	0.02	0.00	2.11
Architecture and engineering occupations	0.52	0.52	0.12	0.48	0.15	0.07	0.01	1.87
Production occupations	0.44	0.46	0.10	0.06	0.04	0.02	0.02	1.13
Computer and mathematical occupations	0.26	0.09	0.13	0.04	0.04	0.01	0.00	0.57
Life, physical, and social science occupations	0.00	0.22	0.02	0.15	0.07	0.00	0.00	0.47
Sales and related occupations	0.17	0.06	0.09	0.03	0.03	0.01	0.00	0.39
Protective service occupations	0.08	0.08	0.02	0.01	0.01	0.00	0.00	0.20
Building and grounds cleaning and maintenance occupations	0.15	0.02	0.01	0.00	0.00	0.00	0.00	0.18
Legal occupations	0.00	0.05	0.01	0.03	0.02	0.00	0.00	0.10

Arts, design, entertainment, sports, and media occupations	0.00	0.03	0.00	0.02	0.01	0.00	0.00	0.06
Healthcare practitioners and technical occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Educational instruction and library occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	31.09	27.40	7.03	6.01	3.07	1.09	0.29	75.97

11B. Out-of-Basin Workers

Occupations	Latino	White	African American	Asian	Filipino	Other race	Native American	Total
Installation, maintenance, and repair occupations	5.74	5.97	1.14	0.71	0.26	0.21	0.03	14.05
Construction and extraction occupations	5.06	3.45	0.80	0.55	0.38	0.13	0.07	10.45
Office and administrative support occupations	1.42	0.51	0.69	0.22	0.22	0.07	0.01	3.15
Management occupations	0.61	1.08	0.28	0.63	0.27	0.03	0.00	2.89
Business and financial operations occupations	0.48	0.84	0.22	0.49	0.21	0.02	0.00	2.26
Architecture and engineering occupations	0.51	0.51	0.12	0.48	0.14	0.07	0.01	1.85
Production occupations	0.61	0.63	0.14	0.09	0.06	0.02	0.02	1.56
Transportation and material moving occupations	0.40	0.42	0.13	0.02	0.01	0.01	0.00	0.98
Computer and mathematical occupations	0.30	0.11	0.14	0.05	0.05	0.01	0.00	0.66
Life, physical, and social science occupations	0.00	0.19	0.02	0.13	0.06	0.00	0.00	0.40
Sales and related occupations	0.12	0.04	0.06	0.02	0.02	0.01	0.00	0.28

Protective service occupations	0.08	0.08	0.02	0.01	0.01	0.00	0.00	0.19
Building and grounds cleaning and maintenance occupations	0.11	0.01	0.01	0.00	0.00	0.00	0.00	0.13
Arts, design, entertainment, sports, and media occupations	0.00	0.03	0.00	0.02	0.01	0.00	0.00	0.07
Legal occupations	0.00	0.03	0.00	0.02	0.01	0.00	0.00	0.07
Healthcare practitioners and technical occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Educational instruction and library occupations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.43	13.91	3.78	3.43	1.71	0.59	0.14	38.99

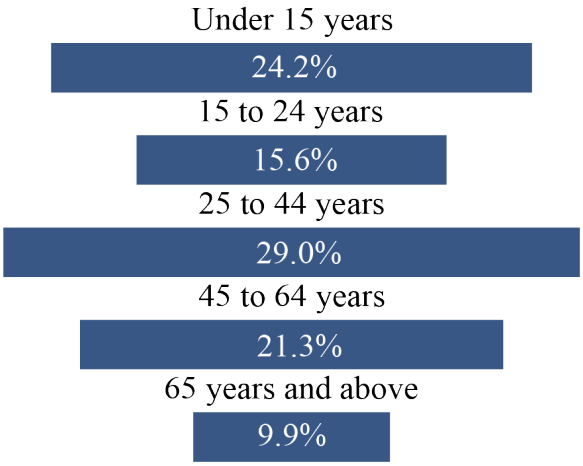
Analyzing these scenarios, the cost of training for LADWP might go from $76 million to $87 million considering only in-basin workers, and from $39 million to $45 million for out-of-basin workers. Adding up both "regions" (in-basin and out-of-basin), the cost might range from a total of $115 million to $132 million.

2. Wilmington Demographics, Case Study & Community Engagement

2.1 Wilmington Demographics: Heart of the Port of L.A.

According to the 2021 American Community Survey (ACS) conducted by the United States Census Bureau, the estimated population of Wilmington (ZIP Code Tabulation Area 90744) is 57,030, with 52.5% male and 47.5% female. The dependency ratio, which compares minors and seniors to adults, is high in Wilmington, almost 1 to 2, mainly due to the high number of children (24% of the population). The average household size in Wilmington is 3.8 people, and the average family size is 4.3 people. For comparison, in Los Angeles County, the average household size is 2.9 people, and the average family size is 3.5 people, both significantly smaller than in Wilmington.

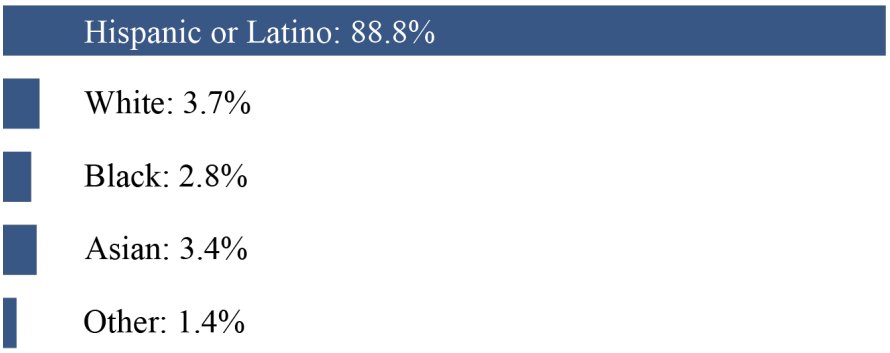
Figure 22: Wilmington Population Pyramid, 2021



Wilmington has a significant population of foreign-born residents, with 38% of its residents born outside of the U.S., higher than the total for L.A. County and most regions in the U.S. (Figure 23). The majority of Wilmington's population identifies as Hispanic or Latinx (89%), while all other racial and ethnic groups are small minorities: White 4%, Black 3%, Asian 3%, and others 1% (Figure 24). Historically, Wilmington has been an immigrant community, mainly from Latin America. Only 22% of the population speaks English at home, while 75% of the population speaks Spanish at home, with over half of Spanish speakers speaking English less than "very well".

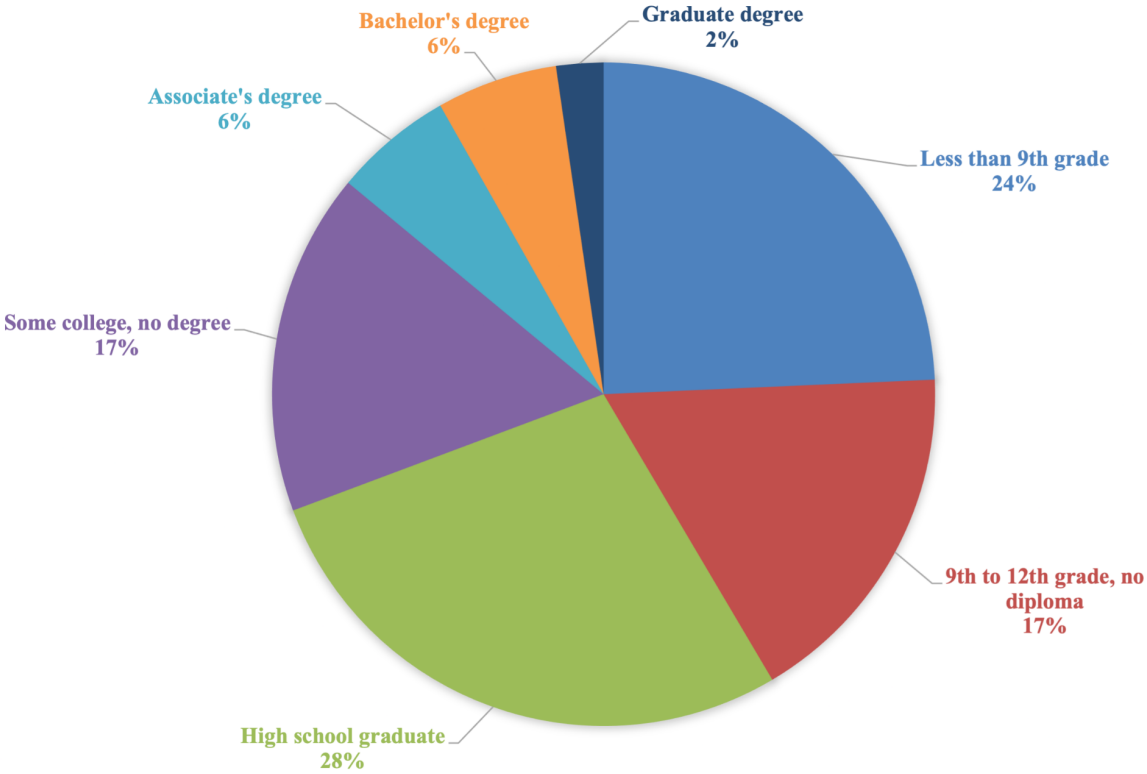
Figure 23: Wilmington's Population Nativity, 2021

Figure 24: Wilmington's Population by Race, 2021



Wilmington's population has low educational attainment, with almost half of the population aged 25 and over not having achieved a high school diploma or equivalent (42%). Only 28% have a high school diploma or equivalent, and 31% have some college education, with most not receiving a diploma; only 8% have a bachelor's degree or higher (Figure 25). Within Wilmington, there is a racial educational divide, with Hispanic or Latinx individuals having a high school graduation rate of only 52.5%, while the graduation rate for white individuals is 89.6%, Black individuals is 97.5%, and Asian individuals is 94.3%.

Figure 25: Wilmington Educational Attainment for Those 25 and Older, 2021

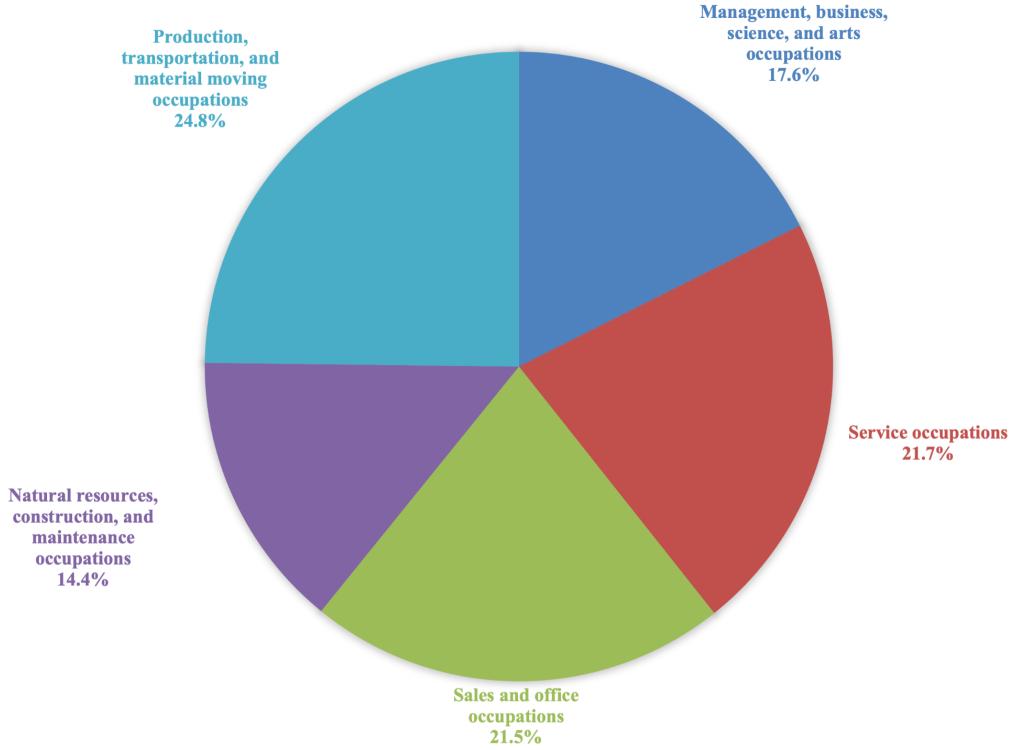


Additionally, Wilmington is a low-income community. The median household income in Wilmington is approximately $55,000, while the median household income in Los Angeles County

is over $77,000; when factoring in the larger household size in Wilmington, the contrast becomes even starker. When comparing country of origin, the median household income for the foreign-born population in Wilmington is approximately $6,000 lower than that of the native-born population.

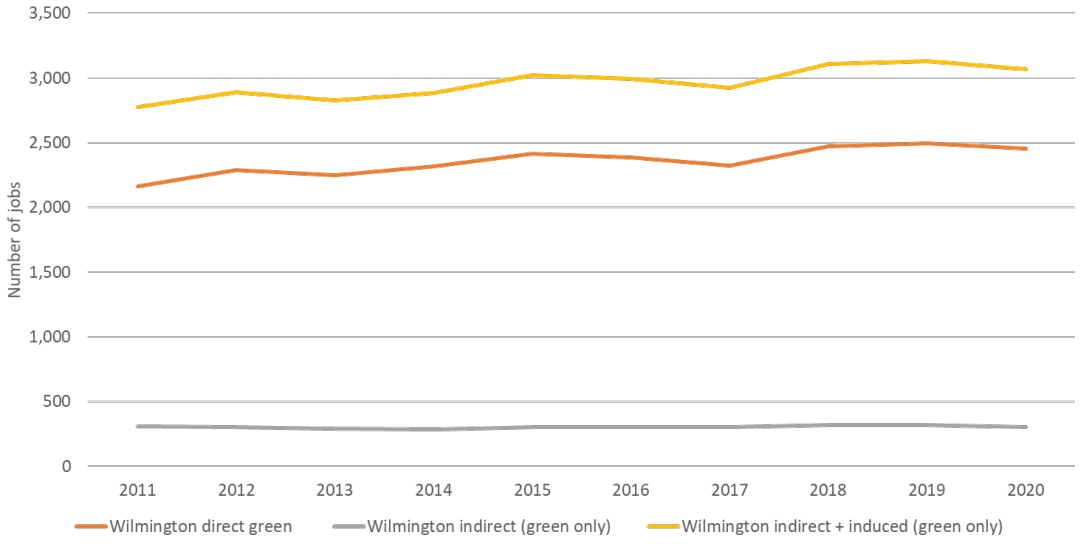
For the jobs analysis, it was integral to know the percentage of employed civilians working in the following five aggregated occupational groups: management, business, science, and arts; services; sales and office; natural resources, construction, and maintenance; and production, transportation, and material moving (Figure 26). We found that most workers in Wilmington are employed in production, transportation, and material moving occupations (25%). The second and third most common occupation groups are service occupations and sales and office occupations, at 22%. The remaining population work in management, business, science, and arts occupations (18%) and natural resources, construction, and maintenance (14%).

Figure 26: Employment for Civilians 16 Years and Older



Using our green jobs calculator for Los Angeles City, we can estimate the number of direct, indirect, and induced green jobs in Wilmington. According to American Community Survey (ACS) data, in 2019 the labor pool in Wilmington was 24,000 workers, and nearly 23% of them had a job considered green. The total number of direct green jobs in 2019 was 3,100, while the total of indirect and induced green jobs was 2,400 (Figure 27).

Figure 27: Wilmington's Direct, Indirect, and Induced Jobs (Green Only)



After analyzing the growth of green jobs within Wilmington, we found that direct green jobs have increased overall since 2011 but have fluctuated over time. Meanwhile, indirect green jobs have declined between 2012 and 2017, compared to 2011. This downward trend could be attributed to the economic structure of Wilmington, which is dominated by sectors with low multiplier effects.

Overall, Wilmington has a relatively young population, a factor which could lead to increased opportunities for development. However, this population also faces significant challenges, such as a high burden of supporting dependents, low voter participation due to language barriers or legal status, and generally low educational attainment. While green jobs in Wilmington have seen some growth, it has been limited. The Port and related industries represent significant economic engines in the area, with high potential for the development of green jobs.

Environmental issues associated with the economic dynamics in the region should be prioritized by both public policy and private initiatives. At the moment, direct green employment lacks a strong link to other green economic activities or industries, which results in limited indirect green job gains. Training and educational programs could aid the Wilmington population in attaining new green jobs, which in turn could address some of the economic issues facing the area.

2.2 Wilmington & Industry Background

The City of Wilmington originated in 1863 and is one of the oldest communities in the City of Los Angeles.[5] In the 1930s the community, at little more than nine square miles, began to experience oil industry fossil fuel extraction and production.[6] The Wilmington oil field is the third largest in the nation: over 3,400 land-based wells have been drilled since 1932 and approximately three billion barrels have been extracted.[7] Beyond extraction, Wilmington also has five oil refineries surrounding the community.[8] These refineries emit large amounts of hazardous chemicals such as benzene, particulate matter (PM), and others that are well known to be the main factor for humans developing respiratory illnesses and cancer.[9]

Wilmington is also in the heart of the Port of Los Angeles, which is the largest container port in the U.S. In 1897, Congress declared the San Pedro Bay as the official Port of Los Angeles. The City of L.A. officially instituted the Port of L.A. Department after Wilmington and San Pedro annexed it to the City of L.A. in 1909.[10] The Port of L.A. not only brought economic growth to the City of L.A., but it also contributed to the development of the state of California and to the rest of the nation by transporting consumer goods in containers all across the country via railroads and trucks. For the purpose of this project, we used this background historical information to show the different industries and sources of energy that impact and surround the community in Wilmington. A map of land use in Wilmington can be found in Appendix D.

The history of the oil industry and Port of L.A. over the years reflect a huge economic benefit and impact not only to the City of L.A., L.A. County, and the State of California; it expands to the whole U.S. From its beginning, the oil industry and the Port of L.A. grew and became one of the largest labor forces in the City of LA. The Port of Los Angeles reported 133,000 jobs for FY 2020 and Marathon (an oil refinery) reported approximately 1,530 full time jobs — this does not include the other four refineries. If adding both job sources, the total equals approximately 134,530 jobs created and counted for the City of L.A. Including the economic impact directly to the Port of LA,

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[5] Sam Gnerre, "South Bay History: Why Wilmington once had its own city hall," *Daily Breeze* (May 20, 2018), https://www.dailybreeze.com/2018/05/20/south-bay-history-why-wilmington-once-had-its-own-city-hall/.

[6] Sujatha Bergen, "Life alongside oil infrastructure in Wilmington, CA," Natural Resources Defense Council, March 21, 2017, https://www.nrdc.org/experts/sujatha-bergen/life-alongside-oil-infrastructure-wilmington-ca#_ftn1.

[7] "History of Oil in Long Beach," City of Long Beach, accessed March 23, 2023, https://longbeach.gov/energyresources/about-us/oil/history/.

[8] Mall, A. & Bergen, S. (2021, October 25). Life Alongside Oil Infrastructure in Wilmington, C. NRDC. Retrieved from https://www.nrdc.org/experts/sujatha-bergen/life-alongside-oil-infrastructure-wilmington-ca.

[9] California Air Resources Board (2003, November), *Community Air Quality Monitoring: Special Studies Wilmington*, California Environmental Protection Agency, accessed April 23, 2023, https://web.archive.org/web/20220901035637/http://www.arb.ca.gov:80/ch/reports/wilmington_sb25_report.pdf.

[10] "History of the Port of Los Angeles," Port of Los Angeles, accessed March 23, 2023, https://www.portoflosangeles.org/about/history.

in fiscal year 2019/2020, the cargo value was $259 billion, and the adopted operating revenue was $533.3 million; this represents a 15.9% increase relative to the FY 2020/21 Adopted Budget.[11]

Wilmington is not only surrounded by five refineries, but it is also the main conduit for all imported goods that exit through the Port of L.A. into the broader West Coast and the rest of the country. A table detailing the proximity of Wilmington Census Tracts to refineries can be found in Appendix E. The Port of L.A. covers 32 miles of waterfront and approximately 7.5 acres of land, mostly within Wilmington. As of 2021, there are a total of 25 cargo terminals in the Port of L.A., including seven container terminals.[12]

Marathon, the largest refinery on the West Coast, has the capacity to process 363,000 barrels of crude oil each calendar day (365) and is in Wilmington. Most of the crude oil is transported from the San Joaquin Valley and extracted from Wilmington, making it the third largest oil reserve in the nation.[13] For the purpose of this case study, the Marathon Refinery is labeled as the primary refinery given that it is the largest refinery on the West Coast. However, there are four other refineries located in Wilmington: ConocoPhillips, Valero, BP Carson, and Phillips 66. Revenues for each individual refinery can be found in Appendix G. It is important to note that the City of Los Angeles Department of Water and Power (LADWP) also has a plant in Wilmington. A map can be found in Appendix .

There is already extensive research on the damaging health effects of urban oil drilling. However, Justice40 funds could be used to research how the community would like to respond to the current issues with oil refineries, and how these plans could be implemented. Being guided by community needs in this way would enable policymakers to understand the necessary social response to drilling, not just the health statistics.

2.3 Wilmington Residents' Health Risk Background

Figure 28 shows that from 2014 through 2018, there were 201,547 new cancer cases in the City of Los Angeles. Of those new cancer cases, 14,432 were found in Congressional District 44, which Wilmington is part of.[14] In Wilmington (ZIP Code 90744), the rate of cancer is 664 per million from air toxic cancer; Wilmington's cancer rate is the highest of any ZIP Code in the South Coast AQMD, at 98%.[15]

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[11] "City of Los Angeles Harbor Department Adopted Annual Budget FY 2021-2022," accessed March 23, 2023, https://kentico.portoflosangeles.org/getmedia/7972487c-0b15-409d-b99a-75d6ae70ede9/Adopted_Annual_Budget_FY2021-2022.

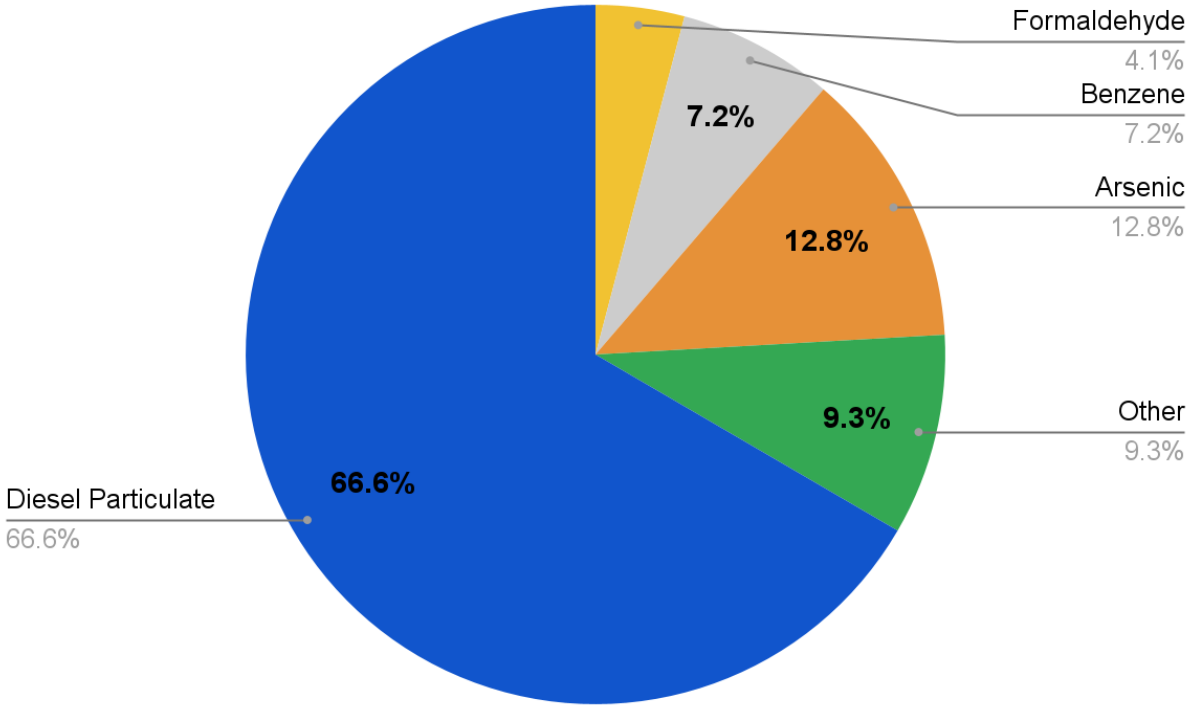
[12] "Harbor Community Off-Port Land Use Study: A Look At The Port Of Los Angeles, San Pedro, and Wilmington," Harbor Community Benefit Foundation, October 2017, accessed March 23, 2023, https://harborcommunitybenefitfound1.app.box.com/s/1f5nlt2mz6mia9w5bpeejyjy0nlwzut3

[13] "Los Angeles Refinery," Marathon Petroleum Corporation, accessed March 23, 2023, https://www.marathonpetroleum.com/Operations/Refining/Los-Angeles-Refinery/.

[14] "United States Cancer Statistics (USCS): Data Visualizations - Congressional Districts," Centers for Disease Control and Prevention, accessed March 23, 2023, https://gis.cdc.gov/Cancer/USCS/#/CongressionalDistricts.

[15] "U.S. Cancer Atlas," American Cancer Society, accessed March 23, 2023, https://experience.arcgis.com/experience/79d3b6304912414bb21ebdde80100b23/page/Main-Page/?data_id=dataSource_105-a5ba9580e3aa43508a793fac819a5a4d%3A153&views=Cancer-Risk%2CClick-tabs-for-other-data.

Figure 28: Pollutants in Diesel Particulate Matter



In the South Coast Air Quality Management District (AQMD) population, pollutants contributing to cancer risk include diesel particulate matter (66.6%), arsenic (12.8%), benzene (7.2%), formaldehyde (4.1%), and other (9.3%)[16]"

- "The highest concentration distribution of diesel particulates was simulated to occur in the grid cells around the Ports of Los Angeles.; Ports area air toxics risk was 1,208; the Ports area experienced an approximate 17% increase in risk[17]"

According to the TRI Toxics Tracker, within an 8-mile radius of Wilmington, there are 91 TRI

[16] "U.S. Cancer Atlas," American Cancer Society, accessed March 23, 2023, https://experience.arcgis.com/experience/79d3b6304912414bb21ebdde80100b23/page/Main-Page/?data_id=dataSource_105-a5ba9580e3aa43508a793fac819a5a4d%3A166&views=Click-the-map-to-see-data%2CCancer-Risk.

[17] "South Coast Air Quality Management District MATES III Final Report, September 2008, accessed March 23, 2023,https://www.aqmd.gov/home/air-quality/air-quality-studies/health-studies/mates-iii/mates-iii-final-report

facilities and there have been 93 chemicals reported in 3 years (from 2018 through 2020). Wilmington released 1,869,167 pounds of toxic chemicals; there were only two source reduction activities found in 90744.[18]

2.3.1 Pollution and Education

Carbon monoxide (CO) is an air pollutant primarily released by cars. According to the Carbon Monoxide and Health overview produced by the California Air Resources Board, "For people with cardiovascular disease, short-term CO exposure can further reduce their body's already compromised ability to respond to the increased oxygen demands of exercise, exertion, or stress. Inadequate oxygen delivery to the heart muscle leads to chest pain and decreased exercise tolerance. Unborn babies whose mothers experience high levels of CO exposure during pregnancy are at risk of adverse developmental effects."[19]

Using concentration estimates developed by the Center for Air, Climate, and Energy Solutions (CACES),[20] we can compare specific portions of Los Angeles to the rest of the County. Every single residential census block group in Wilmington has a higher estimated concentration of carbon monoxide than the L.A. County concentration, ranging from .407 to .442 parts per million. Further, in the residential block groups containing or adjacent to industry, the concentration is estimated to be even higher than in the other residential block groups. This can be seen in the map form in Appendix F.

Beyond the health impacts, carbon monoxide poisoning can have other negative downstream effects. The educational effects mentioned earlier correlate with carbon monoxide concentration: the higher the concentration, the lower the graduation rate. This does not establish causation but does point to an important correlation that should be studied further.

There is also strong evidence that in-utero exposure to roadway air pollution may lead to an increased risk of autism spectrum disorder in children.[21] The heavy corridors of traffic in gateway communities thus may lead to higher rates of autism in the children being raised there. The environmental health justice aspect here is clear and very important; such an exposure situation could also negatively affect the scholastic outcomes of these children; especially as marginalized parents may not have the money or time to ensure academic success.

While there is a strong correlation between carbon monoxide concentration and health and educational impacts, that relationship is not causation. More research needs to be conducted on this front; a good target for Justice40 research funding would be to investigate the residential areas

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[18] "TRI Toxics Release Inventory," United States Environmental Protection Agency, accessed March 23, 2023, https://edap.epa.gov/public/extensions/TRIToxicsTracker/TRIToxicsTracker.html#continue.

[19] "Carbon Monoxide and Health," California Air Resources Board, accessed March 23, 2023, https://ww2.arb.ca.gov/resources/carbon-monoxide-and-health#:~:text=Carbon%20monoxide%20is%20harmful%20because,oxygen%20delivery%20to%20the%20brain.

[20] CACES Data, Center for Advancing Community Engaged Scholarship, accessed March 23, 2023, https://www.caces.us/data.

[21] Cortez-Lara, A., Munoz, C., Hasheminassab, S., & Gomaa, H. (2022). A novel approach to assess health disparities related to air pollution exposure in Los Angeles. Environment International, 158, 106992. https://doi.org/10.1016/j.envint.2021.106992

surrounding industry in Wilmington and to determine whether carbon monoxide and other pollutants are leading to an increase in birth defects, including autism.

2.4 State Policy Impacting Wilmington and Challenges

According to the California Air Resources Board (CARB), "the Cap-and-Trade Program is a key element of California's strategy to reduce greenhouse gas emissions."[22] Yet Cap-and-Trade continues to allow polluters to burden Wilmington, as it is part of the 15 air pollution impacted communities under Assembly Bill 617 (AB 617) authored by Assemblywoman Christina Garcia and signed by Governor Newsom on July 26, 2017.[23] After the Cap-and-Trade legislation reauthorization, the Environmental Justice (EJ) community in California supported a bill that would mitigate air pollution estimated to increase under Cap-and-Trade concentrated along low-income, underrepresented, disadvantaged fence-line communities where mostly poor people of color live.

2.4.1 Cap and Trade Function

The Cap-and-Trade Program aims to regulate 80 percent of California's greenhouse gas (GHG) emissions through economic incentives towards the investment of efficient, cleaner technologies. Under the Cap-and-Trade Program, CARB establishes the cap, which is an allowance that includes the total amount of permissible emissions for each eligible entity. Using the 100-year global warming potential, one allowance is equivalent to one metric ton of carbon dioxide emissions.

The annual cap declines each year as fewer allowances are created; however, covered entities are able to acquire allowances through three of the following ways: auction, limited free allocation, and trading with other entities in the program (also referenced as the trade). Most allowances are accessible to registered entities through quarterly allowance auctions. These entities are required to surrender allowances and a limited number of offset credits in order to cover GHG emissions. A steady and sustained carbon price signal that prompts action to reduce GHG emissions is set by the increasing annual auction reserve price on allowances and the reduction of annual allowances.[24] An in-depth analysis should be conducted of the businesses tied to Wilmington to evaluate the degree to which this program has resulted in decreased emissions.

CARB implemented the Community Air Protection Program, referred to as CAPP or the Program, in response to Assembly Bill (AB) 617, as a way to reduce exposure to communities most impacted by air pollution.[25] As a result, communities throughout California are working together to develop and implement new strategies to measure air pollution and reduce health impacts.

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[22] "Cap-and-Trade Program," California Air Resources Board, accessed April 22 2023, https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program.
[23] "CalEnviroScreen 4.0 - California Communities Environmental Health Screening Tool," California Air Resources Board, accessed March 23, 2023, https://ww2.arb.ca.gov/capp-communities.
[24] "FAQ - Cap-and-Trade Program," California Air Resources Board, accessed March 23, 2023, https://ww2.arb.ca.gov/resources/documents/faq-cap-and-trade-program#ftn22.
[25] "Community Air Protection Program," California Air Resources Board, accessed April 22 2023, https://ww2.arb.ca.gov/capp.

CAPP created programs in communities, such as air monitoring and emissions reduction, and provided funding and grants to further support the efforts against air pollution. Funding and grants were allocated by the Legislature with the intention of having cleaner technologies in these communities; Wilmington, West Long Beach, and Carson were the first to be considered for AB 617 Community Steering Committee implementation. AB 617 established requirements in CA to control industrial sources, increase penalty fees, and provide transparency on data about air quality and emissions.[26]

2.5 Wilmington Residents' Low Political Participation

Low voter turnout and political participation pose significant challenges in Wilmington. According to the American Community Survey, there were 25,947 citizens in Wilmington eligible to vote in the 2020 presidential election. However, only 8,642 votes were cast, with Biden receiving 6,725 and Trump receiving 1,917. This means that only 33% of the eligible population voted, highlighting a low level of political participation and civic engagement in the community. In addition to the eligible population, there is a significant population of non-citizens in Wilmington, both reported and unreported. This has significant consequences, as it means that the government may not fully represent the needs of the community. To address this issue, a network of outreach programs could be established to strengthen civic engagement in the community and encourage eligible individuals to vote.

2.6 Community Engagement in Wilmington: Guide for Community Outreach Methodology

To conduct effective community outreach, we outline the following important actions that must be taken into account. We also include considerations for community engagement curriculum. In our quest to identify the best approaches and methods for developing community engagement curricula in DACs, our team of two researchers at the UCLA IRLE decided to create this step-by-step community engagement guide. This guide can be used to replicate, test, or learn from to craft community engagement best practices specific to each community. One of the researchers and project managers has extensive knowledge of the Wilmington Case Study and is closely related to it.

Our goal is to find pro-environmental solutions that mitigate pollution by empowering community leaders to lead conversations on what Wilmington residents need and want, based on factors such as the environment, education, health, and green jobs. Community residents want to lead and work in the Wilmington Green Jobs Workforce Development pilot project, which can help create economic sustainability, equity, and neighborhood resiliency.

Going to the residents. A great way to partner with communities is by going where residents are, such as hair salons, stores, community events, schools, local centers, and parks. Do not call for a virtual meeting expecting that community stakeholders, specifically residents, will attend. The majority of environmentally disadvantaged communities (DACs) are not equipped with the technology to enroll and attend virtual meetings. Many residents living in DACs do not have a laptop or computers, and on most occasions do not have internet service, know how to download

[26] "About the Cap-and-Trade Program," California Air Resources Board, accessed March 23, 2023, https://ww2.arb.ca.gov/capp/about.

apps, or use virtual platforms, even though most do have a cell phone. Consider approaching community-based organizations to learn from their experiences with the community and the challenges they face.

Connect with people individually. When calling for residents of DACs to attend in-person meetings, it is important to speak to each participant individually before the first meeting. This will help establish the most effective and sensitive form of communication. Consider the level of language used and the approach to information delivery when creating any presentation, simplifying government language/terms as well as academic jargon.

Interpretation. Interpreters should always be available if the majority of the community speaks a language other than English. Knowing the demographics of the community and languages preferred before conducting community engagement meetings is crucial to preparation. Research the area and learn from residents about any commonly used lingo or terms.

Building trust. To build trust, it is important to be transparent, honest, and direct. Listen to the community first before presenting the reasons why you are there. Always remember that you are in the community space, and they are the experts on the issues affecting them.

Let the community lead. Plan *with* the community, and let them lead. Avoid organizing and planning for a series of meetings ahead of time, as each meeting will direct the flow of the next. In this way, the community can help shape meetings. Avoid having your own expectations or those of your company, as this may make the community partnership and engagement meetings ineffective and may result in losing the community's trust and partnership.

2.6.1 Survey Methodology

Collecting data via surveys for metric purposes is an essential aspect of community engagement. It helps to measure levels of knowledge on a subject, levels of understanding, and degrees of language proficiency. It is important to consider the level of difficulty in simplifying government and academic language to people's language. In our work, most of the participants did not have high school diplomas.

Our team developed and tested a survey (Appendix I) to measure the best approach for sharing data and information. Before starting the first community engagement meeting, participants filled out a questionnaire to help us gauge their initial level of understanding. After the last meeting, the survey was retaken. The goal was to measure any increased understanding and familiarity with green jobs and workforce development for each individual pre- and post-engagement meeting. A second survey was administered (Appendix J) to capture and compare the demographic representation of participants within the group with census data for Wilmington.

In the second survey, we aim to capture the participants' awareness of and participation in rebates and discounted City of Los Angeles Department of Water and Power (LADWP) programs, including the Low-Income Discount program, the Physicians Certified Allowance Discount (PCAD) program, the Life Support Equipment Discount program, and the Senior Citizen/Disability Lifeline program. Our goal with this question was to compare the number of households in ZIP Code 90744 participating in income based LADWP discounted programs with those in our sample population. In the next section, we analyze LADWP data on rebates and discounted programs for Wilmington. Figures 29, 30, 31, and 32 all show the number of

participants for each program from 2017 through 2021, while the raw data can be found in Appendix K.

2.6.2 Survey Findings

To assess the participants' familiarity with green jobs and workforce development, we created a survey that was conducted before the community engagement sessions. The purpose of this survey was to inform the development of the curriculum. Additionally, the same survey was administered after the completion of all community sessions to track the increase in understanding and confidence in the material among community members. The survey was completed anonymously by the same 20 participants on both occasions. Based on our analysis, the main findings are:

1. The level of understanding about green jobs increased greatly, with 85% of participants indicating an above average or very high understanding compared to only 15% in the first survey.

2. The level of understanding about the purpose of LADWP increased greatly, with 70% of participants indicating a higher than average or very high understanding in the second survey, compared to only 55% in the first survey.

3. While participants feel better informed about job opportunities in their communities, some still feel like they could use more guidance. The number of participants who felt very empowered or extremely empowered more than doubled between the first and second survey. However, 60% of participants still felt either slightly or moderately informed.

4. Participants feel more comfortable about training others, with 75% of participants indicating they feel either very empowered or extremely empowered to train other community members on green jobs and workforce development, compared to only 50% in the initial survey. Furthermore, only 1 participant indicated feeling slightly empowered, compared to 7 people in the initial survey.

5. All participants maintained their interest in having a green job, with 80% indicating their desire for a green job in the second survey, compared to 75% in the initial survey.

6. There was a slight increase in participation in workforce development programs, with 2 more participants indicating participation in a workforce development program in the second survey, and four others unsure if they had been part of a program. In the initial survey, 90% of participants indicated they had never been a part of a workforce development program, with only one participant stating they participated in a program.

7. Interest in certification and training slightly increased, with 75% of participants indicating a very high interest in receiving certification or training from LADWP in the second survey, compared to 55% in the first survey. In both surveys, all participants had indicated an interest in receiving certification or training from LADWP.

Figure 29: Low Income Program Participants (2017-2021)

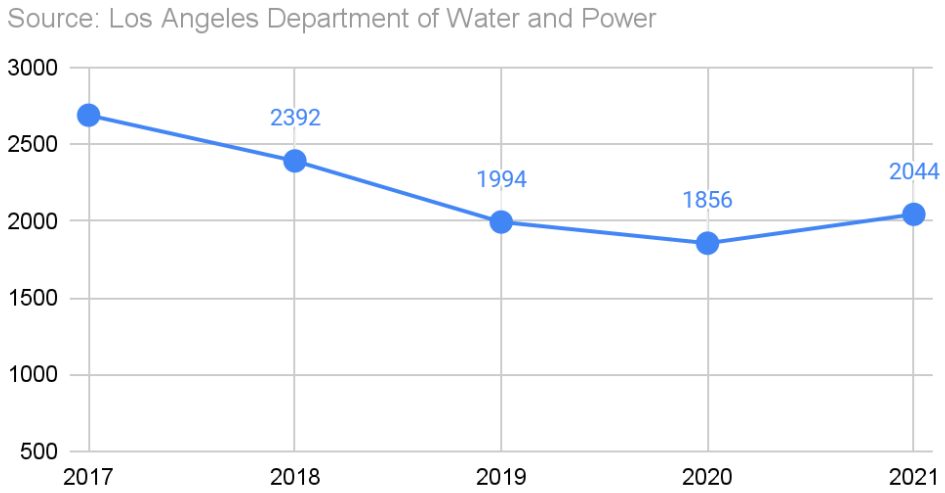


Figure 29 illustrates a decrease in the number of Low-Income Program participants. While the number has increased since the COVID-19 pandemic, it has not returned to its peak level of 2017. Despite the decrease, this program has higher enrollment rates than the other three. The reason for the decrease in participants is currently unknown. However, it is important to note that due to the pandemic, a local DWP office in Wilmington was shut down and has not been reopened.

Figure 30: PCAD Program Participants (2017-2021)

Source: Los Angeles Department of Water and Power

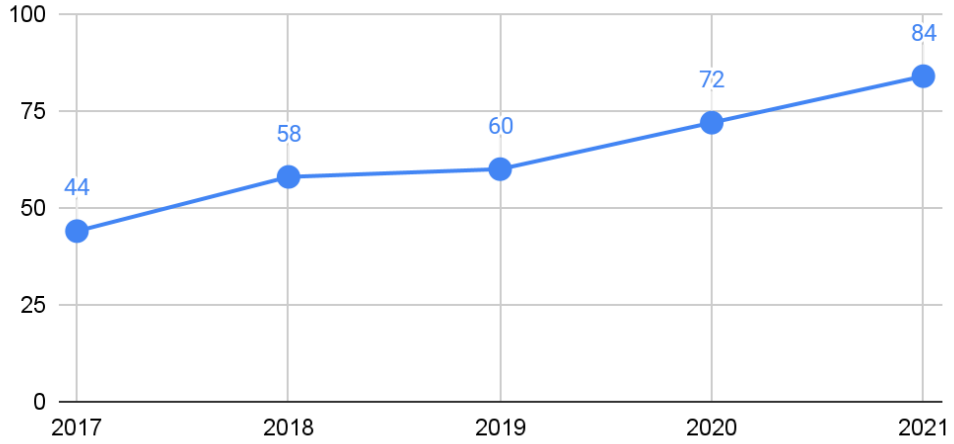
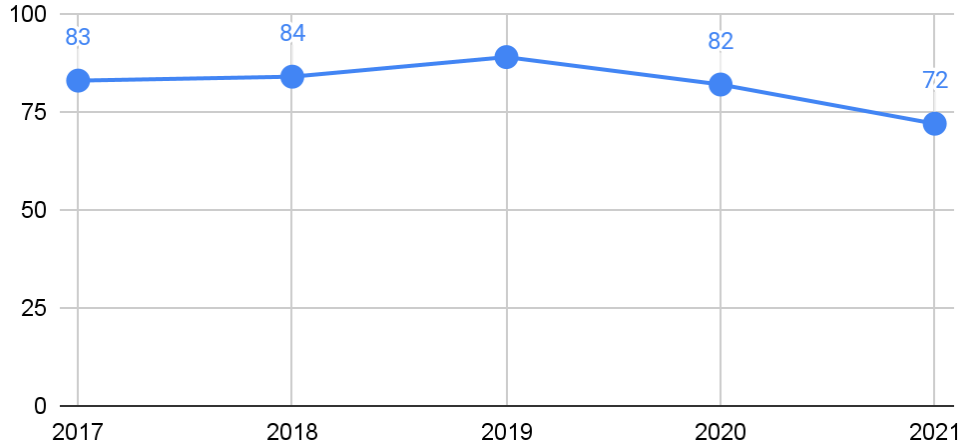


Figure 30 depicts a different story: an increase in participants since 2017. Yet the overall enrollment is significantly less than the low-income program.

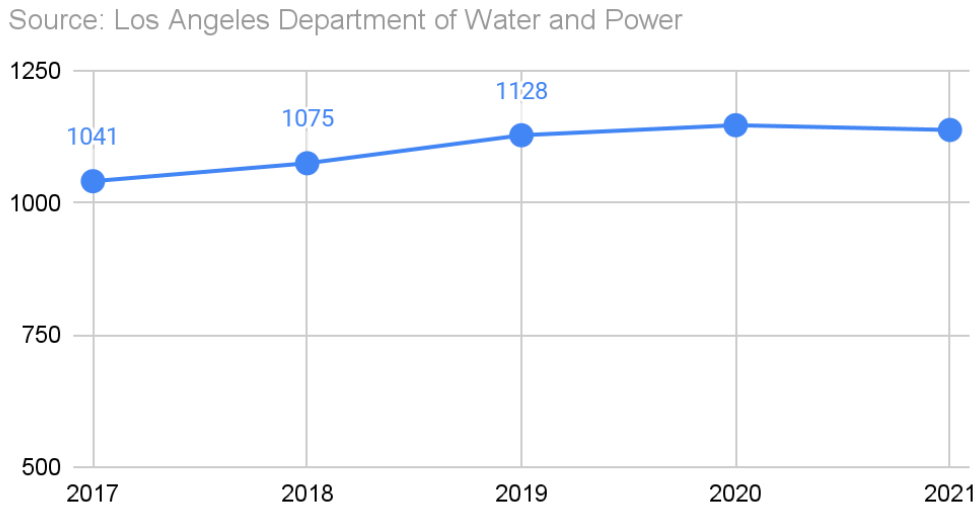
Figure 31: Life Support Program Participants (2017-2021)

Source: Los Angeles Department of Water and Power



The Life Support program has also experienced a small decrease in enrollment, as demonstrated by Figure 31. Yet it is still the most consistent of the four programs.

Figure 32: Lifeline Program Participants (2017-2021)



The Lifeline Program has the second highest number of Wilmington residents enrolled, and has been rather consistent since 2017, as shown in Figure 32. In fact, the number of participants has increased since 2017 by about 100 residents.

When we compare the number of Wilmington households enrolled in the program with the total number of households in Wilmington, we see that the share of households for all programs is under 30% (Table 11). This percentage is particularly alarming given that both our data and census data place Wilmington residents at the lower end of the income distribution when compared to the rest of Los Angeles County.

This could potentially mean that eligible households are not enrolled. We speculate that this low enrollment could be due to a few reasons, such as a lack of legal status, which can also mean a lack of accepted government identifications often required by utility companies, a lack of accessibility to a LADWP representative, and the fact that most low-income individuals are renters rather than homeowners.

Table 11. Percentage of Wilmington Households Enrolled in LADWP Rebate and Discount Programs

Year	Total Households	Households receiving LADWP rebates/discounts	Share of households with benefits
2017	14509	3858	27%
2018	14638	3609	25%
2019	14788	3271	22%

2020	14938	3157	21%
2021	14995	3338	22%

Source: American Community Survey and LADWP administrative data

Furthermore, in our second survey, we asked participants if they had applied to any discount or rebate programs with LADWP. Approximately 70% said no, and 30% said yes. Considering that more than half of the respondents' yearly income lies between $0 and $39,000, we believe that Wilmington residents are under-enrolled in these programs.

2.7 Green Jobs Workforce Development Literature

The team also conducted a literature review to identify best practices for workforce development that are specific to green jobs. As various traditional jobs transition to clean or green jobs, it is important to discuss the investments that need to be made for these transitions to happen successfully. According to policy experts at UC Berkeley, some of the key elements are:

- Investing in adult education and workforce training programs to help workers gain new skills and advance their careers;
- Supporting apprenticeship programs in high-growth industries like clean energy;
- Expanding access to quality daycare and early education programs to allow parents to enter the workforce;
- Increasing funding for community colleges and universities to ensure students can afford to attend; and
- Implementing labor standards and protections, such as paid leave, to improve working conditions and promote job quality.[27]

Moreover, we know that these considerations will be particularly important given the projections for increased green jobs. According to the Bureau of Labor Statistics' Green Jobs 2030 Projection Report, there is a predicted "growth in occupations related to helping the environment or conserving natural resources."[28] Solar and wind occupations will see the largest growth through 2030. Meanwhile, other related occupations such as environmental scientists, environmental engineers, and environmental technicians are expected to see smaller but consistent growth.

While many pieces of literature were reviewed, there was one aspect that none of the literature touched on, which is immigration status. One of the characteristics that makes the people of Wilmington so unique when thinking about workforce development is the lack of legal status and thus work authorization for many residents. More research is needed regarding the potential

[27] Berkeley Labor Center, Putting California on the High Road: A Jobs and Climate Action Plan for 2030 (Berkeley: UC Berkeley Center for Labor Research and Education, September 2020), https://laborcenter.berkeley.edu/wp-content/uploads/2020/09/Putting-California-on-the-High-Road.pdf.

[28] Bureau of Labor Statistics. "Green growth: Jobs in the U.S. renewable energy industry," Career Outlook, U.S. Department of Labor, February 2022, accessed March 23, 2023, https://www.bls.gov/careeroutlook/2022/data-on-display/green-growth.htm.

inclusion through other avenues, such as Individual Taxpayer Identification Numbers (ITINs), for the undocumented workforce.

2.7.1 Alignment with State Efforts for Workforce Development & Lessons Learned

California is currently making efforts to address the barriers that many individuals like those in Wilmington face in accessing quality employment. In 2017, the California Legislature passed Assembly Bill 1111, also known as the Removing Barriers to Employment Act, which established the Breaking Barriers to Employment Initiative (Breaking Barriers). Since then, the program has expanded and received over $25 million in implementation funds.[29]

The program has 21 target populations, including:

- Youth disconnected from the education system or employment;
- Women seeking training/education to enter nontraditional careers;
- Unskilled or under-skilled low-wage workers;
- English learners;
- Economically disadvantaged people; and
- Immigrants, migrants, and/or seasonal workers.[30]

As of January 2021, which was 22 months into the 24-month program, the Breaking Barriers grantees had already enrolled 2,510 participants, exceeding the enrollment goal of 2,301.[31] The program's high enrollment rates indicated a strong interest and demonstrated the need for workforce preparation among marginalized populations, particularly after the effects of the COVID-19 pandemic.

After evaluating the program, the California Workforce Development Board developed recommendations for improving Breaking Barriers for future efforts. These recommendations are broadly applicable to other workforce development programs and are important to consider. The recommendations are:

- Identifying ways to strengthen the relationship between community-based organizations (CBOs) and local workforce development boards (WDBs). This can be done by defining clear expectations for each group and identifying partnership strengths and weaknesses.
- Finding ways to standardize program elements. While each program should be crafted around the specific needs of the population it is serving, there are some elements that could be standardized across the board to ensure cohesion in training. An example of this would be grantees using CalJOBS to define goals and easily track goal completion.

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[29] California Workforce Development Board, Breaking Barriers to Employment Initiative, accessed April 20, 2023, https://cwdb.ca.gov/initiatives/breakingbarriers/.
[30] Ibid.
[31] California Workforce Development Board, Breaking Barriers to Employment Initiative Evaluation Report, February 2023, accessed April 20, 2023, https://cwdb.ca.gov/wp-content/uploads/sites/43/2023/02/Breaking-Barriers-Evaluation-Report-Final_ACCESSIBLE.pdf?emrc=5af3c9.

- Refine and target technical assistance. This change would reflect the above recommendations and should focus on strengthening relationships between CBOs and WDBs.[32]

2.7.2 Wilmington Equitable Green Jobs Workforce Development Pilot Project & Funding

During the community engagement process, our team had the opportunity to meet with various stakeholders, including community based organizations (CBOs), unions, small business owners, schools, church clergy, and others. We held weekly meetings with grassroots groups and monthly meetings with the Environmental Justice EPA Region 9 Community. Through these engagements, we identified several community grants aimed at supporting CBOs located in disadvantaged communities, in line with the Justice40 prerequisite.

As part of President Biden's Inflation Reduction Act, approximately $3 billion in Environmental and Climate Justice (ECJ) program funds have been allocated specifically for overburdened communities like Wilmington. One of the areas of focus for funding is workforce development and green jobs. In the summer of 2023, the EPA will be announcing the ECJ grant opportunities and technical support.

In partnership with two CBOs and Congresswoman Barragan, we were able to secure the first Community Grant of $4 million for a Career Technology and Innovation Center for Green Jobs Workforce Development Pilot Project. Wilmington grassroots groups have expressed the need for residents to be involved in running, developing, and working in the new Green Jobs Workforce Pilot Project. Other organizations are also planning to join efforts in the near future.

2.8 Recommendations

- Develop strategies for combating environmental racism in frontline communities such as Wilmington, which are disproportionately affected by industrial and transportation pollution. This approach includes exploring how policies related to reducing the emissions from the movement of goods and the oil industry can be improved, with a focus on how proximity between residences and toxins can have negative health outcomes. Research could help find the right approach that can mitigate respiratory health impacts as well as cancer and other diseases.[33]
- Identify green jobs industry sectors from the Port of L.A. and/or refineries and move towards a pilot program or laboratory approach for a larger scale case study in Wilmington.[34]
- To address environmental justice/racism/migration and income inequality: Expand the analysis of the population in Wilmington, particularly foreign-born and Latinx, which

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[32] Ibid.

[33] Los Angeles Cleantech Incubator & HR&A Advisors (2021, January 29). Green Jobs in Los Angeles: Opportunities for Economic Recovery Through Equitable Workforce Training. https://laincubator.org/wp-content/uploads/LACI-GREEN-JOBS-REPORT.pdf.

[34] Zabin, Carol., et al. "Diversity In California's Clean Energy Workforce: Access To Jobs For Disadvantaged Workers In Renewable Energy Construction." University of California, Berkeley Center for Labor Research and Education, 2017

might explain the low voter turnout, poor political participation, and minimal representation at every level of government. Further research is needed to understand the low educational attainment in Wilmington.[35]

- Prioritize workforce development opportunities in Wilmington for individuals with lower educational attainment opportunities to include them in access to green jobs skills training.
- Include ITINs (Individual Taxpayer Identification Numbers) as an alternative to social security number as a requirement to qualify for Workforce Development Center services. Furthermore, expanding acceptable forms of identification that do not comply with federal requirements to include California driver's licenses would expand the pool of applicants.

[35] Union of Concerned Scientists Fact Sheet. Inequitable Exposure to Air Pollution From Vehicles in California, February 2019, accessed January 2022, https://www.ucsusa.org/sites/default/files/attach/2019/02/cv-air-pollution-CA-web.pdf

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Methodology for Calculator[36]

L.A. City asked for a Green Goods and Services (GGS) Employment Calculator Platform that relies on publicly available information/data sources. We have designed a Platform that uses data from the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA). To undertake a comprehensive estimate of the total employment created by GGS sectors, we consider the a) direct, b) indirect, and c) induced effects of job creation in those industries, which are explained in the following sections.

Direct Effects

Direct employment is jobs created due to investments in specific sectors, here defined as Green Goods and Services (GGS). To estimate the direct employment effects created by GGS sectors, we have built a database that relies on publicly available actual data from the BLS, using the shares of jobs considered as GGS by sector, and the yearly employment data presented in the Quarterly Census Employment and Wages (QCEW).

The database was built based on the sectors that the Bureau of Labor Statistics has designated as benefiting the environment at a 6-digit North American Industry Classification System (NAICS) sector level[37] from 2011 to 2020. The shares of GGS jobs by sector presented by BLS in 2011[38] were multiplied by the total number of jobs in L.A. County by sector in those years, which is presented by the BLS Quarterly Census of Employment and Wages (QCEW). The shares of GGS by sector are shown at 4-digit and 6-digit NAICS levels, so we have made an analysis of both 4-digit NAICS (aggregating the 6-digit NAICS levels for some sectors), and 6-digit NAICS. The results presented here reflect the 6-digit NAICS analysis, due to greater accuracy.

Indirect and Induced Effects

Indirect employment arises from jobs created in sectors that are related to the GGS sectors in supply chains of intermediate inputs as a consequence of the economic activity created by the GGS sectors. Induced employment refers to jobs that are created as a result of the increased income and consumption expenditure by workers employed in the sectors both directly and indirectly linked to the GGS sectors.

To estimate the indirect and induced effects, we used a Multisector Social Accounting Matrix (SAM)-based multiplier model. The advantage of using SAM models over input-output models is that the SAM model includes the full circular flow of income in the economy, including the generation of income in production value chains (value added), and how that income is distributed to households and government (through taxes), providing households with income to buy the goods and services produced. The SAM provides a highly disaggregated picture of the

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[36] The results for the GGS jobs calculator can be accessed at this link:. https://naid.center/gis-maps

[37] Bureau of Labor Statistics (2010), "Industries where green goods and services are classified,"https://www.bls.gov/green/final_green_def_8242010_pub.pdf

[38] Bureau of Labor Statistics (2013), "Green Goods and Services (GGS) private sector employment by detailed industry" and "Green Goods and Services (GGS) employment by industry sector in government," https://www.bls.gov/green/final_green_def_8242010_pub.pdf

economy. In the SAMs for this study, there are 184 production sectors (industries), employing four different types of labor and capital to produce 102 different commodities. The income generated in the production sectors is distributed to 10 different household types (differentiated by income level). The income they receive is used for private consumption expenditure (disaggregated by commodity), savings, transfers, and taxes. Governments receive taxes and make expenditures, including transfers to households. There are also indirect taxes on commodities. Finally, the economy is open, with imports of goods and services adding to domestic supplies, and exports and other international transfers adding to demand. Input-output analysis only considers the relations between industries through flows of intermediate inputs, which is only part of the circular flow in the economy.

In standard multiplier analysis, there are two key assumptions:

- Industries demand inputs in fixed proportions to output; technology and preferences are linear.
- Prices are fixed. Adjustments to shocks work through changes in quantities, not prices.

Considering how the effects at the disaggregated sectoral level are transmitted across the economy requires a multisector approach that captures the complexity of an interconnected economy. Historically, empirical work focused on inter-industry linkages as measured by input-output tables.[39] An extension of that work is based on a SAM matrix that expands the input-output table to include more linked economic actors than just industries.[40] A SAM shows the full circular flow of income in the economy, including the generation of income in production value chains (value added) and how that income is distributed to households and government, which in turn buys the goods and services produced in the economy.

Spatially and visually, a SAM is a square matrix where each entry represents a payment by a column account to a row account. Each account provides expenditure/receipt data for an economic "actor" and the table reflects double-entry bookkeeping. The column and row sums for each account must balance. For a national SAM, the table provides a complete and potentially highly disaggregated picture of the domestic economy that includes all economic transactions and integrates sectoral (input-output) data with the national income and product accounts in a consistent framework.

Figure 1 provides a simplified example of a "standard" SAM. The first three accounts (industries, commodities, value added) provide disaggregated data for goods and services. "Industries" produce goods and services, buy intermediate inputs ("use" matrix), pay factors of production (value added or factor cost) and pay indirect taxes. Industries represent the "productive" side of the economy, generating Gross Domestic Product (GDP) at factor cost. The "commodity" accounts purchase all sectoral production net of intermediate demand (supply/make matrix) and also purchase all imports. This account represents the total supply of goods and services. The "supply/make" matrix allows for the possibility of industries producing more than one

[39] SAM multiplier models are described in detail in Ronald E. Miller and Peter D. Blair, "Social Accounting Matrices," in *Input-Output Analysis: Foundations and Extensions*, 2nd ed., (Cambridge: Cambridge University Press, 2009), 499–541.
[40] See Miller and Blair (2009), chapter 11, "Social Accounting Matrices."

commodity and commodities being produced by more than one industry. Total supply available for use in the domestic economy nets out exports.

In Figure 1, the link between the SAM and the national accounts is clear from accounting identities (row sums equal column sums):

$$\text{GDP (factor cost)} + \text{indirect taxes/tariffs} = \text{GDP (market prices)} = C + I + G + E - M.$$

$$\text{GDP} + M - E = \text{aggregate supply} = \text{aggregate demand} = C + I + G.$$

SAMs and models based on SAMs provide an appropriate empirical framework for analyzing the comprehensive effects of sectors considered as Green Goods and Services in other industries and household segments of the economy.

A SAM-Multiplier model starts from the SAM shown in Figure 1. A matrix of coefficients is created by dividing all column entries by column sums. These coefficients are assumed to be constant and to define production technology (input-output and value-added coefficients) and a fixed-share demand system for final demand (consumption, government, investment, and exports). Prices are also assumed to be fixed, so any adjustments to "shocks" occur through changes in quantities demanded and supplied. rather than through changes in prices in commodity and factor markets.

To estimate the indirect and induced GGS employment effects, we have multiplied the total GGS direct jobs, described in the previous section, by the multiplier estimated through the SAM. Adding the GGS direct, indirect, and induced effects, we estimate the total employment on GGS sectors.

Figure 1: Simplified Example of Standard Social Accounting Matrix (SAM)

		Input-output accounts			Macro accounts			
		Industries	Commodities	Value added	Households	Investment	Government	World
I-O accounts	Industries		supply/make matrix					
	Commodities	use matrix (i-o matrix)			consume C	invest I	govt G	exports E
	Value added	factor cost						
Macro accounts	Households			household income	transfers		transfers	
	Savings				private saving		govt saving	foreign saving
	Government	indirect taxes	indirect taxes/tariffs		direct taxes			
	World		imports M		net remittances			

Excel Platform Methodology

Two SAM Multiplier Models to Estimate GGS Jobs

The SAM multiplier model provides estimates of direct, indirect, and induced multipliers depending on which sectors and institutions we consider as endogenous. These effects are the result of changes in exports, government spending, or changes in output. The direct effects are those pertaining to the sectors that are being affected by the changes in one of the variables. The effects considered indirect changes in this Platform are generated by production linkages related to the sector directly impacted by the changes, which can be backward and forward linkages in supply chains of intermediate inputs. Induced effects are those related to the generation of additional incomes for factors and households as a result of the direct and indirect effects.

We have estimated two models, SAM1 and SAM2, which capture different interrelations through transfers and transactions between sectors and institutions, and thus, reflect different multiplier effects. To estimate these effects, we first created the Los Angeles County SAM. Then, a coefficient matrix was derived through the division of each column in the SAM by its column total, which is called the M-matrix. As a third step, we subtracted the M-matrix from an identity matrix, resulting in the (I - M) matrix, which will be used to estimate the multiplier effects depending on the sectors and institutions considered as endogenous.

SAM1 Model

The SAM1 model reflects the indirect multiplier effects that are related to changes in output in a given sector. For this, we have considered only the "productive" sectors or activities as endogenous, while other sectors or institutions, such as households, factors, government, and the rest of the world, have been considered exogenous. Inverting the (I-M) matrix only for the sectors considered as endogenous results in the indirect multiplier effects for each of the 184 sectors.

SAM2 Model

The SAM2 model includes the indirect plus induced multiplier effects that are related to changes in output in a given sector. In this model, activities (such as the SAM1 model) and households were considered endogenous, which reflects both the increase in production due to economic linkages between sectors and increased demand, the increase in household income, and the increased direct and indirect production. Inverting the (I-M) matrix for the endogenized sectors and institutions results in the indirect plus induced effects for each of the 184 sectors. These effects are larger than with the SAM1 model because it takes into account the production of related sectors and the production due to the increases in income and spending.

Los Angeles City Estimates

The SAM used in the model is for Los Angeles County, since there is not enough information available to estimate a SAM for Los Angeles City. We have created a jobs calculator for Los Angeles City based on available information from the American Community Survey (ACS), retrieved from IPUMS, which provides information on employment in different industries and geographic levels, including cities and counties. This data set is used to downscale the Los Angeles County SAM multiplier results to the level of the city of Los Angeles.

We estimated shares by industry between Los Angeles City and Los Angeles County, and then aggregated the average share using the bridge between NAICS sectors and our 184 SAM sectors. These average aggregated shares are multiplied by the number of jobs estimated through our Los Angeles County SAM.

Appendix B: Green Jobs Calculator Platform: Training Manual

The Los Angeles Green Jobs Calculator Platform was designed to track the evolution of data on green jobs in Los Angeles City and County historically as well as on an ongoing annual or quarterly basis. The Training Manual is designed to assist L.A. City staff on the step-by-step process of using the Calculator Platform to create a historical back-tracking as well as facilitating the incorporation of new annual or quarterly data on the evolution of green jobs in Los Angeles, including direct, indirect, and induced jobs. The Training Manual also contains a detailed Methodological Appendix on data sources, software files, definition of terms, and uses of the Calculator Platform.

The Training Manual provides details on three major steps for using the Green Jobs Calculator Platform.

1) Data preparation
    a) Data downloading
    b) Data sorting by establishment ownership
2) Steps for green jobs calculations
    a) Step 1: Direct green jobs calculation
    b) Step 2: Calculation of direct, indirect, and induced green output and jobs in Los Angeles County and Los Angeles City
    c) Step 3: Calculation of direct, indirect, induced green and non-green jobs by race categories in Los Angeles County and Los Angeles City
3) Preparation of final tables

The Calculator Platform will generate data on green jobs directly related to green sectors, as well as indirect and induced jobs related to those direct jobs. Direct jobs are estimated as only green jobs, while indirect and induced jobs are estimated both as a combination of green and non-green jobs, as well as only green jobs.

In this manual, we describe a step-by-step process to calculate the number of direct, indirect, and indirect + induced total green jobs in Los Angeles County and Los Angeles City, as well as green jobs by race categories in both regions. The only information the user will need is Quarterly Census of Employment and Wages (QCEW) data accessible from the U.S. Department of Labor, sorted by ownership codes (Private, Local Government, State Government, and Federal Government).

This Platform has been set up to calculate the number of green jobs by a predetermined list of 184 input-output and Social Accounting Matrix (SAM) sectors created by the research team, as well as for a list of sectors of interest by the Los Angeles City.

Step-by-Step Process

In the following paragraphs, we describe the process to estimate the number of green jobs. First, we describe the data preparation process, and then we describe the steps to calculate green jobs in Los Angeles County and Los Angeles City. In step 1**,** the Platform calculates direct green jobs at the level of Los Angeles County. In step 2, the Platform calculates the "output" data required for jobs estimates. In step 3, the Platform estimates direct, indirect, and induced green jobs and

linked non-green jobs (differentiated by race categories) in Los Angeles County and Los Angeles City, which provides results for 184 sectors. Also, the county-level results are downscaled to provide results for Los Angeles City, focusing on sectors of particular interest for the city.

Data Preparation

First, to calculate the number of direct, indirect, and induced green jobs, you need to provide data from the Quarterly Census of Employment and Wages (QCEW) provided by the Bureau of Labor Statistics. You can download the input data from https://www.bls.gov/cew/downloadable-data-files.htm. On this site, the user will be able to download the data by different codes and titles, as shown in Figure 1. However, we recommend downloading the CSVs By Area (comma separated value files). Also, you can download both quarterly and annual data.

For the calculator, we have used "Annual Averages." Once the compressed file has been downloaded, search for the "Los Angeles County, California.csv" file and unzip it to your preferred folder.

Figure 1: Quarterly Census of Employment and Wages Website View

Associated Codes and Titles

Industries Areas Ownerships Size Classes Aggregation Levels

QCEW NAICS-Based Data Files (1975 - most recent)

Excel Files	CSVs By Area		CSVs By Industry		CSVs Single Files		CSVs By Size	Legacy Flat Files
County High-Level	Quarterly	Annual Averages	Quarterly	Annual Averages	Quarterly	Annual Averages	First Quarter	All ENB/END
File Layout	File Layout	File Layout	File Layout	File Layout	File Layout	File Layout	File Layout	File Layouts
2021	2021	N/A	2021	N/A	2021	N/A	2021	2021
2020	2020	2020	2020	2020	2020	2020	2020	2020
2019	2019	2019	2019	2019	2019	2019	2019	2019
2018	2018	2018	2018	2018	2018	2018	2018	2018
2017	2017	2017	2017	2017	2017	2017	2017	2017
2016	2016	2016	2016	2016	2016	2016	2016	2016
2015	2015	2015	2015	2015	2015	2015	2015	2015
2014	2014	2014	2014	2014	2014	2014	2014	2014

Data Sorting by Establishment Ownership

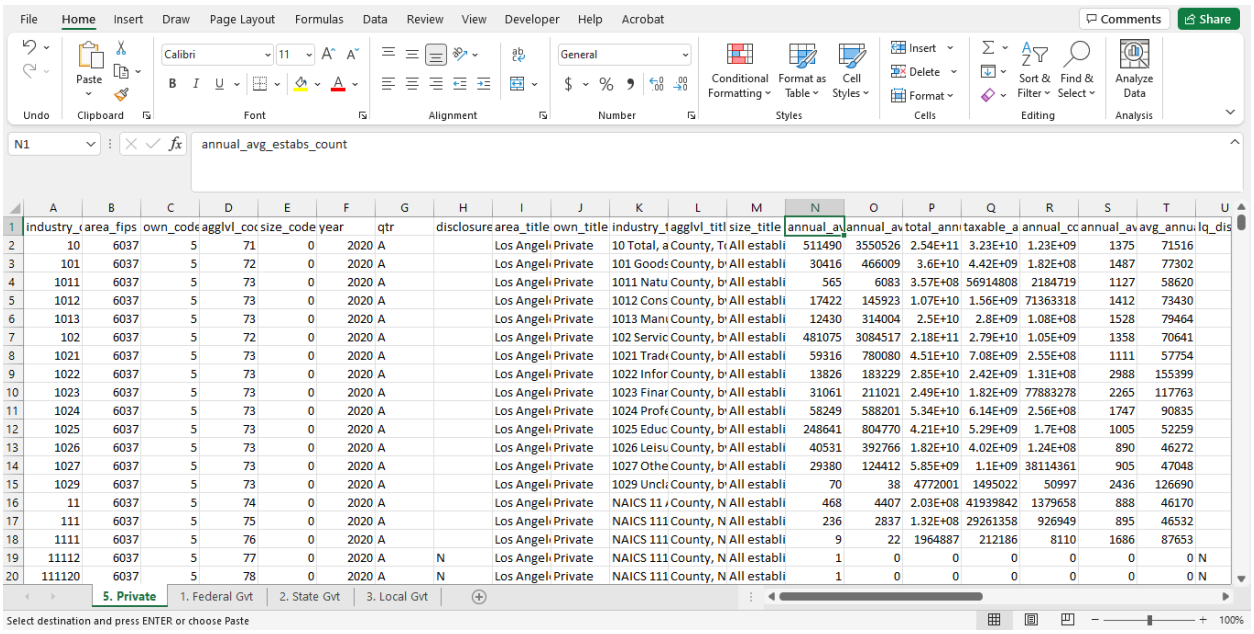
The downloaded file contains variables on employment, number of establishments, and wage levels by industry at 6-digits NAICS, establishment ownership, and establishment sizes. For the Platform, we focus on the annual average employment ("annual_avg_empllvl") variable by industry and establishment ownership.

Once the file is opened, the next step is to sort the data by establishment ownership. Figure 2 shows the Bureau of Labor Statistics (BLS) ownership codes. The Platform requires data on the following ownership codes: Federal Government (code 1), State Government (2), Local Government (3), and Private (5). We recommend sorting the data by ownership codes (Figure 3), and then copying and pasting in a new Excel file, making a separate sheet for each ownership cod; make sure that in the first column is the "industry _code" (NAICS codes) variable. Saving the sorted original file might lead to data loss.

Figure 2: QCEW Ownership Codes for NAICS Coded Data[41]

Code	Ownership Title
0	Total Covered
5	Private
4	International Government
3	Local Government
2	State Government
1	Federal Government
8	Total Government
9	Total U.I. Covered (Excludes Federal Government)

Figure 3: Sorted Data by Ownership Codes



industry_c	area_fips	own_code	agglvl_coc	size_code	year	qtr	disclosure	area_title	own_title	industry_t	agglvl_titl	size_title	annual_av	annual_av	total_anni	taxable_a	annual_cc	annual_av	avg_annui	lq_dis
10	6037	5	71	0	2020	A		Los Angel	Private	10 Total, a	County, Tc	All establi	511490	3550526	2.54E+11	3.23E+10	1.23E+09	1375	71516	
101	6037	5	72	0	2020	A		Los Angel	Private	101 Goods	County, b	All establi	30416	466009	3.6E+10	4.42E+09	1.82E+08	1487	77302	
1011	6037	5	73	0	2020	A		Los Angel	Private	1011 Natu	County, b	All establi	565	6083	3.57E+08	56914808	2184719	1127	58620	
1012	6037	5	73	0	2020	A		Los Angel	Private	1012 Cons	County, b	All establi	17422	145923	1.07E+10	1.56E+09	71363318	1412	73430	
1013	6037	5	73	0	2020	A		Los Angel	Private	1013 Man	County, b	All establi	12430	314004	2.5E+10	2.8E+09	1.08E+08	1528	79464	
102	6037	5	72	0	2020	A		Los Angel	Private	102 Servic	County, b	All establi	481075	3084517	2.18E+11	2.79E+10	1.05E+09	1358	70641	
1021	6037	5	73	0	2020	A		Los Angel	Private	1021 Trad	County, b	All establi	59316	780080	4.51E+10	7.08E+09	2.55E+08	1111	57754	
1022	6037	5	73	0	2020	A		Los Angel	Private	1022 Infor	County, b	All establi	13826	183229	2.85E+10	2.42E+09	1.31E+08	2988	155399	
1023	6037	5	73	0	2020	A		Los Angel	Private	1023 Finar	County, b	All establi	31061	211021	2.49E+10	1.82E+09	77883278	2265	117763	
1024	6037	5	73	0	2020	A		Los Angel	Private	1024 Profe	County, b	All establi	58249	588201	5.34E+10	6.14E+09	2.56E+08	1747	90835	
1025	6037	5	73	0	2020	A		Los Angel	Private	1025 Educ	County, b	All establi	248641	804770	4.21E+10	5.29E+09	1.7E+08	1005	52259	
1026	6037	5	73	0	2020	A		Los Angel	Private	1026 Leisu	County, b	All establi	40531	392766	1.82E+10	4.02E+09	1.24E+08	890	46272	
1027	6037	5	73	0	2020	A		Los Angel	Private	1027 Othe	County, b	All establi	29380	124412	5.85E+09	1.1E+09	38114361	905	47048	
1029	6037	5	73	0	2020	A		Los Angel	Private	1029 Uncl	County, b	All establi	70	38	4772001	1495022	50997	2436	126690	
11	6037	5	74	0	2020	A		Los Angel	Private	NAICS 11	County, N	All establi	468	4407	2.03E+08	41939842	1379658	888	46170	
111	6037	5	75	0	2020	A		Los Angel	Private	NAICS 111	County, N	All establi	236	2837	1.32E+08	29261358	926949	895	46532	
1111	6037	5	76	0	2020	A		Los Angel	Private	NAICS 111	County, N	All establi	9	22	1964887	212186	8110	1686	87653	
11112	6037	5	77	0	2020	A	N	Los Angel	Private	NAICS 111	County, N	All establi	1	0	0	0	0	0	0	N
111120	6037	5	78	0	2020	A	N	Los Angel	Private	NAICS 111	County, N	All establi	1	0	0	0	0	0	0	N

Steps for Green Jobs Calculations

Step 1: Direct Green Jobs Calculation

Once the data is sorted by ownership code, the next step is to calculate the number of direct green jobs. These direct green jobs are the source to calculate the "total output" by industry in step 2, and the number of indirect and induced jobs by race categories both for Los Angeles County and City.

To calculate the direct green jobs, open the file called "Direct GGS jobs estimate.xlsx." In this file, you will find different sheets highlighted in light blue and green. The light blue highlighted sheets are for the calculation of direct green jobs at 184 SAM sectors; the green highlighted sheets are for the direct green jobs in those sectors prioritized by Los Angeles City.

184 SAM Sectors

[41] Bureau of Labor Statistics. Retrieved from https://www.bls.gov/cew/classifications/ownerships/ownership-titles.htm

To calculate the green direct jobs for the 184 sectors, first go to the "Total GGS Direct Jobs Estimates" sheet in the previously opened file. In this sheet, you will find empty spaces to include the total county employment data by ownership codes previously sorted. In column E, you can enter the total Private employment by county, and in column F, you will see the result of green direct jobs (private) by county. Column H and I are for Local Government employment, columns K and L are for State Government employment, and columns N and O are for Federal Government employment.

The input data in this sheet is the previously sorted data by the ownership codes described. To allocate the employment data, you can do it manually or you can use the VLOOKUP formula and the industry_code or NAICS codes as the "lookup_value" required by the formula, asis shown in Figure 4. The VLOOKUP formula might be used in columns[42] E, H, K, and N,[43] with their corresponding sheet in the sorted data by ownership codes (Private, Local Government, State Government, and Federal Government).

Figure 4: Direct Green Jobs Calculation for the Private Sector in Los Angeles County at 184 SAM Sectors

E2 =+VLOOKUP(A2,'[Book1]5. Private'!$A:$T,15,FALSE)

	B	C	D	E	F
1	2017 NAICS US Title	184-SAM sectors	GGS shares_Private	County Total Private	County GGS Private
2	Crop Production	crops	0.069	2837	196
3	Animal Production and Aquaculture	lvstk	0.027	236	6
4	Forestry and Logging	lvstk	0.19	5	1
5	Support Activities for Agriculture and Forestry	ag-sup	0.033	1276	42
6	Electric Power Generation, Transmission and Distribution	elctrcty	0.136	5885	800
7	Water, Sewage and Other Systems	water	0.37	0	0
8	Residential Building Construction	constrct	0.101	22769	2300
9	Nonresidential Building Construction	constrct	0.093	14734	1370
10	Utility System Construction	constrct	0.099	7574	750
11	Land Subdivision	constrct	0.037	1429	53
12	Other Heavy and Civil Engineering Construction	constrct	0.091	2883	262

Once you have estimated the County green jobs by ownership codes, go to the "GGS Direct by year and sector" sheet, where you will find a template to copy and paste the previously estimated data in the "Total GGS Direct Jobs Estimates" sheet. (This template has been designed to calculate the green employment from 2021 to 2023, once the data is available.)

When you have added the new data in "GGS Direct by year and sector" sheet, go to the "Pivot table 184 sectors" sheet and select cell "A3;", then go to "PivotTable Analyze" label and click on the Refresh button under the Data label. With this, the pivot table will be updated for the year you are working with.

[42] Only change the columns with no formulas inside, otherwise the Platform might stop working

[43] In columns H, K, and N you might have "#N/A" after applying the VLOOKUP formula. In these cases, copy and paste as values, and then replace the #N/A values by "0".

In cell "B1" you can select the year of interest, and the table "K3:L79" (labeled as "Table for output estimate") will show the number of green jobs by each of the 184 SAM sectors[44] (Figure 5). The number of GGS jobs will be the input for step two.

Figure 5: Direct Green Jobs by 184 SAM Sectors by Year

	A	B	C	D	E	F
1	Year	2020				
2						
3	Sum of GGS jobs	Column Labels				
4	Row Labels	Federal Government	Local Government	Private	State Government	Grand Total
5	accomdn	8.76	21.571	656.726	0	687.057
6	ag-chem-mfg	0	0	2.674	0	2.674
7	ag-sup	0	0	42.108	0	42.108
8	aluminum-mfg	0	0	145.152	0	145.152
9	applicances	0	0	173.184	0	173.184
10	architect+	0	0	5319.61	0	5319.61
11	audiovid-eqpmnt	0	0	41.886	0	41.886
12	auto-repair	0	0	205.344	0	205.344
13	cement-mfg	0	0	129.05	0	129.05
14	chemical-mfg	0	0	95.912	0	95.912
15	civic+	0	5.005	231.449	0	236.454
16	clay-prdcts	0	0	43.036	0	43.036
17	colleges+	0	210.162	964.47	794.206	1968.838

Table for output estimate	
Sectors	GGS Jobs
crops	196
lvstk	7
ag-sup	42
elctrcty	800
water	2232
constrct	13418
textiles	408
wood-mfg	0
wood-prdcts	19
other-wood-prdcts	292
paper-mfg	515
petrol-prdcts	167
chemical-mfg	96

Los Angeles City Sectors of Interest

To calculate Los Angeles City sectors of interest, you follow the same process used for the 184 SAM sectors, but with the respective sheets. First, go to "*L.A. City* sectors of interest" sheet and then apply the "VLOOKUP" formula as was applied for the direct jobs estimates for the 184 SAM sectors.. Columns F, G, H, and I are ready to apply the formula. Some of the values might appear as "#N/A" because there is no register of employment in a given NAICS code and a given ownership code; in these cases, you should manually insert a "0", so you can have the "total number of jobs in county" in column J and the number of green direct jobs in county in column K (Figure 6).

[44] You will only find information for 75 of the 184 sectors, since these are the only sectors considered to be green as defined by the Bureau of Labor Statistics.

Figure 6: Total Direct Green Jobs Calculation in Los Angeles County at L.A. City Sectors of Interest

G2 =+VLOOKUP(B2,'[Book1]3. Local Gvt'!$A:$Q,15,FALSE)

	A	B	C	D	E	F	G	H	I	J	K
1	LA City sector of interest	NAICS Code	NAICS codes description	184-SAM sectors	GGS shares	County private total jobs	County Local Government total jobs	County State Government total jobs	County Federal Government total jobs	Total jobs in county	GGS Direct Jobs
2	Electricity transmission	221121	Electric Bulk Power Transmission and Control	elctricty	0	0	0	0	0	0	0
3	Utility scale renewables	221111	Hydroelectric power generation	elctricty	0.648	0	0	0	0	0	0
4	Utility scale renewables	221114	Solar electric power generation	elctricty	0.979	176	0	0	0	176	172
5	Utility scale renewables	221116	Geothermal electric power generation	elctricty	0.969	0	0	0	0	0	0
6	Utility scale renewables	221117	Biomass electric power generation	elctricty	0.923	0	0	0	0	0	0
7	Utility scale batteries	221122	Electric Power Distribution	elctricty	0	114	0	0	0	114	0
8	Utility scale wind	221115	Wind electric power generation	elctricty	0.917	0	0	0	0	0	0
9	Distributed energy resources	221122	Electric Power Distribution	elctricty	0	114	0	0	0	114	0
10	Solar installers	23821	Electrical Contractors and Other Wiring Installation Contractors	constrct	0.119	19039	0	0	0	19039	2,266
11	Battery manufacturing (power or transportation)	335911	Storage battery manufacturing	other-ele	0.177	736	0	0	0	736	130
12	Battery manufacturing (power or transportation)	335912	Primary battery manufacturing	other-ele	0.177	109	0	0	0	109	19
13	Buildings design	541310	Architectural Services	architect+	0.17	8865	0	0	0	8865	1,507
14	Buildings construction	2361	Residential building construction	constrct	0.101	22769	0	0	0	22769	2,300
15	Buildings construction	2362	Nonresidential building construction	constrct	0.093	14734	0	0	0	14734	1,370
16	Buildings electrification	23821	Electrical Contractors and Other Wiring Installation Contractors	constrct	0.119	19039	0	0	0	19039	2,266
17	Buildings Energy efficiency	23821	Electrical Contractors and Other Wiring Installation Contractors	constrct	0.119	19039	0	0	0	19039	2,266
18	Buildings water efficiency	221310	Water Supply and Irrigation Systems	water	0.37	1084	2881	0	2881	6846	2,533
19	Buildings On-site renewable energy installation	23821	Electrical Contractors and Other Wiring Installation Contractors	constrct	0.119	19039	0	0	0	19039	2,266
20	Buildings energy management	23821	Electrical Contractors and Other Wiring Installation Contractors	constrct	0.119	19039	0	0	0	19039	2,266
21	Water and wastewater	2213	Water, Sewage, and other systems	water	0.37	0	4708	0	4708	9416	3,484
22	Fossil fuel decomissioning	0	No NAICS for this			0	0	0	0	0	0
23	ZE vehicle charger installation and maintenance	541330	Engineering Services	architect+	0.14	19245	0	0	0	19245	2,694
24	Rail and transit	485113	Bus and Other Motor Vehicle Transit Systems	transit-trns	0.845	1327	7082	0	7082	15491	13,090
25	Rail and transit	485210	Interurban and Rural Bus Transportation	transit-trns	0.625	0	0	0	0	0	0
26	Environmental consulting	541620	Environmental Consulting Services	manageme	1	2252	0	0	0	2252	2,252
27	Environmental non-profits	813312	Environment, Conservation and Wildlife Organizations	social-org	1	1471	0	0	0	1471	1,471
28											

Once you have estimated the total direct green jobs by sector of interest, go to the "*L.A. City* direct jobs by sector" sheet, copy and paste the results in the template for the year you are working on. Next, go to the "Pivot table *L.A. City* Sectors" sheet and select cell A3; then go to the "PivotTable Analyze" label and click on the Refresh button under the Data label. The pivot table will be updated for the year you are working with.

In cell B1, you can select the year of interest, and the table "E3:F23" (labeled as "L.A. City sector of interest") will show the number of green jobs by each of the L.A. City sectors of interest (Figure 7). The number of GGS jobs is the input for step 2.

Figure 7: Direct Green Jobs by L.A. City Sectors of Interest by Year

	A	B
1	Year	2020
2		
3	Row Labels	Sum of GGS Jobs
4	Battery manufacturing (power or transportation)	149.565
5	Buildings construction	3669.931
6	Buildings design	1507.05
7	Buildings electrification	0
8	Buildings Energy efficiency	0
9	Buildings energy management	0
10	Buildings On-site renewable energy installation	0
11	Buildings water efficiency	401.08
12	Distributed energy resources	0
13	Electricity transmission	0
14	Environmental consulting	2252
15	Environmental non-profits	1471
16	Fossil fuel decomissioning	0
17	Rail and transit	1121.315
18	Solar installers	2265.641
19	Utility scale batteries	0
20	Utility scale renewables	172.304
21	Utility scale wind	0
22	Water and wastewater	401.08
23	ZE vehicle charger installation and maintenance	2694.3

Table for output estimate	GGS direct jobs
Electricity transmission	0
Utility scale renewables	172
Utility scale batteries	0
Utility scale wind	0
Distributed energy resources	0
Solar installers	2,266
Battery manufacturing (power or transportation)	150
Buildings design	1,507
Buildings construction	3,670
Buildings electrification	0
Buildings Energy efficiency	0
Buildings water efficiency	401
Buildings On-site renewable energy installation	0
Buildings energy management	0
Water and wastewater	401
Fossil fuel decomissioning	0
ZE vehicle charger installation and maintenance	2,694
Rail and transit	1,121
Environmental consulting	2,252
Environmental non-profits	1,471

Step 2: Calculation of Output in Los Angeles County

Now that you have estimated the direct green jobs for each sector (both 184 SAM and L.A. City sectors of interest), open the "GGS Platform.xlsx" file. In this file, you will find many sheets; only seven are relevant for the green jobs estimates:

Direct jobs and output: highlighted in yellow; in this sheet, you will calculate the "green output" in thousands of dollars by each industry, using the direct green jobs previously estimated, for both the 184 SAM sectors and the L.A. City sectors of interest.

Sim calculator for L.A. County: highlighted in light blue; in this table you will use the estimated "green output" to calculate the final results for L.A. County.

Jobs by race in L.A. County: highlighted in green; this sheet shows the total green jobs by race in L.A. County.

Jobs calculator L.A. City: highlighted in green; this sheet shows the total green jobs in L.A. City.

Jobs by race in L.A. City: highlighted in green; this sheet shows the total green jobs by race in L.A. City.

Complete database: highlighted in orange; this is a template where you can copy and paste each of the results and use it for pivot tables and graphs analysis

Race database: highlighted in orange, this is a template where you can copy and paste each of the results and use it for pivot tables and graphs analysis by race categories.

Next, go to the "*Direct jobs and output"* sheet, and you will find two columns for each year (Figure 8). One column is labeled "Direct employment" and the other "Output (thousands $)" for both the 184 SAM sectors (at the bottom) and the L.A. City sectors of interest (Row 191).

In the "Direct employment" column, paste the results estimated in Step 1Direct green jobs estimate) for both the 184 SAM sectors and the L.A. City sectors of interest. Once you paste the direct employment data, the estimated output will appear in the "Output (thousands $)" column.

Figure 8: Direct Jobs and Output Sheet Vectors

	A	B	C	D	E
1	184 SAM sectors				
2		2011		2012	
3	Sectors	Direct employment	Output (thousands $)	Direct employment	Output (thousands $)
4	crops	296	7,594	286	7,345
5	lvstk	12	91	8	65
6	ag-sup	35	1,991	38	2,128
7	elctrcty	0	0	0	0
8	water	2,931	907,102	2,880	891,203
9	constrct	9,531	1,096,540	9,891	1,138,045
10	textiles	381	44,275	388	45,117
11	wood-mfg	0	100	0	128
12	wood-prdcts	41	10,136	43	10,547
13	other-wood-prdcts	357	86,346	344	83,115
14	paper-mfg	606	620,664	584	598,315

	A	B	C	D	E
187					
188	LA City Sectors of interest				
189					
190		2011		2012	
191	LA City sector of interest	Direct employment	Output (thousands $)	Direct employment	Output (thousands $)
192	Electricity transmission	0	0	0	0
193	Utility scale renewables	0	0	7	6,499
194	Utility scale batteries	0	0	0	0
195	Utility scale wind	0	0	0	0
196	Distributed energy resources	0	0	0	0
197	Solar installers	1,684	193,746	1,724	198,388
198	Battery manufacturing (power or transportation)	144	393,576	145	397,449
199	Buildings design	1,080	269,678	1,107	276,300
200	Buildings construction	2,530	291,118	2,643	304,055
201	Buildings electrification	0	0	0	0
202	Buildings Energy efficiency	0	0	0	0

Step 3: Calculation of Direct, Indirect, Induced Green, and Non-Green Jobs by Race in Los Angeles County and Los Angeles City

Now that "output (thousands $)" has been estimated, go to the "Sim calculator L.A. County″ sheet. In column B, you will find the "Change in output (thousands $)" column. Paste in this column the estimated output from the "Direct jobs and output" sheet, as shown in Figure 9. This is the same process for both the 184 SAM sectors and the L.A. City sectors of interest.

Figure 9: "Sim Calculator L.A. County" Sheet Vectors

	A	B	C	D	E	F	G	H	I
1	184 SAM sectors								
2	Sector	Change in output (thousands $)	SAM 1 indirect output (thousands $)	SAM 2 indirect + induced output (thousand	Change in direct jobs (Green Jobs)	SAM 1 change in indirect jobs (Green + non-Green Jobs)	SAM 2 change in indirect + induced jobs (Green + non-Green Jobs	SAM 1 change in direct + indirect jobs	SAM 2 change in direct + indirect + induced jobs
3	crops	4,898	1,567	4,455	191	8	23	199	213
4	lvstk	58	17	40	7	0	8	8	15
5	ag-sup	2,501	204	1,646	44	1	52	45	96
6	elctrcty	714,561	261,322	482,123	753	486	2,391	1,240	3,145
7	water	697,571	275,298	536,683	2,254	1,012	4,629	3,267	6,884
8	constrct	1,580,801	504,476	1,088,200	13,740	1,558	18,330	15,298	32,070
9	textiles	49,499	14,010	26,703	426	55	547	481	973
10	wood-mfg	156	61	101	0	0	1	1	1
11	wood-prdcts	5,123	1,541	2,904	21	5	33	26	54
12	other-wood-prdcts	87,783	27,593	55,480	363	94	601	457	964
13	paper-mfg	543,336	165,566	287,621	531	570	1,733	1,101	2,264
14	petrol-prdcts	1,171,646	272,981	433,764	165	918	1,929	1,084	2,095

When the output is inserted in the "Change in output (thousands $)" vector, the results for that year are printed in the green highlighted sheets. For other printed results, please see the following sheets:

- Jobs by race in L.A. County
- Jobs calculator L.A. City
- Jobs by race in L.A. City

You can then go to the orange highlighted sheets and paste these results in the templates, which will allow you to update the pivot tables and do all the required analysis.

Preparation of Final Tables

Once you have updated the "Complete database" and "Race database" sheets with the printed results in the green highlighted sheets, to prepare tables for analysis, go to the "Pivot table for totals" and "Pivot table for race categories" sheets and click on the current pivot tables. Then go to the "PivotTable Analyze" label and click on "Refresh."

When the pivot tables have been updated with the newest data, you will be ready to generate tables and graphs manually using the "PivotTable Fields" options, selecting the different variables based on your interests.

Appendix C: GIS System Methodology

Considering that the Calculator and the Public Access Data Analysis Platform, LA100, were created to explore and develop public policy analysis related to labor equity and green jobs, the Geographic Information System –GIS- has been built in parallel for data visualization. The System combines the results from data analysis, modeled with the SAM (Social Accounting Matrix) methodology. The main source that feeds this system is a relational database with geo-spatial characteristics; attributes of geographic objects contained under the OGC standards, stored in the cloud and linked to the site https://naid.center/gis-maps or out the box in https://app.powerbi.com/view?r=eyJrIjoiN2JlYzk3YjAtYmI0ZS00MjkyLWEyNTktYzMwYjIyOTQ5ZWEyIiwidCI6ImJlZDMxZmZhLTU5ZTMtNDk5YS05ZjQ3LTliOTQ2NjZiZWUwZSJ9

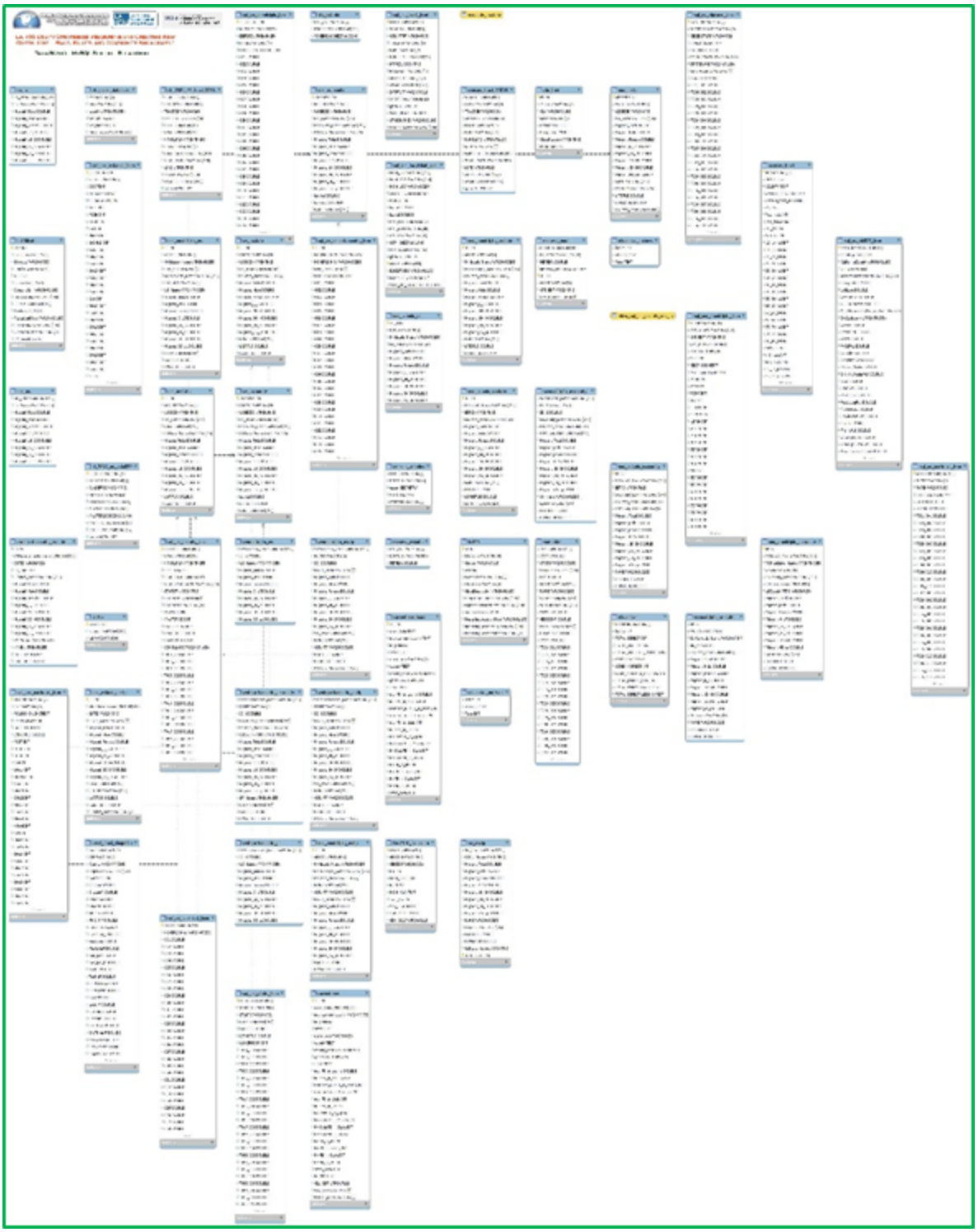
Data Structure

Considering that labor equity and green jobs have multifactorial attributes framed in geographic characteristics, race, income, gender; In the database, an attempt has been made to integrate these attributes, especially the geographic characteristic at the following levels: State, County, ZIP Code (under the geographic structure of the US Census Bureau, ZCTAs) and in some cases Census Tract.

Objective: Mapping the evolution of Green Jobs in Los Angeles with particular emphasis on sectors of special interest to LADWP and the City of Los Angeles, and developing a Jobs and Workforce Development plan aligned with 100% renewable energy goals.

MySQL Spatial Data Model Creation:

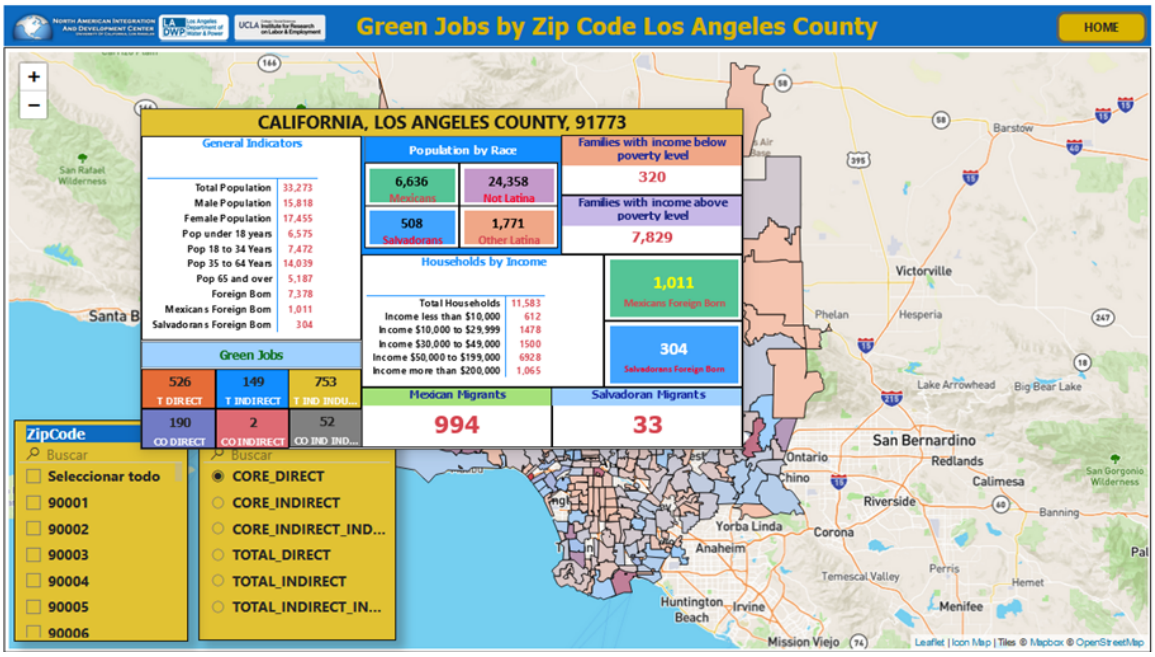
- Repository
  - Logical model
  - ER physical model
  - Data Dictionary
- Data source
  - US Los Angeles County Core Green Jobs: Direct, Indirect and Induced
  - US statistical data
    - DataSet defined variables and indicators USA
    - Geographic levels of presentation
      - Census Tract
      - Census ZIP
      - Census County
      - Census State



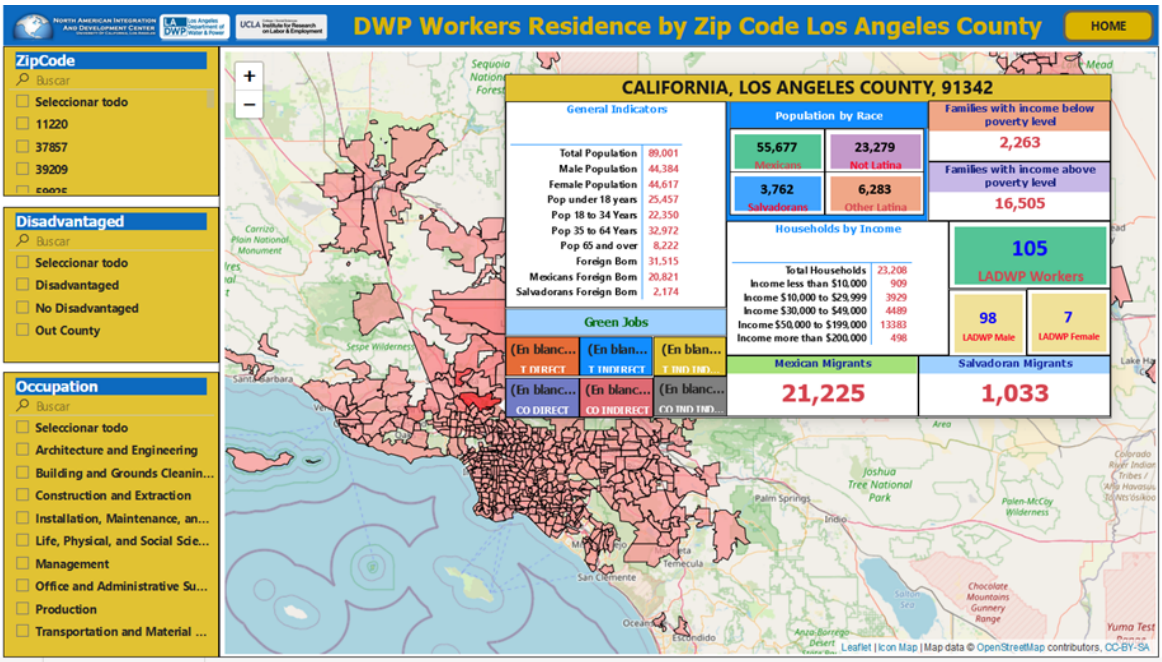
Visualization Tool

1. Green Jobs by Los Angeles County

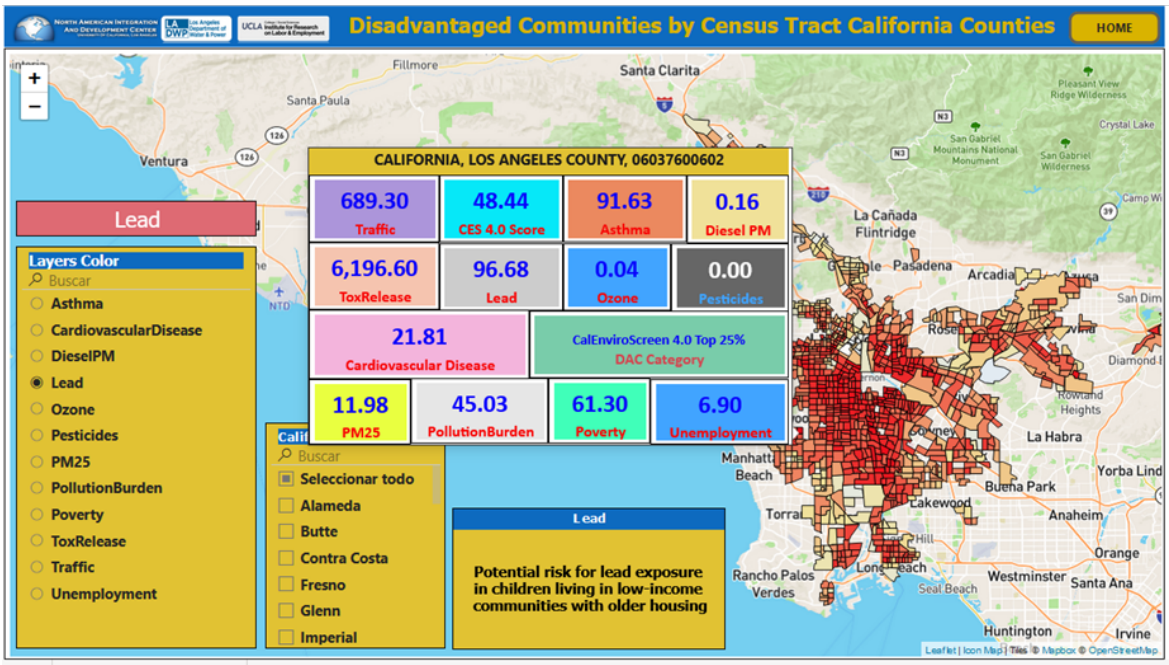
2. Green Jobs by ZIP Code Los Angeles County



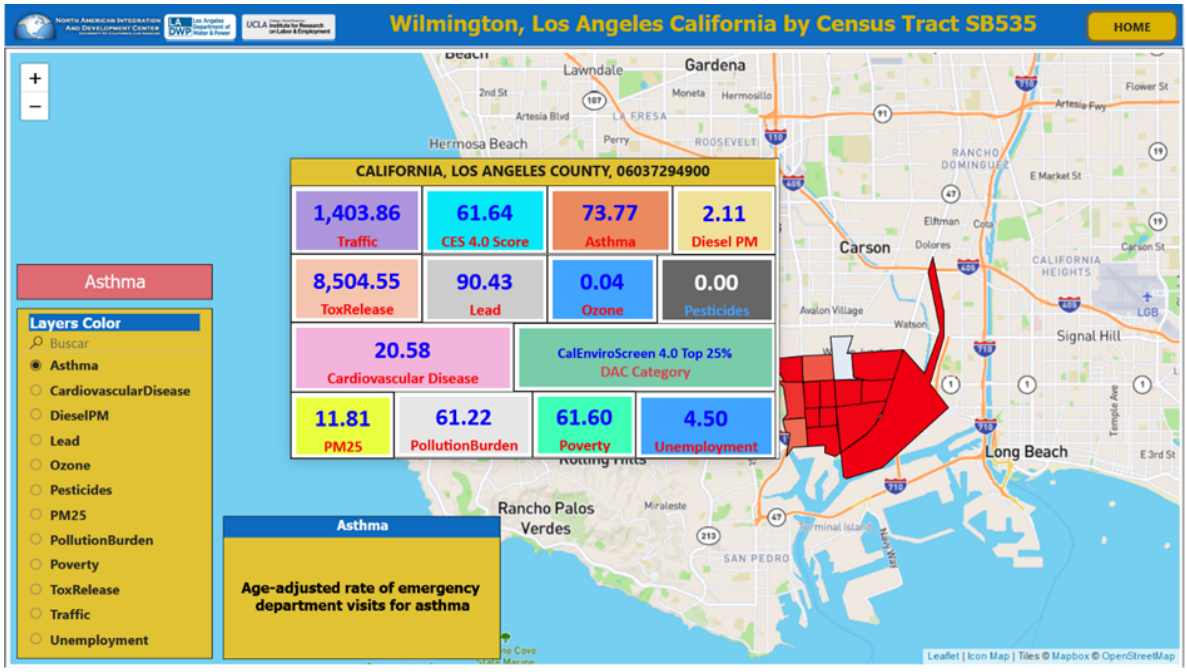
3. LADWP Workers Residence by ZIP Code, Los Angeles County



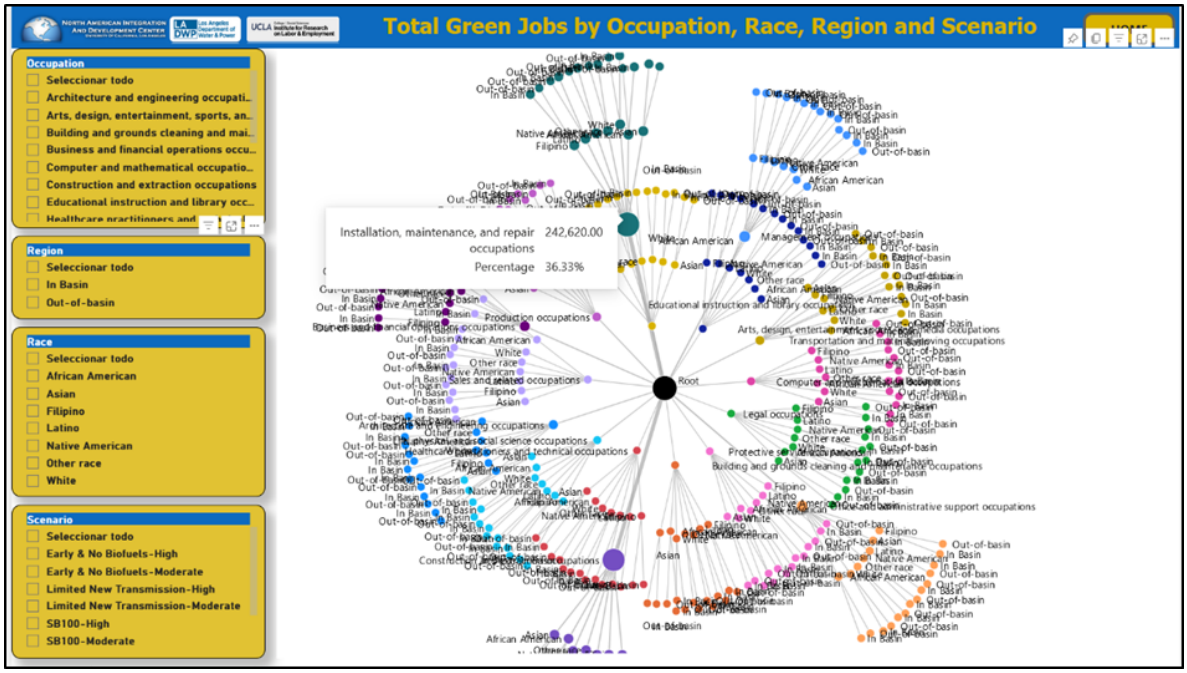
4. Disadvantaged Communities by Census Tract California Counties. CalEnviroScreen, the scores are calculated from the scores for two groups of indicators: Pollution Burden and Population Characteristics.



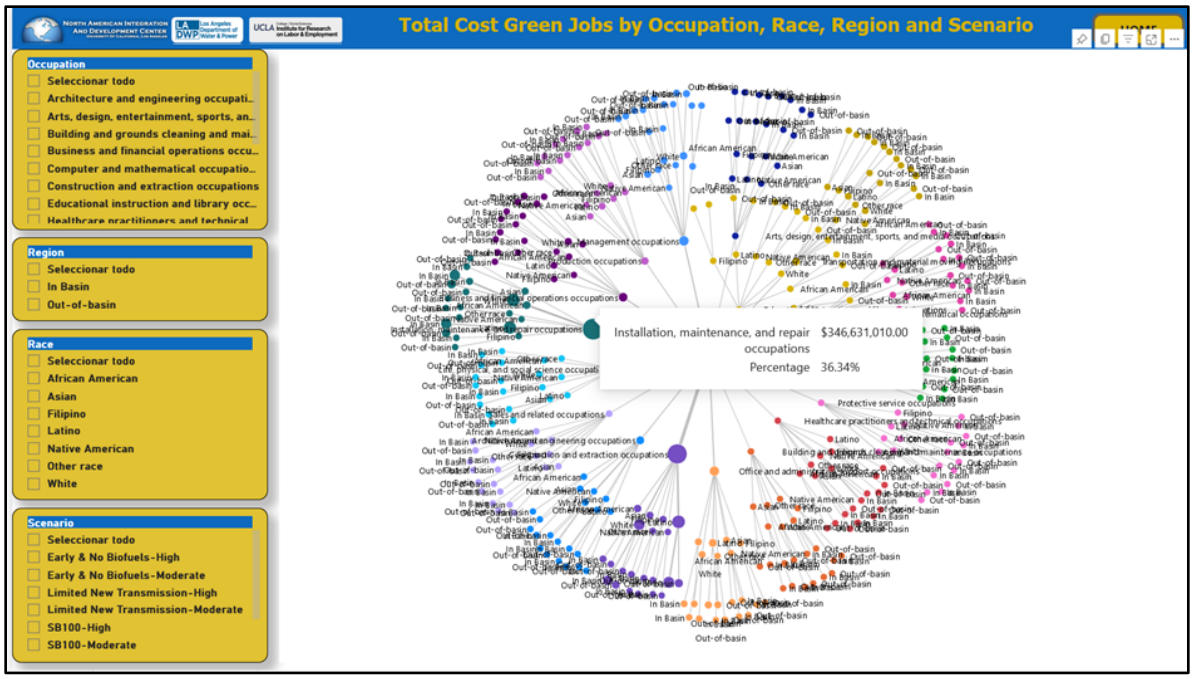
5. Wilmington, Los Angeles SB535, CalEnviroScreen the scores are calculated from the scores for two groups of indicators: Pollution Burden and Population Characteristics.



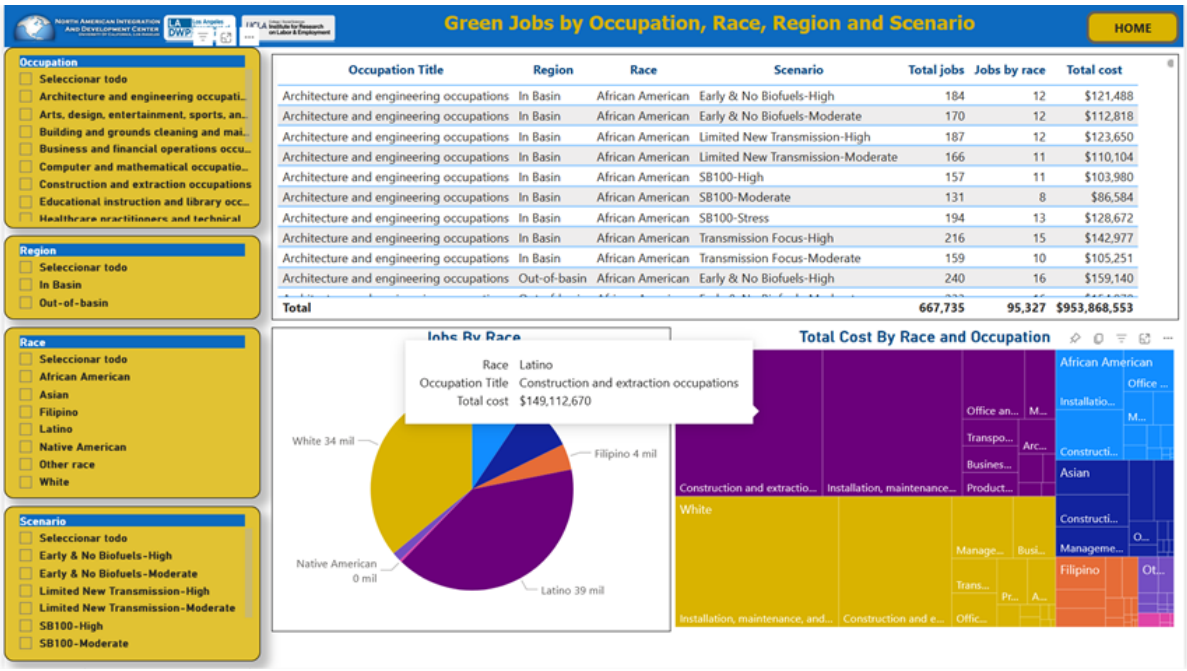
6. Total Green Jobs by Occupation, Race. Region and Scenarios



7. Total Cost Green Jobs by Occupation, Race, Region and Scenario

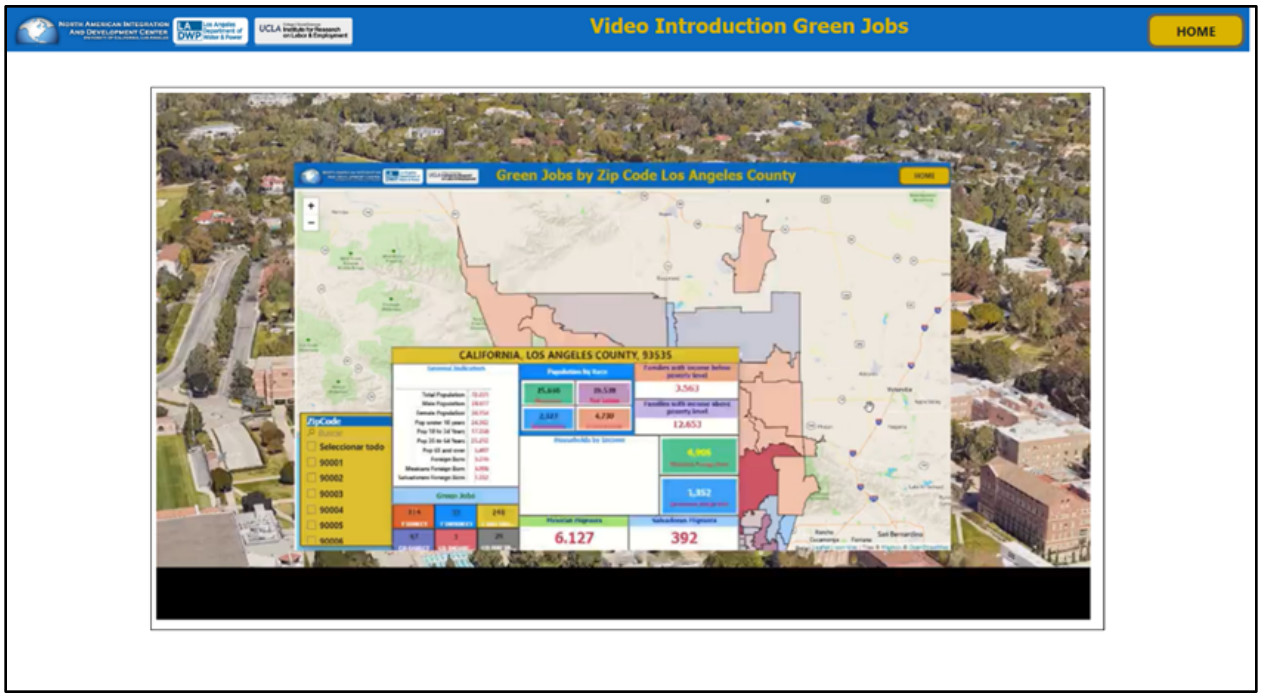


8. Green Jobs by Occupation, Race, Region and Scenario

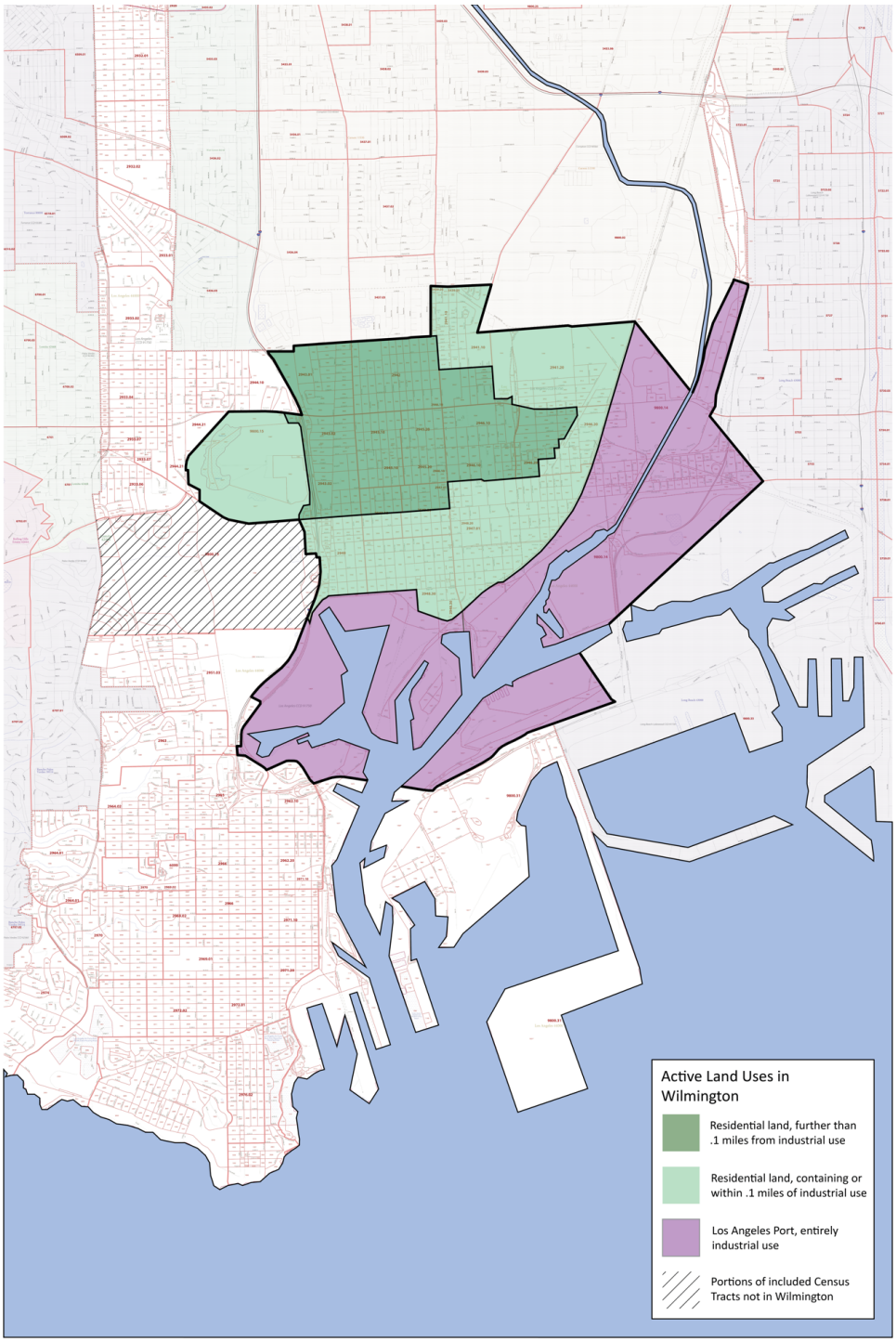


Occupation Title	Region	Race	Scenario	Total jobs	Jobs by race	Total cost
Architecture and engineering occupations	In Basin	African American	Early & No Biofuels-High	184	12	$121,488
Architecture and engineering occupations	In Basin	African American	Early & No Biofuels-Moderate	170	12	$112,818
Architecture and engineering occupations	In Basin	African American	Limited New Transmission-High	187	12	$123,650
Architecture and engineering occupations	In Basin	African American	Limited New Transmission-Moderate	166	11	$110,104
Architecture and engineering occupations	In Basin	African American	SB100-High	157	11	$103,980
Architecture and engineering occupations	In Basin	African American	SB100-Moderate	131	8	$86,584
Architecture and engineering occupations	In Basin	African American	SB100-Stress	194	13	$128,672
Architecture and engineering occupations	In Basin	African American	Transmission Focus-High	216	15	$142,977
Architecture and engineering occupations	In Basin	African American	Transmission Focus-Moderate	159	10	$105,251
Architecture and engineering occupations	Out-of-basin	African American	Early & No Biofuels-High	240	16	$159,140
Total				667,735	95,327	$953,868,553

9. Video Introduction Green Jobs



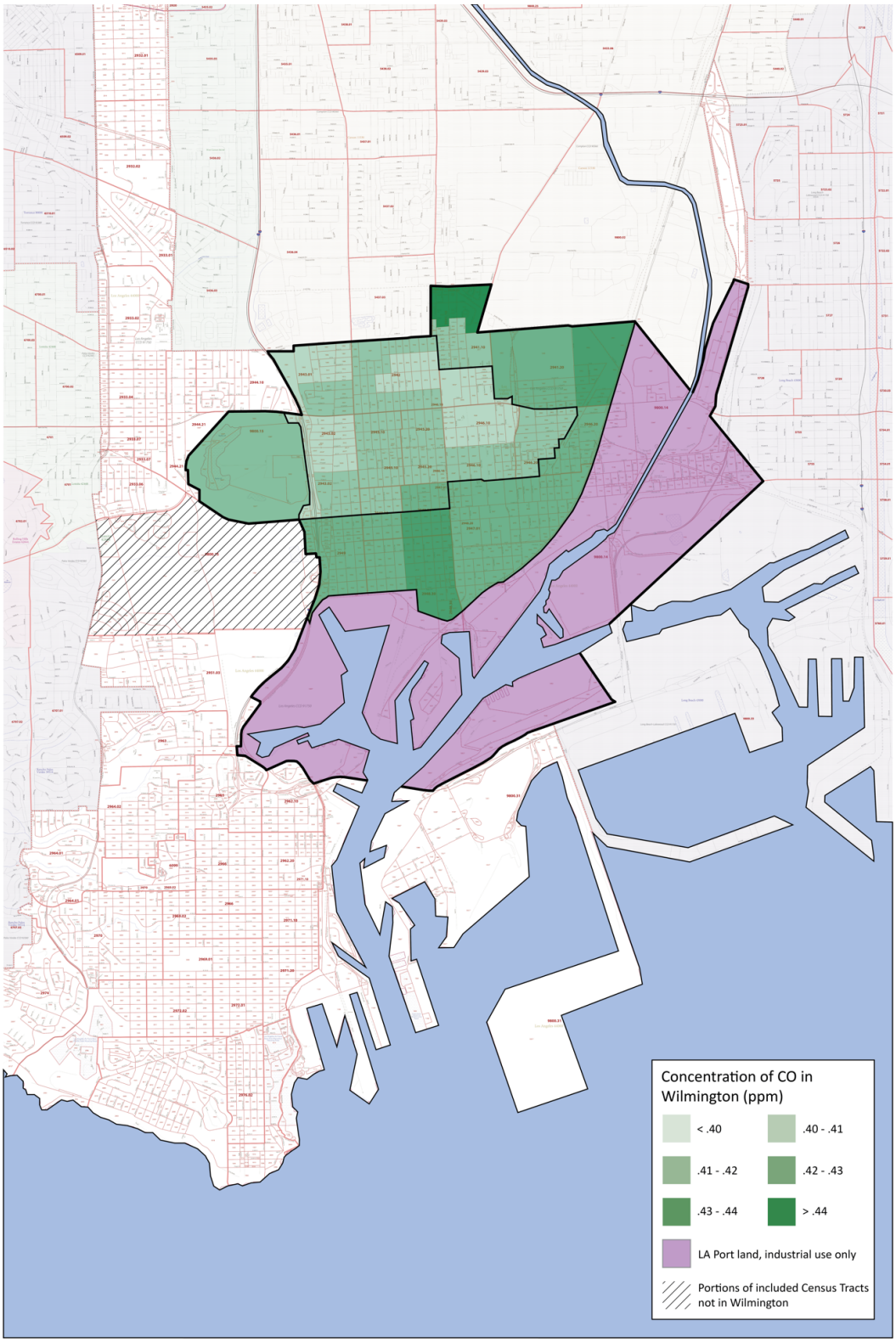
Appendix *D*: Land Use in Wilmington



Appendix *E*: Proximity to Industry by Census Tract

L.A. Port (entirely industrial)	Residential census block groups within .1 miles of industry	Residential census block groups further than .1 miles from industry
Tract 9800.14 Block Group 1	Tract 2941.10 Block Groups 1 & 2	Tract 2941.10 Block Group 3
Tract 9800.31 Block Group 1	Tract 2941.20 Block Groups 1, 2, & 3	Tract 2942 Block Groups 1, 2, & 3
	Tract 2946.20 Block Group 1	Tract 2943.01 Block Groups 1 & 2
	Tract 2947.01 Block Groups 1, 2, & 3	Tract 2943.02 Block Groups 1 & 2
	Tract 2948.10 Block Group 2	Tract 2945.10 Block Groups 1 & 2
	Tract 2948.20 Block Group 2	Tract 2945.20 Block Groups 1 & 2
	Tract 2948.30 Block Group 1 & 2	Tract 2946.10 Block Groups 1 & 2
	Tract 2949 Block Group 1 & 2	Tract 2946.20 Block Groups 2 & 3
	Tract 9800.15 Block Group 1	Tract 2948.10 Block Group 1
		Tract 2948.20 Block Group 1

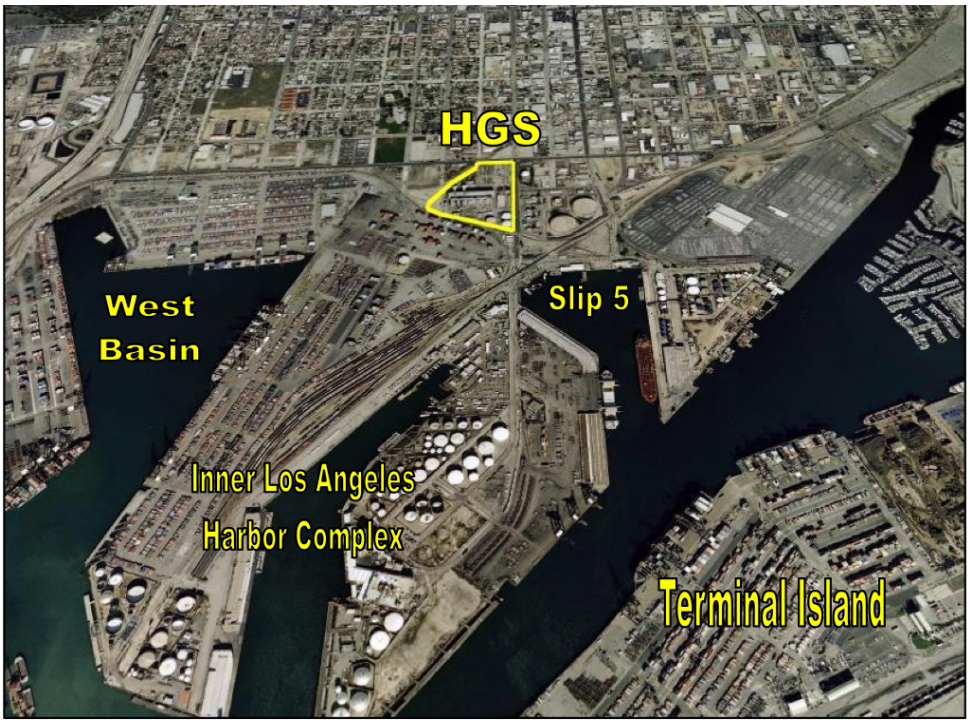
Appendix *F*: Concentration of CO in Wilmington



Appendix *G*: Refineries in Wilmington/Carson Merger: Financial Revenue

1. **Marathon (This is for all 16 refineries and does not have Wilmington separated from the other refineries)**
   https://finance.yahoo.com/quote/MPC/financials?p=MPC
   Marathon Petroleum Corporation reported a total of $119,983,000 in revenue under their Income Statement for the year ending on December 31, 2021
   December 31, 2020 - $69,779,000
   December 31, 2019 - $123,949,000
2. **ConocoPhillips Wilmington**
   https://finance.yahoo.com/quote/COP/financials?p=COP
   ConocoPhillips reported $45,828,000 in total revenue under their Income Statement for the year ending on December 31, 2021.
   December 31, 2020 - $18,784,000
   December 31, 2019 - $32,567,000
3. **Valero Wilmington**
   https://finance.yahoo.com/quote/VLO/financials?p=VLO
   Valero Energy Corporation reported a total revenue of $113,977,000 for the year ending on December 31, 2021.
   December 31, 2020 - $64,912,000
   December 31, 2019 - $108,324,000
4. **BP Carson merger with Wilmington**
   https://www.macrotrends.net/stocks/charts/BP/bp/revenue
   BP Carson Refinery has an annual revenue of $164.195 billion for 2021.
   2020: $183.5 billion
   2019: $282.616 billion
5. **Phillips 66**
   https://finance.yahoo.com/quote/PSX/financials?p=PSX
   Phillips 66 has a total annual revenue of $111,476,000 for the year ending December 31, 2021.
   December 31, 2020: 64,129,000
   December 31, 2019: 107,293,000

Appendix *H*: LADWP Power Plant in Wilmington



[45]

LADWP operating regenerator

The Harbor Generating Station (HGS), E–4, is one of the three coastal power plants of LADWP located on Island Ave in Wilmington, CA 90744.[46] This power station is a natural gas–fired steam electric generating facility.[47]

[45] Christine Blackburn (February 2008), "E. Harbor Generating Station," *California's Coastal Power Plants: Alternative Cooling System Analysis*, California Ocean Protection Council, February 2008 http://www.opc.ca.gov/webmaster/ftp/project_pages/OTC/engineering%20study/CA_Power_Plant_Analysis_Complete.pdf

[46] "LADWP 2018-2019 Power Infrastructure Plan," Los Angeles Department of Water and Power, accessed April 23 2023, https://ladwp-jtti.s3.us-west-2.amazonaws.com/wp-content/uploads/sites/3/2019/10/24100526/LADWP-2018-19-Power-Infrastructure-Plan.pdf

[47] Christine Blackburn (February 2008), "E. Harbor Generating Station," *California's Coastal Power Plants: Alternative Cooling System Analysis*, California Ocean Protection Council, http://www.opc.ca.gov/webmaster/ftp/project_pages/OTC/engineering%20study/CA_Power_Plant_Analysis_Complete.pdf

Appendix I: Pre and Post Community Engagement Meetings Survey

Please read this before filling out the survey and circle the number that best describes your answer:

- We will **not** be collecting any identifiable information (name, address, phone number, etc.)
- Your responses will be jointly collected and analyzed for the Wilmington Case Study
- Although collected responses may be made public or used for future research purposes, your identity will always remain anonymous

Por favor lea antes de completar la encuesta y ponga un circulo en el numero que mejor describa su respuesta:

- **No** estaremos colectando información que lo identifique (nombre, direccion, numero telefonico
- Sus respuestas serán seleccionadas y analizadas conjuntamente para el estudio de caso de Wilmington
- Sus respuestas podrán hacerse públicas o utilizarse para el estudio de caso en el futuro, pero su identidad siempre permanecerá anónima

1. What level of understanding do you have about green jobs?/ ¿Qué nivel de comprensión tiene sobre los empleos verdes?

Very low/ Muy bajo	Below average/ Debajo del promedio	Average/ Promedio	Above average/ Encima del promedio	Very high/ Muy alto
1	2	3	4	5

---

2. What knowledge do you have about the purpose of DWP? / ¿Qué conocimiento tiene sobre el propósito de DWP?

Very low/ Muy bajo	Below average/ Debajo del promedio	Average/ Promedio	Above average/ Encima del promedio	Very high/ Muy alto
1	2	3	4	5

---

3. Would you like to have a green job? (yes, no maybe,) / ¿Le gustaría tener un trabajo verde? (si no tal vez,)

Yes/Si No Maybe/Talvez

---

4. If you had the opportunity to have a certification or training from the DWP, how interested would you be? / Si tuviera la oportunidad de obtener una certificación o capacitación del DWP, ¿que tanto le interesaría? (sí, no, tal vez, etc.)

Zero interest/ Cero interes	Little interest/ Poco interes	Interested/ Interesado	Very interested/ Muy interesado
1	2	3	3

---

5. How well-informed do you feel about job opportunities in your community? / ¿Que tan informado siente que esta sobre oportunidades de trabajo en su comunidad?

Not at all/ No informado	Slightly/ Un poco	Moderately/ Moderadamente	Very empowered/ Muy informado	Extremely/ Extremadamente
1	2	3	4	5

---

6. If you could be the one to train your community about green jobs at a workforce development center, how comfortable would you feel doing so? / Si pudiera ser el que capacitara a su comunidad sobre trabajos verdes en un centro de desarrollo de la fuerza laboral, ¿qué tan cómodo se sentiría al hacerlo?

Not at all/ Nada comodo	Slightly/ Un poco	Moderately/ Moderadamente	Very empowered/ Muy comodo	Extremely/ Extremadamente
1	2	3	4	5

---

7. Have you ever been part of a workforce development program? ¿Alguna vez ha sido parte de un programa de desarrollo de la fuerza laboral?

Yes/Si No Not sure/No estoy seguro

Appendix J: Demographics and LADWP Survey

Please read this before filling out the survey

- We will **not** be collecting any identifiable information (name, address, phone number, etc.)
- Your responses will be jointly collected and analyzed for the Wilmington Case Study
- Although collected responses may be made public or used for future research purposes, your identity will always remain anonymous

Por favor lea antes de completar la encuesta :

- **No** estaremos coleccionando información que lo identifique (nombre, direccion, numero telefonico)
- Sus respuestas serán seleccionadas y analizadas conjuntamente para el estudio de Wilmington
- Sus respuestas podrán hacerse públicas o utilizarse para el estudio en el futuro, pero su identidad siempre permanecerá anónima

1. Have you applied to any discount or rebate programs with the Los Angeles Department of Water and Power (LADWP)? / ¿Ha aplicado a algún programa de descuentos o rebajas del Departamento de Agua y Energía de Los Ángeles (LADWP)?

Yes/Si No Maybe/Talvez

---

2. Are you born outside of the United States? / ¿Nació fuera de Estados Unidos?

Yes/Si No Maybe/Talvez

---

3. What are your country and state of origin? (Example: Jalisco/Mexico) / ¿Cuáles son su país y estado de origen? (Ejemplo: Jalisco/México)

Answer here / Responda aqui: _____

---

4. Select the option below that best describes your current legal status. / Seleccione la opción que mejor describa su estatus legal actualmente.

US citizen/ Ciudadano americano	Legal Resident / Resident legal	Work Permit/ Permiso de trabajo	Other/Otro estatus

---

5. Do you have an Individual Taxpayer Identification Number (ITIN)? / Tiene usted un Número de Identificación Personal del Contribuyente para impuestos (ITIN)?

Yes/Si | No | Not sure/No estoy seguro/a

6. What is your yearly income? / ¿Cuál es su salario anual?

$20,000 - $29,999	$30,000 - $39,999	$40,000 - $49,999	$50,000 - $59,999	$60,000 +

---

7. What is your educational level? / ¿Cuál es su nivel de escuela?

Elementary/ Primara	Middle School/ Secundaria	High School/ Colegio	University/ Universidad

---

8. What is your gender? / ¿Cuál es su género?

Woman/Mujer | Man/Hombre | Other/Otro

---

9. Do you have children? If so, how many? / ¿Tiene hijos? Si es así, ¿cuántos? (Ejemplo: Si, 4 hijos)

   Answer here / Responda aqui: _____

---

10. What is your race? / ¿Cuál es su raza?/

Black or African American / Negro o Afroamericano	White / Blanco	Asian / Asiatico	American Indian/ Nativo de Alaska o Indio Americano	Pacific Islander / Nativo de Hawái o de las Islas del Pacífico

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11. Are you Latino/a? If so, choose one below. / ¿Es latino/a? Si es así, elija una opción a continuación.

Mexican or Mexican American/ Mexicano o mexicano americano	Salvadorean / Salvadoreno	Guatemalan / Guatemalteco	Honduran / Hondureno	Other / Otro

Appendix K: Raw Data for LADWP Programs and Households Enrolled by Year

90744.0	LIFE SUPPORT	2017	83
90744.0	LIFELINE	2017	1041
90744.0	LOW INCOME	2017	2690
90744.0	PCAD	2017	44
90744.0	LIFE SUPPORT	2018	84
90744.0	LIFELINE	2018	1075
90744.0	LOW INCOME	2018	2392
90744.0	PCAD	2018	58
90744.0	LIFE SUPPORT	2019	89
90744.0	LIFELINE	2019	1128
90744.0	LOW INCOME	2019	1994
90744.0	PCAD	2019	60
90744.0	LIFE SUPPORT	2020	82
90744.0	LIFELINE	2020	1147
90744.0	LOW INCOME	2020	1856
90744.0	PCAD	2020	72
90744.0	LIFE SUPPORT	2021	72
90744.0	LIFELINE	2021	1138
90744.0	LOW INCOME	2021	2044
90744.0	PCAD	2021	84