Los Angeles Green Jobs Calculator Tool Project
(Final Report Manuscript)

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1. Introduction

This final (fourth quarter) report fulfills deliverables from Task Order #15 for LADWP and the City of Los Angeles. Official work on this contract began April 1, 2021. This Final Report Manuscript includes three components:

1) **Summary of Data Results from the Green Jobs Calculator Tool (2011-2020).** The report provides summary data results generated using the Green Jobs Calculator Tool described in the step-by-step Training Manual to estimate Green Jobs (direct, indirect and induced) over the period 2011 to 2019 for Los Angeles County and the City of Los Angeles.

2) **Summary of a Community/Sectoral Case Study (Wilmington and Port of LA).** Designed to recommend "on-the-ground/in-the-local-weeds ways of counting", this sectoral and community case study documents community-based sustainable development strategies for climate change abatement and combating environmental racism.

3) **Los Angeles Green Jobs Calculator Tool Training Manual.** The Manual is designed as a step-by-step technical training tool and includes a detailed Methodological Appendix prepared for instruction and training for appropriate LA City staff.

Summary of Data Results for
Los Angeles Green Jobs Calculator Tool Project

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Introduction

This report is generated for Task Order #15 Green Jobs Calculator Project to demonstrate the tool functionality and results that are used as part of a written manual for training purposes and future use. The Primary deliverables of Task Order #15 (Green Jobs Calculator Project) included the development of an input-output/SAM (Social Accounting Matrix) tool for the City of Los Angeles and LADWP to track green job creation. This report provides summary information for Los Angeles County and the City of Los Angeles using the SAM tool to estimate direct, indirect and induced green jobs over the period 2011 to 2019.

The report is divided into three sections. The first focuses on green Job growth in Los Angeles between 2011-2020. The next two sections provide data and findings on the important multiplier impacts of green job creation on green jobs and non-green jobs, including impact findings by race categories highlighting brown and black workers.

I. Growing Green Jobs in Los Angeles 2011-2020:

I.1 Green Job growth Outpaces LA non-green job Growth

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

[1] We are using 2019 as the final year since 2020 data from American Community Survey (ACS) is using experimental weights to account for the effects of the COVID-19 pandemic on the ACS 2020 data products, and the Census Bureau advises against comparing it to other ACS PUMS sample years. Since we are using ACS for the total number of jobs in LA City, comparing it to the other data in 2020 might not give a correct comparison.

Figure 1: LA City and LA County, green and total non-green jobs growth index, 2011 = 100

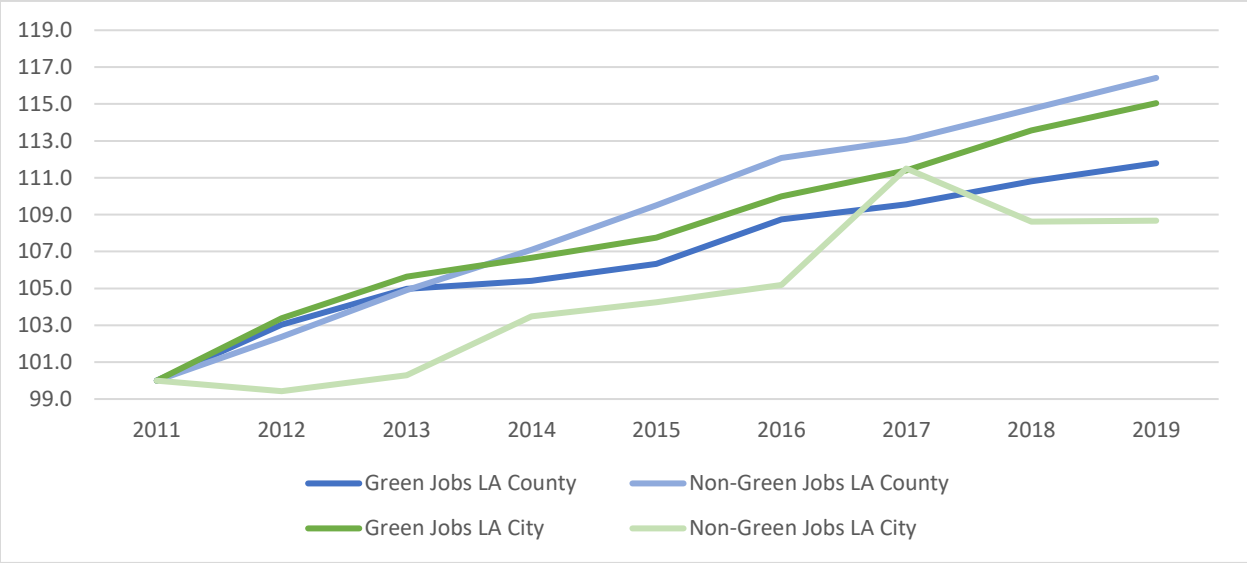


Table 1 shows that Green Jobs represent only 5.4% of Total Jobs in LA County, and 3% in LA city. However, Green jobs in the sectors prioritized by the LA City (Green Core Jobs) are growing faster than green jobs and total non-green jobs. While LA City green jobs grew 1.1% and non-green jobs grew 1.1% over 2011 and 2019, Green Core Jobs grew 2.8% over the same period. In LA County, green jobs and total non-green jobs grew 1.4% and 1.9% respectively, while Green Core Jobs grew 2.1%.

Table 1: Table 1: LA City and LA County, Green, Green Core, and Total Non-Green Jobs

Year	LA County			LA City		
	Non-Green Jobs	Green Jobs	Green Core Jobs	Non-Green Jobs	Green Jobs	Green Core 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

Sources: Total Jobs in LA City is data from American Community Survey; Total Jobs in LA County is data from Quarterly Census of Employment and Wages, BLS.

Note: * 2020 Total LA City jobs is not comparable with other years due to the measure weights used to account for COVID 19 impacts

I.2 LA Green Core Jobs Growing Fastest

Figure 2 shows that Core Green Jobs have become an important growth driver for Green Jobs both in LA City and LA County, especially since 2016, when in 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: LA City and LA County, Core Green, Green and Total Non-Green Jobs Growth index, 2011=100

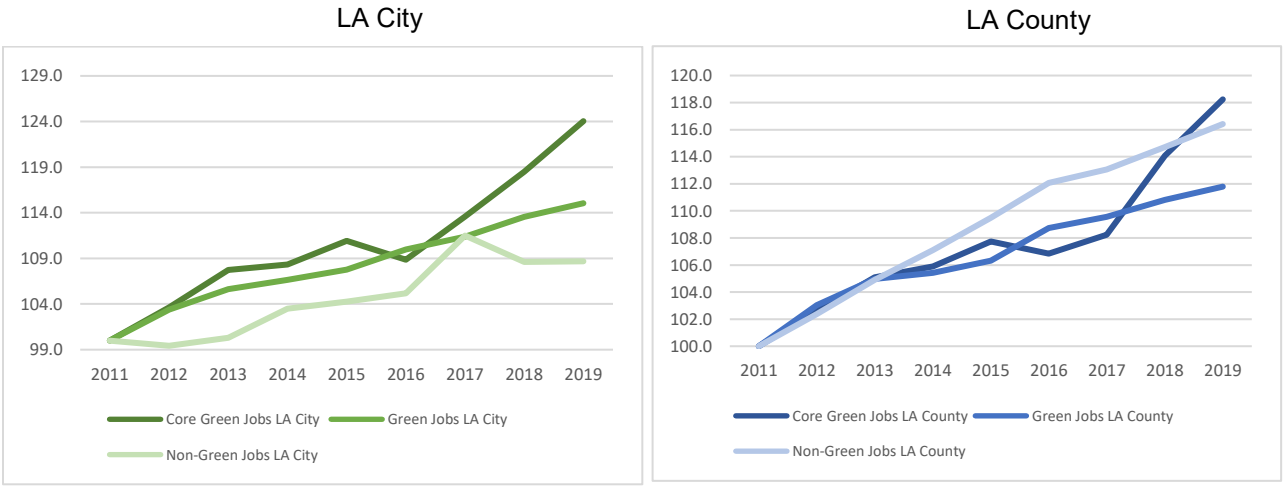
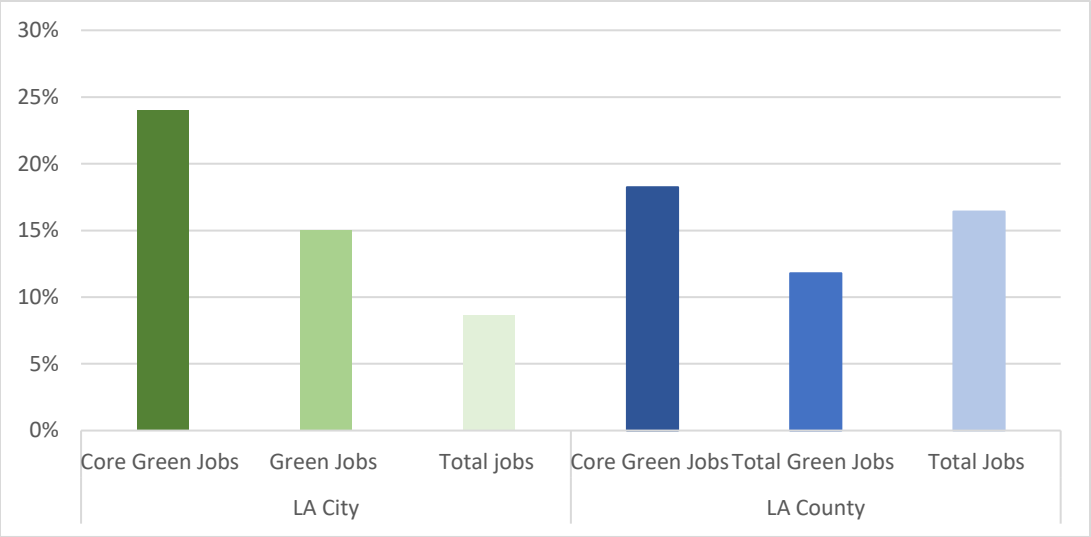


Figure 3 shows that there is a transition between jobs into Green sectors from Non-Green sectors in both LA County and LA City, with especially strong growth among those sectors prioritized by LA City and considered as Core Green Jobs. The inter-annual growth rate in Core Green Jobs between 2011 and 2019 was 24% for LA City and 18% for LA County, which is higher than the inter-annual growth rates for green and total 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

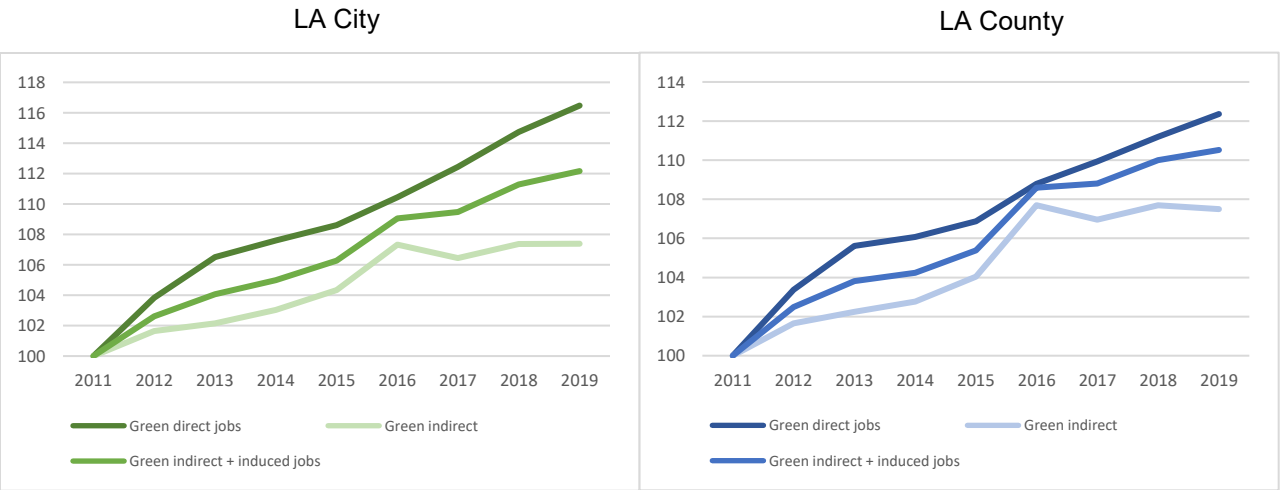


II. Green Jobs Create More Green and Non-Green Jobs

II.1 Direct Green Jobs Create Indirect and Induced Green and Non-Green Jobs

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.

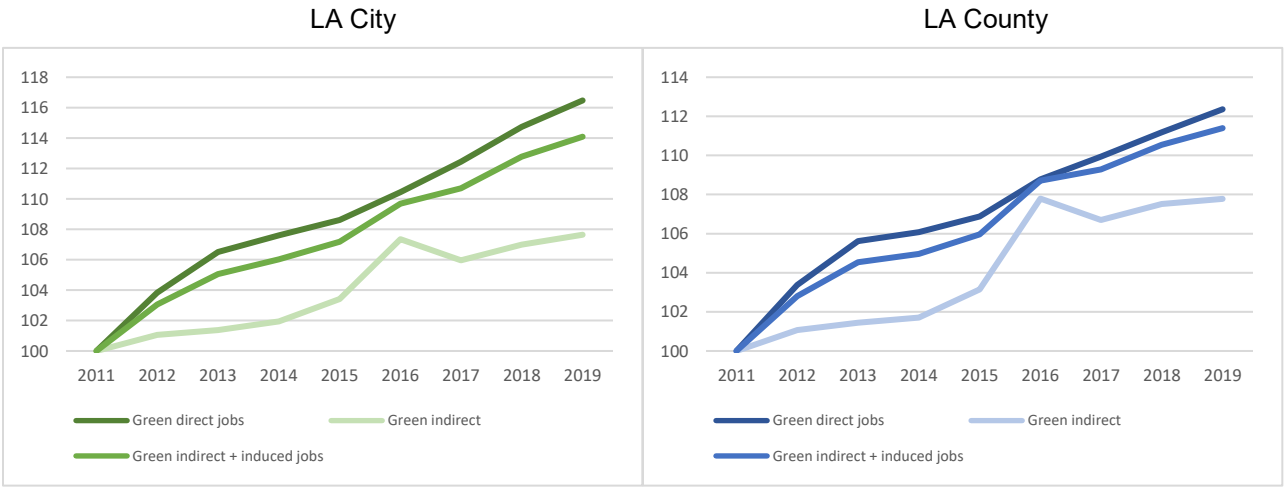
Figure 4: LA City and LA County, Green Direct, Indirect and Induced Green and Non-Green Jobs Green Jobs. 2011=100



II.2 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 drives to higher Green indirect + induced jobs than non-green indirect + induced jobs.

Figure 5: LA City and LA County, Green Direct, Indirect and Induced Green Jobs (Green Only). 2011=100



III. Brown and Black: Leading Inclusive Job Creation

III.1 Latinos are 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 in LA City. The most underrepresented race in Green Jobs is American Indian or Alaska Native, with 0.1% of total Green Jobs in LA City. In LA County, Hispanics 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 LA County.

Figure 6: LA City and LA County, Green Jobs by Race

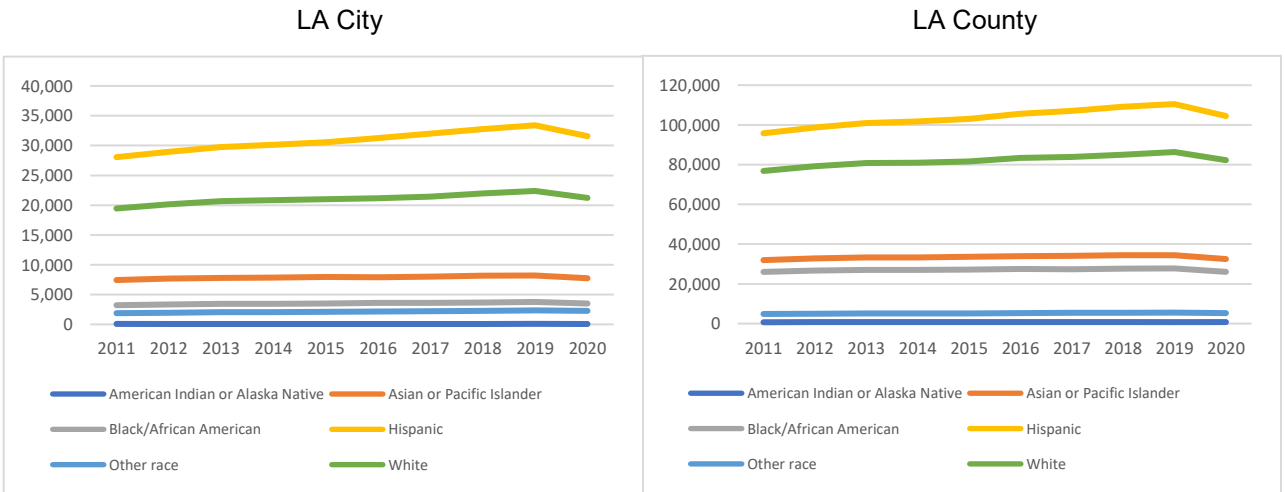
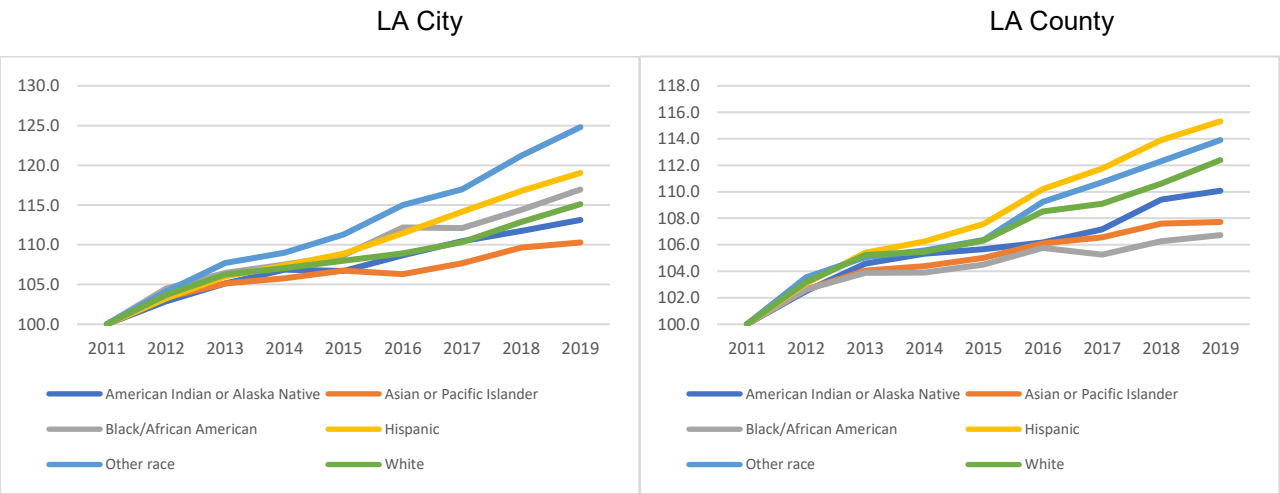


Figure 7 shows that in LA City, the race group that is growing most rapidly is "Other race", followed by Hispanics, and third Black/African American. On the other hand, in LA County the labor category that is growing most rapidly is Hispanics, followed by "Other race", and Whites. Contrary to LA City,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

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



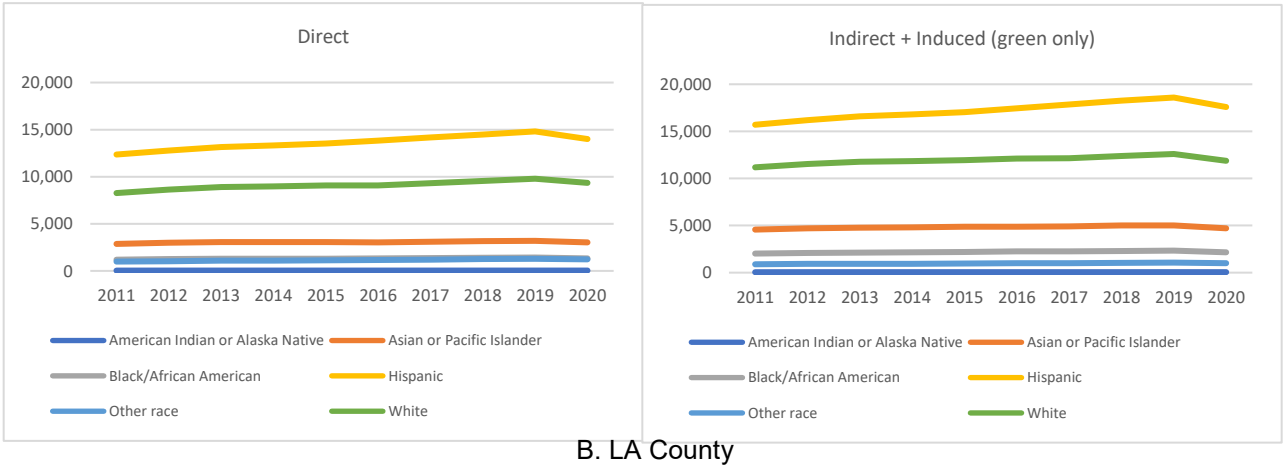
III.3 The Growth of Latino Green Jobs is very complementary and beneficial to White and Black Green and non-Green workers

Figure 8.A. and Table 3.A. show that, though Hispanics are the largest group with Direct Green Jobs, the indirect + induced Green Jobs growth effect for other races is higher than Hispanic own Direct Jobs effects. In this sense, indirect + induced Green Job impacts were 1.26 higher than direct Green Jobs for Hispanics, while the indirect + induced Green Job impacts were 1.67 higher than the Direct Green Jobs for Black/African Americans, 1.58 higher for Asian or Pacific Islander, and 1.3 higher for Whites. All these race groups benefit the most through the indirect and induced linkages of Hispanics direct Green Jobs.

On the other hand, as shown in figure 8.B. and table 3.B., in LA County Black/African American workers benefit less due to the indirect and induced linkages, where the rate for this group is 1.22, for Hispanics is 1.23, for Whites 1.36 and for Asian or Pacific Islander is 1.43, which means that the latter groups benefit the most from the indirect and induced linkages.

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

A. LA City



B. LA County

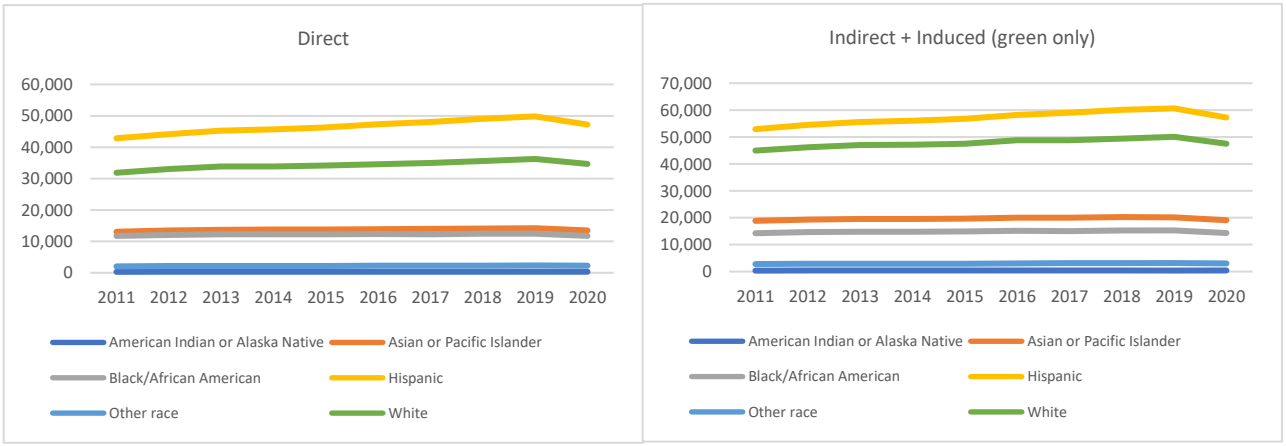


Table 3. LA City and LA County, Direct, Indirect, and Indirect + Induced Green Jobs by Race Category

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

Los Angeles Green Jobs Calculator Tool: Training Manual

Dr. Raul Hinojosa and Dr. Abel Valenzuela
with Dr. Sherman Robinson, Marcelo Pleitez and Magali Sanchez Hall

I. Introduction

The Los Angeles Green Jobs Calculator Tool 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 LA City staff on the step-by-step process of using the Calculator Tool 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 tool.

The Training Manual provides details on three major steps in using the Green Jobs Calculator Tool.

1) **Data Preparation**
    a) **Data downloading**
    b) **Data sorting by establishments ownership**
2) **Steps for green jobs calculations**
    a) **Step I: Direct green jobs calculation**
    b) **Step II: Calculation of direct, indirect, induced green output and jobs in Los Angeles County and Los Angeles City.**
    c) **Step III: 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 tool 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 between 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 US Department of Labor.

This tool 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. The SAM data base is described in …….

II. Step-by-Step process

In the following paragraphs we describe the process to calculate the green jobs. First, we describe the data preparation process. Second, we describe the steps to calculate green jobs in Los Angeles County and Los Angeles City. In step I**,** the tool calculates direct green jobs at the level of Los Angeles County. In step II the tool calculates the "output" data required for jobs estimates. In step III, the tool 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.

1. Data preparation

a. Data downloading

First, to calculate the number of direct, indirect, and induced green jobs, the user must provide data from the Quarterly Census of Employment and Wages (QCEW) provided by the Bureau of Labor Statistics. The user can download the input data from: https://www.bls.gov/cew/downloadable-data-files.htm. In 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 tool, we have used "Annual Averages". Once the compressed file has been downloaded, please search for the "Los Angeles County, California.csv" file and decompress 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

b. Data sorting by establishments ownership

The downloaded file contains a variables on employment, number of establishments, and wages levels by industry at 6-digits NAICS, establishments ownership, and establishments sizes. For the tool, we focus on annual average employment ("annual_avg_emplvl") 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 tool requires data on the following ownership codes: 1. Federal Government, 2. State Government, 3. Local Government, and 5. Private. We

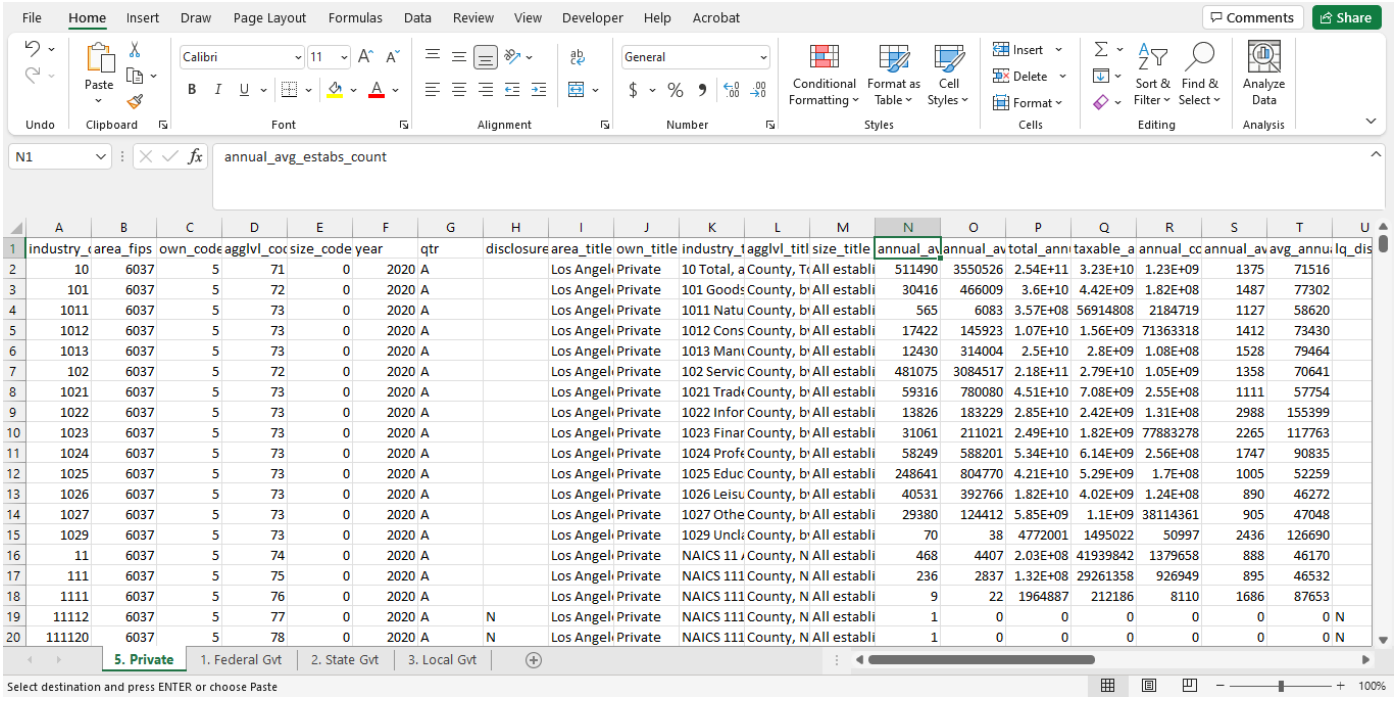
recommend sorting the data by ownership codes (figure 3), and then copy and paste in a separate sheet for each ownership code in a new Excel file; make sure that in the first column is the “industry _code” (NAICS codes) variable. Saving the sorted original file might lead to data loss.

Figure 2: QCEW Ownership Codes for NAICS Coded Data

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)

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

Figure 3: Sorted data by ownership codes



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	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
2	10	6037	5	71	0	2020	A		Los Angel	Private	10 Total, a	County, T	All establi	511490	3550526	2.54E+11	3.23E+10	1.23E+09	1375	71516	
3	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	
4	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	
5	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	
6	1013	6037	5	73	0	2020	A		Los Angel	Private	1013 Mani	County, b	All establi	12430	314004	2.5E+10	2.8E+09	1.08E+08	1528	79464	
7	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	
8	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	
9	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	
10	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	
11	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	
12	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	
13	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	
14	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	
15	1029	6037	5	73	0	2020	A		Los Angel	Private	1029 Uncl	County, b	All establi	70	38	4772001	1495022	50997	2436	126690	
16	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	
17	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	
18	1111	6037	5	76	0	2020	A		Los Angel	Private	NAICS 111	County, N	All establi	9	22	1964887	212186	8110	1686	87653	
19	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
20	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

2. Steps for green jobs calculations

a. Step I: 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 II, and the number of indirect and induced jobs by race categories both for Los Angeles County and City.

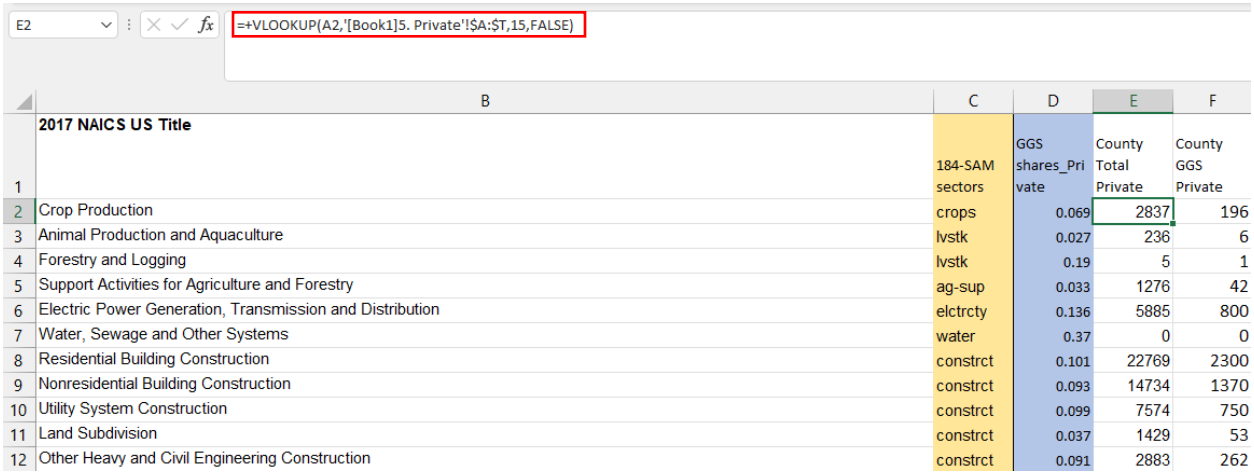
To calculate the direct green jobs, open the file called "Direct GGS jobs estimate.xlsx". In this file you will find different sheets highlighted in light blue and green. The light blue highlighted sheets are for the calculation of direct green jobs at 184 SAM sectors. The green highlighted sheets are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

i. 184 SAM sectors

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 county Private employment and in column F you will have the result of green direct jobs in county at Private level. Column H and I is 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 ownership codes described. To allocate the employment data, you can make it manually or, you can use the "VLOOKUP" formula and the "industry_code" or NAICS codes as the "lookup_value" required by the formula, as it is shown in figure 4. The VLOOKUP formula might be used in columns[2] E, H, K, and N[3], with their correspondent sheet in the sorted data by ownership codes (Private, Local Government, State Government, Federal Government).

Figure 4: Direct green jobs calculation for private sector in Los Angeles County at 184 SAM sectors



	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

[2] Only change the columns with no formulas inside, otherwise the tool might stop working

[3] 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".

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 "*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 "*Pivot table 184 sectors"* sheet and select cell "A3", then go to "PivotTable Analyze" label and click on "Refresh" button under "Data" label. With this, 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 "K3:L79" labeled as "Table for output estimate" will show the number of green jobs by each of the 184 SAM sectors[4] (figure 5). The number of GGS jobs are the input for Step II that will be described in section

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

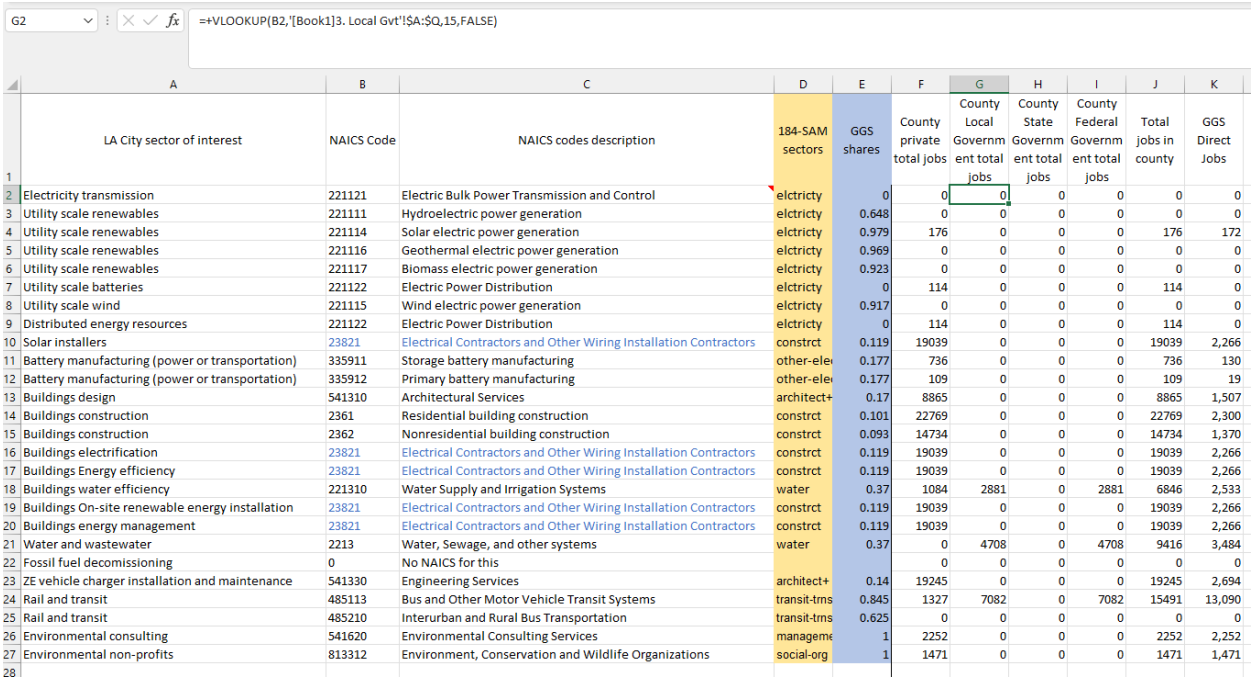
Table for output estimate	
Sectors	GGS Jobs
crops	196
lvstk	7
ag-sup	42
elctrcty	800
water	2232
constrct	13418
textiles	408
wood-mfg	0
wood-prdcts	19
other-wood-prdcts	292
paper-mfg	515
petrol-prdcts	167
chemical-mfg	96

ii. Los Angeles City sectors of interest

To calculate Los Angeles City sectors of interest, we follow the same process as that used for the 184 SAM sectors but with the respective sheets. First, go to "*LA City sectors of interest"* sheet and then apply the "VLOOKUP" formula for each of the ownership codes data filtered before. Columns F, G, H, and I are clear 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 in column J the "total number of jobs in county", and the number of green direct jobs in county in column K (figure 6).

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

Figure 6: Total direct green jobs calculation in Los Angeles County at LA City sectors of interest



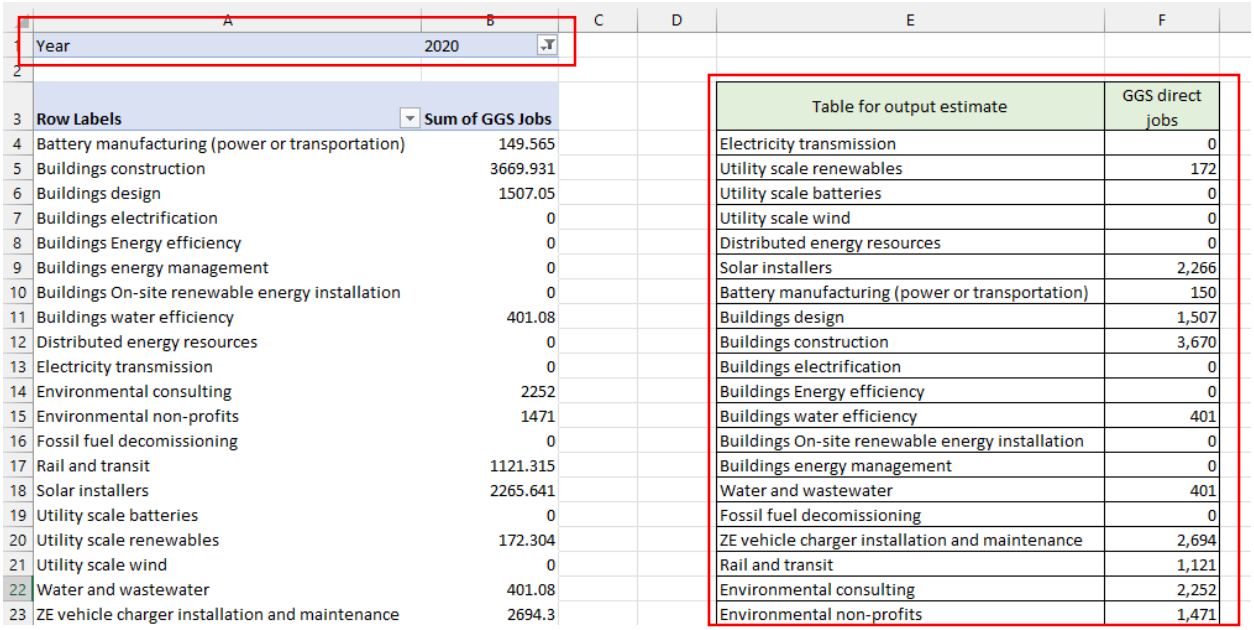
G2 =+VLOOKUP(B2,'[Book1]3. Local Gvt'!$A:$Q,15,FALSE)

	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 "*LA City direct jobs by sector"* sheet, copy and paste the results in the template for the year you are working on. Then, go to the "*Pivot table LA City Sectors"* sheet and select cell "A3", then go to "PivotTable Analyze" label and click on "Refresh" button under "Data" label. With this, 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 "LA City sector of interest" will show the number of green jobs by each of the LA City sectors of interest (figure 7). The number of GGS jobs are the input for Step II that will be described in section

Figure 7: Direct green jobs by LA City sectors of interest by year



Year	2020

Row Labels	Sum of GGS Jobs
Battery manufacturing (power or transportation)	149.565
Buildings construction	3669.931
Buildings design	1507.05
Buildings electrification	0
Buildings Energy efficiency	0
Buildings energy management	0
Buildings On-site renewable energy installation	0
Buildings water efficiency	401.08
Distributed energy resources	0
Electricity transmission	0
Environmental consulting	2252
Environmental non-profits	1471
Fossil fuel decomissioning	0
Rail and transit	1121.315
Solar installers	2265.641
Utility scale batteries	0
Utility scale renewables	172.304
Utility scale wind	0
Water and wastewater	401.08
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

b. Step II: Calculation of output in Los Angeles County.

Now that we have estimated the direct green jobs for each sector (both 184 SAM and LA City sectors of interest), open the "GGS tool.xlsx" file. In this file, you will find many sheets. However, 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 $ by each industry, using the direct green jobs previously estimated, for both the 184 SAM sectors and the LA City sectors of interest.

Sim calculator LA County: highlighted in light blue, in this tables you will use the estimated "green output" to calculate the final results on LA County.

Jobs by race in LA County: highlighted in green, this sheet shows the results on green jobs by race in LA County.

Jobs calculator LA City: highlighted in green, this sheet shows the total green jobs results in LA City.

Jobs by race in LA City: highlighted in green, this sheet shows the total green jobs by race in LA City.

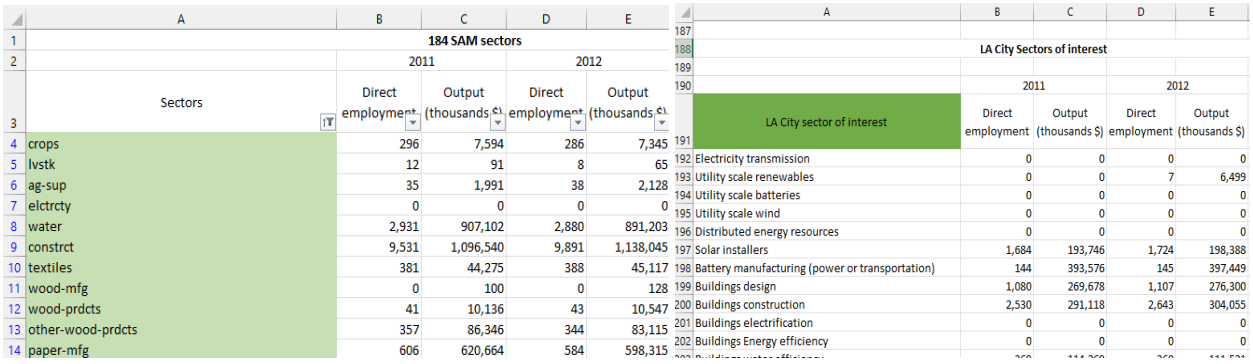
Complete database: highlighted in orange, this is a template where you can copy and paste each of the results and use it for pivot tables and graphs analysis.

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 "*Direct jobs and output"* sheet, and you will find two columns for each year (figure 8). One of them is called "Direct employment" and the other "Output (thousands $)" for both the 184 SAM sectors (at the bottom) and the LA City sectors of interest (row 191).

In the "Direct employment" column, paste the results estimated in "Step I: Direct green jobs estimate", for both the 184 SAM sectors and the LA 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



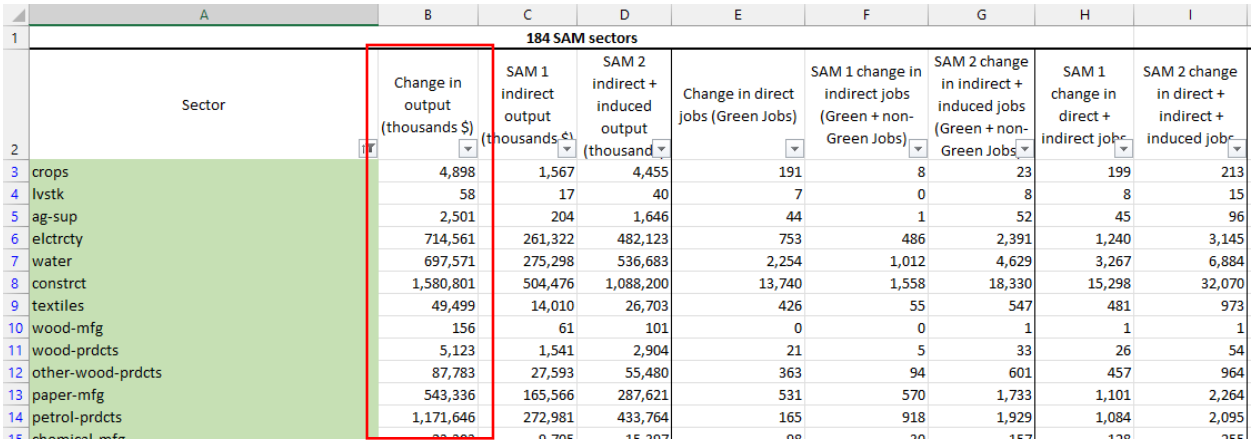
184 SAM sectors				
	2011		2012	
Sectors	Direct employment	Output (thousands $)	Direct employment	Output (thousands $)
crops	296	7,594	286	7,345
lvstk	12	91	8	65
ag-sup	35	1,991	38	2,128
elctrcty	0	0	0	0
water	2,931	907,102	2,880	891,203
constrct	9,531	1,096,540	9,891	1,138,045
textiles	381	44,275	388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

LA City Sectors of interest				
	2011		2012	
LA City sector of interest	Direct employment	Output (thousands $)	Direct employment	Output (thousands $)
Electricity transmission	0	0	0	0
Utility scale renewables	0	0	7	6,499
Utility scale batteries	0	0	0	0
Utility scale wind	0	0	0	0
Distributed energy resources	0	0	0	0
Solar installers	1,684	193,746	1,724	198,388
Battery manufacturing (power or transportation)	144	393,576	145	397,449
Buildings design	1,080	269,678	1,107	276,300
Buildings construction	2,530	291,118	2,643	304,055
Buildings electrification	0	0	0	0
Buildings Energy efficiency	0	0	0	0

c. Step III: Calculation of direct, indirect, induced green and non-green jobs by race categories in Los Angeles County and Los Angeles City

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

Figure 9: "Sim calculator LA County" sheet vectors



184 SAM sectors								
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
crops	4,898	1,567	4,455	191	8	23	199	213
lvstk	58	17	40	7	0	8	8	15
ag-sup	2,501	204	1,646	44	1	52	45	96
elctrcty	714,561	261,322	482,123	753	486	2,391	1,240	3,145
water	697,571	275,298	536,683	2,254	1,012	4,629	3,267	6,884
constrct	1,580,801	504,476	1,088,200	13,740	1,558	18,330	15,298	32,070
textiles	49,499	14,010	26,703	426	55	547	481	973
wood-mfg	156	61	101	0	0	1	1	1
wood-prdcts	5,123	1,541	2,904	21	5	33	26	54
other-wood-prdcts	87,783	27,593	55,480	363	94	601	457	964
paper-mfg	543,336	165,566	287,621	531	570	1,733	1,101	2,264
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 LA County
- Jobs calculator LA City
- Jobs by race in LA City

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

3. Preparation of final tables

Once the user has 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, 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, the user will be ready to generate tables and graphs manually using the “PivotTable Fields” options, selecting the different variables based on their study interests.

Methodological Appendix: Green Jobs Calculator Project

1. Introduction: Methodology for Tool[5]

LA City asked for a Green Goods and Services (GGS) employment calculator tool that relies on publicly available information/data sources, we have designed a tool 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.

a. Direct effects

Direct employment are jobs created due to investments in specific sectors, here defined as GGS. To estimate the direct employment effects created by Green Goods and Services 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 those Sectors that the Bureau of Labor Statistics has designated as benefitting the environment at a 6-digit NAICS sector level[6] from 2011 to 2020. The shares of GGS jobs by sector presented by BLS in 2011[7] were multiplied by the total number of jobs in LA 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 both at a 4-digits NAICS and 6-digits NAICS levels, so we have made an analysis of both 4-digit NAICS (aggregating the 6-digit NAICS databases for some sectors), and at 6-digit NAICS. The results presented here are the results of the 6-digit NAICS analysis, due to greater accuracy.

b. Indirect and c. 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

[5] The refined GGS jobs calculator can be accessed in this link: GGS jobs tool. The results are shown in the green highlighted sheets.

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

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

of the increased income and consumption expenditure by workers employed in the sectors directly and indirectly linked to the GGS sectors.

To estimate the indirect and induced effects, we use a Multisector Social Accounting Matrix (SAM)-based multiplier model. The advantage of using SAM models over Input-Output models is that the SAM model include 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 in the economy. The SAM provides a highly disaggregated picture of the 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.

To consider how the effects at the disaggregated sectoral level are transmitted across the economy requires a multisector approach that captures the complexity of an inter-connected economy. Historically, empirical work focused on inter-industry linkages as measured by input-output tables.[8] An extension of that work is based on a Social Accounting Matrix (SAM) that expands the input-output table to include more linked economic actors than just industries.[9] A SAM shows the full circular flow of income in the economy, including the generation of income in production value chains (value added), how that income is distributed to households and government, which in turn buy the goods and services produced in the economy.

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 table is square and the column and row sums for each account must balance. For a national SAM, the table provides a complete and potentially

[8] 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.

[9] See Miller and Blair (2009), chapter 11, "Social Accounting Matrices".

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 the possibility of industries producing more than one 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):

GDP (factor cost) + indirect taxes/tariffs = GDP (market prices) = C + I + G + E − M.

GDP + M − E = aggregate supply = aggregate demand = C + I + G.

SAMs and models based on SAMs provide an appropriate empirical framework for analysing the comprehensive effects of sectors considered as Green Goods and Services in other industries and household segments of the economy[10].

A SAM-Multiplier models start 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 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 both, 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			

3. Excel Tool Methodology

[No need to mention GAMS. We did not use it for this project.]

Two SAM multiplier models to estimate GGS jobs

The SAM multipliers 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. What are considered indirect changes in this tool are those effects 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, reflects different multiplier effects. To estimate these effects, we first created the Los Angeles County SAM. Then, a coefficients 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.

<u>SAM1 model</u>

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 were considered endogenous: activities (such as SAM1 model) and also households, which reflects both the increase in production due to economic linkages between sectors and increased demand due to the increase in household income due to 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 the SAM1 model because it takes into account the production of related sectors and the production due to the increase in income and spending.

3. 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 at different industries and geographic levels, including cities and counties. This data set is used to downscale the Los Angeles Country 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.