

Expanding Pathways to Quality Jobs in Austin's Growing Green Economy



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EXECUTIVE SUMMARY



Source: ACCC American YouthWorks Member for photovoice project (pages 28 and 29 of this report)

The Issue

Despite important events currently dominating the headlines, climate change and related stresses present a fundamental challenge that will shape the future of our world and region. Climate scientists and leading institutions have identified the next ten years as a make or break period to address the climate crisis. If forceful actions are not taken to transform the way we produce, consume and travel, the economic costs of climate change and associated effects will undermine our livelihoods and way of life.

In the struggle to limit climate change, U.S. cities have been leading from the front in light of mixed policies at national and state levels. The City of Austin (COA) is a recognized leader on a range of

environmental issues. With active citizen support, policies implemented by COA enterprises and departments have yielded significant progress in reducing per-capita greenhouse gas emissions, water consumption and in protecting our lands and groundwater resources. Numerous city environmental actions have been recognized as best practices at the national and international levels.

Aggressive actions to limit environmental harms are often criticized as job killers. Some accept the proposition that there is a sharp tradeoff between improving environmental outcomes and economic growth and jobs. However, there is a plethora of evidence that greening the economy actually generates net increases in economic growth and employment.

The Report

This report shows that jobs directed to improving environmental outcomes have grown significantly faster than overall employment both nationally and in the Austin region. More specifically green jobs are defined as 1) involving work that produces goods or services that benefit the environment and or conserve natural resources; 2) involving work that makes production processes more environmentally friendly or consuming fewer resources. We produce two estimates of green job growth based upon this definition: a core estimate based strictly on a Bureau of Labor Statistics definition of green job content by detailed occupation; and an expanded estimate drawing on additional information from other studies and interviews with local actors. In both “scenarios” green job growth has been robust and is forecast to grow rapidly in future years.

- In the core estimate, green job growth in the Austin Metropolitan Statistical Area (MSA) over the 2010-2019 period equaled 19,520, and the green job share of total employment increased from 3.33% of total employment in 2010 to 4.18% by 2019.
- In the expanded estimate, the Austin region added 23,820 green jobs from 2010 to 2019, and the green share of total employment increased from 4.72% of total employment in 2010 to 5.56% by 2019.
- Analyzing the forecasted growth in employment by occupation for Travis County between 2018 and 2028, our estimates show that there will be between 14,000 (core estimate) and 21,000 (expanded estimate) job openings in occupations with some green activities.

These estimates clearly demonstrate that green activity and jobs represent a major economic development opportunity for the city and the region. Furthermore, green development opportunities are predicted to grow in future years in light of more aggressive actions at the federal and local levels. The above job estimates may be conservative as they are based on historic data incorporating national, state and local policies in effect in 2018. Our projections do not account for significant federal policy changes over the past year or the continued “greening” of occupations as environmental concerns continue to gain prominence.

Our analysis demonstrates that the Austin area is especially well placed to capture the economic development opportunities of robust green job growth in the future. Our estimates show that green activity and employment is disproportionately supported by local demand versus exports stimulated by demand from outside the region. We estimate that close to seventy five percent of green jobs in the Austin MSA are supported by local consumers and businesses. This pattern implies that green job growth will be strongly shaped by the preferences and actions of local consumers, businesses and local government policies.

Seriously addressing climate change and other environmental challenges is contingent on addressing growing patterns of inequality in the economy and in our communities. The fundamental relationship between environmental progress and environmental justice is powerfully detailed in Austin’s recently adopted Climate Equity Plan. In this light, it is crucial to address the fact that green job growth is tilted towards occupations that require at least a bachelor’s degree to enter. We also find that women and people of color are underrepresented in the current green job mix. Furthermore, in the Austin labor market women, African American and Latinx residents entering the skilled trades make lower wages than their white counterparts¹. This discrimination must be attacked head on for women and communities of color to secure the full benefits of green economic growth.

A key aim of this report is to outline ways to better seize upon the formidable economic development opportunities offered by green economic growth, while opening new pathways to high quality jobs and careers for those who have historically had limited opportunities in the green economy. The report highlights opportunities for family-supporting jobs in green occupations not requiring high levels of educational attainment such as a college degree. As a reference, we use an estimate of living wage jobs for a four-person family with two full time

workers in Travis County as paying \$21.20 per hourⁱⁱ. We estimate future job openings in green occupations paying a living wage and relate these opportunities to Austin area workforce development strategies and institutions. When we think of quality job opportunities, we also consider health care and other benefits, such as job stability and opportunities for advancement.

The report focuses on five key domains of environmental activity. In each area, local action and policies can have significant impacts on environmental and employment outcomes:

- Energy Efficiency and Alternative Energy Sources
- Water Management and Conservation
- Waste Management and Resource Recovery
- Transportation
- Lands, Parks and Urban Agriculture

Suggested Actions

We look closely at market trends, local policy actions and specific economic and job opportunities related to each of these five domains. We focus on how low- and moderate-income residents can secure environmental benefits, household budget savings and access to quality career building jobs. The report highlights specific green jobs that provide opportunities for advancement in an occupation and offer possibilities to build a career through on-the-job experience and additional education and training (career pathways). We table a series of suggested actions that might strengthen links between growing green occupations and communities and residents seeking quality jobs that improve environmental conditions. Among the actions that we discuss are the following:

- 1. The City of Austin could host a series of convenings or green job summits.** The purpose of this initiative would be to disseminate information on the characteristics and growth of green activities and jobs, create stronger and more durable networks to support green job initiatives and training pathways, and to foreground the green economy as a sustainable driver of Austin’s future economic prosperity.
- 2. The City of Austin can work to burnish and perhaps reimagine the recently established Austin Civilian Conservation Corps (ACCC).** ACCC currently offers paid green jobs and was established as part of the City’s response

to the COVID crisis. This program currently operates to provide participants with income and training for future jobs and careers that improve environmental outcomes. Based upon a review of civilian conservation corps type programs, the broader workforce development literature, interviews with program leaders and a photovoice engagement project with ACCC participants conducted by part of our research team, several options for the future development of ACCC could be evaluated:

- **More closely integrate ACCC workforce pathways and job experience with the City of Austin's hiring needs.** After an initial training and job exposure period in the ACCC program, successful participants should be able to apply to a range of well-paid departmental internships or apprenticeships. The City would need to review and revise its policies that generally limit COA internships to public school or university attendees. But department internships for those finishing ACCC programs could lead into direct hiring or to further training or apprenticeship with support and commitment by the City to hire upon completion of further training.
 - Separately, or in combination with City hiring, **ACCC could develop deeper partnerships with key workforce development institutions to create specific transitions from the ACCC program into further training for career-building jobs.** Creating strong partnerships with institutions like Austin Community College and select non-profit workforce organizations could create clear pathways to green careers for ACCC graduates.
3. As part of the COA's efforts to improve information and organizational networks around green economic activity, **stronger links between specific communities and community-based partners and green activities and green job access could be forged.** The City created a Climate Ambassadors program for the Climate Equity Plan process to engage communities typically excluded from discussions of climate-related issues. The City can consider extending and redesigning this concept to create a permanent network of residents who, as paid workers, could help increase awareness of, and participation in, a variety of environmental policies and actions at the community level. Such community climate action leaders could monitor and report

local environmental issues to the City as well as helping to mobilize greater community participation in energy, water, resource recovery and alternative transportation incentives and opportunities. By increasing disaster resilience, the adoption of conservation measures and alternative transportation access, such an initiative would spur environmental activity and green job growth while tangibly benefitting participating communities. Ambassador programs differ from traditional community engagement strategies, such as boards and commissions; for example, since ambassador positions are paid, these positions expand the pool of participation beyond residents who can afford to volunteer their time.

4. Austin's workforce development organizations provide a rich variety of job access and job training opportunities for local residents, including some training opportunities for jobs that have green tasks as part of the work. **It is critical that green job training initiatives develop as an integrated piece of broader workforce development efforts,** and not as stand-alone programs. There are numerous opportunities to scale up and diversify green job training and career pathways. However, unlike in some regions, Austin workforce development organizations are not centered on specific communities or areas of the city. While Austin workforce organizations do recruit through community-based institutions, it might be worth examining how stronger community links could be forged, especially in recruiting residents of color for training for quality, living wage jobs that improve environmental outcomes.
5. One significant gap in Austin's workforce development architecture is the shortage of formal, paid apprenticeship programs. Paid apprenticeship programs in the region are limited because Austin has a relatively weak legacy in manufacturing and unionized trades. Unlike other training and employment programs, formal apprenticeships pay living wages as workers are training and building skills. To link Austin residents without a college degree to green careers, **the City should collaborate with the Austin Workforce Solutions-Capital area, and with employers and labor unions to find innovative means to expand apprenticeship programs in occupations with significant green tasks** (such as plumbers and pipefitters, sheet metal workers, electricians and auto, bus and truck mechanics).

INTRODUCTION

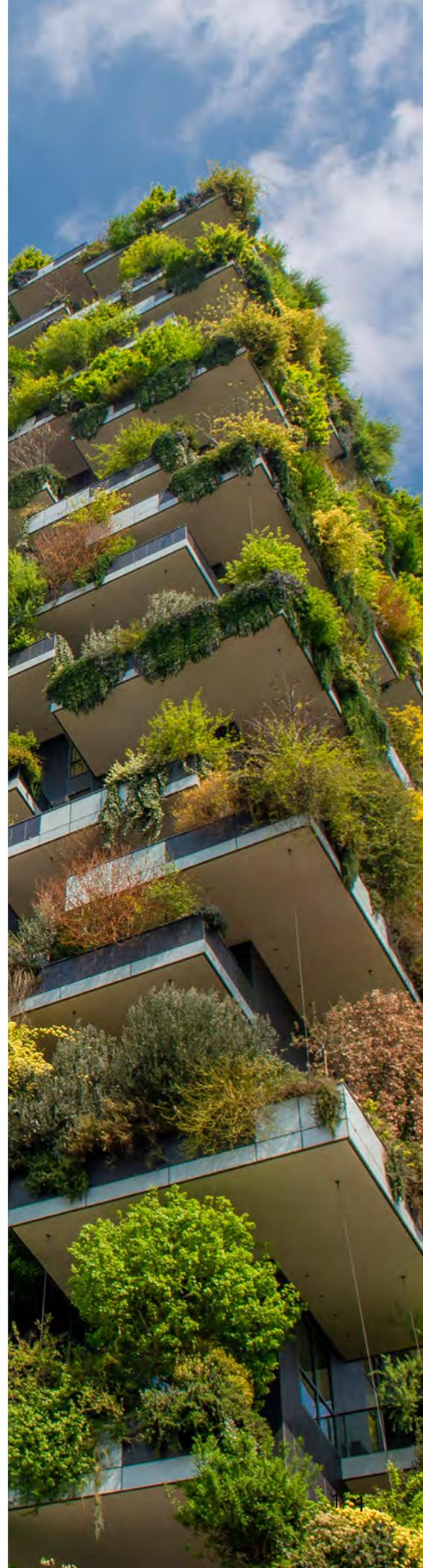
This report was produced as part of a project conducted by researchers at the University of Texas at Austin (UT) for the City of Austin. The report aims to address important questions related to green activities and jobs in the Austin region. First, how do we define green activity and jobs? In this report we first define and estimate green employment and the growth of green employment nationally and in the Austin region. We highlight a range of occupations that involve green activity and show that growth in these occupations has been strong and will generate considerable job opportunities in the future.

Second, in what ways are local public and private sector institutions active in the green economy? Here we briefly highlight how local leadership and policies have supported and stimulated environmental activities and jobs over the past decade. We further suggest that the alignment of residents, business firms and local governments to seriously address climate change and other environmental challenges is strong and augurs well for environmental progress and green job growth in the future. The evidence strongly suggests that in future years there are burgeoning opportunities to connect economic development and workforce training to a growing green economy.

Next we probe how the local workforce development system is positioned to take advantage of green job opportunities. The report examines the workforce development system in the Austin area. We find that while area workforce development strategies and organizations have significant strengths, there are specific opportunities to better link residents without a bachelor's degree to attractive, high quality jobs involving green activities.

Finally, what are the major opportunities for green job growth moving forward? We explore five major areas of environmental activity: energy efficiency and alternative energy sources; water management and conservation; waste management and resource recovery; transportation; and lands, parks and urban agriculture. We profile the main trends and public policies shaping actions and green employment in each of these areas, and we examine specific occupations that involve green activities and tasks in each of these domains. The focus in each area is on job opportunities in specific green occupations that provide pathways to family-supporting jobs. We tie Austin's main workforce development institutions to recruiting and training activities related to these areas of environmental activity and opportunity. We outline national examples of innovative training programs for green jobs and propose some ideas about how Austin workforce institutions could better seize on future green job growth opportunities. In this context we discuss how the Austin Civilian Conservation Corps (ACCC) initiative can position itself as a gateway to the high-quality green jobs we project will be created in the Austin region over the next years.

The research and findings in this report are based upon extensive reviews of academic, professional and public agency articles and reports in the key subject areas of the research. In addition, we conducted 25 interviews with City personnel and non-profit organizations in a number of areas related to the topic of green activity and green jobs. Finally, to increase the depth of our understanding about the opportunities and barriers to green job transitions encountered by participants in the ACCC initiative we did intensive photovoice interviews with the current ACCC cohort.



DEFINING GREEN ECONOMIC ACTIVITY AND JOBS

The Challenges

Defining green industries and jobs has challenged experts and scholars and has sown some confusion in the broader public discourse. Ask five different people what a green job is, and one will likely get five different answers. Some would reference obvious examples such as jobs at a solar panel manufacturing plant, the assembling of wind turbines or working at a recycling facility. Others may reference less common types of employment such as working at an urban organic farm, a second-hand store re-selling clothes or an architect designing a “green” building. There are three key definitional challenges in defining green economic activity:

- Defining a product, service or production process as green;
- Translating green environmental products or services into specific industrial or occupational categories as defined by federal agencies such as the Bureau of Labor Statistics;
- Accounting for the numerous jobs or industry activities that involve a mix of green job tasks or outputs and conventional (non-green) activities.

that clearly improves environmental outcomes. Solar panel production and installation, green building design and construction, building and water conservation activities map to a diverse set of industry or occupational categories. For example the construction and operation of a wind turbine may draw inputs from various industries such as industrial machinery manufacturing, fabricated metals, electronic connector manufacturing and power transmission equipment, etc.^v While these inputs might not meet the definition of green products, increased demand for wind turbines would stimulate sales and employment in the firms supplying the inputs.

Finally, there is the formidable problem of industries or occupations where part of the product or production activity meets the above definition of improving environmental performance or outcomes while other parts do not meet the definition. A plumbing equipment manufacturing firm that produces low-flow toilets and standard flow toilets or an automotive mechanic that services electric vehicles and conventional gas-powered vehicles are examples of mixed industries or occupations. Hence, activities and jobs are best understood on a spectrum, not as a simple binary categorization of green or non-green activities or jobs.

As a result of these definitional and estimating challenges, there is a wide divergence in estimates of employment in green activities that improve environmental performance or outcomes across numerous studies.^{vi} Foggy definitions of environmental industries and occupations are more than just academic challenges. State and local economic development planners have found it difficult to define green economic activity, isolate or target specific growth industries, delineate strengths and gaps relevant for firm retention or attraction or devise workforce development strategies linked to specific green employment demands^{vii}. After an extensive review of the literature, we adopted an approach that seemed to best address these definitional and estimating challenges.

In regard to the basic definitional issue, a review of the literature led us to adopt a relatively straightforward definition put forward by the US Bureau of Labor Statisticsⁱⁱⁱ:

- A. “Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.
- B. Jobs in which workers’ duties involve making their establishment’s production processes more environmentally friendly or consuming fewer natural resources.”^{iv}

The activities or a subset of activities carried out by an industry or a worker in a particular occupation can be set against this definition to specify an economic activity as green.

Another challenge is that the production of a good, a service or changing a production process fitting the above definition will often involve a number of industries or occupations that are part of the value chain for a “green” end product or service

In this report we center our national and local green job estimates on methods recently developed by Vona, Marin, & Consoli.^{viii} They employ an occupational approach that uses public secondary data to estimate green employment and employment growth. A major advantage of their methodology is that it provides green employment estimates that account for the fact that many occupations involve both job tasks that improve environmental performance or outcomes and other tasks that do not. In addition, this method allows estimates that are replicable at the national and regional scale and can offer consistent estimates over time.

In this method, Vona et al. first identify green tasks according to the Department of Labor's Occupational Information Network (O*NET). The O*NET program has created a green economy project that identifies specific job tasks within occupations as oriented to improving environmental performance or outcomes.^{ix} The green tasks are either associated with 'green enhanced skills' or 'green new and emerging' occupations. Many occupations have no green tasks associated with their work activities. For occupation with some green tasks, O*NET uses the distinction between green tasks and non-green tasks to quantify the portion of work time that each occupation dedicates to green activities at the 8-digit Standard Occupational Classification (SOC) level. For example, for occupation SOC - 47-2181-Roofers, O*NET identifies 29 discrete job tasks associated with this occupation. O*NET identifies nine tasks associated with roofing that improve the environmental performance of roofs. This yields a green score or ratio of .31 (9 divided by 29) for this occupation. In Appendix 2 we list the greenness ratios for all the occupations used in our estimates.

We utilize this general approach to generate what we term the **core** green job estimates. We calculate "greenness ratios" for each occupation using the O*NET green job task analysis for 2010 and 2019. We then produce an alternative set of estimates for the Austin region that relaxes some assumptions in the core model, adds jobs in some occupations that are affected by demand for more environmentally beneficial goods or services and puts in activities identified in the literature as improving environmental outcomes that are not part of our basic estimating model.

While this approach has limitations and is based on certain assumptions (which will be discussed below), it offers the most consistent, transparent and replicable method available to estimate the number of green jobs and the growth of green jobs over time. Moreover, the estimate provides valuable information about job openings in specific green occupations that can be used by economic and workforce development organizations to support green job growth.



GREEN EMPLOYMENT AND GREEN JOB GROWTH - CORE ESTIMATES

Using the methods described above we first generate estimates of historic and future national green job growth. We then develop estimates of green jobs in the Austin metro area and projections of future jobs and job openings. In general, our estimates confirm a strong consensus that over the past decade green activity and employment represent a compelling growth opportunity for economic and workforce development organizations.^x

National Green Job Estimates

We updated estimates of national green employment and used employment projections for the 2018-2028 period to estimate green job growth and employment shares at the national level. Our results are generally consistent with the widely cited studies above, with the green share of total employment growing from about 2.8% of aggregate employment in 2010 to 3.4% in 2018. Green employment is also projected to outpace overall employment growth through 2028.

Table 1: Green Employment Estimates and Projections - National Employment (in thousands)

<i>Year</i>	<i>Total Jobs</i>	<i>Green Jobs</i>	<i>Green Share of Total Employment</i>
2010	143,068	3,996	2.78%
2018	161,038	5,439	3.38%
2028	169,436	5,776	3.41%

The detailed national occupational estimates and forecasts show a somewhat bifurcated distribution of green jobs between occupations that have higher levels of educational attainment (SOC 11-29, 41) and occupations such as construction-installation, production, transport and waste management where workers have fewer years of formal education. This differentiation of occupations is often made according to categories such as professional-non-professional or high skilled-low skilled. In this report we avoid these pejorative terms and simply differentiate

according to the average level of educational attainment of workers in the various occupational categories. At the national level, roughly 66% of 2018 green employment is in occupations requiring on average about 15.5 years of formal education^{xi}. In many of these occupations the majority of employees hold a bachelors or higher degree.

Table 2: Green Jobs by Educational Levels (in thousands)

<i>Jobs With Higher Educational Attainment Levels (in thousands) SOC 11-29, 41</i>	<i>Year</i>	<i>Total Jobs (in thousands)</i>	<i>Green Jobs (in thousands)</i>	<i>Green Share of Total Jobs</i>	<i>Jobs With Higher Educational Attainment Levels as a Share of Green Jobs</i>
	2010	61,002	2,748	4.50%	69%
2018	68,939	3,579	5.19%	66%	
<i>Jobs Not Associated with Higher Levels of Educational Attainment SOC 31-39, 43-53</i>	<i>Year</i>	<i>Total Jobs (in thousands)</i>	<i>Green Jobs (in thousands)</i>	<i>Green Share of Total Jobs</i>	<i>Jobs With Lower Educational Attainment Levels as a Share of Green Jobs</i>
	2010	82,066	1,218	1.48%	31%
2018	92,099	1,860	2.02%	34%	

Another important finding is that the national green jobs workforce has a disproportionate share of male workers and lower levels of racial diversity when compared with all occupations nationally. Women, African American and Hispanic or Latinx workers are significantly underrepresented in national green job occupations.^{xii} These data demonstrate that the current mix of workers in green occupations is far from inclusive, indicating significant barriers to access that require attention and focused actions moving forward (see table, 3 below).

Table 3: Total and Total Green Employment of Women and by Race and Ethnicity 2019 (in thousands)

	<i>Total</i>	<i>Women</i>	<i>White</i>	<i>Black or African American</i>	<i>Asian</i>	<i>Hispanic or Latinx</i>
Total National Employment (over 16 years of age)	152,581	71,408	104,306	16,181	8,558	23,536
Percentage		46.80%	68.40%	10.60%	5.60%	15.40%
Total National Green Employment	5,439	1,296	3,869	420	357	793
Percentage		23.80%	71.10%	7.70%	6.60%	14.60%

Historic Green Jobs Estimates for the Austin MSA

In our project related estimates for the Austin MSA, we largely mimic the method of Vona et al., 2019. It is noteworthy that in our **core estimates** of green jobs we do not include occupations that are stimulated by green demand, but have no discrete green jobs tasks (e.g., bus drivers, insulation workers). Using this method, we first estimated historic green employment in the Austin MSA for the years 2010 and 2019 (table 4, below).

These estimates for Austin MSA green employment offer several significant insights. First, the green share of total employment increased significantly between 2010 and 2019 in the Austin MSA indicating that green job growth has been faster than the growth in aggregate regional employment (Total Jobs). Second, the regional (Austin MSA) green shares are significantly

higher than the green shares of employment nationally. The national green share grew from 2.79 percent in 2010 to 3.38 percent by 2019; the Austin region’s share and growth in the share exceeded national estimates. It is noteworthy that the green share increased in a rapidly growing regional economy, suggesting that the Austin MSA may have characteristics that indicate regional specialization and competitive strength in green activities.

Table 4: Total Jobs and Green Jobs - Core Method for Austin MSA

<i>Year</i>	<i>Total Jobs</i>	<i>Green Jobs</i>	<i>Green Share of Austin MSA Employment</i>
2010	759,910	25,328	3.33%
2019	1,073,340	44,848	4.18%

Table 5: Green Jobs by Educational Levels - Austin MSA

<i>Jobs With Higher Educational Attainment Levels - SOC 11-29, 41</i>	<i>Year</i>	<i>Total Jobs (in thousands)</i>	<i>Green Jobs (in thousands)</i>	<i>Green Share of Total Jobs</i>	<i>Jobs With Higher Educational Attainment Levels as a Share of Green Jobs</i>
	2010	357,206	17,310	4.85%	68%
2019	513,300	34,298	6.76%	76%	
<i>Jobs Not Associated with Higher Levels of Educational Attainment - SOC 31-39, 43-53</i>	<i>Year</i>	<i>Total Jobs (in thousands)</i>	<i>Green Jobs (in thousands)</i>	<i>Green Share of Total Jobs</i>	<i>Jobs With Higher Educational Attainment Levels as a Share of Green Jobs</i>
	2010	402,704	8,018	1.85%	32%
2019	560,040	10,550	1.88%	24%	

We estimate that close to 75% of green jobs in the Austin MSA are supported by local consumers and businesses.

It is also noteworthy that the breakdown of green jobs by average years of formal education is more skewed towards occupational categories with higher levels of educational attainment than the national estimates. In the Austin MSA, roughly 76% of green employment in 2019 is in occupations with higher average education levels (SOC occupational categories 11-29, and 41). However, there was a growth of over 2,500 green jobs in occupations with lower average years of formal education. An important additional finding from this analysis is that a significant share of green jobs in the Austin MSA are supported by local demand for green products and services. Using an occupational location quotient technique, our estimates show that green activity and employment is disproportionately supported by local demand versus exports supported by demand outside the region. This pattern implies that green job growth will be strongly shaped by the preferences and actions of local consumers and businesses and local government policies.

Projected Green Job Growth Capital Workforce Development Area (Travis County)

A key objective of this research is to project growth in jobs in occupations that make significant contributions to improved environmental performance or outcomes (green jobs). To generate these projections we use the same method, but drew upon projections of the Texas Workforce Commission – Capital Workforce Development Area. It is not possible to obtain job projection estimates for the MSA, only for the workforce development area that encompasses only Travis County. These numbers are different from the estimates for the five-county Austin MSA. This data source projects jobs by occupation and annual job openings for 2018-2028 for Travis County. Job opening estimates are different from the total change in employment over the period. Annual job opening estimates account for job growth in the occupation over the period but also consider the estimated number of people quitting and retiring each year over the forecast period.

The projections we generated for Travis County show robust projected growth and job openings in occupations with green tasks. Overall green employment is projected to grow from 33,695 in 2018 to 38,637 in 2028, or from 4.20 percent of total Travis County employment in 2018 to 4.25 percent by 2028.

Our estimates suggest that job growth in occupations with some green activity over the 2018-28 period will produce 14,686 annual job openings over the period. The majority of these job openings - roughly 68 percent - will be in occupations that require higher average levels of education. However, there will also be an estimated 4,748 annual job openings in occupations not requiring high average formal education levels. The occupations not requiring higher numbers of years of education, estimated below, combine relatively low wage occupations with occupations offering median wages of over \$20.00 per hour. Over half of the job openings in these occupations had average wages of over \$20.00 per hour (in 2019 dollars).

This report's focus on green jobs that do not require a high number of years of formal education (greater than high school) is intentional because labor hierarchies are racialized. Sixty-five percent of Austin's White workers hold a bachelor's degree or higher. Yet only 28.8% of Black workers and 25.8% of Latinx workers hold a bachelor's degree or higher.^{xiii} This suggests that existing patterns of green employment favor White workers. We thus focus on green job pipelines for workers who do not hold a bachelor's degree.

These projections provide an estimate of job growth and annual job openings in occupations that have some green activity or tasks as part of the job. They can also provide important information to assess future demand for workers and specifically how workforce development programs are positioned to provide training for high demand occupations offering higher wages in these green occupational categories. It is again important to note that these projections are based on conditions in 2018 and do not account for subsequent changes in the policy environment of the market for green job activities.

Table 6: Occupational Growth in Green Jobs Not Associated With High Levels of Educational Attainment

SOC-6	Greenness Ratio*	Title	Total Green Occupations Employment			Green Jobs Wage	
			Travis County Employment (2018)	Travis County Projected Employment (2028)	Annual Job Openings 2018-2028	Average Hourly Rate (2019\$)	Occupation/MSA Average Wage (2019)
43-5011	0.084	Cargo and Freight Agents	389	441	55	\$21.76	0.82
43-5071	0.085	Shipping, Receiving, and Traffic Clerks	3,144	3,437	356	\$16.71	0.63
47-2061	0.158	Construction Laborers	6,257	7,010	813	\$15.71	0.59
47-2152	0.241	Plumbers and Pipefitters	2,775	3,189	372	\$24.66	0.93
47-2181	0.301	Roofers	748	879	97	\$16.87	0.64
47-2211	0.214	Sheet Metal Workers	760	839	95	\$23.09	0.87
47-4011	0.264	Construction and Building Inspectors	666	818	107	\$29.86	1.13
47-4041	1	Hazardous Materials Removal Workers	239	271	32	\$22.51	0.85
47-4090	1	Construction and Related Workers, All Other	120	136	16	\$25.95	0.98
49-3023	0.22	Automotive Service Technicians and Mechanics	2,958	3,224	328	\$25.64	0.97
49-3031	0.151	Bus and Truck Mechanics	782	876	86	\$24.30	0.92
49-9021	0.132	Heating, Air Conditioning and Refrigeration Mechanics	918	1,058	111	\$21.25	0.8
49-9071	0.135	Maintenance and Repair Workers, General	7,052	8,230	859	\$18.35	0.69
49-9099	1	Installation, Maintenance, and Repair Workers	456	549	63	\$22.16	0.84
51-4041	0.066	Machinists	1,007	1,012	103	\$23.15	0.87
51-8013	0.203	Power Plant Operators	142	161	15	\$35.84	1.35
51-9012	0.054	Separating, Filtering, Clarifying, Precipitating Machine Setters	299	339	31	\$26.49	1
51-9061	0.058	Inspectors, Testers, Sorters, Samplers, etc.	3,383	3,252	396	\$21.64	0.82
51-9199	1	Production Workers, All Other	593	611	71	\$15.86	0.6
53-3032	0.086	Heavy Truck Drivers	4,700	5,554	668	\$20.35	0.77
53-7081	1	Refuse and Recyclable Material Collectors	406	513	74	\$18.25	0.69
Total			37,794	42,400	4,748		

*Greenness ratio= Estimated Share of Occupation that is Green (Green Job Tasks/Total Tasks in Occupation)

MORE COMPREHENSIVE ESTIMATES OF THE GREEN ECONOMY - EXPANDED MODEL

The estimates detailed above are based on what we term the **core model**. In this section we outline green job activities and estimates based upon relaxing some assumptions in the core model, adding in some jobs that are shaped by demand for more environmentally friendly goods and services and adding activities identified in the literature as improving environmental outcomes that are not part of our core estimating model.

Challenges with the Core Model

In the occupation-based green job estimating model used to generate the above core estimates there are certain limitations and assumptions that must be considered when we estimate green jobs at the regional level (MSA) or for Travis County. There are four issues that we consider and address to generate a second, more expansive estimate of green jobs for the Austin MSA and Travis County:

1. The core model estimates above do not account for occupations/ industries that are affected by green demand (e.g., public transit bus drivers, zoologists and wildlife biologists) but are not defined as performing green tasks in O*NET;
2. The core model estimates do not account for regional variations in occupational work tasks (e.g., building inspectors or roofers in Austin may spend more time on green tasks than building inspectors in Little Rock). In general, some workers in Austin may spend more of their work time on green tasks due to local policies (e.g., recycling or building standards) and local preferences (e.g., more electric or hybrid vehicle ownership than the national average);
3. The core model doesn't account for jobs/activities that do not fit neatly into OES occupational categories – (e.g., workers engaged in urban agriculture, workers in environmental non-profits, teachers incorporating environmental education in their curricula);
4. The occupational projections (both national and for Travis County) assume no changes in government policies or the ongoing “greening” of occupations based on more recent market trends. The projections are based on the national, state and local policy mix and market conditions in effect in 2018. The projections, for example, do not account for significant federal policy changes over the past year or the substantial employment generated by Tesla's EV plant opening operations in Travis County.

green tasks. These occupations are referenced in the literature and by local informants as being part of the “green economy.”^{xiv} We added employment from these occupations to our estimates under this scenario. Based on interview information and parts of the literature we made judgments about the greenness ratios

Expanding the Model

In our work developing an alternative, more expansive green jobs estimate, we have made a provisional estimate of MSA employment by making adjustments to some of the above constraints. We have produced a provisional alternative estimate or “**expanded model**” based on the following changes.

First, we added a select group of occupations that are strongly shaped by green demand, but do not directly involve green tasks as defined by the O*NET green jobs definitions. For example when consumers choose public transit versus private automobile transit this intrinsically improves environmental outcomes, hence we assume that public transit and intercity bus drivers are a green occupation. Similarly, growing demand for green buildings and public facilities with higher energy and water conservation standards shapes the way that architectural and civil drafters carry out their work.

Second, based upon a review of the literature and information from interviews, we added a number of occupations that did not register in the BLS –O*NET green jobs system as involving

of the added occupations. For example, based on information that environmentally related curriculum were increasingly embodied in K-12 curriculum, we assumed that 10% of teaching and library activities were related to green activity (see Occupation Code 25-000 below). In the case of electricians, the literature suggest that the occupation is increasingly engaged in installing and wiring energy efficient systems in residential and commercial buildings.

Estimating green jobs by differentiating activities and occupations that improve environmental performance or outcomes from those that do not is inherently somewhat subjective. For example, circular economy strategies focus on the recovery of useful resources and energy out of disposed products and waste but also on decreasing per-capita waste generation. This involves pushing a range of changes including extending product life cycles by increasing the repair and upgrading of products for extended use or resale. Some working in this area argue that most maintenance and repair occupational categories are intrinsically green as they extend the use of products and reduce resources required to produce new replacement products. We do include select maintenance occupations in both our core and expanded estimates, but we did not classify a number of other maintenance and repair occupations as green. In Appendix 4 we provide an estimate of employment in all maintenance and repair occupations in the Austin MSA.

Table 7: Added Occupations - Expanded Estimate

<i>Occupation Code</i>	<i>Greenness Ratio</i>	<i>Occupation</i>
11-9151	0.10	Social and Community Service Managers
17-2131	0.20	Materials Engineers
17-3011	0.27	Architectural and Civil Drafters
19-1022	0.33	Microbiologists
19-1023	1.00	Zoologists and Wildlife Biologists
19-1031	1.00	Conservation Scientists
19-2032	0.20	Materials Scientists
19-2043	1.00	Hydrologists
19-3092	0.14	Geographers
25-0000	0.10	Education, Training and Library occupations
29-9011	1.00	Occupational Health and Safety Specialists
33-2011	0.10	Firefighters
37-3011	0.10	Landscaping and Grounds Keeping Workers
45-0000	1.00	Farming, Fishing and Forestry Occupations
47-2031	0.16	Construction Carpenters
47-2111	0.33	Electricians
49-9051	0.46	Electrical Power-Line Installers and Repairers
51-6031	0.20	Sewing Machine Operators
51-6052	0.20	Tailors, Dressmakers and Custom Sewers
51-8031	1.00	Water and Wastewater Treatment Plant and System Operators
53-3021	1.00	Bus Drivers, Transit and Intercity

Making these additions to the core model estimates for the Austin MSA, we see that the green share of total employment was higher and growing more robustly than in the core model estimates. In the expanded model, 10,520 additional green jobs were added in 2010. By 2019 there are about 14,840 additional green jobs in the above occupations (over the core model estimates). By far the largest increment in green jobs was the result of adding Education, Training and Library occupations. Even though we assumed that just ten percent of these

Table 8: Total Jobs and Green Jobs - Expanded Method - for Austin MSA

<i>Year</i>	<i>Total Jobs</i>	<i>Green Jobs</i>	<i>Green Share of Austin MSA Employment</i>
2010	759,910	35,865	4.72%
2019	1,073,340	59,684	5.56%

occupations were related to environmental science and education and incorporation of environmental material in curricula, this led to the addition of 6,233 jobs to the green employment total in 2019. There was an addition of over 9,000 to green employment in 2019 (over the base estimate) excluding these educational and teaching occupations.

The job mix in this expanded estimate is slightly less skewed to jobs requiring higher levels of educational attainment. In the expanded green jobs estimate there is a slightly higher ratio of employment, and more jobs in occupations not requiring high education attainment, than in the core model scenario.

Table 9: Green Jobs by Educational Levels - Expanded Estimate - Austin MSA

<i>Jobs With Higher Educational Attainment Levels - SOC 11-29, 41</i>	<i>Year</i>	<i>Total Jobs</i>	<i>Green Jobs</i>	<i>Green Share of Total Jobs</i>	<i>Educational Attainment Levels as a Share of Green Jobs</i>
		2010	357,206	23,246	6.51%
	2019	513,300	42,262	8.23%	71%
<i>Jobs Not Associated with Higher Levels of Educational Attainment - SOC 31-39, 43-53</i>	<i>Year</i>	<i>Total Jobs</i>	<i>Green Jobs</i>	<i>Green Share of Total Jobs</i>	<i>Educational Attainment Levels as a Share of Green Jobs</i>
		2010	402,704	12,438	3.09%
	2019	560,040	17,422	3.11%	29%

The ongoing growth of green activities supports current and future jobs in a wide range of professional occupations (management occupations, electrical, mechanical and environmental engineering occupations, architecture, zoologists and wildlife biologists and many others). A full estimate of employment and job opening estimates in this set of occupations is provided in Appendix 3.

Projected Green Job Growth Capital Workforce Development Area (Travis County) with Expanded Estimate

We used the projections of the Texas Workforce Commission – Capital Workforce Development Area over the 2018-2028 period with the occupations added in the expanded green jobs scenario. The projections generated for Travis County under this expanded scenario show strong projected growth and expanded job openings in the added occupations with green content. These estimates show green employment growing from 45,181 in 2018 to 50,536 in 2028 with the green job share of total Travis County employment equaling about 4.6% in both 2018 and 2028.

In the expanded estimate, job growth in occupations with some green activity over the 2018-28 period will produce 20,966 annual job openings over the period. Excluding projected job openings in the educational and teaching professions there will be over 17,000 annual openings in green occupations in this scenario. The majority of these job openings (roughly 72 percent) will be in occupations that require higher levels of educational attainment (at least 14 years of education and an average of 15.5 years for all occupations in the high education attainment category (SOC 11-29 and 41). However, there will also be 2,140 additional annual job openings in occupations not requiring higher levels of formal education in this expanded estimate. These

are in addition to the over 4,700 jobs occupations not requiring high educational attainment detailed in the core estimate (see table 5, above). The occupations not requiring high levels of formal education added in this expanded estimate are a mix of relatively low wage occupations and occupations offering median wages of over \$20.00 per hour. In five of the following twelve occupations average wages were over \$20.00 per hour (in 2019 dollars).

Table 10: Occupational Growth in Green Jobs Not Associated with High Levels of Educational Attainment

SOC-6	Greenness Ratio	Title	Total Green Occupations Employment			Green Jobs Wages	
			Travis County Employment (2018)	Travis County Projected Employment (2028)	Annual Job Openings 2018-2028	Average Hourly Rate (2019\$)	Occupation/MSA Average Wage (2019)
33-2011	0.10	Firefighters	1,859	2,402	202	\$30.17	1.18
37-3011	0.10	Landscaping and Groundskeeping Workers	6,211	7,060	588	\$14.63	0.57
45-0000	1.00	Farming, Fishing and Forestry Occupations	2,269	1,453	213	\$16.04	0.63
47-2031	0.16	Construction Carpenters	2,687	2,996	325	\$18.96	0.74
47-2111	0.33	Electricians	3,424	3,923	499	\$25.61	1.00
49-9051	0.46	Electrical Power-Line Installers and Repairers	261	323	31	\$31.12	1.21
51-6031	0.20	Sewing Machine Operators	495	508	57	\$11.65	0.45
51-6052	0.20	Tailors, Dressmakers and Custom Sewers	219	267	37	\$13.94	0.54
51-8031	1.00	Water and Wastewater Treatment Plant and System Operators	325	364	35	\$21.60	0.84
53-3021	1.00	Bus Drivers, Transit and Intercity	1,069	1,182	153	\$19.24	0.75
Total			18,819	20,478	2,140		

The more expansive definition of employment that involves green activities demonstrates that the green economy is undeniably a source of current vibrancy and future growth. There is little question that green activities and jobs constitute a promising economic development opportunity for the city and the region. In the following sections the growth in the green economy will be related to more recent trends and strong environmental policies advanced by the City of Austin. The report will then link the occupational job opportunities detailed in the above sections to specific areas of environmental activity being driven by private sector and public actions. In this context we will analyze existing workforce development organizations and possible ways to fully exploit channels into growing green occupations offering living wages and opportunities for advancement.

AUSTIN'S STRENGTHS IN THE GROWING GREEN ECONOMY

Austin citizens and the leaders they elected have supported strong actions to preserve and improve the region's environment for over three decades. Across the spectrum of environmental challenges from greenhouse gas (GHG) reductions to water conservation to waste diversion and recycling, Austin is at the forefront of innovative and effective actions.

With strong citizen support, the City of Austin (COA) passed a climate action plan in early 2007, adopted a range of strong climate protection plans and policies from 2014 through 2020, and advanced an innovative Climate Equity Plan in late 2021. "Green jobs and entrepreneurship" is listed in the 2021 Climate Equity Plan as an overarching strategy that "touch[es] all areas" of the plan^{xv}. The Plan argues that the creation of green jobs will not only drive improved environmental and economic outcomes, but also address the equity goals of the Plan. Specifically, the Plan encourages increasing green job training opportunities for people of color and providing financial support to local green businesses owned by people of color. The Plan lists various ways that green job development could contribute to its goals, including the promotion of tree-health through targeted curriculum in green job training programs and the creation of new workforce development programs that directly support the operations of Austin Water.^{xvi}



A central theme in the City's Climate Equity Plan is that future actions of Austin's public and private institutions must focus on expanding opportunities in communities that have disproportionately suffered environmental harms in the past and have not benefited from the opportunities provided by green economic development.

In terms of COA actions, it can be argued that all parts of city government are aligned in emphasizing environmental goals in their operations. To better grasp the environmental commitments and impacts of COA policies and initiatives it is useful to highlight actions of a subset of departments and enterprises at the forefront of improving environmental performance and outcomes.

Source: ACCC American YouthWorks Member for photovoice project (pages 28 and 29 of this report)

Table 11: Environmental Leadership of City Departments and Enterprises

<i>Department or Enterprise</i>	<i>Employment</i>	<i>Examples of Plans and Guidance</i>	<i>Environmentally Oriented Activities and Actions</i>
Office of Sustainability (Management Services)	10	Austin Climate Equity Plan, Food-Environment Analysis and Action Plan	Works to achieve community-wide net-zero greenhouse gas emissions by 2050. Promotes healthy and just local food system, advances resource-efficient strategies for municipal operations and supports tangible projects that demonstrate sustainability, and a resilient and adaptive city.
Equity Office (Management Services)	10	Equity Assessment Tool	Provides leadership and capacity building across the City to advance equity and transform our local city government to meet the needs of communities of color and other vulnerable populations. Works with other departments to ensure that the large scale public transit investments of Project Connect provide equitable access and limited neighborhood displacement.
Innovation Office (Management Services)	7	Design Manual for Community Participation	Examines challenges and opportunities to advance better ideas and solutions that make a lasting, positive impact on City services. The Innovation Office supports various projects to stimulate environmental entrepreneurship.
Parks and Recreation	704	Our Parks, Our Future Long Range Plan	Focuses on park and open space preservation and development, city trails and urban forestry. Houses the Austin Civilian Conservation Corps initiative.
Austin Energy	1,813	Resource, Generation, and Climate Protection Plan to 2030.	Publicly owned utility that engages in expansion of alternative, clean fuel sources in the utility's generation portfolio. Manages a range of marketing, outreach and incentive programs for residential and commercial energy conservation upgrades and residential and commercial solar installations. Also supports adoption of green building standards and is supporting EV charging station installations.
Austin Water	1,236	Water Forward - Austin's 100-year integrated water resource plan.	Publicly owned water utility promotes and manages a range of water conservation efforts including different types of wastewater reclamation and reuse, incentives for xeriscape transformation and rainwater collection. Also markets and provides a range of water conservation support and incentives for residential, commercial and public properties.
Austin Resource Recovery	501	Austin Resource Recovery Zero Waste Comprehensive Plan (updated plan expected out 2022)	Focuses on resource recovery waste diversion and waste management. Manages a robust residential recycling program, including curbside single stream recycling and compost service. Administers and implements zero waste programs and policies, such as recycling requirements for apartments, businesses and construction sites. ARR has more recently focused on expanding "circular economy" activity across a range of function and economic sectors that aims to reduce waste by reusing, repairing and sharing products.
Watershed Protection	377	Watershed Protection Strategic Plan	Focuses on flood protection, erosion control and water pollution in city streams and lakes. Work includes water quality evaluation, stormwater permit compliance, stream restoration, stormwater treatment, watershed education and green infrastructure construction.
City of Austin - ABIA Airport	549	Airport Master Plan, Airport Carbon Accreditation Certificate	City of Austin enterprise has worked to attain carbon neutrality through a range of measures including construction of a 1,800 kW Community Solar array covering airport parking structures.
Austin Transportation	353	Austin Strategic Mobility Plan	Works to deliver safe, reliable, and sustainable multi-modal transportation for City residents and businesses. Invests to improve and enhance bikeways and pedestrian mobility. Manages projects to expand the use of alternative fuel vehicles.
Capital Metro	456	Capital Metro Strategic Plan, Project Connect	Regional public transportation operator serving Central Texas localities. It builds and operates the area's public transportation system that includes bus, rail and other mobility services. CapMetro is leading a major \$10 billion expansion of bus and rail systems in its service area.

The range of policies and actions implemented by COA departments and enterprises have yielded significant progress in reducing per-capita greenhouse gas emissions, resource consumption and protecting lands and groundwater resources. Numerous City environmental actions have been recognized as best practices at the national level.^{xvii} Initiatives by COA departments have shaped green development through policy, education and collaboration across city government. Specific policies and incentives of COA enterprises and agencies have directly stimulated green jobs within City government and among numerous private sector firms carrying out projects linked to City projects, regulations and incentives.

These public sector actions are strongly complemented by economic development institutions and green activities in the private sector. Austin has been highlighted in the economic development literature as having a very strong, coherent and durable economic development coalition and associated networks. This growth coalition has been centered on the Greater Austin Chamber of Commerce (GACC), the City of Austin and a shifting array of industry trade organizations and public sector institutions (most notably, the University of Texas at Austin).^{xviii}



This coalition has had a specific focus on green industry development since 2006. The GACC has foregrounded green technology/clean energy as a “target” industry for the past 15 years. Currently, GACC has a Clean Tech technology project focused on information sharing, convenings and promotion of clean technology initiatives and firms. Their partners include: the Pecan Street Research Institute that focuses on modeling, testing and verifying new smart home technology, electricity pricing, electric vehicle infrastructure, solar energy and energy storage; CleanTX, a nonprofit economic development and professional association focused on green development; and the

Clean Energy Incubator which is part of Austin Technology Incubator (ATI) founded in 1989. With the help of the City of Austin, ATI also launched business incubation initiatives for start-ups in circular economy areas and water technology.

Private sector trends seem to connect to and complement public and non-profit initiatives. The Austin region sports many firms focused on environmental products and services. For example, Active Power is a medium sized manufacturer of flywheel uninterruptible power supply (UPS) systems with about 90 local employees. The GACC lists 39 Austin firms as active in clean technology industries.^{xix} In terms of our green jobs estimates, local initiatives may have bolstered the growth of green jobs in management and professional and technical services occupations, a strong segment in Austin’s overall green economy (see Appendix 3). There are also a large number of consulting, service and installation firms related to the area’s strong residential and commercial solar sector. In addition, our green jobs estimates and projections do not account for the new Tesla plant that will add thousands of green jobs in automotive assembly, an occupational category that did not previously exist in the Austin region.

THE AUSTIN WORKFORCE DEVELOPMENT SYSTEM AND LINKS TO GREEN JOB GROWTH

The promise of green jobs can only be fully realized when public policies and economic development initiatives are closely and thoughtfully linked to workforce training. This occurs when strong partnerships between the private, public and non-profit sectors are supported and sustained to link skilled workers to growing industries and occupations in the green economy. In addition, workforce development is most effective when targeting job categories that can be accessed by residents who most need living wage jobs offering upward mobility and career building opportunities.

An important component of this report is examining Austin's main workforce development institutions in terms of their training strategies, the occupations they are targeting and their job placement performance. In our analysis of literature and reports on local workforce development and in our interviews with staff in workforce development institutions, we were particularly interested in how the types of jobs targeted for training and placement might link to growing occupations involving green activities or tasks. Based on this assessment of the local workforce development architecture and programs we then reference the broader literature and case studies of best practice workforce development elements and programs.

Traditional workforce development systems are organized to address mismatches between specific skills and capacities employers need, and the skills and capacities potential employees possess. It can be uniquely difficult to address this mismatch in industries where technology and workplace policies continue to evolve and where new skills training and continuing education may be necessary. The evolving green economy will create new industries and new occupations in select areas. But most workforce development will be shaped by transformations of existing industries and skill mixes in occupations that are already present in the regional economy.

There are many barriers to accessing education and training pathways to quality jobs, especially in communities that have historically been excluded from continuing or higher education. Most workforce programs require the completion of high school, fluency in English and forgoing wage income and/or making some payments for training. Reliable transportation, a place to study and skills to navigate a professional environment are resources that residents of disadvantaged communities may also struggle to access. Many nonprofit workforce development organizations (sometimes referred to as CBOs) step in to help bridge these barriers.



Source: ACCC American YouthWorks Member for photovoice project (pages 28 and 29 of this report)

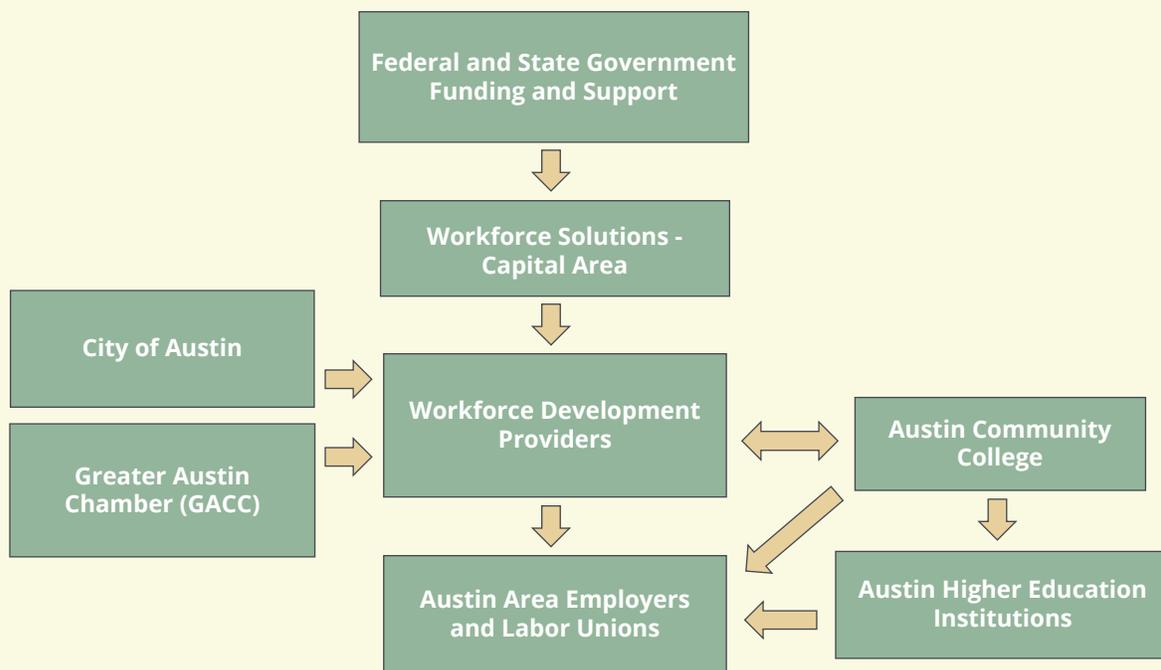
The Workforce Development Framework in the Austin Region

The structure of the workforce development system in the Austin region is shaped on one level by the federal legislative framework under the Workforce Innovation and Opportunity Act of 2014. To receive federal funding for workforce development, a region is required to establish a workforce development board which researches local labor market conditions, identifies growing occupations with high numbers of job openings and provides support and funding for local workforce development organizations. Local workforce boards are also required to produce four-year strategic plans that align with the Texas Workforce Commission’s state level plan.

In the Austin region the workforce development board is Workforce Solutions-Capital Area. This non-profit entity plays a central role in advancing workforce development goals and supporting and funding (with federal, state and other funds) local training and job placement providers (see Figure 1, below). The workforce development board operates as a key workforce intermediary that brings all the players—labor, private employers, education, government, and non-profits—to the table. A central strategic goal of Workforce Solutions-Capital Area 2017 plan [was] to “help 10,000 economically disadvantaged individuals’ secure middle-skill jobs by 2021.”

The City of Austin has a role in the regional workforce development system by participating in Workforce Solutions-Capital Area meetings and planning activities, providing modest funding directly to certain providers and working to align City economic development activities with workforce needs. However, the City has historically been a secondary player in the system, and workforce development has not been a high profile element of the City’s economic development activities. In addition, the Greater Austin Chamber of Commerce (GACC) engages with Austin Community College and the workforce development board to assess workforce needs. The GACC also provides some direct workforce development funding for K-12 programs.

Figure 1: The Basic Architecture of Workforce Development in the Austin Region



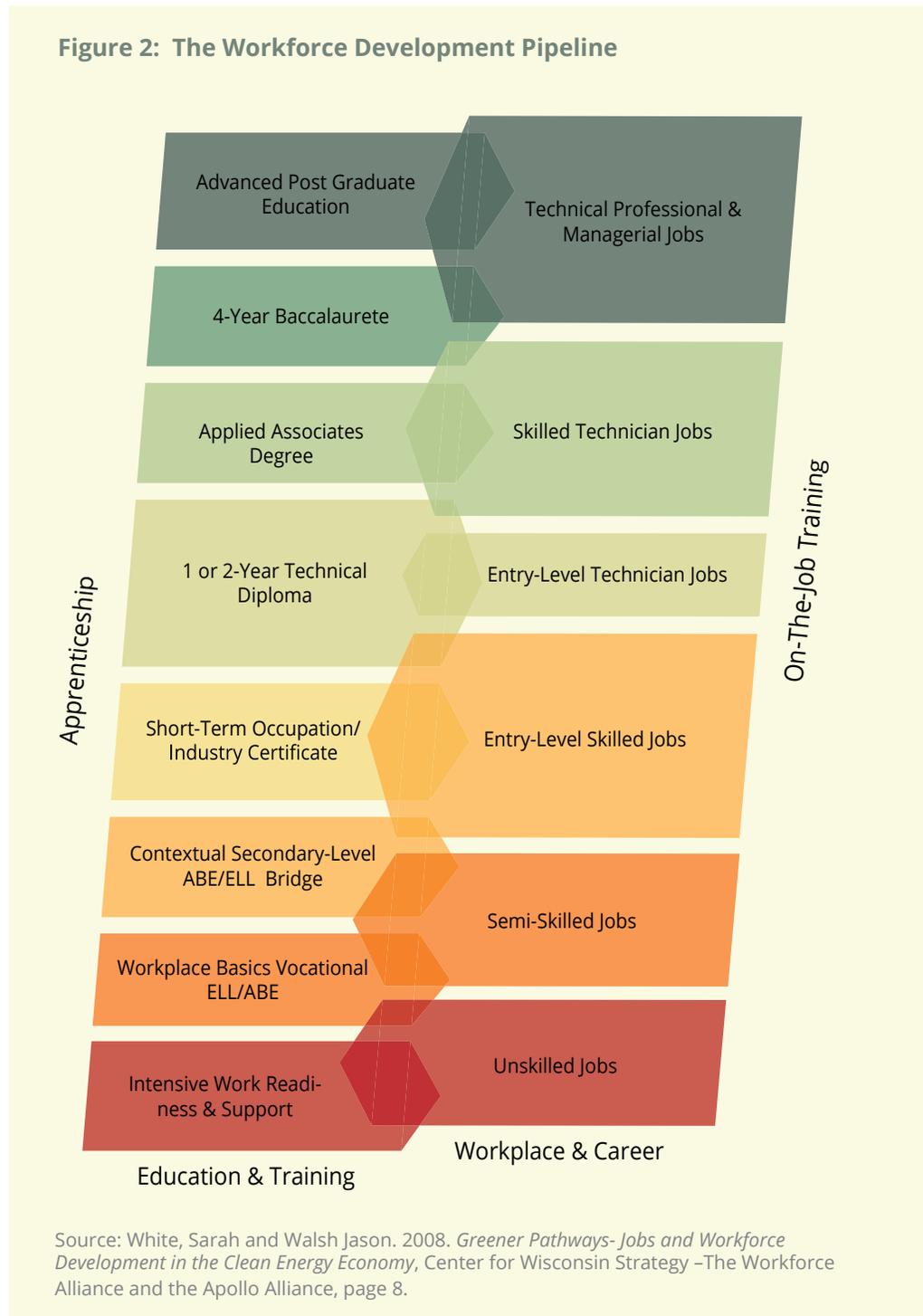
A cornerstone institution in Austin’s workforce development architecture is the Austin Community College system (ACC). ACC performs multiple roles in the regional workforce system. It offers direct education and training leading to associate degrees or occupational certifications in multiple areas ranging from accounting to welding. They also partner with workforce development organizations to supplement and complement their

direct training activities, including providing certifications or associates degrees related occupations targeted by direct training providers. ACC offers bachelor's degree programs in just two areas: a Bachelor of Applied Science in Computer Information Technology: Software Development; and a Bachelor of Science in Nursing. However, it plays a critical role in preparing students for transitions to the area's higher education institutions offering bachelor's degree and graduate programs.

In addition, the region's higher education institutions (e.g., University of Texas, Texas State, St. Edwards University, Huston-Tillotson University, and Southwestern University) are crucial contributors to the region's vaunted high skilled workforce. Austin higher ed. institutions can be seen as preparing individuals to access the large and growing segment of green jobs in professional occupations outlined in the above analysis.

In a macro sense the workforce development system can be understood as a pipeline that begins with ensuring that potential workers have basic language, literacy and numeracy skills (English Language –ELL and Adult Basic Education-ABE) and moves to higher education degree granting activities (see Figure 2, below). There are many possible entry and exit points as individuals build skills or change their work careers. In this report we focus on moving from the lower to middle rungs of the pipeline; skill building processes that can move un- and underemployed workers into middle-wage, career building employment. However, improving access to the region's higher education institutions for individuals from low- and moderate-income families and communities of color remains a central challenge and priority in the Austin region.

Another important way to view workforce development centered on creating career pathways is that the main goal is more than encouraging an individual to train for a specific job available in the local labor market. A career pathways approach seeks to support youth or un- and underemployed individuals in developing and executing a plan that will allow them to enter and steadily advance in a rewarding career of their choosing. This may first require acquisition of basic skills and high school



credentials. This can then lead to training to secure an occupational certification or a two year associate degree at a community college. On-the-job experience in the chosen occupation leads to higher skills and income over time. An individual might then choose to start a business in their area of work or pursue a bachelor's degree to advance into higher levels of the profession.

For example, an individual may acquire a GED, then undertake a basic set of courses at ACC leading to certification in the plumbing trade. They might then enter an apprenticeship program or get other longer term training in the trade. After significant experience they may then choose to operate as an independent business person with their own plumbing firm. Another example relevant to a green occupation is a student with a GED entering the Level 1 Environmental Technology Certificate through Austin Community College. This 16-hour certificate program can be completed in two semesters, or a student can continue to pursue the Level 2 certificate, a 31-hour program leading to an Associate of Applied Science in Environmental Technology. ACC reports that the median salary for Environmental Science and Protection Technicians is over \$22 per hour.^{xx} With an associate degree in this field and on-the-job experience, this individual would be well positioned if they choose to pursue a bachelor's degree in a range of environmental sciences. A particular career pathway is determined by each individual, but a strong workforce development system supports such career building processes.

In terms of pathways out of poverty and low wage jobs, a critical set of workforce development service providers in the Austin region are non-profit organizations (often termed CBOs) and unions. The specific areas of training offered by CBOs and unions are diverse and are aimed at industry employers motivated to hire participants to meet their labor needs. In the Austin region these currently include, but are not limited to healthcare, HVAC, plumbing, welding, fashion, construction, software technology, manufacturing, electrical, and solar installation. Many of these programs are designed for disadvantaged populations that face barriers of entry into the workforce.



Among the interviewed organizations, one is a labor union, one is a manufacturing association and four are organizations that specialize in education and advocacy related to economic and job development. The organizations include:

- Austin Community College
- Austin Regional Manufacturers Association
- Capital IDEA
- Goodwill Central Texas
- Greater Austin Asian Chamber of Commerce
- Hispanic Chamber of Commerce
- International Brotherhood of Electrical Workers
- Literacy Coalition of Central Texas
- Ray Marshall Center for the Study of Human Resources
- Skillpoint Alliance
- Texas Climate Jobs Project
- Workforce Solutions Capital Area
- American YouthWorks

To better understand the local workforce development system we reviewed the literature on national and local workforce development initiatives and conducted interviews with thirteen organizations involved in regional workforce development^{xxi}. For example, the Ray Marshall Center for the Study of Human Resources is a leading national organization in the study of workforce development and provides sophisticated evaluation reports on Travis County workforce development programs.^{xxii} The organizations involved in economic development are notable for their interest and close relationships with the workforce development organizations we talked to. These partnerships are crucial for both the workforce development organizations and economic development organizations, as well as the communities and industries that they support.

We interviewed a number of administrators and personnel involved in Austin area workforce development. In broad terms, many argued that the

Austin area workforce development system was well organized, strategically sophisticated and embodied a high level of communication and collaboration among Workforce Solutions-Capital Area area employers and training providers. Several interviewees commented that employers are deeply engaged in identifying occupational employment opportunities, developing training standards and curriculum and committing to hire individuals completing training programs and/or certifications.

The various CBO workforce providers target different types of individuals, offer different training strategies and focus on building skills for distinct segments of the labor market. Broadly speaking workforce development groups tend to focus on three training frameworks:

- **Short term job readiness training** which might include literacy, language skills, obtaining a high school credential (e.g., a GED) and basic interview and job search skills;
- **Intermediate term** (usually less than one year) job exposure training and internship- pre-apprenticeship experiences and non-degree certification training to secure a job in a specific occupation;
- **Longer term training** (usually more than one year) involving more intensive skill building for specific occupations, often involving a certification or associates degree and/or linked to internships or apprenticeship training.

The training costs per worker tend to be higher the more intensive the training. However, the net benefits in terms of job tenure, wage premiums and career mobility tend to be higher with more intensive training.

The interviewed organizations offered programs that ranged from short term job placement to pre-apprenticeship training to full certification or associate degrees (see Table 12 below). Training levels were somewhat evenly split among the workforce-development organizations studied; four of the CBO organizations provided multi-year training from which participants depart with job offers at living wage levels. One of these organizations overlapped with the three that offered primarily pre-apprenticeship training, job exposure, or programs that help with the prerequisites for a number of training tracks. These programs include ESL and GED classes that help individuals qualify for either pre-apprenticeship training or longer-term training programs. Several programs offer pre-apprenticeship, certification or apprenticeships for skilled-trade jobs that require physical labor.

Table 12: Key Characteristics of Austin Area Workforce Development Institutions

<i>Workforce Development Provider</i>	<i>Type of Training</i>	<i>Occupational Focus</i>	<i>Training for Occupations with Green Activities</i>	<i>Annual Number of Trainees (by program type)</i>
Goodwill Industries	Short-term job readiness	General	Not directly	~1000 in job training programs ^{xxiii}
Skillpoint Alliance	Short-term job readiness and pre-apprenticeship	Skilled trades/ advanced manufacturing	Not directly – some support for pre-apprenticeship training in plumbing trades	47 in certified production technician program 52 in electrical pre-apprenticeship 25 in short-term HVAC training 9 in plumbing pre-apprenticeship
Literacy Coalition of Central Texas	Short-term job readiness	General	Not directly	~350 trainees in workforce development programs ^{xxiv}
American YouthWorks	Pre-apprenticeship and national service (AmeriCorps)	Healthcare/ skilled trades/IT/ manufacturing/ natural resource management	Yes (natural resource management)	36 construction pre-apprenticeship 24 in IT pre-apprenticeship 75 in natural resource management service year 24 in healthcare pre-apprenticeship 125 in manufacturing pre-apprenticeship
Workforce Solutions Capital Area	Short-term, intermediate, and long-term training	Healthcare/IT/skilled trades/advanced manufacturing/ business	Not directly	~500 in skills training programs
Austin Community College	Intermediate and long-term	Multiple Occupations... Includes Skilled Trades	Yes (solar panel installation; HVAC)	~12,000 taking at least one continuing education course ^{xxv}
Capital IDEA	Long-term linked to certification and associate degrees	Health care/IT/other occupations	Very small amount	~1,200 received direct career development support
Austin Area Urban League	Short-term job readiness	Administrative assistant/customer service/computer support specialist/ several other foci	Not directly	~450 enrolled in workforce & career development program
IBEW – Local 520	Apprenticeship program	Electrical trades	Yes (solar installation; electrical vehicle charging)	~350 total apprentices over 5 years of programming

Source: Organizations shared these numbers during interviews and/or electronic communications. In other instances, we found program enrollment information online; in these, cases, we've included the source.

With the exception of the labor union and manufacturing association, the organizations interviewed actively serve historically marginalized groups. Most of Austin’s employment and training providers have very diverse cohorts of trainees. Across the various organizations this includes people with disabilities, those who are currently unhoused or at risk of becoming unhoused, people of color, unemployed/underemployed populations, and low-income populations/populations well below the poverty line, at-risk youth and the formerly incarcerated.

OPPORTUNITIES AND CHALLENGES IN AUSTIN AREA WORKFORCE DEVELOPMENT

When reviewing the workforce development literature there is a degree of consensus on what constitutes best practice in terms of regional workforce systems that emphasize positioning trainees for living wage, career building jobs. There are seven key elements to successful workforce development outcomes:

- A strong and sophisticated regional workforce development system where workforce intermediaries (development boards) and key labor market institutions identify demand-driven career pathways that offer prospective and incumbent workers clear and accessible training paths to better jobs with higher wages and benefits^{xxvi};
- Successful targeting and intake of trainees to ensure they are prepared and committed to engage in and complete the training program;
- Organizing the provision of support services and financial aid to ensure that enrollees can participate in and complete the training program;
- Securing strong participation and commitment from employers including direct participation in program design, curriculum and teaching. Employers should also make a strong commitment to hire trainees to signal there is a job waiting for those that complete the program;
- Programs should demonstrate that the completion of training will lead to a secure job with significant wage premiums over what they could earn without training;
- For many trainees from specific communities' mentorship from a member of their community can support a more successful transition to work. Mentors can be prior graduates of the program, community members working in the occupation or employees working at the hiring firms;
- Training the employer in specific needs or challenges of workers that they hire may improve retention of new employees from a training program. This may be particularly important for trainees with prior exposure to the criminal justice system, with pressing family obligations or transportation challenges.^{xxvii}

These best practices relate to the main challenges of successful workforce development processes: effective recruiting of individuals into programs; achieving high completion rates of a program's training elements; and high placement of program graduates into jobs offering living wages and promising career pathways.

Most Austin workforce development organizations we interviewed were aware of and incorporating many of these best practices. It is important to note that many of these success elements are more relevant to programs engaged in intermediate or long term training activities. One important insight that stood out from interviews is that Austin has historically been a very hot job market with high demand for workers in many occupations, including those that do not demand high levels of education or prior experience (such as retail, food service and landscaping related occupations). This was seen as an advantage and a challenge. The high demand for employees in occupations not requiring more intensive training benefitted programs focused on job readiness. If organizations focused on short term training to improve potential worker's basic skills, help them secure a GED and improve their job search skills, there is a high probability of securing

a job in the Austin market. However, in these cases wage and benefit levels can sometimes be relatively low and upward mobility limited. For programs focused on longer term training and upskilling (middle rungs of the career pipeline in Figure 2 above), the hot Austin job market makes it more difficult to recruit and retain people. Individuals considering these programs will have to consider the costs of forgoing an existing job or job opportunity to commit to a longer-term training scheme.

In the context of Austin's comparatively low unemployment rate, the regional workforce system has recently increased its focus on enhancing the community's awareness of, and access to high-demand, middle-skill



careers with entry level wages at least 200% of the federal poverty rate (200% of the federal poverty rate in 2020 for a household of two was \$15.83/hr.). In FY 2019, Austin metro area workforce development organizations and numerous partners organized a comprehensive initiative under the Austin Metro Area Master Community Workforce Plan (MCWP). This initiative involved more in-depth actions to link un- and underemployed Austin residents to living wage jobs through new and innovative outreach and recruitment efforts and new mechanisms and funding to help lower income job seekers complete intermediate and longer term training^{xxx}. Included in the MCWP initiative was a strong emphasis on recruiting, training and placing community residents in the skilled trades. This is clearly relevant to avenues leading to living wage green jobs.

Outreach and Recruitment

A generic challenge for workforce development is effectively marketing training programs, recruiting residents who can benefit from training and career development and identifying those interested, motivated and capable of undertaking training activities for particular occupations. People considering a training opportunity must think about reorganizing their lives, obtaining the resources to sustain themselves and their families during the training, and the probability that participation will lead to quick employment in a quality job in an attractive career. For many struggling to make ends meet with their existing jobs, opportunities and benefits of changing careers may not be known or clearly understood.

Clearly communicating program characteristics and job opportunities is a significant task for most workforce organizations. Programs advancing public awareness and recruiting campaigns realize that recruiting efforts must be embedded in channels and contexts that are familiar to the target audience.

The MCWP initiative mentioned above carried out an innovative advertising and career outreach campaign focused on the skilled trades. For example, they organized Trade Up Texas, a collaborative effort between Workforce Solutions-Capital Area, KVUE News and Texas Mutual Insurance. This effort promoted training and employment in the skilled trades through on-air and online advertisements, video testimonials, and a centralized platform for sign-ups. The initiative generated interest from over 2,000 individuals, and a successful apprenticeship showcase at the end of the campaign linked 40 employers with over 200 Austin residents.^{xxx}

Generating interest and providing information is a necessary but not sufficient condition to effectively match interested residents to specific training and employment opportunities. Highly effective workforce development operates with a career pathways framework. Working closely with employers to delineate what current skills workers in a sector need, CBOs and community colleges work to design curricula into flexible steps that work for participants with different needs. The training must lead to employment in entry level jobs paying living wages. The career pathways approach further identifies ladders for advancement and longer term career development after initial employment. When recruiting participants, workforce organizations also must convince prospective participants that they will receive the necessary support and resources and accessible training options to successfully complete course of training.

Support Services Requirements

Career coaching and access to childcare, transportation and other assistance significantly increases the chances that participants can successfully complete programs and secure jobs. In many programs case management of individual program participants can identify and address barriers to successful progress and completion of training curricula.

In our interviews with Austin workforce development organization and with ACC leaders, all respondents understood the need to provide support services such as childcare, transportation access, ESL and GED classes, housing and food assistance and tuition support. Several were actively partnering with area service providers to address these needs. Programs seemed to offer solid case-based approaches to meeting needs for specific program participants based on their unique situations. Workforce programs communicated with participants to determine their current needs and then offered benefits and assistance to address those needs. Support offered ranged from resume and interview preparation to childcare and gas money.

Additionally, there was program coordination between various workforce development organizations to provide support and assistance. Sometimes two programs work closely together, such as recruiting graduates from one program to participate in another. In one case, one program provides childcare for participants in another program. Many programs interviewed wanted to expand the network of services they are able to provide. There was an emphasis on being able to provide childcare, affordable housing and transportation to every participant that needs it. Expanding these efforts will be essential to making programs more accessible to people who may be a good fit, but cannot make time or fully access programs given their current conditions.

Racial Equity

As emphasized previously, Austin CBOs and ACC actively serve historically marginalized groups and generally have strong diversity among their participants. However, only about a third of the organizations interviewed said they were actively engaged in efforts to recruit people of color for their workforce development/training programs. Given the historical legacies of racism in U.S. and in local employment practices, we expected that more of the organizations would be actively addressing racial equity through recruitment strategies which target people of color.

Our interview findings revealed a subset of Austin's workforce/economic development organizations that are meaningfully and thoughtfully engaging in a diverse set of recruitment strategies to advance racial equity through their programs.

For example, one organization discussed making their job posting and interview questions more inviting and inclusive for non-white individuals, and another discussed building strong relationships with community organizations serving communities of color. These strategies provide examples of how racial equity can play a strong role in workforce development program recruitment efforts.

Four organizations discussed retention strategies crafted to support their clients of color. The most common retention strategy of organizations working on racial equity-focused program development was hiring staff whose racial composition mirrored their client bases, and then providing racial-equity focused training for those staff. All those organizations acknowledge that this was challenging (one said that "one of our biggest challenges is having staff that reflect the community"), but they recognized the impact it had on the experiences of their clients of color ("a focus... is to make sure that we're ethnically and racially diverse and supporting people [and] having a welcoming environment for everyone"). Additional retention strategies included customizing program



curricula in ways that support participants of color and developing culturally appropriate case management and wrap-around services.

Another finding from our discussions with Austin CBO's and ACC around racial equity was at the organizational scale; those interviewed appeared to either strongly engage in issues of race or to not address those issues at all. In line with the findings on race-based recruitment, the groups explicitly considering racial equity in their programs and operations made up only a third of the CBOs interviewed. These organizations had robust and sophisticated values and approaches to recruiting and retaining trainees of color. Two organizations discussed attempting to address legacies of racial trauma in their workforce development program design. A different set of two organizations discussed ensuring that the mix of their board of trustee members' racial identities mirrored the racial composition of their clients. These approaches are in stark contrast with the remaining two thirds of the organizations interviewed that did not emphasize racial equity considerations in their programs and operations. The most common response to our question on racial equity amongst this group is reflected in a comment from an interviewee who said, "Oh, we don't recruit based on race. It's solely based on income." Enhancing how and the extent to which organizations consider racial equity in their program recruitment and design is an area for improvement in Austin's workforce development efforts.

Another finding from our conversations with Austin CBOs and ACC was that amongst the organizations that did not explicitly adopt racial equity as a central tenet, there were three organizations whose clientele were still disproportionately people of color. These organizations all claimed that their clientele was diverse due to "word of mouth" amongst communities of color, the historical makeup of their organizations and the geographic location of their services. It appears that these organizational characteristics contribute to the recruitment of people of color; other workforce development organizations seeking to adopt or strengthen their racial equity efforts may want to emulate them.

Racial equity challenges in the workforce development system extend to disparate outcomes for hiring and wages for program graduates. The continued presence of racial discrimination in Austin area labor markets is documented in a Marshall Center 2020 evaluation of the wages and annual incomes of individuals completing training. In the year following completion of a set of training programs that were part of the MCWP initiative this study found a deeply problematic pattern:

"Breaking down median earnings for Year One employed completers by industry, race/ethnicity, and gender demonstrates that non-Hispanic Black and Hispanic men and women in their most common fields of education and training earn less than their same-gendered non-Hispanic White counterparts. The largest earnings differences for men occur in the skilled trades industry, with the median difference in one-year post-completion earnings between non-Hispanic White males and non-Hispanic Black males of \$9,320 [annually]."^{xxxi}

These disturbing findings demand that all of Austin's workforce development institutions and partners mobilize to ensure that women and people of color making the sacrifices to build new careers are fairly and equitably treated by Austin area employers.

Enhancing Workforce Development and Green Job Pathways

The analysis of green job growth in the earlier sections showed there were a subset of occupations where work activities could be largely defined as green. However, in most green job categories green activities are mixed in with traditional tasks in the occupations. At the same time, several occupations are greening over time, adding new skills and tasks related to improving environmental outcomes as demands from the market and public sector for cleaner goods and services continue to increase.

With some exceptions there is not a need to develop new “green” training programs. For example, retrofitting existing buildings to improve energy efficiency and reduce GHGs will stimulate jobs for workers with traditional construction skills who also must be trained on the latest energy-efficient construction practices.^{xxxii}

Given the current realities of the Austin area workforce system, what are important ways forward to better align policies and workforce programs to the burgeoning green economy?

First, our interviews indicated that specific opportunities for job development related to the green economy needed to be more legible to workforce institutions. Respondents indicated that they needed to better understand long-term opportunities and job advancement ladders in green occupations. While many interviewees mentioned Austin’s perceived status as a “green city” (i.e., one that champions environmentally-focused initiatives city-wide), it was less clear how local policies and aspirational plans aligned with local resources dedicated to green job development in the workforce system. Organizations interviewed emphasized the need for more communication and active partnerships between local governments, other non-profit organizations, for-profit companies and surrounding communities to advance green economic and workforce development goals. In particular, workforce organizations needed more intensive interactions with private firms about their green activities and needs for green skills. These insights point to certain specific actions that can be considered to expand green job pathways.

More clearly understanding how the green economy is evolving underscores why the most efficient and effective way to enhance Austin’s growing green workforce is to build upon the existing local workforce development system. This involves expanding the number of trained workers in occupations with green content while adding and embedding emerging green skills training into existing training regimes.





Possible City Actions Linking Green Job Growth to Equitable Workforce Development

A central challenge and role for the City is to significantly expand access to green jobs for residents who have had limited access historically and in the current setting. Our analysis of the green economy demonstrated that green job growth is tilted towards occupations that require higher levels of formal educational attainment to enter and that women and people of color are underrepresented in the current green job mix. How can the City help redress these inequities?

In light of the prominent leadership role of the City of Austin in advancing strong environmental policies, the City should substantially enhance its leadership in the region's workforce development system. The City has played a rather minor role in workforce development, mostly providing contracts to CBOs to carry out training programs. Until recently there were multiple departments, Austin Public Health (APH) and the Economic Development Department (EDD), overseeing workforce development programs. A 2017 report of the City Auditor noted that City workforce efforts lacked a lead department, were not sharply focused on industries identified in their Target Market Assessment and did not systematically evaluate the outcomes of its workforce investments.^{xxxiii} The City subsequently put workforce development activities under The Economic Development Department (EDD) and worked to improve its workforce development activities. But there is much more the City could do to tie together its aggressive climate and other environmental policies with workforce development targeting diverse communities. One example from our interviews was a program of American YouthWorks, CasaVerde Builders. Participants in this program worked to build over 90 green-built homes for low-income, first-time homebuyers in Austin. Participants, aged 18 to 28, received on-the-job training in green construction methods whilst building affordable homes for community residents. This example hints at much more expansive opportunities to link a range of City policy goals and programs in environmental domains to workforce development, incorporating specific actions suggested in the Climate Equity Plan.

Austin's workforce development organizations provide a rich variety of job access and job training opportunities for residents, including training opportunities for jobs that have green tasks as part of the work. While Austin workforce organizations do recruit through community based institutions, it is important to examine how stronger community links could be forged, especially in recruiting residents for training for high opportunity jobs in the green economy.

In our research and interviews we found that it was challenging to recruit youth or young adults into training for certain high opportunity occupations, especially manufacturing and the skilled trades. It was noted that recruiting for health care and tech occupations was easier because young people saw these areas as more attractive, higher status careers. The City could supplement the more recent innovative efforts such as Trade Up Texas to intensify marketing and outreach for the trades. But in addition, as will be profiled below, there are compelling examples of how workforce organizations have developed strong and

durable connections with specific communities to expand access to quality jobs and career building for youth and un- and underemployed workers. The City, including the ACCC initiative (also discussed below), can help build stronger connection to communities historically excluded from educational and training opportunities.

As a complementary move, the City could also more energetically participate in expanding training channels and numbers of trained workers in the skilled trades. We noted many opportunities in the skilled trades to link expanded workforce development to high quality, family supporting jobs with green content. Only three workforce development institutions interviewed were involved in training for these occupations (American YouthWorks, ACC, and the IBEW). There is strong evidence that there is a persistent supply shortage in many of these trades and real opportunities to expand the scale of programs in these areas.

In particular, apprenticeships are attractive career pathways in a number of occupations (particularly in manufacturing and the skilled trades). They provide intensive skill building and work experience while paying the apprentices for their work.

This avoids several of the issues discussed above (the need for certain support services, opportunity costs of forgoing employment for training and job guarantees when completing training). Austin does not have a long manufacturing legacy and has a very weak union presence; hence, apprenticeship opportunities are limited in the region. Apprenticeship programs can register with the Department of Labor or the Texas Workforce Commission (TWC), and some incentives are provided. While there have been encouraging recent initiatives to expand apprenticeship opportunities across the Austin region, there is room for significant expansion in apprenticeship programs in numerous occupational categories.^{xxxiv} Because many green jobs are linked to the skilled construction trades, expanding paid apprenticeship programs in these occupations is an area where the City could provide leadership and targeted incentives.

Austin Civilian Conservation Corps- Opening New Channels to Quality Green Jobs

One goal of our detailed analysis of the Austin workforce development architecture is to evaluate possible transitions from the Austin Civilian Conservation Corps (ACCC) program to quality career building green jobs. More specifically, what are the opportunities to expand and reimagine ACCC as a stronger pipeline program that starts with exposing underrepresented residents to green career opportunities and then moves participants into more formal paid pre-apprenticeship positions or longer-term training or apprenticeships leading to living wage green jobs with strong career ladders?

ACCC was rapidly established through an Austin City Council resolution in May of 2020. A major objective was to provide employment to workers laid off due to the COVID crisis. By March of 2021 ACCC had created roughly 100 positions in numerous City departments and had partnered with non-profits to establish and implement job exposure experiences for participants. The CBO American YouthWorks administers the most ACCC positions of any of the City's partners, currently overseeing three crews with a total of 23 corps members. All of YouthWorks' ACCC positions have a duration of 8 months (participants can apply to participate for multiple years) and are compensated at least \$15 an hour. Influenced by the program's lineage to the 1930s federal Civilian Conservation Corps, most ACCC positions were in the Parks and Recreation Department and involved "outdoor" work including park trail development and maintenance, wildfire mitigation and habitat conservation.

ACCC leadership has worked energetically to fashion a long-term plan to sustain and enhance ACCC's activities. The organization has commissioned studies to aid in charting a path forward. One report, produced by Build with Humanity carefully charted out crucial elements of a career pathway workforce development strategy and suggested the potential role of ACCC in such as strategy.^{xxxv}

To better understand the experience of ACCC participants, we facilitated a photovoice research project with ACCC members.^{xxxvi} Photovoice is a research methodology where participants are asked to take photographs that respond to prompts provided by the research team.^{xxxvii} Participants are then interviewed to elaborate on the lived experiences that their photographs depict. Seven ACCC crewmembers working under American YouthWorks participated in this part of the project, as well as four apprentices in the City of Austin's Park Ranger Cadet Program. The Cadet Program is operated through the City of Austin Parks and Recreation Department and is not officially affiliated with the ACCC. However, the leadership of both programs are close collaborators, and the Cadet Program's apprenticeship offerings are expected to serve as a model for future ACCC positions. Both the ACCC members and AYW participants were asked to share photographs and narrate the photographs in response to the following questions:

1. What have you learned in the ACCC, and what skills have you acquired?
2. What kind of work do you hope to do after ACCC?
 - 2b. Has the ACCC supported you getting there? If so, how?
3. Does your work with ACCC contribute to racial and social equity in Austin? If so, how?



Source: ACCC American YouthWorks Member for photovoice project (pages 28 and 29 of this report)

The ACCC members who participated in the photovoice project represented two crews: one focused on City parks and preservation projects, and another that worked on projects specifically based in Austin's Eastern Crescent. The four Cadet Program apprentices included in the project were all young adults who had graduated from high school in the past one to three years. Three of the apprentices worked in roles that involved both outdoors parkland management and environmental education programs for school aged youth, and one worked on digital communications for the Cadet Program.

With regard to the first question, participants indicated that they are learning specialized skills, such as operating power tools, environmental conservation techniques, and how to use certain software programs. Some noted that they were still learning and struggling in some of these areas, but that through their continued support and community within the program, they were rapidly developing those skills. In addition, participants indicated that they have further developed their interpersonal skills, such as teamwork and leadership. Participants pointed out that ACCC members would benefit from additional training in these areas.

In response to questions #2 and #2b, most participants enthusiastically identified long-term career pathways they are interested in pursuing, nearly all of which fell into the category of "green jobs." For example, one participant spoke of hoping to be a wildlife therapist. Another member hopes to have a role caring for small wild animals and insects:

"This is a picture of an endangered little salamander that has been around one of our projects in Goat Cave. I wanted to work with animals, but not like normal animals. I want to work with small endangered critters and insects... By being in the ACCC I am able to be outside and be around all of these fun little critters all day."

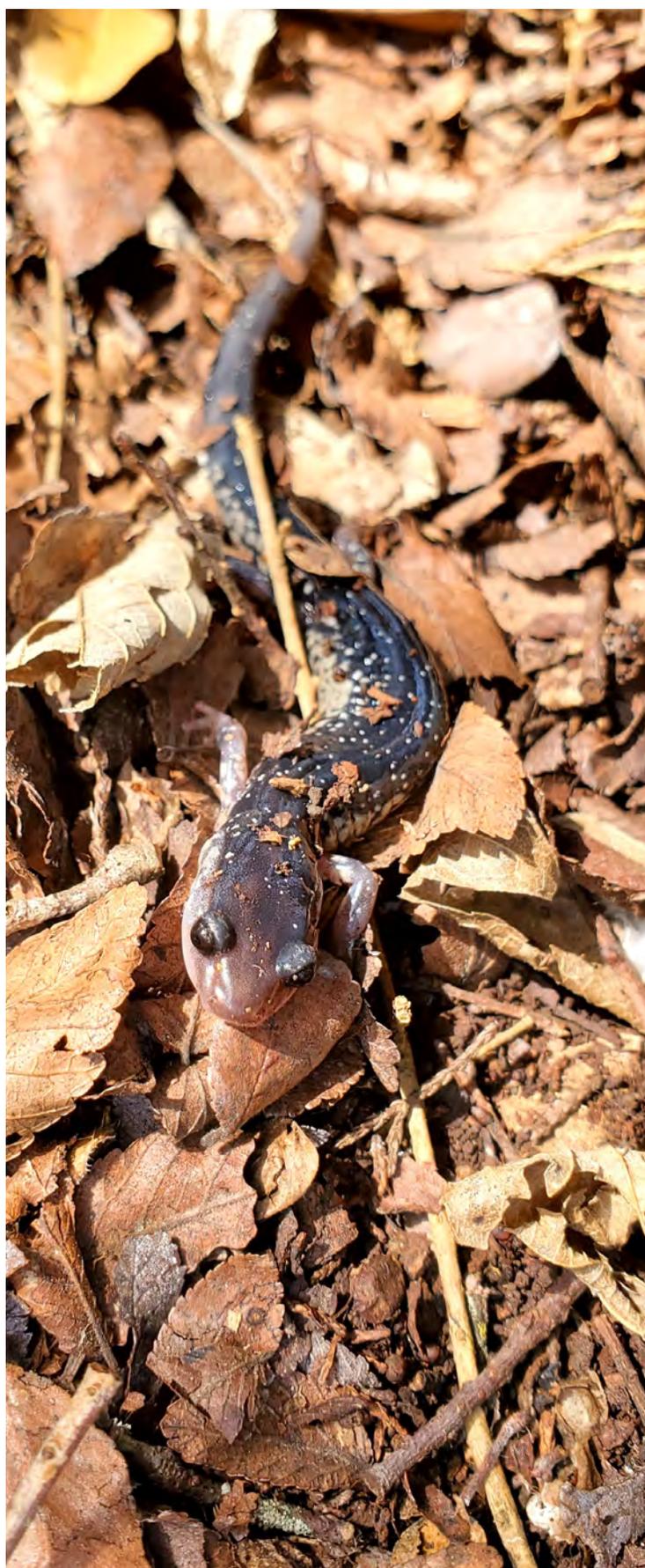
Several participants emphasized that they had learned about conservation and green careers that they would not have been

exposed to otherwise. Two of the participants expressed that through the program they had found a “passion,” and that they wanted to do the type of work they were doing for the rest of their careers. Six participants expressed interest in continuing education.

Members expressed gratitude and enthusiasm for being in the program and noted the role of strong mentors. However, participants named few concrete examples of how their individual post-program goals were currently being supported. The main example participants offered was a monthly workshop that covered topics like resume writing. More structured professional development and job placement opportunities related to their individual post-program goals would make the ACCC more effective. For example, the ACCC can connect the program participant who wants to work with small critters to conservation or veterinary career pathways.

ACCC participants offered important reflections in response to question 3—the racial and equity implications of the program and their work. They pointed out that the program’s participation criteria are equitable, particularly because of the wide age-range and because no experience or college degree was needed to participate. Indeed, the inclusive criteria is what prompted some to apply. In addition, ACCC participants felt they were doing important service work. The Cadets, for example, shared a strong sense of pride and meaning that the apprentices gained from serving communities of color. All four apprentices identified as Latinx and were bilingual in English and Spanish. All expressed how they felt pride and fulfillment from providing environment-focused educational programming to Spanish speaking youth. One participant discussed how she found much personal fulfillment in teaching Latinx youth about outdoor jobs and conservation efforts, both of which she felt people of color are not typically exposed to. Additionally, all participants agreed that they were helping youth in the communities in which they worked become excited about parkland-based green jobs by being “someone that looks like them” in such a job.

On the other hand, ACCC participants pointed to two problematic dimensions of their work. First, their pay is too low and does not reflect inflation or Austin’s already high cost of living. Second, they raised concerns about where and why they are working particular sites. Several members spoke of having to clear out sites where houseless individuals and families lived. This work was troubling especially for at least two ACCC members who had experienced homelessness themselves. Several members also questioned their work in affluent or gentrifying areas. “Who are we improving these parks for?” one member asked. These reflections about where ACCC members are assigned present critical questions about how to align place-based and anti-displacement initiatives with green jobs work.



Source: ACCC American YouthWorks Member for photovoice project (pages 28 and 29 of this report)

Building on the ideas in the Build with Humanity report, interviews with ACCC leadership and the insights provided by participants in the Photovoice project, we present a number of ideas about how ACCC could redesign its outreach and workforce development activities to become a powerful partner in creating pathways into quality green jobs and careers.

If the City made a stronger commitment to prioritize and invest in workforce development, ACCC could be redesigned and built up to be a critical part of an expanded workforce development effort. First, ACCC (perhaps renamed as the Green Job Corps) could become a major conduit bringing underrepresented workers into City jobs. ACCC's initial job exposure experience could be a first step linking participants with hiring needs of major COA enterprises and departments. After an initial training and job exposure period, a range of well-paid internships or apprenticeship in major City enterprises or departments could be developed. Here, the Cadet program is an encouraging model. While the City would need to revise its current policies limiting internships to public school or university attendees, internships for ACCC participants could lead in some circumstances to direct hiring and in other cases to further training or apprenticeships with support and commitment by the City to hire upon completion of further training.

This path will require changing existing barriers to ACCC employment in three areas. First, departments ought to assess and address how their education and minimum qualifications inhibits equitable hiring practices. Second, we recommend that the city examine barriers to employment created by the collegiate requirement for internship pathways and adjusting how temporary staff transition into full-time employment. Finally, the City ought to enhance its equitable recruitment and retention efforts by paying participants living wages for the Austin area.

Figure 3: ACCC Transition Paths



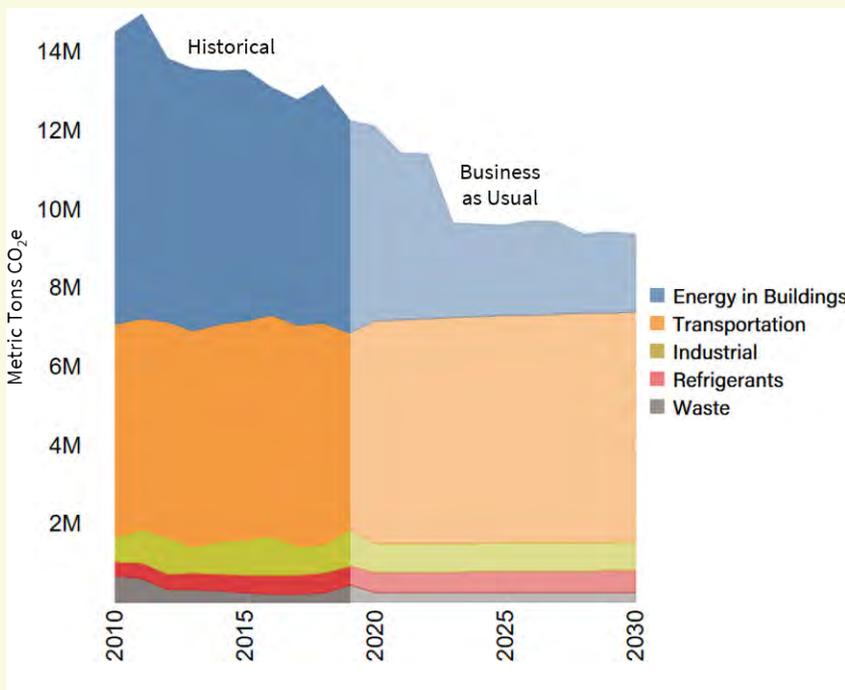
Separately, or in combination with City hiring, ACCC could develop deeper partnerships with key workforce development institutions to create specific transitions from ACCC job training and exposure experiences into further training for jobs with career pathways. Creating strong partnerships with Austin Community College and select non-profit workforce organizations would create legible and attractive pathways for ACCC graduates into green careers.

WHERE THE ACTION IS - THE KEY DOMAINS OF THE GREEN ECONOMY

Decades of rapid growth has led expansions in population, the built environment and the infrastructure to support a booming region. This is a crucial context influencing how we understand environmental stresses, local policies to address those stresses and private sector growth and trends. We can get a clearer – on the ground - understanding about how general trends, policy actions, green job growth, and workforce development interact by closely examining five key domains of environmental activity:

- Energy Efficiency and Alternative Energy Sources
- Water Management and Conservation
- Waste Management and Resource Recovery
- Transportation
- Lands, Parks and Urban Agriculture

Figure 4: Sources of Austin’s Green House Gas Emissions - Historic and Projected^{xxxviii}



In terms of trends and policy action, an important lens is the human activities that contribute to greenhouse gas (GHG) emissions and related environmental problems.

Environmental actions in all six of the domains influence GHG emissions in the region. Major transformations in each area are necessary to meet Austin’s ambitious climate goals. Expansion of energy conservation and alternative energy sources have already led to encouraging reductions in the impacts of residential, commercial and industrial energy use (see Figure 4). Greater recycling and reuse of materials reduces GHG emissions related to managing waste streams. Expanding resource recovery further limits GHG impacts inside and outside the region by reducing the need for the manufacture and transport of new resource consuming products. Conserving and reusing water resources reduces energy-related emissions related to heating and cooling water in residential and commercial buildings and for industrial processes and the conveyance, treatment and distribution of water.

The most important contributor to GHG emissions in Austin and most cities is the transportation sector. This is also the sector where progress has been most limited. Transitions to alternative fuel vehicles, expansion of public and non-motorized transit options and land use policies are the tools local governments can apply to reduce transport related impacts.

In addition to its contribution to GHG emissions, water conservation and reuse is critical to manage potable water resources for our rapidly growing industries and population. As noted, Austin Water leads local efforts in this area supported by preferences of consumers and businesses to limit their water use.



It is estimated that agricultural activities account for 8-10 percent of GHG emissions. Alternative agricultural practices, land use management and tree cover initiatives can contribute to both GHG reductions, water conservation as well as hazard mitigation (including GHG producing wildfires).

It is important to highlight how private sector actions are related to the pace of progress in these domains. In our interviews there was a common belief that traditional industries would become more environmentally friendly in the future. Organizations focused on economic development in the region explained that a reputation of environmentally friendly practices would be a great reputation for Austin to 'own,' particularly amongst the backdrop of other Texas cities. An economic development organization representative remarked:

"The trend over the past decade or so has been one that's focused more on the environment, since businesses are starting to realize that ...we are experiencing climate change and that reality is starting to set in on different businesses and organizations... as we continue to move on to that trend, I do think that businesses are making more improvements on their environmental performance and outcomes, especially, as they continue to create those dedicated offices and positions, such as chief sustainability officer."

In what follows, we look closely at market trends, local policy actions and specific economic and job opportunities related to each of these five domains. We focus on demand for green jobs in occupations related to each area and associated workforce development initiatives related to job and career opportunities. Ideas and innovative approaches are profiled that have expanded pathways to quality green jobs and careers, especially for residents with less than a college degree.

Improving Energy Efficiency and Alternative Energy Sources

The private sector and consumers drive change in the domain of energy efficiency and the substitution of clean alternative energy sources for GHG intensive conventional energy. Solar, wind and other alternative power sources are now competitive with fossil fuel based sources, including new natural gas generation facilities. While there are still significant challenges in moving to a generation mix completely based on low carbon sources, technological change, incremental improvements and attractive costs have led to the rapid adoption of wind and solar energy sources in Austin and around the nation.

To buttress these trends Austin Energy (AE) has moved aggressively to expand alternative energy in its generation portfolio. As of August 2021, the 12-month rolling average for Austin Energy's generation mix was at 46% renewable energy.^{xxxix} This strong move to clean energy sources offers extremely important environmental benefits, but a major share of AE's green power portfolio involves purchases from exogenous sources and has little impact on local employment.

However, there has also been robust growth in distributed energy production especially in the form of residential and commercial solar

installations. According to AE data, installed rooftop solar capacity increased tenfold from 6.2 MW to 63 MW from 2011 to 2019. This rapid increase in solar installations has local employment impacts, promoting growth in a range of green occupations from inspectors to solar installers to electricians.

The utility also has pilot projects under their Community Solar program. This strategy involves installing larger concentrated arrays on land or open space to provide energy to nearby residential, commercial or public buildings. This approach can provide customers access to locally-generated solar energy, with no installation required for individual residential units. There are currently three project sites, two of which are linked to public facilities (the Palmer Events Center and Austin-Bergstrom International Airport). It will be interesting to see if AE plans to scale up the community solar projects in the future as it may be an avenue to significantly expand residential and commercial solar adoption, especially to low-and moderate income households.

A second major element of AE's drive to reduce GHG emissions are conservation programs for existing residential, commercial and multifamily properties. Energy conservation is an action that provides environmental benefits and green jobs. The utility provides consumer information and incentives promoting private expenditures for energy efficiency measures and retrofits. Examples of these retrofits include more efficient lighting, HVAC equipment, appliances, and building envelope materials such as insulation and windows. For example, in residential energy conservation AE offers a means tested weatherization program (the threshold is 80% Median Family Income) adjusted for household size. As part of this, households are offered a free energy audit, a range of free weatherization improvements and interest free loans on new HVAC units. The utility serves approximately 695 households annually through this program.^{xi} Additional conservation programs are driven by assistance and incentives to homeowners and multifamily and commercial property owners, which stimulate adoption and installation of improvements.

Another important energy conservation action is AE's effort to improve the energy and resource efficiency of new construction. Central to this initiative are AE's programs to increase and enhance the adoption of green building standards. The Austin Energy Green Building (AEGB) program largely focuses on marketing, educational and technical assistance to private builders to achieve higher green building ratings on new or remodeled buildings. AEGB is also active in enhancing local standards for energy efficiency, water quality and conservation, indoor environmental quality, material resources and site development.^{xii} Adopting higher environmental standards for new construction generates employment in green occupations and stimulates the greening of a number of occupations by pushing demand for additional green skills.

Table 13: Jobs Related to Energy Efficiency and Alternative Energy Sources in Occupations Not Associated with High Educational Attainment Levels - Travis County

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019\$)</i>	<i>Workforce Solutions Capital Area - High Growth Middle Wage Occupation</i>
47-2061	Construction Laborers	6,257	813	\$15.71	No
47-2031	Construction Carpenters	2,687	325	\$18.96	Yes
47-2111	Electricians	3,424	499	\$25.61	Yes
47-2181	Roofers	748	97	\$16.87	No
47-2211	Sheet Metal Workers	760	95	\$23.09	Yes
47-4011	Construction and Building Inspectors	666	107	\$29.86	No
47-4090	Construction and Related Workers, All Other	120	14	\$25.95	No
49-9021	Heating, Air Conditioning and Refrigeration Mechanics	918	111	\$21.25	Yes
49-9051	Electrical Power-Line Installers and Repairers	261	31	\$31.12	No
49-9099	Installation, Maintenance and Repair Workers	456	63	\$22.16	No
51-8013	Power Plant Operators	142	15	\$35.84	No

Market trends and public sector initiatives to increase energy efficiency and alternative energy use enhance demand for the above occupations that involve green activities.^{xiii} Many of these green jobs pay over \$20 per hour. Several of these occupations are classified as high growth, middle wage occupations by Workforce Solutions-Capital Area and attractive targets for workforce development. Two occupations, construction laborers and roofers, offer relatively low wages. However, these wage data do not account for the tight and turbulent pandemic labor market which is pushing up wages in construction-related segments in the labor market.

Our review of workforce development related to these job categories identified one CBO (YouthWorks) and one union (IBEW) that are very active in employment and training in a number of these construction related trades. The largest training provider in this domain, ACC, offers a range of programs, including renewable energy specializations linked to certifications and associate degrees and a range of certification and pre-apprenticeship programs in carpentry and electrical work through their Construction Trades Academy.

The job picture in this domain suggests room for expansion and innovation in workforce development activities targeted to these occupations. Outreach to underrepresented communities and building of new pipelines to living wage jobs should be a priority for the City. An example of innovative workforce training programs that reach unique populations is a program that begins with exposure to installing energy efficient retrofits and leads to public sector jobs at the local utility. This case might offer interesting ideas about how the ACCC project might tie into hiring at city utilities or other departments.

Case #1: Los Angeles Department of Water and Power Utility (LADWP) Pre-Craft Training Program

The LADWP Utility Pre-Craft Training Program provides a best practice model that combines demand-side workforce policy with a robust training program to prepare and train disadvantaged workers. The program has a wage floor (\$16 per hour) and a career ladder, using the training and work experience doing weatherization work as a pipeline into career-track utility work in trades. It was designed to expand the utility's greenhouse gas emission reduction efforts by funding energy efficiency retrofits in low-income households while generating paid training and employment for entry-level utility workers. The LADWP in-sourced weatherization work that had previously been performed by subcontractors. The utility created a new job classification and corresponding training program called the Utility Pre-Craft Training (UPCT) program. As an earn-while-you-learn pre-apprenticeship training program, UPCT works as a pipeline into a family-supporting career. The program recruits entry-level workers from disadvantaged communities who may lack the background needed to score high enough on civil service exams to be considered for direct, permanent employment in the public utility.

Once accepted into the program, pre-apprenticeship trainees become union members, even though they are "exempt" from civil service that is required for permanent public employees. As union members, UPCT trainees work as full-time, paid weatherization installers in LADWP's low-income-targeted residential weatherization program, while receiving classroom and on-the-job training as well as online instruction to prep for civil service exams so that they can become eligible for permanent employment. The program established a wage floor of \$16.00 per hour with full family health benefits.

Participants also gain experience working in other parts of the utility, including in the warehouse and the water system. Once they are hired into an apprentice-level civil service position, graduates of the UPCT program are in the pipeline for many occupations, including line-worker, electrical mechanic, and steam plant operator. UPCT thus channels people into long-term careers with family-supporting wages and benefits, including health care, pension, and career training.

Source: Zubin - Putting California on the High Road: A Jobs and Climate Action Plan for 2030.

Not only do the green jobs generated by energy efficiency and alternative energy development offer opportunities to train and expand labor supply by bringing in new workers, but accelerating future demand in these areas will boost the job opening numbers pictured in the above table (again based on 2018 projections). At the local level, there are a set of barriers to more rapid adoption of commercial or residential solar and energy efficiency retrofits.

Landlords and homeowners face a complicated decision making process when considering solar installations or energy efficiency improvements. The economic and environmental benefits of these investments may not be clear enough for firms and residents to implement energy saving building changes. A number of commentators have emphasized important barriers including:

- Accessing information to understand the types of upgrades needed, the process to get them completed, available incentives or subsidies and securing good contractors to execute the work;
- Owners may forgo improvements if they are uncertain they will realize energy savings gains before they sell the property;
- High upfront costs to install solar or make major energy upgrades make them unaffordable for many households;
- Different incentives between owners of rental property who would make the investments and tenants who typically pay utility bills.

Austin Energy has implemented a number of marketing, technical assistance, incentives and rebates in an attempt to transcend these frictions. But the overall process and specific financial assistance available remains opaque to some commercial and residential customers. Understanding the options and securing financing for energy efficiency upgrades is especially challenging for low- and moderate-income residents. There are additional steps that AE could consider to expand conservation and solar adoption. These might include more targeted outreach and assistance to low adoption communities, expansion of community solar where feasible and more aggressive efforts to expand solar and conservation investments in multi-family housing in ways that make shared benefits between landlords and tenants more common. The second case example from Philadelphia highlights how city-wide energy conservation and home retrofit efforts are closely tied to community-based centers and specific workforce training channels for community members to secure jobs in conservation activities.

Case #2: Philadelphia Energy Coordinating Agency- Innovative Initiative to Target Energy Efficiency Savings and Green Job Opportunities to Low Income Residents.

The Philadelphia Energy Coordinating Agency (ECA) was created in 1984 to address energy access and cost burdens affecting low-income Philadelphia residents. The agency historically focused on assisting residents with paying utility bills and gaining access to federal low income weatherization assistance programs. To increase the number of residents aware of, and accessing support for energy conservation improvements, ECA created 15 neighborhood centers across the city. Energy efficiency experts at these centers conducted outreach activities and worked directly with residents to reduce their energy consumption and costs. Personnel at the centers help community members determine needed energy conservation improvements, assist them in securing financing and overseeing installation and repair projects. ECA also draws upon funds from other City departments to finance the repair or replacement of heating systems for qualified residents.

ECA created a number of training and certification programs targeted to community residents to meet the growing demand for workers to complete the

various energy conservation projects. In 2009 the agency partnered with a private foundation to open the Knight Green Jobs Training Center. The center established training programs in a number of green occupations targeted to un- and underemployed individuals. Starting with training programs and certifications focusing on lead removal and weatherization the Center has expanded to training, certification and apprenticeship programs in HVAC repair and installation, solar system installation and building operations management. In many of these training tracks the Knight Center partners with the Community College of Philadelphia. Since 2009, the Knight Green Jobs Training Center has trained and estimated 5,700 workers and achieved very high placement rates in the industry and in the public sector.

This project is an example of integrating the benefits of environmental action with job creation and career development for residents of low- and moderate income communities.

Source: Fitzgerald, Joan. 2020. *Greenovation*, page 192 and Philadelphia Energy Authority. 2018. *The Philadelphia Energy Campaign – Year 1 Update*



Improving Water Management and Conservation

Securing a sustainable supply of potable drinking water for Austin residents and providing water required by industrial and commercial users is challenging in a rapidly growing city and region. The municipal water system includes a complex infrastructure designed to facilitate the capture, use, conveyance, storage, conservation, and treatment of water and wastewater. The main City enterprise sustaining and improving Austin's municipal water system is Austin Water (AW). Given AW's broad mission of providing clean water, managing wastewater/reclaimed water, water conservation and environmental protection services, most of AW's total employment (over 1,200) could be classified as green jobs.

It is crucial to understand that the strong market incentives supporting energy conservation and alternative energy use are not as strong in the domain of water conservation and reuse. Because water is viewed as an essential resource for survival, the "price" of water often does not incorporate the full costs of water provision. Because water is relatively cheap, price incentives for residents to conserve and reuse water are weaker than in the energy sector. Therefore to drive conservation and reuse of water the public utility must assume a stronger, more central role. AW has a two pronged strategy to reduce overall demand for potable water. It promotes a range of aggressive water conservation efforts across residential, public and commercial sectors. Second, AW is rapidly expanding initiatives to reclaim and reuse water for uses not requiring potable water standards.

AW has implemented a range of water conservation initiatives from rainwater collection rebates, to household plumbing improvements, to xeriscaping and water efficient irrigation systems. The water utility leads marketing and educational campaigns and offers an array of incentive and rebates to drive residential conservation. On the commercial and industrial side, AW offers water audit rebates for commercial, industrial and institutional customers of up to \$5,000. These audits encourage organizations to undertake water saving measures and investments from fixing leaks, to using reclaimed water to improving plumbing systems.

AW has more recently expanded initiatives to reclaim and reuse water. AW has built up a reclaimed water infrastructure (purple pipe) that delivers low-cost non-potable water for landscape irrigation, cooling towers, and other uses not requiring higher-quality drinking water. This reclaimed water is recycled from wastewater generated by customers. Reclaimed water is less expensive to use and treat, costing as little as one-half the price of drinking water. Users who access the reclaimed water hook ups can see a reduction in water fees.^{xiii} AW continues to expand this reclaimed water infrastructure. In the area of reclaimed water, AW collaborates with the Austin Watershed Protection Department, especially in the area of managing and reusing storm water.

In addition, AW is piloting a major new initiative to encourage larger commercial and industrial users to develop on-site water reuse systems to reduce their water consumption. It is offering significant subsidies to initial projects undertaken by commercial customers. This project is pushing the envelope in that the City is working toward making mandatory on-site reclamation for large commercial projects a part of the Austin Building Code in the future. Interviews with AW personnel suggested that the proliferation of on-site reclamation would generate new employment and the greening of existing occupations in building management and maintenance occupations.

Source: Park Ranger Cadet Program Apprentice (pages 28 and 29 of this report)

Table 14: Jobs Related to Water Conservation and Reuse in Occupations Not Associated with High Educational Attainment Levels - Travis County

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019\$)</i>	<i>Workforce Solutions Capital Area - High Growth, Middle Wage Occupation</i>
47-2061	Construction Laborers	6,257	813	\$15.71	No
47-2111	Electricians	3,424	499	\$25.61	Yes
47-2152	Plumbers & Pipefitters	2,775	372	\$24.66	Yes
47-2211	Sheet Metal Workers	760	95	\$23.09	Yes
47-4011	Construction and Building Inspectors	666	107	\$29.86	No
49-9021	Heating, Air Conditioning & Refrigeration Mechanics	918	111	\$21.25	Yes
49-9099	Installation, Maintenance and Repair Workers	456	63	\$22.16	No
51-8031	Water and Wastewater Treatment Plant and System Operators	325	35	\$21.60	No
51-9012	Separating, Filtering, Clarifying, Precipitating Machine Setters	299	31	26.49	No

Austin Water’s conservation and water reuse programs and incentives stimulate private and public employment in a range of occupations not associated with high levels of formal education. A number of the green occupations linked to water conservation and reuse mirror many of construction related trade categories involved in energy conservation (above). However, there are specific occupations with significant green content that are more uniquely related to expanding water conservation and reuse. A 2018 Brookings Institution study found that largest occupations in the water sector workforce were plumbers, and pipefitters, followed by construction laborers and water and wastewater treatment plant and system operators.^{xliv}

In terms of job openings and workforce needs, there has been a persistent shortage of trained plumbers and pipefitters. Workforce Solutions Capital Area has consistently identified this as a high growth middle wage occupation. Career ladders in this trade are strong with trained workers moving from apprenticeship, to well paid workers, to in some cases owners of independent plumbing businesses.

In terms of workforce training, the only organization we interviewed offering specific curricula for the plumbing trades was ACC. The community college offers basic course and certifications that prepare participants for entry into the trade. However, a recent initiative is a 2018 partnership between the Skillpoint Alliance mentorship program and Austin Community College’s (ACC) ongoing work with the Plumbers and Pipefitters Local Union 286 to institute an associate’s degree in construction management for union apprentices. Skillpoint received private foundation support to develop and implement a mentorship program to bring more diverse individuals into a pre-apprenticeship program in the trade. The program seeks to strengthen industry employer partnerships and help participants navigate their initial entrance into the industry. Another regional workforce board recently provided assistance to establish a formal articulation agreement creating a pathway from the Skillpoint pre-apprentice plumbing program, into the Plumbers and Pipefitters Local Union 286 apprenticeship program. This is a noteworthy example of a career pathways strategy to diversify and increase trained workers in a high opportunity occupation.

There are also training programs aimed at the high opportunity Heating, Air Conditioning & Refrigeration Mechanics occupation with ACC and at least one CBO offering training and certifications in this area.

AW's efforts have reduced per-capita water pumpage by close to 22% since stronger conservation programs were put in place in 2008.^{xiv} The acceleration of water conservation and water reuse initiatives by Austin Water will boost job openings in the above set of occupations. If the onsite water pilot projects move from the pilot project phase into the Austin City Code and become a standard in new construction, this will be a significant locus of new green job growth. In addition, there may be new avenues to increase water conservation and reuse.

Water efficiency investments are needed in lower-income areas where water distribution infrastructure may be older or less well maintained and where household plumbing and appliances tend to be older and less efficient. Expanding marketing, outreach, technical assistance and expanded incentives to low and moderate income homeowners could reduce potable water use through efficiencies, reuse and landscaping changes. In this context we outline a crosscutting initiative that promises to bring environmental benefits in numerous domains and green job pipelines to Austin low- and moderate-income communities and communities of color.



A Climate Ambassadors Strategy to Accelerate Equitable Energy and Water Conservation

Austin Energy and Austin Water could leverage the development of City of Austin's recently instituted Ambassador programs, as well as the nonprofit Go Austin, Vamos Austin!'s Climate Navigator program, to create networks of residents who could help increase awareness of, and participation in, utility conservation and incentive programs with neighbors. The City of Austin created a Climate Ambassador program during the development of the 2020 Climate Equity Plan. Staff issued a citywide call for residents willing to liaison with other residents who have been systematically excluded from climate-related issues. Twelve demographically diverse Climate Ambassadors were recruited and paid a stipend to facilitate discussions with other residents about challenges, barriers, and opportunities. These discussions led to interviews with residents, resulting in 60 interviews used to incorporate resident input into the plan. This innovative strategy increased the diversity and equity of participation in the development of the plan, and other City of Austin units (Austin Water and the Watershed Protection Department) are currently adopting similar ambassador programs.

City departments could consider developing programs (via the utilities or other units) that would pay Ambassadors to connect community residents with information about incentive programs and provide support in decision-making. This program could also help with application processes to increase adoption of green job-related household behaviors, such as weatherization, installation of solar and water conservation strategies. Better connecting residents to incentive programs—especially residents belonging to demographic groups less likely to participate in these programs—could both increase green job development as well as equity outcomes. However, before doing so, an important first step would be to carefully examine existing weatherization, solar and water conservation incentives and make changes to address existing equity gaps in program design in order to ensure incentive programs are structured in a way that increases potential for future adoption by households with lower incomes, BIPOC households and households of renters.

In addition to the City's Ambassadors programs, the nonprofit Go Austin, Vamos Austin! has created a similar program called the Climate Navigators, which offers another possible opportunity to increase green job-related economic activities by leveraging existing residential networks and relationships. The Climate Navigators program began in 2019 when GAVA received a grant from the City of Austin to train Dove Springs neighborhood residents in disaster preparedness and community organizing. A few months later, GAVA, City of Austin staff, and UT Austin researchers developed a grant proposal focused on expanding the Climate Navigators program. The grant proposal proposed a process to formalize the information sharing already happening by developing a website and phone application to serve as a central distribution place for disaster-related information, but which would also allow residents to share their local knowledge about climate change and climate adaptation with municipal and nonprofit sectors.

Participants in navigator or ambassador types of programs are boundary-spanning individuals who connect residents and other groups with information and resources focused on a topic of interest or a system that is difficult to understand or access.^{xlvi} The Climate Navigators program is structured around a "train the trainer" approach adapted from public health to build a network of community members who gather and disseminate climate-related local knowledge.^{xlvii} Between the winter 2022 and spring 2023, Navigators will train 150 other residents in disaster preparedness in general and the use of the website/phone application in particular. After the Navigator network and website/phone application is fully in place, there is an additional opportunity to use the communication networks that the Navigators develop to share information about other green-job related programs, such as solar adoption and water conservation that may result in green job development, or related green-job opportunities such as the ACCC.

Other communities have adopted programs similar to the City of Austin's Ambassador and GAVA's Navigator programs. However, Austin appears to be one of the first municipalities to adopt an ambassador program that pays participants to connect other residents with municipal programs, trainings and projects. For example, land grant extension offices have developed ambassador and navigator programs focused on healthy living and public health; other extension offices and public agencies have used the ambassador/navigator framework to promote and accelerate clean energy programs.^{xlviii} In 2020, the Ann Arbor (MI) City Council created the A2Zero Climate Ambassador Program.^{xlix} This program trains 15-20 volunteers who participate in nine weeks of training focused on climate mitigation and sustainability tools and resources. Participants are not paid for training or work, which likely limits who can serve as ambassadors.

Although ambassador/navigator programs appear to be growing in popularity, these programs will not be inclusive until they structure engagement so that people who cannot afford to volunteer their time can participate. The City of Austin appears to be an innovator in the way they have conceptualized residents as vendors and have used that structure to pay participants for their involvement, both as a way to make these programs more inclusive and equitable as well as to acknowledge the value that ambassadors provide as important connectors to groups of residents likely to be excluded from City processes and programs. Likewise, the emerging GAVA Navigator network, if adopted in other neighborhoods, could serve as another pathway to better connect Austin residents with green-job related and workforce development programs. We recommend that the City consider how to leverage these emerging networks of residents to broaden participation in incentive programs, as part of a larger process to expand adoption of household scale decisions that can increase green-job related activities such as weatherization, solar installation and water conservation.





Waste Management and Resource Recovery

The management, reuse and reduction of solid waste is a rapidly evolving and growing field of environmental action. Waste reduction and recycling has become a more common part of business operations in many parts of the private sector. In sectors such as steel, apparel and construction, the use of recycled materials in the production process is a common and growing practice. For example, the majority of U.S. steel production now occurs in “mini-mills” that use recycled ferrous scrap metal to produce new steel products

Increased recycling and reuse in the private sector has contributed to, and complemented municipal efforts to divert material from landfills. Diversion rates from municipal landfills increased over the past two decades across the U.S.ⁱ Austin Resource Recovery (ARR) is Austin’s lead public sector organization in waste management, reduction and resource recovery. ARR advanced an ambitious Austin Resource Recovery Master Plan in 2011 that laid a plan to achieve the City’s Zero Waste goal by 2040 to divert 90 percent of all materials away from landfills and incineration. An update to the Comprehensive Plan is expected in 2022, providing an updated roadmap to reaching this goal. ARR provides curbside services for single-family residences with less than 4 dwelling units, and operates a robust residential recycling program that now includes curbside pickup of organic, compostable material. Commercial and multi-family properties must contract with a licensed hauler(s) for services but are required to offer residents and/or tenants convenient access to recycling and to submit a recycling plan. Food permitted businesses must also have a plan to keep back-of-house organic material out of the landfill.

ARR also oversees a policy initiative directed to reduce waste and increase recycling of materials at construction sites. In term of tonnage, construction and demolition material is the largest single waste stream.ⁱⁱ Construction projects over 5,000 square feet, and demolition projects of all sizes are subject to the City’s Construction and Demolition (C&D) Recycling Ordinance. ARR has a business outreach team that actively works with contractors to facilitate compliance with the ordinance to increase recycling and reuse of materials from construction and demolition. It is noteworthy that compliance with the C&D Ordinance has, to date, relied primarily on voluntary reporting. A recent study showed that the percent of projects that are submitting the necessary information is relatively low compared to the total number of projects that meet the criteria for compliance.ⁱⁱⁱ ARR is working to increase waste diversion rates and compliance in this area.

ARR's recycling programs generate significant employment within the department and downstream through its policies and programs in areas including collection, processing and recycled materials wholesalers. In addition, expanding C&D materials reuse has been shown to create additional jobs and economic activity in recycling industries and to provide increased opportunities for local businesses.ⁱⁱⁱⁱ

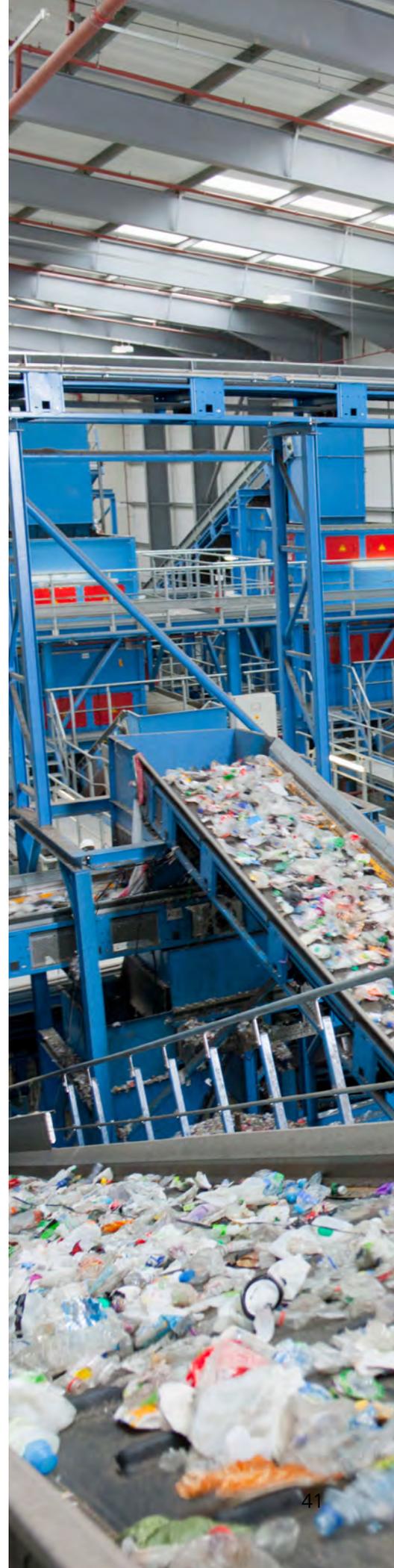
A 2016 diversion study estimated that Austin had achieved a 42% citywide diversion rate. While an updated study of ARR's overall diversion rate is underway, it is unlikely that Austin has achieved its 2020 goal of diverting 75 percent of material from landfills. Significant challenges have emerged as cities work towards increasing diversion rates. Municipal solid waste generation continues to increase nationally on a per-person, per day basis. This partly because historically, producers have not been responsible for what happens to their products at the 'end-of-life.' Instead, consumers and ultimately municipal programs are left to handle the material. Instead, consumers and ultimately municipal programs are left to handle the material. The demand for recycling and higher forms of diversion, such as reuse or repair not only reduce greenhouse gas emissions, but prevent the need for expanding and creating landfills, which are often located near communities of color. As the market continues to move to lightweight and more innovative packaging, it has become more difficult to find end markets for certain recycled materials. International markets for recycled materials are beginning to shift back to the U.S., where there is a shortage of domestic remanufacturing facilities to handle the volume of materials.

To tackle these challenges cities and the federal government have moved to more comprehensive strategies focused on building circular economy linkages. A circular economy strategy focuses on keeping and using materials at their highest and best use for as long as possible, and to meet the needs of community residents while doing so. At current time, that involves reducing, reusing, repairing, sharing and recycling as much as possible. But in the future focus will be directed to: redesigning materials and products to be modular, less resource-intensive and designed for end-of-life; extending product life cycles by increasing consumer ability to repair and upgrade products for extended use or resale; and expanding product sharing or increasing utilization rates of products by creating new platforms for shared use or ownership.

ARR advocates for circular economy strategies to increase the volume of materials that are reused, repaired, remanufactured and shared within the local economy. They are reviewing and assessing City procurement practices, incentives for businesses, and changes in regulations to accelerate these practices. However, a significant share of this activity is shaped by the decisions of consumers, private businesses and higher levels of government.

Currently the Circular Economy program within ARR works closely with the Economic Development Department to support and grow businesses engaging in circular business practices. They also develop programming to encourage residents to engage in behaviors, such as repair and reuse that support said businesses.

A circular economy perspective is additionally valuable at expanding our understanding of the larger set of economic activities and jobs associated with recycling and reuse. This was highlighted in a 2020 report by TXP Inc., *The Recycling & Reuse-Related Economy of Austin*. This report estimated that 3,150 direct jobs in the Austin area were linked to recycling and reuse



activities in the public and private sectors.^{iv} Larger sectors in this area included solid and hazardous waste collection and recycled materials merchant wholesalers, but also commodity reuse activities such as used merchandise retailers (e.g., secondhand clothing establishments). There are exciting ways to expand future circular economy practices in a range of industries such as expanding the use of recycled material in apparel manufacturing and increasing activities to facilitate the local repair and life extension of devices and appliances and consumer household goods. These types of activities will stimulate the local market (repairing a computer locally versus buying a new one from a global manufacturer) and support existing green jobs. Future federal regulatory interventions may open possibilities to make producers responsible for recycling or reusing products or components that are not at the end of their useful lifespans. This might increase the demand for certain technical and maintenance repair jobs in the private sector.

Table 15: Jobs Related to Resource Recovery in Occupations Not Associated with High Educational Attainment Levels - Travis County

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019\$)</i>	<i>Workforce Solutions Capital Area - High Growth, Middle Wage Occupation</i>
47-2061	Construction Laborers	6,257	813	\$15.71	No
47-4011	Construction and Building Inspectors	666	107	\$29.86	No
47-4041	Hazardous Materials Removal Workers	239	27	\$22.51	No
49-9071	Maintenance and Repair Workers, General	7,052	859	\$18.35	Yes
49-9099	Installation, Maintenance and Repair Workers	456	63	\$22.16	No
51-6031	Sewing Machine Operators	495	57	\$11.65	No
51-6052	Tailors, Dressmakers and Custom Sewers	219	37	\$13.94	No
51-9061	Inspectors, Testers, Sorters, Samplers, etc.	3,383	396	\$21.64	Yes
53-3032	Heavy Truck Drivers	4,700	668	\$20.35	Yes
53-7081	Refuse and Recyclable Material Collectors	406	74	\$18.25	No

The employment structure in the waste management and resource recovery sector spans many occupations and is rapidly evolving. While the occupational mix in Table 15, above, captures the historic pattern of green jobs in this domain, other activities and jobs may be greening through deepening of circular economy activities. Currently, the largest share of occupational employment in this area is in occupations related to materials collection and materials processing.^{iv} But there is considerable employment supporting maintenance and repair of products and systems, including increased reuse and recycling of clothing supporting jobs in sewing and apparel producing manufacturing.

In terms of workforce and career development there are several existing and emerging opportunities in the field. ACC has developed several training and career development tracks in fashion and apparel, including fashion design and marketing associate degrees and a fashion incubator to promote independent fashion designers and small business start-ups. Training and business development in this area can increase a focus on reusing fabric and using sustainable materials.

The City can also build on and expand efforts to improve wage and workplace conditions and training requirements through its contracting processes for commercial and residential pick up, trucking and recycling activities. Local governments can also support the growth of circular economy activity by leveraging their purchasing power to support initiatives such as procurement of post-consumer recycled content products, integrating repair services into contracts and vendor expectations, and rewarding producers who take responsibility for extending the lives of their products or take responsibility for returns.

The ongoing challenges of waste management and resource recovery and innovative circular economy solutions to meet those challenges will generate new types of business enterprises, new occupations and the greening of existing occupations in areas such as maintenance and repair, computer wholesaling and retail. The case study below profiles a successful start-up that expanded employment through an innovative approach to managing surplus and redundant IT equipment.

Case #3: Liquid Technology- New Businesses and Jobs in the Circular Economy: Electronics Recycling and Reuse

Liquid Technology is a fast growing enterprise that offers a comprehensive set of services to safely and securely manage excess information technologies and generate revenue through the resale and reuse of equipment and devices. Companies generate large volumes of surplus computers, servers and other IT system hardware for a variety of reasons. When firms migrate to cloud based data storage, relocate data centers or replace existing systems with upgrades they need to offload large volumes of excess equipment.

Liquid Technology (LT) offers comprehensive solutions to this common business problem. LT will take excess equipment, safely wipe drives and sensitive data and resell equipment on the behalf of their customers to recover some value from their prior IT investments.

LT follows the highest industry standards and provides a data destruction certificate to companies that applies to all recycled technologies.

By safely repurposing surplus IT, this company keeps large volumes of e-waste out of landfills and reduces materials consumption by reuse versus the new manufacturing of equipment. LT has grown to 90 employees, with a range of job and skill characteristics. It employs both professional workers and trained IT workers without a higher education degree. It has expanded its facilities at the Brooklyn Navy Yard and has recently opened a new facility in Bentonville, Illinois.

Source: van Heel, Oliver D. 2020. Complex Challenges. Circular Solutions, New York City Circular City Initiative- Freshfields, page 23.

Sustainable Transportation Initiatives

Reducing GHG emissions and other negative environmental effects from the transportation sector is a difficult aspect of improving environmental performance across urban regions. In the case of Austin, as Figure 4 above shows, GHG emissions related to the transportation sector have increased modestly over time as the City continued to experience rapid growth. The transportation domain includes the movement of goods and the movement of people. Passenger travel accounts for the vast majority of GHG emission nationwide and can be directly influenced by local policies.

Market trends and national regulatory and incentive policies are driving some changes in the environmental impacts of passenger travel. National and state fuel economy (CAFE) standards have modestly reduced fuel consumption and GHG emission per vehicle mile traveled. Regulations and incentives encouraging purchases of zero emissions and low emissions vehicles have bolstered the growth in consumer demand for fully electric (EV) and hybrid vehicles (HEV). In addition, funding from all levels of government for public and non-motorized transit has continued and promises to grow in the future due to recent federal investment initiatives. Finally, there are efforts at the national and local levels to reduce the environmental footprint of air travel and airport operations through airport energy efficiency improvements, flight handling efficiencies and more active carbon offsetting programs.

At the local level there are two main levers to improve environmental outcomes of passenger transportation: encouraging the production, purchase and use of cleaner vehicles (EVS and HEVs); and reducing the number of

vehicle miles traveled through transportation, housing, and land use planning policies. We will highlight market and policy changes influencing the growth in cleaner vehicle travel and public transportation.

Austin has EV and HEV ownership rates that are above the national average.^{lv} The City has intensified efforts to support growth in EV and HEV ownership. Austin Energy promotes clean vehicle ownership federal rebates and has constructed a number of fast charging stations across the City. In 2022, AE further offers a rebate of up to \$1,200 dollars to install level 2 chargers in private residences. As the EV market expands there will need to be more charging stations across the region. This build out will likely be driven by private charging vendors. This coming expansion of the EV infrastructure will provide increased employment opportunities for the skilled trades, especially electricians. In terms of the overall green jobs picture it is also important to highlight the location of the new Tesla “Gigafactory” that will be producing EV based trucks of various classes. This new factory will bring at least 5,000, and up to 10,000 jobs in the automotive assembly industry – an industrial sector that had no major presence in Austin previously.

By far the biggest green job driver in the transportation domain moving forward will be the expansion of public and non-motorized transit. The City and Cap Metro have steadily made investments in bus transit, bike and pedestrian infrastructure. But the Project Connect transit plan currently being implemented will be the largest single infrastructure project in recent history. Project Connect will carry out roughly \$10.3 billion in capital projects to improve the area’s transit network, including new light rail and bus rapid transit lines and expanded public transit services across the city. The majority of these and other Project Connect investments will be dedicated to system construction over the 2023-2028 period. The large scale expansion of public transit will also include \$300 million allocated to mitigate possible displacement of low- and moderate-income residents due to transit impacts. Project Connect activities will clearly act as a major demand stimulus for workers across the construction trades in the coming decade.

Table 16: Jobs Related to Transportation in Occupations not Associated with High Educational Attainment Levels - Travis County

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019\$)</i>	<i>Workforce Solutions Capital Area - High Growth, Middle Wage Occupation</i>
47-2061	Construction Laborers	6,257	813	\$15.71	No
47-2111	Electricians	3,424	499	\$25.61	Yes
47-4011	Construction and Building Inspectors	666	107	\$29.86	No
47-4090	Construction and Related Workers, All Other	120	16	\$25.95	No
49-3023	Automotive Service Technicians and Mechanics	2,958	328	\$25.64	Yes
49-3031	Bus and Truck Mechanics	782	86	\$24.30	Yes
49-9051	Electrical Power-Line Installers and Repairers	261	31	\$31.12	No
49-9071	Maintenance and Repair Workers, General	7,052	859	\$18.35	Yes
49-9099	Installation, Maintenance and Repair Workers	456	63	\$22.16	No
51-4041	Machinists	1,007	103	\$23.15	Yes
51-9199	Production Workers, All Other	593	71	\$15.86	No
53-3021	Bus Drivers, Transit and Intercity	1,069	153	\$19.24	No
53-3032	Heavy Truck Drivers	4,700	668	\$20.35	Yes

Many occupational categories that will benefit from increased demand for green jobs in the transportation domain offer promising job and career opportunities. High wage, high opportunity jobs related to transportation include auto, bus and truck mechanics, identified as a high growth, middle wage occupation by the local workforce development board. In addition, demand for Bus Drivers and other transit operators will continue to experience growth.

Not fully captured in the above table are the major employment opportunities in manufacturing associated with vigorous hiring at the Tesla Gigafactory (in numerous engineering occupations and in occupations such as Machinists, Electrical, Electronic and Electromechanical Assemblers and Engine and Other Machine Assemblers not associated with high levels of educational attainment). Recently Tesla and Austin Community College (ACC) created a 14-week manufacturing training program for Gigafactory workers. According to program descriptions, students entering this program will be paid by Tesla during training, although pay and subsequent wage rates were not noted.

The major construction activities associated with expanding Austin’s public transit system will add considerably to the already strong demand for workers across the skilled trades. The Project Connect initiative incorporates a strong commitment to community hiring and prevailing wage standards. This will expand living wage and career building opportunities in several green occupations where demand for new workers is already extremely strong. Labor demand from energy conservation and alternative energy, water conservation and reuse and other environmental domains is already adding to brisk demand for workers in skilled trades. The demand for new workers linked to Project Connect projects suggests a need to rapidly scale up recruiting, training and apprenticeships in trades ranging from electrical workers, plumbers and pipefitters, sheet metal workers and construction and building inspectors.

Parks, Lands and Urban Agriculture

This domain of environmental action spans an extensive group of activities. Expanding City and regional parks while maintaining and improving natural conditions in parkland and open space is just one part. Numerous City departments and non-profits engage in wildlife habitat preservation, tree cover expansion, native species plantings, erosion control and urban creek restoration. Private farmers, non-profits and community groups are engaged in urban agricultural activities from small organic farms to community gardens to farmers markets. Urban agriculture activities have spilled over into complementary pushes to improve the quality and accessibility of food through new markets and new channels of distribution.

Some of these activities are supported with market demands or voluntary actions. The three main City departments operating in this domain are the Austin Parks and Recreation department (PAR), the Office of Sustainability, and the Watershed Protection Department. Austin Parks and Recreation manages parks and preserved lands, recreational facilities and conducts educational programs. The department also engages in open space preservation and development, city trails development and management and urban forestry projects on parkland. Austin’s Community gardens program is also overseen by PAR.

Austin Fire Department in partnership with PAR are increasing their activities to reduce the potential impact of wildfire risks and improve response to wildfires across the city. Parks and Recreation is also the home department for the Austin Civilian Conservation Corps initiative.

In terms of urban agriculture, the Office of Sustainability’s Healthy and Equitable Food System program supports development of urban gardening and agriculture. They host the Central Texas School Garden Network, which supports the K-12 schools in the Austin Independent School District that have school gardens. At least one



Source: ACCC American YouthWorks Member for photovoice project (pages 28 and 29 of this report)

K-12 school in Austin (Russell Lee Elementary) provides space for local farmers to grow produce, in exchange for help with school garden maintenance. The Office of Sustainability also began a Food Justice Mini Grant program; awardees include the Multicultural Refugee Coalition, which provides access to food production space and training for Austin-area refugees. The Office of Sustainability is also building links between producers and healthy food for distribution through the Good Food Purchasing Program, a national framework to assist municipalities and public institutions in incorporating demand for local food into purchasing decisions. This program can help expand future markets for Austin-area urban agricultural producers.

The Austin Watershed Protection Department focuses on infrastructure development and related activities to manage storm water, flooding and water quality in rivers, streams and lakes. They engage in an array of projects that could be classified as green infrastructure and oversee storm-water regulations and systems in larger developments. Watershed Protection also recently began a community engagement division which focuses on better integrating their work with issues of equity and community participation, potentially making Watershed's work more just and responsive to frontline communities. The department, furthermore, launched an initiative to utilize "greener" concrete materials in its storm-water management and related infrastructure projects. The use of this alternative material promises to substantially reduce CO2 emissions in "grey" infrastructure projects. The agency has prioritized finding ways to utilize more widespread adoption of more environmentally friendly infrastructure solutions.

Table 17: Jobs Related to Parks, Land and Urban Agriculture in Occupations not Associated with High Educational Attainment Levels - Travis County

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019\$)</i>	<i>Workforce Solutions Capital Area - High Growth, Middle Wage Occupation</i>
33-2011	Firefighters	1,859	202	\$30.17	No
37-3011	Landscaping and Groundskeeping Workers	6,211	588	\$14.63	No
45-0000	Farming, Fishing, and Forestry Occupations	2,269	213	\$16.04	No
47-2061	Construction Laborers	6,257	813	\$15.71	No
47-4011	Construction and Building Inspectors	666	107	\$29.86	No
47-4090	Construction and Related Workers, All Other	120	16	\$25.95	No
51-9061	Inspectors, Testers, Sorters, Samplers, etc.	3,383	396	\$21.64	Yes

There are a number of occupations associated with Parks, Lands and Urban Agriculture that require higher levels of educational attainment (e.g., Zoologists and Wildlife Biologists, Hydrologists and Conservation Scientists). The occupational mix not requiring higher levels of formal education is more limited and somewhat distinct from the other environmental domains. Low wages are a concern in the Construction Laborers and Landscaping and Groundskeeping occupations related to stormwater infrastructure projects and park facility construction and maintenance. In the broad occupational category of Farming, Fishing and Forestry, workers in the Austin region are largely working in urban agricultural operations and perhaps sales of agricultural produce on-site or in markets. Average wages in this sector are also relatively low (as of 2018).

There are some higher wage occupations supported by activities in this domain. An interesting occupation with solid wages and an attractive career tack is Firefighters. The growing risk of wildfires is both a consequence and a contributor to climate change. Wildfire risks are present and growing in the Austin region. One obvious training and career path is into the Austin Fire Department. But beyond this, there will likely be robust demand for firefighting and vegetation management in less developed areas of Travis County and other areas of the five county Austin MSA. The State of California, facing perhaps the highest wildfire risk in the nation, has developed an innovative firefighter pre-apprenticeship training and inclusive hiring program. This initial training program links to certified apprenticeship and professional tracks in regional fire departments. This project has had significant success in bringing African-American, Hispanic/Latinx and women firefighters into a field where these groups are under-represented.^{lvii}

CONCLUSION

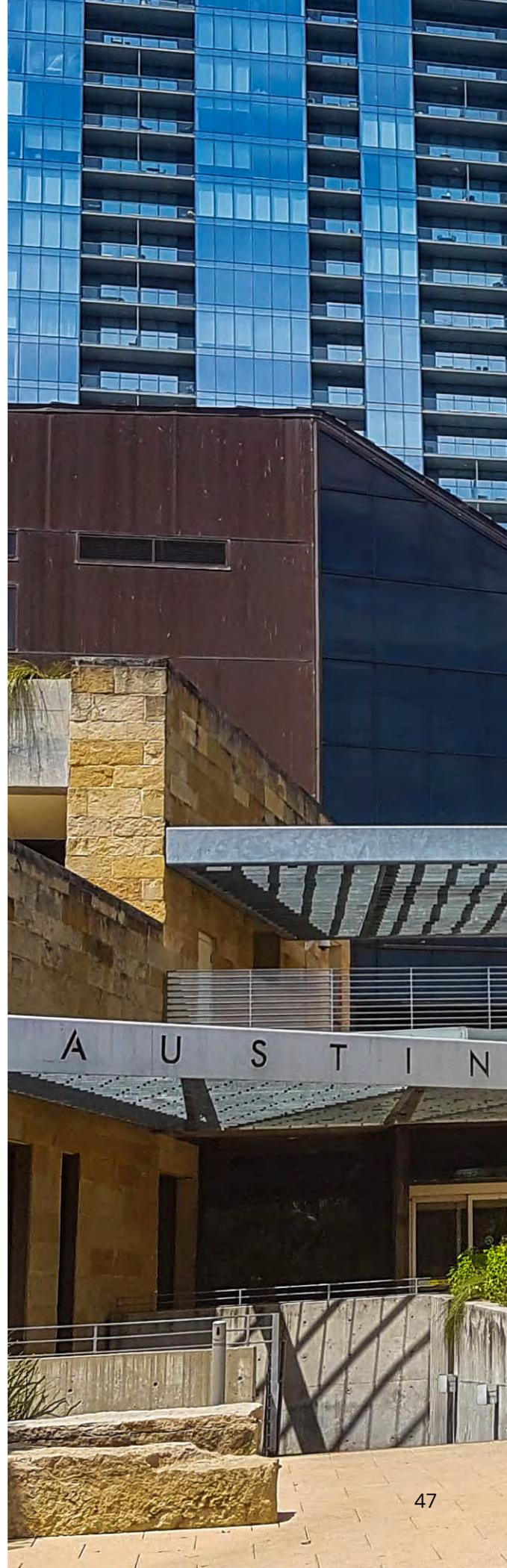
Consumers, businesses and public sector institutions are altering their behaviors and practices in reaction to climate change and other environmental pressures. Technologies and the ways that we work, consume and travel are also changing rapidly. The Austin region is in an excellent position to benefit from these larger trends, and this report shows that across the main domains of activity, Austin is becoming increasingly green.

Austin's industrial base contains few firms in the fossil fuel industry, but strong and growing sectors in clean energy, transportation and resource conservation. This report shows that the vibrant growth of the green economy is opening up numerous opportunities for quality jobs and rewarding careers. These opportunities will only grow in the future.

As the City's Climate Equity Plan emphasizes, building a future with shared prosperity and a high quality of life for all is dependent on fusing green economic growth to environmental justice. This requires first ensuring that communities who have historically and are currently most exposed to environmental harms directly benefit from the City's environmental initiatives – renewable energy and energy conservation, improved public transit, electric vehicles, parks and land conservation, and repair and reuse of products. At the same time, residents across Austin's communities must have clear pathways to the education and training needed to secure good jobs and careers in the green economy. Advancing environmental justice in these ways depends on solidifying new forms of collaboration between community members and the agencies and enterprises of the City through climate navigator/ambassador type initiatives.

Leveraging green economic opportunities to improve economic and social equity also depends on creating a more systematic and powerful green workforce development alliance. This report advances several ways to scale up job training and career pathways, while improving access to BIPOC residents. In this regard the City could support green job access by becoming a more central institution in the region's workforce development system. The COA could more energetically participate in expanding training channels and job opportunities for workers in the skilled trades, especially by supporting the expansion of formal apprenticeship opportunities. Expanding the innovative ACCC initiative to become an important component of a green workforce pipeline will also open up new opportunities for community members to secure quality career building jobs.

The old narrative that improving environmental performance suppresses economic growth and kills jobs is false. The growth and evolution of the green economy offers unique and inspiring opportunities to build a better future - greener and more prosperous - for all residents of Austin.



APPENDICES

Appendix 1: Green Jobs Estimate Methodology

Basic Estimation of Occupational Green Task Ratios: Our key data source to calculate the greenness ratio for each occupation is from the O*NET database. Since the year 2011, the *ONET Green Economy Program* has been releasing green occupational data. From ONET Version 16.0 to version 24.1, the releases include a list of *Green Occupations* and *Green Task Statements*. Versions after version 24.1 adopted the same Green Occupations and Green Task Statements from version 24.1. Rather than a binary categorical approach of defining a job as green or not green, our approach following Vona's methodology (Vona et al., 2019) defines a gradient of greenness for each occupation, since many traditional jobs are greening their processes and job tasks. It is important to capture these greening jobs.

We give the greenness ratio to each 8-digit occupational code according to job tasks, which is to calculate how many green job tasks are performed in each occupation. According to O*NET's *Task Ratings*, each task is given a value to indicate the amount of this task's work time associated with the occupation. Therefore, we attribute the weight to each task j of the total n tasks associated with the 8-digit occupation i according to the task rating. We normalized the weightings and make sure the sum of the n task-weightings is up to one. This is to indicate whether task j is a green task or not (according to *Green Task Statements*). If it is a green task, then it gives a value of one. If not, it gives a value of 0.

We then converted the greenness ratio for the 8-digit occupational code to 6-digits according to Vona's appendix (Vona et al., 2019). For 715 out of 822 occupations, the 6-digit greenness ratio is simply the greenness ratio of the 8-digit code because there is only one 8-digit occupation under the 6-digit category. For example, under 13-1151, there is only one 8-digit occupation code 13-1151.00.

For the rest of the 107 occupations, if the 8-digit occupational group that ends with ".00" has zero or few green tasks compared to the total tasks of the 8-digit occupational groups, we assign the greenness ratio of the 8-digit occupational group that ends with ".00" to the 6-digit occupation. For example, under "11-1011 Chief Executives", there are two 8-digit occupations: 11-1011.00 and 11-1011.03. Although 11-1011.03 has a greenness ratio of one, occupation 11-1011.00 has zero green tasks, and there are 50 total tasks. Therefore, 11-1011's greenness ratio is the greenness ratio of 11-1011.00, which is zero. According to this logic, occupational group 11-1011, 11-2011, 11-3051, 17-2072, 41-4011, 19-3011, 19-4051, 47-1011 and 53-1021 have a greenness ratio of each of its 8-digit occupational group that ends with ".00". This is to avoid overestimating the greenness ratio of the occupation if green tasks only compose a very small number of total tasks that are associated under the given occupational group. For the rest of the 107 occupations, the 6-digit greenness ratio is the average value of all 8-digit greenness ratios under it. For example, under the category "13-1041 compliance officers", there are six 8-digit occupational codes. The greenness ratio of "13-1041 compliance officers" will be the sum of the six greenness ratios divided by six.

The derived greenness ratios were then applied to Occupational Employment historic data at the national and regional (MSA) levels (Bureau of Labor Statistics – Occupational Employment System, Six digit, SOC). For the Travis County estimates and projections (to 2028) we used the Texas Workforce Commission – Capital Workforce Development Area job estimates and projections, 2018-2028. In each case we multiplied the derived six digit greenness ratio by the total employment in the occupation to produce a green jobs estimate for each occupation

Developing Estimates at the Regional Levels – The Austin MSA and Travis County: To develop green job estimates for the Austin MSA (five county area) and Travis County (Texas Workforce Commission – Capital Workforce Development Area) we first assumed that the green ratio for all occupations at the national level applied to occupational employment at the regional levels. There is no O*NET data that derives green tasks at the sub-national level. This necessary approach likely leads to inaccuracies in the estimates for the Austin MSA and Travis County. It obviously does not account for regional variations in occupational work tasks. Because Austin residents and the local public sector likely have stronger preference and policies related to improved environmental performance than the nation as a whole, some workers in Austin may spend more of their work

time on green tasks due to local policies (e.g., recycling) and local preferences (e.g., more electric or hybrid vehicle ownership) than the national average.

At the regional level, OES six digit occupational employment data (historic and projected) has suppressed data in a number of occupational categories. This means that in some six digit occupational categories no employment number is given for a specific year. To derive an estimate for occupational employment in a suppressed cell we used a simple procedure. We used occupational estimates for the previous three years (for 2010, the estimates for 2007, 2008, 2009; the estimates for 2019, 2016, 2017 to estimate 2018). Using prior year data to estimate employment in a suppressed cell we simply took the ratio of employment in a six digit occupation to the employment in prior years in the related higher level 2 digit occupational category in the prior years.

$$\frac{\text{Employment in 6 digit occupation, } n_1, \dots, n_3}{\text{Employment in related 2 digit occupation in } n_1, \dots, n_3} \times \text{Employment in related 2 digit occupation in estimate year}$$

Estimating the share of occupational employment supported by local versus export demand: To generate a basic (crude) estimate of the share of employment in an occupation supported by demand from outside the region, versus the share supported by local demand we employed an occupational location quotient approach. Location quotients are used as indicators of a region’s relative specialization in particular occupations. Mathematically, it is a ratio of ratios: the ratio of specialization variables X_r and X_n (employment in occupation X in the region and the nation, respectively) to reference variables Y_r and Y_n (e.g., total employment in the region and nation, respectively). If the location quotient (LQ) result for an occupation is greater than 1, this means that the region is more specialized in that occupation than the nation and likely to export some of the product or service provided by employees in the occupation. If the location quotient is less than 1, then the occupation is less present in the region than in the nation suggesting that the region is a net importer of the products or services provided by that occupation. To estimate the share of occupational demand supported by exports versus local demand we multiply $(LQ - 1/LQ \text{ for each occupation}) \times (\text{total employment in each occupation})$. If the LQ in a given occupation was greater than one, some share of the jobs and that occupation were supported by demand from outside the region. Summing up the jobs supported by exports in each occupation, we derived an estimate of the total green jobs supported by demand from outside the region. Total employment minus the jobs supported by exports provided an estimate of jobs in the Austin region supported by local demand.

Appendix 2: Greenness Ratios by Occupation used to Generate Core Green Job Estimates

The following table outlines the green task shares from the O*NET, 2019 “Green Task Statements,” https://www.onetcenter.org/dictionary/22.0/excel/green_task_statements.html.

In the Austin MSA or Travis County Occupational Employment Statistics data for 2010 and 2019 and 2018-2028 (Travis County projection) a number of the occupations with a “greenness ratio” (below) are not present in the region or the County.

SOC6	Occupations with Green Task Shares	Greenness Ratio
11-1021	General and operations managers	0.1134
11-2021	Marketing managers	0.1720
11-3071	Transportation, storage, and distribution managers	0.2219
11-9013	Farmers, ranchers, and other agricultural managers	0.0481
11-9021	Construction managers	0.2510
11-9041	Architectural and engineering managers	0.5890
11-9121	Natural sciences managers	0.3333
11-9199	Managers, all other	0.3937
13-1022	Wholesale & retail buyers, except farm products	0.2485

SOC6	Occupations with Green Task Shares	Greenness Ratio
13-1041	Compliance officers	0.0240
13-1081	Logisticians	0.1646
13-1151	Training and development specialists	0.0862
13-1198	Project management specialists and business operations specialists, all other	0.3333
13-2051	Financial and Investment analysts	0.2961
13-2052	Personal financial advisors	0.1168
13-2098	Financial and investment analysts, financial risk specialists and financial specialists, all other	0.1193
17-1011	Architects, except landscape and naval	0.2683
17-1012	Landscape architects	0.2601
17-2011	Aerospace engineers	0.4607
17-2051	Civil engineers	0.3155
17-2071	Electrical engineers	0.1607
17-2072	Electronics engineers, except computer	0.1967
17-2081	Environmental engineers	1.0000
17-2141	Mechanical engineers	0.5251
17-2161	Nuclear engineers	0.3308
17-2199	Engineers, all other	0.3896
17-3023	Electrical and electronic engineering technologists and technicians	0.1003
17-3024	Electro-mechanical and mechatronics technologists and technicians	0.0737
17-3025	Environmental engineering technologists and technicians	1.0000
17-3026	Industrial engineering technologists and technicians	0.2105
17-3027	Mechanical engineering technologists and technicians	0.1389
17-3029	Engineering technologists, technicians, except drafters, all others	0.2599
19-1013	Soil and plant scientists	0.6218
19-1031	Conservation scientists	0.3333
19-2021	Atmospheric and space scientists	0.4624
19-2041	Environmental scientists and specialists, including health	0.7500
19-2042	Geoscientists, except hydrologists and geographers	0.4360
19-2099	Physical scientists, all other	0.0716
19-3051	Urban and regional planners	0.3604
19-3099	Social scientists and related workers, all other	0.1259
19-4042	Environmental science and protection technicians, including health	0.0551
19-4099	Life, physical, and social science technicians, all other	0.1331
23-1022	Arbitrators, mediators, and conciliators	0.0281
27-3023	News analysts, reporters, and journalists	0.0386
27-3031	Public relations specialists	0.2130
29-9098	Health information technologists, medical registrars, surgical assistants and healthcare practitioners and technical workers, all other	0.3340
41-3031	Securities, commodities, and financial services sales agents	0.0290
41-4011	Sales representatives, wholesale and manufacturing, technical and scientific products	0.1125
43-5011 and 10	Cargo and freight handlers	0.0843

<i>SOC6</i>	<i>Occupations with Green Task Shares</i>	<i>Greenness Ratio</i>
43-5071	Shipping, receiving and inventory clerks	0.0734
47-2061	Construction laborers	0.1585
47-2152	Plumbers, pipefitters, and steamfitters	0.2413
47-2181	Roofers	0.3009
47-2211	Sheet metal workers	0.2141
47-2231	Solar photovoltaic installers	1.0000
47-4011	Construction and building inspectors	0.2642
47-4041	Hazardous materials removal workers	1.0000
47-4090	Miscellaneous construction and related workers	1.0000
47-5013	Service unit operators, oil and gas	0.0501
47-5041	Continuous mining machine operators	0.1447
49-3023	Automotive service technicians and mechanics	0.2201
49-3031	Bus and truck mechanics and diesel engine specialists	0.1508
49-9021	Heating, air conditioning and refrigeration mechanics and installers	0.1316
49-9071	Maintenance and repair workers, general	0.1348
49-9081	Wind turbine service technicians	1.0000
49-9099	Installation, maintenance and repair workers, all other	1.0000
51-2011	Aircraft structure, surfaces, rigging and systems assemblers	0.1295
51-4041	Machinists	0.0658
51-8011	Nuclear power reactor operators	0.2752
51-8013	Power plant operators	0.2029
51-8099	Plant and system operators, all other	1.0000
51-9012	Separating, filtering, clarifying, precipitating, and still machine setters, operators, and tenders	0.0540
51-9061	Inspectors, testers, sorters, samplers, and weathers	0.0584
51-9199	Production workers, all other	1.0000
53-3032	Heavy and tractor-trailer truck drivers	0.0856
53-6051	Transportation inspectors	0.1452
53-7081	Refuse and recyclable material collectors	1.0000

Appendix 3: Green Jobs and Green Job Growth in Occupations Associated with Higher Levels of Educational Attainment– Travis County

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Travis County Projected Employment (2028)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019)</i>	<i>Occupation/MSA Average Wage (2019)</i>
11-1021	General and Operations Managers	13,022	15,251	1,450	\$60.03	2.34
11-2021	Marketing Managers	1,540	1,797	174	\$69.15	2.70
11-3071	Transportation, Storage, and Distribution Managers	498	571	49	\$45.36	1.77
11-9021	Construction Managers	3,396	3,745	292	\$47.19	1.84

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Travis County Projected Employment (2028)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019)</i>	<i>Occupation/ MSA Average Wage (2019)</i>
11-9041	Architectural and Engineering Managers	1,010	1,052	78	\$79.31	3.09
11-9121	Natural Sciences Managers	313	372	36	\$70.03	2.73
11-9151	Social and Community Service Managers	618	856	88	\$34.36	1.34
11-9199	Managers, All Other	3,673	4,006	324	\$56.24	2.19
13-1022	Wholesale and Retail Buyers, Except Farm Products	832	958	97	\$30.26	1.18
13-1041	Compliance Officers	1,359	1,574	151	\$31.58	1.23
13-1081	Logisticians	997	1,125	114	\$36.80	1.44
13-1151	Training and Development Specialists	1,860	2,235	257	\$28.15	1.10
13-1199	Business Operations Specialists, All Other	9,024	10,504	1,085	\$40.54	1.58
13-2051	Financial Analysts	2,458	2,826	261	\$43.58	1.70
13-2052	Personal Financial Advisors	1,134	1,291	108	\$43.21	1.69
13-2099	Financial Specialists, All Other	1,522	1,724	160	\$38.70	1.51
15-1199	Computer Occupations, All Other	3,360	4,009	332	\$39.98	1.56
17-1011	Architects, Except Landscape and Naval	1,419	1,437	112	\$44.24	1.73
17-1012	Landscape Architects	164	173	14	\$32.49	1.27
17-2011	Aerospace Engineers	248	262	22	\$57.81	2.26
17-2051	Civil Engineers	3,514	3,783	311	\$43.79	1.71
17-2071	Electrical Engineers	1,753	2,062	157	\$50.72	1.98
17-2072	Electronics Engineers, Except Computer	2,662	2,894	206	\$62.93	2.46
17-2081	Environmental Engineers	272	299	25	\$42.42	1.66
17-2131	Materials Engineers	336	355	29	\$47.51	1.85
17-2141	Mechanical Engineers	997	1,065	76	\$45.27	1.77
17-2199	Engineers, All Other	1,155	1,258	93	\$52.55	2.05
17-3023	Electrical and Electronic Engineering Technicians	2,646	2,467	231	\$33.00	1.29
17-3024	Electro-Mechanical Technicians	33	35	3	\$27.26	1.06
17-3025	Environmental Engineering Technicians	126	133	11	\$24.10	0.94
17-3026	Industrial Engineering Technicians	92	94	9	\$22.44	0.88
17-3027	Mechanical Engineering Technicians	218	247	27	\$27.58	1.08
17-3011	Architectural and Civil Drafters	1,081	1,097	105	\$29.90	1.17
19-1022	Microbiologists	263	295	28	\$23.16	0.90
19-1023	Zoologists and Wildlife Biologists	35	41	6	\$32.10	1.25
19-1031	Conservation scientists	360	381	31	\$27.57	1.08
19-2032	Materials scientists	290	258	21	\$64.56	2.52

<i>SOC-6</i>	<i>Title</i>	<i>Travis County Employment (2018)</i>	<i>Travis County Projected Employment (2028)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Average Hourly Wage Rate (2019)</i>	<i>Occupation/ MSA Average Wage (2019)</i>
19-2041	Environmental Scientists and Specialists, Including Health	565	683	80	\$33.40	1.30
19-2042	Geoscientists, Except Hydrologists and Geographers	234	261	30	\$48.37	1.89
19-2043	Hydrologists	118	132	14	\$28.62	1.12
19-2099	Physical Scientists, All Other	152	160	14	\$38.23	1.49
19-3051	Urban and Regional Planners	452	554	56	\$30.20	1.18
19-3092	Geographers	75	78	8	\$30.73	1.20
19-3099	Social Scientists and Related Workers, All Other	129	154	18	\$38.92	1.52
19-4041	Geological and Petroleum Technicians	143	157	16	\$28.70	1.12
19-4091	Environmental Science and Protection Technicians, Including Health	121	148	19	\$22.63	0.88
19-4099	Life, Physical, and Social Science Technicians, All Other	461	689	91	\$28.26	1.10
23-1022	Arbitrators, Mediators, and Conciliators	110	115	5	\$26.20	1.02
25-0000	Education, training, and library occupations	34,777	39,599	3,860	\$26.06	1.02
27-3031	Public Relations Specialists	3,589	4,200	466	\$30.03	1.17
29-9011	Occupational Health and Safety Specialists	779	947	66	\$34.83	1.36
41-3031	Securities, Commodities, and Financial Services Sales Agents	3,133	3,649	374	\$36.71	1.43
41-3099	Sales Representatives, Services, All Other	10,676	12,663	1,676	\$26.12	1.02
41-4011	Sales Representatives, Wholesale and Manufacturing, Scientific Products	6,714	7,183	776	\$49.58	1.93
Total		126,508	143,904	14,142		

Appendix 4: Austin's Maintenance and Repair Economy

The demand for recycling and higher forms of diversion, such as reuse or repair, is essential to reduce waste streams and their negative environmental impacts, including greenhouse gas emissions. The circular economy strategies discussed in this report focus on keeping and using materials at their highest and best use for as long as possible. This currently involves reducing, reusing, repairing, sharing and recycling products and materials as much as possible. In the future focus will be directed to: redesigning materials and products to be less resource-intensive; extending product life cycles by increasing the repair and upgrading of products for extended use or resale; and expanding product sharing or increasing utilization rates of products by creating new platforms for shared use or ownership.

Extending product life cycles by making products easier and more economical to repair and upgrade is a crucial element of reducing waste streams and environmental stresses over time. We can move away from a “throw away” culture by making our household goods and devices easier and more economical to repair and upgrade and our household appliances economical to repair. In terms of local economic development, expanding maintenance and repair to extend lifecycles stimulates local jobs in many sectors of the local economy relative

to buying new products made elsewhere.

In light of this, a number of occupations in both our core and expanded green job estimates include maintenance and repair activities. However, we did not include certain maintenance and repair activities in our estimates, and in most of the occupations included, the greenness ratio was less than one. There is one main reason we limited our green job estimates in the areas of the maintenance and repair economy.

In a number of cases a product's life cycle is such that product replacement can have superior environmental outcomes than continued maintenance and repair. If we consider the resources and energy consumed in the production of a good, the operation of a good, and the disposal of a good, replacement after a certain period reduces overall life-cycle environmental costs. This is true of replacing appliances with high operating energy consumption with new Energy Star rated appliances such as refrigerators or washing machines that consume significantly less energy and water.^{lviii} This is also true of motor vehicles where 75% of GHG production is related to fuel consumption, not the production of the vehicle.^{lix} Also older cars tend to have higher levels of other tailpipe emissions. Hence, maintenance of a 12 year old car or big truck could hardly be considered green. This relationship between the environmental costs of production versus operation of a product also holds for a range of other equipment such as outdoor power equipment and industrial machinery and even medical equipment. On the other hand, textiles, furniture and small kitchen appliances can substantially extend their life spans and usefulness through stronger commitments to maintenance and repair.

To get a sense of the employment and wage structure in the overall maintenance and repair economy, we estimate jobs and job growth in Travis County in the broader sector in the table below. As circular economy activities expand through consumer demands and increased incentives and regulation, the broader set of maintenance and repair may experience significant greening.

The Broad Maintenance and Repair Sector - Travis County

Occupation Code	Occupation Title	Employment (2018)	Employment (2028)	Annual Job Openings (2018-2028)	Wage rates (2019\$)
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	2,062	2,378	236	\$32.11
49-2011	Computer, Automated Teller, and Office Machine Repairers	1,005	1,135	127	\$18.43
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	300	345	32	\$27.61
49-2098	Security and Fire Alarm Systems Installers	607	702	88	\$22.63
49-3011	Aircraft Mechanics and Service Technicians	462	515	45	\$30.63
49-3021	Automotive Body and Related Repairers	542	659	69	\$21.00
49-3022	Automotive Glass Installers and Repairers	291	370	40	\$17.99
49-3023	Automotive Service Technicians and Mechanics	2,958	3,224	328	\$25.64
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	782	876	86	\$24.30
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	564	655	70	\$24.65
49-3053	Outdoor Power Equipment and Other Small Engine Mechanics	270	300	31	\$19.86
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	918	1,058	111	\$21.25
49-9041	Industrial Machinery Mechanics	911	1,095	110	\$26.08
49-9043	Maintenance Workers, Machinery	224	264	26	\$21.67
49-9051	Electrical Power-Line Installers and Repairers	261	323	31	\$31.12
49-9052	Telecommunications Line Installers and Repairers	792	961	114	\$24.73
49-9062	Medical Equipment Repairers	313	361	40	\$22.78

<i>Occupation Code</i>	<i>Occupation Title</i>	<i>Employment (2018)</i>	<i>Employment (2028)</i>	<i>Annual Job Openings (2018-2028)</i>	<i>Wage rates (2019\$)</i>
49-9071	Maintenance and Repair Workers, General	7,052	8,230	859	\$18.35
49-9091	Coin, Vending, and Amusement Machine Servicers and Repairers	115	129	15	\$14.85
49-9098	Helpers--Installation, Maintenance, and Repair Workers	563	678	91	\$14.28
49-9099	Installation, Maintenance, and Repair Workers, All Other	456	549	63	\$22.16
51-6031	Sewing Machine Operators	495	508	57	\$11.65
51-6052	Tailors, Dressmakers, and Custom Sewers	219	267	37	\$13.94
51-7011	Cabinetmakers and Bench Carpenters	324	353	38	\$16.22
51-7021	Furniture Finishers	50	51	5	\$13.54
Total - Maintenance and Repair Economy		22,536	25,986	2,749	

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- ii This living wage estimate is from The Massachusetts Institute of Technology Living Wage Calculator for Travis County (for 2021) <https://livingwage.mit.edu/counties/48453>
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- v Pollin, Robert, Garrett-Peltier, Heidi, Heintz, James, Scharber, Helen. 2008. *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*, Center for American Progress, Washington D.C.
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- ix Ibid. Specifically, the O*NET green jobs taxonomy identifies three types of green jobs:
Green New and Emerging: new occupations that are created to meet the demand of green economy technologies and activities; Green Enhanced Skills: existing occupations that are undergoing significant change because of green economy technologies and activities. Green Increased Demand: existing occupations are in higher demand because of green economy technologies and activities, but the job task and worker requirements are unchanged. One issue with this approach is that the jobs under the green demand category are counted as zero. For example, initiatives on public transit projects will increase the demand for bus drivers. Bus drivers contribute to the reduction of greenhouse gas emissions to some extent but do not count as green jobs
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- xi This measure is based on an estimate of the average years of formal education of workers in two digit occupations. The average years of education for workers in SOC 11-29 41 is estimated as 15.5. The average years of education in SOC 31-39, 43-53 is 12.4. See also Vona, F., Marin, G., & Consoli, D. 2019. "Measures, drivers and effects of green employment: Evidence from US local labor markets, 2006-2014," *Journal of Economic Geography*, Vol. 19, Issue 5, p. 1030.
- xii This finding is consistent with the analysis of Muro et al. 2019. They find that "The clean energy economy workforce is older, dominated by male workers and lacks racial diversity when compared to all occupations nationally." See Muro, M, Tomer, A. Shivaram, R. and Kane, J. 2019. *Advancing Inclusion through Clean Energy Jobs*. Washington D.C.: Brookings Institution, page 5. However, the workforce is substantially less diverse in fossil fuels industry than the green occupational mix. In coal .oil and gas extraction and support industries, "women account for only 5.2 percent of overall employment in the coal industry, 18.3 percent in oil and gas extraction, and 13.2 percent in all mining support activities. African Americans accounted for only 1.5 percent of employment in coal, 3.5 percent in oil and gas, and 6.1 percent in support activities" see Pollin, Robert and Callaci, Brian. 2019. "The Economics of Just Transition: A Framework for Supporting Fossil Fuel-Dependent Workers and Communities in the United States," *Labor Studies Journal*, Vol. 44(2), page 95.
- xiii U.S. Census Bureau. 2022. 2019 ACS 5-year Estimates, <https://data.census.gov/cedsci/table?q=Austin,%20TX&t=Educational%20Attainment&tid=ACSST5Y2019.S1501>
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