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EVSE Worker Co-Operative in Crenshaw: A Feasibility Study

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EVSE Worker Co-Operative in Crenshaw: A Feasibility Study

A comprehensive project submitted in partial satisfaction of the requirements for the degree Master of Urban & Regional Planning

Antonia Izuogu • 2023

Client: Worker Ownership Resources and Cooperative Services/

Downtown Crenshaw Rising

Faculty Advisor: Chris Tilly, PhD



UNIVERSITY OF CALIFORNIA
Los Angeles

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A Feasibility Study

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Master of Urban and Regional Planning

by

Antonia Izuogu

Client: Worker Ownership Resources and Cooperative Services/ Downtown Crenshaw Rising
Faculty Chair of Committee: Chris Tilly, PhD

2023

DISCLAIMER

This report was prepared in partial fulfillment of the requirements for the Master in Urban and Regional Planning degree in the Department of Urban Planning at the University of California, Los Angeles. It was prepared at the direction of the Department and of [insert client name] as a planning client. The views expressed herein are those of the authors and not necessarily those of the Department, the UCLA Luskin School of Public Affairs, UCLA as a whole, or the client.

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Executive Summary

Introduction

This project is a feasibility study of electric vehicle charging station manufacturing and electrician businesses. My client, Downtown Crenshaw Rising/Worker Ownership Resources and Cooperative Services has a vision of creating a hub of Black led-and -controlled cooperatives in the Crenshaw and South Los Angeles area of industries that maintain sustainable growth, pay livable wages, and operate under eco-friendly standards. Crenshaw is a predominately Black community with below-average household income and above-average poverty levels compared to overall the City of Los Angeles. My research is an extension of the cooperative research completed by the 2022's UCLA MURP group collaborative capstone project. The overall research question is: What is the feasibility of establishing and maintaining a manufacturing worker-owned cooperative in the Crenshaw District and South Los Angeles area? This report details the literature review, methods, findings of each sector, conclusion, and summary of recommendations.

Literature Review

Existing literature supports the significance of cooperatives and process of sectoral analysis. Cooperatives are a practice of community-wealth building utilizing a shared ownership business model. Black communities have a history with cooperatives, typically used out of necessity in the past as alleviation from racial discrimination practices or support through communal poverty. In the present day, people have shifted the use of cooperatives from a necessity to advancing an economic system that does not cause harm to people or the environment, a solidarity economy. Although cooperatives offer several benefits, educating member owners is essential to the business success. I conducted sectoral analysis on the electric vehicle charging station and electrician industries. Sectoral analysis examines several aspects of an identified sector to draw a larger picture. I assessed the following sectors, Electrical Equipment, Appliance, and Component Manufacturing, and Electrical Contractors and Other Wiring Installation Contractors.

Methods

I used a quantitative data, secondary literature, and expert interviews to research each sector. I identified the NAICS code for each sector, and used the codes to access federal databases such as U.S. Bureau of Labor Statistics, the U.S. Census Bureau, etc. Electric Vehicle Charging Stations, technically known as Electric Vehicle Supply Equipment (EVSE), connect electric vehicles to the power grid to fuel the vehicle's battery. EVSE does not have a clear North American Industry Classification System (NAICS) code. NAICS codes organize industry-specific quantitative data. The NAICS code 335999, All Other Miscellaneous Electrical Equipment and Component Manufacturing is the most relevant classification to the production of EVSE. Without a definite NAICS Code, finding specified data was challenging, when using government databases or other data sources that use NAICS codes to disaggregate sector data. The NAICS code for electricians is 238210.

The remaining sources were secondary literature found through online searching. Such sources including industry reports, company profiles, supply chain information, etc. In addition to online data, I interviewed experts in the EVSE field for manufacturing and electrician insight. I spoke to professionals throughout the EVSE industry, such as professionals working in the

clean transportation technology industry, a grant writer for an off-grid energy storage manufacturing business, a business owner creating software for charging station repair, grant representatives, electrician cooperative worker-owners and labor policy researchers. Their knowledge and advice provided a new perspective and expanded my research scope.

Findings

EV Charger Manufacturing

My client was interested in the manufacturing sector prior to me starting my feasibility study. Originally, my project was to research multiple industries within the sector, including baked goods, pre-fabrication housing materials, aerospace and defense, and electric vehicle charging stations. I started my research journey with electric vehicle charging stations and my investigation took so long that I followed through with completing a detailed a report on this industry rather than complete shallow reports on the other industries. Additionally, manufacturing electric vehicle charging stations was a primary interest to my client due to the Infrastructure Investment and Jobs Act, mentioned in the “Growing Need and Government Support” section.

Background

Electric vehicle charging stations are either for home use or publicly accessible units. As of November 2022, there were over 56,256 electric vehicle charging stations totaling around 148,000 charging ports in the United States, 52,000 were public stations, and the rest were residential stations¹. Typically, residential units are Level 1 AC charging or Level 2 AC charging, which charges slower than DC charging. Level 1 AC (Alternating Current) charging could take over 20 hours to fully charge an electric vehicle, most suited for personal/home charging stations. Level 2 AC charging fuels vehicles faster than Level 1. Level 2 AC charging could take an average of five to six hours to charge a car. Level 2 charging stations can be found at work establishments and multifamily residential areas.

Energy in the power grid flows at an alternating current. Electric vehicle (EV) batteries require a direct current (DC) to refuel. AC charging is a slower charge than DC charging because the EV has to first convert the current direction from AC to DC power before charging the battery. Public charging stations are usually DC charging options found at public access charging stations and retail environments, with charging lengths between 15 to 45 minutes.

To use a publicly accessible charging station, the vehicle owner has to utilize a charging network. A charging network is a company that either manufactures EVSE and owns the charging station units, or solely operates the network technology for partnering station manufacturers and requires customers to own a membership to access their operating network to charge their car. Customers primarily use the network to pay charging fees, get help with station maintenance and locate nearby stations.

¹ (USAFacts, n.d.)

Findings

There are only two EVSE manufacturers in the Los Angeles region, which may be good or cautionary news.

Andromeda Power, LLC, and Tritium Technologies LLC have manufacturing facilities in the City of Long Beach and Torrance, respectively. Under the NAICS code 335999, there are only 23 EVSE manufacturing establishments in LA County in 2021. The small number of establishments is likely a result of the high capital intensity in this industry. The average cost of commercial property, production equipment, and other expenditures electric vehicle charging station manufacturers have was not transparent in my industry search. I did find Beam Global, a San Diego-based EVSE supporting equipment manufacturer, pays \$52,000 in base rent for its 53,000 sq ft facility. The capital intensity of this sector may be one barrier to more EVSE manufacturers. But if the capital becomes available, the little local competition can be advantageous to components parts to larger EVSE manufacturers or having fewer local competitors producing whole charging stations.

The manufacturing supply chain is not transparent, making it difficult to assess whether manufacturing whole stations or subcomponents is ideal for the client.

Researching the details of the supplies and production of electric vehicle charging stations was complicated and not clear. I did find the basic conversion of power that fuels the electric battery beginning with connecting to the power grid, or an alternative power source. The most popular electric vehicle charging stations are residential and public charging units. The residential units usually charge batteries with AC and the car battery converts the energy to DC. Most public chargers are fast charging meaning they convert AC to DC within the station, which cuts the time it would take for the EV to convert the current direction. Charging stations also have internal technology to display messaging, take contactless payments, switch on and off receiving energy from the power source, take the temperature of the surrounding environment and other features for smooth operations. The stations, such as most electronics require semiconductors and circuit breakers which are under a global shortage but improving as of now.

This hardware requires minerals such as copper, steel, and iron. The demand for copper will increase as the production of charging stations rises. Rectifiers and other components of EV chargers require ferrous metals (steel and iron). EVSE manufacturing companies should be aware of the need for such minerals and how their shortage can affect production lines. The shortage of minerals can arise from tariff barriers, dependence on the availability of minerals from foreign countries mined minerals, and required alignment with the Build America, Buy America Act of 2021 (discussed later in this summary section).

Existing manufacturers are facing limitations because of the supply chain.

Existing manufacturers are experiencing obstacles to reaching their ideal success, whether because of dependence on other companies' production and capacity needs, etc. Blink Charging Co. is a Florida-based company that owns, operates, and provides electric vehicle charging equipment and networked charging services. Blink Charging receives its EVSE from a manufacturing company located in Taiwan. But the company acquired SemaConnect, an EVSE manufacturing company based in Maryland, in 2022 and is

expanding the American facility to produce an additional 13,000 chargers to its current capacity. Three major challenges company faces are maintaining a business relationship with its Ukraine supplier, relying on a limited number of vendors for its EVSE manufacturing, and paying tariffs that affect the production of EVSE. Any or all these factors can affect business operations.

Beam Global also believes tariffs can affect its production. Its only supplier is exempt from tariffs, but if something happened to that international company or if tariffs were put on EVSE-relevant surging imports, their operations would be significantly impacted. Beam Global is considering outsourcing some of its fully in-house production, to help increase its production capacity. Although Tesla, Inc., a Texas-based company, vertically integrated throughout the creation, use, and maintenance of its battery electric vehicles and energy generation and storage systems products. The Gigafactory located in New York specifically manufactures the company's EVSE, while the company's other products are manufactured in six other facilities across the country and globe. Any delays in production within the “limited” number of facilities could affect their business, financial condition, and operating results.

The need for electric vehicle charging stations is growing nationally, and federal dollars are flowing to support its production, largely in California.

The demand for electric charging vehicle stations is growing, especially with the Biden signed Infrastructure Investment and Jobs Act (IIJA) in 2021. IIJA calls for federal funding to support a large range of infrastructure projects but including electric vehicle charging projects, under the implementation of the Department of Transportation. The federal government funneled \$300 million for the fiscal year of 2022 and is to increase by \$100 million every fiscal year ending in 2026 with \$700 million. California is expected to receive a total of 41.9 billion. The law offers two opportunities for eligible entities/applicants to apply for project funding, regarding electric vehicle charging, either through the Corridor Charging Grant or Community Charging Grant. The corridor grant applicants must prioritize producing electric charging infrastructure along the alternative corridor highways, which is an interconnected web of national highways, to connect consumers to charging while traveling. Grant recipients must consider the collaborative engagement needed with stakeholders to carry out the project regarding coordinated investment between public and private interests, deployment of the infrastructure, security of personal privacy, and the trained workforce needed to construct and install the charging infrastructure. The community grant calls for electric vehicle infrastructure to be placed in publicly accessed locations including, but not limited to, public roads, parking facilities, public roads, public schools, and public schools. Projects placing charging infrastructure in rural areas, low and moderate neighborhoods with a low ratio of private parking space to households, or a higher ratio of multi-unit dwellings to single-family houses are given priority.

All IIJA-funded projects must meet the Build America, Buy America Act, which aligns with the Buy America laws promoting domestic content procurement preferences. The sourcing requirements of IIJA projects should use only iron and steel produced in the United States, and American-made manufactured products and construction materials. A waiver option is available under three circumstances: the procurement preference is inconsistent with the public interest, there are types of iron and steel, manufactured

products or construction materials not produced in America at adequate amounts, or adherence to the procurement preference will increase the project cost by more than 25%. Kevin M. Dempsey, President and CEO of the American Iron and Steel Institute, wrote a memo to the Federal Highway Administration in opposition to the Build America, Buy America Requirements for Electric Vehicle Chargers claiming there is enough steel produced in America for coming projects (Dempsey, 2022).

Large business grants and loans are available, but many need external help to qualify for financing.

The Department of Energy (DOE) and California Energy Commission (CEC) are funding EVSE manufacturing projects to increase the number of available charging infrastructures to consumers. The DOE offers the Advanced Technology Vehicles Manufacturing Loan Program, which includes manufacturing electric and alternative fuel vehicle charging infrastructures. The program is a low-cost debt capital program with \$17.7 billion in funding. Past recipients are Ford Motor Company, Nissan North America, Tesla, and Ultium Cells, LLC. The CEC has a past grant named Zero-Emission Transportation Manufacturing under the state agency's Clean Transportation Program. The \$25 million grant funded “in-state manufacturing of zero-emission vehicles (ZEV), ZEV components and batteries, and ZEV charging or refueling equipment”². The grant requires a match share of the awarded amount, meaning the applicant must have the funds to match what amount they receive from the CEC. Match contributions can be monetary, whether from the recipient’s available funds or a subcontractor or third party, or equivalent non-cash contributions. ChargePoint, Inc, a California-based charging network, won an award of over \$14 million for their “The ZEV Charging Manufacturing Project: Creating and Scaling Production Lines in California” project.

As for local options, the Local Initiatives Support Corporation organization in Los Angeles (LISC LA) has a few funding opportunities for local businesses. LISC is a nationwide community development financial institution, and one of its thirty-eight offices is in the City of Los Angeles. The office offers three small business loans under its Economic Development Lending Products: Permanent Working Capital Loans, Acquisition/Leasehold Improvements/FF&E Loans, and Commercial Real Estate Loans. All three loans require the applicant’s business to have been in operation for at least two years when applying. When the cooperative matures, it is eligible for these loans which range from \$100,000 to \$5,000,000 to support day-to-day operations, purchasing facility equipment, and large purchases such as leasing or buying property. LISC LA is distributing \$20 million of a fund from Wells Fargo called the ABC program. One of the program goals is to “create opportunities for cooperative ownership and alternative wealth-building vehicles” through acquisition assistance, growth capital, micro-loans, and grants³.

Most funding opportunities award established companies with some time experience. One expert I interviewed suggested the WORCS workgroup emphasize how they will de-risk their status as a new business in their funding application and pitches, for example by engaging with experienced persons. I created a power map of key persons and groups that will likely support or oppose this cooperative receiving government

² (California Energy Commission, 2022)

³ (LISC LA, n.d.)

funding opportunities. I selected the supporters due to their support of cooperative businesses, manufacturing jobs, interest in EVSE, and/or overall support of workforce development in minority communities. The opponents are established EVSE manufacturers or electric vehicle charging network companies that have either received government funding or would generally feel the client's business will be a competitor to their business. Experienced supporters would likely be the United Steelworkers Local 675, which has electric bus manufacturing workers, who have exposure to the electric vehicle industry likely including charging infrastructure as well. As well as the City of Los Angeles' Economic & Workforce Development, which has connections to vocational training and workforce development that can show worker-members are qualified to work in electric vehicle charging manufacturing. These first steps can help de-risk the investments agencies are willing to provide if they see the steps taken to build the cooperatives' credibility.

Feasibility

As of now, I think the feasibility of the WORCS workgroup creating a manufacturing cooperative to produce electric vehicle charging stations is very low. The two primary barriers to the cooperative's success are available capital to fund operations and lack of experience in EVSE manufacturing. Most agencies are willing to fund seasoned companies. The materials needed to produce chargers are not clear, but insight from industry analysts may help clarify the supply chain.

On the other hand, the WORCS workgroups have a few factors that give them a competitive advantage. First, the future cooperative will be a Black-led and Black-controlled cooperative business. Some funders may prioritize investing in minority businesses, especially those creating green jobs. Workforce development in cleantech is a big movement. Also, how few local EVSE manufacturers is good, if the cooperative is looking to service local businesses with stations or their components. But knowledge of the local needs is essential. And lastly, working as a cooperative to share the risk amongst multiple people is a true practice of a solidarity economy.

Recommendations

Primarily, I recommend the WORCS workgroup considers starting a cooperative that tends to the installation, maintenance, or training provider installation and maintenance of electric vehicle charging stations. Manufacturing is a capital-intensive sector. I believe starting a cooperative in a different point of EVSE usage could be a less capital-intensive field to get acclimated and network within the EVSE industry, given the current absence of operational experience the cooperative has in electric vehicle charging station manufacturing. Installing electric vehicle charging stations is a necessity.

Secondly, I would suggest that if the WORCS workgroup wishes to continue to pursue a manufacturing option, it consider being a subcontractor for an established company. Such partnerships will give the cooperative consistent work and learn all that goes into the production line for electric vehicle charging manufacturing and its components. For example, Beam Global is hoping to expand its production capacity by outsourcing some of its in-house production. The company will likely share what machinery and materials are needed to produce their products at their preferred quality. The cooperative could try to partner with Beam Global and produce some of the

components of its EVSE equipment. The partnership would benefit from its interstate relationship. After getting experience as a component manufacturer for an established company, the cooperative can expand its production as either an independent contract manufacturer or produce its own designed charging stations.

EV Charger Installation and Maintenance

My research pivoted after concluding the low feasibility of my client opening an electric vehicle charging station manufacturing business. I believed having an electrician cooperative was more feasible plan. The following information is not a full sectoral analysis but identifies key knowledge about the electrician sector to understand the viability of it being a possible cooperative within the greater hub.

Background

Electricians are usually called to fix broken charging stations. But electric vehicle charging station technicians can fix stations as well. Electricians have other electrical equipment to tend to, so specified technicians can get stations back in operation faster. Such technicians make \$80,000 annually or \$39 per hour. Installers make more money depending on the charging station level. Level 1 installers can \$1,000-\$1,700 per station, \$1,200-\$2,000 per Level 2 station, and around \$50,000 for each Level 3 station⁴. I could not find the exact number of electricians within Crenshaw nor the South Los Angeles area. Amateur and existing electricians maybe interested in joining the electrician cooperative, given the potential pay in installing and maintaining stations and access the benefits of cooperative businesses.

Skill Requirements

Electricians are required to have a range of skills to conduct their jobs accurately and safely, including the

- Ability to read blueprints and other documentation such as wiring rules and electrical plans.
- Extensive knowledge of electrical systems and wiring, basic electrical theory, and safety measures.
- Ability to use hand tools and power tools.
- Proficient in the use of test meters and other diagnostic equipment
- Excellent analytical and problem-solving skills, including mathematical skills.
- Capability to see color to discern color-coded wiring.

Training Opportunities

State certified electricians are required to pass the state certification test with 8,000 hours of supervised on-the-job experience. People wanting to become electricians can use a couple of routes to accomplish certification, either as an electrician trainee or apprenticeship. Before choosing a route, amateurs can utilize pre-apprenticeships programs for help preparing for the state exam or as an introduction to the electrical field to confirm their

⁴ (Courtney, 2021)

interest before continuing the path to becoming an electrician, which can take years. Los Angeles Cleantech Incubator, LACI, is offering an Electric Vehicle Supply Equipment (EVSE) Technician Fellowship, and a Project Management Training Course to train technicians and those looking to manage EVSE maintenance projects under LACI's Green Jobs Workforce programming⁵. The fellowship helps low-income people learn about the industry and connect them to jobs, but further education is needed to become an electrician.

Electrician trainees are required to complete 720 hours of instruction in a state-recognized school to prepare for the State Electrical Certification test. There are local programs that can support electrician trainees like the Los Angeles Trade-Technical College (LATTC) with its Electrical Construction and Maintenance curriculum. Trainees must complete the 8,000 hours of experience, while enrolled in school.

Another route to certification is completing a professional association-run apprenticeship program. An apprenticeship provides more guidance for apprentices but requires an application process with possible waitlisting. Unions, such as International Brotherhood of Electrical Workers Local 11, also offer apprenticeships, but can be competitive to join. IBEW 11 has free trainings and beneficial connections for such as new cooperative. But I would advise my client to be cautious when entering a relationship with a union.

Once an electrician is certified, they can complete the Electric Vehicle Infrastructure Training Program (EVITP) to be certified to install and maintain electric vehicle charging stations. The twenty hours technical course is a product of a "collaboration of industry stakeholders from the private sector and educational institutions", and the sole provider of licensing electric vehicle technicians (Federal Highway Administration & U.S. Department of Transportation, 2022). This additional state certification is what worker-owners of the electrician cooperative should strive to obtain, in addition to more general electrician training.

Funding for Obtaining Training & a Business

The California Workforce Development Board offers the High Roads Training Partnerships: Resilient Workforce Program (HRTWP). The program grants are awarded to collaborations that bring together employers, employee representatives, and training providers, to "fund training partnerships with high-road employers to directly increase the number of skilled workers from underserved populations in high-quality jobs in the priority sectors" (California Workforce Development Board, n.d.- b). Three grants are available on a quarterly basis for projects in phases of planning and development, implementation, or expansion, starting at \$500,000 to \$15,000,000 (Griseta, n.d.). Jesse Flores, a representative of the HRTWP, told me the program is looking to expand its funding to cooperatives, meaning this program is ideal to apply to fund the training for all worker-owners, whether an amateur or certified electrician missing the EVITP training.

The LISC LA financial products and ABC program, from the manufacturing section, are also available to an electrician business. But these funding opportunities requires at least two years of operational experience. Exploring the conversion of an existing electrician business will likely strengthen the cooperatives opportunities to access greater funding

⁵ (LACI. n.d.)

because they can take over an established business, ideally with years of experience to bypass barriers to obtaining capital if starting as an inexperienced business.

Feasibility

I believe an electrician cooperative is more feasible than a manufacturing cooperative for the client for prompt operations, especially with already licensed worker-owners. But the cooperative's feasibility depends on a few components. One, member-owners need to be trained properly to install and maintain charging stations. Two, the cooperative should use its competitive advantage as a marketing tool to gain customers. The cooperative will be a Black-led and -controlled cooperative in a white and male-dominated industry but should try to prioritize recruiting Black women worker-owners. The electrician field is white and male-dominated. Three, capital is crucial for the cooperative to begin operations. Accessing capital for training and operations are separate needs.

Recommendations

I recommend my client move forward with an electrician cooperative. Becoming an electrician can take years to accomplish, so I strongly suggest, after getting member-owner interest, the client explores buying an existing electrician company.

Hosting listening sessions is crucial to the success of the client strategically creating a hub of cooperatives within Crenshaw and the South Los Angeles area. The session moderator should survey what existing skill sets attendees have to better translate their expertise and job experiences into potential business ideas. The knowledge of existing skill sets on an individual level can also note what areas of skills are absent but ideal for more quality industry jobs. Third, for focused inquiry, the sessions can also act as exploratory meetings for certified electricians and intrigued residents on their attitude towards joining a cooperative. Time should be reserved to give a brief but digestible explanation of what a cooperative business is and how it can benefit them.

When purchasing a standing business, the cooperative may benefit from acquiring their clientele relationships and providing proof of operational years for financial support and client interest. This route would likely be most successful with a cooperative that already includes certified electricians, who can start accepting contract work as soon as possible.

I recommend a multi-generational cooperative, with existing electricians as the founding worker-owners, while beginners and others in between matriculate through the training process as electrician trainees or apprenticeships. This continuous training of worker-owners would prevent a shortage of electricians.

I project the launch of the electrician cooperative to be as soon as 2025, under ideal circumstances following this hypothetical schedule:

- Months 1-2
 - Host listening sessions and collecting worker-owner interest.
- Months 3-14
 - Facilitate cooperative education training for worker-owners.
 - Apply for funding opportunities.
 - Complete EVITP Training.
 - Locate electrician businesses that are close to closing, or open to expanding via a cooperative.
 - Create a business plan.

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- Months 15-17
 - Apply and secure all business permits.
 - Market services to potential customers,
 - Procure electrician supplies.
- Month 18 and beyond
 - Begin answering Requests for Quotes and other contract jobs.
 - Begin recruiting amateur worker-owners and start their training.

Conclusion

Manufacturing electric vehicle charging stations is a timely industry but has many barriers to entry for my client. Such manufacturing is capital-intensive and calls for operational knowledge. A more feasible, relevant cooperative for my client is installing and maintaining charging stations. The most opportune scenario is to create an electrician cooperative of certified electricians to launch operations.

Overall, my client should prioritize sharing information with the community, discussing options, and moving forward based on a broadly shared vision. I believe my client has the potential to create a strong Black-controlled and-led cooperative in a growing industry, immediately as an electrician business.

Introduction

My project is a feasibility study to guide my client on what industry to pursue as a worker cooperative business in Crenshaw and the South Los Angeles area. My client is Downtown Crenshaw Rising (DCR) and Worker Ownership Resources and Cooperative Services

(WORCS), a partner organization that created a workgroup of DCR members to build out DCR's goal of community ownership. This report is for my client to aid in their future business plans to build Black-centered and -led cooperative businesses that will maintain sustainable growth, pay livable wages, and operate under eco-friendly standards. My guiding research question is: What is the feasibility of establishing and maintaining a manufacturing worker-owned cooperative in the Crenshaw District and South Los Angeles area? What sectors would be an ideal cooperative business? And how would South Los Angeles residents feel about a manufacturing cooperative and the possibility of being employee owners?

Introduction to Crenshaw

Crenshaw is a predominantly low-income Black community in Los Angeles. Sixty-five percent of the residents in Crenshaw identify as African American/Black (DP05|ACS Demographic and Housing Estimates, 2020). Crenshaw is within the 37th Congressional District, with Culver City, Inglewood, and most South Los Angeles neighborhoods. The median age in this district is 35.3 years old. Almost 70% of district residents have a high school diploma or higher, and 27% of residents have a bachelor's degree or higher. The median household income in the Crenshaw community is \$47,230, which falls below the City of Los Angeles calculation of \$77,456, resulting in about a \$30,000 difference (U.S. Census Bureau, 2020) and (U.S. Census Bureau, 2021-b). In the Crenshaw area, zip code 90008, 20.1% of the residents live below the poverty level (U.S. Census Bureau, 2020). The large disparity in income and poverty level in Crenshaw is a strong indicator to investigate strategies for community-wealth building.

Journey with DCR/WORCS

Last summer, I was introduced to my client by members of the 2022's group collaborative capstone project. The ten UCLA students produced the "C3: Crenshaw Community Control Community Plan" report for DCR. The team wrote four reasons why worker cooperatives are an ideal implementation in Crenshaw. The reasons are worker cooperatives present the opportunity to develop sustainable, high-quality jobs, worker cooperatives are Black self-determination in action when developed by and for the historically Black community of Crenshaw, worker cooperatives build wealth tied to a racial justice lens, and development of worker cooperatives by and for the community is best (Andrade et al., 2022). The UCLA group recommended potential industries of Food/Restaurant, Health care, Construction/Property Management, and Manufacturing.

My client is developing its first cooperative business, a bakery, and restaurant, with hopes to expand into a hub of Black-led and Black-centered cooperatives in South Los Angeles. My project will assist Downtown Crenshaw Rising in assessing the feasibility of establishing and maintaining a manufacturing cooperative in South Los Angeles. I desired to expand the cooperative portion of the C3 report and help my client grow a network of local cooperatives. Lisbeth Ryder, my client representative, founded WORCS and is connected with DCR. After discussing my cooperative interest, Lisbeth and I settled that I would complete a feasibility study on a manufacturing cooperative in South Los Angeles. I informed the DCR/WORCS workgroup of my potential project. The group supported the research idea and shared the industries they would like to explore, such as food, healthcare materials, electrical charging equipment, transportation, energy, and construction materials. The overall goal is to create and maintain a

cooperative with fifty-plus employees, produce high margins, and pay high-paying wages operating under eco-friendly standards. I identified electric vehicle charging station manufacturing as a potentially promising sector and inquired down that research path. After completing more research, I deduced that this manufacturing sector is not feasible for my client. Consequently, pivoted to exploring how to create an electrician cooperative to install and maintain electric vehicle charging stations instead of producing them.

Plan of the Report

The remainder of the report includes the following sections:

- i) Literature review
- ii) Methods
- iii) Findings on EV charger manufacturing
- iv) Findings on EV charger installation and maintenance
- v) Conclusion and summary of recommendations

The literature review will detail existing literature on cooperatives and sectoral analysis. The methods section explains my methodology of how I conducted my research and utilized sources for quantitative and qualitative information. I separated my findings for the electric vehicle charging manufacturing and electric vehicle charging technicians/electricians, detailing for each the information I synthesized for my client's knowledge. The conclusion and recommendations summarize my research findings and further advise my client on how to reach their goal of strategically planning a hub of cooperatives.

Literature Review

This review will explore the significance of cooperative businesses, especially for Black communities. My client is investigating the use of cooperatives to reach its community ownership goals, and background literature supports their reasoning to strategize through shared ownership models. Also, this review discusses the basics of how to complete a sectoral analysis. Most of this project's findings were collected via sectoral analysis methods.

Cooperatives

Cooperative businesses are akin to traditional businesses but practice a governance structure of "member-owners" (University of Alaska Anchorage, n.d.). Every member has an equal share in the company, sharing the proceeds and the responsibility equally, with no hierarchy in power. Communities create shared ownership businesses to produce goods and services for their community, create local jobs, and gain high margins, amongst other reasons. There are five types of cooperatives: consumer cooperatives, worker cooperatives, producer cooperatives, purchasing cooperatives, and multi-stakeholder cooperatives (*Types of Co-Ops*, n.d.).

Cooperatives are community-driven businesses utilizing a shared ownership model to fill an identified gap in the area, whether job creation of stable jobs or providing necessary goods and services, amongst other reasons. Such development "creates quality jobs and wealth-building opportunities for low- and moderate-income workers" (Hoover & Abell, 2016). Place-based jobs creation policies, of which cooperatives are an example, "increase local employment rates, increase long-run employability and yield earnings benefits that exceed costs, affect income distribution and reduce crime and improve child

development” (Bartik, 2019). Thus cooperatives offer a list of benefits, including wealth building.

This strategy was birthed out of necessity during two explicit periods of history: the Great Depression and the Jim Crow Era. Although the well-known economic depression event is within the Jim Crow era, I will speak to the Great Depression as a catalyst for Black cooperative creation in addition to the existing racial discrimination. White-owned businesses discriminated against African Americans during Jim Crow, whether not hiring them to work at their establishments or not allowing them to purchase their goods or services. Racial equality has come a long way, but communities still find themselves intrigued by cooperatives to meet their needs. Black-owned businesses, especially cooperatives, improve their communities by overcoming racial discrimination while practicing a solidarity economy.

A solidarity economy is a “system in which everyone has their needs met in a way that does not exploit anyone or harm the environment” (Cooperation Humboldt, n.d.). Downtown Crenshaw Rising seeks to create a cooperative that provides a sizable amount of livable wage jobs and creates products with green standards. Cooperatives result in a range of benefits that create positive externalities, such as the increase in training and education of member-owners and their consumers, supporting other local businesses and business spin-offs, increasing civic participation, vocalizing changes for industry or community improvements (Gordon-Nembhard, 2006). The hub of cooperation may be a version of business spin-offs, benefiting the South Los Angeles community with a greater amount of new stable, high-quality, livable wage jobs.

For a cooperative to be successful, educating member-owners is foundational to keeping the business harmonious and functional (Nembhard, 2014). Study circles and peer-based education are educational tools for starting and maintaining cooperatives and practicing a solidarity economy.

Sectoral Analysis

A sector is “a part of the economy into which various industries consisting of a great number of companies can be fit, and is larger in comparison” (Langager, 2023). An industry is “a group of companies that operate in a similar business sphere, and its categorization is narrow” (Langager, 2023). Electric vehicle charging station manufacturing is within the manufacturing sector, and most related to the Electrical Equipment, Appliance, and Component Manufacturing industry. Electrician work is within the Construction sector.

Sectoral analysis is “an assessment of the economic and financial condition and prospects of a given sector of the economy” (Kenton, 2021). I utilized sectoral analysis skills to research electric vehicle charging station manufacturing and electrician industries learned in the UCLA Sectoral Analysis course taught by Justin McBride, a Department of Urban and Regional Planning Doctoral Student. Groups of students of two to four people worked together to research a particular sector, whereas I worked alone to analyze the electric vehicle charging station. Every two weeks, I studied and produced a section of a full report meant to answer my client’s questions and expand their knowledge of the sector. I could not find background literature on how to conduct a sectoral analysis, but the syllabus of my UCLA Sectoral Analysis course provides an outline of sectoral

analysis elements. These following elements combined to depict the big picture of the sector or industry in question and specifics of comparable companies:

- Definitions, Scale, History, Sector Significance in LA
- Industry Structure and Internal Composition of the Sector
- Markets, Customers, and Competition
- Geographical Dimensions of the Industry
- The Labor Force
- Industrial Relations
- Finances and Sources of Capital
- Ownership Profiles of Key Firms
- Government Influence and Relations
- Power Mapping

Methods

I compiled and analyzed quantitative data and secondary literature and conducted expert interviews. I assessed the compiled data for my client to interpret their feasibility of launching and operating the manufacturing and electrical cooperatives. The industry data I found allowed me to assess the outlook of each sector as a business.

Quantitative Sources and Methods

I utilized the course instruction and structure to guide my quantitative data collection. The most detailed sector within this report is Electric Vehicle Charging Station, or Electric Vehicle Supply Equipment (EVSE) Manufacturing, as it was the primary interest of the DCR workgroup. The EV Charging Station industry, as a whole, is young, making its search difficult and limited. Identifying each sector's North American Industry Classification System (NAICS) code was the primary step to investigating as it directs the focus of your research. Most data tools use NAICS code to narrow your search, such as those provided by the U.S. Bureau of Labor Statistics, the U.S. Census Bureau, etc. I used the same data sources for the electrician sector to explore electric vehicle charging station technician work. I used the U.S. Bureau of Labor Statistics and the U.S. Census to generate descriptive statistics, such as the number of jobs, average wage, number of establishments, etc. Specific to EVSE Manufacturing, I used the Security and Exchange Commission's EDGAR to read existing manufacturers' corporate filings for internal business details and USASpending to view EVSE manufacturers' government contracts for business procurement information.

Secondary Literature

Secondary literature are publications that summarize or review reports of original data and non-scholarly information, including articles, reports, and websites (Hickey, 2023). Researching manufacturing, specific to producing electric vehicle charging stations and charging station technician industries, was challenging to investigate. The manufacturing industry is dominated by large businesses that are not transparent with product supply chain, relations with sub-contracted manufacturers, and other manufacturing operation details. Information on technicians who specifically service electric charging stations is very limited, given electricians typically install and maintain stations.

I employed secondary literature to fill the information gaps after reviewing the quantitative sources and learning industry-specific details, like necessary skills, education, supply chain, typical tasks, etc. For example, I viewed existing manufacturing companies' websites for information like company location, product details, and company press releases. I used IBISWorld, an industry research online tool, and searched online for insight into this specific manufacturing sector. I utilized IBISWorld to access their industry reports for key statistics, market characteristics, industry segmentation, industry conditions, key competitors and market share, performance analysis, key success factors, and five-year forecasts and forecasts analysis. Also, I searched online for funding sources that apply to each sector from government and small business programs.

Interviews

I chose this mixed-methods, quantitative and qualitative, approach to synthesize a holistic analysis of the researched sectors. I interviewed several experts/professionals knowledgeable about cooperatives or within the sectors of interest. The interviews either confirmed found data or guided my research to expand or narrow down avenues of inquiry as qualitative data. The feedback from the expert interviews gave a different perspective on the feasibility of a manufacturing and technician cooperative. My interviewees are listed in Appendix A.

Findings

In conversation with my client, we decided I would study the manufacturing sector based on the prior UCLA group's findings. The UCLA group recommended potential industries of Food/Restaurant, Health care, Construction/Property Management, and Manufacturing. Manufacturing is a sector, but focusing on a few industries, and better yet a few industrial products will result in a more accurate feasibility study. I studied the feasibility of electric vehicle charging station manufacturing, concluding with limited feasibility. I shifted my project to research creating an electrician cooperative to install and maintain charging stations. This Findings section has a subsection on each of these sectors.

Electric Charging Stations Manufacturing

I completed this feasibility study to assess the potential success of a manufacturing cooperative by analyzing what industries would likely work best for sustainable growth and pay livable wages. The client had an interest in an eco-friendly industry, either operating a business under green standards or producing environmentally safe items. Niki Okuk had the idea to investigate the industry of manufacturing electric vehicle charging stations, influenced by her work electrifying ports. Also, a couple of members have previous experience working in manufacturing and have some technical knowledge within the manufacturing sector, but none within this industry. I focused on this industry based on the client's interest, the popularity of electric vehicles, and basic knowledge of the Infrastructure Investment and Jobs Act, which is mentioned in detail later in the report.

Electric vehicle charging stations, technically known as electric vehicle supply equipment (EVSE), connect electric vehicles to the power grid to fuel the

vehicle's battery. EVSE does not have a clear North American Industry Classification System (NAICS) code. NAICS codes organize industry-specific quantitative data. The NAICS code 335999, All Other Miscellaneous Electrical Equipment and Component Manufacturing is the most relevant classification to the production of EVSE.

Background

Electric vehicle charging stations are either for home use or publicly accessible units. As of November 2022, there were over 56,256 electric vehicle charging stations totaling around 148,000 charging ports in the United States, 52,000 were public stations, and the rest were residential stations (USAFacts, n.d.). Currently, most EVs are charged at home using relatively slow charging technology, which relies on AC electricity. The industry will expand rapidly using newer and substantially faster DC charging technology, primarily located at public charging stations.

To use a publicly accessible charging station, the vehicle owner has to utilize a charging network. A charging network is a company that either manufactures EVSE and owns the charging station units, or solely operates the network technology for partnering station manufacturers and requires customers to own a membership to access their operating network to charge their car. Customers primarily use the network to pay charging fees, get help with station maintenance and locate nearby stations.

Growing Need and Government Support

In February 2023, the Biden-Harris administration announced the federal goal to build a network of 500,000 EV chargers by 2030 across America's highways and communities, while encouraging purchases of electric vehicles and increasing domestic business presence in the industry (The White House, 2023). Currently, there are around 130,000 public chargers in the United States. Working to reach the goal of half a million will bring manufacturing and installation jobs.

President Joe Biden signed the Investment Infrastructure and Jobs Act in 2021. The act (H.R.3684 - 117th Congress, 2021-2022) calls for federal funding to support infrastructure projects for,

- “roads, bridges, and major projects;
- passenger and freight rail;
- highway and pedestrian safety;
- public transit;
- broadband;
- ports and waterways;
- airports;
- water infrastructure;
- power and grid reliability and resiliency;
- resiliency, including funding for coastal resiliency, ecosystem restoration, and weatherization;

- clean school buses and ferries;
- electric vehicle charging;
- addressing legacy pollution by cleaning up Brownfield and Superfund sites and reclaiming abandoned mines; and
- Western Water Infrastructure”.

The federal government funneled \$300 million for the fiscal year of 2022 and is to increase by \$100 million every fiscal year ending in 2026 with \$700 million. The IJA is meant to mobilize to attain the federal public charger goal by offering grants specific to charging and fuel infrastructure on highway corridors and within communities. It is estimated that California will receive \$41.9 billion in IJA funds (State of California. n.d.). IJA expenditures are required to comply with the Build America, Buy America (BABA) Act, which specifies domestic content procurement preferences. This act influences the procured materials of electric vehicle charging infrastructure. The Act’s sourcing requirements mandate projects receiving federal financial assistance, such as the IJA grants, to use only iron and steel produced in the United States, and American-made manufactured products and construction materials. All IJA-funded projects must meet the Build America, Buy America Act. The BABA Act promotes American manufacturing and related jobs but is also attracting offshored manufacturing and foreign companies to comply with and capitalize on the Buy American Initiatives.

Concentration in the Sector

There are a few key companies manufacturing EVSE, including Schneider Electric SE (France), Siemens AG (Germany), Tesla, Inc. (California, USA), Eaton Corporation (Ireland), and EVBox B.V. (Netherlands). Tesla, Inc. is generally the only major player in manufacturing electric vehicle charging stations based in the United States, as Tesla produces electric vehicles and has a unique charging port design compared to universal designs used by other car brands.

Locally, Andromeda Power, LLC and Tritium Technologies LLC have manufacturing facilities in the Cities of Long Beach and Torrance, respectively. Under the NAICS code 335999, there were only 23 EVSE manufacturing establishments in LA County in 2021. But this NAICS code is a group of miscellaneous electrical equipment and component manufacturing, so most likely only a few of the companies are producing electric vehicle charging stations.

The small number of establishments is likely a result of the high capital intensity in this industry. The average cost of commercial property, production equipment, and other expenditures electric vehicle charging station manufacturers was not transparent in my industry search. However, the sector is clearly capital intensive. The ratio of capital’s share of value, the value of sales to labor’s share, a measure of capital intensity, is 0.82 for Electrical Equipment Manufacturing, about the same as Fabric

Manufacturing and about 60% as high as in Motor Vehicle Manufacturing, but 14 times as high as Cut & Sew Apparel Manufacturing (U.S. Bureau of Labor Statistics, 2023). Another way to understand this capital intensity is by calculating the total value of a typical plant’s capital. The 2017 Economic Census (2022 Economic Census figures have not been released yet) shows average sales of an Electrical Equipment Manufacturing establishment as \$22.5 million (the average plant employs 64 people (U.S. Census Bureau, 2017). Applying capital’s 21.3% share to this sales figure shows \$4.8 million of capital a year going into output. If we multiply that figure by a rough estimate that capital takes 20 years to depreciate, we get an estimate that the full value of the average plant’s capital (land, building, equipment, inventory) is \$96 million. Of course, starting a plant with 64 people would be an ambitious target, so consider smaller businesses, those with sales of \$2.5-\$5 million per year (employing an average of 17 people): the estimated full value of capital for these smaller establishments is still \$15 million. Even plants with sales of \$1-\$2.5 million (averaging only 7 employees) have an estimated value of capital of \$7 million. In short, starting a business in this sector requires much capital investment to start production. The capital intensity of this sector may be one barrier to more EVSE manufacturers.

The location quotient of EVSE manufacturing is 0.58 in June 2022, see Figure 1 (U.S. Bureau of Labor Statistics, 2022-b). This score means EVSE manufacturing in Los Angeles County has a lower share of total employment compared to the nation. A score of less than one could imply there is room to grow, a positive indicator for potential start-ups in the sector. However, the low location quotient score may be an indicator that starting and maintaining an EVSE manufacturing business is challenging within this region. For example, Proterra, an electric bus, and EVSE manufacturer, recently moved its LA County operations in the City of Industry to South Carolina. Proterra announced its move to the East Coast to mitigate its supply chain disruptions and save on facilities’ costs (Nair, 2023).

County	Quarterly Establishments	April Employment	May Employment	June Employment	Total Quarterly Wages	Average Weekly Wage	June Employment Location Quotient
	V Λ	V Λ	V Λ	V Λ	V Λ	V Λ	V Λ
U.S. TOTAL	1,720	32,683	33,056	33,286	\$716,503,398	\$1,670	1.00
Los Angeles County, California	22	545	543	579	14,110,009	1,953	0.58

Figure 1: Quarterly Census of Employment and Wage in Los Angeles County for NAICS Code 335999 in the Second Quarter of 2022⁶

⁶ (U.S. Bureau of Labor Statistics, 2022-b)

Complex Supply Chain

There are residential and public electric vehicle charging stations but differ in charging systems. Energy in the power grid flows at an alternating current (AC). Electric vehicle batteries require a direct current (DC) to refuel. Residential charging stations utilize AC to charge electric vehicles, whereas public stations are usually power electric vehicles with DC. AC charging is a slower charge than DC charging, as the electric vehicle converts AC to DC power internally, which is slower than the conversion that DC charging stations do themselves before refueling the electric vehicle battery. Level 1 AC charging could take over 20 hours to fully charge an electric vehicle, which is why it is most suited for personal/home charging stations. Level 2 AC charging could take an average of five to six hours to charge a car. Level 2 charging stations can be found at work establishments and multifamily residential areas. Type 1/SAE J1772 or “J Plug” is a connector for Level 1 and Level 2 AC charging and is not compatible with Tesla vehicles. DC charging is usually found at public access charging stations and retail environments, with charging lengths between 15 to 45 minutes. The following information details internal technology and relevance to the supply chain of electric vehicle charging stations.

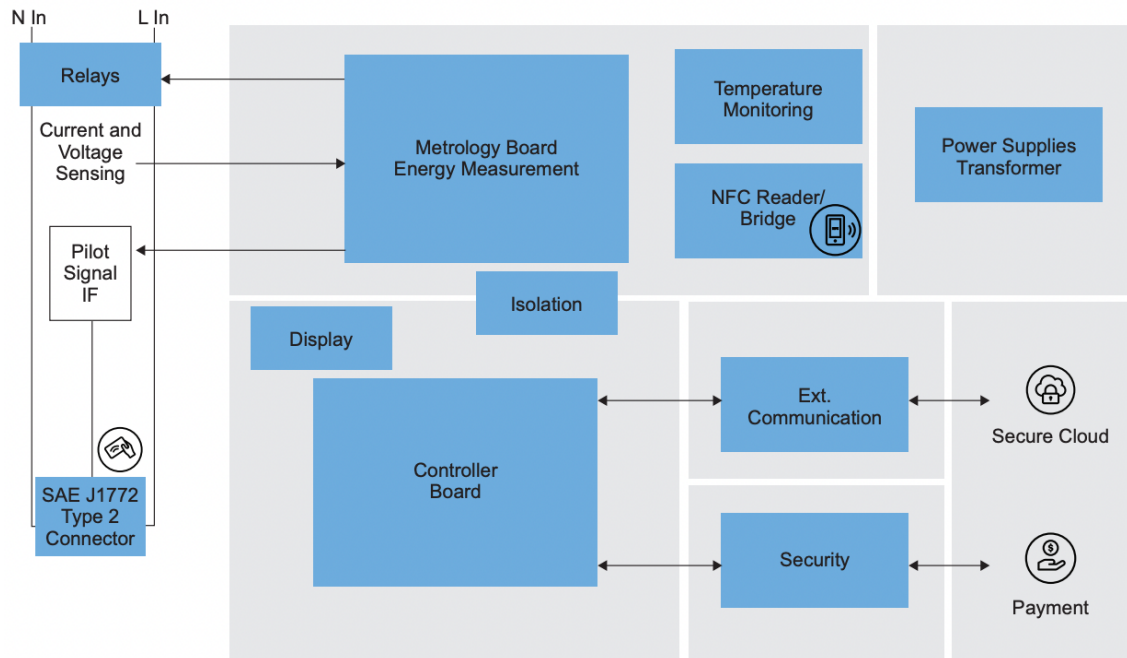


Figure 2: AC EVSE Block Diagram⁷

Figure 2 displays the flow of charge in residential/AC charging stations. The station is divided into two sections, a power socket

⁷ (NXP, 2021)

function/board, and a smart controller function/board. The process starts with power sockets function with the input of AC through the wires labeled “L In” and “N In”. The L In, known as a live wire, wire carries in the AC to the EVSE from the power source, which could be the power grid, smart grid, etc. The N In wire, known as a neutral wire, carries the AC back to the power supply. The wires are connected to relays, which is “electrically operated switches that open and close the circuits by receiving electrical signals from outside sources” (Omron, n.d.). The relay is receiving signals to either open or close the outside power source, from the Metrology Board Energy Measurement unit. The current and voltage sensing uses sensors to monitor and provide signals to the Metrology Board Energy Measurement, which measures the current and voltage to either have the relay switch on or off to control the influx of current. The Metrology Board Energy Measurement also sends signals to influence Pilot Signal IF (intermediate frequency), which controls the charging rate through the charger, in Figure 2 labeled as the SAE J1772 Type 2 Connector.

Also, the station has a temperature monitoring sensor(s) that “measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes” (Jost, 2019). The NFC (Near Field Communication) Reader/Bridge enables vehicle drivers to make contactless payment to use the station. The power supplies transformer raises or lowers the AC voltage to charge the electric vehicle.

The smart controller board is isolated from the power socket board to separate the two circuits. The controller board “is the processor which allows connection of different video source inputs to be selected and shown on a screen” (Meade, 2017). The controller board is connected to the ext. (external) communication, which is messaging between the company supplying the stations and the station user and drawn from and inputted into the secure cloud. The communications are likely promotional advertisements and user instructions shown on the station display, and station data reported to the company. The security part of the smart controller board is a secure payment mechanism.

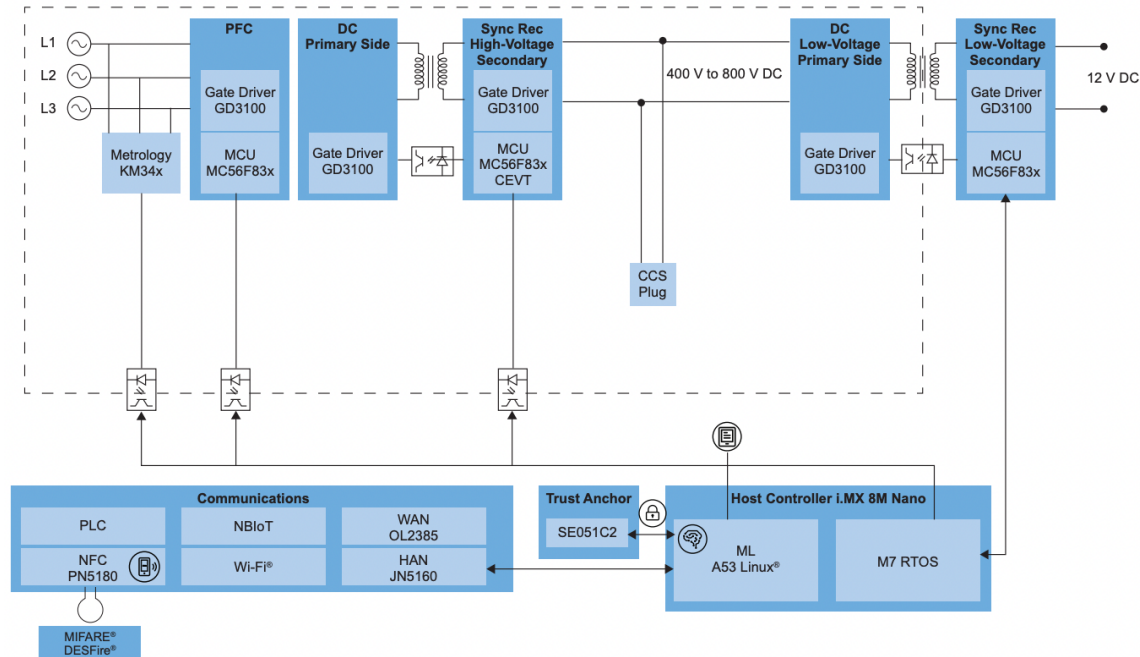


Figure 3: DC EVSE Fast Charge Diagram⁸

The federal goal to increase public charging stations are primarily DC charging stations alike to the EVSE technology in Figure 3. DC charging stations are similar in function to AC EVSE Block function, except for a few additions. The most important differences are the internal conversion of AC to DC power. And DC charging, also known as fast charging, charges electric vehicles at a faster rate because the charger has two currents inputs connecting to the car battery. The Power factor correction (PFC) corrects the AC input to draw a sinusoidal current very close to unity or one (meaning a constant rather than oscillating current), which is an ideal power factor, and benefits charger efficiency by requiring 30% less AC input equating to the same DC charging current (Sigineer Power, 2016). The synchronous rectifier converts the AC power to DC power and is connected to the CCS plug/connector with high and low DC voltage.

The supply chain needed to produce chargers was not clear from my online search. Insight from industry analysts may help clarify the supply chain. But I found relevant raw materials and hardware used in electric vehicle charging stations. The hardware requires minerals such as copper, steel, and iron. The demand for copper will increase as the production of charging stations rises. According to the International Energy Agency, copper is a “cornerstone for all electricity-related technologies”, meaning there is an increased demand for copper as electric

⁸ (NXP, 2021)

vehicle charging demand increases (International Energy Agency, n.d.). Rectifiers and other components of EV chargers require ferrous metals (steel and iron). The president and CEO of the American Iron and Steel Institute, Kevin M. Dempsey, wrote a memo (see Appendix B) to the Federal Highway Administration in response to the Build America, Buy America Requirements for Electric Vehicle Chargers. The memo explains the Institute's opposition to the proposed waiver of the requirement that a portion of the steel and iron needed for the expansion of electric vehicle chargers be imported to the U.S. EVSE manufacturing companies should be aware of the need for such minerals and how their shortage can affect production lines. The shortage of minerals can arise from tariff barriers, dependence on the availability of minerals from foreign countries, and required alignment with the Build America, Buy America Act of 2021.

Most of the technology is semiconductors and circuit boards. A semiconductor is a “a solid chemical element or compound that conducts electricity under certain conditions but not others” (Zola, 2021). Semiconductors support electronics that harness electricity for processing power. There was recently a significant global semiconductor, also known as chips, shortage prompted by multiple factors, including Intel’s chip shortage in 2018, decline in memory chip prices, shipment disruptions because of the COVID-19 pandemic, and more (Sun, 2021). The supply of chips started to recover in 2022 (J.P. Morgan, 2023). Circuit boards connect the electrical components of electronic products A circuit board “facilitates the transmission of electronic signals and ensures the proper functioning of the electronic product” (Hillaman Curtis, 2021). The pandemic and Russia-Ukraine war also affected the supply of circuit boards (Proto-Electronics, 2023). The complexity of the electric vehicle charging station components, and supply chain shortages will likely be a significant barrier to my client manufacturing stations.

Struggles of Manufacturers

Existing manufacturers face obstacles, partially due to their dependence on other companies' production capacity and needs. Blink Charging Co. is a Florida-based company that owns, operates, and provides electric vehicle charging equipment and networked charging services (Blink Charging Co., 2022). Blink Charging receives its EVSE from a manufacturing company located in Taiwan. But the company acquired SemaConnect, an EVSE manufacturing company based in Maryland, in 2022. Blink Charging is expanding its American facility to produce an additional 13,000 chargers annually beyond its current capacity. Three major challenges the company faces are maintaining a business relationship with its Ukraine supplier, who supplies Blink Charging with “certain electronic equipment”, relying on a limited number of vendors for its EVSE manufacturing, and paying tariffs on imported

inputs (Blink Charging Co., 2022). Any or all these factors can affect business operations.

Beam Global, a San-Diego based EVSE-supporting equipment manufacturing company, also believes tariffs can affect its production. Currently its only supplier is exempt from tariffs, but if something happened to that company or if tariffs were put on EVSE-relevant imports, their operations would be significantly impacted. Beam Global is considering outsourcing some of its fully in-house production, to help increase its production capacity (Beam Global, 2022).

In contrast, Tesla, Inc., a Texas-based company, is vertically integrated throughout the creation, use, and maintenance of its battery electric vehicles and energy generation and storage systems products. The Gigafactory located in New York specifically manufactures the company's EVSE, while the company's other products are manufactured in six other facilities across the country and globe. Any delays in production within the "limited" number of facilities could affect their business, financial condition, and operating results (Tesla, 2022).

My client should take heed of what existing companies are facing when considering moving forward with the EVSE manufacturing cooperative.

Availability of Grants and Loans

The US Department of Energy (DOE) and California Energy Commission (CEC) are funding EVSE manufacturing projects to increase the amount of charging infrastructure available to consumers. The DOE offers the Advanced Technology Vehicles Manufacturing Loan Program, which includes manufacturing electric and alternative fuel vehicle charging infrastructures (Department of Energy, 2023a). The program is a low-cost debt capital program with \$17.7 billion in funding. Past recipients are Ford Motor Company, Nissan North America, Tesla, and Ultium Cells, LLC. The CEC had a past grant named Zero-Emission Transportation Manufacturing under the state agency's Clean Transportation Program (California Energy Commission, 2022). The \$25 million grant funded "in-state manufacturing of zero-emission vehicles (ZEV), ZEV components and batteries, and ZEV charging or refueling equipment". The grant required a match share of the awarded amount, meaning the applicant had to have the funds to match what amount they receive from the CEC. Match contributions could have been monetary, whether from the recipient's available funds or a subcontractor or third party, or equivalent non-cash contributions. ChargePoint, Inc, a California-based charging network, won an award of over \$14 million for their "ZEV Charging Manufacturing Project: Creating and Scaling Production Lines in California."

As for local options, the Local Initiatives Support Corporation organization in Los Angeles (LISC LA) has a few funding opportunities for local businesses. LISC is a national community development financial

institution, and one of its thirty-eight offices is in the City of Los Angeles. The office offers three small business loans under its Economic Development Lending Products: Permanent Working Capital Loans, Acquisition/Leasehold Improvements/FF&E Loans, and Commercial Real Estate Loans (LISC LA, 2023c). All three loans require the applicant's business to have been in operation for at least two years when applying. When the cooperative matures, it will be eligible for these loans which range from \$100,000 to \$5,000,000 to support day-to-day operations, purchasing facility equipment, and large purchases such as leasing or buying property. LISC LA is distributing \$20 million of a fund from Wells Fargo called the ABC program (LISC LA, n.d.). One of the program goals is to "create opportunities for cooperative ownership and alternative wealth-building vehicles" through acquisition assistance, growth capital, micro-loans, and grants.

Most funding opportunities award established companies operating beyond some threshold number of years and level of experience. One expert suggested that partnerships between community-based organizations like my client and more experienced firms would be more likely to attract awards from potential funding opportunities.

Feasibility

As of now, I think the feasibility of the WORCS workgroup creating a manufacturing cooperative to produce electric vehicle charging stations is very low. There are three related primary barriers to the cooperative's success. The first is the capital-intensive nature of the business, leading to large startup costs. The second is the lack of experience in EVSE manufacturing within the Crenshaw community. The third is that this lack of experience reduces opportunities for alternative sources of capital, since most public and nonprofit agencies are only willing to fund seasoned companies.

On the other hand, the WORCS workgroups have a few factors that give them a competitive advantage. First, the future cooperative will be a Black-centered and Black-led cooperative business. Some funders may prioritize investing in minority businesses, especially those creating green jobs. Workforce development in cleantech is a big movement.

Recommendations

I have two recommendations for the client based on the barriers to entry to EVSE manufacturing. The most practical recommendation is for my client to instead consider starting a cooperative that tends to the installation, maintenance, or training provider installation and maintenance of electric vehicle charging stations. Manufacturing is a capital-intensive sector. I believe starting a cooperative in a different point of EVSE usage could be a less capital-intensive field to get acclimated and network within the EVSE industry, given the current absence of operational experience the cooperative has in electric vehicle charging

station manufacturing. See the next section for more information on this option.

Secondly, I would suggest the WORCS workgroup consider moving to become a subcontractor for an established company after accumulating capital and building knowledge and partnerships. Such partnerships can give the cooperative consistent work and learn all that goes into the supply chain for electric vehicle charging manufacturing and its components. I assume a company would likely share what machinery and materials their subcontractor would need to produce their products to maintain their preferred quality if they are not able to expand their operations themselves. The cooperative could try to partner with Beam Global and produce some of the components of its EVSE equipment. The partnership would benefit from its intrastate relationship as transporting materials between each business would cost less compared to out-of-state or international costs. After getting experience as a component manufacturer for an established company, the cooperative can expand its production as either an independent contract manufacturer or producing its own design of charging stations. But the most immediately feasible recommendation is to move forward with an electrician cooperative that specializes in installing and maintaining electric vehicle charging stations.

Electric Vehicle Charger Station Installation & Maintenance

EVSE provision does not end at manufacturing. About 370,000 charging stations are due to come by 2030 to meet the federal 500,000 station goal. These stations have to be installed and maintained. Installing electric vehicle charging stations is a necessity. Installers make more money depending on the charging station level. Level 1 installers can \$1,000-\$1,700 per station, \$1,200-\$2,000 per Level 2 station, and around \$50,000 for each Level 3 station (Courtney, 2021). Electricians are usually called to fix broken charging stations. But electric vehicle charging station technicians can fix stations as well. Such technicians make \$80,000 annually or \$39 per hour (LeVine, 2021). My client can be involved in these activities to access this level of income.

As for the next steps, I researched the path to creating an electrician cooperative, as an alternative to a manufacturing business. My client is interested in having the cooperative specialize in electric vehicle charging station technicians, but I could not find literature on the occupation as it is a specialized job within the electrician industry. However, there is research emphasizing the necessity of electricians and their relation to such charging stations.

Electricians traditionally install and repair electric vehicle charging stations, activities that fall within electricians' traditional tasks to "install, maintain, and repair electrical power, communications, lighting, and control systems" (U.S. Bureau of Labor Statistics, 2023). Electrician work is a \$239.1 billion revenue industry with \$14.8 billion in profits from 2018-2023 (Faber, 2023). There is a seven percent employment growth projection from 2021 to 2031, with 79,900 projected openings per year across the United States. In Los

Angeles County, there are 19,075 electricians with an average annual pay of \$77,086 in 2021 (U.S. Bureau of Labor Statistics, 2021).

Electricians are classified within the Utilities or Construction sectors, and within the South LA Congressional district, 149 and 5,157 people are paid employees in each of those sectors respectively (U.S. Census Bureau, 2021-a), with 9 local establishments in Utilities and 774 in Construction. These totals are likely to include electricians, though probably not all employees reside in South LA. The electrician industry may be a promising industry to explore as a cooperative business given the industry outlook and likely availability of skill sets in the South Angeles area. And an opportune venture since electrician businesses are low capital intensity but demand physical labor.

Local certified electricians may be open to joining the cooperative, while interested residents are trained. The following report shares the opportunities available to the client to pursue operating an electrician cooperative in Crenshaw with South Los Angeles worker-owners.

Skill Requirements

Electricians require a range of skills and abilities such as^{9,10,11}:

- Ability to read blueprints and other documentation such as wiring rules and electrical plans.
- Extensive knowledge of electrical systems and wiring, basic electrical theory, and safety measures.
- Ability to use hand tools and power tools.
- Proficient in the use of test meters and other diagnostic equipment.
- Excellent analytical and problem-solving skills, including mathematical skills.
- Capability to see color to discern color-coded wiring.

Training Opportunities

There are a few routes of training electricians can undergo to reach state certification. The main requirement to be certified is to pass the state certification test with 8,000 hours of supervised on-the-job experience. Some electricians-to-be choose to start with pre-apprenticeship training to understand if the electrician field is the right fit for them or prepare for the state certification content.

The Los Angeles Cleantech Incubator (LACI) is a “non-profit organization creating an inclusive green economy for the people of Los Angeles”. LACI is offering an Electric Vehicle Supply Equipment (EVSE) Technician Fellowship, and a Project Management Training Course to train technicians and those looking to manage EVSE maintenance projects under LACI’s Green Jobs Workforce programming. The incubator also provides a fellowship for youth (18-24 years old), which may be ideal for

⁹ (*Most Essential Electrician Skills*, 2022)

¹⁰ (NECA Education and Careers, 2017)

¹¹ (SHRM, 2022)

South Los Angeles youth looking for a career when recruiting member-owners for the electrician cooperative. After pre-apprenticeship opportunities, rookies can either become electrician trainees or apply for an apprenticeship program before taking the state certification exam. Once certified, electricians can work unsupervised and start independent jobs. As a cooperative, electrician worker-owners can respond to Request for Quotes from potential clients and other clients that reach out for services.

The path to becoming an electrician is a timely process of several years to become certified (Wade, 2018). There are two routes to becoming eligible to take the State Electrical Certification test, either being an electrician trainee or completing an apprenticeship.

Electrician Trainee

Electrician trainees must complete 720 hours of instruction. State-recognized schools offer programs that prepare trainees for the State Electrical Certification test. Locally, Los Angeles Trade-Technical College (LATTC) has Electrical Construction and Maintenance associate degrees and a certification program. The State of California's Department of Industrial Relations recognizes LATTC's Whole General Electrician Curriculum. The two-year Associate in Science degree will prepare trainees for the electrician certification exam (Los Angeles Trade-Tech College, n.d.). While enrolled in school, students can apply for the Electrician Trainee Card. These cards have to be renewed yearly with an annual requirement of 150 hours of trade school classes until the trainee passes the exam.

Trainees also need to complete 8,000 hours of on-the-job experience under the direct supervision of a certified electrician. Completed course instruction and supervised job experience qualify trainees to take the exam, which has a \$100 fee, to become electricians, technically called C-10 electrical contractors or journeymen electricians.

Apprenticeship

Prospective electricians can also complete apprenticeships to become C-10 electrical contractors. Unions or other professional organizations offer apprenticeship programs (Ferriere, n.d.). Apprenticeships can be competitive to enter as there are often waitlists and prerequisites to be approved entry. Applicants usually have to successfully complete a written exam, interview, orientation, and drug screening to be accepted. The following apprenticeship programs are registered program sponsors with the State of California's Department of Industrial Relations:

Trade or occupation:	Committee:
Electrician	Southern California Chapter Of The Associated Builders & Contractors Inc., Electrical U.A.C.
Electrician (Inside Wireman)	Los Angeles Electrical J.A.& E.T.C.
Electrician Construction	Western Electrical Contractors Assoc., Inc. (W.E.C.A.) Apprenticeship And Training Committee
Electrician Inside Wireman	Los Angeles/Ventura Chapter Of A.B.C. Inc. E.U.A.C.
Inside Wireman Electrician	I.B.E.W. Local Union No. 40 Los Angeles County Chapter Neca J.A.C.
Residential Wireman	Los Angeles Electrical J.A.& E.T.C.
Residential Wireman	Western Electrical Contractors Assoc., Inc. (W.E.C.A.) Apprenticeship And Training Committee
Transportation Systems Electrician	La County Intelligent Transportation Systems Electrical Joint Apprenticeship And Training Committee

Figure 3: Apprenticeship Programs in Los Angeles County¹²

The main union of electricians is the International Brotherhood of Electrical Workers union and more specifically the Southern California branch, IBEW Local 11. IBEW Local 11 has a general electrician apprenticeship program. The five-year program is free of charge but requires applicants to pass a given exam and interview. I discuss further opportunities with IBEW and unions in general under the Union Relationships section.

Electric Vehicle Infrastructure Training Program

Installing and repairing electric vehicle charging stations would be a specialty within the electrician industry. Certified electricians can continue their training through the Electric Vehicle Infrastructure Training Program (EVITP) to be qualified to install electric vehicle supply equipment, including electric vehicle charging stations. The training program is a 20-hour technical installation course with additional information relevant to customer relations and satisfaction, concluding with a final exam (“EVITP,” n.d.). In California, the training is conducted online with an in-person exam and a \$275 fee. EVITP is a product of a “collaboration of industry stakeholders from the private sector and

¹² (Department of Industrial Relations, n.d.)

educational institutions”, and the sole provider of licensing electric vehicle technicians (Federal Highway Administration & U.S. Department of Transportation, 2022). Electricians can complete a State Registered Electrical Apprenticeship program that includes EVSE-specific training as an EVITP-alternative due to the concern that the privatization of the training can cause a barrier to interested qualified electricians.

Union Relationships

Exploring the training opportunities unions offer may be feasible to the client for affordability needs. Cooperatives can also partner with unions to become union cooperatives, “where at least some of the employees are represented by a union” (Craig, 2021). Some electrician apprenticeship programs cost a fee, but utilizing the shared goals of worker empowerment and access to greater income between unions and cooperatives can be an advantage to gaining training (Ji, 2018). IBEW has a goal to get 10,000 licensed electricians EVITP-credentialed. The EVITP training is free for electricians that apply through IBEW.

Unions like IBEW 11 have existing relationships with potential clients, possible guidance within the electrician field and other benefits. However, I recommend the client be cautious when pursuing union relationships as literature (Ji, 2018) shares that though cooperative-union partnerships can be beneficial, they are often challenging, and interviewed experts confirm this assessment.

EVSE Technician Training

LACI offers an EVSE Technician Fellowship as one of their Workforce Development initiatives. The fellowship is open to person interested in joining this green job industry. Forty participants will receive training to “perform maintenance, troubleshooting, and commissioning of EVSE”, and “acquire technical knowledge, understand safety processes and procedures, and gain hands-on maintenance experience” (LACI, n.d.). Cohorts receive a free eight-week training and supplied with a paid stipend, laptop or WIFI access, meals during trainings, transportation reimbursement and access to internships and job opportunities with cleantech startups. Applicants must be 18 and older, have a high school diploma or equivalent, be a Los Angeles County resident, qualify as low to moderate income, and underemployed or unemployed. For the youth fellowship, applicants must be between 18 to 24 years old. Graduated trainees obtain the following certifications, OSHA-10 and NFPA 70-E. OSH-10 is a “basic safety and health information to entry-level workers in construction and general industry” (OSHA Education Center, n.d.). NFPA 70-E trains for “safe work practices to protect personnel by reducing exposure to major electrical hazards” (National Fire Protection Association, n.d.). Fellowships such as these are a good opportunity offering less demanding and supportive training.

Funding for Obtaining Training

The California Workforce Development Board offers the High Roads Training Partnerships: Resilient Workforce Program (H RTP RWP). The program grants are awarded to collaborations that bring together employers, employee representatives, and training providers, to "fund training partnerships with high-road employers to directly increase the number of skilled workers from underserved populations in high-quality jobs in priority sectors" (California Workforce Development Board, n.d.-b). H RTP RWP addresses training projects that intersect equity (advancing economic opportunity in disinvested groups), jobs (delivering skills for quality jobs), and climate (building economic and environmental resilience). The program prioritizes the following sectors for funding: Healthcare; Construction; Manufacturing; Forestry; Agriculture and food supply chain; Energy, utilities, and public works; Information Technology; Public Sector, including education, hospitality, and tourism.

Three grants are available on a quarterly basis for projects in phases of planning and development, implementation, or expansion, starting at \$500,000 to \$15,000,000 (Griseta, n.d.). Award grantees can re-apply for funds such as funds to implement their training curriculum and then funds to expand their project. Cooperatives act as an alternative to traditional worker representatives as worker-owners serve as employers and workers. H RTP RWP is looking to aid cooperatives in applying to meet their funding needs. This funding opportunity can help the electrician cooperative afford funds to put worker-owners through pre-apprenticeship training such as the LATTC training or pre-requisite courses necessary to prepare for apprenticeship exams. At a point where the cooperative has adequate electrical expertise, it could expand to provide certified training to prospective electricians as a state-registered apprenticeship program provider.

For additional funding, the California Workforce Development Board also offers the High Road Construction Career program that "prioritizes partnerships that link local building and construction trades councils to workforce boards, community colleges, and community-based organizations, creating structured pathways" (California Workforce Development Board, n.d.-a). This grant program focuses on supporting pre-apprenticeship programs, a good opportunity to train unskilled worker-owners from disadvantaged backgrounds.

Funding for a Business

Local funding is a possibility for the electrician cooperative. An electrician cooperative could also qualify for the LISC LA and ABC program financial products detailed within the grants and loans section for the electric vehicle charging station business. The primary concern with the LISC LA products is that they require the applicant's business to be operational for at least two years. For funding opportunities requiring operational experience, converting an existing business into a cooperative is a good option to help worker-owners overcome start-up costs.

Feasibility

I believe an electrician cooperative is more feasible than a manufacturing cooperative for the client for prompt operations, especially with already licensed worker-owners. But the cooperative's feasibility depends on a few components. One, member-owners need to be trained properly to install and maintain charging stations. The vocational programs described above will help member owners reach full certification to become electric vehicle charging technicians.

Two, the cooperative should use its competitive advantage as a marketing tool to gain customers. The electrician field is white and male-dominated. My client should consider prioritizing recruiting women into the cooperative. Only 2.4% of electricians are women in the United States, while 6.8% of electricians are Black or African American (Hannon, 2020). A Black-centered and-led electrician cooperative will add to the number of Black and women electricians. Having a diverse demographic of member-owners will help the cooperative attract customers who are seeking to patronize inclusive businesses.

Three, capital is crucial for the cooperative to begin operations. Accessing capital for training and operations is separate. Utilizing funds from the CWDB or using union programming can help train member-owners. As for operations, funds from LISC are ideal as they are a local source and cater to diverse, small businesses—but again, they only become available after two years of business operation, unless the cooperative builds on an existing electrical business.

Recommendations

I recommend my client move forward with an electrician cooperative. Becoming an electrician can take years to accomplish, so I strongly suggest, after getting member-owner interest, the client explores buying an existing electrician company.

But first, will the people and communities the cooperative is intended to benefit find this type of business and job attractive? Hosting listening sessions is crucial to the success of the client strategically creating a hub of cooperatives within Crenshaw and the South Los Angeles area. First, the listening sessions will act as a setting to hear both what businesses citizens wish to have to serve them and what jobs they wish to work for a better quality of life.

Second, the session moderator should survey what existing skill sets attendees have to better translate their expertise and job experiences into potential business ideas. Currently, the top three industries congressional district residents work in are educational services, and healthcare and social assistance; professional, scientific, and management, and administrative and waste management services; arts, entertainment, and recreation, and accommodation, and food services (U.S. Census Bureau, 2021)—although as noted above there are also groups of employees working in construction and utilities. The knowledge of existing skill sets on an individual level can also note what areas of skills are absent but ideal for more quality industry jobs.

Third, for focused inquiry, the sessions can also act as exploratory meetings for certified electricians and intrigued residents on their attitude towards joining a cooperative. Time should be reserved to give a brief but digestible

explanation of what a cooperative business is and how it can benefit them. If interest is shown, formal cooperative education and workforce development training can commence with committed worker-owners.

When purchasing a standing business, the cooperative may benefit from acquiring their clientele relationships and providing proof of operational years for financial support and client interest. One of the primary requirements for any new business, including cooperatives, is start-up funds. Starting with a developed company would make it easier to start operations as a cooperative rather than starting from scratch. This route would likely be most successful with a cooperative of certified electricians, who can start accepting contract work as soon as possible. Or subcontracting to an established business, like ChargerHelp! (CH!). CH!, a Los Angeles-based minority and women-owned company servicing electric vehicle charging stations and train their employees as specialized technicians. CH! Technicians work nationwide. My client may be able to partner with existing companies who may be short staffed and need extra hands to fill service requests.

Training should begin after gaining worker-member interest. I recommend a multi-generational cooperative, with existing electricians as the founding worker-owners, while beginners and others in between matriculate through the training process as electrician trainees or apprenticeships. This continuous training of worker-owners would prevent a shortage of electricians. It would also benefit the cooperative to have worker-owners of all ages as younger or able-bodied persons can take on more of the physically taxing tasks, while the older or physically challenged persons can do stationary or administrative work.

Next, my client should formulate a business plan that will depict how they will access the grants and loans I identified. A clear business plan will help my client apply for funding opportunities and make the case that they can make good use of capital. The U.S. Small Business Administration discusses two business plan formats: a traditional plan and a lean start-up plan (U.S. Small Business Administration, 2023). A traditional business plan has an executive summary, company description, market analysis, organization and management, service or product line, marketing and sales, funding request, financial projections, and appendix. A lean start-up plan is a simple version of a traditional business plan that is faster to draft. The elements of this plan are key partnerships, key activities, key resources, value propositions, customer relationships, customer segments, channels, cost structure, and revenue streams. Having a formal business plan will help prepare the client when applying for capital.

I project the launch of the electrician cooperative to be as soon as 2025, under ideal circumstances. For the swiftest beginnings, the cooperative should start with certified electricians as the first worker-owners and buy out an existing business. Starting with an established business and prepared technicians will allow the cooperative to start contract work and bring in revenue and profits. In the meantime, unskilled but interested South Los Angeles residents should progress with training to reach certification while creating new jobs. That training timeline will take years, so having certified worker-owners at the start will help establish the cooperative sooner. Here is a hypothetical, but plausible, timeline:

- Months 1-2
 - Host listening sessions and collecting worker-owner interest.
- Months 3-14
 - Facilitate cooperative education training for worker-owners.
 - Apply for funding opportunities.
 - Complete EVITP Training.
 - Locate electrician businesses that are close to closing, or open to expanding via a cooperative.
 - Create a business plan.
- Months 15-17
 - Apply and secure all business permits.
 - Market services to potential customers
 - Procure electrician supplies.
- Month 18 and beyond
 - Begin answering Requests for Quotes and other contract jobs.
 - Begin recruiting amateur worker-owners and start their training.

Conclusion

Manufacturing electric vehicle charging stations is a timely industry but has many barriers to entry for my client. Such manufacturing is capital-intensive and calls for operational knowledge. Presently, my client is not prepared to pursue a charging station manufacturing cooperative. A more feasible, relevant cooperative for my client is installing and maintaining charging stations. The most opportune scenario is to create an electrician cooperative of certified electricians to launch operations. Buying an existing electrician business and converting it to a cooperative with trained electricians will shorten the time it would take to train member-owners and establish a business. Although the electrician cooperative is more feasible, organizing the business will take some significant time and effort to launch, so having community priorities, funding options, potential customers, and interested and capable potential worker-owners in order are the primary objectives for a successful cooperative.

As for directions for future research, I suggest my client investigate becoming a training cooperative after obtaining years of experience and offering battery maintenance services. With the growth of the cooperative, I recommend that my client contemplate extending their technician services to train electricians-to-be as an apprenticeship program. H RTP RWP can help the cooperative expand to provide a registered apprenticeship program. I believe a training arm of the cooperative will guide more BIPOC citizens through the white male-dominated industry to access such quality jobs. In another possibility for future research, Somer Skye, previous worker-owner of the, now closed, Pacific Electric cooperative, suggested my client investigate lithium battery cell repair and recycling. Apparently, the field calls for swapping out different cells of EV cars before battery disposal and has no required certifications. The client should review the following links for more information^{13,14,15}. I think this field would be a good idea once a cooperative develops reasonable knowledge of battery cell repair, and recycling for resale could add to cooperative proceeds.

¹³ (Evergreen, 2022)

¹⁴ (Kendall et al., 2022)

¹⁵ (Markets and Markets, 2023)

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Overall, the client should prioritize sharing information with the community, discussing options, and moving forward based on a broadly shared vision. I believe my client has the potential to create a strong Black-centered and-led cooperative in a growing industry. To the extent that an electrician cooperative fits with the interests and preferences of community residents, I advise my client to put plans for an electrician cooperative in motion when ready as an important step in strategically creating a hub of cooperatives.

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Appendix

Appendix A: Interview List

I interviewed the following persons with their affiliation:

- Antonio Sanchez, IBEW Local Union 11
- Gilda Haas, L.A. Coop Lab
- Ian Elder, Jobs to Move America
- Jesse Flores, California Workforce Development Board
- Justin Knapp, All Power Lab
- Justin McBride, UCLA Sectoral Analysis Course Instructor
- Kameale Terry, ChargerHelp!
- Niki Okuk, CALSTART
- Ralph Troute, CALSTART
- Somerset (Somer) Waters, Pacific Electric
- Steve Sokolsky, CALSTART
- Omer Sohail, UCLA Labor Center CARE at Work
- Abhilasha Bhola, Jobs to Move America (Former Analyst)

Appendix B: Notice of Proposed Waiver of Buy America Requirements for Electric Vehicle Chargers (Docket No. FHWA-2022-0023) Memorandum (Attached)