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Contra Costa County Workforce Training Program Framework & Strategic Plan

Training for Electricians

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Prepared for:

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Introduction

Since the rollout of the General Motors EV1 electric car, California has been a leader in crafting policy in support of electric vehicle (EV) adoption. Today, California continues to lead the way with ambitious goals of greenhouse gas emission reduction through the electrification of the transportation sector. As the adoption of EVs has been increasing, so too has the need for electric vehicle service equipment (EVSE), for either range extension or destination chargers. EVSE is any equipment used to supply electricity to EVs, and throughout this report all electric vehicle chargers will be referred to as EVSE. EVSE may also include panel board upgrades, transformer upgrades, and any other equipment for the supply of electricity to the EV, but most commonly refers to the charging units themselves. To meet the charging demand of an increasing number of EVs in the state, Executive Order B-48-18 directs state entities to collaborate to spur the installation of 250,000 Level 2 and Level 3 EV chargers within California by 2025. This goal does not include chargers located at private residences, which are expected to be even more numerous than publicly accessibly EV chargers. Developing a plan to meet workforce training needs is an integral part of ensuring EV readiness within Contra Costa County. This workforce training program framework and strategic plan is focused on training needs for electricians within the county, to help meet the needs of increased demand for EVSE.

To develop this plan, the authors consulted with workforce development industry partners, local groups, and industry training institutions to put forth a creative approach of meeting the program goals of driving EVSE work to Contra Costa County and creating more jobs within this field for residents of the county, with special interest given to those from disadvantaged communities. Entities consulted include the California Department of Industrial Relations, representatives of the Electric Vehicle Infrastructure Training Program (EVITP), engineering firms, GRID Alternatives, local community colleges, and potential trainers from the Electrical Training Alliance (formerly the National Joint Apprenticeship and Training Committee for the Electrical Industry) and the International Brotherhood of Electrical Workers (IBEW).

The authors also engaged with commercial electrical contractors to develop an outline of a training program coordinated with policy to provide a pathway for increased opportunity in the market of EVSE installation for Contra Costa County. These partnerships have brought ideas from many different players within the electrical contractor space, providing valuable insight into best practices and goals for the training program. The authors were able to make projections of opportunity based on state policy from the California Energy Commission (CEC), the California Building Commission's accessibility standards, the California Public Utilities Commission (CPUC), and from internal mapping exercises based on National Renewable Energy Laboratory (NREL) data of regional growth of EVs and EVSE.

Options for developing a workforce program to capture the opportunity associated with this substantial build-out of EV chargers are described below.

Goals

The overall goal of this document is to provide the framework for a workforce development and training initiative within Contra Costa County to provide residents, particularly those in the electrical contracting business, with the skills and knowledge required for the safe installation of EVSE. The safer the installations, the greater the adoption of EVs. The training initiative seeks to ensure that the financial and job security benefits of providing EVSE installation services flow to local workers, particularly from disadvantaged communities. The program is also intended to provide an enticing pathway for younger vocational students, people looking to change careers, or those looking to rejoin the workforce to direct their studies towards electrical apprenticeship; the program leverages adult education programs and electrical training institutions to provide equitable access to these skillsets.

Training Needs

This section identifies needs for training to equip electricians to handle a growing volume of EVSE installations in Contra Costa County. Exploring future training needs and anticipating demand for a potential county agency-sponsored training requires an understanding of the volume of work available, how well equipped the workforce is to perform it, and other factors that may entice the existing workforce to seek training and/or factors that may entice new entrants into the workforce.

How much work is required?

The electrical work required to make Contra Costa more EV ready can be divided into (1) straightforward installations of single port Level 1 or Level 2 equipment in private residences and (2) more complex projects including multiple ports or capable of higher charging rates.

Simple residential Installations

The number of homes that will need charging will be roughly equivalent to the number of EVs anticipated in the county, which the CEC staff report "California Plug-In Electric Vehicle (PEV) Infrastructure Projections: 2017-2025" estimates as 45,873 by 2025.[1] The vast majority of these vehicles will have either a Level 1 or Level 2 charger associated with it (the CEC report estimates that 93% of the PEVs in Contra Costa will participate in residential charging). More often than not, the Level 1 chargers will plug into existing electrical circuits, while the Level 2 chargers will require an electrician to upgrade the circuit feeding the charger and install the unit. In some cases, there may already be an appropriate outlet for Level 1 charging within approximately 20 feet of the location where the EV would be parked. Using these assumptions and additional statistics about EV charging in residential settings, Table 1 estimates the quantity of home installation jobs that could be expected by 2025.

[1] California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025. https://www.nrel.gov/docs/fy18osti/70893.pdf

Table 1. Approximate number of new Level 1 and Level 2 ports likely needed in the county by 2025

Number of PEVs by 2025[2]	Number of EVs already owned as of Oct 1, 2018[3]	Number of new EVs (existing EVs are expected to already have residential charging)	% of PEVs participating in residential charging[4]	Number of residential charging participants	% of homes that have a 120V outlet within 20 feet of parking[5]	Number of Level 1 or Level 2 ports needed in residences
45,873	13,411	32,462	93%	30,190	50%	15,095

The 15,000 ports calculated above can be viewed as a conservative estimate because some percentage of the half of homeowners that do have 120V outputs within 20 feet of their parking spot may opt to install Level 2 charging for more flexibility.

Non-Residential Installations

In addition to these 15,000 installations, CEC and NREL estimate that between 3,654 and 4,601 Level 2 or Level 3 chargers will be needed in Contra Costa by 2025, as shown in Table 2.

Table 2. CEC and NREL estimates of number of destination and public charging ports needed by 2025

Workplace Level 2		Public Level 2		Fast Chargers		Total	
Low	High	Low	High	Low	High	Low	High
1195	1507	2107	2420	352	674	3654	4601

If the state reaches the goal of 250,000 public chargers by 2025, the number of non-residential charging ports could be closer to 7,500 (versus the high estimate of 4,601 in Table 2), if the county installs an amount of public charging proportional to its share of the 250,000 statewide goal (Contra Costa is roughly 3% of the total statewide population). In most cases these ports will be installed at facilities that will install multiple charging ports and will contract out the work to a company that would provide engineering services.

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[2] Ibid.

[3] EV registration data provided by the East Bay Clean Cities Coordinator.

[4] California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025. https://www.nrel.gov/docs/fy18osti/70893.pdf

[5] Office of Governor Gavin Newsom. https://www.law.berkeley.edu/wp-content/uploads/2019/06/Session-2-Barriers-and-Solutions-for-Plug-In-EV-Charging-Infrastructure.pdf

Table 3. Total amount of ports to be installed by 2025

	Residential	Non-Residential		Total
		Workplace Level 2 and Public Level 2	Fast Chargers	
Using average of the low and high estimates of the CEC report	15,000+	3,600	500	19,100+
Using 3% of the California goal of 250,000 non-residential charging ports	15,000+	7,200	300	22,500+

What will local electricians need to learn? And how prepared is the local workforce?

At present, one must be a licensed electrician to install EV chargers. Most charging systems funded by grants from utilities and government agencies will fall into construction contracts that would require a professional engineer (PE), and therefore the design and know-how surrounding the EVSE will be expressed to the electrician by the engineer through the construction drawings. On the other hand, many charging systems installed at private residences may be done by electrical contractors without engineers on staff, and the requirements may be as minor as simply applying for an electrical permit.

The level of expertise among electricians that will be installing EV chargers varies. Electricians should already have the competency to properly design and install the chargers, based on their required apprenticeship coursework. However, not everyone has practiced those skills in recent memory, nor are they all familiar with new, emerging technologies. Some will be able to learn very quickly from prior experience or on-the-job training. Others may be less exposed to similar applications and may need further training to become knowledgeable enough of the new technology so that they can easily avoid common mistakes and successfully position themselves within the market.

The main safety concern stems from the fact that EVSE circuits require large current draws for long durations, and it is essential to understand how to properly design the circuit for overcurrent protection and wire size. The high current draw raises concern since small mistakes in the wiring can result in heat buildup and potential for fire. There are also many special features regarding EVSE that may not be common knowledge, like the differences in the types of chargers, the communication requirement between the charger and the vehicle, and the space required for parking lot chargers. Similar to the photovoltaics industry in the early 2000s—where the installation workmanship and skill level was not nearly where it is today and a lot of training helped the industry mature in a much safer way—the installation of EVSE equipment will grow and training will be important to keep installations safe.

The educational needs are expected to align with the curriculum of the Electric Vehicle Infrastructure Training Program (EVITP), which provides training and certification for electricians installing EVSE. EVITP is on its fourth iteration of its training curriculum, which is included in Appendix A and which includes basic EV and EVSE background information, National Electrical Code (NEC) requirements, load calculations, site assessment, commissioning, and troubleshooting with a goal of ensuring the workforce is safe and well-informed.

Suggestions for the Electrician Training Program

To ensure consistency in the quality and safety of the installations being performed, the authors recommend that Contra Costa County offer a training program and use a variety of techniques to bolster interest and participation. Some industry participants may be skeptical of the value of attending training. One option would be to mandate that any permit for EVSE requires the electrical contractor (or employed electrician that will be performing the installation), to either have an EVITP certificate, or a C-10 contractor's license, or provide a PE stamp on the electrical drawing.[6] Smaller contractors that will be putting in level 2 chargers at single family residences, small commercial businesses, or multi-unit dwellings will be served well by the EVITP program as these contractors may be doing their own engineering. Larger contractors will already have engineering staff on hand and may already have EVITP training. It must be noted that a requirement for a PE stamp on the electrical drawing could modestly increase the cost of filing permits, and may be unnecessary for small straightforward installations. However, the benefit of such a mandate is that it would create a demand for the county's training program and result in more electricians and contractors being trained in EV charging design and safety. Another option to stimulate demand would be to offer the training for free for any student residing in a disadvantaged community, any student currently enrolled in any electrical training apprenticeship, and any student enrolled in a vocational training program. Subsidizing these populations would have the added benefit of stimulating interest in the electrical trades and EV charging among new entrants into the workforce.

Design

Effective design of the training program will drive participation. As noted above, California is anticipated to have significantly more single-family installation of Level 1 and Level 2 chargers than the CEC mandated Level 2 and Level 3 chargers, so it is important that the training address small contractors' needs. The main audiences/trainees that will be targeted for participation in the program include:

- Licensed electricians
- Licensed electrical contractors
- Electrical apprentices
- Vocational students
- Facility managers
- PEs

[6] Many (but not all) installations that will occur in the county already are required to have EVITP-trained contractors. As outlined in the CPUC's *Decision Directing PG&E to Establish an Electric Vehicle Infrastructure and Education Program,* contractors who construct, install, and maintain the EVSE that will be owned by PG&E will be required to have EVITP certification. Additionally, PG&E will require that all construction, installation, and maintenance of EVSE that is not performed by employees of PG&E shall be performed by a contractor's signatory to the IBEW who holds a valid C-10 contractor's license.

Conducting EVITP training courses and marketing them to the first four groups listed above will help meet the goals of training the existing workforce and driving EVSE installation jobs to contractors within Contra Costa County. The need for the course is driven by ensuring that all EVSE installations are planned and executed in a safe manner, as described above. Facility managers and PEs should also be targeted since they are typically early adopters of new technology trends and because they have a vested interest in understanding the applications of the technology.

To further attract licensed electricians, the course should be registered to count towards continuing education for their license renewal. In order to obtain certification, the crosswalk (or curriculum) must be submitted to the Electrician Certification Curriculum Committee of the Department of Industrial Relations. The course would fall under the general electrician classification. Upon the committee's approval, the course can count towards continuing education credits. This typically takes a little over a month for approval after submittal of all coursework.

The county should offer EVITP courses quarterly and hold them in the evening to accommodate work schedules since most of the target audience is actively working during the day. The county should make the courses free for any student from a disadvantaged community, students currently enrolled in an electrical apprenticeship program, and students currently enrolled in a vocational training institute. For those that are not from disadvantaged communities, they should pay a course fee equivalent to standard curriculum fees. Additionally, the courses should be advertised through the IBEW, Western Electrical Contractors Association (WECA), and PG&E to existing electricians for continuing education credit.

The county has roughly 1000 electrical contractors, each of whom may want one electrician to attend from their company. Not every contractor will send a person, but there will be other interested parties such as PEs, facility managers, and apprentices that may keep the overall number at 400 to 600 potential recipients. It is anticipated that each EVITP class should be limited to 20 students. This translates to about 20 to 30 classes over 5 years, or classes offered roughly quarterly. Based on this estimate, it would be suitable to have three to six trainers certified to deliver the course. Initially a class can be held to train the trainers so that the number of trainers can be grown. Each instructor receives about $2000 for delivering the 18-hour course. The most logical choice for trainers would be existing instructors within the participating community colleges that already teach electrical trade skills, or existing instructors within the IBEW or WECA.

To hold the training, a standard classroom within an institution that meets the California guidelines for training facilities will be required. The classroom must be accessible to all and meet equal opportunity standards. Diablo Valley Community College, Los Medanos Community College, as well as the IBEW / National Electrical Contractors Association (NECA) training facility are already approved educational training sites.

As an attempt to provide job opportunity for those in disadvantaged communities, the authors suggest additional outreach through hands-on experiential learning with the goal of encouraging participants to become excited about EVSE installations enough to pursue opportunities within the electrical trade. To

this extent the authors suggest that the program allow for a grant opportunity to fund a few Level 2 charger installations for vocational schools who apply to participate in the program. The vocational school would be provided with the equipment through the grant, but must provide the site and the labor associated with the installation. The authors suggest that one of the first projects for the vocational students would be to construct a portable Level 2 charger installation to then utilize at the facilities hosting EVITP trainings and / or to utilize for additional classes at the vocational school as a take down and reassemble exercise. This endeavor would get support from existing electrical trades programs; it also serves the interests of the local electrical unions that are looking to get more younger people enrolled into apprenticeship programs.

Conception to implementation of the training would take approximately one year and would involve: coordination with the community colleges, selecting qualified instructors and training them, marketing the course, and getting approval of the new version 4 EVITP coursework by the Electrician Certification Curriculum Committee of the Department of Industrial Relations (see timeline below).

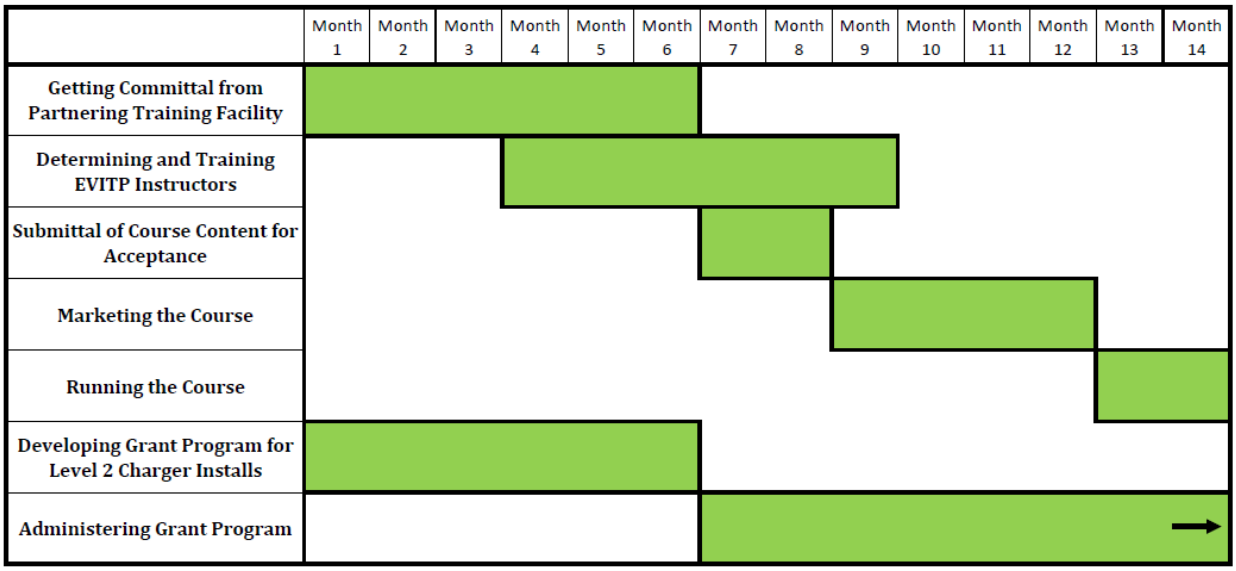

Figure 1. Estimated Timeline of Training Program Implementation

Partnerships and Collaboration

Table 4 lists good potential partners for conducting trainings and/or providing facilities for the training. The least expensive option would be the PG&E Stockton training center, since they would provide the facility for free. The IBEW and NECA typically charge for their trainer and a nominal fee for the facility. However, typically they only conduct trainings for their members. The community colleges charge for the trainer and a fixed fee based on course hours and whether or not the students are receiving college credit. The course would not be certified for collegiate credit, but rather run as a continuing education course, with the completion certificate being applicable for continuing education certification for electrical license renewals. Contact information and program websites for each of these entities are provided in Appendix B.

Table 4. Potential Training Hosts

Potential Training Host	Location
PG&E Energy Training Center	Stockton, CA
IBEW Local 302 / NECA Training Facility	Martinez, CA
Diablo Valley College	Pleasant Hill, CA
Los Medanos College	Pittsburg, CA

In addition to partners that could physically host the training, several other partners provide useful resources. Table 5 provides a few notable partners.

Table 5. Additional partnership ideas to explore

Potential Partner	Value of Partnership
California Department of Industrial Relations	Current listing of certified electricians and trainees within the county by zip code, which could be leveraged for outreach
Electric Vehicle Infrastructure Training Program	Curriculum, curriculum updates, and pool of instructors
GRID Alternatives, Future Build East County, and other nonprofits	Connection with potential apprentices and training participants in disadvantaged communities, ideas for tailoring program offerings, and collaboration on grant applications, and other collaboration

Costs

The costs to run a training program of the scale described above can be broken into staffing costs and costs per course. Table 6 provides estimates, assuming that course fees received from students would partially cover the costs of offering each class session, but would not cover the fixed costs of program setup.

Table 6. Estimated Costs Associated with Training Program[OL1]

Item	Cost per Item	Number of Items	Staffing Cost	5 Year Total
Licensing the Class for Continuing Education Credits			Administrative staff hours (one-time)	
Coordinating Training Facilities			Administrative staff hours (ongoing)	
Training the Trainers[a]	$2,000	6 instructors (?)		$12,000
Subsidizing Class Participants	$5,000	30 classes		$150,000
Marketing Each Class	$1,500	30 classes		$45,000
Setting up Vocational School Grant			Administrative staff hours (one-time)	
Administering Vocational School Grant			Administrative staff hours (ongoing)	
Funding for Grant Recipients	$25,000	8 recipient institutions		$200,000
Total Program Costs			**Administrative staff hours**	**$407,000**

[a] May also need to pay employee hourly rate for time spent in class.

The total administrative staff time required is likely to be significantly less than one full time equivalent employee (FTE), perhaps ¼ FTE. Given that a workforce training program for EV mechanics and technicians is also being planned within the county, there may be opportunities to have the same individual coordinate both programs, or reallocate work responsibilities for an individual at a county agency to enable them to cover the EVSE workforce development effort.

Potential avenues for funding the training program include payments from participants, EV Ready Communities Challenge Phase II funding from the CEC, county workforce development funds, and/or sponsorships from the IBEW and WECA for the vocational program utilizing EVSE installations to get vocational students excited about the electrical trade.

Appendix A. Sample Curriculum (from EVITP v4.0)

The suggested curriculum to use for the electrician training program would be as follows.

1. Electric Vehicles (EVs)
    - 1.1 The History of EVs
    - 1.2 Modern EVs
    - 1.3 EV types/drivetrains including: passenger vehicles, light-duty trucks, & heavy-duty vehicles.
2. EVSE
    - 2.1 What is EVSE & types
    - 2.2 AC EVSE – level 1, 2, and High Power
    - 2.3 DC Charging – High Power and Overhead
    - 2.4 Wireless charging
    - 2.5 EVSE Communications and Networks
3. 2017 National Electrical Code (NEC)
    - 3.1 NEC Art. 90
    - 3.2 NEC Chapter #1
    - 3.3 NEC Chapter #2
    - 3.4 NEC Chapter #3
    - 3.5 NEC Art. 625 + add notes on 702 and 705
    - 3.6 NECA 413-2012 Standards for EVSE Installation
4. Load Calculations, based on the 2017 NEC
    - 4.1 Planning and Installing EVSE (introductory materials)
    - 4.2 Load considerations
    - 4.3 Ampacity considerations including conductors, temperature ratings, and OCPD.
    - 4.4 BC, Feeder, and Service Calculations
    - 4.5 Voltage Drop
    - 4.6 Examples
5. Site Assessment
    - 5.1 Customer service / considerations / and facility tour (meet and greet)
    - 5.2 EVSE market drivers – incentives, LEED
    - 5.3 Locating
    - 5.4 Signage
    - 5.5 ADA – accessibility
    - 5.6 Installation
    - 5.7 Shawbell's Hardware case study
6. Commissioning
    - 6.1 Why commission?
    - 6.2 Documentation
    - 6.3 Municipality and Utility considerations
    - 6.4 Equipment and cord management
    - 6.5 EVSE communications and networking, customer interface, setting up network interfaces
7. Troubleshooting
    - 7.1 Common EVSE failure point
    - 7.2 Troubleshooting examples
    - 7.3 EVITP troubleshooting flow chart
    - 7.4 Troubleshooting tips
    - 7.5 EV simulators

Appendix B. Contact information and information on potential host sites

PG&E Energy Training Center

- **Address:** 3136 Boeing Way, Stockton, CA 95206
- **Phone:** (800) 244-9912
- **Website:** https://www.pge.com/en_US/small-medium-business/business-resource-center/training-and-education/energy-centers.page?WT.mc_id=Vanity_energycenters

IBEW Local 302

- **Address:** 1875 Arnold Drive, Martinez, CA 94553
- **Phone:** (925) 228-2302
- **Website:** http://www.ibewlu302.com/?zone=/unionactive/contact.cfm

NECA

- **Address:** 3 Bethesda Metro Center # 1100, Bethesda, MD 20814
- **Phone:** (301) 657-3110
- **Website:** https://www.necanet.org/

Diablo Valley College (Pleasant Hill Campus)

- **Address:** 321 Golf Club Rd, Pleasant Hill, CA 94523
- **Phone:** (925) 685-1230
- **Website:** https://www.dvc.edu/

Los Medanos (Pittsburg campus)

- **Address:** 2700 East Leland Road, Pittsburg, CA 94565
- **Phone:** (925) 439-2181
- **Website:** http://www.losmedanos.edu/