Washington
Green Transportation Program

Initial Research Review for Workforce Development

Phase 1

Summary, Recommendations & Appendices

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Green Transportation Program
Moving forward with Washington's public fleets

The Washington State legislature passed legislation in 2019 directing the **WSU Energy Program** to establish and administer a technical assistance and education program for public agencies on the use of alternative fuels and vehicles. The **Green Transportation Program** provides education and assistance about alternative fuels and vehicles to all public agencies in the state, including cities, counties, tribes, transit agencies, ports, school districts, colleges and universities, utilities and PUDs, and other political subdivision.

Summary

The EV industry is undergoing a rapid transformation in technology, propelled by strong clean energy goals and increasing consumer demand spurred by incentives through public policy and forward-focused industry leadership. This growth will have impacts on the labor market. This report is a first step to aggregating information in support of planning efforts to ensure the equitable and timely scaling-up of education and training programs.

This report begins to compile existing research on the labor markets related to the EV sector. The current data has limited use in projecting the future for job growth as it is historically-based and relies on measures of traditional automotive industry occupations that are not likely reflective of changes underway the EV sector. Also, we know very little about the actual knowledge, skills and abilities required of EV-specific occupations. Very little is known about the EV industry within Washington, specifically, how many jobs could be expected and what job skills will be needed. Women and people of color will need targeted programs to ensure access to training and education programs.

Recommendations

The following section provides some options for collecting more detailed and current information which support more predictive analysis. Our recommendations are:

Additional research into existing data and model programs: This report was a quick overview of some readily found research. Some conversations with industry leaders would likely reveal additional information about data sources, studies and existing programs.

Interview EV Employers and Industry Leaders: Employer interviews provide rapid and detailed information about industry changes. Interviewing a cross-section of employers and industry leaders can rapidly advance understanding of workforce needs and expectations for growth. Although those findings are not statistically representative of all Washington employers in the EV sector, the results can identify broad workforce challenges, as well as the skill-needs and industry trends within the sector.

Suggestions for interviews:

- The *Amping Up* authors: Their study focuses on supply chain/production/manufacturing jobs. Do they have a sense of the impact on maintenance workers?
- Public fleet managers and maintenance workers leading EV transition: What new and upgraded skills do they need? What training is available? How have jobs changed?
- Community colleges and private-sector technical training programs: Do they have EV-specific programs? Why/why not? Overview of curriculum? Partner with industry?
- EV parts and supply manufacturer interviews?
- Unions: Are union and company-sponsored apprenticeship and pre-apprenticeship programs being developed or modified to support the requirements of clean transportation careers, and to expand the employment and career pathway opportunities for workers, including underrepresented groups?

We would need to talk with training centers and colleges as well as industry leaders who have experience designing programs to learn how those programs are being customized to expand the inclusion of underrepresented populations.

Create a network of industry and technology employers and education and training providers: A network can provide real-time information on emerging labor market trends and quickly provide ground-level feedback from a wide range of employers. A network could allow educators to learn from industry leaders and enable nimble adaptation of their programs to industry and worker's needs, ensure their ability to attract, develop and retain a skilled green transportation workforce. A stakeholder network could provide invaluable guidance to policy-making and education and training program decisions.

An example is Washington's Health Workforce Sentinel Network. Here is a recent news excerpt:

> HEALTH SENTINEL NETWORK OPENS FRIDAY FOR EMPLOYER FEEDBACK
>
> Washington's Health Workforce Sentinel Network is once again ready to hear from employers around the state about their greatest health workforce needs starting Friday, April 9. Twice a year, the Sentinel Network helps capture key recruitment, retention, and skills issues being confronted, including during the COVID-19 pandemic, and make that information available to educators, policymakers, and others. Washington's Sentinel Network is a collaboration of the Washington Workforce Board and the University of Washington Center for Health Workforce Studies.

Additional ideas to consider for further research include:

Hiring web-crawling service to scanning job postings: Job postings measure an employer's *intentions*. Analyzing job postings yield details such as skills employers are seeking and job titles being used. The information is gathered in real time. However not all jobs are posted online and a job posting may not reflect the actual number of people hired.

Purchase proprietary databases: This report does not thoroughly examine the options available from proprietary databases but it is possible that sources such as Bloomberg EV Outlook could contain useful industry surveys and analysis of the EV labor market.

Conduct industry surveys and/or focus groups: This helps provide a better understanding of which occupations employers are hiring for and the specific skills they need to better fill these positions. This will also help better anticipate future employment and skills demand.

Appendix A. Community and Technical College Automotive Programs

The following information was provided by the Washington State Board for Community and Technical Colleges, in their college programs search tool.

Click a college name below to see a list of degrees and certificate programs offered.

- Bates Technical College
  - Automotive Mechanic
  - Chassis and Electrical Certificate of Competency
  - Electrical Certificate of Training
  - Engine and Electrical Certificate of Competency
  - Power Sports & Equipment Technology
- Bellingham Technical College
  - Automotive Technology
  - Automotive Technology
  - General Automotive Repair
  - Vehicle Service Technician
- Big Bend Community College
  - Automatic Transmission & Transaxle Repair
  - Automotive Heating & Air Conditioning
  - Automotive Technology
  - Brake Repair
  - Electrical/Electronic Systems
  - Engine Performance
  - Engine Repair
  - Manual Drive Train & Axle
  - Suspension & Steering
- Clark College
  - General Automotive Service Technician
  - General Automotive Service Technology
  - HiTecc Automotive Technician
  - HiTECC Automotive Technology
  - T-TEN Automotive
  - T-TEN Automotive
- Clover Park Technical College
  - Automotive Technician
  - Drive Train Technician
  - Electrical, Electronics & AC/Heating Technician
  - Engine Repair & Engine Perform Technician
  - Ford Maintenance & Light Repair Technician
  - Front End & Brakes Technician
  - Hybrid & Alternative Fuel Vehicle Technician
  - Hybrid & Alternative Fuel Vehicle Technician
  - Hybrid and Alternate Fuel Vehicle Operation & Maintenance
- Columbia Basin College

- Automotive Technology
- Automotive Technology Certificate
- Basic Automotive Technician Short-Term Certificate
- Parts Business Short-Term Certificate

- Grays Harbor College
  - Advanced Engine Performance, Air Conditioning, and Heating
  - Automotive Technology
  - Automotive Technology
  - Brakes, Suspension, and Steering
  - Electrical, Electronics, and Anti-Lock Brake Systems
  - Engines - Electrical Tune-Up and Ignition
  - Fuel Systems - Electronic Testing and Computer Controls
  - Power Train, Manual and Automatic Transmissions
- Green River College
  - Automotive Brakes, Suspension & Steering
  - Automotive Electrical Systems
  - Automotive Engine Performance
  - Automotive Heating/Air Conditioning
  - Automotive Technology
  - Automotive Transmission & Transaxle
- Lake Washington Institute of Technology
  - Auto Repair Technician
  - Auto Repair Technician
  - General Service Technician
- Lower Columbia College
  - Automotive Technology
  - Automotive Technology-Maintenance and Light Repair
  - Suspension, Brakes & Alignment
- Peninsula College
  - Automatic Transmissions & Transaxles
  - Automotive Technology
  - Automotive Technology
  - Automotive Technology - Alternate Fuels Certificate
  - Brakes
  - Electrical/Electronic Systems
  - Engine Performance
  - Engine Repair
  - Heating & Air Conditioning
  - Manual Drivetrains & Axles
  - Suspension & Steering
- Renton Technical College
  - Automotive Maintenance and Light Repair
  - Automotive Technology
  - Automotive Technology

- Automotive, Ford ASSET
- Shoreline Community College
  - Automotive - Brakes Specialist
  - Automotive - Drive Train Specialist
  - Automotive - Electrical Specialist
  - Automotive - Engine Specialist
  - Automotive General Service Technician (GST) - IBEST
  - Automotive Service Technician (AST)
  - Electric Vehicle Technician (TESLA)
  - General Motors, Auto, Service Educ. Program (ASEP)
  - Honda - Prof Automotive Career Training (PACT)
  - Mopar College Automotive Program
  - Toyota - Technical Education Network (T-TEN)
- Skagit Valley College
  - Automotive Electronics & Diagnostics Specialist
  - Automotive Technology
  - Transmission Specialist
  - Undercar Specialist
- South Puget Sound Community College
  - Advanced Automotive
  - Automotive Apprentice
  - Automotive Technology
  - Beginning Automotive
- South Seattle College
  - Automotive Technology
  - Automotive Technology
  - Certificate in Automatic Transmission/Transaxle
  - Certificate in Brakes
  - Certificate in Electrical/Electronic Systems
  - Certificate in Engine Performance
  - Certificate in Engine Repair
  - Certificate in Heating and Air Conditioning
  - Certificate in Manual Drive Train and Axles
  - Certificate in Steering and Suspension
  - Maintenance and Light Repair 1 Year Certificate (MLR)
  - NATEF Master 2 Year Certificate
- Spokane Community College
  - A1 Engine Repair
  - A2 Auto Transmission/Transaxles
  - A3 Manual Drive Train & Axles
  - A4 Suspension and Steering
  - A5 Brakes
  - A6 Electrical/Electronic Systems
  - A7 Engine Heating and Air Conditioning

- A8 Engine Performance
- Automotive Maintenance & Light Repair
- Automotive Technology
- Automotive Technology
- Automotive Technology/Toyota T-TEN

- Walla Walla Community College
  - Advanced Automotive Repair Technology
  - Automotive Repair Technology
  - Automotive Repair Technology
- Wenatchee Valley College
  - Automotive Technology
  - Automotive Technology
- Yakima Valley College
  - Automotive Electrical and Electronic Systems Certificate
  - Automotive Service Technology
  - Steering/Suspension and Brake Systems Certificate

Appendix B. California EV Occupation Information

Union of Concerned Scientist "Delivering Opportunity: Assessing Electric Vehicle Jobs and Workforce Training in California" 2016, Chapter 3 Assessing EV Jobs and Workforce Training in CA) Jobs are expected to increase in charging infrastructure, EV maintenance and transportation-related electrification and EV manufacturing. Additional information on each of these job categories is provided below.

Jobs Related to EV Charging Infrastructure

Moderately accessible: Typically require high school, vocational school, or work-related experience. Well-paying: Often offer family-supporting wages, well above minimum wage. Typically unionized. Career-ladder: Often offer advancement opportunities through pre-apprenticeships, apprenticeships, and training (p 38).

Infrastructure jobs are typically not permanent jobs, but rather project-based which means they have a start and finish, with no guarantee about the next project.

Electrical skills are critical for opening up EV-charging. Basic electrical skills are required for installing, maintaining infrastructure job opportunities to members of underserved communities, and repairing EV charging stations. They also provide a pathway to other growing occupations in the clean energy economy (e.g., solar panel installer, wind turbine installer).

In California, many electricians train through the International Brotherhood of Electrical Workers. The union gives access to training and certification for work in the EV-charging infrastructure.

Types of Jobs: The installation of EV-charging infrastructure has several stages combining civil work and electrical work. General contractors start with design and permitting, which includes drawing the electrical panel and submitting the design to the permitting authority. Once a project is permitted, civil workers break the ground and then electrical workers lay down the wires. The utility and the permitting authority inspect this work. Once they approve that work, civil workers cover up the site and then electrical workers place the equipment on the circuits. Finally, the utility comes and turns on the power.

The civil work consists of concrete and asphalt trenching and other tasks necessary for preparing the site for the electricians to complete the electrical wiring. The electrical work consists of tasks like laying the electrical wires and installing the charging station. Typically, general contractors with electrical specialization work with subcontracted civil workers to design electrical panels for the charging infrastructure. According to one interviewee, the two types of work typically comprise nearly 75% of the expenses for installing EV-charging infrastructure.

We emphasize electrical skills here because work in EV charging infrastructure requires knowledge of electrical wiring for installing, maintaining, and repairing. Those same electrical skills open the door to other opportunities in the clean energy economy (e.g., solar installers, wind turbine installers, EV technicians). Two occupations associated with the EV-charging infrastructure have an especially bright outlook in the coming years: electrician and electrical power-line installer and repairer (Table 3, p 40).

For electricians alone (there are around 24K now), there's relatively small new job growth, but will be around 9K annual openings between 2023 and 2028, mostly due to retirements. Similar but smaller number pattern for electrical power line installers. (See ESD for WA electrician job growth projections.)

Installing an Electric Vehicle Charging Station (Profile, p 40, inset). This profile is adapted from an interview with Phil Haupt, who now installs EV-supply equipment after working as an oil-refinery electrician:

- Background: After about 20 years as an oil-refinery electrician, Haupt started a business in solar-installation services in 2005. In 2010, he and his company switched to focus on EV services.
- Skills needed: "It requires the broad skill set of electrical contracting, as well as knowledge of each specific EV—where their charge ports are located and their own individual power requirements. Additional knowledge about American[s] [With] Disabilities Act accessibility laws, parking space requirements, EV supply equipment brands and capabilities and permitting is required."
- Career pathway: "The career path to installing EV supply equipment begins with a solid proficiency in electrical work. The specialties involved come with working in the field and understanding the vehicles and the various EV supply equipment brands."
- Best part of the job: "I enjoy watching the paradigm shift from internal combustion engines to electrically powered vehicles. Once a person experiences the difference, there is no going back. I also love the fact that I am providing a 'green' opportunity."
- Advice: "Start an electrical apprenticeship. The growth rate of EVs is vertical, so the jobs will be there."

EV Maintenance Jobs

Moderately accessible: Typically require high school, vocational school, or work-related experience.
Well-paying: Typically offer family-supporting wages, well above minimum wage.

EV maintenance and repair jobs differ considerably from conventional automotive maintenance and repair jobs. They require knowledge of electrical safety when repairing high-voltage components like EV batteries. As a result, incumbent auto mechanics will require training to update their skills.

Electrification of vehicles will result in increased demand for EV maintenance.

Types of Jobs: Electric vehicles, like any vehicle, need occasional maintenance and repair. For example, batteries can degrade and need replacing every few years, with the interval depending on usage and the type of battery. Normal repair workers can do routine maintenance and repair work, like rotating tires, but fixing or tuning electrical systems and drivetrains will often need skilled workers familiar with EVs (Hamilton 2011).

O*NET data lack specific information about EV maintenance and repair occupations. To assess EV maintenance and repair jobs, we compared them with conventional automotive maintenance and repair jobs, assessing two occupations associated with automotive maintenance: master mechanics and specialty technicians. We then reviewed training programs for EV maintenance to find distinguishing skills and duties (Table 6, below).

TABLE 6. Occupations in Automotive Maintenance and Repair

O*NET Occupation	Job Description
Automotive Master Mechanics	Repair automobiles, trucks, buses, and other vehicles Repair virtually any part on the vehicle or specialize in the transmission system
Automotive Specialty Technicians	Repair only one system or component on a vehicle, such as brakes, suspension, or radiator
EV Technicians	Has evolved from doing simple mechanical repairs to high-level, technology-related work, such as work with integrated electronic systems. Distinguishing skills and duties (see Appendix A: Job Profiles at *www.ucsusa.org/ElectricTrucks* for more information) (Hamilton 2011): • Use computerized shop equipment and work with electronic components as well as traditional hand tools • Work with electrical systems and drivetrains, which often requires skills specific to electric vehicles • Repair or install EV batteries, a job requiring training to work with specific types of batteries • Replace batteries every few years, with the timing depending on usage and type of battery

SOURCES: USDOL/ETA 2016L; HAMILTON 2011.

TABLE 7. Wages and Education Requirements in Automotive Maintenance and Repair

O*NET Occupation	California Hourly Median Wage (2014)*	Education Requirements
Automotive Master Mechanics	$19.46	Usually requires training in vocational schools, related on-the-job experience, or an associate's degree
Automotive Specialty Technicians	$19.46	Certificate; associate's degree

*Salary information comes from the US Bureau of Labor Statistics, Occupational Employment Statistics Program, a semiannual survey providing wage and employment statistics for the nation, each state, and substate regions. O*NET combines salary information for automotive master mechanics and automotive specialty technicians into one category.

SOURCE: O*NET BUREAU OF LABOR STATISTICS DATA.

Wages and accessibility: The wages of automotive maintenance occupations assessed are well above California's $10 per hour minimum wage. For example, the median hourly wage for master mechanics in California is $19.46, higher than the U.S. median hourly wage of $17.84 (Table 7, p 42) (USDOL/ETA 2016). *(Wage data is for California and is outdated.)*

Automotive maintenance jobs are middle-skill and increasingly require formal training. Workers usually need a few weeks to two years of training involving both on-the-job experience and less formal training with experienced workers (Hamilton 2011). For employment at larger repair shops and auto dealerships, auto service workers must be certified by the National Institute for Automotive Service Excellence (ASE). Typically, it takes two to five years of experience to become a fully qualified automotive service technician through ASE. Additionally, programs like the National Alternative Fuels Training Consortium train workers on a variety of skills needed to work on electric or alternative fuel vehicles.

In short, low-skill workers from underserved communities cannot access these jobs without targeted and robust training programs. To grow the EV sector equitably, incumbent automotive maintenance workers from underserved communities must receive training to upgrade their skills to the rapidly evolving automotive technology.

Projected Growth in Jobs Related to Maintenance

Electric trucks and buses require less maintenance and repair than do conventional vehicles. For example, heavy-duty, pure-battery EVs need no oil changes or spark-plug replacements. However, as noted, the periodic maintenance and repair of heavy-duty EVs will require specialized skills.

Automotive maintenance and repair jobs are expected to grow 15% in California through 2022, significantly higher than the projected 5% growth for these jobs nationwide (Table 8) (USDOL/ETA 2016l).

Electric Truck and Bus Manufacturing Jobs

Typically require a high school diploma and may require some vocational training or work-related experience; an associate's degree may be needed. Generally not unionized (p 33).

Similar to conventional automotive manufacturing, many occupations in heavy-duty EV manufacturing have an increased need for electrical skills, depending on the components and technology being assembled, prompting a shift away from mechanical skills and toward electrical skills and safety. One interviewee noted a trend in heavy-duty EV manufacturing toward electrifying all components of trucks and buses because of the savings associated with maintaining electric components. For example, air brakes on buses require more maintenance than do electric brakes. As a result, conventional brake assemblers will need to acquire wire-harnessing skills and electrical-safety training if they become responsible for assembling electrical parts and components. This raises the barrier to entry for low-skilled workers without electrical skills, indicating a need for robust, targeted job training to ensure that workers from underserved communities are not left behind.

Industry representatives unanimously reported that "assembler" is the occupation likely to grow the most with increased investment in and adoption of electric trucks and buses. This growth potential, coupled with potential pathways into higher-paid, higher-skilled occupations, means that assembler jobs can play an important role in fostering economic opportunity in underserved communities" (p 33).

While our research uncovered few apprenticeship programs that lead directly to heavy-duty EV manufacturing careers, we found community colleges and other job-training organizations with established vocational programs in transportation electrification; these programs can provide pathways to heavy-duty EV careers. Community colleges play a major role in training jobseekers to fill the skill needs of the heavy-duty EV sector and will continue to be important partners for heavy-duty manufacturers. Training programs can expose young adults from underserved communities to career opportunities in EV manufacturing, engineering, and other careers in clean energy technology

Heavy-Duty EV Workforce Development and Job-Training Resources

Findings ((p 42): California's electric truck and bus industry relies on community colleges to train workers. Transit agencies, unions, and other organizations have begun assessing workforce development and training needs for electrifying the truck and bus industry. There is an increasing need to build career pathways that help residents of underserved communities access electrical training and careers in heavy-duty EVs.

Widespread transportation electrification is rapidly changing workforce needs. To meet these changing demands, community colleges, training organizations, and government agencies have begun developing

programs and partnerships to create a sustainable workforce for manufacturing and maintaining electric trucks and buses and installing EV- charging infrastructure.

Providing underserved communities with access to transportation electrification occupations will require strong partnerships among manufacturers, educational institutions, government, and job-training programs, with a high priority on developing soft and technical skills for those with barriers to employment. Nontraditional partnerships will be necessary. For example, community-based, environmental justice, and economic justice organizations will be crucial partners for identifying and understanding barriers that may prevent people in underserved communities from entering particular training programs or applying for certain jobs. In addition, labor unions can play a critical role in helping design curricula for jobs in EV-charging infrastructure and in connecting qualified graduates of electrician-training programs with opportunities in union apprenticeships and union-track, EV-charging infrastructure careers.

The most successful programs will provide participants with stipends or other forms of support during training. In addition, they will connect participants to union-apprenticeship programs or well-paying employers, while providing "wraparound" support services like case management, soft skills, job-readiness training, and literacy and basic-skills training (Kim, Kirsch, and Reyes 2010). Some programs will combine on-the-job training with education around safety and clean energy so that those who secure emerging jobs will understand the importance of their work in supporting the sustainable, clean-energy economy.

Four types of programs can help prepare people for jobs in transportation electrification (see Appendix B: Training Programs, at www.ucsusa.org/ElectricTrucks):

- Government-sponsored training programs
- Community college and undergraduate general education, advanced undergraduate education, general Master's education, focused graduate education, and research programs related to transportation electrification
- Private-sector and nonprofit training programs
- Apprenticeship programs

Government -Sponsored Training

Federal and state governments can help connect underserved workers with high-quality jobs by sponsoring in-house training for manufacturers as well as by investing in community college programming. As transportation electrification grows, a variety of existing programs provide useful models for cities and counties that seek to prepare the workforce for transportation electrification jobs.

For example, California's Employment Training Panel (ETP), is a government-sponsored training program that addresses skills gaps by providing funding for in-house training. ETP can enable early-stage manufacturers to provide unique training to new hires while at work, and it can jumpstart the training programs needed to employ incumbent workers who may not have the skills or extended experience necessary for their new roles.

Training Sponsored by Community Colleges and Voc/Tech Institutions

Community colleges are a major resource for clean transportation employers, including electric truck and bus manufacturers. In particular, their vocational and technical programs provide advanced transportation curricula and training, as well as workforce development services in general. All

interviewees mentioned some level of collaboration with community colleges as part of their workforce efforts. These partnerships are especially important for manufacturers: community colleges have responded to workforce needs by creating EV-specific certifications and degree programs. One heavy-duty EV company representative noted the importance of community colleges for hiring locally and extending the firm's recruitment network.

The Alternative Transportation and Renewable Energy Program (ATRE), established by California Community College's Economic and Workforce Development Program, illustrates the effectiveness of partnerships of industry with community colleges. Throughout California, ATRE provides training and work experience for clean transportation and energy technology, as well as related technical education, assistance, and outreach programs. Its ability to offer up-to- date curricula, based on the participation of employers, leads to training for students and teachers.

Job Training and Education Nonprofit Organizations or Managed by Industry

Nonprofit and industry-managed job training and education programs are key to creating pipelines for jobseekers from underserved communities to enter careers in transportation electrification. These programs often include member organizations with direct access to the community and the capacity and experience to work hand in hand with local unions or industry.

For example, the Oakland Green Jobs Corps prioritizes connecting underserved communities with clean energy jobs as a pathway out of poverty. The program is operated by the nonprofit Cypress Mandela Training Center, which partners with Laney College to offer courses in electrician training, job safety, and other areas.

Apprenticeship Programs

Apprenticeships are critical for developing technical skills for the growing number of middle-skill jobs in transportation electrification. Apprentices receive pay while they learn skills in the classroom and on the job working alongside experienced teachers. Labor unions, large companies (like electric utilities), and local colleges typically operate apprenticeship programs.

For example, American River College runs a number of pre-apprenticeship and apprenticeship programs. The college develops skills relevant to the clean energy economy through apprenticeship, certificate, and degree offerings. It offers a pre-apprenticeship certificate in green technology, certificates in alternative fuels and green vehicles, and an electrical apprenticeship, among other opportunities.

Appendix C. Potential Models for Washington: California Sustainable Freight Action Plan

Further research could include identifying programs that offer best-practices which Washington may want to consider.

California Sustainable Freight Action Plan: "Action Item 8. Convene stakeholders and the California Workforce Development Board to identify and implement steps to ensure that the existing and future workforce meets the needs of the California sustainable freight transport system and sufficiently skilled labor is available to meet the needs of an expanding freight-related job market." Details on page C-82:

A. Regional Workforce Development Initiatives

Overview: California's Sustainable Freight Action Plan can result in economic benefits to communities across the State, reflected primarily, but not exclusively, in job creation and retention. A skilled and nimble workforce will be one key factor in competitiveness as freight industry firms move toward a zero emissions future. Targeted human capital investments to up-skill journey-level workers and creating apprenticeship pipelines have the potential to support increased operational efficiency and effective technological deployment across the freight sector, while bringing benefits to local communities in the form of improved job quality and access.

Implementing Agency: GO-Biz and the California Workforce Development Board

Type of Action: Partnership, coordination

Timing: Agency Development Work: 2016+, Implementation: 2017-2030

Proposed Actions: Convene regional partners to propose and coordinate workforce investment initiatives and opportunities. Strategies may include:

- Establishing a robust, integrated system of pre-apprenticeship pipelines and journey-level upskilling programs in the top twenty mission-critical occupations in the freight industry.
- Spanning the State with a network of regional training partnerships, driven by local industries and connected to seamless supply-side coalitions of community, workforce, labor, and education partners, that can guarantee a consistent, high-quality supply of skilled labor to manufacture, build, operate, and maintain the State's zero emissions freight infrastructure.
- Aligning regional, multi-modal freight transportation plans with regional workforce initiatives like the California Workforce Development Board's SlingShot Initiative.

Estimated Cost: Because these proposed activities consist of unknown future actions, estimated costs are not identified at this time.

Benefits: These strategies can bring benefits to local communities in the form of improved job quality and local pathways to family-supporting careers. C-82

B. Training Models

Overview: Traditional occupations will require new skills and aptitudes as the freight industry moves toward a zero emissions model.

Implementing Agency: GO-Biz and the California Workforce Development Board

Type of Action: Training development

Timing: Agency Development Work: 2016+ Implementation: 2017-2030

Proposed Actions: Convene stakeholders to develop training models like the California Workforce Development Board's Proposition 39 multi-craft construction pre-apprenticeships that can be replicated along key freight corridors.

Estimated Cost: Because the proposed activity consists of unknown future actions, estimated costs are not identified at this time.

Benefits: These strategies can bring benefits to local communities in the form of improved job quality and local pathways to family-supporting careers.

C. Community Workforce Agreements

Overview: Community Workforce Agreements can help secure local economic benefits from public and private investment in the freight network by guaranteeing both job quality and access through negotiated terms like local hire and apprenticeship utilization. Negotiated with input from key community stakeholders, including business, labor, the public workforce system, community based organizations, and education providers, Community Workforce Agreements have seen tremendous success in major cities across the country.

Implementing Agency: GO-Biz and the California Workforce Development Board

Type of Action: Partnership, coordination

Timing: Agency Development Work: 2016+ Implementation: 2017+

Proposed Actions: Support development of Community Workforce Agreements wherever possible.

Estimated Cost: Because the proposed activity consists of unknown future actions, estimated costs are not identified at this time.

Benefits: These strategies can bring benefits to local communities in the form of improved job quality and local pathways to family-supporting careers and help to provide the State and its modernizing infrastructure a growing cadre of highly skilled workers.

Quote from page G-3: In terms of workforce composition, "one out of every seven jobs in the U.S. is transportation related," according to the U.S. Department of Transportation."

California Sustainable Freight Foundations Certificate for Middle Managers. A Workforce Development Pilot Project for the California Sustainable Freight Action Plan, developed by the Center for International Trade and Transportation, College of Professional and International Education, California State University, Long Beach, California Energy Commission, Governor's Office of Business and Economic Development. Program Summary

Appendix D. Additional Potential Models for Washington

ATL – Ensuring that California has a Highly Skilled Clean Transportation and Logistics Workforce.

ATL (Formerly CETI, ATRE, Advanced Transportation and Renewable Energy) represents an array of clean energy technologies that form a critical part of California's strategy for reducing its climate change impact and its dependency on foreign energy, as well as growing a robust green economy by helping California's businesses remain competitive in a global market.

California has always been a world leader in clean energy technologies, but to advance our competitiveness a superior workforce – skilled for the rapidly changing clean energy technologies – must exist. Ensuring that California has a highly skilled, clean energy workforce is the goal of the Advanced Transportation and Logistics Sector and the focus of its state-level Sector Navigator and regionally focused Deputy Sector Navigators.

ATL PROGRAMS:

- **Electric, Hybrid, and Hydrogen Fuel Cell Programs**
- Gaseous Fuel Programs for Heavy Duty Vehicles
- Gaseous Fuel Programs for Light Duty Vehicles
- Intelligent Transportation Systems Programs
- Railroad Operation Programs
- Aeronautics and Flight Technology Programs
- Motorcycle Maintenance Programs
- Automotive Clean Air Car, Emissions Programs
- Photo Voltaic, Concentrated Solar, Geothermal, and Wind Technology Renewable Energy Programs

Bibliography, Notes and Abbreviations

Summary of Reports	
Electrification Assessment of Public Vehicles in WA, 2020	https://leg.wa.gov/JTC/Meetings/Documents/Agendas/2020%20Agendas/Nov%2017%20Meeting/Electrification_draftfinalreport.pdf Establishes a baseline for the number, type and cost of EVs in public fleets in WA. Lacks data for city and county fleets. Assumed similar ratio of EVs to state fleets. Report recommends additional data tracking.
Seattle Jobs Initiative: Amping Up Electric Vehicle Manufacturing in the PNW: Opportunities for Business, Workforce, and Education (2020)	https://webuildgreencities.com/wp-content/uploads/2020/05/READ-THE-EV-REPORT-HERE.pdf Addresses the capacity of Oregon and Washington to advance the electrification of their transportation systems through economic and workforce development strategies. Focus is more on supply-chain, production and manufacturing than maintenance. These tend to be higher-paying tech and engineering jobs.
Connecting Disadvantaged Communities to Quality Jobs in the Transportation Electrification Sector: An Initial Assessment Dec 2018, Prepared by Hays Witt, Strategic Action LLC For the Drive Clean Seattle Program	https://webuildgreencities.com/amping-up-electric-vehicle-manufacturing-in-the-pacific-nw/
Union of Concerned Scientist "Delivering Opportunity: Assessing Electric Vehicle Jobs and Workforce Training in California" and Appendix A Job Profile and Appendix B Training Programs (CA) (2016)	https://www.ucsusa.org/resources/delivering-opportunity https://www.ucsusa.org/sites/default/files/attach/2016/10/delivering-opportunity-appendix-b.pdf
United Autoworkers Union's report "Taking the High Road: Strategies for a Fair EV Future" UAW Research Dept.	https://uaw.org/wp-content/uploads/2019/07/190416-EV-White-Paper-REVISED-January-2020-Final.pdf
National Academies of Sciences, Engineering, and Medicine 2021. Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy 2021-2023.	https://www.nap.edu/catalog/26092/assessment-of-technologies-for-improving-light-duty-vehicle-fuel-economy-2025-2035
Municipal Research Service – MRSC: Planning for Electric Vehicles	https://mrsc.org/Home/Explore-Topics/Environment/Energy-Topics/Planning-for-Electric-Vehicles.aspx
EV Charging Station Statistics	https://evadoption.com/ev-charging-stations-statistics/
Bus Electrification: The Role Agencies Can Play in Workforce Equity	Link to the webinar slides: https://www.enotrans.org/wp-content/uploads/2021/02/Bus-Electrification-The-Role-Agencies-Can-Play-in-Workforce-Equity.pdf
Jobs to Move America	https://jobstomoveamerica.org/
USDOT Local Labor Hiring Pilot	https://jobstomoveamerica.org/resource/analysis-of-usdot-local-labor-hiring-pilot-local-hire-increases-opportunities-for-disadvantaged-workers-strengthens-local-economies/
Transforming Transit, Realizing Opportunity:	https://jobstomoveamerica.org/resource/transforming-transit-realizing-opportunity/

Summary of Reports	
Green New Deal	https://www.congress.gov/116/bills/hres109/BILLS-116hres109ih.pdf
BlastPoint 2021 EV Outlook Report	https://blastpoint.com/wp-content/uploads/2020/02/BlastPoint-2021-EV-Outlook_Report.pdf
Summary of Bloomberg EV Outlook 2020 report	https://about.bnef.com/electric-vehicle-outlook/
Drehobl, A. & Ross, L. Lifting the high energy burden in America's largest cities: How energy efficiency can improve low income and underserved communities (American Council for an Energy-Efficient Economy, 2016)	https://www.aceee.org/sites/default/files/publications/researchreports/u1602.pdf
Ross, L., Drehobl, A. & Stickles, B. The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency (American Council for an Energy-Efficient Economy, 2018)	https://www.aceee.org/research-report/u1806
One in three U. S. households face challenges in paying energy bills in 2015. Residential Energy Consumption Survey. U.S. Energy Information Administration (2015)	https://www.eia.gov/consumption/residential/reports/2015/energybills/
Sanya Carley and David M. Konisky, The justice and equity implications of the clean energy transition, June 2020	https://www.nature.com/articles/s41560-020-0641-6
International Labour Organization sees net increase in international jobs with shift to EVs. "The future of work in the automotive industry: The need to invest in people's capabilities and decent and sustainable work." Issues paper for the Technical Meeting on the Future of Work in the Automotive Industry (Geneva, 15–19 February 2021)	https://www.ilo.org/sector/Resources/publications/WCMS_741659/lang--en/index.htm

Summary of Organizations	
WSU Energy Program Green Transportation Program	http://www.energy.wsu.edu/GreenTransportationProgram.aspx The Washington legislature set ambitious goals and provides a variety of grants and incentives to support green transportation at all levels of government. The WSU Energy Program maintains the Green Transportation website to provide unbiased, up-to-date education and technical assistance to support the transition of public fleets to cleaner fuels.
Western Washington Clean Cities Coalition	https://www.wwcleancities.org/ We are a not-for-profit membership organization dedicated to expanding the use of alternative fuels and advanced vehicle technologies. A program of the U.S. Department of Energy, we provide education, technical expertise, networking opportunities and funding assistance to help members invest in local, sustainable transportation solutions – which not only supports our regional economy and protects our beautiful environment, but can green your bottom line. We are one of nearly 100 Clean Cities coalitions across the country advancing the nation's economic, environmental and energy security by supporting local actions to reduce petroleum consumption in transportation.
Columbia-Willamette Clean Cities Coalition	https://www.cwcleancities.org/ Founded in 1994 the Columbia-Willamette Clean Cities Coalition (CWCCC) is committed to encouraging both public and private fleet operators to convert their fleets to alternative fuels where economically practical. CWCCC's main goal is to reduce petroleum consumption in the transportation sector through education and outreach. Our coalition is an integral part of a greater national effort by the U.S. Department of Energy's Clean Cities program. CWCCC is one of almost 100 coalitions across the United States who are working together to reduce petroleum consumption on a grassroots level.
Seattle Office of Sustainability and Environment – Transportation Electrification	https://www.seattle.gov/environment/climate-change/transportation-electrification
The Eno Center for Transportation	https://www.enotrans.org
Alternative Transportation and Renewable Energy Program (ATRE), established by California Community College's Economic and Workforce Development Program	http://www.atreeducation.org/
CA Energy Commission Clean Transportation Program	https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program

Union Notes

UAW "Taking the High Road: Strategies for a Fair EV Future" (2019) Union-related issues:

Infrastructure: Vehicle electrification requires building a charging infrastructure for drivers and upgrading our energy infrastructure to meet electricity demand while ensuring electricity production is as green as the EVs themselves. This is an opportunity to create quality jobs to build, install, and maintain EV infrastructure.

Training: Workers will need new skills and displaced workers will need re-training programs. Strong industrial policy should include every effort to re-train and place workers in quality jobs, provide strong economic support for workers during transition periods, and create robust government jobs programs to guarantee quality jobs for all those seeking work.

Trade Policy: The economic potential of EVs will be lost if their components are imported. Advanced vehicle technology should be treated as a strategic sector to be protected and built in the U.S.

Investment Supports: Government incentives promote production of EVs and EV components in the U.S. Incentives should be used in a targeted way to promote a domestic EV supply chain and enforce high-road manufacturing practices.

Government Procurement: Government EV fleet purchases, from cars to public transportation, can be a tool to spur demand and create cleaner transportation. Such purchases should be used to promote high-road jobs by considering where vehicles are assembled, their level of domestic content, and the labor conditions under which they were produced.

Consumer Incentives: Consumer incentives are a tool to create a robust domestic EV market. This will encourage companies to orient their EV strategies toward the U.S. market. Consumer incentives should also be used to promote high-road domestic EV production. Incentives should be based on where the vehicle and its contents were produced and under what labor conditions.

Environmental Policy: Strong environmental standards can be structured as a win-win for the environment, workers, and the economy. Environmental policy should be used to address climate change while also promoting investment in future technologies that create quality jobs in the process.

Union of Concerned Scientist "Delivering Opportunity: Assessing Electric Vehicle Jobs and Workforce Training in California" 2016, Chapter 3 Assessing EV Jobs and Workforce Training in CA)

Manufacturing (p 32): "California heavy-duty EV manufacturing jobs are typically not unionized. No major electric truck and bus manufacturer in California has a unionized workforce. This stands in contrast with much of conventional automotive manufacturing in the United States. For example, the United Automobile Workers represents autoworkers at the nation's Big Three car manufacturers (Ford, General Motors, and Fiat Chrysler America) (Cutcher-Gershenfeld, Brooks, and Mulloy, 2016). Nevertheless, a small sample of reports from California manufacturers indicates that these jobs pay decently; however, further research is needed."

List of Common Abbreviations

BEV	battery electric vehicle
EV	electric vehicle
EVSE	electric vehicle supply (or service) equipment
ET	electric truck
FCEV	fuel cell electric vehicle
GST	general service technician
I-BEST	integrated basic education and skills training
ICE	internal combustion engine
LMI	Labor market information
NAICS	North American Industry Classification System
OEM	original equipment manufacturer
PSADA	Puget Sound Automotive Dealership Association
TE	transportation electrification