Amping Up Electric Vehicle Manufacturing in the PNW

OPPORTUNITIES FOR BUSINESS, WORKFORCE, AND EDUCATION
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Abbreviations

EV....................................................................................................................Electric Vehicle
ET............................................................................................................................Electric Truck
GST............................................................................................................................General Service Technician
I-BEST....................................................................................................................Integrated Basic Education and Skills Training
ICE...............................................................................................................................Internal Combustion Engines
NAICS....................................................................................................................North American Industry Classification System
OEM.............................................................................................................................Original Equipment Manufacturer
PSADA..................................................................................................................Puget Sound Automotive Dealership Association
SJI.................................................................................................................................Seattle Jobs Initiative
ZEB.............................................................................................................................Zero-Emissions Bus
Executive Summary

Both Oregon and Washington are national leaders in adopting and supporting climate change policies and initiatives. A key component in both states’ broader climate strategy is the electrification of transportation. Only by significantly increasing the share of electric passenger and commercial cars (EVs) on the roads will the states be able to reduce their greenhouse gas emissions and meet their climate goals.

This report addresses the capacity of Oregon and Washington to advance the electrification of their transportation systems through economic and workforce development strategies. The report analyzes the existing EV manufacturing sector in the two states and its capacity for growth, as well as the current workforce and training programs in the EV field. The analysis suggests that Oregon and Washington are well positioned to attract new EV-related business, given the existing activity in the field and the strength of well-established regional tech and aerospace sectors, both of which offer potential synergies in the production of EVs.

Despite the strength and potential of EV manufacturing in the two states, additional workforce initiatives are needed to ensure the field is more equitable and sustainable. In particular, women and people of color are currently over-represented in EV-related occupations with negative economic outlook. By designing and implementing training initiatives that increase access to promising career paths, and by working with the private and education sectors to develop EV specific curricula, the public sector can help build a pipeline of qualified and diverse workers to support the growth of EV business in the region.

Key Findings

Supply chains are developing, making room for new businesses. The production of electric motor vehicles, including passenger and commercial fleets, is undergoing dramatic changes due to technological innovations and new business models in the field. Many of the main components of EVs are not among the key competencies of traditional car manufacturers. Consequently, the barriers to entry to EV manufacturing are low, and new small- and medium-sized companies that have been excluded from the traditional car supply chain have more room to enter the market.

Oregon and Washington have existing EV business and the potential for growth. This report draws from existing work and original research to identify 39 companies in Oregon and Washington in the EV field. The companies include large multinational corporations, such as Daimler in Oregon and Paccar and its subsidiary Kenworth Trucks in Washington, and smaller businesses such as custom car producers Arcimoto in Oregon and Commuter Cars Corporation in Washington. The number of identified companies with explicit connections to the EV supply chain does not fully reflect the region’s potential to EV manufacturing, however. This is because the region hosts well-established tech and aerospace industries, which offer potential synergies in the EV field.

Jobs in EV supply chains are predicted to grow, though the predicted growth varies across occupations. With the increasing electrification of transportation, jobs in the EV supply chain in the region are growing. Oregon is predicted to have 6% more jobs in occupations most closely related to the EV supply chain in 2025 than in 2019, and the predicted growth in Washington is 7%. There are differences between occupations, however. For example, jobs for Electricians, Software Developers, and Operations Research Analysts, the highest growing occupations in both states, are expected to grow at an average of 13.4% in Oregon and 15.0% in Washington. At the same time, the occupations with most negative outlook, Electronic Equipment Installers and Repairers for Motor Vehicles, and Electrical,
Electronic, and Electromechanical Assemblers are predicted to decline at an average of 8.0% in Oregon and 9.3% in Washington.

**Women and people of color in the EV-related workforce are particularly vulnerable to economic trends.** The different growth rates of occupations most closely related to the EV supply chain have dramatic implications for the workforce because the demographics of the workforce varies across occupations. In particular, the share of women is much higher in the occupations that are expected to see a decline in jobs, 33%, than in the occupations with expected growth, 16%. For comparison, the overall share of women in the field in the Pacific Northwest is 19%. Similarly, the share of people of color is higher in the occupations with a negative outlook: 36% of the workforce in the declining occupations are people of color, compared to the 31% in the occupations with predicted growth. Overall, people of color are 33.5% of the workforce in the field in the Pacific Northwest. The demographics vary greatly between occupational groups and occupations, however. For example, the share of Asian and Asian American workers is particularly high in many Architecture and Engineering Occupations (19% of the workforce in Oregon and 18% in Washington) and Computer and Mathematical Occupations (21% of the workforce in Oregon and 39% in Washington), thus driving up the overall share of people of color in the field and in the EV-related occupations with a positive outlook. For comparison, the share of Asian and Asian American workers in the overall workforce in the Pacific Northwest is 8.0%.

**Recommendations**

To ensure a pipeline of qualified workers in the growing EV field, and to develop a workforce development strategy that leads to a more equitable and more sustainable sector, this report recommends the following:

**Innovate together with key partners in industry, the public sector, and education and training institutions.** Multiple industry experts consulted for this project called for collaboration and coordination between the public, private, and education sectors. The findings of this report support such collaboration. The final section presents the Professional Automotive Training Center at Shoreline Community College in Washington as an example of a successful public-private training partnership: The Center hosts various Service Technician training programs in which auto manufacturers work together with the college to provide the curriculum. The Center has trained more than 1,300 students and the programs have resulted in significant savings in training costs for the partnering employers. Moreover, the programs have successfully placed students in living-wage jobs. By bringing the different stakeholders together, the public sector can play a leading role in ensuring that the technological and business advancements occurring in the EV field are coupled with equally innovative training programs and initiatives in the public sector.

**Design and implement training initiatives directed at underserved populations.** The workforce research highlights a lack of diversity in certain EV-related occupations and economic trends with negative implications for women and people of color. We recommend designing training programs in the EV field that would target underserved populations and connect them to living wage jobs. For example, the I-BEST programs in Washington provide educational access to individuals who have traditionally struggled in college-level occupational programs, including adult basic education and English-as-a-second-language students. The I-BEST programs provide joint instruction by a basic skills teacher and a technical or academic teacher, helping students with low levels of academic skill to succeed in college-level coursework. In addition to these sorts of college-led programs, underserved populations can benefit from shorter training programs that focus on creating access to entry-level positions. These initiatives have shown promise in many other sectors.
Develop EV-specific curricula and trainings. As the technology in electric vehicles continues to develop and the mass production of EVs expands, the need for a more specialized workforce increases. We recommend working with institutions that have strong educational programs in the EV-related fields to develop curricula and training that is directed at the particular needs of EV production. Public-private training partnerships can also play a role here, as partners in the private sector know the rapidly-changing industry and its occupational needs best, whereas the public sector can ensure that the interventions and initiatives adopted lead to a more diverse and inclusive industry.
The Openings for New Business that Electric Vehicle Production Can Create

As the electrification of transportation continues in the U.S., drivers in the Pacific Northwest have proven to be among the early adopters. In 2018, the market share of sold electric vehicles (EVs) was higher in Washington (4.3%) and Oregon (3.4%) than in any other state, except for California (7.8%). Moreover, the growing number of electric motor vehicles in the region is not limited to electric cars. For example, the region has adopted an electric school bus, an electric solid waste truck, and electric buses powered by wind energy.

Yet, for two main reasons, we have a very limited understanding of the potential implications of growing electric vehicle sales on workers. First, the supply chains of electric motor vehicles are still developing, due to dramatic technological changes in the field. Many of the key actors in the emerging electric motor vehicle manufacturing are start-ups or small-to-medium sized enterprises that may not be involved in the established supply chains of non-electric motor vehicles. Given this emergence of new actors, and the dramatic changes in technology and business models that are closely related to their entrance to the field, the impacts of growing electric motor vehicle manufacturing on the labor force are hard to predict.

Second, the existing labor market data does not track the businesses and jobs in electric motor vehicle manufacturing. More specifically, the standard classification system for businesses and jobs in the U.S., the North American Industry Classification System (NAICS), does not distinguish between the manufacturing of traditional cars and electric cars; or the manufacturing of electric and traditional light trucks and utility vehicles; or the manufacturing of electric and traditional heavy-duty trucks. As a result, the classification does not allow us to analyze the labor force involved in electric motor vehicle manufacturing. The lack of labor market data complicates the analysis of current workers in the sector and this, in turn, makes it difficult to predict future trends.

This report is based on original research that Seattle Jobs Initiative (SJI) conducted with the goal of analyzing the electric motor vehicle-related business in Oregon and Washington, assessing the current and future regional occupational needs in the industry, and identifying potential partners to engage in workforce training. To overcome some of the challenges that the changing supply chains and the lack of data pose, and to achieve a comprehensive assessment of Oregon’s and Washington’s capacity and potential in EV-related motor vehicle production, SJI undertook the following research tasks:

- Review of existing literature on electric motor vehicle production, including cars, trucks, and buses. The literature review helped us identify the NAICS codes most relevant to the electric

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* In this report, the term "electric motor vehicle" will include both electric cars and electric commercial vehicles, including buses and trucks.
† The Bureau of Labor Statistics (BLS) began to address this issue in 2010 by developing a coding standard that would identify industries and jobs related to producing goods or services that benefit the environment or conserve natural resources. However, due to budget cuts, the project was cancelled in March 2013. In that time, BLS identified the sectors of the auto industry that contain production of green goods and services. However, it is of limited use for analyzing EVs, ETs, and ZEBs production today because the coding does not consider heavy duty truck manufacturing, a significant part of the emerging EV industry.
motor vehicle supply chains. The existing literature and the NAICS codes that we selected for further analysis are presented in the first section of the report.

- Database and online search to identify and examine the businesses in Oregon and Washington that have electric motor vehicle–related production. The details of the research methodology and the results will be presented in the second section.

- Analysis of the existing and potential workforce in electric motor vehicle manufacturing in Oregon and Washington. The third section focuses on analyzing the industry in the region and, especially, its occupational makeup and future occupational demand.

- Identification of key partners. The fourth section introduces institutions and organizations with the greatest potential to contribute to the education and training of the future EV-related workforce in the region.

- The fifth section offers recommendations for future steps.

Throughout this report, the terms “electric vehicle” (EV) and “electric motor vehicle” will be used interchangeably when referring to electric passenger cars and electric commercial vehicles, including buses and trucks. The next section will introduce some technical differences between different types of electric vehicles. However, in general the term “electric car” will refer to battery-run passenger cars, and the terms “electric bus” and “electric truck” will refer to all zero-emissions buses and trucks, including battery- and hydrogen fuel cells–powered vehicles.

**Good News: The Barriers to Entry Are Lower in EV-Related Industries**

Perhaps the most important difference between the production of EVs and traditional, internal combustion engine vehicles (ICEs) is in the barriers to entry: the barriers to entry are much lower in EV production than in the production of ICEs. This, in turn, creates openings for new small- and medium-sized companies that have been excluded from the existing ICE supply chains. The high entry barriers in the conventional auto industry are created by the well-established manufacturing process: the car is divided into different car sub-systems, or modules, that are then produced simultaneously. This allows companies to increase the scale of production and shrink the associated costs. However, it also requires expensive upfront investment in assembly line equipment, making it difficult for new actors to break into the industry.¹⁰

Some of these high entry barriers are removed in the mass production of electric vehicles. In EVs, the traditional components of the powertrain (fuel storage, engine and related transmission) are replaced by new modules: battery, electric motor and related transmission. Moreover, many components that are currently used in internal combustion engine vehicles will be no longer necessary (e.g. exhaust, intake, O₂ sensor, exhaust gas recirculation or EGR).¹⁰ Other components, such as air conditioning, water units, brakes and steering systems need to be adapted.¹¹ All these changes are reflected in the supply chain; car manufacturers have traditionally considered the ICE powertrain module as one of their core competencies and, in turn, have not focused on electrical components.¹¹ As a result, the production of EVs requires new components and competencies outside the existing, established auto supply chain. This creates room for small- and medium-sized enterprises excluded from the traditional car supply chain to enter EV production.¹⁰,¹²,¹³ †

¹ Given proprietary rights, the lack of standard classification system for the industry, and the challenges created by the changing technology and business models, the existing research on electric motor vehicle supply chains remains limited. This section is based on analyses that identify some key differences between the supply chains of electric vehicles (EV) and traditional, internal combustion engine (ICE) vehicles.

† For example, about 56% of the content of a Chevy Bolt, an EV, comes outside the traditional supply chain.
Less research exists on the supply chain of electric commercial vehicles but, in general, their manufacturing is undergoing similar changes as EVs. Various traditional truck and bus manufacturers are currently working on developing electric models and addressing the technical challenges in the sector, and, since 2016, there has been notable progress especially in the development of heavy-duty trucks and city buses. Just as with EVs, the manufacturing of electric trucks and buses has also opened the industry to new actors: according to analysts, new manufacturers like Nikola and Tesla have the potential to disrupt the market and make electric trucks more available even sooner than currently expected. An example of the innovation taking place in the electric bus sector is U.S.-based company, Proterra, that recently announced a partnership with Mitsui & Co. to lease electric batteries. By separating the cost of batteries from the costs of its buses, Proterra promises to bring the cost of its electric buses to roughly the same with a diesel bus.

**Who Could Enter the EV Field? The Supply Chain in More Detail**

In order to identify the companies in EV-related production, and the companies with potential to enter the field, we need to establish the unique components in electric vehicle production. The key difference between an electric motor vehicle and the corresponding traditional vehicle is their power source: while traditional vehicles have an internal combustion engine that generates power by burning gasoline, electric motor vehicles run either on energy stored in rechargeable batteries or on hydrogen fuel. The replacement of the internal combustion engine with a battery and an electric motor – the more common technology in passenger cars – changes the established supply chain dramatically, since the internal combustion engine is one of traditional auto manufacturers’ core competencies. Consequently, they have built the engine in-house with components from established suppliers that specialize in auto hardware. With EV production, things change: many of the components of internal combustion engine vehicles will no longer be necessary (e.g., exhaust, intake, O2 sensor, EGR) and manufacturers will need to direct their focus to electrical components. Moreover, other existing components, such as air conditioning, water units, brakes and steering systems need to be adapted. These differences force auto manufacturers to modify their existing supply chain.

To compare the components of electric cars and ICEs in more detail, we can look at the supply chain of Chevy Bolt, an electric car. The financial firm UBS took a Chevy Bolt apart and compared the breakdown to a similar ICE car. Figure 1, below, present the key differences between the cars’ main components. The figures illustrate that the role of the traditional auto hardware suppliers, often called Tier 1 suppliers, diminishes dramatically when moving from producing an ICE to producing a Chevy Bolt: whereas the role of Tier 1 suppliers beyond powertrain electronics is 68% in the ICE, this percentage is only 28% in the Chevy Bolt. In turn, the battery and powertrain electronics are 56% of Chevy Bolt’s contents, while the ICE does not have a battery and the powertrain electronics are only about 2% of the car’s contents. In short, many traditional Tier 1 suppliers have only a small role in EV production, and EV production is creating openings for new businesses outside the established supply chains, especially in the production of batteries and electronics.

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* In electric passenger cars, the battery-driven cars dominate the market, and, for this reason, the analysis below focuses on that technology. The development of hydrogen fuel technology is more advanced in commercial vehicles so the sections on electric trucks and buses will return to the topic.

† The Appendix (Appendix A) includes a more detailed presentation of the ICE supply chain.
To identify the openings for new companies in the sector, we tracked down the NAICS codes for the suppliers of Chevy Bolt, as identified by UBS. More specifically, we conducted online searches to find the primary NAICS codes of particular companies supplying certain components to Chevy Bolt. The results of our research are listed in Table 1. This list will then help identify which companies in Oregon and Washington operate in industries that are related to the EV supply chain.


Figure 1. Comparison of Chevy Bolt and Comparable ICE Car Components

* It is important to note that there is no central agency that assigns companies their “official” NAICS codes. Moreover, the federal government does not release data on companies’ NAICS codes or indicate the codes that some of its entities have assigned to businesses. Consequently, different sources might list different codes for companies, making it difficult to establish their “true” NAICS codes. That said, we
Table 1. NAICS Codes for Manufacturing of EV Components

<table>
<thead>
<tr>
<th>Component</th>
<th>NAICS code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Cell</td>
<td>335911 – Storage Battery Manufacturing</td>
</tr>
<tr>
<td>Battery Management</td>
<td>335912 - Primary Battery Manufacturing (for fuel cell technology)</td>
</tr>
<tr>
<td>Battery Pack</td>
<td></td>
</tr>
<tr>
<td>Battery Charger</td>
<td>335999 - All Other Miscellaneous Electrical Equipment and Component Manufacturing</td>
</tr>
<tr>
<td>Electric Motor</td>
<td>335312 - Motor and Generator Manufacturing</td>
</tr>
<tr>
<td>Gearbox</td>
<td>336350 - Motor Vehicle Transmission and Power Train Parts Manufacturing</td>
</tr>
<tr>
<td>Power Distribution Module</td>
<td>336320 – Motor Vehicle Electrical and Electronic Equipment Manufacturing</td>
</tr>
<tr>
<td>Inverter</td>
<td>334419 - Other Electronic Component Manufacturing</td>
</tr>
<tr>
<td>DC/DC Converter</td>
<td>334413 – Semiconductor and Related Device Manufacturing, 335999 - All other miscellaneous electrical equipment and component manufacturing</td>
</tr>
<tr>
<td>Thermal Management</td>
<td>336390 - Other Motor Vehicle Parts Manufacturing</td>
</tr>
<tr>
<td>Connections/Wiring</td>
<td>336390 - Other Motor Vehicle Parts Manufacturing</td>
</tr>
</tbody>
</table>

Source: Hummel P, Lesne D, Radlinger J, et al. UBS Evidence Lab Electric Car Teardown-Disruption Ahead; SJI’s research

Consultations with industry experts suggest that the NAICS codes for electric commercial vehicle production resemble those of EV production. As with electric cars, the supply chains of electric trucks and buses are still developing. In fact, the Director of Product Planning at Kenworth, one of the main truck manufacturers globally, describes the supply base for all electrified components as “relatively immature.” The increasing mass production of electric cars does not translate directly to the manufacturing of trucks, as the electrified components of cars cannot be simply applied to trucks. Consequently, truck manufacturers must work with their suppliers to develop electrified components and build up the production of those components. For example, Kenworth is currently ordering components from suppliers and integrating them into the chassis in-house but, at the same time, it is working towards a more vertically integrated supply chain, aiming to build the components in-house at the lowest price possible.

Whereas the mass production of electric vehicles has converged on battery-powered vehicles, electrified trucks and buses are being developed and produced with both battery and hydrogen fuel cell technology. This is partly because of the technical limitations of batteries: today’s batteries are too heavy and too expensive to be viable for commercial vehicles. Hydrogen cell technology, in contrast, gives trucks a greater range and quicker refueling times. For this reason, the demand for hydrogen fuel cell buses is also increasing. In order to be able to identify the companies that could participate in the electric commercial vehicle supply chain, we complement the list presented in Table 1 with the code for Primary Battery Manufacturing (335912), a category we identified for businesses that supply fuel cell components on the list of NAICS above, and they confirmed the codes’ relevance to the EV production.
technology used to power electric trucks and buses. The next section of the report proceeds to identify the companies that operate under these NAICS codes in Oregon and Washington, with the goal of establishing the state of the EV related business in the region and the opportunities that the lower barriers to entry in the field offer for business.

**Existing and Potential Businesses in the EV-Related Industries**

One of the most consistent recommendations across the field of economic development is to improve coordination between industry, education and training institutions, and the public sector. Coordination is needed because when there is a local shortage of appropriate labor, offshoring and automation become increasingly cost-effective options, moving economic activity and jobs out of the region. In addition, many fields are evolving so quickly that workers need to engage regular training and upskilling in order to stay relevant in their field. To facilitate the coordination, we have identified the businesses in Oregon and Washington that are or may be part of the EV supply chain.

**Identifying EV-Related Firms in Oregon and Washington**

As the electric vehicle industry is emerging, the North American Industry Classification System (NAICS) has not yet developed a classification for it. For this reason, we identified EV-related businesses by searching in two main directions: traditional motor vehicle manufacturing and manufacturing of additional EV-related components, such as electronics and battery manufacturing. By including these two directions, we aim to capture both businesses involved in developing new EV technology, and businesses that integrate existing technology into new, EV products.

We used the database “Business Data” by DatabaseUSA.com, provided by labor market analytics software Emsi. Database USA uses sources such as new business filings, press releases, corporate websites, and annual reports to gather data on existing businesses. For the motor vehicle manufacturing, we used their database to identify all companies in Oregon and Washington that lists their primary NAICS code as any of the following:

- 3361 Motor Vehicle Manufacturing
- 3362 Motor Vehicle Body and Trailer Manufacturing
- 3363 Motor Vehicle Parts Manufacturing

These 4-digit NAICS codes capture manufacturing in the entire motor vehicle industry, including automobiles, light trucks and utility vehicles, and heavy-duty trucks. In other words, these codes capture the ICE-vehicle manufacturing that is or can also be part of EV-vehicle supply chain. The code 336310 - Motor Vehicle Gasoline Engine and Engine Parts Manufacturing was excluded, however, as that code contains production exclusive to ICE cars.

The list includes parts manufacturing but, importantly, there are several firms that manufacture body panels that are not captured via this list. Body panels are particularly important for EV production, as

* DatabaseUSA.com collects the data using proprietary methods, Emsi does not endorse or warrant the data's accuracy or consistency.
electric cars need to be lighter than their ICE counterparts. For this reason, the following codes were added:

331315 Aluminum Sheet, Plate, and Foil Manufacturing
331318 Other Aluminum Rolling, Drawing, and Extruding
331512 Steel Investment Foundries
335991 Carbon and Graphite Production

In order to capture the parts of electric motor vehicle industry that are not classified under the codes for traditional motor vehicle manufacturing, we supplemented the search codes with the EV-relevant NAICS codes, as identified in Section 1.† These NAICS codes include:

334419 Other Electronic Component Manufacturing
335312 Motor and Generator Manufacturing
335911 Storage Battery Manufacturing
335912 Primary Battery Manufacturing
335999 All Other Miscellaneous Electrical Equipment and Component Manufacturing
336320 Motor Vehicle Electrical and Electronic Equipment Manufacturing
336350 Motor Vehicle Transmission and Power Train Parts Manufacturing

Identified Firms in the Region

The Business Data database identifies a total of 355 locations for 353 unique firms in Oregon and Washington associated with the selected NAICS codes. This search was augmented by reviewing previous research done in the area, adding design, engineering, and manufacturing for a total of 417 businesses.‡ We reviewed the companies’ websites for any connection or potential connection to EV related business, including trucks and buses, and identified six categories of business:

1. Explicit EV Manufacturing
2. EV Infrastructure Manufacturing (Charging)§
3. General Automotive Manufacturing
4. ICE-Oriented Automotive Manufacturing
5. Other Related Manufacturing
6. Not Related††

We excluded 204 businesses. This included businesses which were no longer in operation, distributors, metal fabrication and electronic manufacturing that are unrelated to EV, those that manufactured materials tools and instruments that were not themselves EV components, small automotive customization businesses, automotive repair shops, and integrated lock installation companies. The final count is 213 business in 13 industries (Figure 2 & Appendix B).

† The Business Data database returned no Carbon and Graphite Production businesses currently operating in Oregon or Washington.
‡ The NAICS code 334413 Semiconductor and Related Device Manufacturing was excluded. DatabaseUSA.com identifies 47 businesses in Oregon and Washington with 334413 as their primary NAICS code.
§ Other work has looked more broadly at EV market and infrastructure including sales and advocacy, which are outside of the scope of this work. In addition, a number of the businesses identified are either no longer in operation or no longer in operation in the region.
†† Though EV charging was explicitly excluded from the scope of this project, eleven firms identified both through the database search and previous work manufacturing charging stations.
Figure 2. Map of EV-Related Manufacturing in Oregon & Washington
<table>
<thead>
<tr>
<th>Business Name</th>
<th>City</th>
<th>State</th>
<th>Primary NAICS</th>
<th>Business Size</th>
<th>Year Established</th>
<th>Sales Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest Power, Inc.</td>
<td>Portland</td>
<td>OR</td>
<td>334419</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tektronix Component Solutions</td>
<td>Beaverton</td>
<td>OR</td>
<td>334419</td>
<td>200</td>
<td>1994</td>
<td>$43,462,120</td>
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<td>Te Connectivity</td>
<td>Wilsonville</td>
<td>OR</td>
<td>334419</td>
<td>300</td>
<td>2000</td>
<td>$65,193,180</td>
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<tr>
<td>Tate Technology Inc</td>
<td>Spokane</td>
<td>WA</td>
<td>334419</td>
<td>33</td>
<td>1991</td>
<td>$6,801,649</td>
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<td>Sunstone Circuits</td>
<td>Mulino</td>
<td>OR</td>
<td>334419</td>
<td>168</td>
<td>2005</td>
<td>$36,508,181</td>
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<tr>
<td>Sanmina Corporation</td>
<td>Vancouver</td>
<td>WA</td>
<td>334419</td>
<td>4</td>
<td></td>
<td>$869,242</td>
</tr>
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<td>Qorvo</td>
<td>Bend</td>
<td>OR</td>
<td>334419</td>
<td>25</td>
<td>1989</td>
<td>$5,187,832</td>
</tr>
<tr>
<td>Midnite Solar</td>
<td>Arlington</td>
<td>WA</td>
<td>334419</td>
<td>10</td>
<td>2006</td>
<td>$2,301,075</td>
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<td>Mcx Inc</td>
<td>Klamath Falls</td>
<td>OR</td>
<td>334419</td>
<td>36</td>
<td>1981</td>
<td>$7,148,073</td>
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<td>Maxim Integrated Products</td>
<td>Beaverton</td>
<td>OR</td>
<td>334419</td>
<td>600</td>
<td>1981</td>
<td>$130,386,360</td>
</tr>
<tr>
<td>Linear Technology</td>
<td>Bellevue</td>
<td>WA</td>
<td>334419</td>
<td>4</td>
<td>2000</td>
<td>$920,430</td>
</tr>
<tr>
<td>Honeywell Electronic</td>
<td>Spokane</td>
<td>WA</td>
<td>334419</td>
<td>400</td>
<td>1961</td>
<td>$82,444,232</td>
</tr>
<tr>
<td>Crane Electronics+B252</td>
<td>Redmond</td>
<td>WA</td>
<td>334419</td>
<td>275</td>
<td>1980</td>
<td>$63,279,574</td>
</tr>
<tr>
<td>Analog Devices</td>
<td>Camas</td>
<td>WA</td>
<td>334419</td>
<td>295</td>
<td>1996</td>
<td>$64,106,627</td>
</tr>
<tr>
<td>Alpha Technologies Inc</td>
<td>Bellingham</td>
<td>WA</td>
<td>334419</td>
<td>400</td>
<td>1978</td>
<td>$152,328,041</td>
</tr>
<tr>
<td>Toshiba International</td>
<td>Vancouver</td>
<td>WA</td>
<td>335312</td>
<td></td>
<td></td>
<td>$368,260</td>
</tr>
<tr>
<td>Cooper Bussmann Transportation</td>
<td>Tualatin</td>
<td>OR</td>
<td>335312</td>
<td>55</td>
<td>1972</td>
<td>$20,254,295</td>
</tr>
<tr>
<td>SGL Carbon</td>
<td>Moses Lake</td>
<td>WA</td>
<td>335991</td>
<td>450</td>
<td></td>
<td>$107,000,000</td>
</tr>
<tr>
<td>Entek International LLC</td>
<td>Lebanon</td>
<td>OR</td>
<td>335999</td>
<td>250</td>
<td>1983</td>
<td>$89,979,350</td>
</tr>
<tr>
<td>Anderson Electric Controls Inc</td>
<td>Kent</td>
<td>WA</td>
<td>335999</td>
<td>20</td>
<td>1969</td>
<td>$8,248,897</td>
</tr>
<tr>
<td>Excide Technologies</td>
<td>Portland</td>
<td>OR</td>
<td>336111</td>
<td></td>
<td></td>
<td>$13,084,342,825</td>
</tr>
<tr>
<td>Daimler Truck North America</td>
<td>Portland</td>
<td>OR</td>
<td>336111</td>
<td></td>
<td>2018</td>
<td>$13,084,342,825</td>
</tr>
<tr>
<td>Arcimoto Inc</td>
<td>Eugene</td>
<td>OR</td>
<td>336111</td>
<td></td>
<td>2007</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>Paccar Inc</td>
<td>Bellevue</td>
<td>WA</td>
<td>336111</td>
<td>55</td>
<td>1961</td>
<td>$96,139,207</td>
</tr>
<tr>
<td>Commuter Cars Corp</td>
<td>Spokane</td>
<td>WA</td>
<td>336111</td>
<td>3</td>
<td>1998</td>
<td>$4,697,836</td>
</tr>
<tr>
<td>Tesla Power Electric</td>
<td>Portland</td>
<td>OR</td>
<td>336390</td>
<td>139</td>
<td>2003</td>
<td>$9,586,506</td>
</tr>
<tr>
<td>Cascade German</td>
<td>Gresham</td>
<td>OR</td>
<td>336390</td>
<td>11</td>
<td>2004</td>
<td>$4,715,479</td>
</tr>
<tr>
<td>Kenworth Truck Co</td>
<td>Kirkland</td>
<td>WA</td>
<td>336390</td>
<td>523</td>
<td>1923</td>
<td>$237,402,205</td>
</tr>
<tr>
<td>Heavy Duty Transaxle Inc</td>
<td>Monroe</td>
<td>WA</td>
<td>336390</td>
<td>139</td>
<td>1995</td>
<td>$63,095,423</td>
</tr>
<tr>
<td>Consolidated Metco Inc</td>
<td>Vancouver</td>
<td>WA</td>
<td>336390</td>
<td>100</td>
<td>1964</td>
<td>$80,591,821</td>
</tr>
</tbody>
</table>
The database search identified 30 companies with explicit connections to the sector (see Table 3) and additional 19* were drawn from prior research. These firms are a variety of sizes. There are several small businesses alongside large multinational corporations. The presence of the small firms is evidence there are lower barriers to entry in the EV-sector. However, these firms are by-and-large established firms. Twenty-one of them were established 20 years or more ago and none were founded this decade.

The presence of the large multinationals is evidence that this is a viable business model, particularly as EVs require new infrastructure—charging stations and overhead lines—and the large multinational corporations also manufacture EV infrastructure.

Fourteen of the companies identified operate in Oregon, and 15 in Washington. According to the Business Data database none of the companies is female- or minority-owned. Their median number of employees is 139, and their median sales volume is $39,985,150.50†, though this is the overall sales volume and not unique to EV manufacturing with a few key exceptions. However, we are missing data from a few key firms, both those represented in the Business Data and those not represented in that data.

According to our research, six companies in the region produce electric motor vehicles. Daimler in Oregon and Paccar and its subsidiary Kenworth Trucks in Washington manufacture electric heavy trucks, Commuter Cars Corporation in Washington and Arcimoto in Oregon produce custom-made electric commuter cars, and Boxx and RYN0 Motor make specialty scooters. In addition to these actors, other employers in the sector are involved in battery manufacturing, battery management and control, body panels, and other components (such as axles), particularly related to heavy industry.

The firms that already have explicit connections to EV manufacturing do not fully reflect the potential for EV manufacturing in the region. Outside of the powertrain, ICE vehicle and EV manufacturing are largely comparable. For example, both ICE vehicles and EV have seats, mirrors, and body panels, though innovative EV companies may also employ unconventional materials or production methods in many of their components. Other components may be more specific to one or the other but existing ICE capacity can be retooled and retrained to make the EV analog.

In contrast, electronics and battery manufacturers, particularly those that do not already have explicit connections to EV manufacturing are not necessarily good fits for the EV supply chain. Several make products that are not directly applicable (e.g., glassware for semi-conductor manufacturing). Others are explicitly committed to another industry (e.g., aerospace) supply chain and, though they may produce something directly applicable to EV production, would have to develop a new market. However, the large presence of both aerospace, defense, and electronics/computer hardware manufacturing in the region means there are many firms that make applicable parts, including several firms that specialize in

* Because they were not present in the Business Data database, we do not have data regarding their size, founding, or sales volume. These companies are a mix of local, multinational, small, and large. They are included in Appendix B.
† Excludes Daimler Truck North American Sales as the only figures available were sales for the global corporation and not the operations in the Pacific Northwest.
customizing and supporting rapid prototyping, which is promising for an emerging field and keeps barriers to entry low as new firms can contract with these producers for small components.

**Volume of Business in the Region**

Many of the companies reviewed are privately owned and, as a result, detailed information on their markets, revenues, and role in electric motor vehicle supply chains are not publicly available. However, we can assess the purchases that the companies with the electric motor vehicle relevant NAICS codes are making in and out the region. While this does not allow us to focus only on EV-related business, it gives us an estimation of how much of their supply comes from within and outside the Pacific Northwest.

*Table 3. Industry Purchases and Sales in Oregon and Washington in 2018: All Motor Vehicle Industry*  

<table>
<thead>
<tr>
<th>State</th>
<th>NAICS codes group</th>
<th>In-state/ In-region Purchases</th>
<th>% In-state/ In-region Purchases</th>
<th>Imported Purchases</th>
<th>% Imported Purchases</th>
<th>Total Purchases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OR</strong></td>
<td>Motor vehicle industry (4-digit NAICS)</td>
<td>$780,617,741</td>
<td>45.0</td>
<td>$952,231,519</td>
<td>55.0</td>
<td>$1,732,849,260</td>
</tr>
<tr>
<td><strong>WA</strong></td>
<td>Motor vehicle industry (4-digit NAICS)</td>
<td>$738,696,223</td>
<td>34.1</td>
<td>$1,429,075,739</td>
<td>65.9</td>
<td>$2,167,771,962</td>
</tr>
<tr>
<td><strong>OR and WA</strong></td>
<td>Motor vehicle industry (4-digit NAICS)</td>
<td>$1,783,606,777</td>
<td>45.7</td>
<td>$2,117,014,446</td>
<td>54.3</td>
<td>$3,900,621,223</td>
</tr>
</tbody>
</table>

Source: Emsi

Table 3 presents the in-region purchases for the companies that operate in the “traditional” auto industry (NAICS codes 3361 Motor Vehicle Manufacturing, 3362 Motor Vehicle Body and Trailer Manufacturing, 3363 Motor Vehicle Parts Manufacturing). Both in Oregon and Washington, the companies import more components than buy them in-state. However, Washington relies more on imports than Oregon: Washington imports 65.9% of the purchases and buys 34.1% in-state, whereas in Oregon the share of out-of-state imports is 55.0% and the share of in-state purchases is 45.0%.

Similarly, when we focus on the purchases of all electric motor vehicle–related industries, including the “traditional” auto industry and the producers of other components of electric motor vehicles, as identified in Section 1, Washington relies more on imports than Oregon does. Companies in Washington import

* For Oregon and Washington, the table presents the in-state and out-of-state purchases. For Oregon and Washington combined (the last row of the table), the table presents the in-region and out-of-region purchases.
54.8% of their purchases, whereas that share is only 40.1% in Oregon. Table 4 presents these in-state and out-of-state purchases for electric motor vehicle–related industries in Oregon, Washington, and the states combined. The table also lists the total in-region sales to other industries. The last two columns of the table show that while the total purchases in these industries are about the same in Oregon and Washington, the industries in Washington sell more of their products and services to other industries in the state ($1,317,983,538) than the industries in Oregon do ($913,268,274).

Finally, it is important to keep in mind that the traditional auto industry is relatively small in the Pacific Northwest. According to EMSI, the traditional auto industry (NAICS codes 3361, 3362, 3363) employed 10,525 people in Oregon and Washington in 2019. The number is 71% below the national average. A producer of a custom-made electric car in Washington suggests that the lack of well-established passenger car manufacturing makes it difficult to find parts in the region. We consulted with Rick Woodbury, President of Commuter Cars, in order to gain additional insight into the in-region purchases of the EV field. Commuter Cars, based in Spokane, WA, produces the Tango, an extra-narrow electric car. According to Woodbury, it is hard to obtain parts for the Tango in the region. He has made deals with local dealerships for some parts of the Tango and bought some of the required materials, such as copper sheets and carbon fiber, regionally. Most of the components, however, have been ordered online, usually from the U.S. Midwest or China.

Table 4. Electric Motor Vehicle-Related Industry Purchases and Sales in Oregon and Washington in 2018

<table>
<thead>
<tr>
<th>State</th>
<th>In-state/In-region Purchases</th>
<th>% In-state/In-region Purchases</th>
<th>Imported Purchases</th>
<th>% Imported Purchases</th>
<th>Total Purchases</th>
<th>Total In-state/In-region Sales (to other industries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>$1,379,502,171</td>
<td>59.4</td>
<td>$942,406,992</td>
<td>40.1</td>
<td>$2,321,909,163</td>
<td>$913,268,274</td>
</tr>
<tr>
<td>WA</td>
<td>$771,288,206</td>
<td>35.2</td>
<td>$1,420,764,015</td>
<td>54.8</td>
<td>$2,192,052,221</td>
<td>$1,317,983,538</td>
</tr>
<tr>
<td>OR &amp; WA</td>
<td>$2,449,214,803</td>
<td>54.3</td>
<td>$2,064,746,582</td>
<td>45.7</td>
<td>$4,513,961,385</td>
<td>$3,760,325,847</td>
</tr>
</tbody>
</table>

Industries of companies identified above (6-digit NAICS). Source: Emsi

* The industries include the following NAICS codes: 3361, 3362, 3363, 334419, 335312, 335911, 335912, 335999, 336320, 336350.
† For Oregon and Washington, the table presents the in-state and out-of-state purchases. For Oregon and Washington combined (the last row of the table), the table presents the in-region and out-of-region purchases.
To conclude, the EV industry has a foothold in the region. This is thanks to a combination of low barriers to entry, making it possible for new firms to enter, along with the well-established tech sector and aerospace industry, which have a cadre of firms that make customized components for rapid prototyping. This is promising for the industry as a whole, even if the region has not been considered a stronghold for manufacturing of traditional passenger cars. Our consultations with industry representatives suggest that while there are not many regional suppliers overall, there are potential synergies in the EV and related fields like aerospace and computer hardware manufacturing, large industries in Oregon and Washington.

Taking advantage of the potential synergies in the EV and other related fields does present some specific workforce challenges, however. Namely, workers must be adaptable and receive ongoing training in an emerging industry that is developing prototypes. In order to take advantage of the strengths created by these existing, emerging industries, effective coordination with players in the field is critical so that both workers entering the field and incumbent workers are supported. The next section of the report takes a closer look at the workforce that is connected to the EV-related industries in the Pacific Northwest, and Section 4 will identify key partners to consider for workforce development.

The Current and Future Workforce in the EV-Related Industries

This section analyzes the workforce related to the electric vehicle supply chain in Oregon and Washington. The research leads to a few important conclusions. First, the EV-related industries employ plenty of workers in Oregon and Washington. While the overall predictions for future job openings in these industries are somewhat negative, partly due to offshoring and automation, there is notable variation between different occupations. For example, openings in occupational groups such as Engineering and Computer Science Occupations are predicted to increase, while jobs in many Production Occupations are expected to decrease. Furthermore, when we analyze the current workforce in these occupations in more detail, we uncover some concerning trends. For instance, the occupations with disproportionately high shares of women and people of color tend to have more negative outlooks than the occupations that are dominated by white and male workers. The findings have clear implications when considering preparing the regional workforce for the electrification of transportation: while the EV-related industries employ plenty of workers, education and training policies and initiatives are needed to ensure that the most vulnerable workers in these sectors are able to enter the growing fields.
Figure 3 presents the projected overall change in the number of jobs in the industries connected to the EV supply chain from 2019 to 2025. In 2019, Oregon and Washington employed 37,884 and 15,826 workers in the sector, respectively. The workforce in Oregon is projected to decline by 11 jobs (0%) and in Washington by 328 jobs (2%) by 2025. For comparison, the graph also includes the predicted change in the U.S. as a whole which is, at a 4% increase, higher than in the Pacific Northwest.

In both states, the Semiconductor and Other Electronic Component Manufacturing (NAICS code 3344) industries employ the largest share of workers: 79% of the workforce in Oregon and 44% of the workforce in Washington works in that sector. To ensure that changes in this industry—or any other industry among the electric motor vehicle-related industries—is not driving the overall pattern in Figure 3, we can examine

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* The analysis is done with the following 4-digit NAICS codes: Motor Vehicle Manufacturing (NAICS code 3361), includes the manufacturing of cars, light trucks and utility vehicles, and heavy duty trucks, Motor Vehicle Body and Trailer Manufacturing (NAICS code 3362), Motor Vehicle Parts Manufacturing (NAICS code 3363), Semiconductor and Other Electronic Component Manufacturing (NAICS code 3344), Electrical Equipment Manufacturing (NAICS code 3353), and Other Electrical Equipment and Component Manufacturing (3359, includes primary battery and storage battery manufacturing).

† The share of workers in these industries of overall workforce in the state is 2.0% in Oregon and 0.5% in Washington.
the projections in each EV-related industry individually. Table 5 presents these projections, highlighting some variation between the industries.

Table 5. Predicted Change in Jobs in Electric Motor Vehicle-Related Industries in 2019-2025

<table>
<thead>
<tr>
<th>Industry</th>
<th>Oregon</th>
<th>Washington</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor Vehicle Mfg (3361)</strong></td>
<td>-7% (791 and 733)</td>
<td>10% (1,353 and 1,489)</td>
<td>9% (238,287 and 259,350)</td>
</tr>
<tr>
<td><strong>Motor Vehicle Body and Trailer Mfg (3362)</strong></td>
<td>4% (3,569 and 3,694)</td>
<td>2% (797 and 813)</td>
<td>7% (165,133 and 176,878)</td>
</tr>
<tr>
<td><strong>Motor Vehicle Parts Mfg (3363)</strong></td>
<td>-3% (1,604 and 1,551)</td>
<td>2% (2,412 and 2,460)</td>
<td>5% (601,655 and 630,203)</td>
</tr>
<tr>
<td><strong>Semiconductor and Other Electronic Component Mfg (3344)</strong></td>
<td>0% (29,897 and 29,943)</td>
<td>-1% (6,954 and 6,910)</td>
<td>-2% (373,151 and 365,065)</td>
</tr>
<tr>
<td><strong>Electrical Equipment Mfg (3353)</strong></td>
<td>4% (658 and 686)</td>
<td>10% (3,183 and 3,500)</td>
<td>1% (142,396 and 143,212)</td>
</tr>
<tr>
<td><strong>Other Electrical Equipment and Component Mfg (3359)</strong></td>
<td>-8% (1,369 and 1,265)</td>
<td>-13% (1,128 and 983)</td>
<td>7% (147,842 and 158,757)</td>
</tr>
</tbody>
</table>

Source: Emsi

Analysts often point out that electric cars are mechanically less complex than traditional cars and, for that reason, the production of electric cars is less labor intensive. This is predicted to disrupt the workforce in the traditional auto industry. Unfortunately, since the NAICS codes do not distinguish production of electric motor vehicles from production of traditional motor vehicles, the data does not allow us to tease out the impacts of electrification of transportation on the workforce in more detail. However, Table 2 suggests that the Pacific Northwest should be somewhat insulated from this trend. This is because the industries that include the traditional auto manufacturing – Manufacturing of Motor Vehicles, Motor Vehicle Bodies, and Motor Vehicle Parts – are relatively small employers in the Pacific Northwest. Their share of the workers in the region is 20%, compared to the remaining 80% employed in the industries identified as exclusive to the EV supply chain. Moreover, the outlook for job growth between 2019 and 2025 is better for the exclusively EV-related industries: those jobs are predicted to grow in the region at an average rate of 1.7%, compared to a 1.7% average decline in jobs in the traditional auto manufacturing industries.

To analyze the occupations that work in the industries connected the electric motor vehicle supply chain, we can map out the industries’ occupational makeup following the federal Standard Occupational Classification (SOC) system, a system that classifies all workers into one of over 800 occupational categories. Figures 4 and 5 present the broader groups of occupations that work in the electric motor vehicle –related industries in Oregon and Washington.

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* It is important to keep in mind that the industries considered “traditional auto manufacturing industries” also include activity related to EV production, and the “exclusively EV-related industries” contain production outside of EV components. Since the NAICS codes do not separate between ICE and EV production, this analysis is the closest estimation possible of their differences.
Figure 4. Occupational Makeup of Electric Motor Vehicle-Related Industries in Oregon, 2019

Source: Emsi
In both states, Production Occupations are the most common occupations in these industries: in Oregon, they form 39% and in Washington 49% of the total workforce connected to these industries. The second largest occupational group in both states is Architecture and Engineering Occupations, with 24% of the workforce in the industries in Oregon and 17% in Washington. After these two occupational groups, the remaining workforce in both states is divided relatively equally between Management, Business and Financial Operations, Office and Administrative Support, Computer and Mathematical Occupations; and to somewhat lesser extent between other occupational groups such as Transportation and Material Moving; and Installation, Maintenance, and Repair Occupations.

This high-level analysis illustrates that Oregon and Washington have industries connected to the EV supply chain. Moreover, the growth in industries that produce EV components outpaces that of the traditional auto industries: jobs are expected to increase 1.7% in the former and decrease 1.7% in the latter. This analysis is tentative, since the absence of industry codes prevents us from fully separating the production of EVs and their components from the production of traditional cars. Keeping this in mind, the

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* The three most common occupations in this occupational groups in these sectors are Semiconductor Processors; Electrical, Electronic, and Electromechanical Assemblers; and Assemblers and Fabricators in Oregon; and Assembler and Fabricators; Electrical, Electronic, and Electromechanical Assemblers; and First-Line Supervisors of Production and Operating Workers in Washington.

† The three most common occupations in this group are General and Operations Managers; Industrial Production Managers, and Computer and Information Systems Managers in Oregon; and Industrial Engineers; Electrical Engineers; and Electronics Engineers in Washington.
analysis offers reason for some optimism: some of the workforce necessary for the electrification of transportation already exists in the Pacific Northwest, and jobs in some of the industries connected to EV supply chain are projected to grow. The following section will take a closer look at this workforce and their demographics.

The Occupational Infrastructure Exists: Workers in EV-Related Occupations

To gain insight into the regional workforce in jobs most relevant to the EV supply chains, we build on the work of the Luskin Center for Innovation at UCLA. The Center has developed a list of occupations related to the supply chain of plug-in electric vehicles. We modify their list by excluding the occupations that are not core to the production: Customer Service Representatives, Fire Fighters, Police and Sheriff’s Patrol Officers, and Retail Salespersons. Our conversations with industry experts confirm that the list that we adopt after these modifications – 30 occupations in total – include the key occupations in electric truck and bus manufacturing, as well.

Tables 6 and 7 offer key labor market data for jobs in these occupations in Oregon and Washington, respectively. Specifically, the table presents for each occupation the number of jobs in 2019, the number of projected annual openings (including new jobs and openings due to retiring workforce), the percent change in jobs from 2019 to 2025, the median hourly earnings in 2019, and the median hourly earnings adjusted to cost of living.

Table 6. Electric Motor Vehicle-Related Occupations in Oregon

<table>
<thead>
<tr>
<th>Occupation</th>
<th>2019 Jobs</th>
<th>Annual Openings (incl. new jobs &amp; retirements)</th>
<th>2019 - 2025 % Change</th>
<th>Median Hourly Earnings</th>
<th>COL Adjusted Median Hourly Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Engineers</td>
<td>403</td>
<td>35</td>
<td>11%</td>
<td>$44.11</td>
<td>$38.36</td>
</tr>
<tr>
<td>Computer Hardware Engineers</td>
<td>1,316</td>
<td>90</td>
<td>2%</td>
<td>$53.59</td>
<td>$46.60</td>
</tr>
<tr>
<td>Electrical Engineers</td>
<td>2,613</td>
<td>220</td>
<td>10%</td>
<td>$42.73</td>
<td>$37.16</td>
</tr>
<tr>
<td>Electronics Engineers, Except Computer</td>
<td>5,512</td>
<td>389</td>
<td>3%</td>
<td>$41.60</td>
<td>$36.17</td>
</tr>
<tr>
<td>Industrial Engineers</td>
<td>4,084</td>
<td>341</td>
<td>10%</td>
<td>$42.62</td>
<td>$37.06</td>
</tr>
<tr>
<td>Materials Engineers</td>
<td>529</td>
<td>41</td>
<td>2%</td>
<td>$42.66</td>
<td>$37.10</td>
</tr>
<tr>
<td>Mechanical Engineers</td>
<td>4,140</td>
<td>330</td>
<td>9%</td>
<td>$39.75</td>
<td>$34.57</td>
</tr>
<tr>
<td>Mechanical Drafters</td>
<td>580</td>
<td>61</td>
<td>10%</td>
<td>$26.31</td>
<td>$22.88</td>
</tr>
<tr>
<td>Electrical and Electronics Engineering Technicians</td>
<td>3,525</td>
<td>325</td>
<td>3%</td>
<td>$30.17</td>
<td>$26.23</td>
</tr>
<tr>
<td>Electro-Mechanical Technicians</td>
<td>105</td>
<td>12</td>
<td>13%</td>
<td>$25.64</td>
<td>$22.30</td>
</tr>
<tr>
<td>Mechanical Engineering Technicians</td>
<td>594</td>
<td>58</td>
<td>4%</td>
<td>$24.69</td>
<td>$21.47</td>
</tr>
</tbody>
</table>

† To be clear, the data on occupations does not allow for an exclusive focus on electric motor vehicle-related business either, but it offers us a more detailed picture of the workforce in jobs most relevant to the EV supply chains.
<table>
<thead>
<tr>
<th>Occupation Category</th>
<th>Occupation</th>
<th>Total Jobs</th>
<th>Openings</th>
<th>% Change</th>
<th>Median Earnings</th>
<th>Previous Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer and Mathematical Occupations</strong></td>
<td>Computer Systems Analysts</td>
<td>5,650</td>
<td>447</td>
<td>8%</td>
<td>$42.61</td>
<td>$37.05</td>
</tr>
<tr>
<td></td>
<td>Computer Programmers</td>
<td>2,489</td>
<td>160</td>
<td>(-2%)</td>
<td>$39.07</td>
<td>$33.97</td>
</tr>
<tr>
<td></td>
<td>Software Developers, Applications</td>
<td>15,967</td>
<td>1,431</td>
<td>13%</td>
<td>$48.11</td>
<td>$41.83</td>
</tr>
<tr>
<td></td>
<td>Software Developers, Systems Software</td>
<td>2,878</td>
<td>246</td>
<td>11%</td>
<td>$50.90</td>
<td>$44.26</td>
</tr>
<tr>
<td></td>
<td>Network and Computer Systems Administrators</td>
<td>3,832</td>
<td>293</td>
<td>8%</td>
<td>$38.71</td>
<td>$33.66</td>
</tr>
<tr>
<td></td>
<td>Operations Research Analysts</td>
<td>1,238</td>
<td>114</td>
<td>17%</td>
<td>$38.62</td>
<td>$33.58</td>
</tr>
<tr>
<td><strong>Construction and Extraction Occupations</strong></td>
<td>Electricians</td>
<td>8,955</td>
<td>1,254</td>
<td>14%</td>
<td>$34.12</td>
<td>$29.67</td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings</td>
<td>8,955</td>
<td>1,254</td>
<td>14%</td>
<td>$34.12</td>
<td>$29.67</td>
</tr>
<tr>
<td><strong>Installation, Maintenance, and Repair Occupations</strong></td>
<td>Telecommunications Equipment Installers and Repairers, Except Line Installers</td>
<td>2,234</td>
<td>236</td>
<td>(-3%)</td>
<td>$29.04</td>
<td>$25.25</td>
</tr>
<tr>
<td></td>
<td>Electric Motor, Power Tool, and Related Repairers</td>
<td>239</td>
<td>25</td>
<td>5%</td>
<td>$20.87</td>
<td>$18.15</td>
</tr>
<tr>
<td></td>
<td>Electronic Equipment Installers and Repairers, Motor Vehicles</td>
<td>82</td>
<td>8</td>
<td>(11%)</td>
<td>$19.95</td>
<td>$17.35</td>
</tr>
<tr>
<td></td>
<td>Automotive Service Technicians and Mechanics</td>
<td>6,779</td>
<td>699</td>
<td>5%</td>
<td>$20.93</td>
<td>$18.20</td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings</td>
<td>9,334</td>
<td>967</td>
<td>3%</td>
<td>$20.90</td>
<td>$18.17</td>
</tr>
<tr>
<td><strong>Life, Physical, and Social Science Occupations</strong></td>
<td>Chemists</td>
<td>679</td>
<td>76</td>
<td>11%</td>
<td>$33.62</td>
<td>$29.23</td>
</tr>
<tr>
<td></td>
<td>Materials Scientists</td>
<td>95</td>
<td>10</td>
<td>9%</td>
<td>$46.99</td>
<td>$40.86</td>
</tr>
<tr>
<td></td>
<td>Urban and Regional Planners</td>
<td>907</td>
<td>84</td>
<td>6%</td>
<td>$39.01</td>
<td>$33.92</td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings</td>
<td>1,680</td>
<td>170</td>
<td>8%</td>
<td>$39.01</td>
<td>$33.92</td>
</tr>
<tr>
<td><strong>Management Occupations</strong></td>
<td>Industrial Production Managers</td>
<td>2,798</td>
<td>225</td>
<td>5%</td>
<td>$43.30</td>
<td>$37.65</td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings</td>
<td>2,798</td>
<td>225</td>
<td>5%</td>
<td>$43.30</td>
<td>$37.65</td>
</tr>
</tbody>
</table>
Tables 6 and 7 point out a notable difference between Oregon and Washington: Washington employs twice as many workers in the occupations related to the EV supply chain as Oregon: 225,116 workers in Washington compared to Oregon’s 101,489 workers. Most of this difference is driven by the much greater demand in Computer and Mathematical Occupations in Washington: 112,964 of the state’s workers are in this occupational group, whereas that number is 32,054 in Oregon. Overall, the high numbers of workers in the different occupational groups suggests that when it comes to considering starting new electric motor vehicle business in the Pacific Northwest, a key piece of infrastructure, occupational supply, exists in the region already.

Table 7. Electric Motor Vehicle-Related Occupations in Washington

<table>
<thead>
<tr>
<th>Occupation</th>
<th>2019 Jobs</th>
<th>Annual Openings (incl. new jobs &amp; retirements)</th>
<th>2019 - 2025 % Change</th>
<th>Median Hourly Earnings</th>
<th>COL Adjusted Median Hourly Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Architecture and Engineering Occupations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical Engineers</td>
<td>629</td>
<td>45</td>
<td>2%</td>
<td>$48.29</td>
<td>$42.36</td>
</tr>
<tr>
<td>Computer Hardware Engineers</td>
<td>1,701</td>
<td>130</td>
<td>7%</td>
<td>$57.95</td>
<td>$50.83</td>
</tr>
<tr>
<td>Electrical Engineers</td>
<td>5,794</td>
<td>403</td>
<td>2%</td>
<td>$53.71</td>
<td>$47.11</td>
</tr>
<tr>
<td>Electronics Engineers, Except Computer</td>
<td>3,338</td>
<td>229</td>
<td>2%</td>
<td>$51.40</td>
<td>$45.09</td>
</tr>
<tr>
<td>Industrial Engineers</td>
<td>7,082</td>
<td>531</td>
<td>5%</td>
<td>$50.11</td>
<td>$43.96</td>
</tr>
<tr>
<td>Materials Engineers</td>
<td>1,024</td>
<td>77</td>
<td>0%</td>
<td>$51.87</td>
<td>$45.50</td>
</tr>
<tr>
<td>Mechanical Engineers</td>
<td>7,875</td>
<td>541</td>
<td>3%</td>
<td>$43.52</td>
<td>$38.18</td>
</tr>
<tr>
<td>Mechanical Drafters</td>
<td>2,040</td>
<td>182</td>
<td>1%</td>
<td>$38.23</td>
<td>$33.54</td>
</tr>
<tr>
<td>Electrical and Electronics Engineering Technicians</td>
<td>2,404</td>
<td>227</td>
<td>4%</td>
<td>$34.58</td>
<td>$30.33</td>
</tr>
<tr>
<td>Electro-Mechanical Technicians</td>
<td>150</td>
<td>14</td>
<td>1%</td>
<td>$42.31</td>
<td>$37.11</td>
</tr>
<tr>
<td>Mechanical Engineering Technicians</td>
<td>980</td>
<td>88</td>
<td>(-2%)</td>
<td>$30.89</td>
<td>$27.10</td>
</tr>
<tr>
<td>Occupational Field</td>
<td>Total Jobs, Openings, and % Change; Median Earnings</td>
<td>Median Earnings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Jobs, Openings, and % Change; Median Earnings</strong></td>
<td>33,018 2,463 3%</td>
<td>$48.29 $42.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Computer and Mathematical Occupations</strong></td>
<td>Computer Systems Analysts 18,196 1,436 8% $45.12 $39.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Programmers 9,723 620 (-2%) $63.23 $55.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Software Developers, Applications 56,467 5,435 17% $61.63 $54.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Software Developers, Systems Software 16,718 1,309 8% $58.40 $51.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Network and Computer Systems Administrators 8,839 679 8% $43.00 $37.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operations Research Analysts 3,021 271 16% $44.15 $38.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings 112,964 9,751 12% $51.76 $45.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Construction and Extraction Occupations</strong></td>
<td>Electricians 18,992 2,457 9% $31.56 $27.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings 18,992 2,457 9% $31.56 $27.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Installation, Maintenance, and Repair Occupations</strong></td>
<td>Automotive Service Technicians and Mechanics 13,452 1,349 4% $22.88 $20.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electric Motor, Power Tool, and Related Repairers 340 37 6% $26.33 $23.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electronic Equipment Installers and Repairers, Motor Vehicles 221 20 (-17%) $25.64 $22.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telecommunications Equipment Installers and Repairers, Except Line Installers 4,924 526 (-2%) $32.22 $28.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings 18,938 1,932 (-2%) $25.99 $22.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Life, Physical, and Social Science Occupations</strong></td>
<td>Chemists 1,739 171 4% $38.73 $33.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Materials Scientists 396 36 0% $50.33 $44.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urban and Regional Planners 2,126 201 7% $38.90 $34.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings 4,261 408 5% $38.90 $34.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Management Occupations</strong></td>
<td>Industrial Production Managers 2,806 221 4% $57.59 $50.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Jobs, Openings, and % Change; Median Earnings 2,806 221 4% $57.59 $50.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Production Occupations</strong></td>
<td>Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers 4,861 556 (-9%) $18.66 $16.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assemblers and Fabricators, All Other, Including Team Assemblers 16,685 1,931 (-4%) $17.22 $15.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A closer look at the occupations suggests that there is wide variation in the projected demand. Among the occupational groups, the Computer and Mathematical Occupations and the Construction and Extraction Occupations (including only Electricians) are expected to grow the fastest in both states. The lowest growth rates are predicted for Production Occupations: a 2% decrease in Washington and a 1% decrease in Oregon. However, there is a significant variation within the different Production Occupations as well: in both states, Computer-Controlled Machine Tool Operators will be in demand, whereas the number of jobs for Electrical, Electronic, and Electromechanical Assemblers are expected to decrease. This decrease in jobs for Electrical, Electronic, and Electromechanical Assemblers may seem surprising at first, but the trend is a part of a wider decline in manufacturing labor force, caused by offshoring and automation.

Finally, we also examined the regional variation in future occupational needs in the electric motor vehicle-related occupations. Perhaps the most striking regional difference is in the demand for Electricians. The predicted increase in these jobs is 18.4% in the Portland metropolitan area, defined as the Portland-Vancouver-Hillsboro OR-WA metropolitan statistical area by the U.S. Census Bureau. The predicted growth for electricians is smaller in Oregon overall, 13.7%, and it is significantly lower in the Seattle metropolitan area, defined as the Seattle-Tacoma-Bellevue area, at 6.4%. For more on the regional variation between the occupational groups, see the Appendix (Appendix C).

**Challenges that Workforce Development Faces: Low Education Occupations Will Grow Slowest**

Importantly, most of the electric motor vehicle-related occupations require high levels of education. Table 8 lists the key occupations according to the typical level of education required for an entry-level position, together with required work experience and typical on-the-job training. Twenty-one of the 30 occupations require at least an associate degree, and only seven are open for candidates with only high school diploma. In 2019, those seven occupations employed 32% of the workers in EV-related occupations in Oregon and 24% in Washington.
<table>
<thead>
<tr>
<th>Occupation</th>
<th>Typical Entry Level Education</th>
<th>Work Experience Required</th>
<th>Typical On-The-Job Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricians</td>
<td>High school diploma or equivalent</td>
<td>None</td>
<td>Apprenticeship</td>
</tr>
<tr>
<td>Electric Motor, Power Tool, and Related Repairers</td>
<td>High school diploma or equivalent</td>
<td>Less than 5 years</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>Electronic Equipment Installers and Repairers, Motor Vehicles</td>
<td>High school diploma or equivalent</td>
<td>None</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers</td>
<td>High school diploma or equivalent</td>
<td>None</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>Assemblers and Fabricators, All Other, Including Team Assemblers</td>
<td>High school diploma or equivalent</td>
<td>None</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>Computer-Controlled Machine Tool Operators, Metal and Plastic</td>
<td>High school diploma or equivalent</td>
<td>None</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>Machinists</td>
<td>High school diploma or equivalent</td>
<td>None</td>
<td>Long-term on-the-job training</td>
</tr>
<tr>
<td>Telecommunications Equipment Installers and Repairers, Except Line Installers</td>
<td>Postsecondary nondegree award</td>
<td>None</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>Automotive Service Technicians and Mechanics</td>
<td>Postsecondary nondegree award</td>
<td>None</td>
<td>Short-term on-the-job training</td>
</tr>
<tr>
<td>Mechanical Drafters</td>
<td>Associate degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Electrical and Electronics Engineering Technicians</td>
<td>Associate degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Electro-Mechanical Technicians</td>
<td>Associate degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Mechanical Engineering Technicians</td>
<td>Associate degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Industrial Production Managers</td>
<td>Bachelor's degree</td>
<td>5 years or more</td>
<td>None</td>
</tr>
<tr>
<td>Computer Systems Analysts</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Computer Programmers</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Software Developers, Applications</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Software Developers, Systems Software</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Network and Computer Systems Administrators</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Operations Research Analysts</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Chemical Engineers</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Computer Hardware Engineers</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Electrical Engineers</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Electronics Engineers, Except Computer</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Industrial Engineers</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Materials Engineers</td>
<td>Bachelor's degree</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Mechanical Engineers | Bachelor's degree | None | None
---|---|---|---
Chemists | Bachelor's degree | None | None
Materials Scientists | Bachelor's degree | None | None
Urban and Regional Planners | Master's degree | None | None

Source: Emsi

Assessing the job growth by education level, projected growth is highest for jobs that require a bachelor’s or a master’s degree. The trend holds for both Oregon and Washington, as well as the Pacific Northwest and the country as a whole: the predicted increase in openings is almost 10% across the regions. In turn, the occupational demand is predicted to grow the slowest in the occupations that require only a high school diploma. The exception is Washington, where the predicted growth is slightly slower for the occupations that require an associate degree. Table 9 presents these growth rates in more detail.

Table 9. Projected Growth in Electric Motor Vehicle-Related Occupations

<table>
<thead>
<tr>
<th>Occupational Group by education</th>
<th>2019 – 2025 % Change in Jobs, OR and WA</th>
<th>2019 – 2025 % Change in Jobs, OR</th>
<th>2019 – 2025 % Change in Jobs, WA</th>
<th>2019 – 2025 % Change in Jobs, United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS diploma or Postsecondary nondegree award</td>
<td>2.3</td>
<td>3.2</td>
<td>1.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Associate degree</td>
<td>2.7</td>
<td>3.9</td>
<td>1.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Bachelor's degree or master’s degree</td>
<td>9.5</td>
<td>8.7</td>
<td>9.8</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Source: Emsi

**Demographics of Workers Highlight the Need for Workforce Development Initiatives**

This section analyzes the demographics of the workers in the occupations related to electric motor vehicle production in the region. Starting with gender, a breakdown of the workforce reveals that the occupations are dominated by male workers. Figure 6 shows that female workers form only 19.2% of the workforce in Oregon and 18.9% in Washington. The share of female workers is somewhat lower in both states than nationally, as the share of female workers in the electric motor vehicle-related occupations is 21.0% across all U.S. states.
To ensure that the gender distribution in the electric motor vehicle-related occupations is not a reflection of the gender distribution of the workforce in general, we can compare the share of women in the EV-related occupations to their share in the workforce in Oregon and Washington. Figure 7 suggests that these occupations are indeed particularly male dominated: while women are only 19.0% of workers in the EV-related occupations in Pacific Northwest, they represent 48.2% of the region’s total workforce.

An analysis of the race and ethnicity of workers within the electric motor vehicle-related occupations reveals a notable difference between Oregon and Washington. As Figures 8 and 9 point out, the labor force in Washington is more diverse than in Oregon; people of color are 36.5% of the Washington workforce in electric motor vehicle occupations, compared to 26.8% in Oregon. However, as will be discussed below, the difference stems mostly from the larger share of Asian American and Asian workers in Computer and Mathematical Occupations in Washington: Asian American and Asian workers represent 25.3% of workers in these occupations in Washington, whereas their share of Oregon’s Computer and
Mathematical Occupations is only 14.5%. When we exclude the Computer and Mathematical Occupations from the analysis, the share of people of color of the EV-related workforce is 25.7% in Oregon and 26.5% in Washington.

A comparison with all US workers in these occupations reveals that the share of people of color in the EV-related occupations in the U.S. as a whole (35.0%) is about the same in Washington (36.5%) and nearly ten percentage points higher than in Oregon (26.8%). The share of Hispanic or Latino workers is notably lower in both Oregon (7.7%) and Washington (5.6%) than nationally (10.4%).

Finally, there are some differences between the demographics of people who work in the EV-related occupations in Oregon and Washington, and people in the regional workforce in general. Most notably, as Figure 9 illustrates, the electric motor vehicle-related occupations have disproportionally more Asian American and Asian workers. At the same time, the shares of Hispanic or Latino workers and white workers are smaller than in the regional workforce at large.
Looking at the age distribution of workers in the EV-related occupations, the workers in Oregon and Washington skew somewhat younger than the overall labor force in these occupations in the U.S. Figure 10 presents the age breakdown of the occupations. The biggest share of workers in the electric motor vehicle occupations in the Pacific Northwest are between 35-44 years old. This is also the most populated age group across all U.S. states, but the share of this age group is smaller nationally (24.6%) than in Oregon (27.1%) and Washington (27.5%). In Washington, the share of workers in the age group 25-34, 27.6%, is notably higher than in Oregon (24.1%) and in the country as a whole (24.5%).
The regional workforce in EV-related occupations also skews younger than the overall workforce in the region. Figure 11 illustrates this trend. While there is a significantly higher percentage of workers aged 24 or younger in the overall workforce than in the electric motor vehicle-related occupations, this relationship is reversed with the next three age groups. The greatest share of regional labor force in these occupations is between 35 and 44 years of age: 27.3% of the workers fall within this age group. The second largest age group is only slightly smaller with 26.5% of workers.
To make sure that these demographic trends are not driven by certain occupational groups, we compare the demographics of workers in different occupational subgroups. Table 10 presents the gender distribution for all EV–related subgroups. The shares are, overall, close to those at the national level. However, both in Oregon and Washington, and in the U.S. as a whole, there are clear differences between the subgroups. Within the subgroups, the greatest share of women works in Life, Physical, and Social Occupations, a group that includes Chemists, Material Scientists, and Urban and Regional Planners. The share of women in these occupations is 42.3% in Oregon and 41.2% in Washington. The smallest percentage of women, in turn, is in Construction and Extraction Occupations, a group that includes Electricians: 2.3% of Electricians in Oregon are women and the share of female Electricians is 3.1% in Washington.


<table>
<thead>
<tr>
<th>Electric Motor Vehicle-Related Occupations</th>
<th>Oregon</th>
<th>Washington</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture and Engineering Occupations</td>
<td>11.9 (6%)</td>
<td>13.0 (3%)</td>
<td>13.1</td>
</tr>
<tr>
<td>Computer and Mathematical Occupations</td>
<td>24.0 (10%)</td>
<td>22.2 (12%)</td>
<td>25.1</td>
</tr>
<tr>
<td>Construction and Extraction Occupations</td>
<td>2.3 (14%)</td>
<td>3.1 (9%)</td>
<td>2.7</td>
</tr>
<tr>
<td>Installation, Maintenance, and Repair Occupations</td>
<td>3.4 (3%)</td>
<td>4.1 (-2%)</td>
<td>4.1</td>
</tr>
<tr>
<td>Life, Physical, and Social Science Occupations</td>
<td>42.3 (8%)</td>
<td>41.2 (5%)</td>
<td>40.8</td>
</tr>
<tr>
<td>Management Occupations</td>
<td>15.5 (5%)</td>
<td>17.2 (4%)</td>
<td>17.1</td>
</tr>
<tr>
<td>Production Occupations</td>
<td>31.4 (-1%)</td>
<td>27.6 (-2%)</td>
<td>32.4</td>
</tr>
</tbody>
</table>

Source: Emsi

Similarly, there are some significant differences between occupational subgroups when it comes to the ethnicity of the workforce, presented in Table 11. The labor force in electric motor vehicle–related occupations in Pacific Northwest is least diverse in Construction and Extraction Occupations: the share of people of color in these occupations is 12.8% in Oregon and 17.1% in Washington. The workforce is most diverse in Computer and Mathematical Occupations: the share of people of color is 29.2% in Oregon and 46.6% in Washington. These numbers are mostly driven by Asian American and Asian workers: their share of workers in Computer and Mathematical Occupations is 20.7% in Oregon and 38.5% in Washington. The percentage in Washington is much higher than in the country as a whole, where Asian American and Asian workers are 27.4% of the employees in these occupations.

<table>
<thead>
<tr>
<th>Electric Motor Vehicle-Related Occupations</th>
<th>Oregon</th>
<th>Washington</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture and Engineering Occupations</td>
<td>28.0 (6%)</td>
<td>26.7 (3%)</td>
<td>27.8</td>
</tr>
<tr>
<td>Computer and Mathematical Occupations</td>
<td>29.2 (10%)</td>
<td>46.6 (12%)</td>
<td>41.3</td>
</tr>
<tr>
<td>Construction and Extraction Occupations</td>
<td>12.8 (14%)</td>
<td>17.1 (9%)</td>
<td>25.4</td>
</tr>
<tr>
<td>Installation, Maintenance, and Repair Occupations</td>
<td>19.3 (3%)</td>
<td>25.4 (-2%)</td>
<td>31.3</td>
</tr>
<tr>
<td>Life, Physical, and Social Science Occupations</td>
<td>18.5 (8%)</td>
<td>25.1 (5%)</td>
<td>32.5</td>
</tr>
<tr>
<td>Management Occupations</td>
<td>16.0 (5%)</td>
<td>19.0 (4%)</td>
<td>20.5</td>
</tr>
<tr>
<td>Production Occupations</td>
<td>32.5 (-1%)</td>
<td>32.9 (-2%)</td>
<td>37.6</td>
</tr>
</tbody>
</table>

Source: Emsi

We also evaluated the demographics of workers in occupations with lower educational requirements and compared those to demographics of workers in occupations with higher educational requirements. The differences are not drastic in Oregon, due to the high share of Asian American and Asian workers in the Architecture and Engineering Occupations and Computer and Mathematical Occupations, occupations that oftentimes require a bachelor’s degree. The share of non-white workers in the occupations that require a bachelor’s or a master’s is 28.0% in Oregon, compared to the share of non-white workers in the occupations with only high school diploma or equivalent required, 25.3%. In Washington, non-white workers are actually a greater share of workers in occupations with high educational requirements: 41.8% of workers in occupations with bachelor’s or master’s required are non-white, whereas in high school diploma required occupations this share is only 26.7%.

To assess the demographics of growing versus declining occupations, Table 12 groups together the occupations in Oregon and Washington that are expected to experience job growth between 2019 and 2025, and the occupations that are projected to lose jobs within that time frame. The share of women is much higher in the declining occupations, 32.6%, compared to 16.0% in the growing occupations. Similarly, the share of people of color is higher in the occupations with a negative outlook: 36.0% versus a 31.1% share in the occupations experiencing growth. The table includes a separate category for Asian American and Asian workers, as their higher number in the growing occupational groups that include engineering and computer science-related fields drives up the share of people of color in the category for growing occupations.


<table>
<thead>
<tr>
<th>Electric Motor Vehicle-Related Occupations</th>
<th>Female</th>
<th>People of Color</th>
<th>Asian American and Asian (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growing Occupations (9.1%)</td>
<td>16.0</td>
<td>31.1%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Declining Occupations (-3.7%)</td>
<td>32.6</td>
<td>36.0%</td>
<td>17.4%</td>
</tr>
</tbody>
</table>

Source: Emsi

Finally, there is some variation across the occupation groups in the age of the workforce. For example, there are more younger workers in Production Occupations than in some of the occupations that require
higher education or more experience, especially Management Occupations. However, these differences are less notable. The table illustrating these trends is included in the Appendix (Appendix D).

This section has analyzed the current workforce in the industries connected to the EV supply chain and its growth projections. Due to lacking data, the analysis cannot examine the workers employed directly in EV-related industries. However, we can examine the overall labor force in jobs considered essential for EV production. Such analysis is of interest when considering the region’s potential for new electric motor vehicle business. For example, most of the workers in Computer and Mathematical Occupations in Washington are undoubtedly employed in high tech. One industry expert consulted for this research described the implications for the EV industry: on the one hand, the region has trained and attracted plenty of skills and talent in fields relevant to EV production. On the other, that talent is often not in the exact fields most in need in EV production and, moreover, the competition for that talent is intense. In other words, the existence of a workforce with training and skills needed for EV production is an asset for the region. However, specific training or other interventions might be necessary to prepare that workforce for the electrification of transportation.

The demographic analysis of the current and future workforce stresses a need for policies and interventions, as well. It is important to note that the demographic data vary greatly among the relevant occupations and the occupational groups. For example, women are about a fifth of the workforce in Computer and Mathematical Occupations both in Oregon and Washington, while their share of Electricians is 2.3% and 3.1% respectively. However, overall, women and people of color will be challenged by the economic decline in EV-related occupations more than men and white people. This is because the shares of women and people of color are notably higher in the EV-related occupations that are expected to decline in the short-to-median term. In other words, women and minorities are particularly vulnerable to economic changes in the field. Therefore, we need interventions that aim to ensure that women and people of color have opportunities to upskill or gain additional training that prepare for economic trends in the EV fields. In a similar vein, policies and initiatives can increase access for women and people of color into fields they are currently underrepresented in and that are economically promising.

Key Partners for Innovation in Workforce Development

The analysis so far has established that Oregon and Washington have both plenty of business with possible openings in the EV supply chain, and a labor force with workers in the occupations required for the EV production. However, the analysis has also shown that workforce development is needed in order to prepare industry and the labor force better for the electrification of transportation. For that development to happen, coordination between industry, public sector, and education is required.

This section assesses the educational infrastructure that currently prepares local workforce for occupations relevant to EV production in the Pacific Northwest. The section also highlights where curricula and training development is needed. In particular, there are two types of recommended interventions. First, in order to ensure a diverse workforce in the sector, we need to consider how to

* As a reminder, the share of Asian and Asian American workers is high in the Computer and Mathematical Occupations, especially in Washington. When we exclude these occupations from the analysis, the difference between the demographics of growing and declining occupations becomes more evident.
increase access to the trainings that provide a pipeline for the EV sector and, especially, how to increase access for those populations who are currently left behind. Second, collaboration between industry, the public sector, and the education sector is required to ensure that the education and training programs in the region are well suited for the demands of the EV sector. The first intervention is about ensuring access to the field, and the second aims to improve the existing education and training programs in the region so that they include EV specific components.

Table 13 presents some demographic data for EV related occupations that are expected to experience negative growth between 2019 and 2025 in Oregon and Washington. The share of women in these declining occupations is 32.6%. For comparison, female workers represent 16.0% of the labor force in growing occupations. In other words, the share of women in declining occupations – most with low entry-level educational requirements – is dramatically higher than in the growing occupations – most of which require an associate degree or higher. The relationship is similar for people of color, though not quite as striking: in the declining occupations, people of color are 36.0% of the workforce, compared to 33.1% in growing occupations. For this difference, it is important to keep in mind that Asian American and Asian workers form a disproportionally great share of many of the growing occupations that require relatively high education.

Table 13. Occupations in Decline in Oregon and Washington (combined), 2019

<table>
<thead>
<tr>
<th>Occupation</th>
<th>2019-2025 % Change in Jobs</th>
<th>Typical Entry Level Education</th>
<th>Female %</th>
<th>People of Color %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Programmers</td>
<td>-1.8</td>
<td>Bachelor’s degree</td>
<td>20.9</td>
<td>37.8</td>
</tr>
<tr>
<td>Telecommunications Equipment Installers and Repairers, Except Line Installers</td>
<td>-2.2</td>
<td>Postsecondary nondegree</td>
<td>10.6</td>
<td>22.5</td>
</tr>
<tr>
<td>Electronic Equipment Installers and Repairers, Motor Vehicles</td>
<td>-15.5</td>
<td>High school diploma or equivalent</td>
<td>3.6</td>
<td>28.3</td>
</tr>
<tr>
<td>Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers</td>
<td>-8.3</td>
<td>High school diploma or equivalent</td>
<td>51.6</td>
<td>47.4</td>
</tr>
<tr>
<td>Assemblers and Fabricators, All Other, Including Team Assemblers</td>
<td>-3.2</td>
<td>High school diploma or equivalent</td>
<td>36.7</td>
<td>36.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-3.7</strong></td>
<td></td>
<td><strong>32.6</strong></td>
<td><strong>36.0</strong></td>
</tr>
</tbody>
</table>

Source: Emsi

This data underscores a need for initiatives and training programs that can provide underserved populations access to career pathways in the growing occupations. The focus of such initiatives should be on trainings that are relatively short, in order to ensure the participants’ ability to complete the programs and begin earning. Moreover, the programs should pay extra attention to the support needs of participants.
Shoreline Community College in Washington offers an example of an institution that has embraced such educational innovations. Shoreline College’s Automotive Department partnered with Seattle Jobs Initiative in 2005 to test a pilot project curriculum for Automotive General Service Technician (GST) training with a group of students from low-income backgrounds traditionally excluded from college-driven training programs. The goal of the pilot was to place program participants in living wage automotive careers and, at the same time, test whether the program could serve as an ongoing entry point to the sector for underserved populations. The college provided the students with tuition and free tutoring, while SJI assisted them with wrap-around supports and case management services, including job readiness training, job search assistance, and support for job retention, among other supports.

The pilot was a part of a broader initiative to increase access to training for underserved populations, and was among the first Integrated Basic Education and Skills Training (I-BEST) programs, developed by the Washington State Board for Community and Technical Colleges together with the community and technical colleges in the state. I-BEST programs are designed to provide low-income students with a structured pathway to jobs in high-demand, high-wage industries. The instruction is team based: one teacher is in charge of basic skills teaching in reading, math and/or English language, while another teacher provides technical skills training. In this way, students who might lack the basics skills needed to enter traditional college-level occupational classes gain access to a promising field.

I-BEST programs, including the Automotive GST program at Shoreline College, have been a success. Research shows that I-BEST students are more likely to continue into credit-bearing coursework, earn credits toward a college credential, earn occupational certificates, and make point gains on basic skills tests than basic skills students in general. Moreover, the students in I-BEST programs are older and more often female than average basic skills students, and higher percentage of them come from the lowest quintiles of socioeconomic status. Based on these positive outcomes, community and technical colleges across Washington have expanded the number of I-BEST programs, now numbering 239, and the programs have attracted attention and interest in replication around the country, as well.

The Automotive Department at Shoreline College has also succeeded in building strong partnerships with the private sector. An instructor in the College approached the Puget Sound Automotive Dealership Association (PSADA) in the 1980s with the goal of connecting better with local employers for the good of the community and the college students. He highlighted the savings that employers would realize by leasing training space on the college campus rather than training incumbent workers in Portland. Thanks to the instructor’s advocacy and two capital campaigns he mounted, the college opened a new training facility, the Professional Automotive Training Center in 1992. The Center was further expanded in 2010. In this space, the instructor brought the college and local dealers together and helped in setting up multiple dealer-sponsored programs in the college. Today, the training site hosts programs with partners such as Chrysler, General Motors, Honda, Tesla and Toyota, and more than 1,300 students have graduated from the Center.

Interestingly, the most recent program addition in Shoreline College’s Automotive Department focuses on training in the EV field. Tesla’s START program started in the College in the fall of 2018, and it is currently one of several START programs across the country. The selected students go through an intensive, 12-week training program that prepares them for Service Technician positions at Tesla Service Centers in

* According to Shoreline College and Washington Auto Dealers Association, the partnership with the college would save employers approximately $8,594/worker that needs ongoing training; $26,928/worker requiring training to the equivalency of a program graduate; $34,152 in employing and training a program graduate; and, if four hours of labor of the eight hours that the student works at the dealership over two years in the program are counted, the dealership realizes $170,280 in additional labor income. For more details on the project and the return on investment calculation, see Nagley 2017.
The program is attractive for students for various reasons. According to Sarah Budriunas, Sr. Project Manager of Tesla’s Workforce Development and Education Programs, the on-the-job training for an electric vehicle technician takes a traditional automotive technician about 1-1.5 years on average. Tesla’s program offers students an opportunity to gain EV training in only 12 weeks. The program is a paid internship allowing students to focus on training and coursework throughout the program duration. Finally, Tesla assists successful graduates with job placement at Tesla Service Center in the U.S. As of December 2019, over 300 students have graduated from Tesla START, 13% of which are from Shoreline.

The goal of Tesla’s program is to build a pipeline of trained professionals for a growing field. The company has a significant presence is the Pacific Northwest: it has three regional service centers in the Seattle area, one regional service center in Spokane, and one in Portland. As more and more consumers choose electric vehicles, the program aims to ensure a supply of service technicians required for that growth. In addition to building a local talent pipeline, one of Tesla’s goals for the program is to invest in the community.

The innovations and initiatives in the Automotive Department at Shoreline College highlight how public-private partnerships can institutionalize and continue to develop in a way that responds to the needs of students and employers. Beyond these examples, there are a number of somewhat less specialized programs in the healthcare industry that aim to increase local access to entry level positions with potential for upskilling in the future. These kinds of short-term trainings designed in collaboration with industry and the public and education sectors have great potential for increasing diversity in the workforce, as the programs can consider both specific industry needs and provide support services that are essential for ensuring that people who enter the program can complete it successfully.

Apprenticeships offer another potential path towards the creation of a more diverse workforce. Just like the shorter trainings discussed above, apprenticeships can be more accessible than traditional college programs, as the on-the-job training component allows trainees to earn while learning new skills. Some relevant programs exist in the region already, including The Puget Sound Electrical Joint Apprenticeship and Training Committee’s programs for electrical contractors and the program for General Journeyman Electricians.

Finally, it is important not to overlook opportunities that exist in the occupations with a negative outlook. Assembler jobs, for example, are entry-level jobs that only require a high school diploma and moderate on-the-job training. Assembler positions in the Pacific Northwest are expected to decline dramatically between 2019 and 2025, partly due to offshoring and automation. Yet, these can be critical jobs in advanced manufacturing career pathways as individuals work while waiting for apprenticeship openings or other upskilling opportunities in the same company. Acknowledging the role that they can play in moving someone towards a career path is important and identifying key employers who are willing to support their workers in this way could be a first step in developing more opportunities to upskill for underserved populations, even if the number of jobs in these occupations declines in the future.

Another type of key workforce development initiative would focus on improving the existing education and training programs in the field by designing components that focus specifically on EV-related skills training. The Luskin Center for Innovation at UCLA identified the occupations in the EV supply chain with the most urgent need for such component.32 They did so by examining which EV related occupations are likely to experience both an increase in openings and a change in the nature of the work. The occupations undergoing these changes need training and curriculum development, in order to ensure the pipeline of qualified workforce amidst the changes. We modify their list by including only the occupations related to EV supply chain. The resulting priority occupations are: Computer Systems Administrators & Analysts, Computer Programmers, Computer Software Developers; Materials, Chemical and Computer Engineers, Chemists, Material scientists, and Operations research analysts.

The following table identifies the institutions in Oregon and Washington that reported completed degrees in 2018 in the programs that most directly translate into these occupations.† The listing of completions in all the EV-related occupations is presented in the Appendix (Appendix E). The institutions in Table 14 are candidates for partners in curriculum development for EV-specific education and training components, as they have existing programs training workforce to these occupations. We recommend engaging these institutions for planning and designing of new educational components that focus on the specific needs of the EV industry. The Appendix (Appendix F) also provides a list of the institutions that rank in top 10 in the region when it comes to the number of completions in different types of programs.

* The data for program completions is collected following the Classification of Instructional Programs (CIP). Since there is no official crosswalk between the occupations analyzed in the previous section, classified according to SOC, and CIP, we conduct this crosswalk according to our best effort. There were no reported completions in programs in Computer Systems Analysis and Operations Research Analysis. More research is needed to identify the programs that prepare students for these occupations in the region.
† Includes distance offered and non-distance offered programs.

Table 14. Completions in EV-related Programs in Oregon and Washington, 2018†

<table>
<thead>
<tr>
<th>Institution</th>
<th>State</th>
<th>Chemists</th>
<th>Computer Programmers</th>
<th>Material Engineers</th>
<th>Chemical Engineers</th>
<th>Computer Hardware Engineers</th>
<th>Material Scientist</th>
<th>Software Developers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bates Technical College</td>
<td>WA</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellevue College</td>
<td>WA</td>
<td></td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big Bend Community College</td>
<td>WA</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cascadia College</td>
<td>WA</td>
<td></td>
<td>57</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Washington University</td>
<td>WA</td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralia College</td>
<td>WA</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clark College</td>
<td>WA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clover Park Technical College</td>
<td>WA</td>
<td></td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columbia Basin College</td>
<td>WA</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concordia University-Portland</td>
<td>OR</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Washington University</td>
<td>WA</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Edmonds Community College</td>
<td>WA</td>
<td></td>
<td>69</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>George Fox University</td>
<td>OR</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gonzaga University</td>
<td>WA</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The data for program completions is collected following the Classification of Instructional Programs (CIP). Since there is no official crosswalk between the occupations analyzed in the previous section, classified according to SOC, and CIP, we conduct this crosswalk according to our best effort. There were no reported completions in programs in Computer Systems Analysis and Operations Research Analysis. More research is needed to identify the programs that prepare students for these occupations in the region.
† Includes distance offered and non-distance offered programs.
<table>
<thead>
<tr>
<th>Institution Name</th>
<th>State</th>
<th>Rank</th>
<th>Full Time Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green River College</td>
<td>WA</td>
<td>77</td>
<td>9</td>
</tr>
<tr>
<td>Heritage University</td>
<td>WA</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Highline College</td>
<td>WA</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Klamath Community College</td>
<td>OR</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Lake Washington Institute of Technology</td>
<td>WA</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Lane Community College</td>
<td>OR</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Lewis &amp; Clark College</td>
<td>OR</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Linfield College-McMinnville Campus</td>
<td>OR</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Linn-Benton Community College</td>
<td>OR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lower Columbia College</td>
<td>WA</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Mt Hood Community College</td>
<td>OR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>North Seattle College</td>
<td>WA</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Olympic College</td>
<td>WA</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Oregon Institute of Technology</td>
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</tr>
<tr>
<td>Oregon State University</td>
<td>OR</td>
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<td>163</td>
</tr>
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<td>Pacific Lutheran University</td>
<td>WA</td>
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</tr>
<tr>
<td>Pacific University</td>
<td>OR</td>
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</tr>
<tr>
<td>Peninsula College</td>
<td>WA</td>
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</tr>
<tr>
<td>Portland State University</td>
<td>OR</td>
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<td>9</td>
</tr>
<tr>
<td>Reed College</td>
<td>OR</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Renton Technical College</td>
<td>WA</td>
<td>77</td>
<td>9</td>
</tr>
<tr>
<td>Rogue Community College</td>
<td>OR</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Saint Martin's University</td>
<td>WA</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Seattle Central College</td>
<td>WA</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seattle Pacific University</td>
<td>WA</td>
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<td></td>
</tr>
<tr>
<td>Seattle University</td>
<td>WA</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Shoreline Community College</td>
<td>WA</td>
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Source: Emsi
In addition to the partners listed in this section, there are plenty of organizations focused on advocating for growing the EV field. When planning the suggested interventions, or other initiatives in the field, these organizations could provide crucial expertise and outreach capacity. Some of these organizations include Plug-in America, Forth, PEV Dialogue Group, and West Coast Electric Fleets.

In conclusion, this report has emphasized the need for coordination between industry, education, and public sector in order to prepare the workforce for the growing EV production. This section presents two types of initiatives and proposes potential partners for such initiatives: first, addressing the lack of diversity in the EV related occupations with training programs that target underserved populations. Second, engaging existing educational programs that train workforce for the EV industries that are in most need when it comes to trained professionals. The goal of this engagement would be to start developing program components and trainings that focus specifically on EV-related content.

Recommendations
The growing adoption of electric passenger vehicles and electric commercial vehicles is creating new business opportunities for companies that have not formed a part of the traditional vehicle supply chains in the past. To be sure, traditional manufacturers are working hard to establish the required supply chains for mass production. Yet, there are also new players entering the field, producing different components for the traditional manufacturers – or even producing their own electric vehicles. As the demand for EVs continues to grow, so do these opportunities, both for established and emerging businesses.

This report has shown that Oregon and Washington are off to a good start when it comes to continuing to develop regional EV production. Both states have plenty of ongoing and potential EV-related business and both have workforce needed in the field. However, the report has also highlighted some challenges that the region faces. Some of these challenges are specific to the Pacific Northwest. Most importantly, the workforce in the EV-related occupations in the region is less diverse than nationally, and many of the more diverse occupations in Oregon and Washington are projected to decline in the short-to-medium term. More specifically, the analysis finds that occupations with a greater share of women and people of color compared to their overall share of the EV-related workforce have a negative economic outlook in the next five years. Other challenges are not unique to the Pacific Northwest: the negative growth projections for certain occupations are partly due to offshoring and automation, both trends occurring regionally and nationally. Another key challenge, also observed across the U.S., is the lack of training and training components that would meet the demand for highly specialized workers in the EV field.

To answer these challenges and continue to work towards greater electrification of transportation, this report recommends the following:

- **Innovate Together with Key Partners in Industry, Public Sector, and Education:** Multiple industry experts consulted for this project called for collaboration and coordination between the public, private, and the education sectors. In fact, some viewed this sort of collaboration essential for the region to ensure a pipeline of qualified professionals for the rapidly changing industry. The research conducted for this report supports such collaboration. The industry needs to be included to share their understanding of the dramatic changes in the field and their occupational needs. The public sector has a crucial role in coordinating the work, and, perhaps even more importantly, ensuring that the resulting interventions and initiatives create a more diverse and inclusive industry. Finally, the education sector offers expertise and existing educational infrastructure to be able to design and implement education and training components quickly. The Professional Automotive Training Center at Shoreline Community College in Washington serves as an
example of a successful and sustainable private-public partnership. By learning from their experiences, and the experiences of other similar partnerships, and by inviting all the stakeholders in the table, the region can develop a creative and comprehensive workforce strategy that prepares the region better for the continuing electrification of transportation.

- **Training Initiatives Directed to Underserved Populations:** The workforce research highlighted lack of diversity in the EV-related occupations, and some troubling trends when it comes to the occupations with least educational requirements. We recommend designing and implementing training initiatives that would specifically target underserved populations. For example, the I-BEST programs in Washington, college programs that combine basic skills training with technical training, have succeeded in improving the educational outcomes for many underserved populations. Similarly, short-term training programs that focus on creating access to entry-level positions have proven to be promising in other sectors. Working with employers willing to upskill their workforce is another way of targeting workers who need help in getting on to a career path. To create a pipeline of qualified and diverse EV professionals, we recommend workforce initiatives that adopt these approaches.

- **Developing EV-specific Curriculum and Trainings:** As the technology in electric vehicles continues to develop and their mass production becomes more and more common place, the need for increasingly specialized labor force increases. We recommend working with institutions that have strong educational programs in the EV-related fields to develop training that is directed at the particular needs of EV production. Another promising venue for improving EV-specific curriculum is to work in close collaboration with the industry. By bringing part of the training in-house, companies can train their workforce in a very targeted way. At the same time, the public sector can ensure that the adopted solutions consider the greater goals of workforce development as well, including diversity and sustainability.
References


Appendix A

There are five key actors in the production of a traditional car: cars are designed and manufactured by original equipment manufacturers, or OEMs. The OEMs receive necessary components from Tier 1 suppliers who specialize in auto hardware and usually work closely with one or two OEM. Tier 1 suppliers, in turn, receive components from Tier 2 suppliers who are experts in their specific domain and serve clients across industries. All of these actors—OEMs, Tier 1 and Tier 2 suppliers—also receive raw materials from Tier 3 suppliers. The ready product is sold at a dealership, which in turn provides OEMs information about their demand - necessary information for OEMs to guarantee the supply of new cars. The table below presents these actors, together with their products and a few examples of products and companies.

<table>
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<tr>
<th>Supplier</th>
<th>Product</th>
<th>Product example</th>
<th>Company example</th>
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<tr>
<td>Tier 3</td>
<td>Raw or close-to-raw materials</td>
<td>Metal, plastic</td>
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<td>Tiers 1 and 2 and OEMs</td>
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<tr>
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<td>Specific parts</td>
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<td>Intel, NVIDIA</td>
<td>Tier 1</td>
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<tr>
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<td>In-car entertainment technologies, steering systems</td>
<td>Delphi, Bosch</td>
<td>OEM</td>
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<td>Design, marketing, and assembling cars</td>
<td>Car</td>
<td>Ford, Toyota</td>
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<td>Dealership</td>
<td>Customer service, maintenance and repair</td>
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Source: Modified from https://medium.com/self-driving-cars/the-automotive-supply-chain-explained-d4e74250106f
Appendix B

Using DatabaseUSA and previous research 415 businesses in Oregon and Washington associated with the selected NAICS codes were identified. Business that were no longer in operation, distributors, metal fabricators, and electronic manufacturers unrelated to EV were excluded, for a total of 211 business is 12 industries. They can be divided into six categories of business:

1. Explicit EV Manufacturing
2. EV Infrastructure Manufacturing (Charging)
3. General Automotive Manufacturing
4. ICE-Oriented Automotive Manufacturing
5. Other Related Manufacturing
6. Not Related

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<th>Category</th>
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<th>Business Size</th>
<th>Primary NAICS Code</th>
<th>Industry Name</th>
<th>Sales Volume (USD)</th>
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<th>Website</th>
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<td><a href="http://www.maxim-ic.com">www.maxim-ic.com</a></td>
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* Other work has looked more broadly at EV market and infrastructure including sales and advocacy, which are outside of the scope of this work. In addition, a number of the businesses identified are either no longer in operation or no longer in operation in the region.
† Though EV charging was explicitly excluded from the scope of this project, eleven firms identified both through the database search and previous work manufacturing charging stations.
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<td><a href="https://www.cummins.com/">https://www.cummins.com/</a></td>
<td>300 W Valley View Rd</td>
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<td>10955 SW Avery St</td>
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<td>EnerG2</td>
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<td><a href="https://energ2.com/">https://energ2.com/</a></td>
<td>3000 SW Calapooia St</td>
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<td><a href="https://evdrive.com/">https://evdrive.com/</a></td>
<td>2123 NE Aloclek Dr</td>
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<td>Hydro Extrusion</td>
<td>331318</td>
<td>Other Aluminum Rolling, Drawing, and Extruding</td>
<td>1905</td>
<td><a href="https://www.hydro.com/en-us">https://www.hydro.com/en-us</a></td>
<td>7933 NE 21st Ave</td>
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<td>2929 W 2nd St</td>
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<td><a href="https://www.hydro.com/en-us">https://www.hydro.com/en-us</a></td>
<td>2001 Kotobuki Way</td>
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<td><a href="https://www.hyster.com/north-america/">https://www.hyster.com/north-america/</a></td>
<td>400 NE Blue Lake Rd</td>
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<td>Intel</td>
<td>334413</td>
<td>Semiconductor and Related Device Manufacturing</td>
<td>1968</td>
<td><a href="https://www.intel.com">https://www.intel.com</a></td>
<td>2501 NE Century Blvd</td>
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<td><a href="http://kerstech.com/">http://kerstech.com/</a></td>
<td>P.O. 1895</td>
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<td>1999</td>
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<td><a href="http://www.metricmind.com/">http://www.metricmind.com/</a></td>
<td>10117 SE Sunnyside Rd</td>
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<td><a href="http://rynomotors.com">http://rynomotors.com</a></td>
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<td><a href="https://shiftev.com/">https://shiftev.com/</a></td>
<td>127 SE 2nd Ave</td>
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<td><a href="http://www.tinitron.com/index.html">http://www.tinitron.com/index.html</a></td>
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<td>Delta Products Corporation</td>
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<td>Other Electronic Component Manufacturing</td>
<td>$217,311.00</td>
<td><a href="http://www.delta-americas.com">www.delta-americas.com</a></td>
<td>15125 SW Koll Parkway</td>
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<td>$651,932</td>
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<td><a href="http://www.dunestar.com">www.dunestar.com</a></td>
<td>59530 Yarmer Ln</td>
<td>Saint Helens</td>
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<td>2</td>
<td>Eit LLC</td>
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<td>$460,215</td>
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<td><a href="https://www.eit.com/">https://www.eit.com/</a></td>
<td>1709 S 76th St</td>
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<td>$2,531,183</td>
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<td><a href="https://new.siemens.com/">https://new.siemens.com/</a></td>
<td>13810 Se Eastgate Way</td>
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<td><a href="https://ev4.website">https://ev4.website</a></td>
<td>2727 SE Raymond St</td>
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<td><a href="https://www.opconnect.com/">https://www.opconnect.com/</a></td>
<td>7150 SW Hampton</td>
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<td><a href="http://www.powinenergy.com">http://www.powinenergy.com</a></td>
<td>20550 SW 115th Ave</td>
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<td><a href="https://www.se.com/us/en/">https://www.se.com/us/en/</a></td>
<td>12345 Leveton Dr</td>
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<td><a href="https://www.shorepower.com">https://www.shorepower.com</a></td>
<td>5291 NE Elam Young Pkwy</td>
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<td>334419</td>
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<td>$620,403</td>
<td>2013</td>
<td><a href="https://911circuits.com/">https://911circuits.com/</a></td>
<td>4785 Portland Rd Ne</td>
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<td>$3,184,237</td>
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<td><a href="http://www.air-weigh.com">www.air-weigh.com</a></td>
<td>1730 Willow Creek Cir Ste 100</td>
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<td>Ametek Tse</td>
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<td>$1,303,864</td>
<td>1930</td>
<td><a href="https://www.ametek.com/">https://www.ametek.com/</a></td>
<td>4755 SW Griffith Dr</td>
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<td>Circuit Graphics Inc</td>
<td>334419</td>
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<td>$651,932</td>
<td>1979</td>
<td><a href="http://www.circuitgraphicsinc.com">www.circuitgraphicsinc.com</a></td>
<td>4075 Ne Beaumead St</td>
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<td>3</td>
<td>Electronics Manufacturing Services</td>
<td>334419</td>
<td>Other Electronic Component Manufacturing</td>
<td>$1,086,553</td>
<td>1984</td>
<td><a href="http://www.emsnw.com">www.emsnw.com</a></td>
<td>10950 SW 5th St Ste 180</td>
<td>Beaverton</td>
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<td>Magnelink Inc</td>
<td>334419</td>
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<td>$4,346,212</td>
<td>1990</td>
<td><a href="http://www.magnelinkinc.com">www.magnelinkinc.com</a></td>
<td>1060 Ne 25th Ave Ste C</td>
<td>Hillsboro</td>
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<td>Northwest Regulator Supply Inc</td>
<td>334419</td>
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<td>$10,865,530.00</td>
<td>1963</td>
<td><a href="http://www.amforelectronics.com">www.amforelectronics.com</a></td>
<td>5061 N Lagoon Ave</td>
<td>Portland</td>
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<td>3</td>
<td>Action Controls Inc</td>
<td>334419</td>
<td>Other Electronic Component Manufacturing</td>
<td>$2,531,183.00</td>
<td>1991</td>
<td>8320 S 259th St</td>
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<td>Creative Microsystems Inc</td>
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<td>$4,372,043.00</td>
<td>1987</td>
<td><a href="http://www.loadman.com">www.loadman.com</a></td>
<td>15224 Se Renton Issaquah Rd</td>
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<td>3</td>
<td>Custom Interface Inc</td>
<td>334419</td>
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<td>$20,449,812.00</td>
<td>1997</td>
<td><a href="http://www.custominterface.net">www.custominterface.net</a></td>
<td>410 S Larch St</td>
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<td>Electonetics LLC</td>
<td>334419</td>
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<td>$4,602,151.00</td>
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<td><a href="http://www.electronics.us">www.electronics.us</a></td>
<td>1320 75th St SW</td>
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<td>2011</td>
<td><a href="http://www.foxlink.com">www.foxlink.com</a></td>
<td>2840 Northup Way Ste 108</td>
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<td>7051 S 234th St</td>
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<td>Stress-tek Inc</td>
<td>334419</td>
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<td>$8,053,764.00</td>
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<td><a href="http://www.stress-tek.com">www.stress-tek.com</a></td>
<td>5920 S 194th St</td>
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<td>Tri Coastal Industries</td>
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<td>$2,301,075.00</td>
<td>1998</td>
<td><a href="http://www.tciscales.com">www.tciscales.com</a></td>
<td>17611 Ok Mill Rd</td>
<td>Snohomish</td>
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<td>336111</td>
<td>Automobile Manufacturing</td>
<td>$45,152,223.00</td>
<td>2002</td>
<td><a href="http://www.advancedtruck.com">www.advancedtruck.com</a></td>
<td>4825 Table Rock Rd</td>
<td>Central Point</td>
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<td>3</td>
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<td>336111</td>
<td>Automobile Manufacturing</td>
<td>$12,261,964.00</td>
<td>2013</td>
<td><a href="http://www.roguetruckbody.com">www.roguetruckbody.com</a></td>
<td>30400 Redwood Hwy</td>
<td>Cave Junction</td>
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<td>3</td>
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<td>336111</td>
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<td>$27,149,759.00</td>
<td>1985</td>
<td><a href="http://www.watertrucks-tanks.com">www.watertrucks-tanks.com</a></td>
<td>13800 Ne Allen Creek Rd</td>
<td>Prineville</td>
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<td>3</td>
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<td>$34,326,286.00</td>
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<td><a href="http://www.startlrs.com">www.startlrs.com</a></td>
<td>230 Highway 241</td>
<td>Sunnyside</td>
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<td>$179,782,031.00</td>
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<td>1385 W Smith Rd</td>
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<td>$784,107.00</td>
<td>1996</td>
<td><a href="http://www.cozycruiser.com">www.cozycruiser.com</a></td>
<td>790 30th St</td>
<td>Springfield</td>
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<td>6500 Se Johnson Creek Blvd</td>
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<td>Truck Trailer Manufacturing</td>
<td>$2,943,159.00</td>
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<td>Truck Trailer Manufacturing</td>
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<td>13985 Interurban Ave S Ste 200</td>
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<td>Battery Charger Sales &amp; Service</td>
<td>28 N Russell St</td>
<td>Portland</td>
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<td>Motor Vehicle Electrical and Electronic Equipment Manufacturing</td>
<td>$1,176,075.00</td>
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<td><a href="http://www.philbingroup.com">www.philbingroup.com</a></td>
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<td>4897 Indian School Rd Ne Ste 150</td>
<td>Salem</td>
<td>OR</td>
<td></td>
<td>Other Motor Vehicle Parts Manufacturing</td>
<td>$56,704,815.00</td>
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<td><a href="http://www.benzspring.com">www.benzspring.com</a></td>
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<td>2625 NW Industrial St</td>
<td>Portland</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
<td>$51,012,908.00</td>
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<td><a href="http://www.griffithrubber.com">www.griffithrubber.com</a></td>
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<td>204 Moore St</td>
<td>Harrisburg</td>
<td>OR</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
<td>$4,753,366.00</td>
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<td><a href="http://www.hurdsinc.com">www.hurdsinc.com</a></td>
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<td>Piaa</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
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<td>1963</td>
<td><a href="http://www.piaa.com">www.piaa.com</a></td>
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<td>5819 Se Johnson Creek Blvd</td>
<td>Portland</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
<td>$59,586,506.00</td>
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<td><a href="http://www.truckrackinc.com">www.truckrackinc.com</a></td>
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<td>Tk Innovation</td>
<td>90433 Prairie Rd</td>
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<td>Other Aluminum Rolling, Drawing, and Extruding</td>
<td>$3,989,690.00</td>
<td>1996</td>
<td><a href="https://www.tkinnovationllc.com/services">https://www.tkinnovationllc.com/services</a></td>
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<td>Kaiser Alutek Inc</td>
<td>3401 N Tschirley Rd</td>
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<td>Other Aluminum Rolling, Drawing, and Extruding</td>
<td>$41,503,871.00</td>
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<td><a href="http://www.kaiseraluminum.com">www.kaiseraluminum.com</a></td>
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<td>$51,344,110.00</td>
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<td><a href="http://www.protech.net">www.protech.net</a></td>
<td>14113 Ne 3rd Ct</td>
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<td>AIMCO</td>
<td>33399</td>
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<td><a href="http://www.aimco-global.com/">http://www.aimco-global.com/</a></td>
<td>10000 SE Pine Street</td>
<td>Portland</td>
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<td>Anixter</td>
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<td><a href="https://www.anixter.com/en_us.html">https://www.anixter.com/en_us.html</a></td>
<td>7661 SW Cirrus Dr</td>
<td>Beaverton</td>
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<td>3</td>
<td>Professional Plastics</td>
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<td><a href="https://www.professionalplastics.com/">https://www.professionalplastics.com/</a></td>
<td>19801 SW 95th Ave</td>
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<td>$2,173,106.00</td>
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<td><a href="http://www.advanced-flight-systems.com">www.advanced-flight-systems.com</a></td>
<td>320 S Redwood St</td>
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<td>Agri Tronics</td>
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<td>Other Electronic Component Manufacturing</td>
<td>$7,942,303.00</td>
<td>1995</td>
<td><a href="http://www.agritronics.com">www.agritronics.com</a></td>
<td>57701 Ione Gooseberry Rd</td>
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<td>$23,351,071.00</td>
<td>2002</td>
<td><a href="http://www.ascentron.com">www.ascentron.com</a></td>
<td>994 Antelope Rd</td>
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<td>4</td>
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<td>$992,788.00</td>
<td>1988</td>
<td><a href="http://www.assembly-line.com">www.assembly-line.com</a></td>
<td>231 Wharf St</td>
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<td>4</td>
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<td>$19,557,954.00</td>
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<td><a href="http://www.axiomsmt.com">www.axiomsmt.com</a></td>
<td>19545 NW Von Neumann Dr</td>
<td>Beaverton</td>
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<td>$869,242.00</td>
<td>2017</td>
<td><a href="https://www.epicnw.com">https://www.epicnw.com</a></td>
<td>1049 SW Baseline St</td>
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<td>Future Technology Devices International</td>
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<td><a href="http://www.ftdichip.com">www.ftdichip.com</a></td>
<td>7130 SW Fir Loop</td>
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<td>$1,452,593.00</td>
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<td><a href="http://www.jodeco.com">www.jodeco.com</a></td>
<td>217 SW Pumice Ave Ste G</td>
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<td>Rank</td>
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<td>www siemens.com</td>
<td>20335 SW Avery Ct</td>
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<td>334419</td>
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<td>1983</td>
<td><a href="https://www.southvalleydesign.com">https://www.southvalleydesign.com</a></td>
<td>31841 Se Compton Rd</td>
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<td>$4,602,151.00</td>
<td>1962</td>
<td><a href="http://www.bicharn.com">www.bicharn.com</a></td>
<td>10401 Mountain Loop Hwy</td>
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<td>$16,136,445.00</td>
<td>1993</td>
<td><a href="http://www.bluese.com">www.bluese.com</a></td>
<td>425 Sequoia Dr Ste 101</td>
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<td>$3,451,613.00</td>
<td>2001</td>
<td><a href="http://www.kemcor.com">www.kemcor.com</a></td>
<td>15925 Woodinville Redmond Rd</td>
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<td><a href="http://www.lyntron.com">www.lyntron.com</a></td>
<td>6001 S Thomas Mallen Rd</td>
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<td>$1,442,774.00</td>
<td>2001</td>
<td><a href="http://mtronic.net/">http://mtronic.net/</a></td>
<td>1620 E Houston Ave Ste 700</td>
<td>Spokane, WA</td>
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<td>334419</td>
<td>Other Electronic Component</td>
<td>$33,915,387.00</td>
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<td><a href="http://www.pacaero.com">www.pacaero.com</a></td>
<td>430 Olds Station Rd</td>
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<td>1990</td>
<td><a href="http://www.schippers.com">www.schippers.com</a></td>
<td>5309 Shilshole Ave NW Ste 100</td>
<td>Seattle, WA</td>
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<td><a href="http://www.tasc-wa.com">www.tasc-wa.com</a></td>
<td>2222 N Pacific St</td>
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<td>Electrochem Solutions</td>
<td>335911</td>
<td>Storage Battery Manufacturing</td>
<td>$105,281,850.00</td>
<td>1985</td>
<td><a href="http://www.greatbatch.com">www.greatbatch.com</a></td>
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<td>770</td>
<td>6936 N Fathom St</td>
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<td>1969</td>
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<td>4355 Turner Rd Se</td>
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<td>1972</td>
<td><a href="http://www.pioneertruckweld.com">www.pioneertruckweld.com</a></td>
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<td>139</td>
<td>3711 Se Caruthers St</td>
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<td><a href="https://www.superiortorqueconverter.com">https://www.superiortorqueconverter.com</a></td>
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<td>1670 Grant Ave</td>
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<td><a href="http://www.pacbrake.com">www.pacbrake.com</a></td>
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<td><a href="http://www.redstartracing.com">www.redstartracing.com</a></td>
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<td><a href="http://www.voltavolare.com">http://www.voltavolare.com</a></td>
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<td>2143 Se 55th Ave</td>
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<td><a href="http://www.c-h-s.com">www.c-h-s.com</a></td>
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<td><a href="http://www.sartron.com">www.sartron.com</a></td>
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<td><a href="https://www.sparkfun.com/">https://www.sparkfun.com/</a></td>
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<td><a href="https://supplyfx.com/">https://supplyfx.com/</a></td>
<td>503 N 13th Ave</td>
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<td><a href="http://www.stillwellbaker.com">www.stillwellbaker.com</a></td>
<td>6077 Lakeview Blvd. Ste B</td>
<td>Lake Oswego</td>
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<td>2010</td>
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<td>15520 Woodinville Redmond Rd Ne Ste D100</td>
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<td><a href="http://www.deltamotion.com">www.deltamotion.com</a></td>
<td>1818 Se 17th St</td>
<td>Battle Ground</td>
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<td>$2,322,763.00</td>
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<td><a href="http://www.esteem.com">www.esteem.com</a></td>
<td>415 N Quay St Ste B1</td>
<td>Kennewick</td>
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<td>Other Electronic Component Manufacturing</td>
<td>$11,505,377.00</td>
<td>1971</td>
<td><a href="http://www.exxelia.com">www.exxelia.com</a></td>
<td>12920 Ne 125th Way</td>
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<td>$4,141,936.00</td>
<td>2002</td>
<td><a href="http://www.frontpanalexpress.com">www.frontpanalexpress.com</a></td>
<td>5959 Corson Ave S Ste I</td>
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<td>Goodwinds Kites Inc</td>
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<td>$1,059,254.00</td>
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<td><a href="http://www.goodwinds.com">www.goodwinds.com</a></td>
<td>1829 Railroad Ave</td>
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<td><a href="http://www.utaerospacesystems.com">www.utaerospacesystems.com</a></td>
<td>4020 Lake Washington Blvd Ne Ste 312</td>
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<td>$618,332.00</td>
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<td><a href="http://www.larkinpower.com">www.larkinpower.com</a></td>
<td>1725 N Park Rd</td>
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<td>$901,958.00</td>
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<td><a href="http://www.leidos.com">www.leidos.com</a></td>
<td>26279 12 Trees Ln NW Ste A</td>
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<td><a href="http://www.lumatech.com">www.lumatech.com</a></td>
<td>13226 Se 30th St</td>
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<td>2716 Ne 168th Ave</td>
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<td>$10,891,000.00</td>
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<td><a href="http://www.microvision.com">www.microvision.com</a></td>
<td>6244 185th Ave Ne</td>
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<td><a href="http://www.net-ig.com">www.net-ig.com</a></td>
<td>21229 72nd Ave S</td>
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<td>$3,451,613.00</td>
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<td><a href="http://www.omnisistem.com">www.omnisistem.com</a></td>
<td>6403 S 2082th St</td>
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<td>$11,505,377.00</td>
<td>1990</td>
<td><a href="http://www.panasonic.aero">www.panasonic.aero</a></td>
<td>22333 29th Dr Se</td>
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<td>5</td>
<td>Prologic Engineering Inc</td>
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<td>Other Electronic Component</td>
<td>$2,151,526.00</td>
<td>1993</td>
<td><a href="http://www.prologic-eng.com">www.prologic-eng.com</a></td>
<td>3979 Hammer Dr Ste B</td>
<td>Bellingham</td>
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<td>334419</td>
<td>Other Electronic Component</td>
<td>$2,531,183.00</td>
<td>2013</td>
<td><a href="http://www.rockwellcollins.com">www.rockwellcollins.com</a></td>
<td>2377 S 200th St</td>
<td>Seattle</td>
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<td>1986</td>
<td><a href="http://www.rigidcomputer.com">www.rigidcomputer.com</a></td>
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<td>$0.00</td>
<td>2006</td>
<td><a href="https://www.unmannedsystemstechnology.com/">https://www.unmannedsystemstechnology.com/</a></td>
<td>727 Harvard Ave E</td>
<td>Seattle</td>
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<td>5</td>
<td>Shipboard Electrical Systems</td>
<td>334419</td>
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<td>1973</td>
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<td>334419</td>
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<td>$23,904,166.00</td>
<td>1998</td>
<td><a href="http://www.siliconforestelectronics.com">www.siliconforestelectronics.com</a></td>
<td>6204 E 18th St</td>
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<td>$41,360,228.00</td>
<td>1976</td>
<td><a href="http://www.pacaero.com">www.pacaero.com</a></td>
<td>434 Olds Station Rd</td>
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<td>$16,107,528.00</td>
<td>1973</td>
<td><a href="http://www.spectralux.com">www.spectralux.com</a></td>
<td>12335 134th Ct Ne</td>
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<td>2005</td>
<td><a href="http://www.spindledynamics.com">www.spindledynamics.com</a></td>
<td>7006 27th St W Ste D</td>
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<td>2012</td>
<td><a href="http://www.system-to-asic.com">www.system-to-asic.com</a></td>
<td>12100 Ne 195th St Ste 180</td>
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<td>6</td>
<td>Other Electronic Component Manufacturing</td>
<td>$1,290,916.00</td>
<td>1992</td>
<td><a href="http://www.sonicpro.com">www.sonicpro.com</a></td>
<td>7044 Portal Way</td>
<td>Ferndale</td>
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<td>9</td>
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<td>$3,314,339.00</td>
<td>1948</td>
<td><a href="http://www.kamandirect.com">www.kamandirect.com</a></td>
<td>1703 Ne Argyle St</td>
<td>Portland</td>
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<td>7</td>
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<td>$2,577,819.00</td>
<td>2005</td>
<td><a href="http://www.dykman.com">www.dykman.com</a></td>
<td>3004 Ne 112th Ave Ste E</td>
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<td>4214 S Sunderland Dr</td>
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<td>18</td>
<td>Motor and Generator Manufacturing</td>
<td>$7,019,026.00</td>
<td>1964</td>
<td><a href="http://www.merequipment.com">www.merequipment.com</a></td>
<td>2400 W Commodore Way</td>
<td>Seattle</td>
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<td>5</td>
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<td>$2,947,892.00</td>
<td>2018</td>
<td><a href="https://www.johnsoncontrols.com/">https://www.johnsoncontrols.com/</a></td>
<td>800 NW 3rd Ave</td>
<td>Canby</td>
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<td>5</td>
<td>American Grounding Systems Inc</td>
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<td>$2,491,263.00</td>
<td>1996</td>
<td><a href="http://www.ags.bz">www.ags.bz</a></td>
<td>385 NW 1st St</td>
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<td>43</td>
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<td>$15,938,829.00</td>
<td>2012</td>
<td><a href="https://blackhawktech.com/contact/">https://blackhawktech.com/contact/</a></td>
<td>220 S 8th St</td>
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<td>All Other Miscellaneous Electrical Equipment and Component Manufacturing</td>
<td>3,599,174.00</td>
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<td><a href="http://www.optimalcontrol.net">www.optimalcontrol.net</a></td>
<td>2324 Three Lakes Rd Se</td>
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<td>Ditco Inc</td>
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<td><a href="http://www.ditco.net">www.ditco.net</a></td>
<td>106 E Titus St</td>
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<td>12,373,345.00</td>
<td>1967</td>
<td><a href="http://www.farwestair.com">www.farwestair.com</a></td>
<td>1415 Meridian Ave E</td>
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<td>8,021,022.00</td>
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<td><a href="http://www.motors-controls.com">www.motors-controls.com</a></td>
<td>430 Carpenter Rd Se</td>
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<td>428 S Highland Dr</td>
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<td>254,620.00</td>
<td>2016</td>
<td><a href="https://forestriverinc.com/rvs/">https://forestriverinc.com/rvs/</a></td>
<td>Dallas</td>
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<td>Company Name</td>
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<td>Year Founded</td>
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<td>336213</td>
<td>Highway 99 S</td>
<td>6210 N Marine Dr</td>
<td>53668</td>
<td><a href="http://www.guaranty.com">www.guaranty.com</a></td>
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<td>336213</td>
<td>2139 N T St</td>
<td>6210 N Marine Dr</td>
<td>53668</td>
<td><a href="https://www.ntpstag.com">https://www.ntpstag.com</a></td>
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<td>6210 N Marine Dr</td>
<td>53668</td>
<td><a href="http://www.chaletrv.com">www.chaletrv.com</a></td>
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<td>Albany, OR</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
<td>336390</td>
<td>195 S 15th St</td>
<td>53668</td>
<td><a href="http://www.mandreibends.com">www.mandreibends.com</a></td>
<td>2003</td>
<td>Saint Helens, OR</td>
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<td>53668</td>
<td><a href="http://www.diamondeyeperformance.com">www.diamondeyeperformance.com</a></td>
<td>2000</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
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<td>53668</td>
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<td>2002</td>
<td>Portland, OR</td>
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<td>Pacific Recreational Products Inc</td>
<td>Other Motor Vehicle Parts Manufacturing</td>
<td>336390</td>
<td>7291 Sw Tech Center Dr</td>
<td>53668</td>
<td><a href="http://www.stowaway2.com">www.stowaway2.com</a></td>
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<td>10510 Sw Industrial Way</td>
<td>53668</td>
<td><a href="http://www.patrickind.com">www.patrickind.com</a></td>
<td>1959</td>
<td>Tualatin, OR</td>
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<td>Other Motor Vehicle Parts Manufacturing</td>
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<td>457 Queen Ave Sw</td>
<td>53668</td>
<td><a href="http://www.prolinebedliners.com">www.prolinebedliners.com</a></td>
<td>1992</td>
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<td>4101 Kruse Way</td>
<td>53668</td>
<td><a href="http://www.yakima.com">www.yakima.com</a></td>
<td>1983</td>
<td>Lake Oswego, OR</td>
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<td>Trail Tech Inc</td>
<td>Other Motor Vehicle Parts Manufacturing</td>
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<td>1600 Se 18th Ave</td>
<td>53668</td>
<td><a href="http://www.trailtech.net">www.trailtech.net</a></td>
<td>2001</td>
<td>Battle Ground, WA</td>
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# Appendix C
Regional Variation in Growth of EV-related Occupations, 2019 - 2025

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*Source: Emsi*
## Appendix E

Number of Completions in Programs that Prepare Students for Specific EV-related Occupations in Oregon and Washington, 2018

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Source: Emsi
## Appendix F

Top 10 Institutions in the Region per Number of Completions in Different Types of Programs that Prepare Students for Specific EV-related Occupations, 2018. Type of institution and number of enrolled students listed below

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Source: Emsi

<table>
<thead>
<tr>
<th>Institution</th>
<th>Type of institution, location, and number of enrolled students</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Washington-Seattle Campus</td>
<td>Public university in Seattle, WA. Serves approx. 54,000 students annually</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>Public university in Corvallis, OR. 32,011 enrolled students in 2018</td>
</tr>
<tr>
<td>Washington State University</td>
<td>Public university in Pullman, WA. 20,976 enrolled students</td>
</tr>
<tr>
<td>Green River College</td>
<td>Public college in Auburn, WA. 19,113 enrolled students in 2015-16</td>
</tr>
<tr>
<td>Portland State University</td>
<td>Public university in Portland, OR. 27,285 enrolled students in 2018-19</td>
</tr>
<tr>
<td>Spokane Community College</td>
<td>Public community college in Spokane, WA. Students served in 2018-19: 17,837</td>
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<tr>
<td>Big Bend Community College</td>
<td>Public community college in Mosel Lake, WA</td>
</tr>
<tr>
<td>Shoreline Community College</td>
<td>Public community college in Shoreline, WA. Approx. 10,000 enrolled students per year</td>
</tr>
<tr>
<td>Perry Technical Institute</td>
<td>Private technical institution in Yakima, WA. Over 750 enrolled students</td>
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<tr>
<td>Oregon Institute of Technology</td>
<td>Public polytechnic university with main campus in Kalamath Falls, OR. Total enrollment in 2019: 5,319</td>
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<td>Eastern Washington University</td>
<td>Public university with main campus in Cheney, WA. 12,635 students enrolled in 2018</td>
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<tr>
<td>Portland Community College</td>
<td>Public community college in Portland, OR. Serves approx. 73,000 students</td>
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<tr>
<td>Institution</td>
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<td>Public community college</td>
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<tr>
<td>University of Portland</td>
<td>Private Catholic university</td>
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<td>University of Washington-Bothell Campus</td>
<td>Public university in Bothell, WA</td>
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<td>Lake Washington Institute of Technology</td>
<td>Public technical institute</td>
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<td>Clover Park Technical College</td>
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<td>Bellingham Technical College</td>
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<td>Everett Community College</td>
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<td>Public university in Eugene, OR.</td>
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<tr>
<td>Gonzaga University</td>
<td>Private Jesuit university</td>
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<td>Central Oregon Community College</td>
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<td>Bates Technical College</td>
<td>Public technical college</td>
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<tr>
<td>Seattle University</td>
<td>Private Jesuit university</td>
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<td>Mt Hood Community College</td>
<td>Public community college</td>
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<td>Bellevue College</td>
<td>Public college in Bellevue, WA</td>
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<tr>
<td>Western Washington University</td>
<td>Public university with main campus in Bellingham, WA.</td>
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<tr>
<td>Tacoma Community College</td>
<td>Public community college with main campus in Tacoma, WA.</td>
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<tr>
<td>Saint Martin's University</td>
<td>Private Benedictine university in Lacey, WA.</td>
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<tr>
<td>University of Washington-Tacoma Campus</td>
<td>Public university in Tacoma, WA.</td>
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</tbody>
</table>

Source: Institutions' websites