Alternative and Renewable Fuels & Vehicle Technology Program

Overview of Advanced Transportation Industries and Occupations in California

Prepared by:
Zhenya Lindstrom, Centers of Excellence
California Community Colleges Chancellor’s Office

Sponsored by:
California Energy Commission
Report Development
Centers of Excellence, www.coeccc.net
Advanced Transportation Technology & Energy Initiative, www.fourenergy.org
Economic and Workforce Development Program
California Community Colleges

This study was possible thanks to the funding provided by the Alternative and Renewable Fuels and Vehicle Technology Program of the California Energy Commission.

Important Disclaimer
All representations included in this report have been produced from secondary review of publicly and/or privately available data and/or research reports. Efforts have been made to qualify and validate the accuracy of the data and the reported findings; however, neither the Centers of Excellence of the California Community Colleges Chancellor’s Office, nor the California Energy Commission are responsible for applications or decisions made by recipient community colleges or their representatives based upon components or recommendations contained in this study.

© 2013 California Community Colleges Chancellor’s Office
Quick Facts

- There are over 64,125 businesses related to the advanced transportation industries cluster across the state.
- The advanced transportation industries cluster accounts for nearly 900,000 jobs in California.
- In 2011, the advanced transportation industries cluster generated $212 billion in total revenue.
- The transportation industries are showing signs of economic improvement; they will add over 62,000 jobs from 2012-2015.
- The freight, transportation, delivery, and port operations industries sub-cluster is the largest among the advanced transportation industries in California – 298,000 jobs in 2012.
- Auto repair and maintenance industries will grow by 14% over the next three years.
- Most advanced transportation occupational jobs are concentrated in Southern California counties. Los Angeles and Orange counties together account for 36% of all advanced transportation jobs in California.
- More than 150 firms were recruiting for jobs that require knowledge and skills in alternative fuel and advanced transportation jobs in 2012.
- From January through December of 2012, there were more than 1,300 online advertisements for jobs requiring alternative fuel and advanced transportation related skills.
Table of Contents

Executive Summary........................................................................................................................................................ 5
Introduction...................................................................................................................................................................... 7
Industry Trends & Factors.......................................................................................................................................... 10
Industries Overview.................................................................................................................................................... 13
Occupational Employment & Growth..................................................................................................................... 18
High-level Training Gap Analysis ........................................................................................................................... 27
Conclusions and Recommendations.......................................................................................................................... 30
References.................................................................................................................................................................... 34
Appendix A – Study Methodology............................................................................................................................ 35
Appendix B – Discussion Guides............................................................................................................................... 37
Appendix C – List of Interview Participant Organizations ................................................................................ 43
Appendix D – Adv. Transp. Industries Cluster Employment, Revenue & Concentration by County ........... 44
Executive Summary

According to the California Air Resources Board (ARB), all mobile sources account for nearly 40% of the greenhouse gas emissions in California¹. The implementation of the alternative fuel and advanced vehicle technologies (AF & AVT) not only reduces the negative impacts on the environment and the health of the population, but also creates employment opportunities that are sustainable and well-paying.

As part of the Alternative and Renewable Fuels and Vehicle Technology Program, the California Energy Commission commissioned a research study from the California Community College Chancellor’s Office Centers of Excellence (COE) in order to understand and document specific workforce needs of employers as they relate to jobs evolving from the development of the alternative fuel and advanced vehicle technologies². This statewide report represents the second in the series of studies conducted by the Centers of Excellence within the project. The study aims to provide a broad overview of the employment in the advanced transportation industries cluster, identify key trends and factors shaping the future direction of the industries, and discuss the emerging employer needs in new skills and knowledge of alternative fuels and advanced vehicle technology. The study also discusses job classifications that are related to advanced transportation.

For the purposes of this study, the advanced transportation industries cluster comprises establishments that focus on vehicles, technologies and fuels with the ultimate goal of reducing petroleum dependence and greenhouse gas emissions. Specifically, the following three alternative and advanced technologies/systems are being considered as part of the advanced transportation industries cluster: 1) advanced technology vehicles (ATV), 2) alternative fuel vehicles (AFV), and 3) alternative transportation systems that focus on the movement of people or goods utilizing any form of advanced or alternative vehicle technology.

As current industry and occupational classification codes utilized to collect and categorize labor market and industry data (such as North American Industries Classification System [NAICS] and Standard Occupational Classification [SOC]) do not specifically identify establishments with alternative fuels and advanced vehicle activities, this study provides statistics for broader (or “traditional”) transportation industries that could potentially include activities related to the advanced vehicle and alternative fuel technologies. However, the proportion of such activities within traditional industries is unknown. To better understand the alternative fuels and advanced vehicle technology component of the traditional transportation industries, this study provides an analysis of the data from executive-level interviews with advanced transportation establishments as well as job postings data specific to alternative fuel and advanced technologies.

The study finds that the importance of the advanced transportation industries cluster in the state of California has been steadily increasing over the past several years. Consumers, employers, and legislators have contributed to the rising awareness and increasing demand for alternative fuels and advanced vehicle technologies. Consumers are interested in reducing their costs at the fuel station and contributing to the overall improvement of the environment; employers are requiring a specialized workforce to help meet the demands of consumers; and legislators have implemented strict guidelines that require adherence to new environmental regulations.

Using broader, traditional industries codes, the advanced transportation is an important industries cluster in California’s economy, with a healthy projected growth rate (7%) over the next three years, or 62,000 new jobs. Although job growth numbers are not available for alternative fuels and advanced technology segments, the majority of industry experts and company executives interviewed expect the establishments engaged in these technologies to add employment over the next one to two years. The study concludes that California firms and municipalities across many sectors are engaged in a variety of advanced transportation activities, including research & development, vehicle manufacturing, fuel production, and

² Centers of Excellence is an initiative of the California Community Colleges Chancellor’s Office, Economic and Workforce Development Program. Centers of Excellence, in partnership with business and industry, provide regional workforce research customized for community college decision making and resource development.
alternative fuel and advanced vehicle usage. Different alternative fuel types are being used, including Flex Fuel/Ethanol, Biodiesel, CNG & LNG, Propane, Hybrids and Electric.

The study also confirms that firms are in need of a workforce that is skilled in alternative fuels and advanced vehicle technologies. In 2012, firms in California posted 1,308 online advertisements for jobs that require such skillsets. Most job announcements were for maintenance and repair workers, electrical/mechanical engineers, and bus and truck mechanics or diesel engine specialists. Employers report difficulties hiring people who are experienced in alternative fuel and advanced vehicle technologies or have had appropriate specialized technology training, such as newer hybrid or electric vehicle technologies.

Job titles for alternative fuel and advanced vehicle technologies employment are largely the same as those for traditional transportation occupations, but require additional skills and knowledge in alternative fuels and advanced vehicles. Most common titles include automotive technicians, bus and truck mechanics, equipment operators/production technicians, general business operations personnel (especially marketing and sales). Employers are looking for workers skilled and knowledgeable in automotive repair, electric vehicle technologies, inspection, alternative fuels, fuel cells, and hand tools. Community colleges have begun introducing related training and education to existing programs and are positioned to train incumbent workers as well.

The study identifies a host of actionable items for both community colleges and workforce development stakeholders. Community colleges have the opportunity to contribute to the growth of the alternative fuels and advanced vehicle technologies field by: 1) adding specialized alternative fuel and advanced vehicle technologies training modules to their traditional automotive/transportation program offerings, 2) connecting with local employers to better understand the skills required for employment, 3) introducing alignment between program offerings and industry recognized certificates, 4) incorporating digital literacy into existing traditional auto-related curricula, 5) developing and sharing best practices curricula across the state, 6) engaging with employers to provide incumbent worker and/or not-for-credit education and training of alternative fuel and advanced vehicle technology skills, and 7) involving local workforce development stakeholders in developing relevant student learning outcomes. The California Energy Commission, employers, and other key stakeholders can partner with community colleges to provide support in the way of equipment attainment, internships, curriculum development, and facilitation of short-term not-for-credit programs.
Introduction

The advanced transportation industries cluster plays a vital role in the lives of Californians and the state's economy. This industries cluster comprises establishments that focus on vehicles, technologies and fuels that help reduce petroleum dependence and greenhouse gas emissions. According to the California Air Resources Board (ARB), all mobile sources account for nearly 40% of the greenhouse gas emissions in California. The implementation of the alternative fuel and advanced vehicle technologies (AF & AVT) not only reduces the negative impacts on the environment and the health of the population, but also creates employment opportunities that are sustainable and well-paying.

As more organizations and businesses are adopting higher fuel and efficiency standards, they require the workforce that is skilled and knowledge to work with alternative fuels, alternative fuel vehicles, and advanced technology vehicles. Both incumbent workers and those just starting their careers will need to have appropriate training and education to maintain or find employment in the rapidly changing advanced transportation industries.

Although there have been a few high-level assessments of jobs evolving from the development of the alternative fuel and advanced vehicle technologies, little has been done to understand and document specific workforce needs of employers. As part of the Alternative and Renewable Fuels and Vehicle Technology Program, the California Energy Commission commissioned a research study from the California Community College Chancellor's Office Centers of Excellence (COE) in order to address this need. This report represents the second in the series of studies conducted by the Centers of Excellence within the project.

The statewide report aims to: 1) provide a broad overview of the employment related to the advanced transportation industries cluster, 2) identify key trends and factors shaping the current and future direction of the industry, including both existing and emerging subsectors within advanced transportation, and 3) identify the emerging needs of employers for new skills and knowledge of alternative fuels and advanced vehicle technology. The study also discusses job classifications that are related to advanced transportation and employment concentrations by region.

Methodology

This study is based primarily on the analysis of secondary labor market data and a variety of published industry information. It draws upon traditional industry and occupational classification systems, specifically the North American Industry Classification System (NAICS) and Standard Occupational Codes (SOC), in order to organize the analysis of employment data and projections. The industry and occupational codes included in this research have been vetted by the oversight team of the project.

To complement secondary labor market data analysis, the COE contacted 111 various California establishments involved in alternative fuel and advanced vehicle technologies for an interview. Out of those companies, 17 executives participated in the interviews. In addition, 10 interviews were conducted with subject matter experts in this field. A mixed method of online and phone interviews was utilized for the data collection. Information collected through these interviews allowed the COE staff to provide a qualitative perspective on the alternative fuels and advanced vehicle technologies workforce, employer needs, emerging job titles, and training requirements.

The study also incorporates the use of aggregated online job postings data to provide a snapshot of the labor demand for the emerging job titles of the advanced transportation industry cluster.

Appendix A supplies more detail on all data sources and methods utilized for this study. Discussion guides utilized in the study are attached in Appendix B.

---

4 Centers of Excellence is an initiative of the California Community Colleges Chancellor's Office, Economic and Workforce Development Program. Centers of Excellence, in partnership with business and industry, provide regional workforce research customized for community college decision making and resource development.
Definition of Advanced Transportation Industries Cluster

The advanced transportation industries cluster includes all business and governmental establishments that focus on vehicles, technologies and fuels with the ultimate goal of reducing petroleum dependence and greenhouse gas emissions. More broadly, advanced transportation includes all modes of transportation on land, sea, and air. However, this study focuses on land transportation, including on- and off-road modes, and specifically the following three alternative fuel and advanced vehicle technologies/systems:

- **Advanced Technology Vehicle (ATV)** that is “a vehicle that combines new engine/ power/ drivetrain systems to significantly improve fuel economy”; ⁵
- **Alternative Fuel Vehicle (AFV)** that refers to “any dedicated, flexible-fuel, or dual-fuel vehicle designed to operate on at least one alternative fuel”; ⁶ and
- **Alternative Transportation Systems** that focus on the movement of people or goods from one place to another either via road or rail utilizing any form of advanced or alternative vehicle technology. Land planning, public administration, and support services related to alternative transportations systems are also captured here.

The COE reviewed existing literature on the subject, analyzed available labor market information, and compiled listings of alternative fuel and advanced transportation establishments in order to identify which standard industry classification codes the activities above would most likely be identified with. Preliminary research showed that transportation related activities and employment occur not only in the industries within the Transportation and Warehousing sector (NAICS codes 48-49), but also in other sectors, such as manufacturing, wholesale, retail, automotive repair services, etc. Some specific six-digit NAICS codes that identify industries within those sectors were added to the definition of the advanced transportation industries cluster.

The following is the list of NAICS codes and their descriptions. For analysis purposes, the industry codes are grouped into seven sub-clusters. These industries were selected because some of the establishments within these codes were found to be engaged in activities related to the advanced vehicle and alternative fuel technologies. However, the proportion of these activities is unknown.

<table>
<thead>
<tr>
<th>NAICS Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle and Parts Manufacturing Cluster</strong></td>
<td></td>
</tr>
<tr>
<td>335312</td>
<td>Motor and Generator Manufacturing</td>
</tr>
<tr>
<td>335999</td>
<td>All Other Miscellaneous Electrical Equipment and Component Manufacturing</td>
</tr>
<tr>
<td>336111</td>
<td>Automobile Manufacturing</td>
</tr>
<tr>
<td>336112</td>
<td>Light Truck and Utility Vehicle Manufacturing</td>
</tr>
<tr>
<td>336120</td>
<td>Heavy Duty Truck Manufacturing</td>
</tr>
<tr>
<td>336312</td>
<td>Gasoline Engine and Engine Parts Manufacturing</td>
</tr>
<tr>
<td>336350</td>
<td>Motor Vehicle Transmission and Power Train Parts Manufacturing</td>
</tr>
<tr>
<td><strong>Vehicle, Parts, and Supplies Wholesalers Cluster</strong></td>
<td></td>
</tr>
<tr>
<td>423110</td>
<td>Automobile and Other Motor Vehicle Merchant Wholesalers</td>
</tr>
<tr>
<td>423120</td>
<td>Motor Vehicle Supplies and New Parts Merchant Wholesalers</td>
</tr>
<tr>
<td>423860</td>
<td>Transportation Equipment and Supplies (except Motor Vehicle) Merchant Wholesalers</td>
</tr>
<tr>
<td><strong>Car Dealers, Auto Retailing and Renting Cluster</strong></td>
<td></td>
</tr>
<tr>
<td>441110</td>
<td>New Car Dealers</td>
</tr>
<tr>
<td>441310</td>
<td>Automotive Parts and Accessories Stores</td>
</tr>
<tr>
<td>532120</td>
<td>Truck, Utility Trailer, and RV (Recreational Vehicle) Rental and Leasing</td>
</tr>
</tbody>
</table>

---

⁵ U.S. Department of Energy, Alternative Fuels Data Center, 2013
⁶ Ibid.
<table>
<thead>
<tr>
<th>NAICS Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>484110</td>
<td>General Freight Trucking, Local</td>
</tr>
<tr>
<td>484121</td>
<td>General Freight Trucking, Long-Distance, Truckload</td>
</tr>
<tr>
<td>484122</td>
<td>General Freight Trucking, Long-Distance, Less Than Truckload</td>
</tr>
<tr>
<td>484220</td>
<td>Specialized Freight (except Used Goods) Trucking, Local</td>
</tr>
<tr>
<td>484230</td>
<td>Specialized Freight (except Used Goods) Trucking, Long-Distance</td>
</tr>
<tr>
<td>488310</td>
<td>Port and Harbor Operations</td>
</tr>
<tr>
<td>488510</td>
<td>Freight Transportation Arrangement</td>
</tr>
<tr>
<td>492110</td>
<td>Couriers and Express Delivery Services</td>
</tr>
<tr>
<td>485111</td>
<td>Mixed Mode Transit Systems</td>
</tr>
<tr>
<td>485121</td>
<td>Commuter Rail Systems</td>
</tr>
<tr>
<td>485131</td>
<td>Bus and Other Motor Vehicle Transit Systems</td>
</tr>
<tr>
<td>485191</td>
<td>Other Urban Transit Systems</td>
</tr>
<tr>
<td>485210</td>
<td>Interurban and Rural Bus Transportation</td>
</tr>
<tr>
<td>485410</td>
<td>School and Employee Bus Transportation</td>
</tr>
<tr>
<td>485510</td>
<td>Charter Bus Industry</td>
</tr>
<tr>
<td>485999</td>
<td>All Other Transit and Ground Passenger Transportation</td>
</tr>
<tr>
<td>488210</td>
<td>Support Activities for Rail Transportation</td>
</tr>
<tr>
<td>488490</td>
<td>Other Support Activities for Road Transportation</td>
</tr>
<tr>
<td>488999</td>
<td>All Other Support Activities for Transportation</td>
</tr>
<tr>
<td>541614</td>
<td>Process, Physical Distribution, and Logistics Consulting Services</td>
</tr>
<tr>
<td>811111</td>
<td>General Automotive Repair</td>
</tr>
<tr>
<td>811112</td>
<td>Automotive Exhaust System Repair</td>
</tr>
<tr>
<td>811118</td>
<td>Other Automotive Mechanical and Electrical Repair and Maintenance</td>
</tr>
<tr>
<td>811198</td>
<td>All Other Automotive Repair and Maintenance</td>
</tr>
<tr>
<td>562211</td>
<td>Hazardous Waste Treatment and Disposal</td>
</tr>
<tr>
<td>562212</td>
<td>Solid Waste Landfill</td>
</tr>
<tr>
<td>562213</td>
<td>Solid Waste Combustors and Incinerators</td>
</tr>
<tr>
<td>562219</td>
<td>Other Nonhazardous Waste Treatment and Disposal</td>
</tr>
<tr>
<td>562910</td>
<td>Remediation Services</td>
</tr>
<tr>
<td>562920</td>
<td>Materials Recovery Facilities</td>
</tr>
<tr>
<td>562991</td>
<td>Septic Tank and Related Services</td>
</tr>
</tbody>
</table>

The outlined industry codes will be utilized to summarize the “traditional” transportation industry employment and projected growth and compare regional employment demand. Considering the current classification system does not clearly identify advanced vehicle and alternative fuels activities, this is a broad look at the advanced transportation industries cluster.
Industry Trends & Factors

Making transportation green requires reducing the levels of smog-forming and environmentally damaging greenhouse gas emissions (GHG) from motor vehicles and other forms of transportation. CALSTART outlines three opportunities for reduction of these harmful emissions:

1. Creating clean alternative fuels from blends, new materials, or advanced technologies.
2. Increasing the efficiency of a vehicle by reducing its fuel use, emissions, and impact using various methods that include such things as design, material use, new and retrofitted emission reduction systems, and idle reduction.
3. Improving transportation systems to reduce GHG emissions by utilizing innovative ways to transport people and goods from place to place, such as improving and expanding mass transit systems, developing new forms of transit, and designing more energy-efficient city transportation and delivery routes.

The California Energy Commission is specifically interested in the innovations and adoptions related to the production of clean alternative fuels and implementation of advanced vehicle technologies.

Fifteen years ago hybrids, electric vehicles (EVs), and many other technologies were relatively unknown to most people. Since then, the adoption of these technologies has grown significantly helping to make transportation green in the state of California. Over the last several years a combination of factors has come together to bring about a climate where nearly every automaker has a hybrid, and fuel derived from corn is commonplace. Economic, environmental, and governmental factors have contributed to these changes.

Economic Factors

A poll conducted by Harris Interactive looked at consumer interests regarding alternative fuel vehicles and found that interests toward hybrid vehicles are growing, and mostly with younger consumers. From 2000 through 2010 the cost of gasoline in California has increased, on average, by 7% each year for the ten year period. The ever-rising cost of fuel for consumers is pushing them to consider what they can do to reduce their consumption and save money. According to the Harris Interactive poll, more than half of those who reported an interest in purchasing an alternative fuel vehicle indicated the primary reason was a desire to save money on the cost of fuel purchases.

Individuals, however, are not the only consumers interested in saving money on fuel. Many large organizations are looking to alternative fuels to power their fleets. For example, the single largest consumer of fuel in the United States, the Department of Defense, is looking to biofuels as a cost saving measure. FedEx also has acknowledged this need and is taking steps to transition its fleets to alternative fuels such as biofuels, battery power, and natural gas. Transitions and fleet upgrades conducted by large corporations often mean a need for a competent workforce that is capable of working with these new fleets.

Environmental/ Social Factors

Saving money, however, is not the only reason why some consumers are considering alternative fuel vehicles. With the discussion of climate change and global warming in the media, an increasing awareness of environmental impact has found its way into the consumer social consciousness. Just over a quarter of those interested in purchasing an alternative fuel vehicle attributed their concern about the environment as their primary reason.

---

7 CALSTART
8 Harris Interactive, 2012
9 California Energy Almanac
10 Environmental and Energy Study Institute
Legislative Factors

While consumer demand for vehicles that use less fuel and generate less impact on the environment is increasing, the largest driver pushing forward the technology and manufacturing of alternative fuels and advanced vehicles in California is related to policies to reduce greenhouse gas emissions, as expressed in a series of statutes and regulations.

- In 2006, **Assembly Bill 32: Global Warming Solutions Act (AB 32)** was adopted with the intent to reduce green-house gas emissions to 1990 levels by 2020.\(^{11}\)

- Subsequent and in support of AB 32, **Assembly Bill 118: The Alternative and Renewable Fuel and Vehicle Technology Program (AB 118)** was passed to provide funds for three programs to “develop and deploy innovative technologies that transform California’s fuel and vehicle types to help attain the state’s climate change policies”.\(^{12}\) One of the AB 118 programs focuses on the development of alternative fuels and new vehicle technologies by providing approximately $100 million a year in grants, loans or loan guarantees.

- In January 2007, Governor Schwarzenegger issued **Executive Order establishing a Low-Carbon Fuel Standard (LCFS)**. This Order directed the Secretary for Environmental Protection to coordinate the actions of the California Energy Commission, the California Air Resources Board (ARB), the University of California and other agencies to develop the protocols for measuring the "life-cycle carbon intensity" of transportation fuels.\(^{13}\)

- The California Energy Commission and Air Resources Board (ARB) jointly developed the **State Alternative Fuels Plan (AB1007)** to increase the use of alternative and non-petroleum fuels for transportation. The plan sets goals to reduce petroleum dependence to 15% below 2003 levels, by 2020, and increase alternative fuels production and use by 26%, by 2022.

- The California legislature has also implemented the “California’s Advanced Clean Cars Program” which is a package of regulations requiring auto manufacturers to produce increasing numbers of Zero Emission Vehicles and plug-in hybrid vehicles.\(^{14}\)

- **Vision for Clean Air: A Framework for Air Quality and Climate Planning** was released by the ARB in June 2012 for public comment. The vision establishes targets for lowering nitrogen oxide (NOx) emissions by 80% by 2032 from the 1990 levels in California and specifically in South Coast Air Basin and San Joaquin Valley Air Basin to meet federal air quality standards. The Vision lays the foundation for an integrated approach to develop and deploy the cleanest emissions control technologies. It also provides a timeline for coordinated development and accelerated deployment of the types of technologies expected to be needed in each of the transportation sectors.\(^{15}\)

- The proposed settlement agreement between NRG Energy, Inc. (NRG) and the California Public Utilities Commission (CPUC) charges NRG to undertake investments in electric vehicle (EV) charging infrastructure and pilot programs in California. The settlement includes the installation of 200 fast charging stations available for public use; the installation of infrastructure to support 10,000 privately-owned chargers at 1,000 multi-family, workplace and public interest sites (e.g., public universities); and the development, funding and implementation of EV car sharing and other related technology pilot programs. The settlement proscribes a total investment of $102.5 million.

Together, these important economic, legislative and social factors are creating an impetus for cleaner fleets, more efficient vehicles and “greener” transportation systems. In fact, these same three dynamics

\(^{11}\) Assembly Bill 32: Global Warming Solutions Act, 2006


\(^{13}\) Low Carbon Fuel Standard, California Energy Commission

\(^{14}\) California’s Advanced Clean Cars Program

\(^{15}\) Vision for Clean Air: A Framework for Air Quality and Climate Planning, June 2012.
were selected by the majority of California employers and subject matter experts, when they were asked by the COE about factors that are driving growth in the advanced transportation industry cluster.\(^{16}\)

Figure 1 represents the responses that were collected by the COE through executive level interviews in the fall of 2012. Please note that multiple responses were allowed.

**Figure 1 - Factors Driving Growth in Advanced Transportation in California (n=26)**

*Multiple responses were permitted*

- Legislative policies (such as air quality regulations) - 85%
- Market factors (such as fuel supply and stability, and changes in gasoline and diesel fuel prices) - 77%
- Environmental factors - 69%
- Technology and innovation - 62%
- Natural resource costs - 46%
- Demand / consumer preferences - 35%
- Off-shoring/outsourcing - 12%
- Human capital and workforce - 12%

Overwhelmingly, employers and non-employers said that drivers of growth for the alternative fuels and advanced transportation industries are market forces, cost savings, sustainability issues, pollution control, and policies for the consumer. These policies include greater consumer awareness of the cost savings versus higher fuel prices, ability to better control greenhouse gases, ability to use renewable energy sources to operate alternative vehicles, and benefit from municipal and state policies including rebates and other paybacks.

The COE also asked employers and subject matter experts in this field to evaluate whether or not the same factors can depress growth. Interestingly, many factors that are key to stimulating growth can also become growth impediments. Figure 2 demonstrates the interview results.

**Figure 2 - Factors Depressing Growth in Advanced Transportation in California (n=25)**

*Multiple responses were permitted*

- Demand / consumer preferences - 64%
- Market factors (such as fuel supply and stability, and changes in gasoline and diesel fuel prices) - 52%
- Legislative policies (such as air quality regulations) - 32%
- Technology and innovation - 28%
- Natural resource costs - 20%
- Human capital and workforce - 20%
- Off-shoring/outsourcing - 8%
- Environmental factors - 4%

\(^{16}\) To learn more about the interviews conducted by the COE, see Methodology section of this report.
As Figure 2 shows, most employers and experts agreed that drivers decreasing growth for alternative fuel and advanced vehicle technologies revolve around the lack of consumer awareness and insecurity about the benefits, performance, and maintenance and fueling of these vehicles. These issues are in part a result of inadequate public information from the media that could provide better reliable data, including additional hidden costs experienced by fleet managers for maintaining and repairing advanced vehicles, lack of charging/fueling infrastructure and up-to-date locations of operational stations in the state, and limited incentives available in the stagnant economy.

**Industries Overview**

The advanced transportation industries cluster (defined using traditional industry classification codes) and all the business activities that it comprises currently employ about 899,000 people in California. This includes all occupational jobs within the industries. Overall, the cluster is expected to grow by 7% in the next three years, adding about 62,000 new jobs.

The largest sub-clusters by traditional industry employment are freight transportation, delivery, and port operations (298,000 jobs), auto repair and maintenance (242,000 jobs), and transportation support and logistics services (145,000). Although most of the advanced transportation industry sub-clusters had lost jobs during the recession from 2007-2009, many of them started growing again in 2010 and are projected to continue recovering, albeit at a slow pace. Prior to the economic crisis, this group of industry sub-clusters experienced a growth of 17% within a 5-year period, from 2002-2007. Among these sub-clusters, the auto repair and maintenance industries are expected to add new jobs at the fastest rate of 14% for a three-year period (or 35,000 positions). Figure 3 features historic and projected employment trends data for all industry sub-clusters of the advanced transportation industries cluster.

![Figure 3 - Industry Jobs by Advanced Transportation Cluster, 2007-2015](chart)

If the uptick in employment continues, this data may serve as an early indicator of optimism for future growth in the advanced transportation industries cluster. The projected employment is likely underestimated, as the data do not account for the implementation of high speed rail, electric vehicle infrastructure, and other projects that are expected to add significantly to job creation.
The advanced transportation industries cluster is an important economic driver in California. In 2011, it generated nearly $212 billion in total revenue. In comparison, healthcare sector accounted for $158 billion in sales revenue in the same year. Among the major sub-clusters of advanced transportation, car dealers and other auto retailers generated the most sales revenue ($106 billion), followed by vehicle, parts and supplies wholesalers ($29 billion), and transportation support activities ($26 billion). The revenue generated in these clusters not only contributes to the state’s economic well-being through sales taxes, corporate taxes and other fees, but also makes it possible for business and government agencies to invest into infrastructure development projects.

Regional Industries Cluster Employment

In order to analyze regional concentration of the advanced transportation industries cluster in terms of traditional transportation (both petroleum and non-petroleum) employment, the COE has calculated the location quotient for each of the counties. A location quotient (LQ) is a measurement of how concentrated a particular industry is in comparison to a larger area of study (state of California in this report). A relative regional concentration factor of greater than 1.2 indicates specialization, a factor of 0.8 to 1.2 indicates the normal distribution of an industry's employment in the region and a factor of less than 0.8 could be indicative of a deficiency in the region.

1) Based on the analysis of the LQs for traditional advanced transportation employment, the counties in California that show relative regional concentration in this cluster are:
   - Shasta County (LQ 1.40)
   - San Bernardino County (LQ 1.35)
   - San Joaquin County (LQ 1.30)

These counties tend to represent smaller overall economies with a large share of transportation and distribution industries, which means that they rely more heavily on the transportation industry cluster in terms of jobs than other regions do. San Bernardino County is known to be a transportation hub located in the proximity of five major airports and Long Beach and Los Angeles seaports. The availability and relatively low real estate prices make this area an attractive location for transportation companies and warehouses. Shasta and San Joaquin counties are also considered transportation hubs in their regions. Both are positioned well along the I-5 corridor with multiple access points to state highways (SR 299, SR 99, etc.) and freight rail transportation which serve as distribution arteries to various communities. In addition, San Joaquin County is home to the Port of Stockton, a deep water port, connecting the San Francisco Bay to rail and truck distribution options.

2) Counties with normal distribution of the advanced transportation industries employment include Riverside, Glenn, Fresno, Humboldt, Kern, Stanislaus, Alameda, Sacramento, San Mateo, Orange, Los Angeles, Contra Costa and others. Many of these counties represent very large overall economies, such as Los Angeles, Orange, and Bay Area regions. These economies do not just rely on transportation cluster employment, but these industries play an important role in their job mix. In absolute employment numbers, most of these counties offer more job opportunities than the first group.

3) Advanced transportation employment deficiency relative to the state’s average can be found in smaller rural counties, such as Mono, Sierra, Amador, Trinity, and others. This indicates that the advanced transportation jobs make up a smaller proportion of the overall employment in these counties compared to average proportion of these jobs in the state.

Figure 4 exhibits a map of the relative concentration of employment and sales revenue in advanced transportation industries cluster by county. Appendix D provides detailed county employment, sales and location quotient data that was used to develop the map.

In absolute employment numbers, Los Angeles and Orange counties together account for 36% of all advanced transportation jobs in the state (over 237,500). These counties also account for the most sales revenue of this cluster – about $55 billion and $20 billion respectively. Other regions with significant advanced transportation cluster employment and sales revenue include San Diego, San Bernardino,
Alameda, Riverside, Santa Clara, and Sacramento Counties. However, the advanced transportation activities differ from region to region. Bay Area counties have higher concentrations of urban transit systems, port operations, and electrical vehicle projects. Los Angeles/Orange and Inland Empire counties have a relative advantage in goods movement, port operations, freight transportation, and natural gas vehicles and infrastructure.

**Figure 4 - Map of Relative Industry Employment Concentration and Sales Revenue by County**

Sources: InfoUSA, 2012; EMSI, 2013; Esri, 2013; CCC Centers of Excellence.

**Alternative Fuel and Advanced Vehicle Technology Activities**

Alternative fuels and advanced vehicle technologies (AF & AVT) constitute an important and fast growing segment of the advanced transportation industries cluster. Current labor market data sources do not allow us to analyze this part of the industries cluster due to the lack of industry and occupational codes related to alternative fuels and transportation. In many cases, AF & AVT activities become a part of overall business activities of a firm, making the classification even more challenging. In order to broadly and qualitatively understand the landscape of these activities in California, the research team conducted additional research and identified 111 companies involved in AF & AVT activities in California, and
conducted online and phone interviews with 17 of them. In addition, the team identified a set of organizations, associations, coalitions and individuals working on understanding and/or advancing this segment of the advanced transportation industries cluster. Interviews with 10 of these experts were conducted.

Employers who responded to the interview questions represented a very diverse group of firms in terms of type of organization, geographic location, industry affiliation, and type of alternative fuel and/or vehicle technology. Specifically, 70% (12) of them worked for a company in a private sector, while 30% (5) represented a public organization. The largest industry sectors representing employers were manufacturing, transportation & warehousing, and automotive services, followed by utilities, wholesale trade, education and environmental services. Many employers (seven out of 17) were located in Northern California, four in Central California, one in Southern California, and three reported having multiple locations across the state.

Appendix C lists the firms that participated in the interviews and provided their information.

In addition to web search and interviews, the COE utilized the Burning Glass real-time labor market information tool to inventory online job advertisements related to alternative fuels and advanced vehicle technologies for a period of 12 months, from January 1, 2012 to December 31, 2012. A total of 156 firms posted advertisements for jobs in this field in California. Figure 5 represents a list of top organizations posting open jobs and the number of their job advertisements in the last 12 months.

Figure 5: Firms with the most postings for AF & AVT jobs, Jan – Dec 2012

<table>
<thead>
<tr>
<th>Description</th>
<th>Job Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air National Guard</td>
<td>148</td>
</tr>
<tr>
<td>Solar City</td>
<td>98</td>
</tr>
<tr>
<td>MV Transportation, Inc.</td>
<td>43</td>
</tr>
<tr>
<td>The Army Civilian Corps</td>
<td>32</td>
</tr>
<tr>
<td>GP Strategies Corporation</td>
<td>31</td>
</tr>
<tr>
<td>Tesla Motors</td>
<td>29</td>
</tr>
<tr>
<td>Republic Services, Inc.</td>
<td>23</td>
</tr>
<tr>
<td>Allied Waste Industries, Inc.</td>
<td>18</td>
</tr>
<tr>
<td>Maizis &amp; Miller Consultants</td>
<td>14</td>
</tr>
<tr>
<td>Pacific Gas and Electric Co.</td>
<td>14</td>
</tr>
<tr>
<td>Toyota Motors</td>
<td>14</td>
</tr>
</tbody>
</table>

In the interviews, employers were asked about specific AF & AVT activities they were involved with. The following represents their responses (selecting multiple responses was permitted):

A. Involvement in Alternative Fuels: 17 employers (100%)
   a. Research and Development 25%
   b. Production 38%
   c. Use 56%

Type of fuels that employers are involved with:
- Compressed Natural Gas (CNG)/ Liquefied Natural Gas (LNG)/ Natural gas (7 firms)
- Bio Diesel/ Synthetic diesel/ E85 /Ethanol (8)
- Electric/ Hybrid (5)
- Hydrogen (1)
B. Involvement in Advanced or Alternative Fuel Vehicles: 12 employers (70%)
   a. Research and Development 50%
   b. Design 50%
   c. Production 50%
   d. Managing Fleets 42%

Type of advanced or alternative fuel vehicles or technology specified:
- CNG (4 firms)
- Electric vehicles and hybrids (3)
- Range extended electric vehicle powertrains (1)
- Skytran elevated personal rapid transportation (1)
- Renewable diesel (1)
- Light and heavy duty trucks (1)
- Sunlight – solar powered (1)

C. Involvement in Transportation System Efficiency/Infrastructure Development: 6 employers (30%)
   a. Design 50%
   b. Operation 83%
   c. Planning/Research 50%

Type of transportation system efficiency or infrastructure development specified:
- Fuel Delivery – manage three stations in San Francisco that provide multiple fuels to multiple types of alternative vehicles (1 firm)
- Wireless Electric Charging On Board Vehicle (1)
- Ultralight Rail Transit System, driver-less, computer operated direct-to-destination rail system (1)
- Largest developed CNG storage tank for Class 8 trucks (1)

D. Management of Automotive Fleets: 7 employers (41%)

Among the alternative fleets that these respondents manage, most common are CNG/LNG, electric or hybrid, and biodiesel.

These responses show a variety of alternative fuel and advanced vehicle technologies activities that California companies are engaged in. Both the employer and non-employer respondents are involved in using a variety of fuel types including Flex Fuel/Ethanol, Biodiesel, CNG & LNG, Propane, Hybrids and Electric. These organizations are also engaged in research and development (R&D), production and managing fleets of a wide range of alternative vehicles such as sedans, heavy and light-duty trucks, forklifts and prototype development for several different types of ultra-light rail transit systems. Innovations in transportation systems are available, and design and development is underway to create greater efficiency and infrastructure. These include wireless electric charging on board vehicle systems, stations dispensing a variety of alternative fuels in an urban region, CNG storage tanks, and ultralight rail transit systems.

Generally, employers believe that there is no apparent regional concentration of AF & AVT industries and employment in any specific areas of California. Most employers feel the lack of fuel infrastructure and delivery is a problem in some parts of the state. Specifically, one interviewee said that the infrastructure for CNG is very limited in the state, with stations being few and far between. At the same time, some indicate the Bay Region is leading the state for bio sources of fuel production. Firms that are involved in proto-type manufacturing design and development are mostly located in the San Francisco Bay region as well. These firms indicated they were poised to begin manufacturing very soon as sales were ramping up.
Occupational Employment & Growth

While industry employment is an important indicator of the broad employment landscape and economic potential, occupational analysis is necessary in order to understand what workforce is critical to these industries, what employer requirements are to the new hires and incumbent workers, and what job titles are emerging and will provide employment opportunities in the near future. As with industries, jobs related to alternative fuels and advanced vehicles are very new and are not yet reflected in the Bureau of Labor Statistics’ occupational classification system; therefore obtaining employment estimates for these jobs is difficult. However, many of the jobs impacted by the implementation of alternative fuel and advanced vehicle technologies implementation represent traditional occupations with a set of new skills and knowledge areas, rather than completely new occupations. Looking at employment statistics for traditional occupations related to advanced transportation could provide a broad understanding of job opportunities.

Traditional Advanced Transportation Occupations

The COE identified fifteen (15) occupations related to advanced transportation. These occupations were chosen for their relevance to the focus of this study. Many of them are classified as requiring only short-term or moderate-term on-the-job trainings. However, these represent only minimum requirements. Previous research and anecdotal evidence suggested that many employers require their employees to have certificates or even degrees for the occupations that are classified as requiring on-the-job training. Two of the occupations studied – automotive service technicians/mechanics and bus and truck mechanics – require a postsecondary award, such as educational certificate from a community college or vocational school. The following are the occupations included in the study, their corresponding standard occupational classification (SOC) codes, and minimum education requirements:

<table>
<thead>
<tr>
<th>SOC Code</th>
<th>Occupation Title</th>
<th>Minimum Level of Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-3071</td>
<td>Transportation, Storage, and Distribution Managers</td>
<td>Work experience in a related occupation</td>
</tr>
<tr>
<td>41-2022</td>
<td>Parts Salespersons</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>43-5071</td>
<td>Shipping, Receiving, and Traffic Clerks</td>
<td>Short-term on-the-job training</td>
</tr>
<tr>
<td>49-1011</td>
<td>First-Line Supervisors of Mechanics, Installers, &amp; Repairers</td>
<td>Work experience in a related occupation</td>
</tr>
<tr>
<td>49-3021</td>
<td>Automotive Body and Related Repairers</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>49-3023</td>
<td>Automotive Service Technicians and Mechanics</td>
<td>Postsecondary non-degree award</td>
</tr>
<tr>
<td>49-3041</td>
<td>Bus and Truck Mechanics and Diesel Engine Specialists</td>
<td>Postsecondary non-degree award</td>
</tr>
<tr>
<td>49-3042</td>
<td>Mobile Heavy Equipment Mechanics, Except Engines</td>
<td>Long-term on-the-job training</td>
</tr>
<tr>
<td>53-1031</td>
<td>First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators</td>
<td>Work experience in a related occupation</td>
</tr>
<tr>
<td>53-3021</td>
<td>Bus Drivers, Transit and Intercity</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>53-3022</td>
<td>Bus Drivers, School or Special Client</td>
<td>Moderate-term on-the-job training</td>
</tr>
<tr>
<td>53-3032</td>
<td>Heavy and Tractor-Trailer Truck Drivers</td>
<td>Short-term on-the-job training</td>
</tr>
<tr>
<td>53-3033</td>
<td>Light Truck or Delivery Services Drivers</td>
<td>Short-term on-the-job training</td>
</tr>
<tr>
<td>53-6099</td>
<td>Transportation Workers, All Other</td>
<td>Short-term on-the-job training</td>
</tr>
<tr>
<td>53-7051</td>
<td>Industrial Truck and Tractor Operators</td>
<td>Short-term on-the-job training</td>
</tr>
</tbody>
</table>

Employment opportunities are available for numerous occupational categories related to advanced transportation, ranging from school bus drivers to transportation management occupations. Together, all fifteen occupations account for over 747,000 jobs, with a projected growth of 3% and a replacement rate of 7% by 2015. Most job openings in the next three years are expected for truck drivers and automotive service technicians/mechanics. These occupations on average pay good wages. The highest paid jobs are transportation managers, supervisors of mechanics, and diesel engine specialists/mechanics. Mobile heavy equipment mechanics are expected to add jobs the fastest, with 8% growth rate in the next three years. Figure 6 shows the current and projected employment as well as wages for the occupations of study. Data are sorted by openings, which are calculated as a sum of new and replacement jobs.
**Figure 6 – Employment and Growth for 15 Advanced Transportation Occupations, 2012-2015**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>2012 Jobs</th>
<th>2015 Jobs</th>
<th>Change</th>
<th>% Change</th>
<th>Replacement Jobs</th>
<th>Openings (new + repl.)</th>
<th>2012 Median Hourly Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy and Tractor-Trailer Truck Drivers</td>
<td>207,357</td>
<td>219,910</td>
<td>12,553</td>
<td>6%</td>
<td>12,575</td>
<td>25,128</td>
<td>$17.56</td>
</tr>
<tr>
<td>Light Truck or Delivery Services Drivers</td>
<td>105,276</td>
<td>107,022</td>
<td>1,746</td>
<td>2%</td>
<td>6,829</td>
<td>8,575</td>
<td>$14.71</td>
</tr>
<tr>
<td>Automotive Service Technicians and Mechanics</td>
<td>79,237</td>
<td>80,229</td>
<td>992</td>
<td>1%</td>
<td>6,586</td>
<td>7,578</td>
<td>$16.91</td>
</tr>
<tr>
<td>Shipping, Receiving, and Traffic Clerks</td>
<td>90,275</td>
<td>89,271</td>
<td>(1,004)</td>
<td>(1%)</td>
<td>7,573</td>
<td>7,573</td>
<td>$14.35</td>
</tr>
<tr>
<td>Industrial Truck and Tractor Operators</td>
<td>59,028</td>
<td>60,251</td>
<td>1,223</td>
<td>2%</td>
<td>5,300</td>
<td>6,523</td>
<td>$16.15</td>
</tr>
<tr>
<td>First-Line Supervisors of Mechanics, Installers, &amp; Repairers</td>
<td>41,323</td>
<td>42,481</td>
<td>1,158</td>
<td>3%</td>
<td>3,292</td>
<td>4,450</td>
<td>$32.45</td>
</tr>
<tr>
<td>Bus Drivers, Transit and Intercity</td>
<td>28,889</td>
<td>29,860</td>
<td>971</td>
<td>3%</td>
<td>1,865</td>
<td>2,836</td>
<td>$20.42</td>
</tr>
<tr>
<td>Parts Salespersons</td>
<td>18,453</td>
<td>18,921</td>
<td>468</td>
<td>3%</td>
<td>2,109</td>
<td>2,577</td>
<td>$15.35</td>
</tr>
<tr>
<td>Mobile Heavy Equipment Mechanics, Except Engines</td>
<td>15,519</td>
<td>16,831</td>
<td>1,312</td>
<td>8%</td>
<td>1,221</td>
<td>2,533</td>
<td>$23.19</td>
</tr>
<tr>
<td>Bus Drivers, School or Special Client</td>
<td>25,238</td>
<td>25,885</td>
<td>647</td>
<td>3%</td>
<td>1,578</td>
<td>2,225</td>
<td>$16.34</td>
</tr>
<tr>
<td>First-Line Supervisors of Transportation and Material-Moving Machine &amp; Vehicle Operators</td>
<td>21,341</td>
<td>22,131</td>
<td>790</td>
<td>4%</td>
<td>1,331</td>
<td>2,121</td>
<td>$26.99</td>
</tr>
<tr>
<td>Bus &amp; Truck Mechanics &amp; Diesel Engine Specialists</td>
<td>22,199</td>
<td>22,619</td>
<td>420</td>
<td>2%</td>
<td>1,505</td>
<td>1,925</td>
<td>$21.19</td>
</tr>
<tr>
<td>Transportation, Storage, and Distribution Managers</td>
<td>12,965</td>
<td>13,499</td>
<td>534</td>
<td>4%</td>
<td>947</td>
<td>1,481</td>
<td>$38.18</td>
</tr>
<tr>
<td>Automotive Body and Related Repairers</td>
<td>14,922</td>
<td>15,099</td>
<td>177</td>
<td>1%</td>
<td>1,265</td>
<td>1,442</td>
<td>$17.79</td>
</tr>
<tr>
<td>Transportation Workers, All Other</td>
<td>5,110</td>
<td>5,199</td>
<td>89</td>
<td>2%</td>
<td>504</td>
<td>593</td>
<td>$17.01</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>747,132</td>
<td>769,208</td>
<td>22,076</td>
<td>3%</td>
<td>54,480</td>
<td>77,560</td>
<td></td>
</tr>
</tbody>
</table>

Source: EMSI, 2013

Advanced transportation occupational jobs can be found across many industry sectors in California’s economy. Figure 7 demonstrates the sectors where at least 1% or more of the employment is attributed to these occupations. One-third (33%) of the advanced transportation occupational employment can be found in transportation and warehousing sector (256,000 jobs). Retail trade and wholesale trade sectors are also responsible for a significant proportion of these jobs — 13% and 12% respectively.

**Figure 7 – Advanced Transportation Occupational Jobs by Industry Sector, 2012**

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Employment</th>
<th>% of Advanced Transportation Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation and Warehousing</td>
<td>256,000; 33%</td>
<td></td>
</tr>
<tr>
<td>Retail Trade</td>
<td>97,000; 13%</td>
<td></td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>95,000; 12%</td>
<td></td>
</tr>
<tr>
<td>Other Services (except Public Admin)</td>
<td>76,000; 10%</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>63,000; 5%</td>
<td></td>
</tr>
<tr>
<td>Public Administration</td>
<td>59,000; 8%</td>
<td></td>
</tr>
<tr>
<td>Administrative &amp; Support and Waste Mgt</td>
<td>31,000; 4%</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>19,000; 2%</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>15,000; 2%</td>
<td></td>
</tr>
<tr>
<td>Real Estate Rental &amp; Leasing</td>
<td>13,000; 1%</td>
<td></td>
</tr>
</tbody>
</table>

*Percentages indicate the portion of all advanced transportation occupational jobs.

17 Occupational jobs by industry were calculated using inverse staffing patterns. Source: EMSI, 2013.
Regional Concentration of Occupational Employment

In terms of regional distribution, many advanced transportation occupational jobs can be found in Southern California counties. Los Angeles county accounts for 28% of total California jobs (213,000) for the fifteen occupations of study, followed by Orange (59,000 jobs; 8%), San Bernardino (57,000; 7%), and San Diego (49,000; 6%) counties. Other counties with the largest numbers of jobs that are not in Southern California include Alameda, Santa Clara, Sacramento, Fresno, and San Joaquin.

Figure 8 – Regional Concentration of Occupational Employment

<table>
<thead>
<tr>
<th>County Name</th>
<th>2012 Jobs</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>213,000</td>
<td>28%</td>
</tr>
<tr>
<td>Orange</td>
<td>59,000</td>
<td>8%</td>
</tr>
<tr>
<td>San Bernardino</td>
<td>57,000</td>
<td>7%</td>
</tr>
<tr>
<td>San Diego</td>
<td>49,000</td>
<td>6%</td>
</tr>
<tr>
<td>Riverside</td>
<td>37,000</td>
<td>5%</td>
</tr>
<tr>
<td>Alameda</td>
<td>33,000</td>
<td>4%</td>
</tr>
<tr>
<td>Santa Clara</td>
<td>29,000</td>
<td>4%</td>
</tr>
<tr>
<td>Sacramento</td>
<td>28,000</td>
<td>4%</td>
</tr>
<tr>
<td>Fresno</td>
<td>22,000</td>
<td>3%</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>20,000</td>
<td>3%</td>
</tr>
<tr>
<td>Kern</td>
<td>19,000</td>
<td>3%</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>15,000</td>
<td>2%</td>
</tr>
<tr>
<td>Ventura</td>
<td>14,000</td>
<td>2%</td>
</tr>
<tr>
<td>San Francisco</td>
<td>14,000</td>
<td>2%</td>
</tr>
<tr>
<td>San Mateo</td>
<td>14,000</td>
<td>2%</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>12,000</td>
<td>2%</td>
</tr>
<tr>
<td>Sonoma</td>
<td>9,000</td>
<td>1%</td>
</tr>
<tr>
<td>Tulare</td>
<td>9,000</td>
<td>1%</td>
</tr>
</tbody>
</table>

Sources: InfoUSA, 2012; EMSI, 2013; Esri, 2013; CCC Centers of Excellence.
Note: Employment numbers are rounded to the nearest thousand.

Emerging Alternative Fuel and Advanced Vehicle Technology Jobs

In order to understand occupations and occupational jobs that are specific to AF & AVT, we used two data sources: 1) real-time labor market information or online job advertisements data through the Burning Glass tool; and 2) interviews with 27 employers and subject matter experts conducted by the COE. The results as they relate to the occupational overview and employment are presented below.
Top Job Titles
In the interviews, both employers and non-employers provided a good variety of occupational titles within the field. They include a mix of traditional occupational titles, such as automotive technicians, mechanics, plant operators, drivers, and engineers, as well as new and emerging positions, such as alternative fuel vehicle service workers, green fleet coordinators, and alternative fuel vehicle marketing specialists. Most occupational titles reported by employers are related to automotive/truck mechanics and technicians, various operators and production technicians, or general business operations personnel (especially marketing and sales). However, many other occupational groups were mentioned as well, including management positions, engineers, laboratory technicians, drivers, supply chain/logistics workers and others.

Using interview data, we classified reported job titles into ten groups. The following list represents these ten groups and specific occupations reported by employers in each:

**Mechanics and Technicians:** Mechanic (3); Automotive Technician (2); Automotive Repair Technician; Technician (3); Alternative Fuel Vehicle Service Worker; Equipment Mechanic; Senior Equipment Mechanic; Light Duty Truck Mechanic; Heavy Duty Truck Mechanic; Heavy Duty Equipment Mechanic; Senior Heavy Duty Equipment Mechanic; Construction Equipment Service Worker

**Operators and Production Technicians:** Production Operator; Operations; CNC (Cylinder Neck Configuration) Operator; Technician/Assembler; Factory/Assembly; Plant Maintenance (2); Filament Winding Operator; Plant Operator; Assistant Plant Operator; Commodity Operator; Technology Worker (CAD, Modeling, Microsoft Office)

**General Business Specialists:** Sales (5); Marketing (3); Sales and Marketing Manager; Alternative Fuel Vehicle (AFV) Marketing Specialist; Finance (2); Accounting; Business Management; Office Staff; AFV Funding

**Managers and Supervisors:** Terminal Manager; Manufacturing Supervisor; Production Manager; Quality Specialist; Fleet Manager (2); Service Manager/Supervisor; Management Personnel (2)

**Drivers:** Driver (2); Bus Driver; Fuel Delivery Personnel; Vehicle Driver

**Engineers:** Engineer (3); Chemical Engineer; Mechanical Engineer

**Laboratory Technicians and Managers:** Laboratory Technician (2); Laboratory Manager

**Supply Chain Workers:** Supply Chain; Material Handler; Logistics

**Sustainability Specialists/Planners:** Transportation Coordinator; Planner; Sustainability Specialist; AFV Training Coordinator; Green Fleet Coordinator; Infrastructure Development Personnel

**Other:** Chemist; Trainer; Specification Writer; Research & Development Personnel (2); Technician/Installer; Product Development; Construction Worker

The analysis of online job postings revealed very similar results regarding the job titles with the highest demand. Employers posting advertisements for jobs in AF & AVT are mainly looking to hire mechanics (including auto, maintenance, truck, and diesel mechanics), as well as engineers, electricians, drivers and information technology specialists. Among the top job titles, 183 postings were for mechanics of various kinds. The following represents the top job titles requiring AF & AVT skills and the number of job postings in 2012:

- **Mechanic** 60 postings
- **Electrician** 36
- **Mechanical Engineer** 36
- **Maintenance Mechanic** 30
- **Truck Mechanic** 29
- **Surface Maintenance Repairer** 28
- **Auto Mechanic**
- **Diesel Mechanic**
- **Software Engineer**
- **Driver**
- **Information Tech. Specialist**
- **Aircraft Mechanic**

18 Numbers in parentheses represent the frequency with which a job title was mentioned by different interviewees.
Number of Job Postings
Firms in California posted 1,308 online advertisements for jobs related to alternative fuel and advanced vehicles from January 1, 2012 through December 31, 2012. A large number of job announcements were for maintenance and repair workers (119 postings; 9% of total), electrical/mechanical engineers (95; 7%), bus and truck mechanics and diesel engine specialists (68; 5%), and other. Many job advertisements were for professionals with community college training and education level. Figure 9 shows the top 15 occupations that employers were recruiting for which required skills related to alternative fuels and advance vehicles.

**Figure 9 – Top 15 Occupations by Job Advertisements, Jan – Dec 2012**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Job Postings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Maintenance And Repair Workers, General</td>
<td>119</td>
</tr>
<tr>
<td>2) Mechanical Engineers</td>
<td>95</td>
</tr>
<tr>
<td>3) Bus/Truck Mechanics &amp; Diesel Engine Specialist</td>
<td>68</td>
</tr>
<tr>
<td>4) Software Developers, Applications</td>
<td>50</td>
</tr>
<tr>
<td>5) Electrical Engineers</td>
<td>44</td>
</tr>
<tr>
<td>6) Electricians</td>
<td>41</td>
</tr>
<tr>
<td>7) Automotive Service Techs and Mechanics</td>
<td>39</td>
</tr>
<tr>
<td>8) First-Line Sups. of Mechanics/Installers</td>
<td>28</td>
</tr>
<tr>
<td>9) Software Developers, Systems Software</td>
<td>25</td>
</tr>
<tr>
<td>10) General and Operations Managers</td>
<td>23</td>
</tr>
<tr>
<td>11) First-Line Sups. of Retail Sales Workers</td>
<td>21</td>
</tr>
<tr>
<td>12) Installation, Maintenance, and Repair Workers</td>
<td>21</td>
</tr>
<tr>
<td>13) Aircraft Mechanics and Service Technicians</td>
<td>19</td>
</tr>
<tr>
<td>14) Electrical and Electronic Eng. Technicians</td>
<td>18</td>
</tr>
</tbody>
</table>

Firms that posted open positions for occupations with alternative fuel and advanced vehicle technology skills mostly represent government entities, professional, scientific, and technical services industries, and specialty trade contractors. Figure 10 provides a list of top industries that employers posting job advertisements are operating in.

**Figure 10 - Industries with Most Jobs Postings, Jan – Dec 2012**

<table>
<thead>
<tr>
<th>NAICS Code</th>
<th>Industry Description</th>
<th>Job Postings</th>
</tr>
</thead>
<tbody>
<tr>
<td>928</td>
<td>National Security And International Affairs</td>
<td>249</td>
</tr>
<tr>
<td>541</td>
<td>Professional, Scientific, And Technical Services</td>
<td>110</td>
</tr>
<tr>
<td>921</td>
<td>Executive, Legislative, And Other General Government Support</td>
<td>84</td>
</tr>
<tr>
<td>238</td>
<td>Specialty Trade Contractors</td>
<td>61</td>
</tr>
<tr>
<td>485</td>
<td>Transit And Ground Passenger Transportation</td>
<td>47</td>
</tr>
<tr>
<td>611</td>
<td>Educational Services</td>
<td>39</td>
</tr>
<tr>
<td>221</td>
<td>Utilities</td>
<td>36</td>
</tr>
<tr>
<td>562</td>
<td>Waste Management And Remediation Services</td>
<td>34</td>
</tr>
<tr>
<td>561</td>
<td>Administrative and Support Services</td>
<td>31</td>
</tr>
<tr>
<td>336</td>
<td>Transportation Equipment Manufacturing</td>
<td>25</td>
</tr>
<tr>
<td>811</td>
<td>Repair And Maintenance</td>
<td>24</td>
</tr>
<tr>
<td>622</td>
<td>Hospitals</td>
<td>19</td>
</tr>
<tr>
<td>482</td>
<td>Rail Transportation</td>
<td>18</td>
</tr>
</tbody>
</table>
Employment Growth Projections

Employment growth projections for jobs related to alternative fuels and advanced vehicle technologies are positive. More than 56% of employers interviewed said they would be adding workers in the short-term (1-2 years), while 44% of industry experts interviewed projected job growth for the same time frame. However, all subject matter experts interviewed overwhelmingly expect an increase in employment in the mid-term (3-5 years) over employers – 62% of them would add workers in 3-5 years. Overall, these figures appear quite optimistic. Several fleet managers in the public sector indicated they have been in several years of austerity after eliminating jobs and/or not filling replacement jobs. Due to these measures and the increasing school district pupil population or growing number of municipal vehicles, they may be able to add workers to supply minimum standards for service and maintenance vehicles. Figure 11 represents the distribution of interviewee responses regarding their expectations to add, reduce, or keep the employment levels.

![Figure 11 – Expectations Regarding AF & ATV Employment (n=25)](image)

Although these numbers can provide an insight into employment expectations of the alternative fuel and advanced transportation firms that were interviewed, the sample size is too small to extrapolate these projections to the universe of all related companies in California.

Wages

Twenty of the interviewed AF & AVT employers and industry experts reported wages paid to the entry-level and experienced workers within the job titles they specified. Some employers reported hourly wages which were converted into annual figures assuming full-time employment as the basis. Figure 12 represents the averages of annual earnings for the same or similar occupations. Within the category of job titles that require less than a bachelor’s degree, annual salaries range from $25,000 for entry-level to $68,400 for more experienced positions. Automotive technicians and truck mechanics are paid the highest wages in this group – from $36,600 to $68,400. The group that requires either a bachelor’s degree or work experience in a related field enjoys annual earnings from $45,000 to $176,800. Job titles vary significantly within this category as well. Engineers seem to be the highest earners, with an average entry-level salary of $77,500.

![Figure 12 – Estimated Annual Occupational Earnings Reported](image)

* Annual earnings for this group represent a range from minimum to maximum reported. Arithmetic mean would not be appropriate considering a wide variety of titles within the group.
Workforce Challenges
Subject matter experts in the alternative fuels and advanced vehicle technologies field agree that among the challenges that employers face in this industry, finding and recruiting qualified employees with experience in AF & AVT and keeping current employees’ skills up-to-date with new technologies, are the most important issues. Two-thirds of the non-employers interviewed put these two challenges at the top. Industry experts report that up-to-date training is very important in the industry as the rapid technology changes typically require continual update of skills. They also point out that older workers do not have the “green certifications” that are now needed for entry-level positions and for advancement and promotion within the industry, especially for working with alternative fuel vehicles.

Less than half of the experts consider finding and recruiting entry-level employees with AF & AVT skills an important issue. However, interviewees point out that few alternative fuel vehicle mechanics are trained in working on CNG/LNG vehicles, and that community colleges should be leading in this area.

Employers were also asked about the difficulties they experience when hiring and training employees within the job titles they reported. The results for all reported job titles/occupations are mixed – employers indicate difficulty in recruiting trained workers for 50% of all occupational titles, and no difficulty for the other 50%. Keeping employees up-to-date with technology changes for all occupational titles seems to be even less of an issue, with 41% of employers reporting “Difficult” or “Very Difficult” (Figure 13). However, these results vary between specific occupational titles. For example, 100% of employers report that recruiting engineers is not an issue, while only one employer reports difficulty in keeping systems integration engineers up-to-date with technology. On the other hand, the majority of employers (73%) think that recruiting trained automotive technicians, productions operators, plant operators, and heavy duty truck mechanics is difficult or very difficult. Laboratory technicians for alternative fuel production facilities are also reported as difficult to hire.

When asked to explain their responses, employers cited issues such as difficulty finding people who are experienced; lack of appropriate advanced vehicle training, such as newer hybrid or electric vehicle technology; lack of available workforce in rural area locations; and high-level of job certification (journey-level) required for entry-level employment, to name a few.
Education, Experience and Skills Required

Employers were asked to elaborate about their expectations regarding the educational level, experience, and skills for the positions they specified. The matrix in Figure 14 represents employer responses for each of the job titles or occupational group identified.

**Figure 14 – Education, Experience, and Skill Requirements for Jobs**

<table>
<thead>
<tr>
<th>Occupation/Occupational Group</th>
<th>Minimum education, degrees, and certifications</th>
<th>Minimum experience or typical work experience</th>
<th>Important basic and soft skills</th>
<th>Important technology skills</th>
</tr>
</thead>
</table>
| Mechanics, Technicians        | • Automotive Service Excellence (ASE) Testing and Certification  
• Entry level, journey I, journey II certificate (for journey level mechanics) | • 5 years journey level work (for light and heavy duty truck technicians) | • Problem solving  
• Computer literacy | • Software programs  
• Laptop and scan tools |
| Operators and Production Technicians | • High school  
• Some industrial certifications  
• Undergraduate (for technology workers) | • 2-5 years of experience in production, technology, etc. | • Communication and process safety  
• Ability to learn a complicated process and related safety procedures  
• Technical Planning and Reporting  
• Spreadsheets & PC skills | • Basic CNC programming  
• Computerized control system that manages the production process  
• Safety, quality, manufacturing skills  
• CAD, Modeling, Microsoft Office |
| Engineers                     | • Bachelor's Degree | • 0-20 years  
• Experience working for manufacturers of high tech products | • Hands-on engineering  
• Laboratory skills | • Computer modeling; mathematical modeling  
• Computers, ACAD, Office, Project  
• Technical computer software  
• Electronics  
• Assembly/testing of components  
• Designing, building, and testing electrical and mechanical components in vehicle development |
| Laboratory Technicians        | • College degree in related field | • Other technical lab experience | • Handling multiple priorities  
• Attention to detail  
• Math skills | • Chemical handling  
• Lab measurement techniques |
| Planners                      | • Bachelor's Degree | • Few years working in planning | • MS Office  
• government relations and community outreach | |

Based on the online job postings data, employers hiring for AF & AVT jobs require a variety of skills ranging from vehicle maintenance and repair to professional functions. The top skill categories required by employers specific to AF & AVT are electric vehicle, fuel cell, and alternative fuels (Figure 15).
Employers were also asked about the best way to develop people for the jobs reported. Overwhelmingly, employers believe that on-the-job training is the best approach – 82% of the employers interviewed prefer this method. Classroom training and certification preparation are also high valued for the AF & AVT positions specified, with 64% of interviewees giving preference to this method. Figure 16 indicates employer preferences related to education and training for these jobs.

Current practices of incumbent worker training and development were also discussed with the employers during the interviews. The results were mixed. All employers reported providing some type of training or development to their employees. However, they use a number of approaches. Depending on employer and occupation, training could be delivered internally with the help of internal staff, internally with the help of an outside trainer, and/or by external organizations (including educational institutions).
High-level Training Gap Analysis

With the increased demand for workers skilled in alternative fuel and advanced vehicle technologies, it is increasingly important for California’s educational institutions to have programs in place that would train and re-train for these new skills. Based on the findings of the Program Assessment of Automotive and Electrical Programs in California Community Colleges, a COE report in this series funded by the Energy Commission, community colleges in California have already started changing their existing for-credit programs to meet the employer demand in the advanced transportation space and also creating new for-credit and not-for-credit programs to address immediate training needs of companies and governments. The rapid pace of the technology change and adoption, however, requires a more strategic approach to workforce development. The following outlines the workforce demand side information from this study for the main occupational groups as well as high level supply side information for these groups. Note that only occupational groups relevant to community colleges offerings were included.

1) Automotive Mechanics for Alternative Fuels & Advanced Vehicles

This group of occupations and job titles represents automotive mechanics skilled in repairing and maintaining alternative fuel and advanced transportation vehicles.

Common job titles:
Mechanic, Automotive Mechanic, Automotive Technician, Automotive Repair Technician, Technician, AF & AVT Service Worker, Light Duty Truck Mechanic.

Related occupations & level of education:
Automotive Service Technicians and Mechanics (SOC 49-3023) – Postsecondary non-degree award
Automotive Body and Related Repairers (SOC 49-3021) – Moderate-term on-the-job training

Traditional occupational employment data:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Current Jobs (2012)</th>
<th>3-year Growth</th>
<th>% Growth</th>
<th>Replacements</th>
<th>Total Openings</th>
<th>Annual Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive Service Technicians and Mechanics</td>
<td>79,237</td>
<td>992</td>
<td>1%</td>
<td>6,586</td>
<td>7,578</td>
<td>2,526</td>
</tr>
<tr>
<td>Automotive Body and Related Repairers</td>
<td>14,922</td>
<td>177</td>
<td>1%</td>
<td>1,265</td>
<td>1,442</td>
<td>481</td>
</tr>
<tr>
<td>TOTAL</td>
<td>94,159</td>
<td>1,169</td>
<td>1%</td>
<td>7,851</td>
<td>9,020</td>
<td>3,007</td>
</tr>
</tbody>
</table>

Online job postings:
From January through December 2012, employers posted only 48 online job advertisements for automotive service technicians and mechanics with skills in alternative fuel and advanced vehicle technology.

Wages:
Annual earnings for automotive technicians and mechanics with alternative fuel/advanced vehicle technology skills reported by employers in the interviews range from $36,600 for entry-level to $68,400 for experienced workers.

Skills, education, and certifications:
- Certification requirements mentioned by employers include Automotive Service Excellence (ASE) Testing and Certification and entry level, journey I, journey II certificate (for journey level mechanics).
- Technical skills in demand for related jobs include auto repair, electrical vehicle, inspections, alternative fuels, fuel cells, as well as knowledge of software programs, laptop and scan tools, etc. Problem solving skills are important on the soft skill side.

Community college programs:19
Forty (40) community colleges in California offer curriculum or programs related to alternative fuel vehicle repair and maintenance. Two-thirds of colleges characterized their program as oversubscribed or at the

---

maximum student enrollment levels. These programs prepare students primarily for automotive master
mechanics and automotive specialty technician careers.

Colleges were asked about the number of “seats” or capacity of their program to train students. The
majority of automotive programs with an alternative fuel vehicle concentration can accommodate more
than 90 students. These responses were then extrapolated to approximate a minimum (low) to maximum
(high) student capacity:

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,350 seats</td>
<td>2,610 seats</td>
</tr>
</tbody>
</table>

Common course topics taught include hybrid vehicle maintenance and development, alternative and
renewable fuel properties, and electric vehicle maintenance. One of the most significant challenges for the
alternative fuel vehicle repair and maintenance programs is finding resources for new training equipment
or soliciting donations of equipment.

Gap analysis:
A training gap analysis needs to be conducted on regional level in order to be meaningful. However, to
gain a high-level understanding of the training and education needed, we have compared annual
projected openings for each group of occupations (using traditional labor market data) with the current
program capacity at community colleges (using low and high estimates of available “seats”).

For the automotive mechanics skilled in repairing and maintaining vehicles, the potential training gap is
estimated to range between 400 to 650 trained workers:

<table>
<thead>
<tr>
<th>Annual Openings</th>
<th>Annual Capacity Range</th>
<th>Potential Gap Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,007</td>
<td>2,350 – 2,610</td>
<td>397 – 657</td>
</tr>
</tbody>
</table>

Note that the gap estimate does not take into consideration potential differences between the programs
or potential skill gaps that might exist. It is likely to be underestimated as annual capacity reflects only the
number of students colleges can accommodate in a given year, not the number of enrollees or graduates.
Additionally, it is important to note that the annual capacity figure only takes into account community
colleges and does not include other training providers.

2) Heavy Duty Mechanics for Alternative Fuels & Advanced Vehicles
This group of occupations and job titles represents the heavy duty or diesel mechanics skilled in repairing
and maintaining heavy duty alternative fuel vehicles.

Common job titles:
Truck Mechanic, Diesel Mechanic, Heavy Duty Truck Mechanic, Heavy Duty Equipment Mechanic, Senior
Heavy Duty Equipment Mechanic, and Construction Equipment Service Worker.

Related occupations & level of education:
Bus and Truck Mechanics & Diesel Engine Specialists (SOC 49-3031) – Postsecondary non-degree award
Mobile Heavy Equipment Mechanics, Except Engines (SOC 49-3042) – Long-term on-the-job training

Traditional occupational employment data:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Current Jobs (2012)</th>
<th>3-year Growth</th>
<th>% Growth</th>
<th>Replacements</th>
<th>Total Opening</th>
<th>Annual Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Heavy Equipment Mechanics, Except Engines</td>
<td>15,519</td>
<td>1,312</td>
<td>8%</td>
<td>1,221</td>
<td>2,533</td>
<td>844</td>
</tr>
<tr>
<td>Bus &amp; Truck Mechanics &amp; Diesel Engine Specialists</td>
<td>22,199</td>
<td>420</td>
<td>2%</td>
<td>1,505</td>
<td>1,925</td>
<td>642</td>
</tr>
<tr>
<td>TOTAL</td>
<td>37,718</td>
<td>1,732</td>
<td>5%</td>
<td>2,726</td>
<td>4,458</td>
<td>1,486</td>
</tr>
</tbody>
</table>

Online job postings:
From January through December 2012, employers posted 81 online job advertisements for bus and truck
mechanics, diesel engine specialists, and heavy equipment mechanics with skills in alternative fuel and
advanced vehicle technology.
Wages:
Annual earnings for these mechanics reported by employers in the interviews range from $36,600 for entry-level to $68,400 for experienced workers.

Skills, education, and certifications:
- Certification and work experience requirements mentioned by employers include 5 years of journey level work and entry-level, journey I, journey II certificate (for journey level mechanics).
- Technical skills in demand for related jobs include repair, inspections, alternative fuels, fuel cells, as well as knowledge of software programs, laptop and scan tools, computer literacy, etc. Problem solving skills are also important.

Community college programs:20
Twenty one (21) community colleges in California offer curriculum or programs related to heavy duty vehicle repair and maintenance. The majority of colleges (67%) characterized their program as oversubscribed or at the maximum student enrollment levels. These programs prepare students primarily for diesel master mechanics and engine technician careers. Sixty-seven percent (67%) of college survey respondents plan to add an alternative fuel and /or alternative fuel vehicle content into existing program curricula.

In terms of number of “seats”, the majority of automotive programs with an alternative fuel vehicle concentration can accommodate more than 90 students. These responses were extrapolated to approximate a minimum (low) to maximum (high) student capacity:

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,680 seats</td>
<td>1,850 seats</td>
</tr>
</tbody>
</table>

Common course topics include hybrid vehicle maintenance and development, alternative and renewable fuel properties, natural gas engine and vehicle maintenance and non-petroleum derived diesel fuel (gas-to-liquids and biodiesel). One of the most significant challenges for the heavy duty vehicle repair and maintenance programs is finding resources for new training equipment or soliciting donations of equipment.

Gap analysis:
To approximate a potential training gap, we have compared annual projected openings for this occupation (using traditional labor market data) with the current program capacity at community colleges (using low and high estimates of available “seats”).

For the mechanics skillful in repairing and maintaining heavy duty vehicles, such as buses and trucks, there is a potential training oversupply of about 200-350 trained workers:

<table>
<thead>
<tr>
<th>Annual Openings</th>
<th>Annual Capacity Range</th>
<th>Potential Oversupply Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,486</td>
<td>1,680 – 1,850</td>
<td>194 – 364</td>
</tr>
</tbody>
</table>

Note that the estimate does not take into consideration potential differences between the programs or potential skill gaps that might exist. The oversupply might not exist as annual capacity numbers might be inflating the gap calculations. Annual capacity reflects only the number of students colleges can accommodate in a given year, not the number of enrollees or graduates. Additionally, it is also important to note that the annual capacity figure takes into account only community colleges and does not include other training providers.

3) Other Occupational Areas
The analysis of job postings and executive interviews data in this study pointed to a variety of other occupations related to the industries cluster of the alternative fuel and advanced vehicle technologies. While the two groups of occupations discussed above can be found across a variety of industries within the cluster, the other occupations/job titles identified tend to be specific to a certain value chain activity. The following represents the occupations/titles identified and the industries that they can be found in:

- Production & Operating Technicians: Manufacturing of alternative fuel & advanced vehicles and parts
- Alternative fuel production
Laboratory Technicians  Alternative fuel production
Chemical Engineers  Alternative fuel production
Mechanical Engineers  Manufacturing of alternative fuel & advanced vehicles and parts
Planners, Sustainability Specialists  Transportation systems
Supervisors/Managers  Manufacturing of alternative fuel & advanced vehicles and parts
Repair and maintenance
Alternative fuel production
Sales & Marketing Staff  Transportation systems
Manufacturing of alternative fuel & advanced vehicles and parts
Alternative fuel production

Currently available information on community college program offerings is very limited for these occupations and occupational groups. Many colleges offer programs in engineering, sales and marketing, electrical technology, and operations technology. However, it is currently unknown which colleges incorporate additional skill sets in AF & AVT into their programs. More research is needed to assess the colleges’ training capacity in these areas and assess the training/skill gaps.

Conclusions and Recommendations

Advanced transportation industries cluster plays an important role in California’s economy. It employs nearly 900,000 people across a variety of sectors and is projected to add 7% more jobs by 2015. It also accounts for $212 billion in total annual sales revenue. Transportation related activities and employment occur not only in the industries within the traditional transportation and warehousing sector, but also in other industries, such as manufacturing, wholesale, retail, automotive repair services, and others.

The regional analysis of employment concentration reveals that densely populated Southern California areas (Los Angeles, Orange, San Diego), Bay Area counties (Alameda, Santa Clara, San Mateo, Contra Costa) and Sacramento county account for most traditional jobs in absolute numbers. However, the counties which show high regional concentration of such employment relative to their overall economies are the counties with smaller overall economies that are known to be transportation/logistics hubs—Shasta, San Bernardino, San Joaquin, Sutter, and Imperial.

The research conducted confirms that the alternative fuel and advanced transportation segment of this industry cluster is growing at a faster rate than others. The majority of experts interviewed project that employers will add alternative fuel and advanced vehicle jobs in the next one to two years, and 76% believe that employers will add jobs in the next three to five years. The growth expectations in this area can be attributed to rising fuel prices, corporate initiatives related to “greening” of fleets, environmental/social awareness factors, and a myriad of legislative mandates and incentives issued by state and municipal governments in California.

California companies are engaged in a variety of advanced transportation activities—R&D, production and managing fleets of a wide range of alternative vehicles such as sedans, heavy and light-duty trucks, forklifts and prototype development for several different types of ultra-light rail transit systems. Different alternative fuel types are being used, including Flex Fuel/Ethanol, Biodiesel, CNG & LNG, Propane, Hybrids and Electric. Some organizations are also engaged in innovations in transportation systems to create greater efficiency and infrastructure, including wireless electric charging on board vehicle systems, stations dispensing alternative fuels in an urban region, CNG storage tanks, and light rail transit systems.

Generally, employers believe that there is no apparent regional concentration of AF & AVT industries and employment in any specific areas of California. The Bay Region is leading the state for bio sources of fuel production and proto-type manufacturing design and development. In general, employers feel the lack of fuel infrastructure and delivery is a problem.
The research also confirms that firms are in need of a workforce that is skilled in alternative fuels and advanced vehicle technologies. In 2012, firms in California posted 1,308 online advertisements for jobs that require such skillsets. A large number of job announcements were for maintenance and repair workers, electrical/mechanical engineers, and bus and truck mechanics or diesel engine specialists. Employers report difficulties hiring people who are experienced in AF & AVT or have had appropriate advanced vehicle training, such as newer hybrid or electric vehicle technology.

Job titles for AF & AVT employment are largely the same as those for traditional occupations, but require additional skills in alternative fuel and advanced vehicle technology. Most occupational titles reported by employers in the interviews and found in job postings are related to automotive/truck mechanics and technicians, various operators and production technicians, or general business operations personnel (especially marketing and sales). Top skill categories needed by employers include repair, electric vehicle, inspection, alternative fuels, fuel cells, hand tools.

As most of the jobs related to AF & AVT require some type of technical certification or vocational award, community colleges are well positioned to provide training. Colleges have already started changing their existing programs to meet the employer demand in the advanced transportation space and also creating new for-credit and not-for-credit programs to address immediate training needs of companies and governments.

- Forty (40) community colleges in California offer curriculum or programs to prepare students for automotive master mechanics and automotive specialty technician careers. Some of these programs offer alternative fuels and advanced vehicle technologies components, such as hybrid vehicle maintenance and development, alternative and renewable fuel properties, and electric vehicle maintenance. Using current capacity and traditional occupational job openings projected, the potential training gap for the automotive mechanics skilled in repairing and maintaining vehicles, is estimated to range from about 400 to 650 trained workers.

- Twenty-one (21) community colleges in California offer curriculum or programs to prepare students primarily for diesel master mechanics and engine technician careers. Some of these programs offer alternative fuels and advanced vehicle technologies components, such as hybrid vehicle maintenance and development, alternative and renewable fuel properties, natural gas engine and vehicle maintenance and non-petroleum derived diesel fuel (gas-to-liquids and biodiesel). For the mechanics skilled in repairing and maintaining heavy duty vehicles, such as buses and trucks, there is projected to be a potential training oversupply of about 200-350 trained workers.

The gap estimates in this report are provided only as a high-level qualitative assessment, not definitive statements as the calculation does not account for potential differences between the programs or potential skill gaps; the supply side statistics are based on the number of students colleges can accommodate in a given year, not the number of enrollees or graduates (which would be a more appropriate measure); and the annual capacity figure does not include other training providers. Additional data and region and occupation specific analyses are needed for a more meaningful gap assessment.

Based on the research findings, the following are the preliminary recommendations to community colleges and workforce development stakeholders:

- Considering growing employer demand for people skilled in alternative fuels and advanced vehicle technologies, community colleges should revise their certificate and degree offerings preparing automotive and diesel mechanics to include these skillsets. Since these are not new titles and many skills required are the same as for traditional occupations, alternative fuels and advanced vehicle technologies should be an add-on curricula, not necessarily a stand-alone certificate or degree program. The AF & AVT topics can also be introduced as a stackable certificate offering to students who completed other automotive or diesel technology programs.

- Based on the most common skills sought by employers in new hires, curricula for AF & AVT should incorporate student learning outcomes related to automotive or diesel repair, electric vehicle maintenance, inspection, alternative fuels, fuel cells, hand tools, schematic diagrams, and welding.
Further discussions with AF & AVT employers are necessary to identify detailed skillsets needed. These may differ depending on the region where a college is located.

- Curricula offered by colleges should be closely aligned with industry recognized certifications in automotive and diesel engine technology areas as employers value workers with these certifications. Considering the importance of experience for the occupations of study, colleges should try to incorporate internships as part of a program.

- Since the advance transportation technology involves work with computers and many firms are reporting knowledge of computer technology and basic software applications as important basic skills for their employees, colleges should review all of their curricula related to transportation technology to make sure they incorporate student learning outcomes on digital literacy. This would make students more prepared for taking advanced vehicle technology courses, such as electric/hybrid technology.

- Community college programs related to advanced transportation need to be available across the state (including rural areas) but should be primarily concentrated in regions with high absolute and relative advanced transportation employment, such as Los Angeles and Orange, San Diego, Bay Area Counties, Sacramento, and other counties that show a high regional concentration of such employment including Shasta, San Bernardino, San Joaquin, Sutter and Imperial.

- Employers report that experience is important for the jobs in advanced transportation and alternative fuels. Therefore, programs that are targeted towards individuals that already have automotive or diesel engine maintenance experience might result in better employment outcomes for participants. These do not necessarily need to be credit programs. Short-term, not-for-credit offerings through the workforce training divisions of colleges and districts could target adults experienced in traditional fields and help them obtain new skills and knowledge in this growing area.

- Short-term, not-for-credit programs need to be developed in partnership with local employers and offered in the areas of need. These programs should be offered only when strong partnerships with local employers exist and these employers have specific incumbent worker training requirements. Local governments, public institutions (such as schools), automotive repair shops, and auto dealers are some of the industries that might have such needs. Partnerships with local workforce investment boards and economic development agencies could facilitate such programs as well. Curricula for short-term training needs to be developed and replicated across the state. Replication of the curricula could happen through train-the-trainer offerings. The following courses/components/curricula could be developed and/or replicated:
  - CNG/LNG
  - Electric and hybrid vehicle maintenance
  - Biofuel/biodiesel vehicle maintenance
  - Construction and maintenance of the alt fuel infrastructure (fueling stations, etc.)
  - Construction and maintenance of electrical charging stations

To serve incumbent workers looking to add to their skillset and advance in this career pathway, some consideration should be given to offering skill-builder or not-for-credit certificate courses for individual enrollment (outside of employer-sponsored training or traditional semester-based, for-credit training).

- Considering that there is a variety of occupational employment opportunities related to advanced transportation technologies (in addition to automotive and diesel mechanics jobs), colleges need to review their relevant curricula to make sure they are providing their students with skills and knowledge related to fuel production technology (lab technicians, plant operators), and manufacturing technology (machine operators and technicians). Since these types of jobs are still emerging and employer demand is limited, focus should be on incorporating relevant topics into existing courses rather than creating new programs or even courses. If students were interested in pursuing a career in alternative fuel production or advance vehicle/parts manufacturing, they would be better informed about these opportunities and more prepared to enter the field.
• Engineering technology programs as well as general engineering courses could also incorporate components related to advanced vehicle technology and/or advanced transportation system design. This would be more relevant for community colleges in the Bay Area and in urban areas of Southern California, where firms are engaged in research, design and manufacturing of these technologies. Such programs could also connect to or offer additional coursework in entrepreneurship geared toward those individuals who are interested in starting a business. For engineering programs, partnerships with four-year educational institutions will be essential. Where possible, community college programs should articulate to four-year degree programs in alternative fuel and advanced vehicle technology fields to create clear pathways for students interested in more advanced AF & AVT careers.

• Community colleges in California have experienced budget cut-backs in the last three years and are not in a position to obtain equipment to set up laboratories needed for hands-on training components. Many colleges report this as a barrier to venturing into the advanced transportation field. The California Energy Commission can support colleges to add an alternative fuel and advanced vehicle technology lab by providing funding for equipment purchases.
References

Assembly Bill 32: Global Warming Solutions Act, 2006


California Air Resources Board, California’s Advanced Clean Cars Program, 2013, http://www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm

CALSTART, www.calstart.org


Environmental and Energy Study Institute, Rising Oil Prices Pushing Large Consumers to Shift to Alternative Fuels, retrieved on April 14, 2013: http://www.eesi.org/rising-oil-prices-pushing-large-consumers-shift-alternative-fuels-06-apr02012


InfoUSA Customized Database, May 2012.


O*NET Online, http://www.onetonline.org/


Appendix A – Study Methodology

To gather qualitative data for this study, the research team utilized available web resources and reviewed the literature on the topic. Traditional labor market data sources, such as Emsi’s proprietary complete employment data, were used for traditional occupational employment estimates and projections. Online job postings data available through the Burning Glass Labor Insight software were accessed to provide an overview of the real-time employment needs related to alternative fuels and advanced transportation jobs. The COE also conducted interviews with employers and experts in the field to obtain additional information.

Interviews

Statewide executive interviews with advanced transportation industry professionals to identify employment and workforce trends, factors, and issues shaping the alternative fuel and transportation industry were completed.

The objectives of the interviews were to:

1. Obtain the qualitative information needed for the statewide overview on advanced transportation industry and alternative fuels/advanced vehicle technologies.
2. Inform the development of a quantitative data collection tool needed for a representative sample employer survey planned as the next phase of this project.

Two discussion guides were developed for the interviews with employers who were known to be involved in alternative fuels and advanced transportation (AF&AT) as well as associations/collaboratives/groups that work in this industry.

<table>
<thead>
<tr>
<th>Target Group</th>
<th>Objective</th>
<th>Titles Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF&amp;AVT Employers</td>
<td>To understand employer’s perspective on workforce and training topics in advanced transportation</td>
<td>CEOs, Directors, or HR Managers</td>
</tr>
<tr>
<td>Non-employers (AF&amp;AVT related associations, groups, collaboratives)</td>
<td>To seek expert opinion on trends, factors, and issues shaping AF&amp;AVT industries in California as they relate to employment, workforce, and training.</td>
<td>Leadership role in an association/group</td>
</tr>
</tbody>
</table>

The in-depth interviews were conducted by web, phone or in-person. A total of 27 interviews were completed; each interview last from 30-45 minutes. The COE utilized a purposeful/convenience sampling method, but made efforts to ensure that the interviewees represent employers across geographic locations, alternative fuels types, and advanced transportation technologies utilized.

A contact database for each group has been developed from a variety of sources and provided to the Energy Commission under a separate cover. This database was utilized to recruit participants for interviews by phone and email.

Real-time Labor Market Information

Real-time labor market information provides a dynamic understanding of employers’ demand for labor by occupation, industry, and geography. Using technology that spiders to multiple sources of online job advertisements, data is aggregated and can be extracted to analyze demand levels, job content, education requirements, skill requirements, and regions of employment concentration.

Labor Insight’s Burning Glass Technologies was used by the research team to search aggregated online job postings related to Alternative Fuels and Advanced Transportation to identify employer demand for skills, certificates, and education requirements and to understand what occupations employers are hiring for and what on-the-job titles they use. The search was conducted for the state of California, for the year 2012 (January 1 through December 31).
Keywords used in the real-time data search were:

- Alternative Fuels
- Alternative Fuel Vehicles
- CNG
- Electric vehicle
- Fuel Cell
- Hybrid Buses
- Hybrid Electric Vehicles
- Hybrid System Architecture
- Hybrid Vehicle
- Hydrogen Fuel Cell

It is important to note some considerations of real-time data that have been documented over the years. First, although a system exists for de-duplication of postings, some duplication may still occur. Second, one online posting may represent multiple vacancies or be an open recruitment posting that does not actually represent a vacancy. Third, jobs that require less than an associate degree are not always posted online but advertised via word-of-mouth or other method and thus not represented here.

**Emsi Complete Employment Data**

In order to capture a complete picture of industry employment, EMSI basically combines covered employment data from Quarterly Census of Employment and Wages (QCEW) produced by the Department of Labor with total employment data in the Regional Economic Information System (REIS) published by the Bureau of Economic Analysis (BEA), augmented with County Business Patterns (CBP) and Nonemployer Statistics (NES) published by the U.S. Census Bureau. Projections are based on the latest available EMSI industry data, 15-year past local trends in each industry, growth rates in statewide and (where available) sub-state area industry projections published by individual state agencies, and (in part) growth rates in national projections from the Bureau of Labor Statistics.

Organizing regional employment information by occupation provides a workforce-oriented view of the regional economy. EMSI’s occupation data are based on EMSI’s industry data and regional staffing patterns taken from the Occupational Employment Statistics program (U.S. Bureau of Labor Statistics). Wage information is partially derived from the American Community Survey.

This report uses state data from the California Labor Market Information Department.

**Important Disclaimer**

Efforts have been made to confirm the accuracy of the data and the reported findings; however, neither the Centers of Excellence, COE host district, California Community Colleges Chancellor’s Office, or California Energy Commission are responsible for applications or decisions made by readers based upon this report.
Appendix B – Discussion Guides

Discussion Guide - Employer Version

Introduction: Thank you for taking time to talk with me today. The California Community Colleges in partnership with the California Energy Commission are interested in hearing from Alternative Transportation and Fuels professionals, employers, and industry experts about the workforce and training needs of the industry. The results of this study will be used to develop new training and education programs as well as improve programs that already exist.

We are in the process of conducting executive interviews to get a more complete understanding of the emerging workforce issues related to the Alternative Fuels and Advanced Transportation industries. Let’s go ahead and begin.

A. PROFILE & GENERAL INFO
[FILL OUT IN ADVANCE - IF NOT ALL INFORMATION IS AVAILABLE, ASK RESPONDENT]

1. Type of organization:
   1. Private sector
   2. Public sector

2. Number of employees in your California location(s):_______

3. What is the organization’s geographic focus, if any (regional, statewide, or national)?
   1. Where are your customers located?_______________
   2. Where is your workforce located?________________

4. What industry sector does your organization work in?
   1. Agriculture
   2. Utilities
   3. Manufacturing
   4. Retail
   5. Wholesale Trade
   6. Healthcare
   7. Transportation and Warehousing
   8. Professional Services/Consulting
   9. Education
   10. Automotive Repair
   11. Government/Public Administration
   12. Other_________________

5. Which of the Alternative Fuels & Advanced Transportation functions are your organization involved in (Check all that apply)?
   1. Alternative fuels (specify___________________)
      a. Research & development
      b. Production
      c. Use
      d. Other:_____________
   2. Advanced or alternative fuel vehicles (specify________________)
      a. Research & Development
      b. Design
      c. Production
      d. Managing fleet(s)
      e. Other:_________________
   3. Transportation system efficiency/Infrastructure development
      a. Design
      b. Operations
      c. Planning/ Research
      d. Other, specify________________

6. Does your organization manage automotive fleets?
   a. Yes [GO TO #7]
   b. No [SKIP #7 AND PROCEED TO #8]

7. What alternative fleets does your organization manage?
   1. Electric/hybrid
   2. CNG/LNG
3. Hydrogen
4. Biodiesel
5. Other: ___________
6. None

B. INDUSTRY ASSESSMENT
8. As we begin our discussion about the Alternative Fuels and Advanced Transportation industries, what do you feel are the factors driving growth in your industry?
   a. PROBE ON EACH FOR GROWTH
      1. Legislative policies (such as air quality regulations)
      2. Environmental factors
      3. Market factors (such as fuel supply and stability, and changes in gasoline and diesel fuel prices)
      4. Technology and innovation
      5. Human capital and workforce
      6. Demand / consumer preferences
      7. Natural resource costs
      8. Off-shoring/outsourcing

9. What are the factors depressing growth in your industry?
   a. PROBE ON EACH FOR DECLINE
      1. Legislative policies (such as air quality regulations)
      2. Environmental factors
      3. Market factors (such as fuel supply and stability, and changes in gasoline and diesel fuel prices)
      4. Technology and innovation
      5. Human capital and workforce
      6. Demand / consumer preferences
      7. Natural resource costs
      8. Off-shoring/outsourcing

10. Thinking about your customers, employees, and other businesses in your industry (competitors), is the implementation of alternative fuels and advanced transportation technologies concentrated geographically within California or evenly dispersed throughout the state?
    [IF NEEDED, e.g. the computer and silicon chip industry is concentrated in Silicon Valley or aerospace concentrated in Los Angeles]
    a. ASK ABOUT REGIONAL CONCENTRATION FOR EACH OF THE FOLLOWING:
       1. Alternative fuels production
       2. Advanced and alternative vehicles (manufacturing, fleet management, service)
       3. Transportation system efficiency/Infrastructure development

C. ASSESSMENT OF WORKFORCE NEEDS
11. What are your expectations for your firm over the next couple years (1-2 years), in terms of adding to or reducing your workforce?
    1. Expecting to add workers (why? ___________)
    2. Expecting to remain current staffing level (why? ___________)
    3. Expecting to reduce our workforce (why? ___________)

12. Thinking further out, 3 to 5 years, what are your expectations for staffing?
    1. Expecting to add workers (why? ___________)
    2. Expecting to remain current staffing level (why? ___________)
    3. Expecting to reduce our workforce (why? ___________)

13. I am going to list a few potential workforce challenges affecting organizations engaged in Alternative Fuel and Advanced Transportation industries cluster. Which of these issues do you think are important and why?
    1. Finding and recruiting entry-level employees trained in Alternative Fuel and Advanced Transportation
    2. Finding and recruiting experienced (non-entry level) employees trained in Alternative Fuel and Advanced Transportation
    3. Keeping current employees trained and up-to-date on Alternative Fuel and Advanced Transportation
4. Retaining employees with Alternative Fuel and Advanced Transportation knowledge who are recruited by competitors
5. Other, specify_______________________________________

14. [OF THOSE THAT WERE CONSIDERED THE MOST IMPORTANT BY THE RESPONDENT FOLLOW UP WITH “What would you recommend as some potential solutions to this challenge”]

D. ASSESSMENT OF OCCUPATIONS
15. Thinking about the different jobs related to alternative fuel and advanced transportation, what occupations/positions does your firm hire for?
   1. Identify occupations________________________
   2. How are the occupational skills different from those in other more traditional transportation jobs?
   3. How difficult is it for your company to recruit trained workers for these jobs? (very difficult, difficult, not difficult,...)
   4. What level of difficulty does ongoing technology change in Alternative Fuel and Advanced Transportation present in keeping your vehicle maintenance employees up to date with needed skills?
   5. What is the best way to develop people for these occupations (on the job, internships, classroom training, certification requirements, vehicle manufacturer’s training, ...)?

16. Thinking about the occupations that you just identified, what are the training and educational requirements for each occupation?
   1. Minimum education, degrees, and certifications required or typical education for someone that is hired:_____________________
   2. Minimum experience requirements or typical work experience requirements for someone that is hired:_____________________
   3. What basic and soft skills are most important:_____________________
   4. What technology skills are most important:_____________________ 
   5. Is ongoing technical training required / typically needed, but not required / not needed.
   6. Are these occupations part of a career ladder or pathway? Yes/No
   7. If they are part of a career ladder, which related occupations provide a good foundation for this position and which provide advancement opportunity?
      a. foundation:_____
      b. advancement:____
   8. What are the typical wages for this position
      a. entry-level:__________
      b. experienced:___________

17. Thinking about the training and development you provide for your current employees, how is the training delivered?
   a. Internally by internal staff
   b. Internally by an outside trainer
   c. Externally through an outside entity (specify the type of agency________ i.e. colleges, universities, private consultant, trade schools, ....)
   d. No training is provided.
   e. Other:

18. That covers all the topics I have planned today, are there any other issues that we did not discuss that you feel are important to training and educating professionals in Alternative Fuel and Advanced Transportation occupations?

19. Is there anyone else who you think is knowledgeable on the subjects we have discussed that you would recommend we speak with?
   Referral’s name: ____________________
   Organization: _______________________
   Contact information: ___________________

Thank you for your time!
Discussion Guide - Non-Employer Version

Introduction: Thank you for taking time to talk with me today. The California Community Colleges in partnership with the California Energy Commission are interested in hearing from Alternative Transportation and Fuels professionals, employers, and industry experts about the workforce and training needs of the industry. The results of this study will be used to develop new training and education programs as well as improve programs that already exist.

We are in the process of completing executive interviews to get a more complete understanding of the emerging workforce issues related to the Alternative Fuels and Transportation industries cluster. Let’s go ahead and begin.

A. Profile & General Info
[FILL OUT IN ADVANCE - IF NOT ALL INFORMATION IS AVAILABLE, ASK RESPONDENT]

1. Type of organization:
   1. Industry Association:
      i. Organization name________
      ii. # of members_____
   2. Academic, educator (specify___________________)
   3. Industry expert/advocate/related non-profit

2. What is the organization's geographic focus (regional, statewide, or national)?
   1. Where are your members/sponsors located?_______________

3. Which of the Alternative Fuels & Advanced Transportation functions does your organization (members) focus on?
   1. Alternative fuels (specify___________________)
      a. Research & development
      b. Production
      c. Use
      d. Other:_____________
   2. Advanced or alternative fuel vehicles (specify________________)
      a. Research & Development
      b. Design
      c. Production
      d. Managing fleet(s)
      e. Other:__________________
   3. Transportation system efficiency/Infrastructure development
      a. Design
      b. Operations
      c. Planning/ Research
      d. Other, specify________________

B. Industry Assessment

4. As we begin our discussion about the Alternative Fuels and Advanced Transportation industries, what do you feel are the factors driving growth in your industry?
   a. PROBE ON EACH FOR GROWTH
      1. Legislative policies (such as air quality regulations)
      2. Environmental factors
      3. Market factors (such as fuel supply and stability, and changes in gasoline and diesel fuel prices)
      4. Technology and innovation
      5. Human capital and workforce
      6. Demand / consumer preferences
      7. Natural resource costs
      8. Off-shoring/ outsourcing

5. What are the factors depressing growth in your industry?
   a. PROBE ON EACH FOR DECLINE
      1. Legislative policies (such as air quality regulations)
      2. Environmental factors
3. Market factors (such as fuel supply and stability, and changes in gasoline and diesel fuel prices)
4. Technology and innovation
5. Human capital and workforce
6. Demand / consumer preferences
7. Natural resource costs
8. Off-shoring / outsourcing

6. Thinking about your members or the research you have done, is the implementation of alternative fuels and advanced transportation technologies concentrated geographically within California or evenly dispersed throughout the state?
   [IF NEEDED, e.g. the computer and silicon chip industry is concentrated in Silicon Valley or aerospace concentrated in Los Angeles.]
   a. ASK ABOUT REGIONAL CONCENTRATION FOR EACH OF THE FOLLOWING:
      1. Alternative fuels production
      2. Advanced and alternative vehicles (manufacturing, fleet management, service)
      3. Transportation system efficiency / infrastructure development

7. How does your organization assess the use of Alternative Fuel and Advanced Transportation amongst organizations that have different primary functions (not transportation), e.g. major companies with their own product distribution fleets, independent distributors, vehicle rental fleets, utility fleets, mail delivery – both private and public, etc.? Please provide us with some statistics that you collect / familiar with.

C. ASSESSMENT OF WORKFORCE NEEDS
8. What are your expectations for the Alternative Fuel and Advanced Transportation firms in the next couple years (1-2 years), in terms of the number of workers? And why do you think so?
   1. Employers will add workers (why? 
   2. Employers will remain at current staffing level(s) (why?
   3. Employers will reduce their workforce (why? 

9. Thinking further out, 3 to 5 years, what are your expectations for staffing among the AF&AT firms? And why do you think so?
   1. Employers will add workers (why? 
   2. Employers will remain current staffing level (why? 
   3. Employers will reduce their workforce (why? 

10. I am going to list a few potential workforce challenges that could be a concern for organizations engaged in alternative fuel and advanced transportation industries cluster. Which of these issues do you think are important and why?
    1. Finding and recruiting entry-level employees trained in Alternative Fuel and Advanced Transportation
    2. Finding and recruiting experienced (non-entry level) employees trained in Alternative Fuel and Advanced Transportation
    3. Keeping current employees trained and up-to-date on Alternative Fuel and Advanced Transportation technologies
    4. Retaining employees with Alternative Fuel and Advanced Transportation knowledge who are recruited by competitors
    5. Other, specify

   [OF THOSE THAT WERE CONSIDERED THE MOST IMPORTANT BY THE RESPONDENT FOLLOW UP WITH “What would you recommend as some potential solutions to this challenge?”]

D. ASSESSMENT OF OCCUPATIONS
11. Thinking about the different jobs related to alternative fuel and advanced transportation, what occupations / positions do firms hire for?
    1. Identify occupations
    2. How are the occupational skills different from those in other more traditional transportation jobs?
3. How difficult is it for companies to recruit trained workers for these jobs? (very difficult, difficult, not
difficult,…)

4. What is the best way to develop people for these occupations (on the job, internships, classroom
training, certification requirements, vehicle manufacturer’s training, …)?

12. Thinking about the occupations that you just identified, what are the training and educational requirements for
each occupation?

   1. Minimum education, degrees, and certifications required or typical education for someone that is
      hired:

   2. Minimum experience requirements or typical work experience requirements for someone that is
      hired:

   3. What basic and soft skills are most important:

   4. What technology skills are most important:

   5. Is ongoing technical training required / typically needed, but not required / not needed.

   6. Are these occupations part of a career ladder or pathway? Yes/No

   7. If they are part of a career ladder, which related occupations provide a good foundation for this
      position and which provide advancement opportunity?

      a. foundation:

      b. advancement:

   8. What are the typical wages for this position

      a. entry-level:

      b. experienced:

13. Thinking about the training and development for these occupations, who are the best training and educational
programs for these occupations?

14. That covers all the topics I have planned today, are there any other issues that we did not discuss that you feel
are important to training and educating professionals in Alternative Fuel and Advanced Transportation
occupations?

15. Is there anyone else who you think is knowledgeable on the subjects we have discussed that you would
recommend we speak with?

   Referral’s name:

   Organization:

   Contact information:

   Thank you for your time!
Appendix C – List of Interview Participant Organizations

The following represents some of the employer and non-employer organizations that participated in the executive interviews with the Centers of Excellence for this study. A total of 111 employers were contacted for an interview. Please note that some companies which participated in the interviews preferred to remain anonymous.

**Employers:**
City and County of San Francisco
City of Los Angeles, Department of Water and Power
Community Fuels
CyberTran International
Elk Grove Unified School District
Madera Unified School District
Pacific Ethanol
Pat's Garage/Green Gears
Renewable Energy Institute International
Skytran, Inc.
Waste Management
Whole Energy Fuels Corp
Wrightspeed

**Associations/Organizations:**
Breathe California of the Bay Area
City of Long Beach
City of Santa Ana
Electric Auto Association
Electric Vehicle Association of Southern California, Inc.
Greater Sacramento Electric Auto Association
San Diego Miramar College
University of California, Davis
Western Propane Gas Association
Western Riverside County Clean Cities Coalition
## Appendix D – Adv. Transp. Industries Cluster Employment, Revenue & Concentration by County

<table>
<thead>
<tr>
<th>County</th>
<th>Sales Volume, 2011</th>
<th>Employment, 2012</th>
<th>Number of Businesses, 2012</th>
<th>Location Quotient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda County</td>
<td>$9,520,871</td>
<td>31,913</td>
<td>2,859</td>
<td>1.05</td>
</tr>
<tr>
<td>Alpine County</td>
<td>$5,117</td>
<td>17</td>
<td>1</td>
<td>0.93</td>
</tr>
<tr>
<td>Amador County</td>
<td>$126,326</td>
<td>320</td>
<td>56</td>
<td>0.51</td>
</tr>
<tr>
<td>Butte County</td>
<td>$799,720</td>
<td>2,966</td>
<td>418</td>
<td>0.83</td>
</tr>
<tr>
<td>Calaveras County</td>
<td>$95,441</td>
<td>383</td>
<td>76</td>
<td>0.74</td>
</tr>
<tr>
<td>Colusa County</td>
<td>$85,496</td>
<td>301</td>
<td>36</td>
<td>0.97</td>
</tr>
<tr>
<td>Contra Costa County</td>
<td>$4,930,649</td>
<td>15,442</td>
<td>1,765</td>
<td>0.99</td>
</tr>
<tr>
<td>Del Norte County</td>
<td>$44,200</td>
<td>239</td>
<td>31</td>
<td>0.70</td>
</tr>
<tr>
<td>El Dorado County</td>
<td>$623,486</td>
<td>1,793</td>
<td>337</td>
<td>0.68</td>
</tr>
<tr>
<td>Fresno County</td>
<td>$8,509,018</td>
<td>16,871</td>
<td>1,753</td>
<td>1.15</td>
</tr>
<tr>
<td>Glenn County</td>
<td>$112,332</td>
<td>478</td>
<td>62</td>
<td>1.19</td>
</tr>
<tr>
<td>Humboldt County</td>
<td>$679,490</td>
<td>2,651</td>
<td>266</td>
<td>1.13</td>
</tr>
<tr>
<td>Imperial County</td>
<td>$1,051,128</td>
<td>3,043</td>
<td>283</td>
<td>1.20</td>
</tr>
<tr>
<td>Inyo County</td>
<td>$75,570</td>
<td>283</td>
<td>47</td>
<td>0.62</td>
</tr>
<tr>
<td>Kern County</td>
<td>$4,122,499</td>
<td>13,253</td>
<td>1,239</td>
<td>1.09</td>
</tr>
<tr>
<td>Kings County</td>
<td>$592,301</td>
<td>2,108</td>
<td>150</td>
<td>0.93</td>
</tr>
<tr>
<td>Lake County</td>
<td>$132,101</td>
<td>507</td>
<td>100</td>
<td>0.63</td>
</tr>
<tr>
<td>Lassen County</td>
<td>$73,461</td>
<td>242</td>
<td>38</td>
<td>0.65</td>
</tr>
<tr>
<td>Los Angeles County</td>
<td>$54,973,339</td>
<td>174,804</td>
<td>16,423</td>
<td>0.99</td>
</tr>
<tr>
<td>Madera County</td>
<td>$418,885</td>
<td>1,527</td>
<td>213</td>
<td>0.86</td>
</tr>
<tr>
<td>Marin County</td>
<td>$1,902,608</td>
<td>5,156</td>
<td>753</td>
<td>0.97</td>
</tr>
<tr>
<td>Mariposa County</td>
<td>$26,295</td>
<td>134</td>
<td>36</td>
<td>0.55</td>
</tr>
<tr>
<td>Mendocino County</td>
<td>$348,061</td>
<td>1,107</td>
<td>202</td>
<td>0.66</td>
</tr>
<tr>
<td>Merced County</td>
<td>$876,973</td>
<td>2,604</td>
<td>280</td>
<td>0.92</td>
</tr>
<tr>
<td>Modoc County</td>
<td>$48,078</td>
<td>159</td>
<td>20</td>
<td>1.05</td>
</tr>
<tr>
<td>Mono County</td>
<td>$54,966</td>
<td>212</td>
<td>20</td>
<td>0.48</td>
</tr>
<tr>
<td>Monterey County</td>
<td>$2,108,322</td>
<td>5,944</td>
<td>637</td>
<td>0.82</td>
</tr>
<tr>
<td>Napa County</td>
<td>$692,992</td>
<td>2,354</td>
<td>275</td>
<td>0.78</td>
</tr>
<tr>
<td>Nevada County</td>
<td>$297,009</td>
<td>1,326</td>
<td>280</td>
<td>0.69</td>
</tr>
<tr>
<td>Orange County</td>
<td>$19,511,015</td>
<td>62,782</td>
<td>6,214</td>
<td>1.01</td>
</tr>
<tr>
<td>Placer County</td>
<td>$2,481,189</td>
<td>7,034</td>
<td>613</td>
<td>1.09</td>
</tr>
<tr>
<td>Plumas County</td>
<td>$55,542</td>
<td>237</td>
<td>49</td>
<td>0.65</td>
</tr>
<tr>
<td>Riverside County</td>
<td>$11,313,432</td>
<td>31,895</td>
<td>2,756</td>
<td>1.17</td>
</tr>
<tr>
<td>Sacramento County</td>
<td>$9,797,119</td>
<td>23,373</td>
<td>2,245</td>
<td>1.03</td>
</tr>
<tr>
<td>San Benito County</td>
<td>$181,988</td>
<td>597</td>
<td>71</td>
<td>0.82</td>
</tr>
<tr>
<td>San Bernardino County</td>
<td>$11,475,570</td>
<td>37,902</td>
<td>3,547</td>
<td>1.35</td>
</tr>
<tr>
<td>San Diego County</td>
<td>$18,740,269</td>
<td>56,284</td>
<td>5,296</td>
<td>0.98</td>
</tr>
<tr>
<td>San Francisco County</td>
<td>$3,485,066</td>
<td>17,817</td>
<td>1,367</td>
<td>0.77</td>
</tr>
<tr>
<td>County</td>
<td>Sales Volume, 2011</td>
<td>Employment, 2012</td>
<td>Number of Businesses, 2012</td>
<td>Location Quotient</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>San Joaquin County</td>
<td>$ 3,775,881</td>
<td>13,308</td>
<td>1,077</td>
<td>1.30</td>
</tr>
<tr>
<td>San Luis Obispo County</td>
<td>$ 1,393,734</td>
<td>4,631</td>
<td>639</td>
<td>0.85</td>
</tr>
<tr>
<td>San Mateo County</td>
<td>$ 3,856,442</td>
<td>14,742</td>
<td>1,447</td>
<td>1.03</td>
</tr>
<tr>
<td>Santa Barbara County</td>
<td>$ 2,049,573</td>
<td>5,855</td>
<td>733</td>
<td>0.69</td>
</tr>
<tr>
<td>Santa Clara County</td>
<td>$ 9,939,035</td>
<td>29,233</td>
<td>2,931</td>
<td>0.79</td>
</tr>
<tr>
<td>Santa Cruz County</td>
<td>$ 963,030</td>
<td>3,806</td>
<td>532</td>
<td>0.72</td>
</tr>
<tr>
<td>Shasta County</td>
<td>$ 1,367,127</td>
<td>4,685</td>
<td>485</td>
<td>1.40</td>
</tr>
<tr>
<td>Sierra County</td>
<td>$ 5,023</td>
<td>17</td>
<td>4</td>
<td>0.49</td>
</tr>
<tr>
<td>Siskiyou County</td>
<td>$ 156,303</td>
<td>639</td>
<td>121</td>
<td>0.87</td>
</tr>
<tr>
<td>Solano County</td>
<td>$ 2,064,046</td>
<td>5,704</td>
<td>607</td>
<td>1.00</td>
</tr>
<tr>
<td>Sonoma County</td>
<td>$ 2,776,140</td>
<td>9,020</td>
<td>970</td>
<td>1.01</td>
</tr>
<tr>
<td>Stanislaus County</td>
<td>$ 2,988,553</td>
<td>8,414</td>
<td>858</td>
<td>1.05</td>
</tr>
<tr>
<td>Sutter County</td>
<td>$ 494,072</td>
<td>1,744</td>
<td>186</td>
<td>1.29</td>
</tr>
<tr>
<td>Tehama County</td>
<td>$ 276,787</td>
<td>766</td>
<td>129</td>
<td>0.88</td>
</tr>
<tr>
<td>Trinity County</td>
<td>$ 25,420</td>
<td>99</td>
<td>16</td>
<td>0.55</td>
</tr>
<tr>
<td>Tulare County</td>
<td>$ 1,940,306</td>
<td>6,241</td>
<td>631</td>
<td>1.04</td>
</tr>
<tr>
<td>Tuolumne County</td>
<td>$ 209,446</td>
<td>590</td>
<td>92</td>
<td>0.58</td>
</tr>
<tr>
<td>Ventura County</td>
<td>$ 5,651,381</td>
<td>14,200</td>
<td>1,395</td>
<td>0.97</td>
</tr>
<tr>
<td>Yolo County</td>
<td>$ 1,463,776</td>
<td>4,973</td>
<td>382</td>
<td>1.14</td>
</tr>
<tr>
<td>Yuba County</td>
<td>$ 203,135</td>
<td>653</td>
<td>76</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$ 211,967,134</strong></td>
<td><strong>655,378</strong></td>
<td><strong>64,125</strong></td>
<td></td>
</tr>
</tbody>
</table>