

4.A. Trends, Issues, and Opportunities

California's goods movement sector is a dynamic sector that has dramatically changed and grown since the end of World War II. Major technological advancements, such as containerized cargo, automation, and open global markets, have contributed to the state's success as an international gateway, while population growth, high-tech manufacturing, and e-commerce have led to increases in domestic freight. Although environmental issues are still a critical concern in freight planning, the State has made significant strides towards addressing community impacts associated with moving goods. For example, when CARB met for its first time in 1968, the Los Angeles basin experienced 200 Stage 1 Smog Alerts that first year. By 1985, that number had fallen to 43. Since 2008, the only Stage 1 Smog Alerts issued have been because of wildfires. Even so, air quality attainment status continues to evade much of the state, thus driving transportation policy toward strategies that will further reduce air pollution and greenhouse gas (GHG) emissions from the transportation sector. As the world's fifth largest economy¹, California's economic health matters to the nation. This careful balance between environmental protection and commerce provides the backdrop for many of the trends that will be described in this chapter.

California has, and continues, to invest in infrastructure improvements to seaports, airports, rail facilities, and roads and bridges. These investments have improved freight fluidity and safety, reduced congestion for freight and passengers, significantly reduced emissions that impact health and contribute to GHG, and attracted industries to do business here, resulting in jobs and economic benefits.

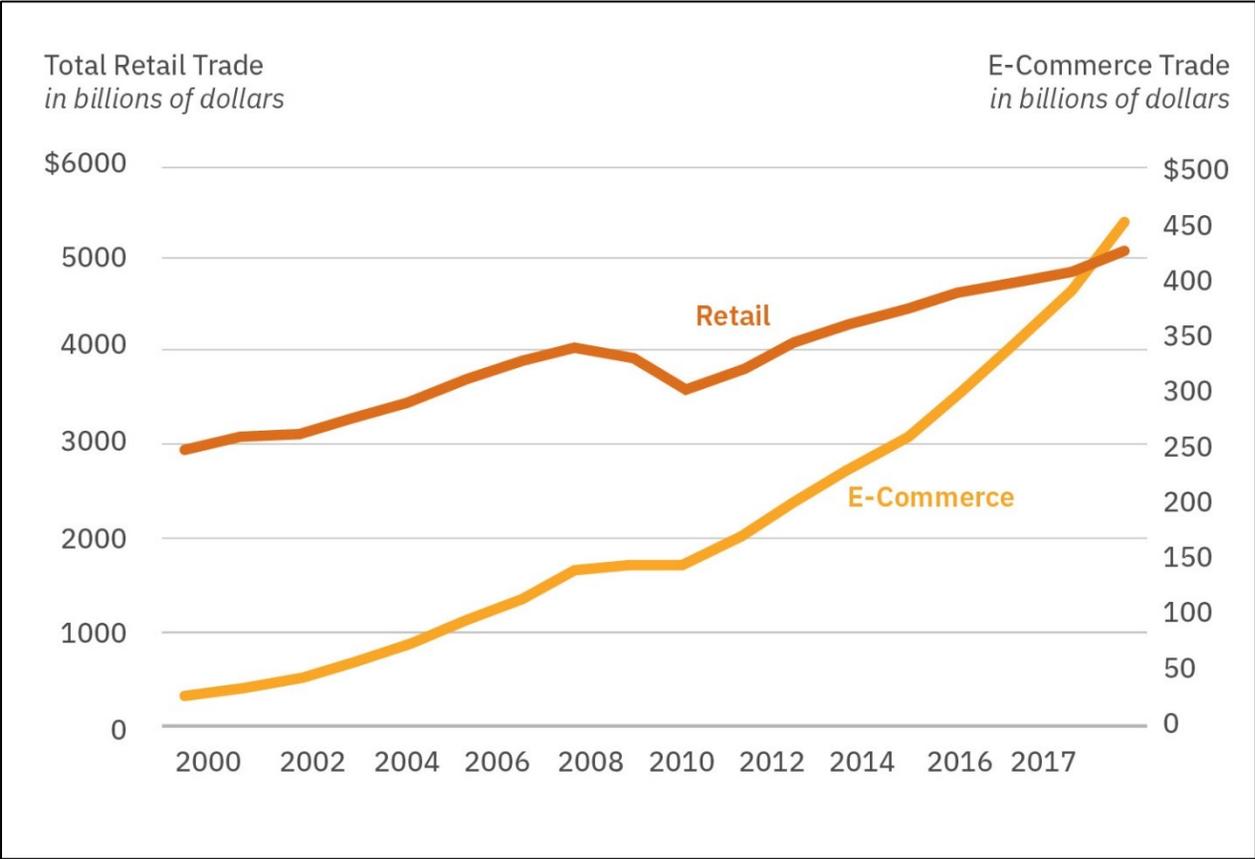
E-Commerce Consumer Trends

The trends with consumers and their buying behavior in California are like those in the rest of the country. E-commerce is growing in part because of the comfort that younger generations have with using online applications and websites. Millennials, notably, grew up with computers and smart phones that have transformed how they socialize, travel, communicate, and consume goods. A Boston Consulting Group (BCG) study found that there are differences in buying behavior and attitudes between Millennials and older populations, including Generation Xers and Baby Boomers.^{2, 3} Generational differences in buying products or rating purchased products are well-correlated with use of social media and the Internet. Millennials tend to shop online more than the traditional consumers, due to their social media and internet use.⁴ Companies that better understand the buying behavior and attitudes of Millennials have adapted their supply chains to meet their needs. Additionally, capturing older populations has partly been a function of providing faster delivery service, since Gen Xers and Baby Boomers grew up driving to the nearest retail store to purchase what they need when they needed it.

As ordering online has become faster and more convenient, growth in e-commerce has continued at a faster rate than traditional retail. As shown in the **Figure 4A.1**, total retail growth has increased from \$3 trillion to \$5 trillion over the past 17 years, whereas e-commerce has

gone from \$25 to \$450 billion in the same time period. This means that e-commerce as a share of total retail has grown 9 percent in 17 years. Even during the 2008 global recession, when total retail trade slowed and dipped, e-commerce grew, capturing an additional one percent of the total retail share. In 2018, e-commerce experienced 16 percent growth, a trend that is anticipated to continue through 2023.⁵

Figure 4A.1. Historical National Total and E-Commerce Retail Trade Sales, 2000-2017



Source: U.S. Census Bureau’s 2017 Annual Retail Trade Survey

E-Commerce and Air Cargo Demand

One factor contributing to the rise of e-commerce, as opposed to traditional retail, is the large variety of goods available for same-day and next-day delivery. Greater emphasis is being placed on reliable deliveries throughout these networks as delivery windows continue to shrink.⁶ According to Caltrans’ latest California Air Cargo Groundside Needs Study 2013, the cargo tonnage at airports is expected to grow at most airports by 2040, as shown in **Table 4A.1**. Since the completion of this study, e-commerce growth and demand for same-day and next-day delivery service has resulted in modest increases in air cargo at urban airports, such as San Francisco, San Jose, and Orange County. For example, over the past three years Amazon has opened nine Prime Now Hubs near urban centers and airports or seaports. This allows Amazon to respond within hours to customer orders. The nine hubs are clustered around Los Angeles, San Francisco, San Diego, Sacramento, and San Jose. The 45,300 square-foot Irvine facility in

Orange County began operating in 2015 less than two miles from John Wayne Airport. This trend could continue given the anticipated growth in e-commerce. First/last mile connections to airports may require additional improvements to accommodate this potential growth in air cargo.

Table 4A.1. Air Cargo Tonnage Trends (in thousands)

California’s Top Air Cargo Airports	2013	2018	% Change from 2013	2040
Los Angeles International Airport (LAX)	1,917	2,444	28%	3,016
Ontario International Airport (ONT)	461	826	79%	972
Oakland International Airport (OAK)	556	670	21%	779
San Francisco International Airport (SFO)	400	628	57%	592
San Diego International Airport (SAN)	162	192	18%	278
Sacramento International Airport (SMF)	74	127	71%	90
Sacramento Mather Airport (MHR)	55	77	41%	69
San Jose International Airport (SJC)	47	61	29%	49
Hollywood Burbank Bob Hope Airport (BUR)	55	55	0%	72
Stockton Metropolitan (SCK)	NA	45	55%*	NA
Long Beach Airport (LGB)	26	24	-10%	20
Santa Ana (John Wayne) Airport (SNA)	18	20	10%	22
Fresno-Yosemite International (FYI)	12	11	-10%	16

Source: Historic data is provided by Caltrans Division of Aeronautics. 2040 estimates are reported from California Air Cargo Groundside Needs Study, Caltrans, 2013 *percentage change is from 2013 to 2018

Independent Delivery Drivers: Transportation Network Companies

In addition to increased demand in the air cargo sector, Transportation Network Companies (TNCs) have become one of the mechanisms used by shippers to deliver goods between fulfillment centers/retail establishments and consumers. For example, over the past five to six years, Amazon has partnered with different delivery and courier services to reduce the delivery time on Amazon orders but has seen limited success. Due in part to complaints about missed delivery times, missing orders, and overall dissatisfaction with courier services, Amazon made the decision to alter last-mile, same-day delivery operations. In 2016, Amazon began contracting with its own drivers through a program called AmazonFlex.⁷ Like TNCs, independent owner-operators of light vehicles work for Amazon to make reliable, same-day delivery possible.

In response, others such as Walmart have contracted with both Uber (UberRUSH) and Lyft to provide delivery capabilities that compete with Amazon. Unlike the Uber and Lyft passenger services, they do not currently operate within the same market areas.⁸ For smaller, local businesses, Postmates.com and DoorDash.com act in a similar capacity. Independent owner-operators of passenger cars respond to online orders for goods that range from restaurant orders to groceries to home improvement products and deliver the items within an hour. These services allow local, non-Amazon retailers to better compete with the faster and more convenient delivery options that consumers are demanding.⁹

Land Use Trends

The advent of e-commerce has changed business as usual for the retail industry, resulting in the closing or restructuring of many traditional retail operators. Consequently, the space previously occupied by retail stores is often being repurposed to office, residential, and other uses. Major malls are closing in favor of other uses.

Large retailers, such as Sears, The Gap, JC Penney, and others have closed hundreds of stores over the past few years. Such closings could accelerate, as lease terms for big retailers are typically between 10 and 25 years. This means that many leases were negotiated before e-commerce really took off. In 2018, only 44 million square feet of retail space opened in the 54 largest U.S. markets, down 87 percent from 325 million in 2006, according to CoStar Group, Inc., a real-estate research firm.¹⁰ There will continue to be more of this trend, as the growth and demand for easy and convenient online shopping and merchandise returns continue.¹¹

The biggest unknown for cities and counties is the true impact of e-commerce on sales tax revenue, land use, and infrastructure. These trends will impact local sales tax revenues, traffic patterns, and occupancy of retail centers. Initial research indicates that e-commerce will reduce overall vehicle trips,¹² eliminate local sales staff jobs, and increase high-tech and warehouse jobs, but the impact on local sales and property tax revenues is not yet well-documented.¹³

Trends in E-Commerce Fulfillment and Distribution Centers

The Inland Empire, Bakersfield, and Stockton have all recently seen significant rise of industrial warehouse development and particularly development related to e-commerce distribution and fulfillment centers. This trend is best explained by exploring the keys to successful e-commerce businesses. According to Prologis, a major industrial warehouse developer/operator, warehousing needs for e-commerce requires three times more logistics space than traditional brick-and-mortar retailers.¹⁴ This need for space, predicated by consumer demand for a wider variety and selection of merchandise (i.e., more Stock Keeping Units, or SKUs) that can be delivered within two days, has led to the development of high-cubed, automated warehouses with minimum ceiling heights of 66 feet. The rise of e-commerce and the need for more logistics space, in lieu of retail space, is rapidly changing the real estate market. In traditional brick-and-mortar retail, the most desirable spaces are located in places with heavy foot-traffic. Successful e-commerce facilities, however, have a very different set of requirements. The most desirable locations for distribution center development have proximity to major urban

population centers, available land for the development of a minimum facility size of one million square feet, zoning that allows minimum building heights of 66 feet, good access to major transportation (road, rail, airports and seaports), an available workforce, and a business-friendly environment.

Another potential impact of a network reconfiguration is a rise in rent for facilities in infill markets, which have doubled in the last five years and are expected to continue to grow.¹⁵ The fulfillment centers are typically smaller, with average sizes between 50,000 and 500,000 square feet located in urban areas. Companies, such as Walmart, use their retail centers to fulfill orders. Others, including Amazon, rely on a network of local fulfillment centers to respond to same-day, next-day, and two-day demand. Amazon (at the time of this report) has 19 fulfillment centers operating in the State, and it ranked California as number 2 on its list of “Top 10 Most Entrepreneurial States.” More than 175,000 small and medium-sized businesses in California sell on Amazon.¹⁶

Emerging Technology Trends

3D Printing/Additive Manufacturing

As a subset of Additive Manufacturing, 3D printing refers to technologies that fabricate products by building up thin layers of material from three-dimensional, computer-aided designs. 3D printing uses machines to “print” successive layers of materials to create a full-range of products. 3D printing, often dubbed the Third Industrial Revolution,¹⁷ is anticipated to cause significant disruptions in both manufacturing and supply chains, including re-shoring manufacturing jobs back to the U.S., co-mingling of manufacturing, storing, and fulfilling orders under one roof, and encouraging local production and customization opportunities for everything from the latest tennis shoes to automobile parts – and all with zero waste. One potentially radical impact of 3D printing is that it may drive down the volume of finished goods shipments. In turn, the nature and destination of raw materials shipments might change dramatically. Businesses will have to figure out which products (or parts of products) can be printed and, accordingly, what manufacturing, assembly and shipment options need to be reinvented. Logistics service providers might offer customers 3D printing services at centralized warehouse locations connected to their shipping facilities. For example, instead of shipping a product from Cleveland to Seattle, a manufacturer might sell the rights to the digital model to a logistics company, which then prints the product in Seattle and delivers it to the customer.¹⁸ 3D printing can lead to more sustainable manufacturing – both economically and environmentally. The ability to print on-demand as orders are received could eliminate shipping costs of unsold goods, discarding unsold goods, and eliminating waste in the manufacturing process itself, which in turn would reduce the amount of energy consumed for both producing and transporting unwanted merchandise.

3D printing is scalable and can support the production of very small items, such as nuts and bolts, to very large-scale items such as houses. The process can occur in small spaces and could lead to the redevelopment of underutilized and antiquated industrial uses in key locations throughout California.

From 2015 to 2017, the 3D printing market growth rate more than doubled from 4.6 percent to 12.5 percent, and analysts at Deloitte estimate that 3D printing will continue to grow at an annual rate of 12.5 to 12.6 percent through 2020.¹⁹ This growth is significant; however, the importance for California is the flexibility and speed to market 3D printing technology. It allows specialized or additive parts to be generated onsite rather than ordering and waiting for those parts to arrive. The total impact on logistics and truck trips is not yet known, but since bulk material requires less space in a truck than manufactured parts, 3D printing may result in fewer truck trips.

Drone Delivery

Large and small delivery companies have been testing alternative delivery vehicles. For example, UPS, Amazon, and DHL have been testing drones since 2016, following a letter from Amazon to the FAA requesting permission to use drones for delivery. In its letter, Amazon stated that 80 percent of the packages that they ship weigh less than five pounds. In 2015, the FAA established a working group to investigate regulatory changes that would be needed to allow drone delivery, including requirements of drone operator's visual contact with the drone, flight height limits of 400 feet, flight prohibitions over government buildings and within five miles of an airport, sense and avoid capabilities, and drones' ability to be identified (which would require Section 336 of the FAA code to be lifted). In April of 2015, the FAA provided limited approval to Amazon for testing drone delivery, and in May 2018, additional approval was provided for a three-year testing period for using drones for deliveries, inspections, and other tasks.²⁰ Aside from the FAA regulations, limited battery life (approximately two hours) and efficient/accurate delivery drop-off pose additional challenges for the successful use of drones for package delivery. The practicality of full-scale drone deployment and use is unknown, but the FAA is evaluating regulatory changes that would support commercialization of drone delivery.

Automation and Supply Chain Analytics

The adoption of robotics and automation is growing rapidly. Robots have been used for the past 20 years on assembly lines in manufacturing, but as costs continue to have decreased and machine learning aided by computing power has increased, robots have become much more common. The advancement of robots through tools such as artificial intelligence (AI), which is the simulation of human intelligence and mimicry of human actions, has benefitted the entire supply chain by streamlining work and creating efficiencies. From warehouses to port complexes, robots and automation are being leveraged to address efficiency, cost, safety, and workforce availability challenges.

According to the 2018 MHI Annual Industry Report:

- Only 22 percent of the surveyed supply chain companies are currently using Internet of Things (IoT) technology, but that is likely to increase to 50 percent within two years and 79 percent within five years
- Currently, only 19 percent of surveyed companies say they are currently using predictive analytics, but over the next five years the adoption rate is expected to jump to 82 percent
- Although the current adoption rate for AI is only six percent among surveyed companies, that number should grow to about 47 percent by 2023.²¹

Warehouse and Manufacturing Automation

Collaborative robots, or “cobots,” are robots that are designed to operate collaboratively with humans. According to research by Interact Analysis, use of the cobot is predicted to grow by more than 60 percent in 2019, an industry value change from less than \$400 million in 2018 to nearly \$600 million in 2019.²² The growth is fueled by the wider availability of collaborative robots from mainstream industrial robot vendors, greater awareness among small- to medium-sized companies, and increasing adoption by major manufacturers and logistics firms.

Emerging automation technologies are enabling companies to make same-day deliveries easier. Not only does the system help retrieve and track thousands of different SKUs, but the robots also assist with providing real-time inventory and replenishment requests. This is important for California because these systems allow sellers to meet consumer demands within a smaller footprint and with less labor in a state where available industrial land and labor are costly.

Blockchain

Blockchain, defined as a system in which records of digital transactions are maintained securely across several computers linked in a peer-to-peer network, is also making its way into the supply chain. Two major challenges for blockchain continue to be:

- Integration of many different systems
- Trust

The use of blockchain applications, although growing more slowly than previously projected by industry leaders such as General Electric, continues to rise. In September 2018, Walmart announced the use of its Food Traceability Initiative, a blockchain technology platform developed by IBM to track food through the supply chain beginning with leafy greens. The globalization of food and lack of tracking that food throughout the supply chain has led to large-scale recalls of both contaminated and non-contaminated products because of the inability to differentiate between them. In response, global retailers have begun to employ technology to better track food and prevent full-scale recalls of products.

For California’s supply chain, additional deployments of blockchain could provide real-time information about how cargo is moving through the system. This would also allow truck drivers to plan arrival times, and terminal operators could reduce peak-hour congestion, truck idling at terminals, and reduce truck-turn times.

Automated Marine Terminals

Automated marine terminals involve the use of automated Rail Mounted Gantries (RMG) and automated trucks. This technology can potentially move more goods while generating fewer emissions than traditional manned marine terminals. In addition to deploying electric and battery-operated equipment, this technology also processes trucks more quickly, resulting in less idling. However, quicker cargo processing at the terminals also potentially means more trucks are released at once into the surrounding roadway network and more demand is placed on the infrastructure beyond the ports. Currently, the POLA, POLB, and other California ports are not contemplating fully automated marine terminals. When and if automated marine terminal technology is adopted, close coordination will be necessary between the ports, Caltrans, and local jurisdictions.

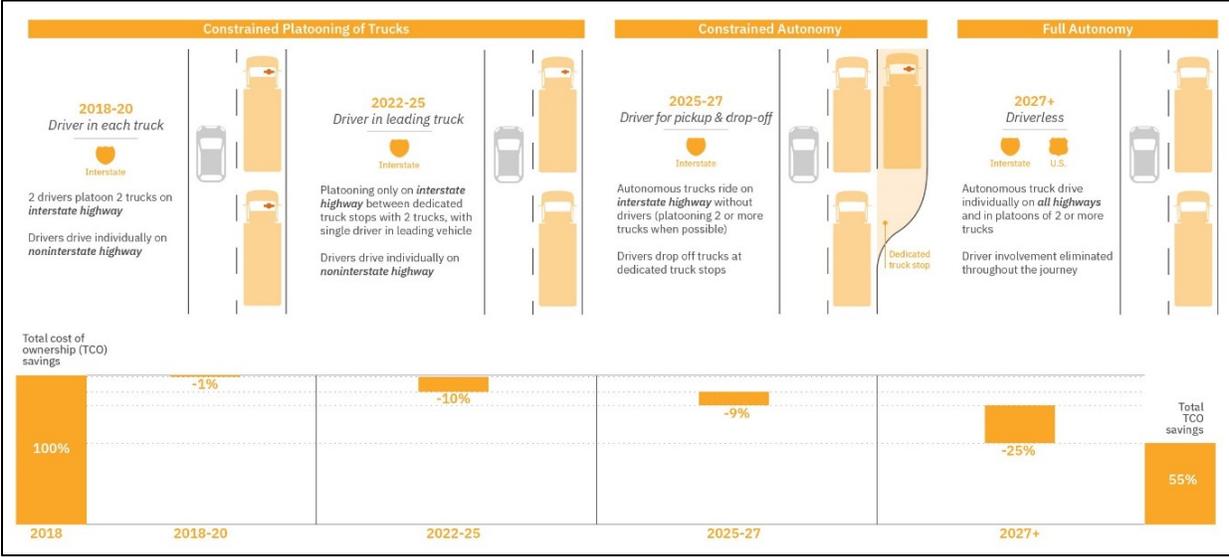
Automated Rail Yards

Automated rail yards offer significant advantages, including decreased dwell times, increased safety, and increased throughput. However, due to complexities and cost of development, the implementation of automation in freight rail yards has been slower than in warehousing. Like marine terminals, automation of intermodal rail yards requires a significant amount of data to successfully plan, implement, and operate. One of the greatest challenges to designing an automated rail yard is developing the Terminal Operating System (TOS) that links equipment, computers, machines, and other elements via a single platform to provide real-time communication and information-sharing throughout the facility for operations, and the planning and monitoring of activities. Fully automated freight rail yards do not currently exist in California but may be deployed in the future.

Connected and Autonomous Trucks

Autonomous, or self-driving, vehicles are increasingly identified as a “disruptive trend.” Disruptive trends are defined as a trend that upends business as usual. It is anticipated that driverless technologies will create several societal benefits ranging from safety to productivity, but this technology will require workforce development for displaced drivers. McKinsey & Company, an American management consulting firm, recently published an in-depth article on the future of automated trucks. According to their research, they anticipate Level 4 (nearly fully autonomous trucks capable of operating within a constrained geo-fenced environment without a driver) will be deployed as early as 2025. **Figure 4A.2** depicts the anticipated timeframes for technology deployment based on this research. It is important to note that in California regulations allowing for the testing and deployment of autonomous motor trucks weighing less than 10,001 pounds (such as delivery vehicles) on public roads is allowed with an approved permit from the California Department of Motor Vehicles (DMV). The DMV began approving new applications for permits for these types of vehicles on January 16, 2020. The DMV’s regulations exclude the autonomous testing or deployment of vehicles weighing more than 10,001 pounds.²³

Figure 4A.2. Timeframes for Autonomous Truck Deployment



Truck Platooning

Connected trucks, also known as truck platooning, refers to the linking of two or more trucks in a convoy using technology to link and automate acceleration and deceleration of the connected trucks. The technology automatically sets and maintains close distance between each vehicle, allowing for fuel savings and increased safety.

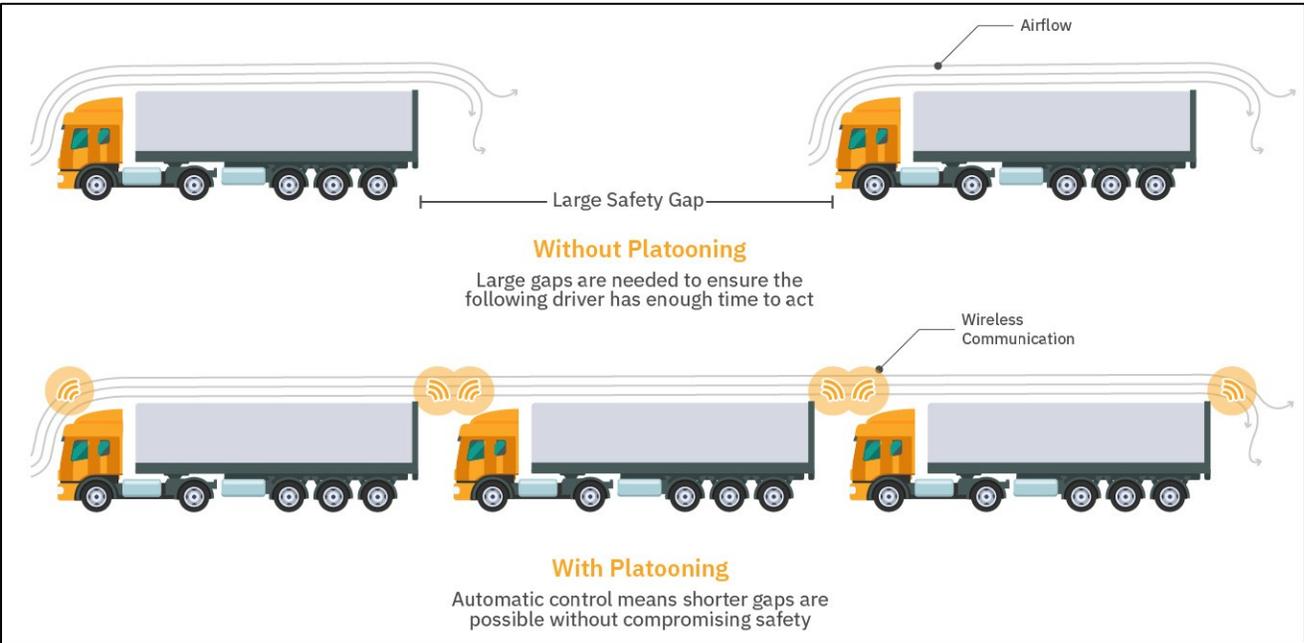
A truck platoon is a series of trucks following each other on the road, with acceleration and deacceleration controlled automatically (steering is typically still manual). When any truck’s speed changes, the others behind it are instantly notified wirelessly, and those trucks respond immediately by following suit. This allows for much closer following distances, which reduces wind resistance and increases the number of trucks that can fit on the road at high speeds, thereby increasing roadway capacity. This also protects against rear-end crashes by automating brake reaction time.

Government and industry have worked closely on the permitting of platooning testing on public roads, and so far, the technology has been effective and safe. As of December 2018, California permits platooning for testing purposes, while 17 states (including neighboring Nevada and Oregon) permit it without limitations. Four other states (including neighboring Arizona) allow for limited commercial deployment. The most significant change to the rules is how closely trucks may follow one another.²⁴ Currently, there is no formal process for implementing new freight technologies. The Federal government is responsible for approving the technology, while the state is accountable for the actual implementation of the new technology.

The certification of vehicles is the responsibility of the original equipment manufacturer, but industry organizations are the ones that provide the recommendations for certification standards and practices. However, Driver Assisted Truck Platooning (DATP) in Nevada has been

classified as only Level 1 automation, which does not require special registration; other states are following suit. California, an early adopter of truck platooning demonstration projects, can capture the full benefits of DATP if the state continues to move towards enabling legislation to support implementation of this technology. The actual benefits of national truck platooning deployment are not yet fully understood because it is unclear how willing competing truck companies will be to connect with one another. However, fuel savings, based on recent truck platooning demonstrations conducted by UC Berkeley Institute of Transportation Studies Partners for Advanced Transportation Technology (PATH) at the Aerodynamics Laboratory in Canada, indicate potential net fuel efficiency gains for a three-truck platoon of 5.2-5.7 percent.²⁵ Enabling legislation in California would allow for the use of this technology, which, if deployed, would result in some emissions reductions.

Figure 4A.3. Truck Platooning Concept



Autonomous Trucks

Autonomous trucks differ from connected trucks since the entire system has an auto-pilot function, including steering. Embark, in partnership with Ryder, has been testing autonomous trucks between El Paso, Texas and Palm Springs, California. The focus has been on the freeway route, with the driver managing the local roadway driving. This accomplishment supports McKinsey and Company research, which anticipates deployment of Level 5 autonomous trucks as early as 2027, which will save the industry approximately 45 percent in operating costs per truck.²⁶ Fully autonomous trucks that do not have an operator on board could potentially not be subjected to Hours of Service (HOS) rules, and could potentially drive continuously until it requires fuel.

Issues

Automation

Jobs Automation

While the use of automation in warehouses, marine terminals, and trucking offers many benefits, their implementation also poses complex planning dilemmas. For example, although automated trucks may address major industry challenges, such as the national truck driver shortage, there is also the potential for unintended economic impacts of job loss if these workers are not transitioned into other jobs. As of 2018, the American Trucking Association (ATA) estimated that there is a shortage of 63,000 truck drivers, and by 2026, they project that the shortage will grow to 174,000 drivers.²⁷ Driver age requirements and anticipation of automated truck technologies are possible factors that are deterring the next generation from choosing truck driving as a career.

In California, a state Supreme Court decision (*Dynamex Operations West, Inc. v. Superior Court*), and later codified under AB 5, made it potentially more difficult for trucking companies to use owner-operators in the state, and some argue that the law effectively eliminates the practice. However, if California logistics companies were to rely solely on automated trucks, the state faces a potential loss of nearly 140,000 jobs.²⁸ Some of this loss will be absorbed through retirement, since half of the U.S. truck driver population is 55 years or older, but the other losses need to be considered and addressed.²⁹

Autonomous Vehicles/Connected Vehicles (AV/CV) Challenges

AV and CV technology will introduce several challenges, such as labor impacts and higher equipment costs, but the most significant challenge impacting deployment is liability. Currently, most highway collisions occur due to human error, but with driver-assisted and fully-automated vehicles, liability will become much more difficult to determine. Additionally, there is little legal precedent on the nature and extent of liability for unmanned vehicles, and therefore, claims by victims will take more time to resolve, if and when liability is determined. The practice and standards need to evolve to address maturing AV/CV technology.³⁰

Clean Energy Capacity and Infrastructure

There is a fine balance between equipment and infrastructure, as operators need available energy to fuel equipment, while energy providers require enough demand to support significant infrastructure investments. For example, large truck fleets enable manufacturers to achieve economies of scale when they order large quantities of alternatively fueled vehicles, which in turn, creates a guaranteed demand for alternative fuel, thus supporting infrastructure investments by the energy providers. These investments may also benefit other users, such as the general motoring population, taxi and TNC drivers, as well as transit providers. However, the cost of new equipment required to meet more stringent emissions standards is difficult for

smaller trucking companies to meet, and could result in the closure or relocation of small trucking firms if standards are enforced without assistance from public and private partners.

Electricity

California's electricity is generated and distributed to much of the state by Pacific Gas & Electric (PG&E) in Northern California region, Southern California Edison (SCE) in the Los Angeles region, and San Diego Gas & Electric (SDG&E) in the greater San Diego region. One significant concern raised during industry stakeholder interviews was the competitive advantages and disadvantages that electricity rates already pose for the state's seaports and industrial uses, and how much the gap could grow as the requirements for all-electric equipment go into effect. In 2018, the average rates for the top three providers in California were: SCE at 14.61¢/kWh, PG&E at 16.27¢/kWh, and SDG&E at 22.50¢/kWh. This significant rate discrepancy gives much of Southern California a competitive rate advantage over the Bay Area and San Diego Regions. This has been an ongoing issue for SDG&E for the past five years:

“Electric system average rates increased annually from 2013 to 2017; approximately 1% for SCE, 4% for PG&E, and 8% for SDG&E. The magnitude of these rate increases, especially in the case of SDG&E, underscores the need to consider cost implications in the policies and programs that keep California's grid green, safe, and resilient.”³¹

Energy competitiveness may be more critical to the ports designated as Special Districts of the State of California, such as San Diego, Hueneme, Humboldt Bay, and Stockton as state entities, and for the Port of Benicia, a private port that does not receive municipal rates. Ports such as Long Beach, Los Angeles, and Oakland are city entities, so they receive lower rates than most others. For example, the Port of Los Angeles benefits from power provided by the City of Los Angeles Department of Water and Power (\$0.12-\$0.15 per kWh), and the Port of Long Beach receives the SCE municipal rate (\$0.04 to \$0.33 with an average of \$0.14/kWh). Both rates are nearly half of the cost of what the Port of San Diego pays (current rate of \$0.23 per kWh and proposed effective rate increase to \$1.00 per kWh), due to the higher SDG&E overall rate structure.³² Cold ironing, also called shore-to-ship power includes running vessel auxiliary power while at port, converting cargo handling equipment from diesel and natural gas to electric, and providing places at the ports for trucks to plug in. The cost of the energy to implement cold ironing could negatively impact California's smaller, niche ports. Demand charges are also being reconsidered in light of SB 100, which encourages more use of electricity and less use of fossil fuels. At present, high electricity use is penalized by rate increases as much as four times the base rates. Suggestions from industry interviews include having the CPUC revisit rate structures, identifying infrastructure investments to facilitate conversion of fuel sources for transportation, and developing policies and plans accordingly.

A recent issue associated with electricity is planned blackouts. Climate change has increased the frequency of wildfires in the state and has made the state vulnerable to wildfires that are caused by faulty or damaged electrical equipment. Six of the ten most destructive fires in California's history were started by electrical equipment. In response, electric companies are

shutting down the electric grids where high winds and other weather events occur, which could cause electrical equipment such as power lines to fall to the ground and create a spark, which could potentially cause a catastrophic wildfire. Electrical blackouts reduce the likelihood of a wildfire being started, however, blackouts disproportionately affect rural and poor neighborhoods. Planned electrical blackouts are projected to be a persistent issue until existing electrical infrastructure is upgraded possibly with underground power lines and the application of a “smart grid,” which would shut down the electrical grid automatically if a problem is detected.³³ Until these improvements are made, planned electrical blackouts are an issue that may affect the reliability of electricity as a source for freight NZE/ZEV vehicles and infrastructure in the years to come.

Charger standardization is another challenge for widespread adoption of electric medium- and heavy-duty trucks. Penske is focusing efforts to promote charging standards for heavy-duty vehicles through the “High Power Charging for Commercial Vehicles Task Force” and in 2018, the Society of Automotive Engineers published a recommended standard for plug-in charging of heavy-duty electric vehicles.³⁴

Natural Gas

Renewable Natural Gas (RNG) is one of the most promising, near-term, fully-renewable alternatives to conventional diesel fuel for Class 8 trucks. RNG-configured heavy-duty tractors combine strong pulling power and long range, so they compete operationally with comparable diesel-powered tractors while offering a lower emission profile. The cost of operation can be lower as well because RNG is growing in availability from sources within the United States, while diesel fuel is experiencing significant price increases due to changes in vessel fuel requirements. Renewable natural gas is a biogas, a form of methane derived from biomass, and upgraded to a quality similar to fossil natural gas (a methane concentration of 90 percent or higher). Many waste facilities and dairy farms power their fleets with renewable natural gas, and companies such as Kroger have been investing heavily in anaerobic digester equipment that is capable of digesting grocery waste into natural gas fuel and high-quality fertilizer. Digester equipment emissions are typically lower than fossil-based natural gas, although it is a higher emitter of pollutants than electric energy. The difference is that RNG is generally considered carbon-neutral because it does not introduce new carbon, but rather regenerates carbon needed for the next generation of plant life.

Hydrogen

Through the San Pedro Bay Ports’ Technology Advancement Program (TAP), Hydrogen Fuel Cell (HFC) trucks have been tested by willing partners. In 2018, CARB awarded \$41 million to the Port of Los Angeles to partner with Toyota to develop and demonstrate 10 ZE Class 8 fuel cell tractors using Kenworth’s T680 platform and to develop two new heavy-duty truck fueling stations. The Toyota fuel cell truck has an operational range of 300 miles. In addition to CARB’s award in 2018, Hyundai announced a planned deployment of 1,000 such trucks in Switzerland in 2019, and Toyota announced its development of a 300-mile range truck. High costs remain a considerable deployment constraint; hydrogen-fueled trucks cost three to four times more than diesel trucks and offer only one-third travel range. Despite this, hydrogen can be produced

from clean, renewable energy sources and does not emit harmful emissions when used as a transportation fuel. Furthermore, one of the benefits of HFC vehicles is they are quicker to refuel than other ZE alternatives, such as battery electric vehicles.

Labor Law Compliance

Federal Labor Laws (Hours of Service / Electronic Logging Devices)

The federal hours of service (HOS) rules (**Figure 4A.4**) updated on March 9, 2017, dictate the allowable driving time for commercial vehicle drivers. In 2018, full implementation of Electronic Logging Devices (ELD) to monitor and track HOS went into effect.

Drivers or carriers who violate the hours of service rules face serious penalties:

- Drivers may be placed out-of-service (shut down) at roadside until the driver has accumulated enough off-duty time to be back in compliance;
- State and local enforcement officials may assess fines;
- The driver's and carrier's scores under the Compliance, Safety, Accountability (CSA) enforcement program can go down, which could result in a variety of enforcement actions;
- The Federal Motor Carrier Safety Administration may levy civil penalties on the driver or carrier, ranging from several hundred dollars to many thousands of dollars per violation depending on the severity;
- The carrier's safety rating can be downgraded for a pattern of violations;
- Federal criminal penalties can be brought against carriers who knowingly and willfully allow or require HOS violations.

Prior to ELDs, drivers found alternative ways to comply, such as maintaining two log books or adjusting numbers in one log book to mitigate unanticipated delays that otherwise would have prevented them from meeting their estimated arrival time. With the implementation of ELDs, this is no longer an option. The unintended consequences include illegal and/or unsafe truck parking and the deployment of additional delivery trucks and drivers. For many companies, complying with the rules and delivering the goods on time means purchasing more trucks, hiring more drivers, and adding more trucks to the highways. The HOS and ELD rules have created truck parking issues throughout the nation, and changes to the rules should be closely monitored by the state as it moves towards the development of a truck parking study.

Figure 4A.4. Hours of Service Rules



California Labor Laws

During the industry outreach, several industry participants cited concerns about California’s rest and break periods as they related to their drivers. While the reasoning behind these standards is obvious, concerns about Labor and Rest Mandates were among the primary issues cited by respondents to the American Truck Research Institute (ATRI) 2018 Survey.³⁵

Section 512, Meal Periods, of the California Labor Code reads, in part, as follows:

“(a) An employer may not employ an employee for a work period of more than five hours per day without providing the employee with a meal period of not less than 30 minutes, except that if the total work period per day of the employee is no more than six hours, the meal period may be waived by mutual consent of both the employer and employee. An employer may not employ an employee for a work period of more than 10 hours per day without providing the employee with a second meal period of not less than 30 minutes, except that if the total hours

worked is no more than 12 hours, the second meal period may be waived by mutual consent of the employer and the employee only if the first meal period was not waived. (b) Notwithstanding subdivision (a), the Industrial Welfare Commission may adopt a working condition order permitting a meal period to commence after six hours of work if the commission determines that the order is consistent with the health and welfare of the affected employees.”

On December 21, 2018 in response to a petition by the ATA, the Federal Motor Carrier Safety Association (FMCSA) pre-empted California Labor Law’s Meal and Rest Break Rules as they apply to “property-carrying commercial vehicle drivers covered by the FMCSA’s hours of service regulations.” Federal law provides for preemption of California’s law, as it was found to 1) provide no additional safety benefit, 2) be incompatible with federal regulations, and 3) cause an unreasonable burden on interstate commerce.

Federal and State Emission Regulation Compliance

More stringent standards in California than neighboring states impacts the competitiveness of California trucking. However, the demand for cleaner and more efficient means of goods movement are driving technological advancements. Truck vehicle miles traveled (VMT) increased from 85 to 98 million between 2014 and 2018. Vehicle Miles Traveled is projected to reach 119 million by 2040.³⁶ The growth in demand for trucking could exacerbate the truck driver shortage and result in longer delivery times and missed opportunities; however, it may also result in speedier implementation of autonomous trucks to address the long-haul segment. Additionally, an increasing number of truck trips, especially in urban areas where an increasing number of distribution/fulfillment centers are being constructed, could increase congestion. Short-haul truck trips in urban areas have increased by more than 17 percent per year since 2015.³⁷

While much of the conversation about the challenges of meeting emissions standards centers on trucking, marine facilities also face many of the same obstacles. The most significant new regulation facing vessel owners and operators is the full implementation of the International Maritime Organization (IMO) 2020 regulations that reduce sulfur oxide emission from 3.5 to 0.5 percent m/m. This rule is scheduled to go into effect on January 1, 2020. This change could cause significant increases in fuel costs, a cost that already equals 50 percent of all operating costs.

Freight Rail Challenges

Rail Cargo Transport Changes

Rail transport has experienced a shift in commodities and implementation of new regulations to address shipping growth of hazardous materials, such as crude oil and liquified natural gas.

Impacts and issues of these changes include the following:

- Decline in the transport of coal by rail has created additional capacity for moving intermodal containers by rail
- The truck driver shortage is creating capacity barriers on the railways as reflected in a 53 percent jump in rail spot rates in 2018 as compared to the same time in 2017³⁸
- The deadline for implementing positive train control was postponed from 2015 to December 31, 2018
- New rules implemented in 2015 improve the safety of transporting crude oil and other hazardous materials by rail. Improvements include enhanced tank car standards, new braking standards, new testing, and sampling requirements to determine product stability and new operational protocols, such as routing requirements, speed restrictions and information sharing with local jurisdictions³⁹

Short Haul Rail and Modal Shift

Use of short haul rail and inland waterways have had some success in California, but costs and operational issues have been persistent challenges. Both operations are limited to bulk cargo unless they have container moving equipment (lifting onto and off rail cars or barges to or from trucks). These extra handling points create competitive price and time advantages for trucking over rail and barge services for short-haul trips. However, with the shortage of truck drivers and the associated upward pressure on trucking rates, the three modes appear to be more closely priced. The following provides a list of impacts and issues associated with these two alternatives to trucking:

- Much of the freight rail infrastructure in urban areas near California's ports is shared with passenger rail, such as Caltrain and Metrolink. Demand for passenger rail is increasing with population growth, higher gas prices, and congestion, and the demand for freight service is increasing due to the shortage of truck drivers.
- Trucks provide the first/last mile connection for most goods moving by short-haul rail or by barge.
- Trucks typically retain a competitive time advantage over goods moved by rail or barge. Railed and barged goods must wait to be loaded with other goods destined for the same inland point, off-loaded at the intermodal yard or inland port, and picked up by a truck for delivery. Trucks provide a direct connection between the arrival and destination.
- Short haul rail, such as those to support an inland port, may require an operating subsidy to be price competitive with trucking. However, the subsidy cost might compare favorably with the debt service and ongoing maintenance costs for a capital project alternative, such as a dedicated truck lane. The permitting challenges may also be fewer and require less time to complete.

Air Cargo Challenges

Air cargo arriving at and departing from the State's airports have been exceeding the projected growth rate of less than three percent. In 2017, international air cargo grew by 9.7 percent, and in 2018, air cargo grew by 3.5 percent. The softer 2018 growth correlates with the potential risks of tariffs.

Impacts and issues of this trend include the following:

- Increased demand for air cargo at California's international airports due to e-commerce
- New technology platforms that employ solutions, such as blockchain, will improve the ease of streamlining online consumer orders across an omni-channel supply chain.
- Growth in air cargo from e-commerce will generate more truck trips to/from the air cargo terminals
- Access to and from air cargo facilities will become a critical first/last mile issue for many airports in California

Opportunities

Clean Trucks and Trucking Efficiencies

Clean Air Action Plans

The San Pedro Bay Ports led the nation by implementing the first Clean Truck Program in 2007 pursuant to adopted emissions reductions standards established in the Clean Air Action Plan (CAAP). CARB and the state's regional air districts implemented similar statewide targets. All agencies, in coordination with the U.S. EPA and the National Highway Traffic Safety Administration (NHTSA), worked toward setting new fuel efficiency standards for the next generation of heavy- and medium-duty trucks. The fuel efficiency standards and the State's emissions reduction targets correlated with the National Ambient Air Quality Standards (NAAQS). In 2017, the POLB and POLA and Los Angeles updated their CAAP, which set new targets for trucks and cargo handling equipment consistent with the CSFAP to reduce GHG from port-related sources to 40 percent below 1990 levels by 2030.

Additionally, the updated CAAP set new targets for the Ports' transition to meet NZE standards beginning in 2020. The Ports will begin assessing a fee on all drayage trucks that do not meet the NZE standard anticipated to be established by CARB in 2020. When the 2017 CAAP was adopted, additional goals set for ZE trucks were anticipated to result in full transition to NZE and ZE by 2036. These targets aligned with the Obama Administration's increasingly stringent NAAQS and fuel efficiency standards referred to as Phase I. Phase II of the emissions reductions were drafted and released for public review in 2016.

Most recently in 2018, the U.S. EPA, in partnership with the NHTSA, placed a hold on the implementation of the 2016 Phase II fuel efficiency standards. Following a letter from the Department of Energy in 2018, the two agencies not only paused the implementation of more stringent fuel efficiency standards, but also stated that a national fuel efficiency standard

should take precedence over state standards, such as the more stringent CARB emissions standards passed in 2018. CARB's stringent standards are a result of more stringent federal NAAQS for 8-hour ozone in 2023. CARB and the state's regional air resource boards have identified ZE implementation as the path necessary to attain NAAQS compliance. CARB's latest ZE targets are based on meeting NAAQS.

Truck Only Lanes

The separation of heavy vehicles and passenger vehicles decreases the risk of collisions.⁴⁰ Approximately 12 percent of passenger vehicle fatalities involve trucks. Speed limits for trucks and autos typically vary by 10 miles per hour in California, impacting the overall flow of freeways. Removing trucks from the general-purpose lanes would likely result in an overall increase in travel speeds, due in part to less merge/diverge conflicts and partly because of a moderation in overall corridor travel speeds. The speeds would also increase since large trucks take up more space; removing them may improve traffic flow.⁴¹

The trucking industry may also benefit from the reduced accident rates of a truck-only lane. Since there would not be the disturbances in this lane usually created by passenger vehicles, the trucks will need to brake, accelerate, and change lanes less often, creating smoother and more efficient travel. An addition of an extra lane will increase capacity, relieve congestion and lower travel times.

When there is a truck-only lane, platooning can be implemented. Platooning, with the aid of wireless communication technology and Dedicated Short-Range Communication (DSRC), reduces the distance between trucks, which in turn reduces wind resistance and increases capacity of a lane.⁴²

Connected Vehicles and Communication Technology

The current national framework for the connected vehicle (CV) environment envisions the use of DSRC, cellular (i.e., 3G, 4G, LTE, 5G), or potentially other types of radio communication between vehicles themselves and the surrounding infrastructure. While some of the anticipated applications for CV-instrumented corridors could conceivably utilize non-DSRC communication to realize functionality, DSRC is the only option that would have specific impacts to the infrastructure.

Roadside DSRC has been established by the United States Department of Transportation (U.S. DOT) as a specifically allocated set of channels and frequencies for use in the anticipated CV world. It is also central to a continuing series of field evaluations and pilot programs led by U.S. DOT. Recent estimates indicate that 20 percent of vehicles will be equipped with some form of CV technology by the year 2025. While other technologies could be implemented to achieve interconnectivity between vehicles, those that are included in the current U.S. DOT-sponsored CV program are the most promising ones for accomplishing nationally coordinated standards through non-proprietary (open) solutions.

For freeway and highway driving, on-board communications equipment would be integrated with application equipment and processors that would implement several envisioned application packages. Much of the enabling technology for the autonomous functions will reside in the vehicles and will include, ultimately, a wide variety of OEM on-board vehicle systems. This on-board equipment and technology will communicate with operation centers and remote application servers. The enabling architecture is expected to utilize cellular and DSRC communication.

Some or all of the proposed CV applications will require continuous DSRC coverage over the lengths of the most heavily used freeways and highways in the region (e.g., I-5 and SR 99). To enable this coverage, DSRC roadside installation sites would need to be implemented at regular intervals. Installation may also need to occur on connecting arterials to provide the degree of coverage necessary for some CV applications.

DSRC is capable of communicating with minimal latency over relatively short distances to ensure timely communication with vehicles. A dedicated DSRC installation would include (at minimum) a DSRC radio, pole, and cabinet. Alternative mounting options include existing light poles, catenary support structures, or signal pole standards. Existing Intelligent Transportation Systems (ITS) control cabinets can be used to house the DSRC equipment as well. The following list summarizes the typical DSRC field components (supporting systems, such as remote monitoring servers, are not included below):

- DSRC radio
- DSRC poles and mounting structures
- DSRC cabinet and equipment
- Communications, power conduit, and cabling
- Splice vaults and pull boxes

Freight Roadway Pricing Applications

There are two types of tolls: fixed and variable tolls. The fixed tolls are predetermined based on the distance covered, axle amount, and/or weight per axle of the vehicle, and do not change during the day. The variable tolls are dependent on features, but also change throughout the day either in response to current conditions or according to a predetermined schedule (i.e., by time of day).⁴³

California currently has no interstate system tolls that are dependent on the weight per axle of the vehicle. However, such a system of tolling would be an ideal method for mitigating the damage caused by heavy trucks. **Figure 4A.5** lists the states and facilities with toll rates based on per-axle weights.⁴⁴

Tolling can be used to fund road maintenance and generate revenue while providing greater travel reliability. Tolling also acts as a travel demand management strategy and therefore may reduce emissions. Discounted toll rates for low-emissions vehicles would encourage operators and fleet managers to invest in low-emissions vehicles and technologies.⁴⁵

The elasticities of toll-paying behavior are different for freight vehicles versus passenger cars. According to a project study jointly sponsored by the National Cooperative Freight Research Program and the National Cooperative Highway Research Program, only a small proportion of freight drivers are open to the idea of roadway tolling.

Truck Size and Weight Limitations Opportunities

In April 2016, FHWA completed an evaluation of truck size and weight limits established by Congress as part of the STAA. Currently, California is limited to 80,000 pounds on interstate highways, whereas Oregon and Nevada can allow up to 105,500 and 129,000 pounds, respectively, on designated corridors, thus retaining their established limits. In addition to weight, both states also allow longer trucks. Heavier and longer trucks cannot continue into California which require loads to be separated at the border in compliance with California’s limits.⁴⁶ The 2016 FHWA Study resulted in no change to the federal law. The study evaluated a range of benefits and costs from fuel consumption and emissions reductions to safety, but no changes have been made to the federal size and weight limits. As U.S. regulatory agencies continue to investigate the safety and potential infrastructure-impact concerns, other countries such as the United Kingdom have increased its size and weight limit and documented a reduction of fatalities, due to freight-related accidents, by 35 percent.⁴⁷

Figure 4A.5. Interstate System Toll Roads in the United States



Port and Waterway Opportunities

Inland Ports

An inland port is a rail or a barge terminal that is linked to a major seaport. To attract customers, an inland port must address what segment(s) of the market would be served and a financially feasible business model that will overcome competitive advantages posed by trucking. The transload and local market segments are the most likely to take advantage of a well-located short haul rail-served inland port. By consolidating imports and exports and transporting them by rail to the seaport, inland ports could reduce peak hour truck traffic in the state's congested urban centers, create opportunities for inland logistics centers (similar to Centerpoint outside of Chicago, Illinois), and create more opportunities for off-peak delivery of goods from inland points to regional destinations. East Coast inland ports have demonstrated the feasibility of inland ports in the U.S., but in most cases, the state government has control over the ports and statewide economic development that allows for subsidization and streamlining of development. Arizona, Nevada, and Utah have all identified the potential for inland ports that serve the Ports of Oakland and Los Angeles/Long Beach, and the Utah Inland Port Authority recently released (November 2018) a request for proposals for a business plan.⁴⁸ Currently, the POLA and POLB are not considering inland ports, but rather have explored the concept of short-haul rail to move non-direct rail containers to staging/transfer locations inland, as discussed below.

Decentralization of goods in favor of storage at regional facilities has led to a significant decrease in average length-of-haul truck trips in favor of shorter truck trips. Since 2000, the average dry van truckload length-of-haul has declined from 800 to 500 miles.⁴⁹ California offers many location advantages over competitor states such as Utah, Nevada, and Arizona, including having the following: proximity to major population centers, major seaports and air cargo hubs, one of the nation's most efficient freight rail networks, high-tech research and development, internationally recognized universities, a ranking as the nation's top manufacturer, and proximity to Mexico's manufacturing and production centers that rely on U.S. exports and also produce key inputs to California's manufacturing activity. However, in the past two years, California lost a bid for the Tesla manufacturing plant and the Hyperloop One test site and fabrication plant to Nevada in large part due to labor costs, site development timeframes, and government incentives. California has also been losing international, containerized cargo market share for the past few years to East Coast and Gulf Coast ports. The development of inland ports could cluster several aspects of supply chains, which would increase efficiencies, decrease costs, and improve competitiveness. Three locations have been (or are being) investigated for inland port operations, as described below.

Stockton Area (Stanislaus County)

The area east of the Port of Oakland on the east side of the Altamont Pass (I-580) has been experiencing significant growth in logistics facilities for the past five years. Some of this growth is due to the high land values in the Bay Area, and some of this new development is in response to e-commerce.

Cities such as Stockton, Lathrop, French Camp, Tracy, Patterson, and Manteca provide good alternatives to the Bay Area, due to available developable industrial land, lower cost of housing, easy access to consumers in the Bay Area, as well as Portland, Oregon and Reno, Nevada, and national access to additional markets via the UPRR and BNSF rail corridors. In 2016, Shippers Transport Express (STE), a subsidiary of SSA Marine, opened an inland cargo depot in French Camp to minimize empty container moves to and from the Port of Oakland. This facility allows drivers to both drop off and pick up empty containers for customers in this area. This idea stemmed from SSA Marine's operations of dray-off yards at the Ports of Oakland and Long Beach. SSA operates empty yards near both ports that allow drivers to drop off and pick up containers during off-peak periods when the marine terminal gates are closed. Similarly, the inland cargo depots operate twenty-four hours a day, seven days a week and reduces the need for drivers to take empty containers back to the Port of Oakland or to go to the Port to pick up empty containers, drive them to warehouses in the Stockton area, and then drive them back to the port loaded. STE is considering expanding this facility for use by all ocean liners. If expanded, this facility could support an inland port concept. CenterPoint is currently developing a new logistics park adjacent to UPRR's Lathrop Intermodal Yard, and the Port of Stockton is in the process of requesting conveyance of the 500-acre Sharpe Army Depot. The conveyance could be the hub of an inland port, as it provides access to Class I railroad operators and resides adjacent to major industrial warehousing uses.

Bakersfield Area (Kern County)

Kern County is a growing logistics hub. In the past decade, 17 new, major warehouse and distribution centers were completed or are under construction with development occurring in Shafter, Bakersfield, Delano, and Tejon Ranch. Similar to Stockton, Shafter has access to both Class I railroad operators and has developed and owns a container yard similar to the STE yard in Stockton. It is currently being leased by BNSF as a construction staging area. However, the Shafter load matching model has morphed into a "virtual" container yard and is designed to save empty container hauls to/from the ports. The Wonderful Industrial Park development in Shafter is home to several importers including Target and Ross Dress-For-Less. The Ross facility has an agreement with the Wonderful Company, a major pistachios and almonds exporter, to use the same oceangoing carrier.

The hard-won agreement enables the nearby empty containers at Ross to be picked up by Wonderful for shipping back to the ports full of agricultural products, rather than traveling a 300-mile roundtrip to pick up an empty from the Los Angeles/Long Beach Ports. This coordination reduces operation costs, on-road emissions, and wear and tear on roads. It is anticipated that the City of Shafter container yard may yet be needed to support the virtual container yard by providing storage, trade and clean-out services for shipping containers or as an intermodal rail access node. The Kern region offers same-day delivery access to both the Bay Area and the Southern California regional populations, as well as to the Ports of Oakland, Los Angeles, Long Beach, San Diego and Hueneme. In addition, the Cities of Shafter and Bakersfield, and Kern County have environmentally cleared industrial development for logistics facilities on over 10 square miles in the Shafter/BFL International Airport area, and another 2.5 square miles along I-5 near the base of the Grapevine at the Tejon Ranch Commerce Center, the primary

gateway between Southern California and the Central Valley. Tejon also provides truck parking at two major truck stops allowing trucks to delay entry into Southern California and the ports until off-peak periods. Tejon Ranch followed suit with a master planned logistics park on nearly 1,500 acres. The region also provides truck parking at six other major truck stops near Tehachapi, Edison, Buttonwillow, Lost Hills, and North Shafter.

Inland Empire (San Bernardino/Riverside Counties)

The Inland Empire (IE), located east of the Ports of Los Angeles and Long Beach, has experienced significant growth in warehouse and logistics facilities over the past 20 years. The development was derived due to large acres of available farmland, access to both Class I railroad operators, the San Bernardino Intermodal Yard, Ontario Airport, the conversion of March Air Force Base to a cargo airport, and same-day access to major markets in Southern California, Nevada, and Arizona. In 2017, the City of Moreno Valley approved a 41 million square-foot logistics park. This new development does not have direct rail access; however, the region has been discussing the possibility of a logistics park of similar size that would be rail-served by both short-haul rail to/from the San Pedro Bay Ports of Long Beach/Los Angeles, as well as expand the IE's intermodal capacity to serve the rest of the nation. To date, no potential sites for such an inland port has been identified in the region.

In California, the Port of Stockton may have a future opportunity to develop a new intermodal rail yard on surplus government property, and this new facility could provide an inland port opportunity for the Port of Oakland. The U.S. Department of Defense has determined that the Sharpe Army Depot is no longer needed. Port of Stockton has requested conveyance of the 500-acre site with existing rail infrastructure that serves both Union Pacific Railroad (UPRR) and BNSF Railway. The site is south of a major UPS logistics facility and west of the UPRR Lathrop Intermodal Terminal and the CenterPoint Intermodal Center, a 190-acre logistics park.

Marine Highways

In 2007, the Energy Independence and Security Act (Energy Act), directed the United States Secretary of Transportation to establish a short sea transportation program and designate short sea shipping routes. The Maritime Administration (MARAD) implemented "America's Marine Highway Program" (the Program) pursuant to this mandate. The Program is intended to expand the use of our inland, Great Lakes Saint Lawrence Seaway System, intracoastal, and coastal waterways for the transportation of freight (loaded in containers and trailers) and passengers to mitigate landside congestion, reduce greenhouse gas emissions per ton-mile of freight moved, etc. U.S. DOT initiated a program to encourage the use of navigable waters to move goods and alleviate traffic and maintenance issues caused by trucks. California has access to two of the designated marine highways: (1) M-5 along the Pacific Coastline from San Diego to Seattle, and (2) the M-580 from Port of Oakland to the Sacramento River and San Joaquin River connecting to the Ports of Stockton and West Sacramento.

Marine-5 (M-5)

In 2014, the West Coast Corridor Coalition sponsored a study of M-5⁵⁰ to determine the market and operational feasibility of short-sea shipping between multiple pairs of West Coast ports, including the following:

- Port of San Diego → San-Pedro Bay
- Ports (Ports of Los Angeles and Long Beach)
- San-Pedro Bay Ports (Ports of Los Angeles and Long Beach) → Port of Hueneme
- Port of Oakland → Port of Redwood City
- San-Pedro Bay Ports (Ports of Los Angeles and Long Beach) → Port of Oakland
- San-Pedro Bay Ports → Pacific Northwest Ports (Ports of Seattle and Tacoma)
- Port of Humboldt Bay → Port of Crescent City
- Port of Oakland → Pacific Northwest Ports

The plan also identified the following key challenges to implementing this type of service:

- Shortage of efficient, right-sized vessels eligible to transport U.S. domestic cargoes
- Shortage of credible market data to identify cargoes available for Marine Highway services
- Lack of maritime entrepreneurs willing to take the risk of starting up a new service

Preliminary discussions regarding a barge service from Seattle to Portland occurred in 2018, and that same year, the Port of San Diego also received some interest from barge operators to provide a short-sea shipping alternative. However, at the time of this report, no official requests have been submitted to MARAD for consideration.

Marine 580 (M-580)

In February 2010, U.S. DOT awarded a \$30 million TIGER grant to the Ports of Oakland, Stockton, and West Sacramento to establish a container-on-barge service between the Central Valley and the San Francisco Bay area. The Port of West Sacramento received \$8.5 million for the purchase of a mobile harbor crane, which can load and unload shipping containers. The Port of Stockton received \$13 million for infrastructure and equipment, which it applied towards the purchase of two 140-ton mobile harbor cranes and infrastructure improvements at the Port to support the project. The Port of Stockton also purchased two barges to support the new service. The M-580⁵¹ barge service operated for 14 months as a pilot project with the intent of shifting truck trips to barge by using the M-580 inland waterway to move containers between the Ports of Oakland and Stockton. This barge service focused on reducing port trucks on the I-80, I-205, I-580, I-238, I-880, and I-980 corridors. Due to operational issues that led to significant cost overruns of approximately \$1 million per month, the service was cancelled.

Per the CSFAP, Caltrans is the implementing agency to Action 3.G: Inland Facility, Short-haul Rail Shuttle, and Inland Seaports Utilization with Less Impact on Nearby Communities. This action tasks Caltrans and Agency to “increase opportunity for use of short haul rail shuttles and waterways that lead to inland seaports and freight distribution hubs that will have less impact on nearby communities (CSFAP, Appendix C: State Agency Actions; Action 3, Sec. G)”.

Caltrans has recently started the M-580 Corridor Multimodal Freight Network Optimization Study to accomplish this task. The study will be completed by 2021.

Short-Haul Rail Access to Port of Humboldt

The Port of Humboldt Bay currently has little shipping activity. It is a deep-water port (35-38 feet) located between San Francisco, California (258 miles south) and Coos Bay, Oregon (180 miles north). There has not been rail service to the Port for over 20 years due to destruction of the previous railway line, which followed a North-South route to Napa. Currently, there are no plans to rebuild the route. Pacific Charter Financial Services Corporation, with the assistance of Humboldt Eastern Railroad LLC, is seeking to create an "American Gateway" with the construction of the Pacific Northwest Railroad rail lines, docks, and hub terminals. It is anticipated that the completion of the Pacific Northwest Railroad connection to the national rail network in the Central Valley near the towns of Red Bluff and Gerber will increase population and economic activity in Northern California. Such a rail connection would also provide access between Northern California and other major world regions along the Pacific Rim.

San Pedro Bay Ports' ZECMS Assessment (2009)

In 2009, the San Pedro Bay Ports of Long Beach and Los Angeles commissioned a study of Zero-Emission Container Mover Systems (ZECMS). The Ports officially issued a "Request for Concepts and Solutions," (RFCS) on June 3, 2009, outlining the goals and requirements of the project. The primary focus of this study was to explore new technology to move containers between docks and the Intermodal Container Transfer Facility (Union Pacific Intermodal Rail Yard), potentially eliminating thousands of short-haul diesel truck trips each day and reducing air pollution. Proposed technologies included electric guideways, zero-emission trucks, and electrified rail, all of which use electricity to power the movement of cargo, rather than diesel-fueled trucks. The project management team for the Request for Concepts and Solutions included representatives from both ports and the Alameda Corridor Transportation Authority (ACTA). The team also enlisted a panel of outside, independent experts, including the USC Keston Institute for Public Finance and Infrastructure Policy, to help evaluate concepts for the ZECMS.⁵² The final conclusion was that this type of technology or system is not viable for a variety of reasons.

Since this time, no additional off-road cargo moving systems have been considered by the two San Pedro Bay ports, and most recently, Los Angeles County Metropolitan Transportation Authority (Metro) selected an I-710 freeway improvement alternative that does not include a zero-emission freight corridor.

Emerging Opportunities

Hyperloop

While some companies are reacting to the increase in demand for same-day and next day deliveries using existing technologies, others are seeking a more efficient way to deliver orders with a short turn-around. In 2013, a new transportation system called Hyperloop was

introduced. Hyperloop consists of a hyperloop vehicle, or “pods,” that accelerate gradually via electric propulsion through a low-pressure tube.⁵³ In 2018, DP World and Virgin's Hyperloop One jointly created DP World Cargospeed, an international brand for Hyperloop-enabled cargo systems to move palletized cargo. DP World Cargospeed will focus on e-commerce. This new partnership was developed in anticipation of projections for a fourfold increase in global trade, which could spur demand for hyperloop technology by 2050.⁵⁴ Speed to market creates a competitive advantage for global trade and national, regional, and local distribution. The Hyperloop delivery system intends to deliver goods at air flight speeds at a cost closer to over-the-road trucking rates.⁵⁵

Hyperloop One, a California-based company, has identified ten initial Hyperloop One routes; however, of the four identified in the U.S., none of them are in California. The four U.S. routes are proposed in Texas, Colorado/Wyoming, Illinois/Indiana/Ohio/Pennsylvania, and Florida. Hyperloop One began initial testing in Los Angeles but eventually established its Apex Test and Safety site in Nevada. In May 2017, the company became the first in the world to test a full-scale Hyperloop that included vacuum, propulsion, levitation, sled, control systems, tube, and structures. Missouri completed the first hyperloop feasibility study for the I-70 corridor from St. Louis to Kansas City, a major freight route. Two Environmental Impact Statements (EIS) are being prepared for routes in Ohio and Colorado. Virgin Hyperloop has conferred extensively with the POLA over the last several years and is currently not proposing their system to serve the POLA-POLB.

Alternative and Renewable Fuels

At the state level, the CEC's Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program, has provided significant investments in electric vehicle charging infrastructure and hydrogen refueling stations as well as innovation in medium- and heavy-duty advanced technology vehicles. The CEC has also invested in workforce training in cleaner transportation technologies. With up to \$100 million per year to promote accelerated development and deployment of advanced transportation and fuel technologies, the Clean Transportation Program provides for the following:

- Funded more than \$125 million to 54 zero and near-zero emission vehicle demonstration projects ranging from cargo handling equipment to medium- and heavy-duty trucks, including plug-in hybrids, battery-electrics, fuel cell, low NOx natural gas, and several biofuel platforms
- Funds the California Electric Vehicle Infrastructure Project (CALeVIP) that provides streamlined incentives for light-duty electric vehicle charging infrastructure, with funding targeted at regions that have low rates of infrastructure installation or lack adequate incentives from utilities and other sources
- Assesses electric charging infrastructure needs of the off-road, light-, medium-, and heavy-duty sectors in response to AB 2127 (Ting, Statutes of 2018), in collaboration with CARB and CPUC
- Provides funding for establishing a network of 100 publicly available hydrogen refueling stations throughout the state, and evaluates the factors affecting timely station

development, the time and public funding needed to reach the 100-station goal by 2024, and the ability of the hydrogen refueling network to serve the anticipated fuel cell electric vehicles projects by the end of 2024

Two noteworthy projects that have been funded through the CEC’s Clean Energy Transportation Program include:

- **Charging Ahead: The Port Community Electric Vehicle Blueprint** - In 2019, through a grant from the Energy Commission, the Port of Long Beach developed a Port Community Electric Vehicle Blueprint, which supports implementation of the joint Clean Air Action Plan and identifies actions and milestones needed to implement and sustain an EV-ready community encompassing the Port of Long Beach and nearby visitor-serving areas. Through active engagement and input from diverse stakeholders, the Blueprint addresses opportunities to dramatically accelerate adoption of zero-emission on- and off-road equipment—both fuel cell and battery-electric vehicles—by structuring a framework for installing infrastructure required to support zero-emission vehicles operating at the port. Since port terminal operators rely on low-margin and high-volume movement of goods through ports in a global economy, it is paramount for tenants to have assurance that their investments in zero-emission vehicles are reliable and are industry-standardized technology.
- **Zero Emission Cargo Transport (ZECT) II Demonstration** - The South Coast Air Quality Management District, in partnership with U.S. Department of Energy and the Energy Commission, is currently demonstrating six hybrid hydrogen fuel cell, battery-electric powered Class 8 drayage trucks for operation in the San Pedro port complex region. In the future, the trucks will have the ability to fuel at a POLB hydrogen fueling station partially funded by the CEC.

Near-Zero and Zero-Emissions Technology

Truck technologies that provide ZE and NZE benefits while in operation and in electric mode include: Dual-Mode Hybrid Electric Vehicles (HEVs), Plug-In Hybrid Electric Vehicles (PHEVs), Range-Extended Electric Vehicles (REEVs) with integrated engine, REEVs with integrated fuel cell, Battery Electric Vehicles (BEVs), and range extenders utilizing roadway power. The market readiness of these truck options continues to evolve, and as batteries become lighter and the amount of energy they can store increases, ZE and NZE engines become a more viable alternative to internal combustion engine trucks. As alternative fueling infrastructure supports charging these batteries and as hydrogen and renewable natural gas fueling becomes more readily available, consumers and original equipment manufacturers (OEM) are anticipated to respond. An overview of the truck technology types under development can be found in the **Appendix G**.

California continues to see a trend in the accelerated deployment of zero and near-zero emission vehicles and equipment through regulatory actions, incentive programs, and voluntary adoption by companies that recognize the operational and environmental benefits of these technologies. The transition of the goods movement fleet from internal combustion engines to NZE/ZE engines will have major implications on freight mobility and the environment. For example:

- Amazon recently agreed to order 100,000 electric delivery vans from the manufacturer Rivian.⁵⁶
- FedEx has announced that it will add 1,000 electric delivery vans to its fleet.⁵⁷
- Anheuser-Bush has partnered with Nikola Motors to utilize hydrogen-powered heavy-duty trucks to deliver its products.⁵⁸

Adoption of ZE and NZE technology is also a trend in freight rail. Currently, line haul locomotives and switcher locomotives are powered by a diesel engine that drives an electric generator or alternator. Locomotives and railyards are a significant source of NO_x, PM_{2.5}, and GHG emissions. Due to historical land use planning, many railyards and tracks are located near residential areas, which exposes residents to harmful emissions. To reduce these emissions and meet GHG emission goals, CARB has developed and implemented a number of measures to understand and reduce locomotive and railyard emissions, including studies, regulations, enforceable agreements, and funding of clean technology. CARB also administers financial incentives for operators to adopt NZE/ZE locomotives and equipment.⁵⁹ In the absence of federal leadership, California will continue to be a leader in deploying NZE and ZE technologies in the freight rail sector.

The California Energy Commission is exploring grant funding opportunities for fuel cell technology demonstrations in locomotives and ocean-going vessels. Hydrogen fueling for these vehicles can help decarbonize historically challenging sectors.⁶⁰

Greener Technology Incentives

Similar to incentives afforded to buyers of clean automobiles, such as single-occupant use of HOV lanes, reduced and no-toll options can be applied to truck-only toll lanes. Caltrans and LA Metro studied multiple alternatives for the proposed I-710 Corridor Project from the southern terminus near the San Pedro Bay Ports to SR 60. The preferred alternative for the I-710 Freight Corridor project includes the I-710 Prototype Clean Truck Incentive Program which provides incentives to encourage fleet turnover to ZE and NZE freight technology. The air quality analysis for the recirculated draft EIR/ supplemental draft EIS indicated that the alternative would help improve air quality with the replacement of older trucks with new zero- and near-zero emission trucks.

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