

4A. 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, 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. Additionally, 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 the 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, and 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 emissions from the transportation sector.

California has strived 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 greenhouse gases, and attracted industries to do business here, resulting in jobs and economic benefits. As the world's 5th largest economy¹⁰⁰, and poised to become the 4th largest¹⁰¹, 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.

E-Commerce Consumer Trends

The growth of e-commerce has been rapid. According to the most recent 2020 Annual Retail Trade Survey, e-commerce sales has continued at a faster rate than traditional retail. As shown in the **Figure 4.1**, total retail growth has increased by \$1.7 trillion or 46 percent since 2010, whereas e-commerce has gone from \$170 to \$815 billion, a 380 percent increase in the same time period. Even during the 2008-2010 global recession when total retail trade slowed and dipped, e-commerce grew, capturing an additional 1 percent of the total retail share.

While the significant growth of online shopping can be attributed to increased convenience and efficiency, the COVID-19 pandemic has accelerated the trend. The lockdowns of the early pandemic facilitated a strong shift in consumer behavior from in-store retail shopping to online purchases. Most retail stores closed during the lockdowns, leaving online shopping as the only choice. E-commerce saw sales increased by \$244.2 billion or 43 percent in 2020, the first year of the pandemic. According to the US Census, e-commerce as a share of total retail sales reached near 17% in 2020, and has slightly decreased but remained constant at around 15% of total retail sales through the first quarter of 2023.¹⁰² Most forecasts expect continued growth in the U.S. based upon global trends in e-commerce market share of retail, the variety of goods becoming available, convenience of product delivery, and change in consumer behavior since the pandemic.

E-COMMERCE IMPACTS TO FRIEGHT INFRTSTRUCTURE IN CALIFORNIA

The rise in e-commerce has drastically changed the nature of purchasing behavior in that a larger percentage of consumers prefer the convenience of having goods shipped to their homes rather than going to a brick-and-mortar stores to purchase goods. This change has had profound impacts to the freight infrastructure in California. The state has seen multiple distribution centers (DCs) and warehouses built, affecting our land use patterns and traffic. E-commerce has increased demand for products produced overseas, which has increased imports, and impacted the ports and their operations. E-commerce has generated a large increase in light and medium duty trucks that perform last mile deliveries directly to consumer’s homes. The increase in “last mile” deliveries has caused an increase in light and medium duty truck VMT. The increase in VMT causes degradation of pavement not only on the State Highway System, but also local arterials and neighborhood roads. Also, most of those vehicles rely on fossil fuels, which increase emissions. There is also the issue of retail returns, as a certain percentage of e-commerce sales are expected to be returned to the retailer, which induces more VMT and emissions. The specific quantitative impacts that e-commerce has on freight infrastructure is currently not well understood and is a topic that warrants more study and will be a focus for research in the coming years. In the meantime, the State will endeavor to support the transition of light and medium duty vehicles to zero emission technologies, and mode shift to zero emission modes such as e-cargo bikes where feasible. See **Chapter 6A** for specific strategies that mitigate impacts from freight generated by last mile deliveries.

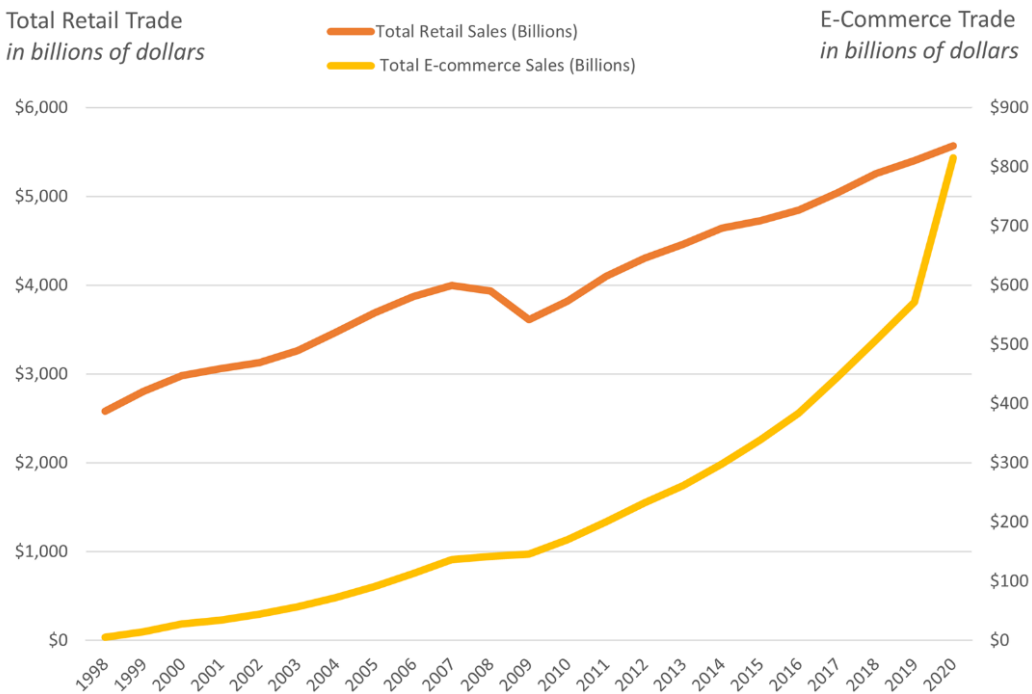


Figure 4.1: Historic National Total and E-Commerce Retail Trade Sales (Source: U.S. Census Bureau’s 2020 Annual Retail Trade Survey)

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 shrink¹⁰³. According to Caltrans' latest California Air Cargo Groundside Needs Study, the cargo tonnage at airports is expected to grow at most airports by 2040, as shown in **Table 4.1**. Since the completion of this study, e-commerce growth and demand for same-day and next-day delivery service is resulting in increases in air cargo at urban airports, such as Sacramento, Ontario, and Los Angeles. For example, in the summer of 2022, Amazon announced that they are constructing their largest warehouse near Ontario International Airport. The warehouse will be a 4.1 million-square-foot, 97-foot-tall and should be completed within a year. However, Amazon also has plans to sublease current warehouses to other companies and scrap other plans for new warehouses across the state to balance the added capacity that the Ontario warehouse will generate. Whether or not that this trend could continue given the anticipated growth in e-commerce or return to pre-pandemic consumer behaviors is unknown. If the air cargo demand does continue at this rate for many of California's airports, intermodal connection improvements should be explored to accommodate for the increased demand.

INDEPENDENT DELIVERY DRIVERS: TRANSPORTATION NETWORK COMPANIES AND DELIVERY 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, Amazon has been partnering 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 used by Amazon, the company 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.¹⁰⁴ Like TNCs, independent owner-operators of light vehicles work for Amazon to make reliable, same-day delivery possible.

In response others, such as Walmart, Target and Costco have contracted with Delivery Network Companies¹⁰⁵ (DNC's) like Instacart, Shipt, Roadie(a UPS company) to provide one day delivery capabilities that compete with Amazon. Unlike the Uber and Lyft passenger services, they do not currently operate within the same market areas.¹⁰⁶ 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, ranging 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.¹⁰⁷

According to a 2020 report by the California Public Utilities Commission, there were over 200,000 active TNC drivers in California in 2019, a 26% increase from the previous year. In addition, TNCs completed over 900 million trips in California in 2019, an increase of 17% from the previous year¹⁰⁸. In terms of DNCs, a 2020 report by the California Air Resources Board found that e-commerce sales in California have increased by over 50% in recent years, with companies such as Amazon and Walmart leading the way¹⁰⁹.

California's Top Air Cargo Airports	2013	2018	2021	% Change from 2018	2040
Los Angeles International Airport (LAX)	1,917	2,444	2,972	22%	3,016
Ontario International Airport (ONT)	461	826	956	16%	972
Oakland International Airport (OAK)	556	670	698	4%	779
San Francisco International Airport (SFO)	400	628	582	-7%	592
San Diego International Airport (SAN)	162	192	146	-24%	278
Sacramento International Airport (SMF)	74	127	167	31%	90
Sacramento Mather Airport (MHR)	55	77	836	986%	69
San Jose International Airport (SJC)	47	61	36	-41%	49
Hollywood Burbank Bob Hope Airport (BUR)	55	55	54	-2%	72
Stockton Metropolitan (SCK)	NA	45	64	42%	NA
Long Beach Airport (LGB)	26	24	16	-33%	20
Santa Ana (John Wayne) Airport (SNA)	18	20	16	-20%	22
Fresno-Yosemite International (FYI)	12	11	17	55%	16

*Source: Historic data is provided by Caltrans Division of Aeronautics. 2040 estimates are reported from California Air Cargo Groundside Needs Study, Caltrans, 2018 *percentage change is from 2018 to 2021*

Table 4.1: Air Cargo Tonnage Trends (in thousands)

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 couple of years. Such closings could accelerate, as lease terms for big retailers are typically between 10 and 25 years, meaning many 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.¹¹⁰ There will continue to be more of this trend, as the growth and demand for easy and convenient online shopping and merchandise returns continue.¹¹¹

The biggest unknown for cities and counties is the true impact of e-commerce on, 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,¹¹² 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.¹¹³

TRENDS IN E-COMMERCE FULFILLMENT AND DISTRIBUTION CENTERS

The Inland Empire, Bakersfield, and Stockton have all seen a 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 retailers¹¹⁴. 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 retail, the most desirable spaces are located on places with heavy foot-traffic, successful e-commerce facilities 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.¹¹⁵ 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 29 fulfillment centers operating in California¹¹⁶ and ranked the state as number 2 on its list of "Top 10 Most Entrepreneurial States," with more than 175,000 small and medium-sized businesses in California selling on Amazon.¹¹⁷

Emerging Technology Trends

TRANSITION TO ZERO EMISSION VEHICLES

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.¹¹⁸
- FedEx has announced that it will add 1,000 electric delivery vans to its fleet.¹¹⁹

- Anheuser-Busch has partnered with Nikola Motors to utilize hydrogen-powered heavy-duty trucks to deliver its products.¹²⁰

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**.

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 NOx, PM2.5, 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.¹²¹ In the absence of Federal leadership, California will continue to be a leader in deploying NZE and ZE technologies in the freight rail sector.

At the federal level, the Infrastructure Investment and Jobs Act (IIJA) provides historic investments of \$7.5 billion in ZEV-related projects, research, and infrastructure. The Inflation Reduction Act (IRA) invests \$1 billion to replace dirty heavy-duty vehicles with clean, zero-emission vehicle infrastructure, and to train and develop workers. At the state level, California state budget includes \$2.7 billion in fiscal year 2021-22 and \$3.9 billion over three years for zero-emission vehicle and infrastructure. This will scale the zero-emission vehicle market in ways that benefit all Californians and accelerate the state toward meeting climate and transportation goals established in the Governor's ZEV Executive Order N-79-20 and consistent with California's Zero Emission Market Development Strategy. California's commitment towards zero-emission vehicles has created a trend that is driving vehicle transitions, infrastructure needs, public investment.

According to data from the California Energy Commission (CEC), electric vehicle sales made up 19 percent of new vehicle sales in California in 2022, with a total of 292,496 battery-electric vehicles hitting the state's roads¹²². Currently, there are about 80,000 EV chargers in California. To meet the increasing charging requirement, there will be approximately 90,000 more EV chargers to be installed as a result of the new funding.

On April 27, 2023, The California Air Resources Board (CARB) passed the "In-Use Locomotive Regulation", a rule aimed at reducing emissions from locomotives when they operate within the state.¹²³ Under the new rule, operators will be required to pay into a spending account, and the amount will be determined by the emissions they create while operating in California.

Companies will be able to use the funds to upgrade to cleaner locomotive technologies. The rule mandates locomotives will have a 30-minute idling limit. Additionally, switch, industrial and passenger locomotives built in 2030 or after will be required to operate in zero-emissions configurations while in California, and in 2035 for freight line haul.

On April 28, 2023, CARB approved the “Advanced Clean Fleets” rule, a first-of-its-kind rule that requires a phased-in transition toward zero-emission medium-and-heavy duty vehicles in California.¹²⁴ Under the new rule, fleet owners operating vehicles for private services such as last-mile delivery and federal fleets such as the Postal Service, along with state and local government fleets, will begin their transition toward zero-emission vehicles starting in 2024. The rule includes the ability to continue operating existing vehicles through their useful life. Due to the impact that truck traffic has on residents living near heavily trafficked corridors, drayage trucks will need to be zero-emissions by 2035. All other fleet owners will have the option to transition a percentage of their vehicles to meet expected zero-emission milestones, which gives owners the flexibility to continue operating combustion -powered vehicles as needed during the move toward cleaner technology. The flexibility is intended to take into consideration the available technology and the need to target the highest-polluting vehicles.

These rules are anticipated to spur the adoption of zero emission technology and the construction of zero emission infrastructure in the state and encourage adoption at the national level as well. Many of these types of projects are already being proposed for funding – please see **Appendix I** for a list of projects that are either fully ZEV or have ZEV components programmed for funding under the Trade Corridors Enhancement Program Cycle 3, approved by the California Transportation commission in June 2023.

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,¹²⁵ 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 driving 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 services 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.¹²⁶

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.

The importance for California is the flexibility and speed to market of 3D printing technology by allowing 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,¹²⁷ and in May 2018, additional approval was provided for a three-year testing period for using drones for deliveries, inspections, and other tasks. 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. In 2022, Walmart and Amazon announced that they would begin launching drone deliveries by air to specific markets in Northern California and other states of the United States.

AUTOMATION AND SUPPLY CHAIN ANALYTICS

The adoption of robotics and automation is growing rapidly. Robots have been used for the past 22 years on assembly lines in manufacturing, but as costs continue to decrease 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) to emulate human activities has led to new applications for robots that are now benefitting the entire supply chain. Technological advancements in both robotics and automation create more efficiencies and increased safety throughout the supply chain – from warehouses to port complexes, robots and automation are being leveraged to address changing dynamics of the freight industry.

According to the 2022 MHI Annual Industry Report:

- 21 percent of the surveyed supply chain companies are currently using Internet of Things (IoT) technology, but that is likely to increase to 80 percent within five years.
- Currently, 22 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.
- Current adoption rate for AI is 14 percent among surveyed companies, that number should grow to about 73 percent by 2027.¹²⁸

WAREHOUSE AND MANUFACTURING AUTOMATION

Emerging automation technologies are enabling companies to make same-day deliveries easier and increase efficiencies. Not only does the system help retrieve and track thousands of different SKUs, but automation also assists 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 of digital transactions across a database or ledger shared among several computer nodes across 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 very 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 food 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, 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. The POLA, POLB, and other California Ports are not contemplating fully automated marine terminals currently. 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, development, and 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, as well as planning and monitoring activity. Fully automated freight rail yards do not currently exist in California but may be deployed in the future.

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, published an in-depth article on the future of automated trucks in 2020¹²⁹. 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 4.2** 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 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.¹³⁰

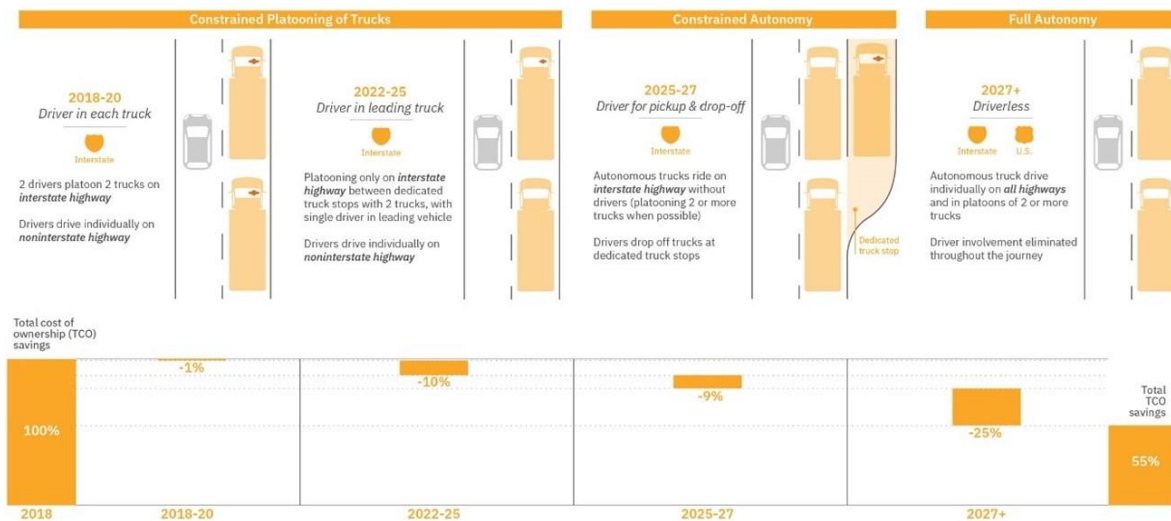


Figure 4.2: Timeframes for Autonomous Truck Deployment

Some regions are identifying local trucking networks for testing this technology. The Kern region’s SAFETEC proposal have identified rural autonomous truck routes for testing autonomous trucks on warehouse to warehouse runs in rural areas.

The Federal Automated Vehicles Policy released in 2016 by the National Highway Traffic Safety Administration (NHTSA), outlines the federal government’s approach to autonomous vehicles

and emphasizes safety, vehicle performance guidance, model state policy, and regulatory tools¹³¹.

The California Department of Motor Vehicles (DMV) has established regulations for the testing and deployment of autonomous vehicles on public roads. These regulations outline requirements for vehicle manufacturers, safety operators, and reporting obligations. Additionally, California Vehicle Code (CVC) includes provisions related to autonomous vehicles, defining their operation, testing, and requirements for manufacturers. It also covers liability and insurance aspects¹³².

Many local jurisdictions in California have developed their own regulations to address the operation and deployment of autonomous vehicles within their boundaries. These regulations often include pilot programs, testing permits, and guidelines for autonomous vehicle operators.

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 braking 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 braking or accelerating. 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.¹³³ 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.¹³⁴

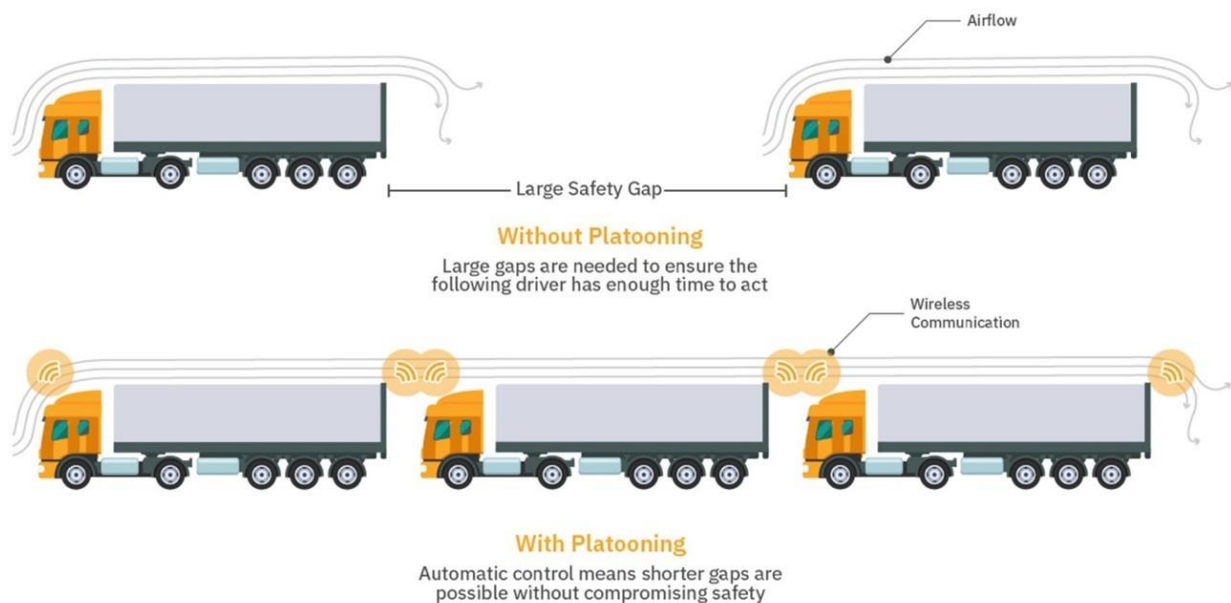


Figure 4.3: Truck Platooning Concept

Issues

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 electricity is generated and distributed to much of the state by Pacific Gas & Electric (PG&E) in Northern California, 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 is 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 2022, the average rate for the largest regions in California were: Los Angeles at 24.40¢/kWh, San Francisco at 31.10¢/kWh, and San Diego at 40.90¢/kWh. This significant rate discrepancy gives much of Southern California a competitive rate advantage over the Bay Area and San Diego region. 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 departments, 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),¹³⁵ due to the higher SDG&E overall rate structure. For cold ironing (also called shore-to-ship power) purposes, running vessel auxiliary power while at port, conversion of cargo handling equipment from diesel and natural gas to electric, and places at the ports for trucks to plug in, these energy cost differences 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 for the CPUC to revisit rate structures, identify infrastructure investments to facilitate conversion of fuel sources for transportation, and develop 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.¹³⁶ 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.

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. In contrast to electricity, however, RNG results in the same emissions as fossil-based natural gas. 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, and 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 through electrolysis 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 4.4**), 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 hours of service violations.



Figure 4.4: 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 Survey¹³⁷

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 American Trucking Association (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.

As mentioned previously in this chapter, In 2019, the Governor of California approved Assembly Bill 5 (AB5) Worker status: employees and independent contractors, which requires companies that hire independent contractors to reclassify them as employees, with a few exceptions. On February 3, 2020, in response to the passage of AB5 the American Trucking Association released a statement in petition of the new law. "AB5 is overbroad: In attempting to protect workers who are misclassified as contractors, it lumps them together with those who have made a deliberate choice to provide freelance services." In Sept of 2020 an additional bill was passed, Assembly Bill 2257 (AB2257), which rewrote several requirements of AB5 and exempts a substantial list of job categories. However, trucking companies who contract with drivers for delivery of goods are not one of those job categories.

The impact on independent carriers or owner-operators who work with multiple shippers is less clear, but more examples should surface quickly as carriers review their lease agreements. In many cases, AB5 would require employers to pay independent truckers as full-time employees.

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 VMT increased from 85 million to 98 million between 2014 and 2018. Vehicle Miles Traveled is projected to reach 119 million by 2040. 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 2015.¹³⁸

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 went into effect on January 1, 2020. This change caused 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 2017¹³⁹
- 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 jurisdictions¹⁴⁰

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 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 would be needed 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 during the Trump administration.

Impacts and issues of this trend include the following:

- Increased demand for air cargo at California's international airports due to e-commerce and 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.

WAREHOUSING CHALLENGES

Warehousing vacancy rates are at all-time lows. The increased demand for e-commerce during COVID-19 lockdowns combined with backlogs created by supply chain congestion has created an unrepresented need for warehousing space. Vacancy rates in 2021 were at 3.4% despite adding 270 million square feet of supply. Prologis has forecasted that warehousing capacity nationwide will need to increase by at least 15% from current levels to accommodate inventory levels and build resilience against future disruptions. This can be a challenge for regions like Southern California that has limited room to expand, and the cost of land is some of the highest in the nation.

Due to the limited land availability near the marine ports in Southern California, the warehousing industry is facing the challenge of expanding into the inland empire to meet the growing demand for storage and distribution.

Opportunities

CLEAN TRUCKS AND TRUCKING EFFICIENCIES

[Clear 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). The California Air Resource Board and the state's regional air districts implemented similar statewide targets. All agencies, in coordination with the federal 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 Ports of Long Beach and Los Angeles updated their

CAAP, which set new targets for trucks and cargo handling equipment consistent with the California Sustainable Freight Action Plan to reduce GHGs 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 which 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.¹⁴¹ 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 increase traffic flow.¹⁴²

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.³⁶

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.¹⁴³

Connected Vehicles and Communication Technology

The current national framework for the connected vehicle (CV) environment envisions the use of DSRC, cellular (e.g., 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 for now is the only option that would have specific impacts to the infrastructure.

Roadside DSRC has been established by USDOT 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 USDOT. 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 USDOT-sponsored CV program are the most promising ones for accomplishing nationally coordinated standards through non-proprietary (open) solutions.

On November 20, 2020, the Federal Communications Commission adopted new rules for the 5.9 GHz band by designating the lower 45 Megahertz (MHz) of the 75 MHz band for unlicensed operations while continuing to dedicate the upper 30 MHz for Intelligent Transportation Systems operations. Additionally, the Commission ordered that ITS operations in the upper band transition from DSRC-based technology to C-V2X-based technology.

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/C-V2X 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 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

Moreover, Vehicle-to-everything (V2X) technologies have the potential to revolutionize the way goods are moved by enabling more efficient, safer, and more sustainable transportation systems. The impact of V2X technologies on goods movement can be significant. By improving communication with each other, sharing information such as speed, position and direction, safety, reducing congestion, and increasing efficiency, these technologies can help to reduce the costs associated with goods movement, including fuel costs, labor costs, and transportation costs. They can also help to improve the overall sustainability of the transportation system, reducing emissions and helping to address climate change.

In addition, V2X technologies can enable new business models, such as real-time tracking and monitoring of goods, which can help to improve supply chain management and reduce waste. They can also enable new forms of transportation, such as autonomous vehicles and drones, which can further improve the efficiency of goods movement¹⁴⁴.

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).¹⁴⁵

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 4.5** lists the states and facilities with toll rates based on per-axle weights.¹⁴⁶

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' greater investment in low-emissions vehicles and technologies.¹⁴⁷

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 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, 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.¹⁴⁸ 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.¹⁴⁹



Figure 4.5: Interstate System Toll Roads in the United States

CLEAN FREIGHT CORRIDORS

An opportunity for the deployment of clean freight technologies was created under Senate Bill 671 (SB671), "Transportation: Clean Freight Corridor Efficiency Assessment (Gonzalez, Chapter 769, Statutes of 2021)." This bill was codified under Government Code 14517 and requires the California Transportation Commission (Commission), in collaboration with various state agencies, to develop a Clean Freight Corridor Efficiency Assessment.¹⁵⁰ The goal of the Assessment is to identify corridors, projects, and other information to support the transition to zero-emission freight. The Assessment is being led by the Commission with input and guidance from the SB 671 Workgroup, which is composed of public and private stakeholders. The Clean Freight Corridor Efficiency Assessment is due to the legislature on December 1, 2023. All information provided in this section is draft and subject to change until adopted by the Commission.

Senate Bill (SB) 671 requires the Commission to identify zero-emission infrastructure projects that would support medium- and heavy-duty trucks, as well as potential project sponsors. As of March 2023, the Commission, in partnership with the California Air Resources Board, the California Energy Commission (CEC), Caltrans, the Governor's Office of Business and Economic Development, and the Senate Bill 671 Workgroup, have identified the proposed top six freight corridors in California, and the number of zero-emission medium- and heavy-duty stations needed statewide. The six proposed Clean Freight Corridors are I-5, I-10, I-15, I-40, I-80, and SR 99, depicted in **Figure 4.6**.



Figure 4.6: SB 671 Proposed Clean Freight Corridors

The benefit with focusing on the number of public stations needed along the top six corridors is to ensure a “minimum viable network” for long-haul and regional truck trips, i.e., the minimum public network of charging and refueling stations required so that a truck driver can complete their freight journeys throughout the state in zero-emissions trucks. Urban centers can be the starting point of the buildout of this minimum public network, especially to support delivery and short haul or regional trips. However, the minimum statewide network will be required to support the state’s goals for 100% zero-emissions trucks by 2040, since freight trips across the state cannot be supported solely by urban public infrastructure alone.

There are several potential areas where entities have expressed an interest in building zero-emission freight stations in the same place where the Commission’s study has identified that it will be important to build. These areas are covered below.

1. EnergIIZE Projects

The first area of overlap is the CEC's EnergIIZE program. This program has funded a number of zero-emission freight infrastructure projects. There are several different "Funding Lanes" available in this program.

- "EV Fast Track" provides incentives of up to \$500,000 per project for electric vehicle charger purchases.
- "EV Jump Start (Equity)" provides incentives of up to \$750,000 per project for electric vehicle charger purchases.
- "EV Public Charging" provides incentives of up to \$500,000 per project to public charging station developers. Level 2 chargers are not eligible.
- "Hydrogen Lane" provides incentives of up to \$3 million per project for deployment of hydrogen refueling infrastructure equipment for medium- and heavy-duty vehicles.

Currently, there are 53 electric charging locations funded through this program and 5 hydrogen locations funded through this program. Some of these projects are located along key corridors or in dense urban areas. See exhibit 1 and exhibit 2 below. The timeframe for these projects is still developing.

On March 28, 2023, the CEC revealed a new initiative at a public workshop under the banner of EnergIIZE projects. The initiative focused on the potential solicitation for medium- and heavy-duty vehicle charging and hydrogen refueling infrastructure projects along designated corridors. The CEC will allocate up to \$20 million in the initial solicitation to fund the establishment of charging and hydrogen stations along these corridors, catering to the medium- and heavy-duty zero-emission vehicles.¹⁵¹

dashboard that can be accessed online here:

<https://calstartorg.maps.arcgis.com/apps/dashboards/93ba3501edad4f51beb4d8d4dda46647>.

The timeline for when these stations will be built is still unknown, but these stations are locations where entities have applied for and received incentive funding for zero-emission freight infrastructure.

2. Truck Stops

There are several large truck stop companies that have plans to add electric truck charging, hydrogen fueling, or both at their existing locations. Since truck stops are public and since many of these locations exist along key freight corridors already, these locations represent an important piece of planned zero-emission freight infrastructure.

The Pilot Company is planning to add zero-emission freight charging and/or re-fueling to all of their California locations. See exhibits 3 and 4 below for locations.

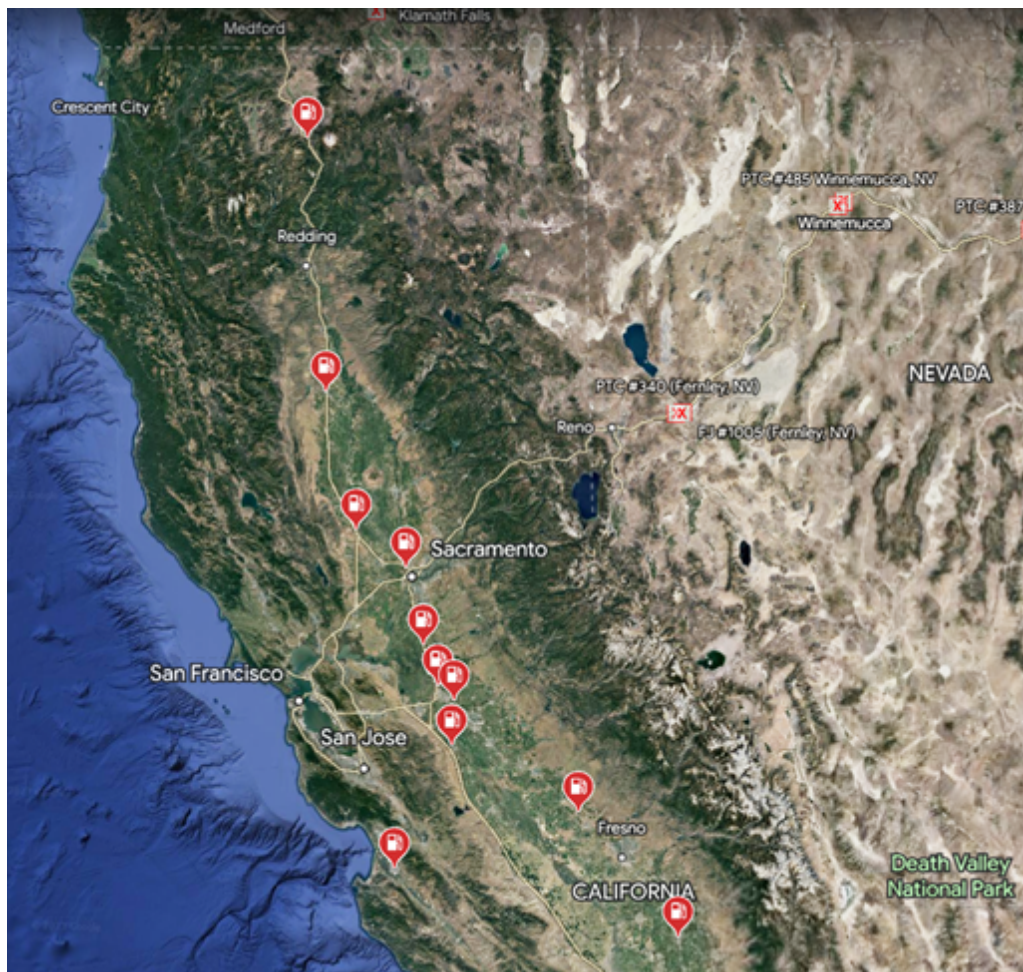


Figure 4.9: Pilot Truck Stop Locations – Northern California

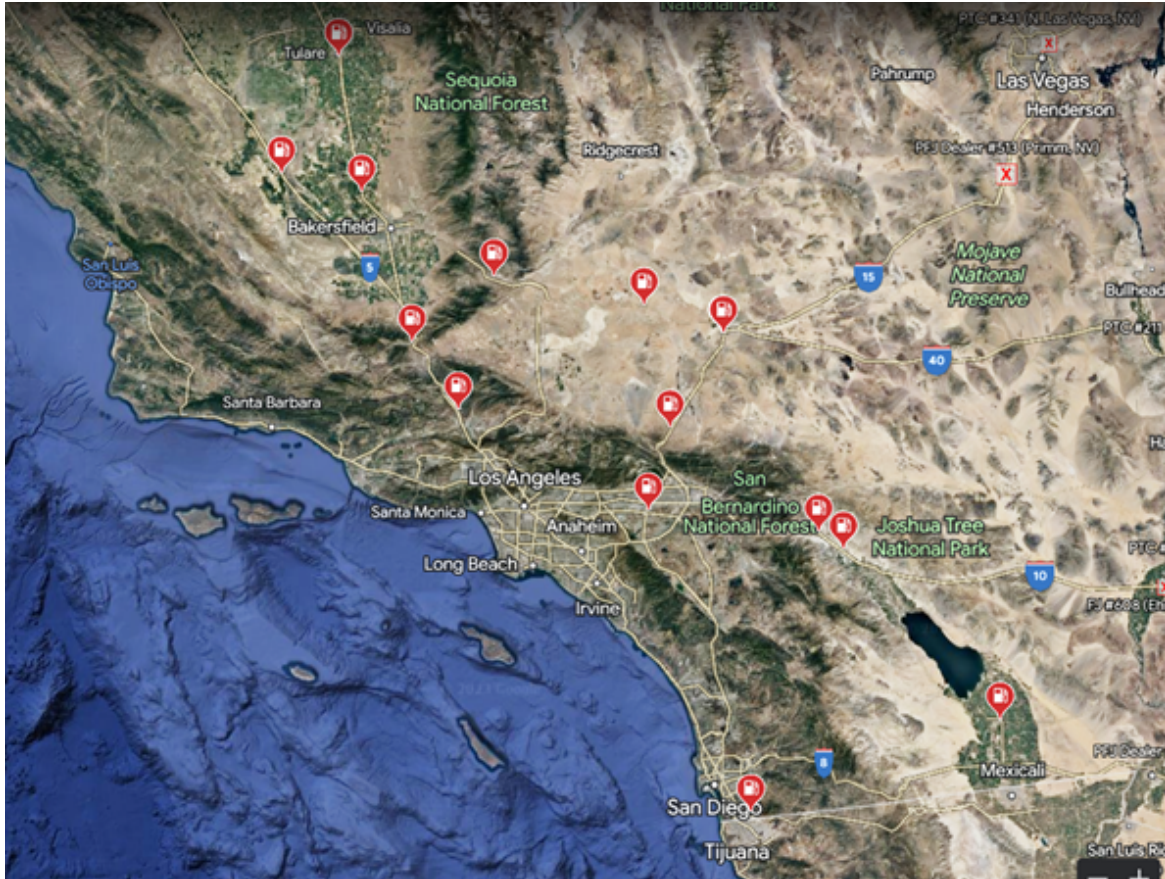


Figure 4.10: Pilot Truck Stop Locations – Southern California

As you can see from these figures, many of the Pilot truck stops are located along Interstate 5. There are several locations along Highway 99, on Interstate 15, Interstate 10, and near the Otay Mesa Port of Entry. At the Truck Net LLC truck stop located near the bustling Otay Mesa Port of Entry in San Diego, the installation of the state's inaugural public chargers specifically designed for electric trucks, delivery vans, buses, and other large vehicles took place on March 27, 2023. As the busiest commercial crossing in the state, the Otay Mesa Port of Entry handles a staggering volume of 1 million trucks, 5 million vehicles, and 2.1 million pedestrians annually.

These chargers represent a milestone as the first of their kind in California, catering specifically to medium- and heavy-duty vehicles. With a power capacity of 250 kilowatts, these chargers can rapidly recharge a typical medium-duty box truck from 20% to 80% in approximately one hour, while a full charge from empty to 100% takes around two hours. Additionally, these chargers can also be utilized by passenger cars, delivering a charging rate of up to 250 miles per hour for such vehicles.¹⁵²

Similarly, Travel Centers of America is also planning to add electric truck high power charging stations to many of their existing locations. See exhibit 5 below for details. As you can see from the exhibit, most of the locations are on Interstate 5, there is also a location on Highway 99, Interstate 40, and Interstate 10.

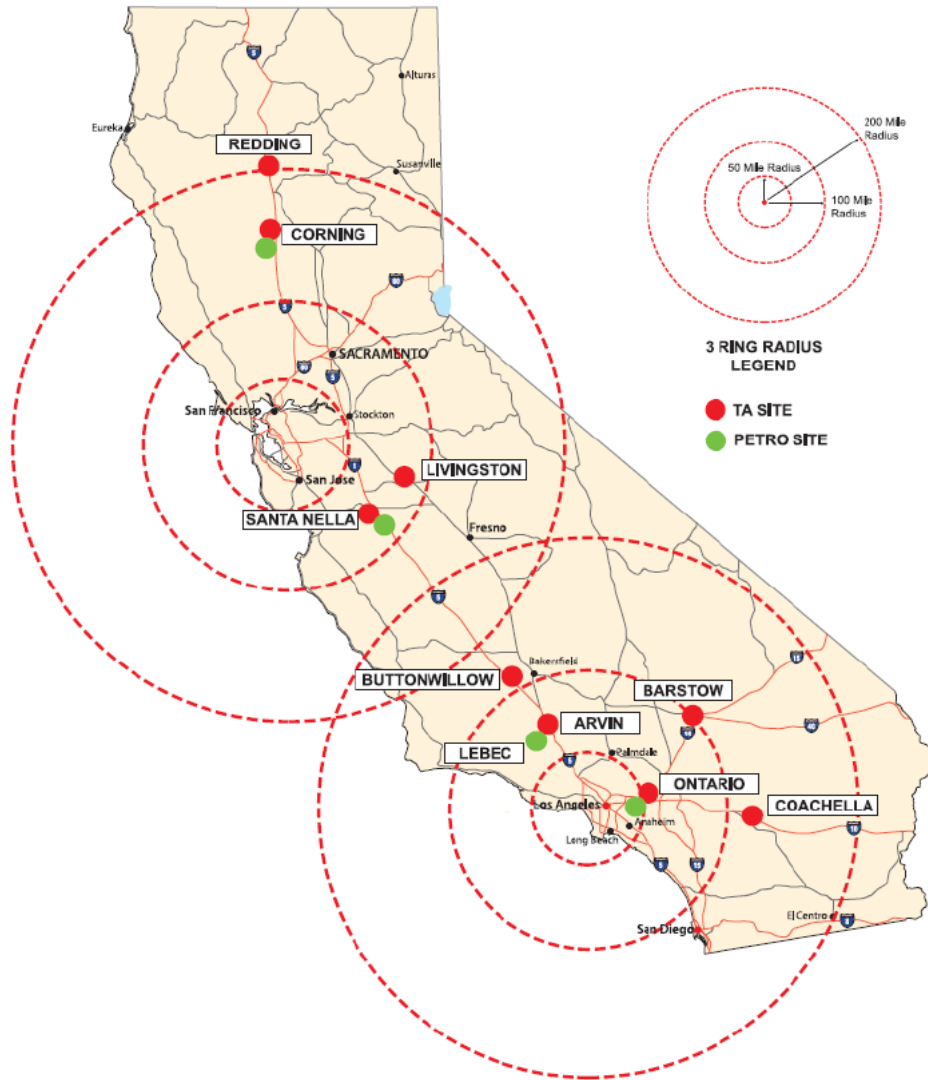


Figure 4.11: Travel Stations of America – Map of California Electric Truck High Power Charging Planned Locations

The Pilot Company and Travel Centers of America may request some state funds to build zero-emission freight infrastructure at these locations, but these companies likely also have private funds for these projects. The timeline for the build out of these projects is unknown at this time.

3. Senate Bill 671 projects

In 2022, the Commission worked with the CEC, CARB, and Caltrans to draft a project nomination form, so that SB 671 workgroup members could identify zero-emission freight charging and hydrogen fueling stations they were interested in building. Seven entities submitted 79 projects for consideration, for hydrogen fueling and charging stations.

Senate Bill 671 projects represent areas where companies have an interest in building mostly public zero-emission freight stations, although funding will be needed from the state and other

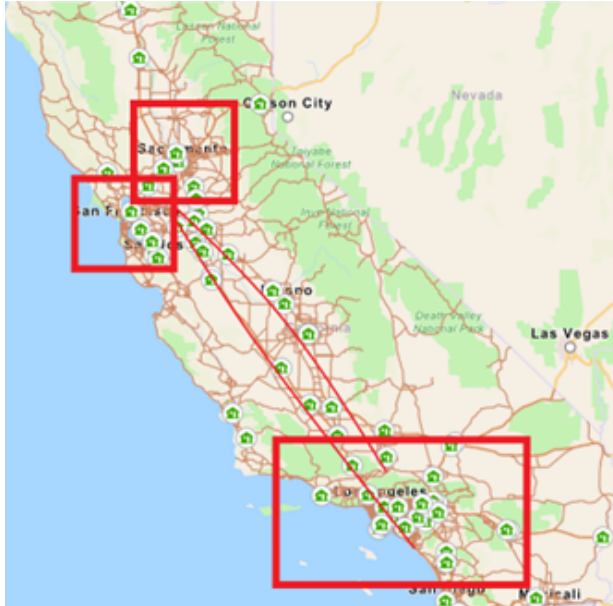


Figure 4.12: SB 671 Project Locations with Highlights



Figure 4.13: SB 671 Project Locations Near United States/Mexico Border

sources to build. Stations located along the top 6 freight corridors or in dense urban areas will be especially important to consider over the next several years.

Again, there are many potential station locations along Interstate 5, Highway 99, the Bay Area, Sacramento, Los Angeles, and the United States/Mexico border. With the exception of some maritime port projects, these locations represent public zero-emission freight stations. There are

some projects that were submitted as part of the SB 671 and that were also submitted as part of the Trade Corridor Enhancement Program (TCEP) Cycle 3. These projects are under review, Commission staff recommendations are planned for release in June of 2023.

The projects submitted for both SB 671 and TCEP are:

- The San Diego Association of Governments and Caltrans – project at the Otay Mesa East Port of Entry.
- Nikola – projects in Hesperia, Rialto, and Colton.
- Travel Centers of America – projects in Buttonwillow, Barstow, Arvin, Ontario, and Coachella.

In addition, WATTEV also submitted a project in Sacramento for TCEP Cycle 3 funds and for the California State Transportation Agency's Port and Freight Infrastructure Program. There are certain areas also where projects submitted as a part of SB 671 serve as a good example of locations where existing and planned stations do not already exist. Here are some examples of those projects and locations. This is not an all inclusive list or a value statement about the projects not included here.

- Travel Centers of America and Nikola both submitted projects for Redding.
- TravelCenters of America – near Corning.
- Nikola – in Truckee near the Nevada border, in Blythe near the Arizona border, on I-15 near Escondido, in Santa Rosa, and in El Centro near the US/Mexico border.
- Air Products and Nikola – on 99 near Visalia.
- Air Products – on I-15 in Fallbrook and in Colton.

Minimum Viable Network

The minimum viable network (MVN) is the minimum number of charging and refueling stations required for zero-emissions trucks to refuel publicly and to attract early adopters, addressing the "chicken and egg" issue in potential zero-emissions infrastructure investment. To build a minimum viable network, electric truck charging stations are needed every 50 miles and hydrogen fuel stations are needed every 270 miles along the top 6 freight corridors. By investing in a minimum viable network, there could be enough stations along these corridors to provide a sufficient network to spur further adoption of zero-emission trucks.

The CEC Energize funded projects, truck stop locations, and SB 671 proposed projects along the top 6 freight corridors represent projects where there is an interest from industry in building, and where the Commission's study has identified that stations are needed in the next few years.

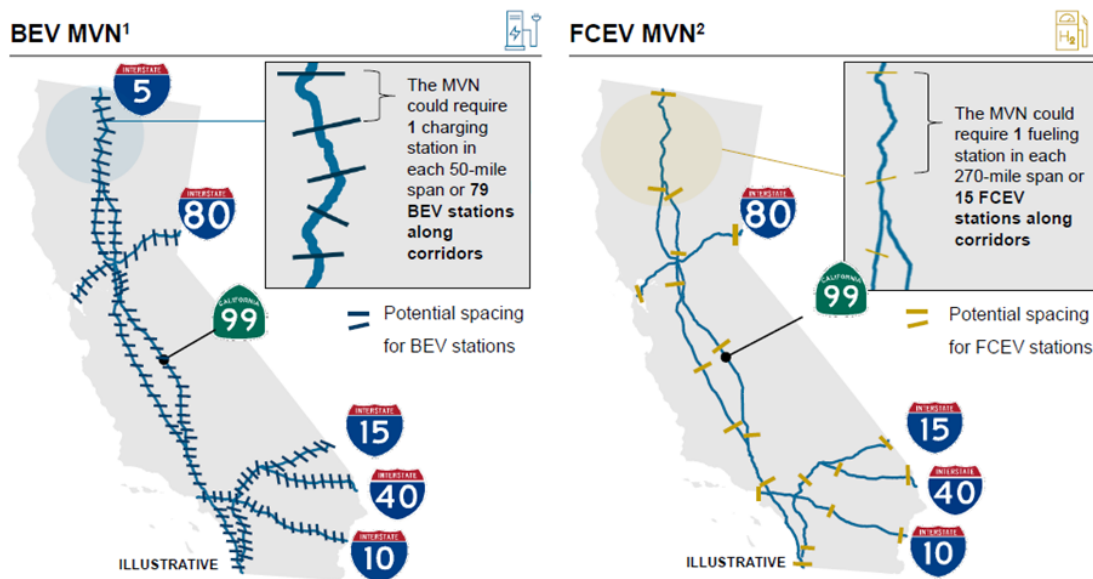


Figure 4.14: Minimum Viable Network (MVN) Along the Top 6 Freight Corridors

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.¹⁵³

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 miles to 500 miles.¹⁵⁴ 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.

[The Port of Hueneme's SEA LINC Project \(Spurring Economic Advantages with Logistical Investments for New Connectivity\)](#)

The SEA LINC project was awarded official designation by the U.S. Department of Transportation, marking the first time a project has been designated in Southern California since the inception of the American Marine Highways Program in 2007. The SEA LINC Project aims to move cargo off federal and state highways by shifting the cargo to barge along Marine Highway 5 (M-5) instead. The cargo, currently being trucked from the Pacific Northwest to Southern California, will now move on the water and reduce traffic and air emissions, improve safety, and eliminate wear and tear on the roadways spanning across three states. The Port's project is also the first American Marine Highway Coastal Service project designated on the entire West Coast of the United States. The SEA LINC Project includes expansion options for future potential stops along the M-5 including the Ports of San Diego, Los Angeles, Long Beach, Oakland, San Francisco, and Coos Bay. This federal designation will also enable program participants to apply for federal grants to support the new services.

[Stockton Area \(San Joaquin County\)](#)

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, 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 where SSA operates 24/7 empty yards near the two 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 24/7 and reduce the need for drivers to take empty containers back to the Port of Oakland or 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 and 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 both Class I railroads and resides adjacent to major industrial warehousing uses.

Bakersfield Area (Kern County)

Kern County is a growing logistics hub. In the past decade, 20 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, City of Shafter has access to both Class I railroads and has developed a container yard with 160 container spaces similar to the STE yard in Stockton. 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. Known in the industry as "street turn containers," 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 region populations, as well as to the Ports of Oakland, Los Angeles, Long Beach, San Diego and Hueneme. In addition, the City of Shafter, 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 (2), Edison, Buttonwillow, Lost Hills, and North Shafter.

High Desert Region Inland Trade Ports

2022 saw two new inland trade ports proposed for the California High Desert region in Mojave, Barstow. The Mojave Inland Port has been completely environmental cleared and lies at the confluence of SR 58, SR 14 and the UPRR branch line to Searles Valley and is just off the BNSF/UP mainlines through Mojave. The line currently sees weekly bulk haul service between Searles Valley Minerals and the Port of LA. This service could be used to attach double stack containers to from this new intermodal rail facility. Being developed by Pioneer Partners, the .65 square mile, \$700M facility is anticipated to service 200 to 3,600 trucks per day.

Then BNSF Barstow International Gateway is 7 square miles, \$1.5 Billion facility and is has been estimated to service up to 5,000 trucks per day (20% of the trucks on the I-110/710 corridor that would be redirected to this facility via SR 58. Just beginning the environmental process, the

private sector financed facility has complete backing of the BNSF. The also sees daily bulk haul rail services between Rio Tinto borax and lithium mining to the Port of LA.

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 railroads, 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 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. USDOT 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.

In 2014, the West Coast Corridor Coalition sponsored a study of Marine Highway (M-5)¹⁵⁵ 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.

Caltrans worked with the Port of San Diego and the Port of Bellingham (Washington) to have the West Coast M-5 Coastal Connector Project officially designated by the United States Maritime Administration (MARAD) under their America's Marine Highway (AMH) program. The M-5 Coastal Connector utilizes the movement of goods by waterborne routes that are served by highway or railway, therefore reducing and augmenting land-based transportation, vehicle-miles-traveled, and associated greenhouse gas emissions. One sailing from the Port of Bellingham to the Port of San Diego carrying 6,000 tons of lumber removes an estimated 250 truck trips and 272,500 truck miles traveled; 197,000 of those miles are in California. In addition to air quality benefits, the shift from roadway to waterway goods movement will dramatically decrease roadway maintenance costs. The project designation was officially awarded in August of 2021, allowing Caltrans and partners to request federal funding for implementation.

In February 2010, USDOT 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-580¹⁵⁶ 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)".

In an effort to reinstate the M-580 barge service, Caltrans completed the M-580 Corridor Multimodal Freight Network Optimization Study¹⁵⁷ in Spring 2021. The study looked at several different modal scenarios which included short-haul rail, but placed more emphasis on possible barge service options from the Port of Oakland to both the Port of Stockton and the Port of West

Sacramento (see project area in map below). The study’s model predicted that the only potentially profitable service would depend on a large barge going to either Stockton or West Sacramento. Even so, the service would operate at a loss during its initial stages and need to be subsidized for the first several years. According to the model, it could take 10 years for a barge service to generate profits. Any potential service would require infrastructure improvements at the smaller ports and potentially designated cargo scanning areas at the Port of Oakland to ensure the security of containers moving further inland.

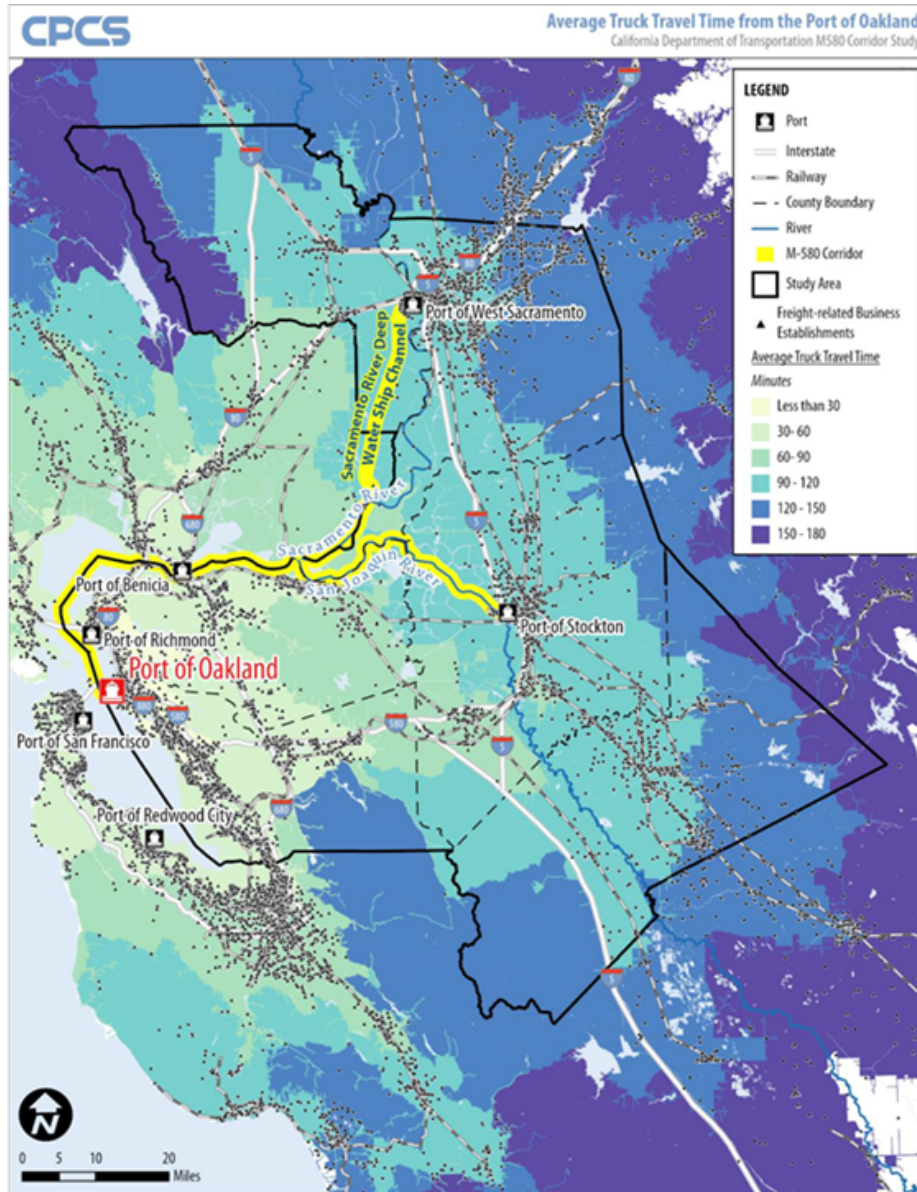


Figure 4.15: Average Truck Travel Time from the Port of Oakland

However, the model also showed substantial air quality benefits, not only in the Bay Area and San Joaquin Valley, but across the entire state. PM2.5 emissions are expected to decrease by more than 30% in the M-580 study area and up to 10% across the state. Meanwhile, PM10

emissions are forecasted to only slightly decline across the State while decreasing by about 17% in the M-580 study area. Forecasts also show a 16% decline in daily CO₂ emissions in the M-580 study area and an 18% decline across California. Diesel engine emissions of other pollutants such as NO_x are also expected to decrease significantly (by more than 40%).

The statewide truck miles traveled are expected to increase by 20% (from 98 million truck miles in 2019 to about 119 million truck miles) by 2040. Such an increase in the number of truck miles traveled along with the recent rise in the development of warehousing and distribution facilities (especially along the highways in Central Valley) can increase congestion, which in turn leads to added truck emissions. Modal shift of freight away from the State Highway System and onto waterways could potentially mitigate, in part, the increase in truck miles traveled and increase travel reliability time for some products.

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.

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.¹⁵⁸ 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 2050.¹⁵⁹ 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.¹⁶⁰

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, including 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 has provided significant investments "to develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies" (Perea, Chapter 401, Statutes of 2013). These investments include electric vehicle charging infrastructure and hydrogen fueling stations, as well as innovation in medium- and heavy-duty advanced technology vehicles. The CEC has also been investing in workforce training in cleaner transportation technologies.

California is leading the nation in building hydrogen fueling stations for Fuel Cell Electric Vehicles (FCEVs). The CEC is investing in public stations to support and encourage these zero-emission vehicles; the Hydrogen Refueling Stations dashboard that shows Hydrogen Refueling Stations in California can be accessed online here:¹⁶¹

https://tableau.cnra.ca.gov/t/CNRA_CEC_PUBLIC/views/DMVDataPortal/Hydrogen?&embed=y&:isGuestRedirectFromVizportal=y&:display_count=n&:showAppBanner=false&:origin=viz_share_link&:showVizHome=n

In a typical year, the Clean Transportation Program allocates up to \$100 million to promote accelerated development and deployment of advanced transportation and fuel technologies. The Clean Transportation Program funding source is set to expire at the end of 2023, however, for 2021 through 2026, through the Budget Acts of 2021 and 2022, and Infrastructure Investment and Jobs Act federal funding, additional funding of nearly of \$4 billion will be provided for ZEV infrastructure and ZEV related manufacturing.

The Clean Transportation Program has been an essential part of making California a leader in near- and zero-emission transportation. Since 2009, the Clean Transportation Program has invested more than \$1 billion in projects supporting zero-emission vehicle infrastructure, alternative fuels, and advanced vehicle technologies. Key highlights through April 2022 include but are not limited to:

- 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
- Funded more than \$175 million to 83 medium- and heavy-duty zero-emission vehicle infrastructure projects
- Funded 27 manufacturing projects supporting in-state economic growth while reducing the supply-side barriers for alternative fuels and advanced technology vehicles, primarily in electric drive-related components and vehicles

- Funds the nation's first commercial vehicle fleet incentive project titled "EnergIIZE Commercial Vehicles" to accelerate the deployment of electric and hydrogen infrastructure needed to fuel zero-emission trucks, buses, and equipment
- 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
- Assesses fuel cell electric vehicle infrastructure and fuel production needed to support the adoption of zero-emission trucks, buses, and off-road vehicles (Archuleta, Chapter 646, Statutes of 2021), in collaboration with CARB and CPUC
- Develops the Zero-Emission Vehicle Infrastructure Plan (ZIP), in coordination with various state agencies including the CPUC, CARB, California State Transportation Agency (CalSTA), California Department of Transportation (Caltrans), GO-Biz, and Department of General Services (DGS), to support decision-making in the public and private sectors by documenting plans and strategies to deploy ZEV infrastructure for all Californians
- Releases targeted grant funding opportunities to provide zero-emission charging and refueling infrastructure for trucks, buses and off-road equipment, with a recent opportunity directly partnering with CARB to provide funding for vehicles that will result in over 250 heavy-duty trucks and related zero-emission infrastructure being deployed

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

- Zero-Emission Drayage Truck and Infrastructure Pilot Project – The CEC and CARB released the first-ever collaborative grant funding opportunity to support large scale projects where CARB will provide funding for zero-emission, on-road, class 8 trucks, and the CEC will provide funding for the infrastructure necessary to support the deployed trucks, in addition to workforce training and development. Five projects were proposed for award to support 250 battery electric and 30 fuel cell electric trucks. These projects will show the feasibility of large-scale infrastructure projects, provide best practices and key lessons learned for resiliency and future replicability, and help other freight transportation fleets understand which technology may work best for their particular duty cycles and driving environments.
- Hydrogen Fuel Cell Demonstrations in Rail and Marine Applications at Ports (H2RAM) – The CEC's Clean Transportation Program and the CEC's Natural Gas Research and Development Program collaborated on this grant funding opportunity to fund the design, integration, and demonstration of hydrogen fuel cell systems and hydrogen fueling infrastructure for locomotive and commercial harbor craft applications at California ports. Several projects were proposed for award including one \$4 million award of Clean Transportation Program funding toward shared hydrogen refueling infrastructure at the Port of West Sacramento that will be capable of providing fueling for a switcher locomotive and will offer a public fueling for heavy-duty on-road trucks.
- Blueprints for Medium- and Heavy-Duty Zero-Emission Vehicle Infrastructure – The CEC released this solicitation to fund planning "blueprints" that will identify actions and milestones needed for the implementation of medium- and heavy-duty zero-emission vehicles and the related electric charging and/or hydrogen refueling infrastructure in the state. 35 projects were awarded to support both public and private entities, totaling

nearly \$7 million. These projects will create roadmaps for large-scale infrastructure projects, plan for resiliency, and provide best practices for future replicability within other public and private agencies. These “blueprints” will help agencies and fleets understand which technology may work best for their applications, routes, and driving environments, which will accelerate meeting the state’s goal of transitioning medium- and heavy-duty trucks, buses, and off-road equipment to zero-emission.

CRITICAL MINERALS

California is home to some of the world's critical material and mineral industries including lithium, boron, and rare earth metals, as shown in **Figure 4.16** and **Figure 4.17**. The International Energy Agency (IEA) in 2021 estimated global demand for critical minerals to increase by 400-600% in the coming decades. With this projected growth, GO-Biz, Caltrans, and its regional partners will continue to work closely with this sector to identify potential infrastructure projects key to these supply chains. For example, the Salton Sea in Imperial County is poised to be a major location for lithium extraction and processing, as brines have been located in a geothermal field below the surface. Critical mineral demand for use specifically in clean energy and transportation technologies is expected to grow exponentially by 2040 and in the International Energy Agency's modelling of that demand, lithium saw the fastest growth rate. Estimates for that resource alone project California's capacity to meet up to 40% of current global lithium demand¹⁶². The State is invested in preparing the region for this activity through outreach activities and planning and development. Due to this expected growth rate, particularly coming from the lithium extraction expected to take place at the Salton Sea, there will be additional demands on Imperial County's infrastructure to accommodate the increased freight activity from this activity and ancillary developments tied to Lithium Valley.

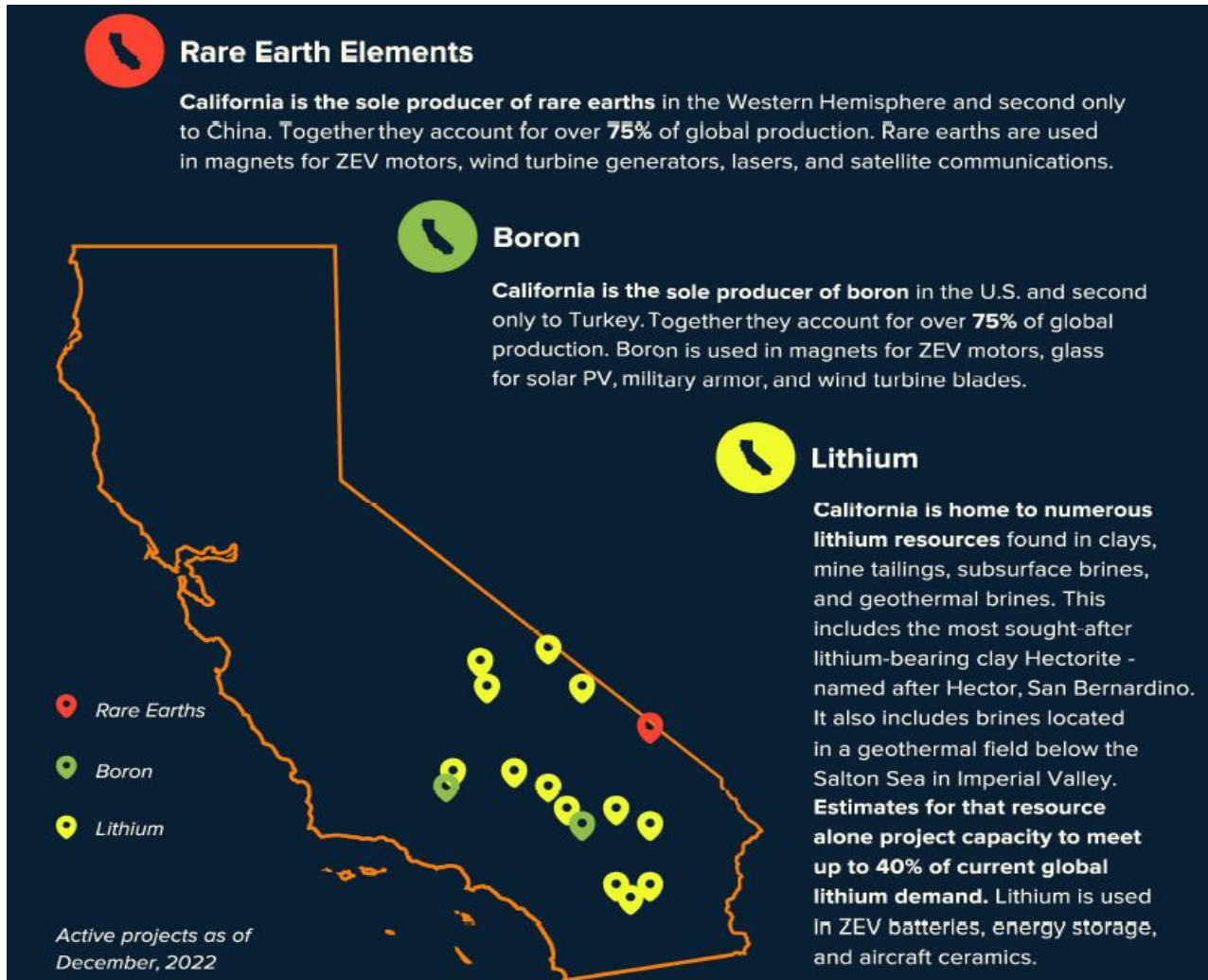


Figure 4.16: California Critical Minerals (Source: GO-Biz Critical Materials and Critical Minerals in California)