MTC Regional Goods Movement Plan

Task 2d – The Importance and Benefits of Goods Movement

Draft White Paper

prepared for

Metropolitan Transportation Commission

prepared by

Cambridge Systematics, Inc.

1.0 WHAT IS GOODS MOVEMENT?

Goods movement refers to the transportation and logistics processes that are involved in moving products from producers to consumers – whether those products are industrial supplies destined for further processing or consumer goods delivered to retail outlets. Industries that rely on goods movement form the backbone of the national, regional, and local economies. Goods movement accounts for $626 billion in domestic and international trade in the San Francisco Bay Area, and provides opportunities for employment to millions in the region.

The *goods movement system* refers to the infrastructure that makes today's supply chains possible – the roads, rail lines and terminals, air and sea ports, and intermodal connectors that allow businesses to ship their goods from business to business, to wholesalers and retailers, and eventually, to the consumer. Warehouses, transloading facilities, manufacturing plants, and even farms and vineyards are all pieces of the supply chain system that must be connected to one another. A safe, efficient and reliable goods movement system allows trade to flourish, and sustains the high quality of life that is a hallmark of Northern California.

The Northern California megaregion is a highly dynamic region comprised of the economically and geographically linked regions of the Bay Area, Sacramento, Northern San Joaquin Valley and the Central Coast. The megaregion is linked to global, national, and local markets economically through commercial and consumer activity, and physically through transportation infrastructure. Goods movement plays a critical role in the economy and way of life in the megaregion. It transcends jurisdictional borders to serve a broad range of industrial and consumer needs. As such, it is imperative to maintain an effective goods movement system – to distribute products quickly and efficiently, to

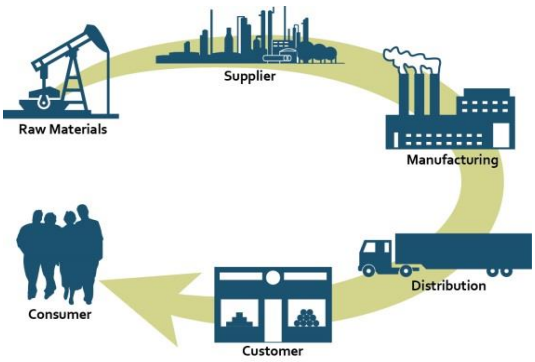
The Megaregion at a Glance

The Northern California megaregion is a goods movement powerhouse.

- *More than $950 billion of freight flowed to, from, and within the megaregion in 2012.*
- *Electronics are the top valued good moving throughout the megaregion, including component parts imported from Mexico and Eastern Asia, and finished goods destined for export or domestic markets.*
- *Goods-movement dependent industries (manufacturing, industrial, and transportation service-providing industries) employed over 7 million people in 2012.*

The megaregion is home to transportation infrastructure vital to the local, regional, and national economies, including:

- *The Ports of Oakland, Stockton, and West Sacramento, the San Francisco, and Oakland International Airports and other ports and airports;*
- *Class I rail lines and intermodal facilities including UP's Railport and BNSF's Oakland International Gateway; and*
- *Major truck routes I-880, I-580, I-80, I-5, SR 99, U.S. 101, and others.*



The goods movement system provides critical links between each step in the supply chain.

accommodate increasing exports and a changing manufacturing base, and to provide basic necessities and luxury goods to the region's consumers. Continued economic growth will require increased coordination and attention to developing a safe and reliable goods movement system that is compatible with the economic, land use, and environmental policies in the megaregion.

This white paper articulates the importance of goods movement to the megaregion and its four "sub" regions, with a particular emphasis on the Bay Area. It begins by presenting a snapshot of goods movement throughout the megaregion, including the goods movement system's contribution to the economy, discussion of goods movement industries and trading partners, and the physical infrastructure supporting this system. Next follows a drill-down into each of the four regions, which are simultaneously independent from one another, yet interdependent on each other's economies and infrastructure connections. The final section discusses trends, issues, and needs of the goods movement system, and their economic, environmental, and equity implications in the megaregion.

2.0 Goods Movement in the Northern California Megaregion

The Northern California megaregion includes a wide range of geographies, metropolitan, rural and suburban areas, and a diverse mix of businesses and industries. Within the megaregion are national and international suppliers of fresh fruits, vegetables, nuts and other produce; wine and artisanal food producing regions in the North Bay and Central Coast; food processing in the Central Valley; and distribution facilities along major corridors and in the San Joaquin Valley. Adding to the region's diversity are some of California's most populous and fastest growing cities, high-tech industries serving a worldwide market, major international trade gateways through the Port of Oakland and Oakland and San Francisco International Airports, and a diverse and affluent consumer market. Each of these megaregion components is tied together both physically and economically – to support not only goods movement in and between the regions, but to and from the greater national and international community. The combination of relatively inexpensive land in the inland regions, major industrial and agricultural centers, and access to global and regional

Megaregion Exports: Almonds

The U.S. produced about $7 billion worth of edible tree nuts in 2013. About 60 percent or $4.2 billion worth were produced in California. By value, almonds are California's top export and the nation's top horticultural export, representing $2.8 billion in 2011.

According to the 2007 USDA Census of Agriculture, there are around 6,500 California almond farms and 100 processors, many of which are located in the megaregion and surrounding counties. Of those, 72 percent are family owned and 51 percent are less than 50 acres. California production of almonds has roughly doubled in the last decade, with the 2013 crop year reaching 1.9 billion pounds, worth more than $2.8 billion.

The U.S. is the largest market for almonds, with about 30 percent of the crop sold for domestic use. Seventy percent of the U.S. almond crop is shipped internationally with Spain, Germany, Japan and India being the leading export markets.

Nut crops have a complex, seasonal supply chain, with September and October being peak months for transportation needs. Growers receive nursery stock, fertilizers, chemicals, and other supplies by truck. Beekeepers bring hives to the almond groves in pick-up trucks. At harvest time, mobile harvesters shake the trees and convey the nuts into bins for truck transport to the processor. Nuts bound for export primarily move by containers trucked to and from the Port of Oakland.

Source: Almond Board of California, www.almonds.com.

gateways to connect the San Joaquin Valley to the gateways in the Bay Area, and beyond are several features of the many interdependencies in the megaregion.

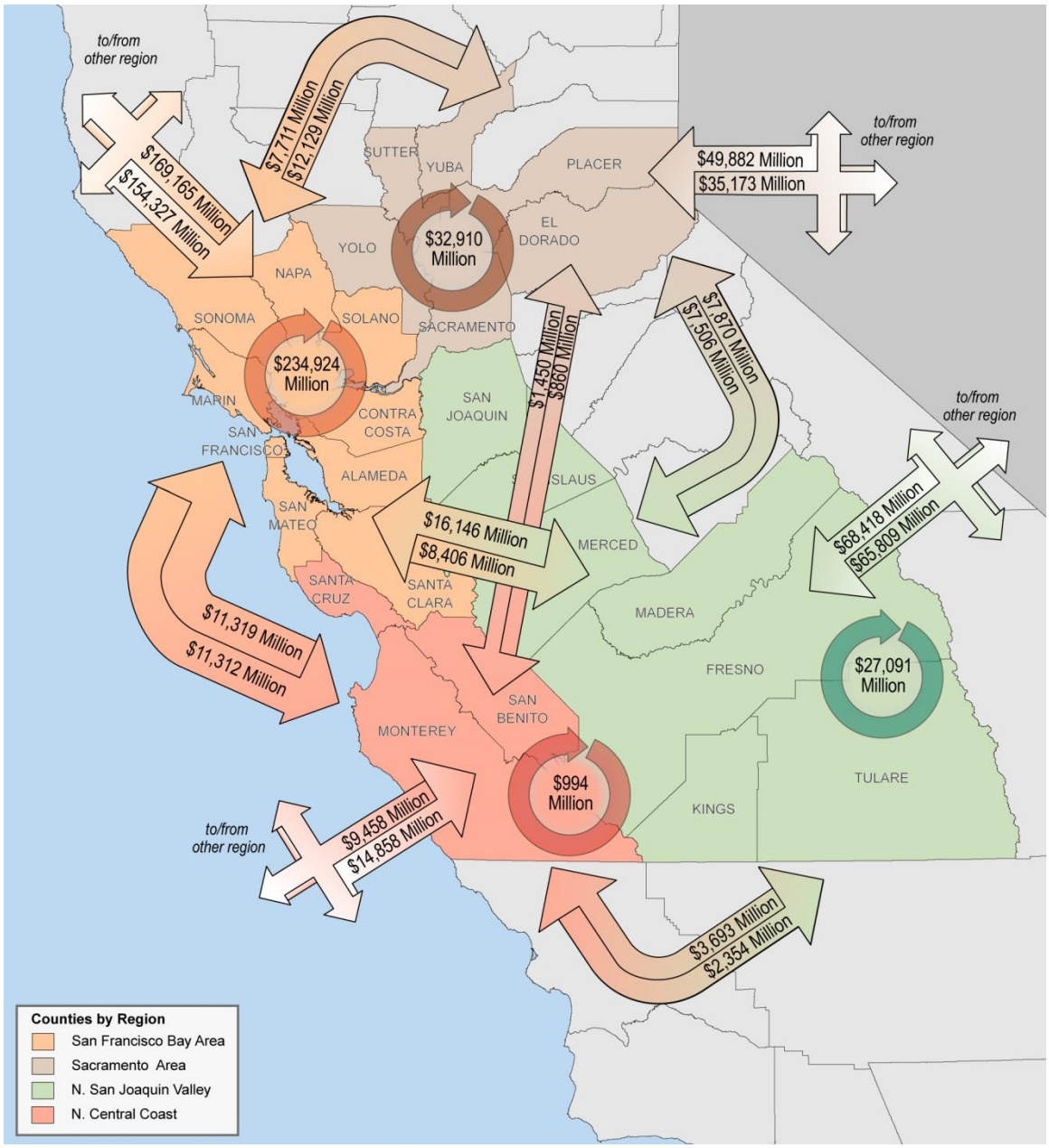
2.1 Goods Movement Flows in the Megaregion

The Northern California megaregion is an economic powerhouse, with more than $953 billion in freight flows moving to, from and within the region in 2012. This is expected to grow to $2.6 trillion by 2040. Each of the four regions within the megaregion has separate characteristics and regional strengths, yet they are tied together through the goods movement system and the patterns of domestic and international trade. Exports of high value, specialty agricultural products from the San Joaquin Valley and wine from the North Bay move through the Bay Area's ports. Medical supplies and precision instrumentation, products of a growing high-tech manufacturing sector in the Bay Area, traverse through domestic and international air cargo centers for shipment all over the world. Figure 2.1 illustrates the freight flows moving within the megaregion, illustrating the critical roles that each region plays as trading partner to the others. Each region's characteristics and strengths are discussed in more detail in Section 3.0.

Goods movement dependent industries in the Bay Area account for $490 billion (51 percent of total regional output); and provide more than 1 million jobs (32 percent of total regional employment).

The Bay Area is at the heart of the megaregion's economy. Approximately two-thirds of the freight moving to, from, and within the megaregion, by value, moves to, from, and within the Bay Area. Each region is highly tied to the Bay Area, both through utilizing the region's global gateways, such as the Port of Oakland and San Francisco International Airport, or to reach the region's manufacturing centers and consumers. Approximately, 17 percent of the freight flows of the rest of the megaregion, are to or from the Bay Area.

Figure 2.1 Northern California Megaregion Freight Flows and Trading Partners, 2012



Source: Freight Analysis Framework (FAF) 3.5 Provisional Data and Forecasts.

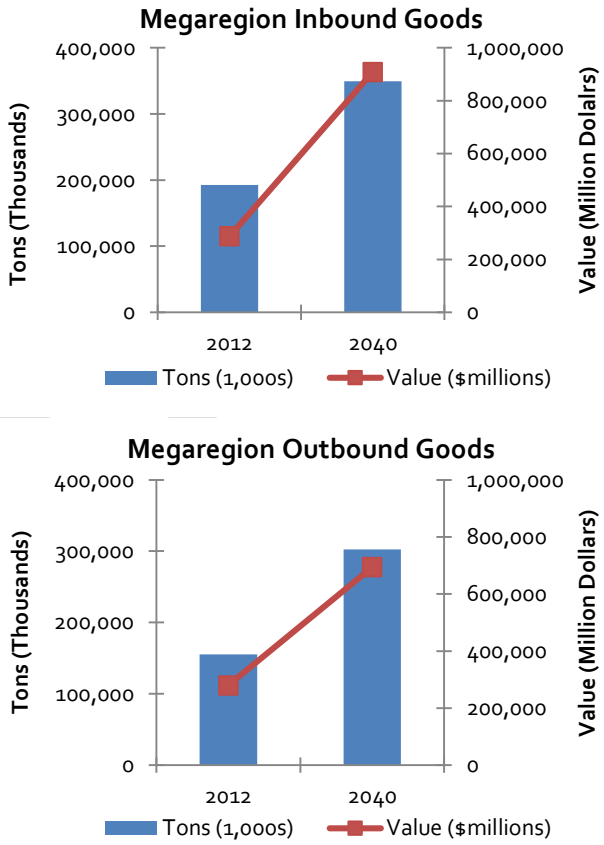
2.2 Connections to the World– – Megaregion Trading Partners and Freight Flows

Goods flowing to and from the megaregion play a key role in its economy and those of its trading partners. 192 million tons of goods worth about $287 billion were brought into the megaregion in 2012. 155 million tons of goods worth about $280 billion were brought out of the megaregion.

Figure 2.2 illustrates the projected growth of freight flows, by both weight and value, moving to and from the megaregion from 2012 to 2040. The megaregion's top inbound commodities, by weight, include petroleum products, gravel, waste/scrap, and cereal grains. Many of these high-weight goods are raw materials destined for construction and manufacturing industries. By value, top inbound goods are electronics, motorized vehicles, machinery, and mixed freight (a category that generally includes a wide array of consumer products). Many of these goods are destined for distribution centers from which they will be distributed throughout the megaregion, and beyond. Top outbound commodities by weight include agricultural and food related commodities, and waste/scrap. By value, they include high-value electronics, precision instruments, machinery, and pharmaceuticals

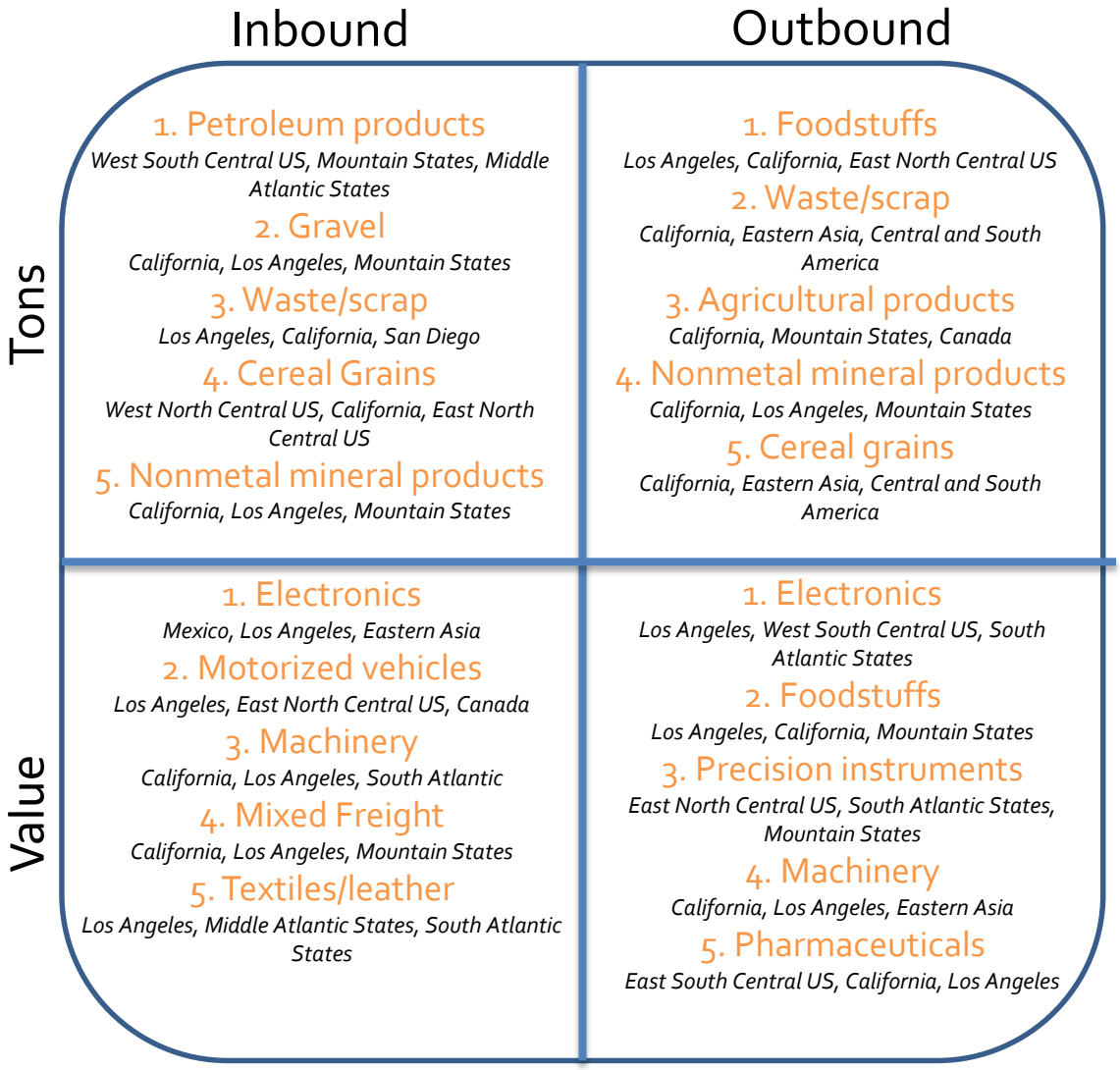
For electronics, component parts and products are imported from Mexico via rail or truck, or Eastern Asia through the Ports of Oakland, Los Angeles, or Long Beach, to be finished by value-added manufacturers in the region. These finished products are then sent out to domestic markets, or returned via ports or airports for export. Other products moving out of the megaregion are primarily destined for domestic markets, and focus both on high-value manufactured items such as precision instruments, as well as food products. Figure 2.3 gives an overview of the top products moving to and from the megaregion, and the associated trading partners.

Figure 2.2 Northern California Megaregion Freight Flows, 2012



Source: FAF 3.5 Provisional Data and Forecasts.

Figure 2.3 Northern California Megaregion Top Commodities and Trading Partners

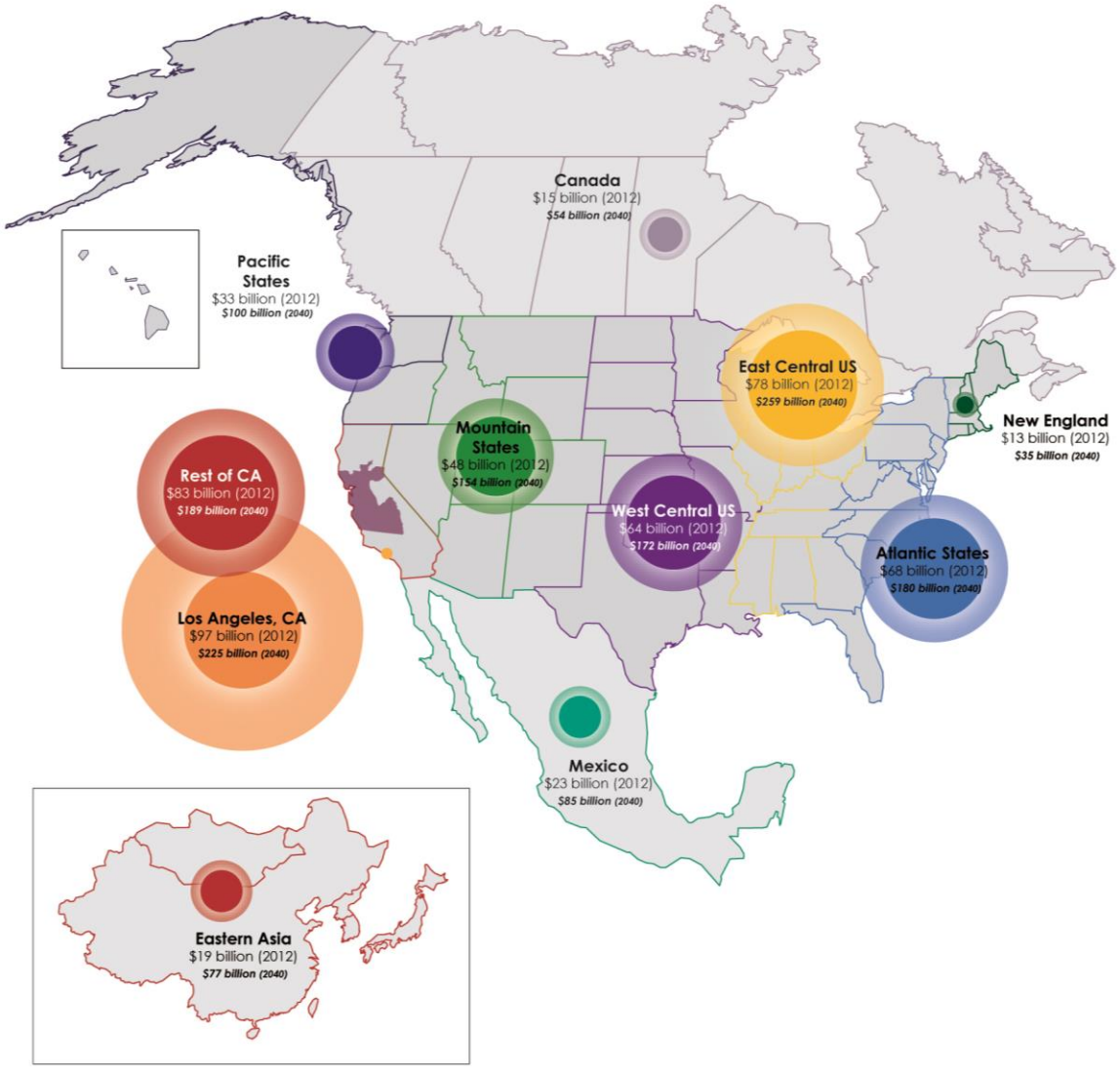


Legend for Figures 2.3			
Region	***States***	***Region***	***States***
East North Central	IL, IN, MI, OH, WI	Pacific (Except CA)	AK, HI, OR, WA
East South Central	AL, KY, MS, TN	South Atlantic	DC, DE, FL, GA, MD, NC, SC, VA, WV
Middle Atlantic	NJ, NY, PA	West North Central	IA, KS, MN, MO, ND, NE, SD
Mountain	AZ, CO, ID, MT, NM, NV, UT, WY	West South Central	AR, LA, OK, TX
New England	CT, MA, ME, NH, RI, VT	California	CA except megaregion, Los Angeles, San Diego

Source: FAF 3.5 Provisional Data and Forecasts.

The megaregion's largest trading partners include both domestic and global locations, as illustrated in Figure 2.4. Eleven percent of the trade moving to and from the megaregion, by value, is comprised of goods moving to and from international trading partners. With increased focus on exports from the megaregion, this increases to 14 percent by 2040. Los Angeles is the region's biggest trading partner, with $97 billion in trade (14 percent of all megaregion trade) in 2012. This includes both domestic products and imports/exports moving through the Ports of LA and Long Beach. The remainder of California also is a major market for goods moving to and from the megaregion – over $87 billion (12 percent) in 2012. The fastest growing domestic and international markets trading with the megaregion are the East Central and Mountain States in the U.S., Mexico, Eastern Asia, and Canada.

Figure 2.4 Northern California Megaregion Freight Flows and Trading Partners, 2012

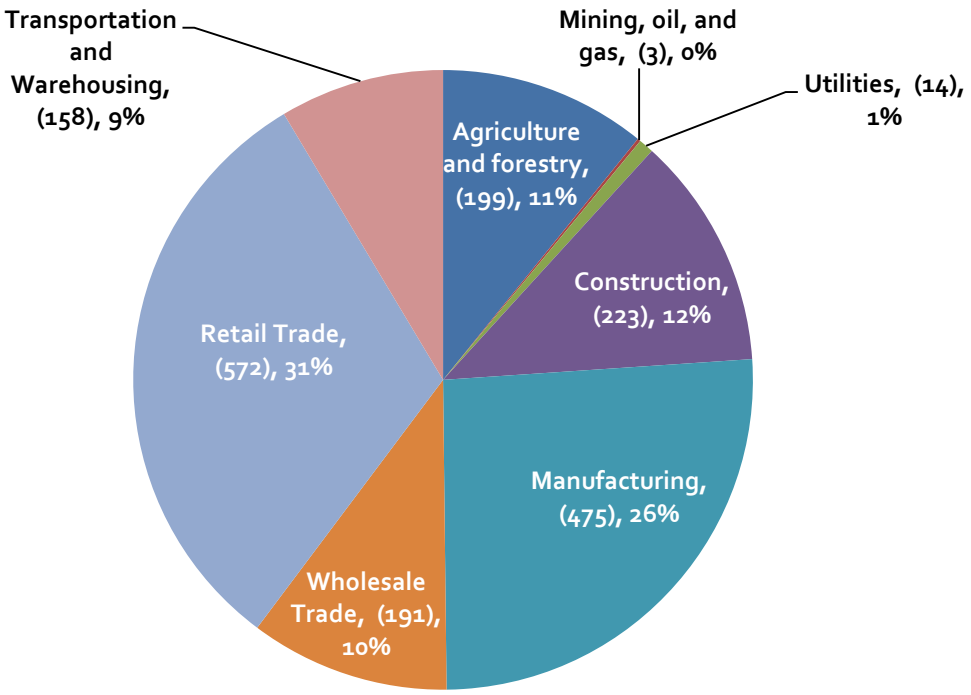


Source: FAF 3.5 Provisional Data and Forecasts.

2.3 Goods Movement-Dependent Industries and Employment

More than 1.8 million people are employed in goods movement-dependent industries in the megaregion (Figure 2.5). Just about 1 million of these jobs are in the Bay Area, which has more than 670,000 jobs in the manufacturing and retail trade sectors, illustrating the region's status as a powerhouse in both the producing and consuming economies. In the megaregion as whole, these two sectors employed over one million workers, over one-half of all employment in goods-dependent industries in 2012. The manufacturing sector as a whole employed almost half-million. Agriculture is another important sector of the megaregion's economy, employing almost 200,000, one-half of which are within the North San Joaquin Valley. Transportation and warehousing employed more than 158,000 in 2012, with over one-half of the jobs concentrated in the Bay Area.

Figure 2.5 Northern California Megaregion Employment in Goods Movement-Dependent Industries, 2012 (Thousands)



Source: U.S. Bureau of Labor Statistics, Association of Bay Area Governments.

2.3.1 Location Quotient Analysis

The Location Quotient (LQ)[1] is an economic analysis tool used to compare the relative importance of different industries within a geographic area. LQ analyses assess the relative concentration of an industry, providing insight on regional "exporting" or wealth generating industries, as well as industries that do not sufficiently produce enough output to meet local demand, and hence goods must be "imported." In this analysis, LQ values above "1" show that a particular industry is more concentrated in a particular region than in the State of California as a whole. The opposite is true for LQ values less than 1.

The LQ analysis of goods-dependent industries in Table 2.1 illustrates the economic diversity among the regions within the megaregion. Agriculture is hugely concentrated in the North San Joaquin Valley and North Central Coast regions. Manufacturing hubs are found in the Bay Area and North San Joaquin Valley, where employment in Manufacturing is about 10 percent more concentrated than in the State as a whole. Retail trade is strong in each region, illustrating the robust consumer economies, whereas Transportation and Warehousing is strong in the North San Joaquin Valley, home to a growing number of distribution centers and transload facilities.

Table 2.1 Location Quotient Analysis for Goods Movement-Dependent Megaregion Industries, 2012

	Industry							
Region	Agriculture and Forestry	Mining, Oil, and Gas	Utilities	Construction	Manufacturing	Wholesale Trade	Retail Trade	Transportation and Warehousing
Bay Area	0.2	0.3	0.5	1.1	1.1	0.8	0.9	0.7
North San Joaquin Valley	4.6	0.2	1.3	0.9	1.1	0.8	1.1	1.4
North Central Coast	6.6	0.4	0.8	0.7	0.6	0.7	1.0	0.4
Sacramento Region	0.6	0.4	0.5	1.3	0.6	0.6	1.2	0.9

Source: Bureau of Labor Statistics Location Quotient Data. Note that regional data is calculated based on counties reporting employment data; data is not available for all counties.

[1] Specifically, the location quotient is estimated by dividing the employment shares from each industry in a given region by the employment share of the same industry in the comparison region (i.e., the State of California).

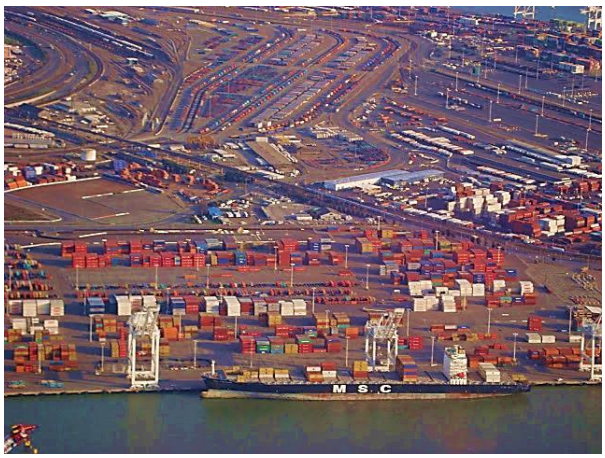
2.4 The Megaregion's Goods-Movement System

2.4.1 Goods Movement Markets and Functions

The world class industrial and consumer markets of the megaregion are served by a goods movement system of global and domestic trade gateways, inter- and intraregional corridors, and supplemented by a complex system of last-mile and urban goods movement connectors. Many individual facilities can play multiple roles in the goods movement system, transporting goods both destined for export as well as those traveling within the region. The geographic context of goods movement facilities is an important part of the story of the broader goods movement system. Each of the three major functions of the goods movement system is summarized below.

Global Gateways

The global gateways that make up the megaregion's freight transportation system consist of the major maritime facilities and international airports that handle freight, as well as passenger cargo. Gateways are entry and exit points that are essential to moving high volumes of trade into and out of the megaregion, i.e., ports, airports, and their associated inland connections.



Inter- and Intraregional Corridors

The interregional corridors consist of primary highways and rail lines that serve to connect the megaregion to the rest of the State and to domestic markets beyond while intraregional corridors are primarily highway links that carry goods within each region of the megaregion. These networks also provide primary access to major facilities, such as the Port of Oakland, rail yards at Lathrop and Roseville, and warehouse/industrial districts.

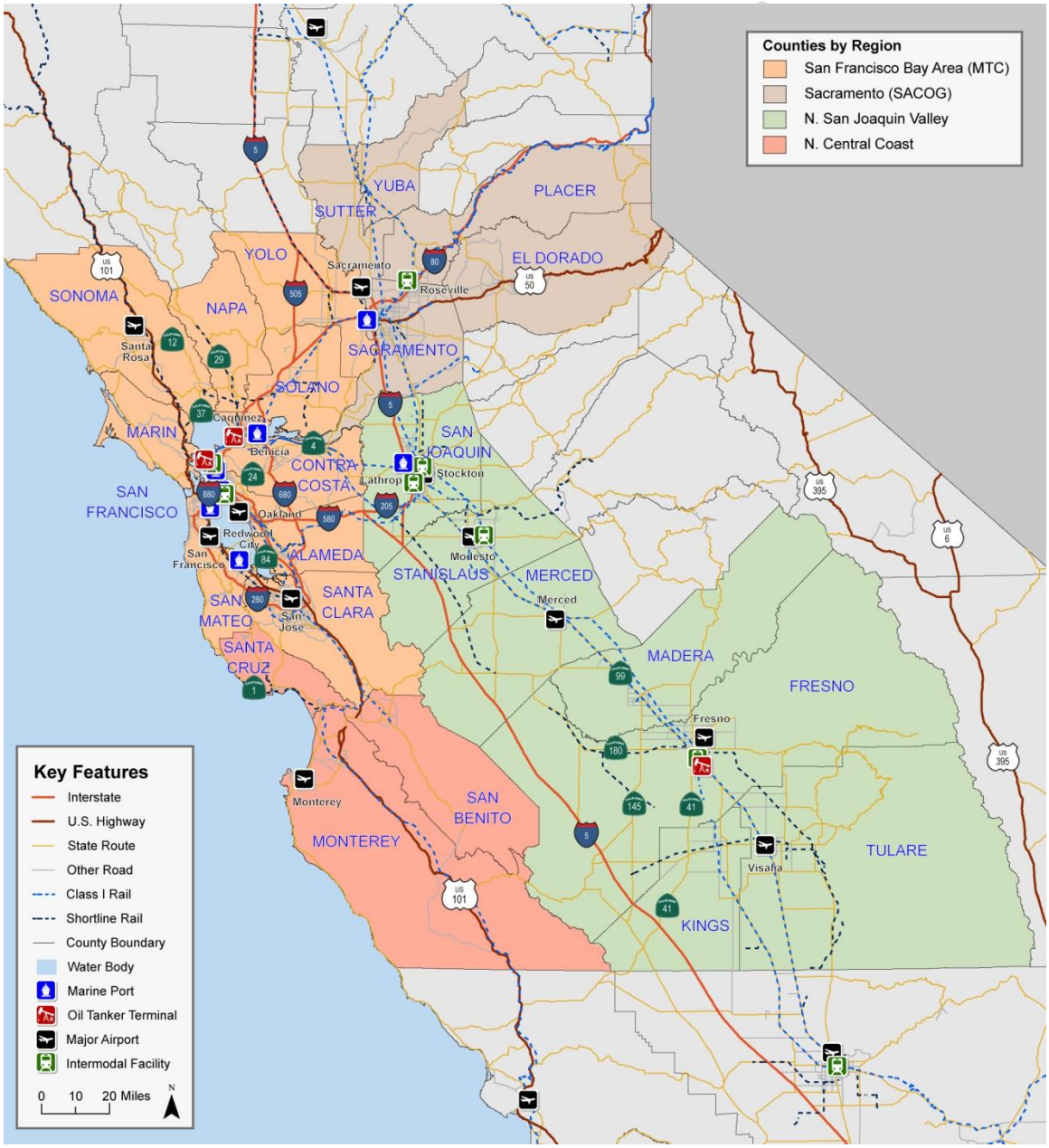
Local Goods Movement System and Last-Mile Connectors

The local goods movement system refers to networks of city streets that move freight to and from its origins/destinations. Last-mile connectors, which also are part of the local goods movement system, provide the critical connections between major freight facilities (global gateways, domestic rail terminals, warehouse/industrial centers, and industrial parks) and the interregional and intraregional systems. Major arterial truck routes are often used as alternatives to congested freeways for city-to-city truck movements. Farm-to-market roads in the rural parts of the megaregion also are elements of the local goods movement system that serve important economic functions.

2.4.2 Key Facilities in the Megaregion

The multimodal goods movement system in the megaregion consists of highways, rail lines, airports, seaports, and warehousing facilities. It provides trade connections with rest of Northern California, Southern California, the rest of the U.S., and internationally. A pipeline system also exists, though it is limited to the transport of crude petroleum and refined petroleum from/to Bay Area refineries located in Rodeo, Richmond, Benicia, and Martinez. Figure 2.7 shows the components of the goods movement system in the megaregion.

Figure 2.7 The Northern California Megaregion Freight System



Source: Caltrans District 4 GIS, July 2013.

Highway

The highway system for the megaregion consists of interstates, state highways, and other Caltrans-managed roadways on which trucks compliant with the Federal Surface Transportation Assistance Act (STAA) of 1982 and/or California-legal trucks are allowed. I-80 is one of the major transcontinental trade corridors in the megaregion, connecting the megaregion from the Bay Area east to Sacramento and on to domestic markets throughout the country. I-5 is a major north-south West Coast U.S. trade corridor that connects the megaregion to its highest value trading partner, Southern California, and also links up with I-15 and I-40 to form another major cross-country route. Within the megaregion, east-west interregional goods movement connectivity is provided by I-580[2]/I-205, SR 12, SR 152, SR 20 and SR 46. North-south interregional goods movement connectivity is provided by U.S. 101 and SR 99; and I-880 provides the final leg of connectivity to the Port of Oakland and central Bay Area. A number of other highways provide additional connectivity. The goods movement system also includes state managed roadways, some with special restrictions, and local truck routes.

Highway Congestion is Increasing on Key Megaregion Facilities

One of the most heavily used truck route in the Bay Area, I-580 also provides connectivity to the San Joaquin Valley. It has daily truck volumes in excess of 10,000 trucks per day east of the junction with I-238, nearly 70 percent of which have four or more axles. Trucks compete for highway capacity with commuter traffic in the westbound direction in the AM peak period and in the eastbound direction in the PM peak period.

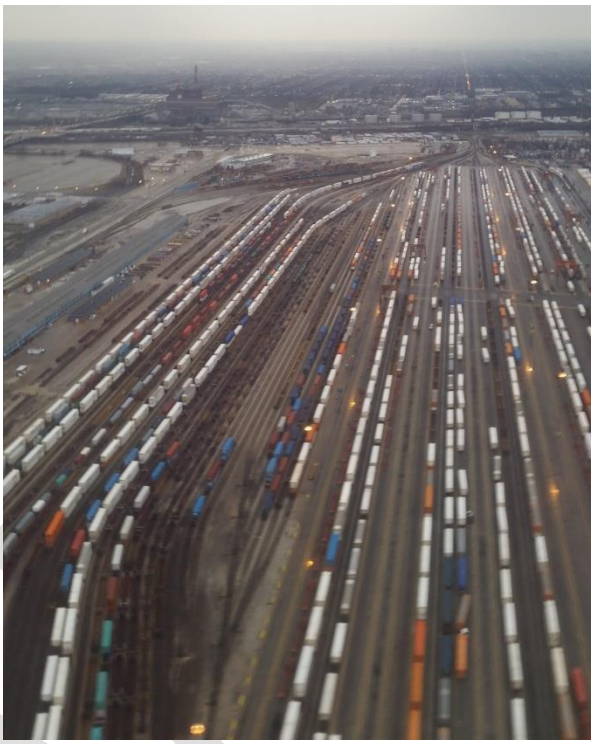
With a continued shift in warehousing facilities from the Bay Area to the San Joaquin Valley, the usage of I-580 will continue to grow. Challenges on the system include the high grade near the Altamont Pass, and the fact that trucks are prohibited from traveling on I-580 in Alameda County north of the I-580/I-238 Interchange. Currently, there are no major highway alternatives with the connectivity of I-580. However, UP's Oakland/Niles rail subdivisions shares the corridor.

The challenges on I-580 will result in increasing truck concentrations on I-880, which is the key access highway for Port of Oakland and Oakland International Airport. This already congested highway also provides regional goods movement connectivity throughout the Bay Area, from Alameda County to the South Bay area. Daily truck volumes on I-880 range between 15,000 and 20,000 trucks per day north of the junction with I-238, nearly 65 percent of which are 4- or more axles.

The region's primary highway connections to the nation, I-5 and I-80, are also seeing high levels of congestion for both truck and passenger travel. I-5 provides connectivity south to the Los Angeles Region and to the Southern U.S., while I-80 is the primary connector between the Bay Area, Sacramento, and the northern U.S. However, increasing use of alternative modes such as carload or intermodal rail is expected to help alleviate the burden on some of these routes in the future, particularly I-80. Nevertheless, continued growth in goods movement will continue to depend heavily on truck movements along these key highway facilities in the megaregion.

[2] Although parts of I-580 provide connectivity for trucks, commercial vehicles are prohibited from traveling on I-580 north of the I-580/I-238 interchange.

Rail



The megaregion is served by two Class I railroads, UP and BNSF, and several shortline railroads. The Class I railroads operate main lines originating near the Port of Oakland and are supported by near-dock rail terminals for intermodal, auto and bulk cargo, and inland rail classification yards throughout the megaregion. Railroads travel out of the Bay Area, largely paralleling the major highway infrastructure, in four directions:

- East along the I-80 corridor through the Sacramento region towards Reno, Nevada, and continuing as a transcontinental route;
- East via I-580/I-205 (Altamont Pass) towards Stockton, and then traveling south via SR 99 corridor in the San Joaquin Valley region to Mojave (south of Bakersfield) and meeting the transcontinental rail routes in Southern California;
- South via the U.S. 101 corridor in the Central Coast region towards Los Angeles; and
- North of Stockton and Sacramento via I-5 corridor towards Klamath Falls, Oregon, and continuing to the Northwest region of the U.S.

The Oakland International Gateway and Railport are the near-dock rail intermodal terminals serving the Port of Oakland and handling international shipments of containers and automobiles. Nearby, the Port of Richmond and Port of Benicia also handle major international shipments of noncontainer traffic. In the Sacramento region, UP's Roseville rail yard, and in the San Joaquin Valley, BNSF's Stockton intermodal rail yard, UP's Lathrop intermodal rail yard and BNSF's Fresno intermodal rail yard focus on serving domestic container and bulk traffic in the Northern California megaregion. The Central Coast has no intermodal facilities, so the region relies on connections through the Bay Area and the San Joaquin Valley to provide intermodal rail access. Short line railroads are spread throughout the megaregion. Many are collocated with agricultural production and food processing industry centers, especially wine, grain, nuts, canned or frozen fruits, and vegetables.

Ports and Airports

The megaregion's ports and airports include the major trade gateways of the Port of Oakland, San Francisco International Airport and Oakland International Airport. Other nearby ports, such as the Ports of Stockton and West Sacramento, which act as export centers for bulk commodities, and the Ports of

Richmond and Benicia, which support crude petroleum and automobile imports, also serve to facilitate goods movement in the region. Other ports and airports in the megaregion include the Port of San Francisco, Port of Redwood City, Sacramento International Airport, Mineta San Jose International Airport, Sacramento Mather Airport, and Travis Air Force Base.

3.0 Regional Profiles within the Northern California Megaregion

The Northern California megaregion is comprised of the economically and geographically linked regions of the Bay Area, Sacramento, Northern San Joaquin Valley and the Central Coast. Each of these regions has characteristics and strengths that make it unique, but also adds to the overall goods movement picture of the megaregion. Table 3.1 shows a profile of each of these regions, which will then be explored in more detail in this section.

Table 3.1 Regional Profiles within the Northern California Megaregion

Bay Area	Sacramento	San Joaquin Valley	Central Coast
• International trade hub – Port of Oakland and SFO • Fuels producer • High value manufactured products • Consumer center • Alcohol (wine) and food products – domestic and export	• Agricultural and food products – domestic and exports • Consumer center • High value manufactured products • Regional warehouse center • I-	• Agricultural/food products – domestic and export • Regional distribution center for Bay Area and Sacramento • Major interregional rail and interstate highway infrastructure	• Wine, fish and agricultural products – domestic and export • Critical agricultural linkages with San Joaquin Valley

3.1 The Bay Area

The nine-county Bay Area region (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma) is California's second largest population center and boasts one of the largest economies in the U.S. and in the world. Ranking 19th in the world when compared to national economies, the region reported a Gross Regional Product (GRP) of $539 billion in 2011.[3] The robust consumer, commercial, and industrial economies that make up this region necessitate a strong goods movement system. The population of the region has grown from 6 million persons in 1990 to about 7.2 million in 2011, to a projected 9.3 million by 2040, with a per-capita income well above the California average. Currently, the Bay Area provides jobs for almost 3.4 million people who live in the region and neighboring counties[4] and in 2011, goods movement-dependent industries in the Bay Area spent $20 billion on transportation, equivalent to 2 percent of regional output.

[3] Ibid, ABAG.

[4] *Plan Bay Area*, Association of Bay Area Governments (ABAG), 2013.

3.1.1 Goods Movement Flows in the Bay Area

Goods movement play a significant role in the Bay Area economy, with the goods movement dependent industries accounting for $490 billion, or 51 percent of total regional output; and provide over 1.1 million jobs, or 32 percent of total regional employment.

Goods movement in the Bay Area is dominated by a large share of intraregional movements. In 2012, intraregional movement accounted for 237 million tons, or just about 51 percent of all flows moved in the Bay Area. In terms of value, this is about $234 billion, or 38 percent of total freight flows. These short-haul freight movements reflect local supply chains – consumer goods moving from local warehouse and distribution facilities to retailers and wholesalers, raw materials and component parts moving among facilities within a manufacturing cluster for production and assembly, and waste and scrap materials moving to/from transfer facilities and recycling industries. Other top commodities moving within the region – foodstuffs, construction materials, and containerized consumer products – are used by or produced by manufacturing companies, such as Bayer Corporation, Seagate Technology, Logitech Inc., Sara Lee Foods, and Pacific Steel Casting.

Bay Area Industries: Wine

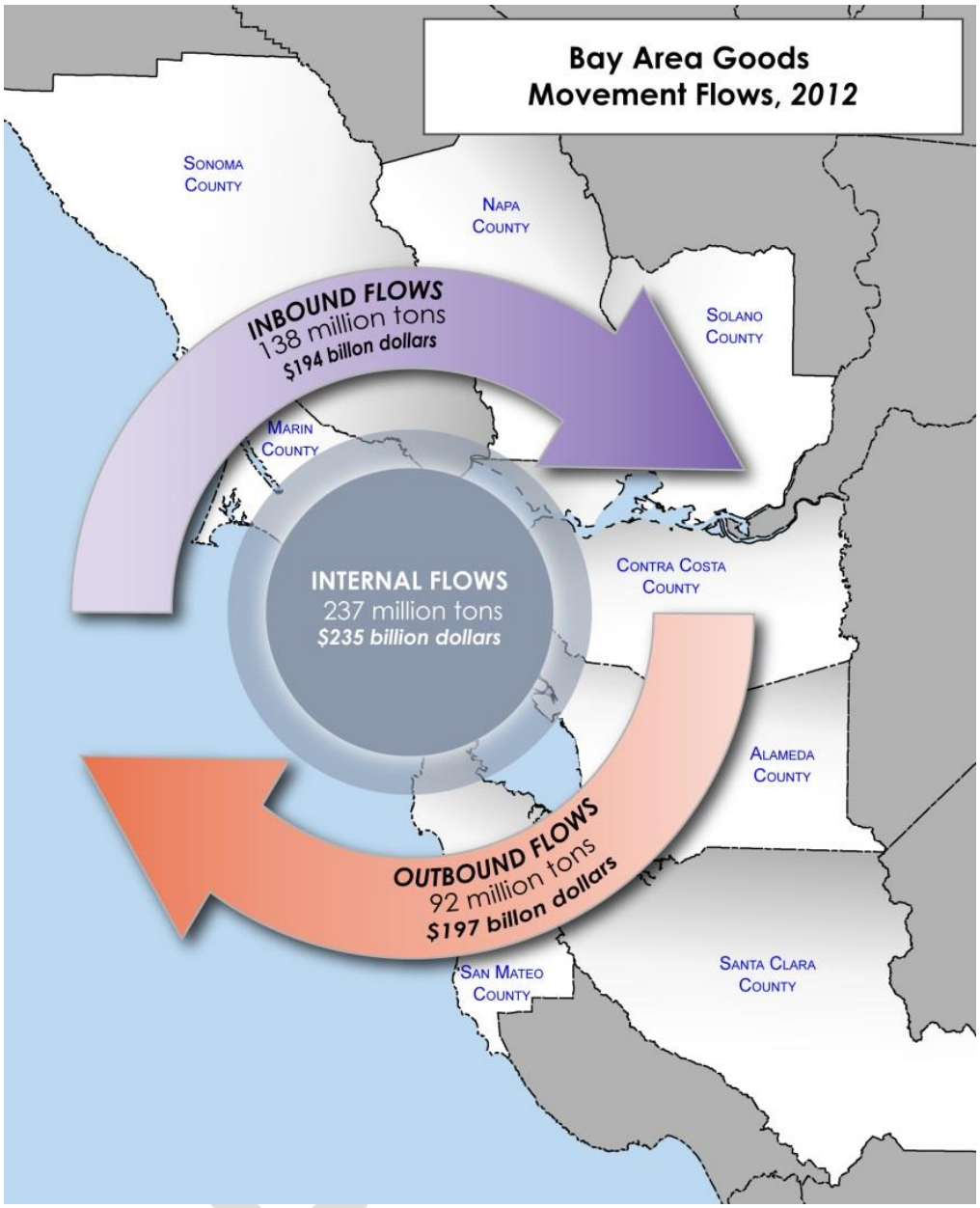
California is known worldwide for the production of high quality wines, and the Bay Area is one of the State's premier wine-producing regions. Major centers of wine growing and production in the Bay Area include the renowned Napa and Sonoma Counties. In 2013, Napa County reported 175,000 tons of grapes crushed; and Sonoma and Marin Counties reported 271,000 tons of grapes crushed, or about 10 percent of the California total. The Central Valley region, however, is the largest producer of wine. San Joaquin, Stanislaus, Merced Counties (and parts of Sacramento County) generated 1.2 million tons of crushed grapes in 2013, making up 27 percent of the state total. Wine and other alcoholic beverages were the fifth highest export product at the Port of Oakland by value in 2013, making up $937 million in exports, or 6.7 percent of total port export.

Vintners receive many types of shipments, from grapes to bottles and other packaging materials. U.S. 101, SR 37, and SR 12 in the Bay Area provide major trucking connections between the wine-producing regions in the North Bay and the interstate highway network. While much of the wine product and supplies are moved to and from wine growers and vintners by truck, an increasing number of bottlers would like to take advantage of short-line and intermodal rail services when they can.

In addition to intraregional movement, movements to the region (inbound flows) also are significant, accounting for 138 million tons of goods (17 percent) worth $194 billion (25 percent) in 2012. Inbound flows into the Bay Area s are projected to increase as the Bay Area continues to be a net consumer of goods produced outside of the region. These flows include supplies for local industries, consumer goods distributed from Central Valley warehouses, and products shipped into the region's ports and airports for export.

Lastly, the Bay Area's industries are specialized around value-added and specialty manufacturing and agriculture activities, resulting in high-value exports and domestic products. In terms of outbound movements, about 92 million tons of goods worth $197 billion are transported outbound from the region to international and domestic markets. Figure 3.1 and Figure 3.2 show the Bay Area goods movement flows and growth rates.

Figure 3.1 Bay Area Goods Movement Flows and Growth Rates, 2012



Source: FAF 3.5 Provisional Data and Forecasts.

Figure 3.2 Bay Area Goods Movement Weight and Value, 2012 and 2040

Millions of Tons

Billions of Dollars

4.0 percent CAGR

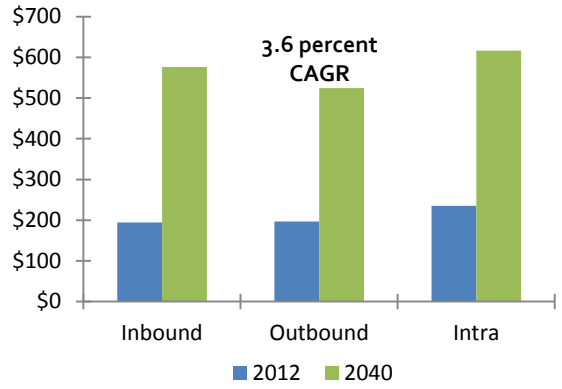
3.5 percent CAGR

The Port of Oakland

The Port of Oakland is the fifth busiest container port in the U.S., handling more than 2.3 million twenty-foot equivalent units (TEU) in 2012 and almost 100 percent of the containerized goods moving through Northern California.

In recent decades, the Port of Oakland has been the only major container port in California where exports consistently exceed imports, providing a unique international trade gateway. Northern California's export economy will continue to be an important demand factor at the Port, and in particular, expanding agricultural export activity from the Central Valley is likely to drive growth. The Port also is investing in opportunities for export bulk products, such as waste, scrap, and recycled products, demand for which is expanding throughout the Pacific Rim.

The Port of Oakland also will continue to be a gateway for imports (largely consumer goods from Asia). Growth will depend to some degree on expansion of rail facilities and development of nearby container transloading warehouses. As transloading has become more common, large importers are increasingly drawn to ports with nearby transload warehouses, and a combination of changing railroad operating practices and the development of new facilities, particularly at the former Oakland Army Base, are helping increase the attractiveness for imports.



Source: FAF 3.5 Provisional Data and Forecasts. CAGR = Compound Annual Growth Rate.

3.1.2 Major Goods Movement Corridors and Key Facilities

The goods movement system in the Bay Area consists of private and public sector modal elements that in many cases also are used for the movement of passengers. The core of the goods movement system consists of major truck routes[5] (I-880, I-580, I-80, U.S. 101, I-238, and I-680), Class I rail main lines (operated by UP and BNSF), the principal international water trade gateway at the Port of Oakland, the principal international air cargo gateway at San Francisco International Airport, the principal domestic air cargo gateway at Oakland International Airport, near-dock intermodal rail terminals, rail classification yards, and rail auto terminals. This core system is complemented by various other truck routes, short line railroads, and other marine and inland ports and airports.

Goods Movement Corridors in the Bay Area

As home to global gateways including the Port of Oakland, and the Oakland and San Francisco Airports, as well as a large and dynamic consumer and industrial population, the nine-county Bay Area serves as a nexus for goods movement in Northern California. The goods movement system supports global supply chains and regional industries that trade in international, domestic, and local markets. The core of the goods movement activities are conducted along various multimodal goods movement corridors that serve the megaregion, domestic, and international markets.

A corridor framework was developed in order to better understand the individual needs of the multimodal freight system in particular corridors, which serve as conduits for industries to various regions and gateways. These corridors are based around highway corridors, but also include parallel rail networks, key freight facilities (airports, seaports, intermodal terminals) and links that extend outward beyond the Bay Area to serve the other parts of the megaregion. Each of these corridors is examined in detail in a separate memo[6] report of this study , and summarized in Table 3.2.

[5] Major and minor truck routes definitions are those proposed by the California Freight Advisory Committee (CFAC) as of Sept. 2013, based on levels of average annual daily truck traffic volumes.

[6] MTC Regional Goods Movement Plan, Task 3c Report: Goods Movement System Needs, Issues, and Opportunities.

Table 3.2 Goods Movement Corridors in the Bay Area

Counties in Bay Area	Corridor	Other Key Corridor Elements	Functions of the Corridor	Corridor Description
Alameda, Santa Clara	I-880	• UP Rail Lines (Niles, Oakland, Coast Subdivisions) • Port of Oakland • UP Railport, BNSF Oakland Intermodal Gateway • Oakland International Airport • San Jose Mineta International Airport	Global Gateway, Interregional, Intraregional	Major North-South truck corridor supporting East Bay. One of the region's primary international gateway corridors and intermodal rail terminals. Major industrial corridor with much of the region's historic industrial core.
San Francisco, Alameda, Contra Costa, Solano, Napa	I-80 (Central Corridor)	• UP Martinez Subdivision • Port of Benicia • Travis Air Force Base • Cordelia Truck Scales • Major Interchange at I-80/I-680/SR 12	Interregional, Intraregional	Primary corridor connecting Bay Area to Sacramento and northern tier states across the U.S. Also connects Bay Area counties.
Contra Costa, Alameda	I-580/SR 238 (Altamont Corridor)	• UP Oakland Subdivision • M580 Marine Highway • Port of Richmond (including Richmond Pacific Rail) • BNSF Rail Yard	Interregional	Primary truck corridor connecting the Bay Area to the rest of the U.S. to the continental U.S. Secondary freight rail line that is expected to grow increasingly important with expansion of rail terminal at the Oakland Army Base.
Santa Clara, San Mateo, San Francisco, Marin, Sonoma	U.S. 101	• SFO • Port of San Francisco (including San Francisco Bay Railroad) • Port of Redwood City • Transbay bridges • SMART rail on NWP Line	Global Gateway, Interregional, Intraregional	Major goods movement corridor serving the Peninsula in the Bay Area. Also connects agriculture shippers on North Bay (Sonoma), Central Coast, and North Coast with markets in Bay Area. Also primary access to SFO.
Santa Clara, Alameda, Contra Costa, Solano	I-680	• Port of Benicia • Valero Oil Refinery	Global Gateway, Intraregional	Serves trucks moving from South Bay and Fremont and connecting to and from the warehouses in the San Joaquin Valley via connections with I-580. Also provides connections to ports and refineries along Carquinez Straits.
Sonoma, Napa, Solano	SR 12/SR 37	• SMART Rail on NWP	Interregional, Intraregional	Helps connect North Bay to the Port of Oakland, San Joaquin Valley, and rest of the region.
Santa Clara	SR 152		Interregional, Intraregional	Important connection providing link that connects the San Joaquin Valley to the coast. Recently selected as a Caltrans Focus Route[a].

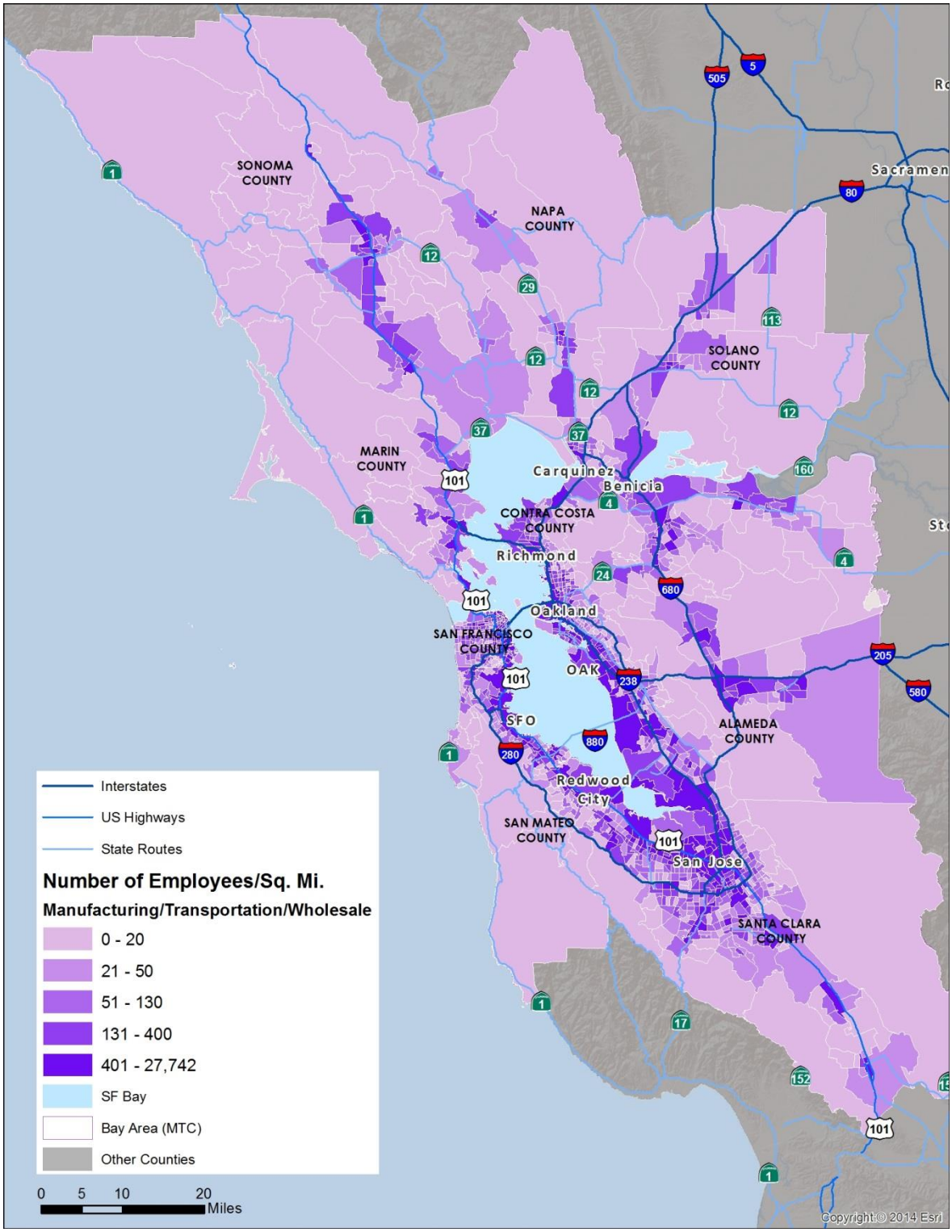
Counties in Bay Area	Corridor	Other Key Corridor Elements	Functions of the Corridor	Corridor Description
Contra Costa	SR 4	• BNSF and UP Lines from Stege/Port Chicago to Stockton • UP Mococo Line (Martinez to Lathrop)	Intraregional, interregional	Serves refineries and chemical manufacturers in CCC, provides connections to Central Valley

[a] Focus routes are a set of 10 corridors designated by Caltrans that are of the highest priority for completion to at least minimum facility concept standards over the next 20 years. Completion of these routes will help ensure that a statewide system is in place that can accommodate higher-volume interregional trip movements. http://www.dot.ca.gov/hq/tpp/offices/oasp/ITSP_document_11_25_2013_rev1.pdf#zoom=75.

3.1.3 Location of and Employment Density of Key Goods Movement-Dependent Industries

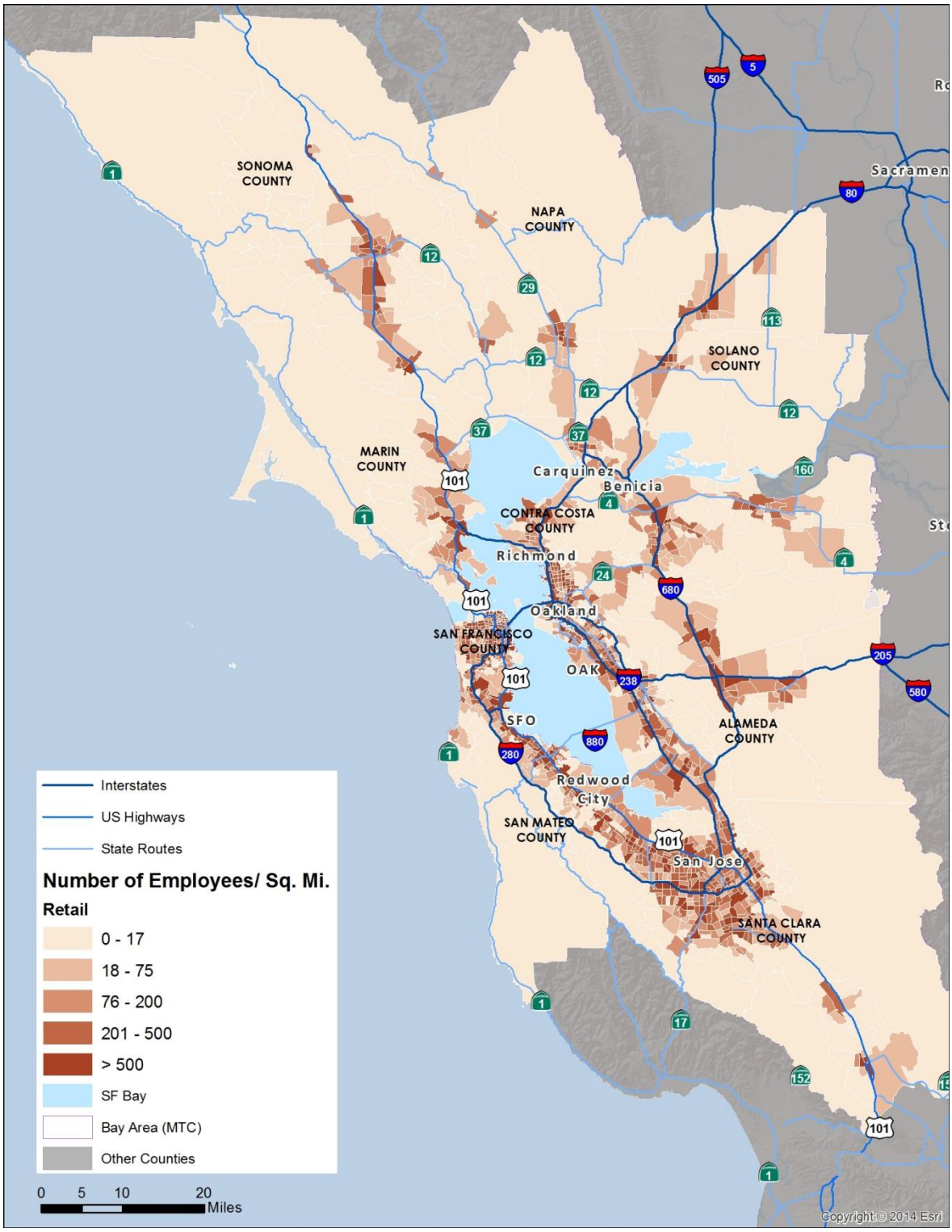
The top goods movement-dependent industries in the San Francisco Bay Area include manufacturing, wholesale and retail trade. Figure 3.3 shows employment density in the manufacturing, transportation/warehousing and wholesale sector. It is evident from the figure that the most dense concentrations of these activities are located along the I-880 Corridor, the U.S. 101 (on the Peninsula/South Bay and in parts of the North Bay), along SR4 and the Northern Contra Costa Waterfront, the I-80 corridor in West Contra Costa County, the I-680 corridor in Solano County, and along the I-580 corridor in Pleasanton and Dublin. Figure 3.4 shows the employment density in the retail sector, which is heavily concentrated along major population centers, with significant employment in Santa Clara County.

Figure 3.3 Manufacturing, Wholesale and Transportation Sectors Employment Density in the Bay Area



Source: MTC; Analysis by Cambridge Systematics, 2014.

Figure 3.4 Retail Sector Employment Density in the Bay Area



Source: MTC; Analysis by Cambridge Systematics, 2014.

3.2 North Central Coast

The North Central Coast is a collection of counties between the San Francisco and Los Angeles metropolitan areas that have thriving agricultural and tourism industries. Counties of the North Central Coast that are part of the Northern California Megaregion include Monterey, San Benito, and Santa Cruz Counties.[7]

The region's key industries center on agriculture, tourism, and the juxtaposition between the two. Much of the tourism in the region is driven by agriculture as visitors come from all over to experience the wine country and coastal regions. Monterey County is known as "the salad bowl of the world" due to the volume of lettuce grown there; and also is home to a thriving wine and flower industry. San Benito and Santa Cruz Counties are smaller, with economies that also depend on agriculture and farming, yet also have a large percentage of their workforces that commute to the Bay Area and other locations for employment. Key shippers in the area include Granite Rock, Martinelli's, Threshold, Santa Cruz Nutritionals, Good Earth Teas, Safeway, and Dallas Electronics.

3.2.1 Goods Movement Flows in the Central Coast

In the North Central Coast region, the mix of commodities is dominated by products that reflect the region's industry makeup. Agricultural products – fruits, vegetables, and field crops – were the largest commodity group in 2007, accounting for about one quarter of all movements. Other top commodities by tons moved included gravel, waste and scrap, petroleum products, and gasoline, which together make up about 49 percent of tonnage moved. The region's trading partners are largely the surrounding counties, with about 70 percent of these movements going to and from the megaregion, primarily the Bay Area.

In terms of value, agricultural products are still the dominant commodity group – they totaled $10.3 billion in 2007, of which more than $6 billion was outbound from the region. Other foodstuffs and alcoholic beverages – both of which are closely related to agriculture – totaled $4.7 billion and $2.4 billion, respectively. Beyond the agricultural sector, other high-value commodities also are important. Electronics are the second largest commodity by value at $7.2 billion (16 percent of the total). These are fairly balanced between inbound and outbound shipments. Motorized vehicles ($3.1 billion), machinery ($2 billion), and precision instruments ($1 billion) also are examples of high-value commodities moving to, from, and within the Central Coast region.[8]

[7] Although Santa Barbara and San Luis Obispo Counties are considered part of the overall Central Coast, they are not included in the Northern California megaregion.

[8] Cambridge Systematics analysis of FAF2 and IMPLAN data.

Agriculture in the North Central Coast

Agriculture is particularly important to the economy and livelihood of the North Central Coast region. The region is a key producer of wine – Monterey County produced grapes for wine valued at $238 million in 2008. Other particularly important crops to the region include broccoli, lettuce, and strawberries.

Top Three Agricultural Products by County
2009, Gross Value of Agricultural Production by Crop

County	Top Crops (Millions of Dollars)
Monterey	Berries, Strawberries, Fresh Market ($746) Lettuce, Romaine ($483) Lettuce, Head ($436)
San Benito	Vegetables, Unspecified ($40) Lettuce, Bulk Salad Products ($21) Nursery Products, Misc. ($20)
Santa Cruz	Berries, Strawberries, Fresh Market ($173) Berries, Raspberries ($104) Flowers Cut, Unspecified ($60)

Source: California Agricultural Resource Directory, 2010 to 2011.

3.2.2 Major Goods Movement Corridors and Key Facilities

Monterey County's main artery for exports is U.S. 101, with SR 152/156 also playing a key role in connecting local producers with I-5 and other food processing centers in the Central Valley. The area also is served by two railroads (UP and Sierra Northern) and one cargo airport in Monterey.

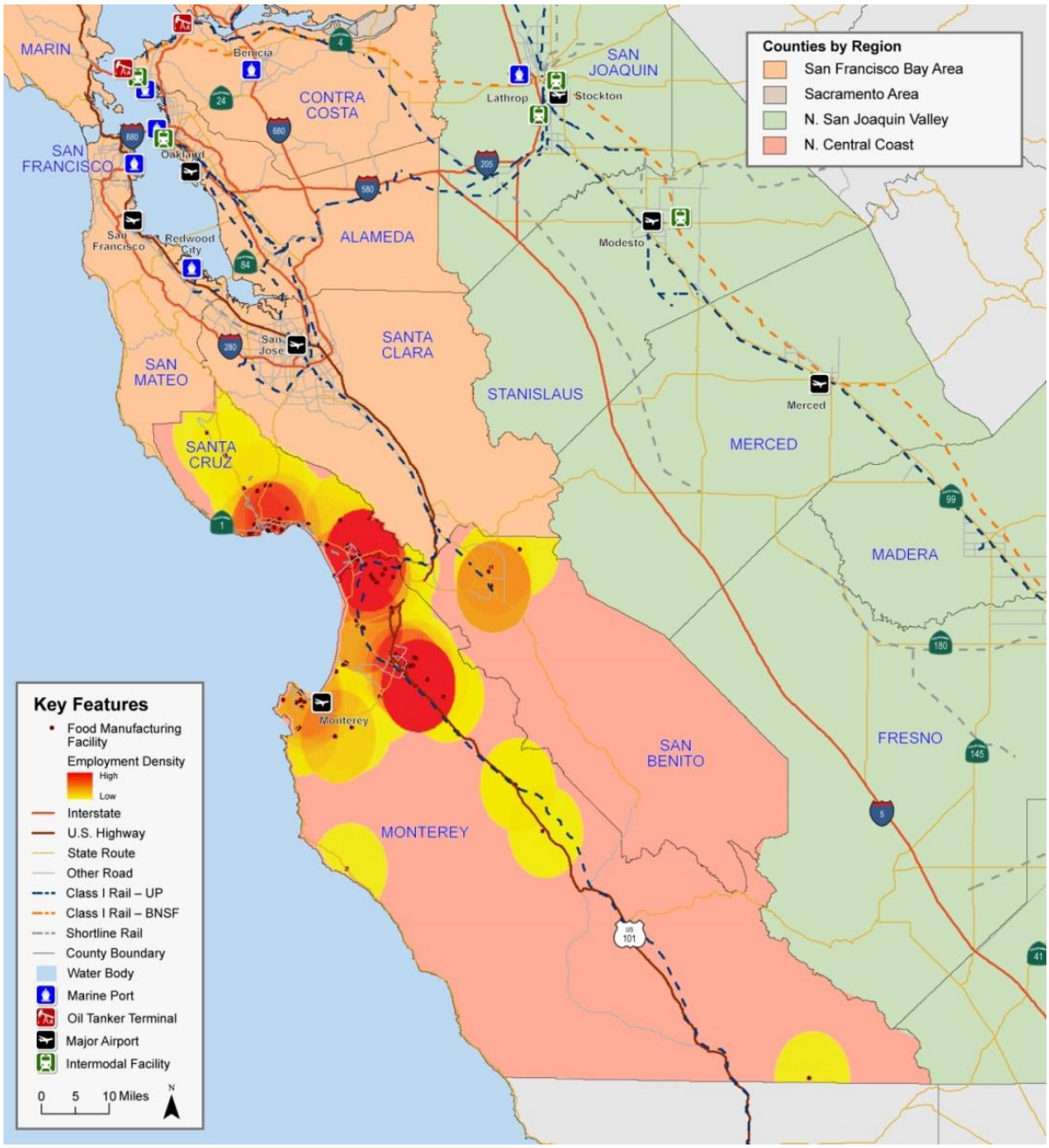
SR 156 is the key connector for San Benito County, both to U.S. 101 and Salinas to the west and to I-5 in the east. SR 25 also is important in connecting more remote agricultural areas of southern San Benito County. In terms of rail, UP operates a branch line from Carnadero to Hollister. The closest major airport is in Monterey, and the region is relatively close to San Jose and San Francisco International Airports.

The key routes that connect Santa Cruz County with the rest of the region's freight network are SR 17 and SR 1. In addition, the Sierra Northern Railroad connects various shippers in the County with the Class I UP mainline in Watsonville. For aviation, the primary cargo airports include those in San Jose and San Francisco, as well as the Monterey airport to the south, which can be reached via SR 1.

3.2.3 Location of and Employment Density of Key Goods Movement Industries

The top two goods movement producing industries (by BLS employment totals) in the North Central Coast are food manufacturing facilities (see Figure 3.5) and wholesale facilities (see Figure 3.6). Food manufacturing is a particularly important component of manufacturing in the region, given that it is a major region for crop production. Figure 3.5 below highlights key food manufacturing locations. The food manufacturing locations are generally in the same regions as the crop production locations, such as in the Salinas Valley, along the northern U.S. 101 corridor, near Santa Maria. Food manufacturing facilities employ 3,348 workers in the North Central Coast, at 107 locations. The majority of these workers and facilities are concentrated around Watsonville near the SR 1 and SR 152 corridors and along the U.S. 101 corridor near Salinas. High concentrations also exist around Santa Cruz near SR 1 and Scotts Valley near SR 17. Moderate concentrations exist around Hollister near SR 156 and along SR 1 near Monterrey and Castroville.

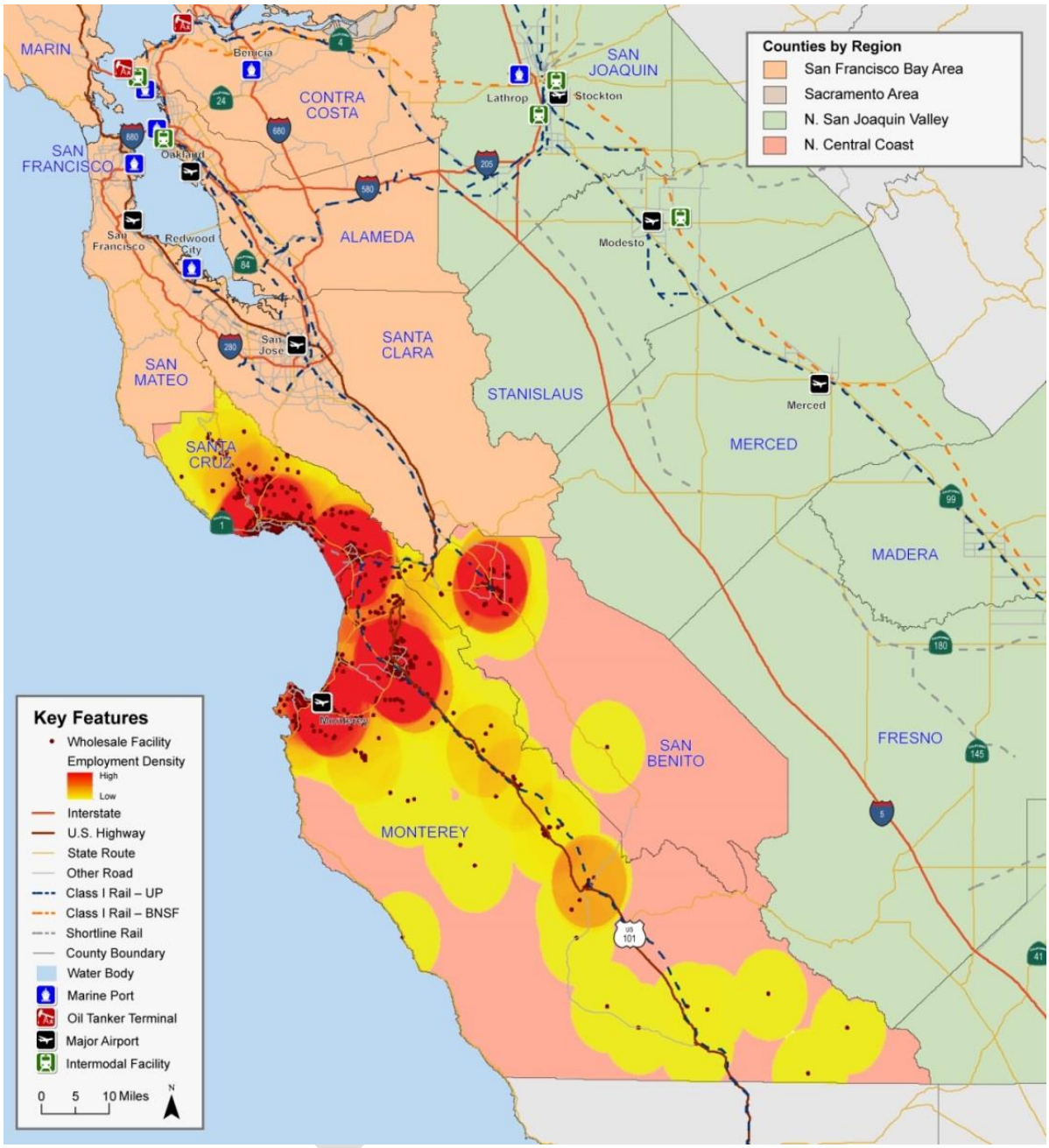
Figure 3.5 Location of Food Manufacturing Facilities in the Northern Central Coast



Source: Dun and Bradstreet, 2014, Analysis by Cambridge Systematics, 2014.

Meanwhile, wholesale facilities employ 8,978 workers in the North Central Coast, at 898 locations. The majority of these workers and facilities are concentrated along the SR 1 corridor through Santa Cruz, Watsonville, and Monterey, as well as the U.S. 101 corridor near Salinas, the SR 156 corridor near Hollister, and the SR 17 corridor near Scotts Valley. Moderate concentrations exist at Castroville along SR 1 and King City along U.S. 101.

Figure 3.6 Location of Wholesaling Facilities in the Northern Central Coast



Source: Dun and Bradstreet, 2014, Analysis by Cambridge Systematics, 2014.

3.3 North San Joaquin Valley

The San Joaquin Valley (SJV) has always been California's geographic and agricultural production center and a main source of exports. It is California's fastest-growing region, with a population of more than 4 million that is anticipated to grow to more than 6 million people by 2035. It is the nation's number one agricultural producer, generating more than $35 billion every year in nuts, lettuce, tomatoes, wine, and other grains and agricultural products.[9] The Northern San Joaquin Valley, consisting of the Counties of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare, is taking on new and diversified roles in California's goods movement economy, playing major roles in the national and international distribution of processed foods, energy, and consumer products. Companies are locating large regional and national distribution centers in the SJV to take advantage of relatively inexpensive land and low cost labor, good access to the national rail and interstate highway networks, connections to major deepwater ports in Oakland, Los Angeles, and Long Beach, and proximity to major consumer markets in Southern California and the San Francisco Bay Area.

Food Manufacturing in the San Joaquin Valley

Many prominent industries in the San Joaquin Valley (such as food processing) rely on the transportation system to receive raw materials and to deliver goods to market. For example, tomato processing facilities located throughout the San Joaquin Valley provide about 76 percent of all tomato processing capacity in California. All tomato shipments move from farm to market by truck using a network of connecting roads and highways. However, rail also is used by tomato processors, in particular, for those products destined for markets outside of California.

There is seasonality to most agricultural industries, which leads to issues with equipment availability, insufficient infrastructure, and truck parking concerns during peak times. Regional agricultural movements by truck peak during the harvest season, usually from July through September/ October. This can mean equipment and labor shortages during this timeframe, as well as excessive truck volumes for the minor roads and resting areas.

3.3.1 Goods Movement Flows in the San Joaquin Valley

In the North San Joaquin Valley region in 2012, the top commodities by tons moved were dominated by agricultural products (16 percent), cereal grains (12 percent), and other foodstuffs (9 percent). These included both movements to and within the region destined for manufacturing plants and distributors, as well as exports to the megaregion and other domestic and international destinations. Commodities including gravel, nonmetal mineral products, and waste and scrap add another 24 percent of goods moved by weight. This is expected of a major agricultural and energy producing region, where there are often several "stages" of production before a particular good is actually sold to a consumer (e.g., processing of tomato sauce or refining petroleum products), and as such a large percentage of goods move along supply chains – between processors, manufacturers, and eventually to consolidation and distribution facilities – within the region. The San Joaquin Valley also is a center for warehousing and distribution, both within and outside the region. Overall, the highest value commodities moving in the region are mixed freight, agricultural products,

[9] San Joaquin Valley Regional Transportation Planning Agencies, *San Joaquin Valley Interregional Goods Movement Plan*, Prepared by Cambridge Systematics, 2012.

foodstuffs, machinery, and motorized vehicles, which together comprise one-half of the movements by value.

3.3.2 Major Goods Movement Corridors and Key Facilities

Trucks are the dominate mode of transportation within the SJV, and in all there are more than 31,420 roadway miles in the SJV as a whole, offering connections between rural agricultural production areas and the coastal population centers. Movements are centered on the main north-south arteries, including I-5 and SR 99, as well as numerous east-west corridors, such as SR 120, SR 180, I-580, SR 152, and SR 198.

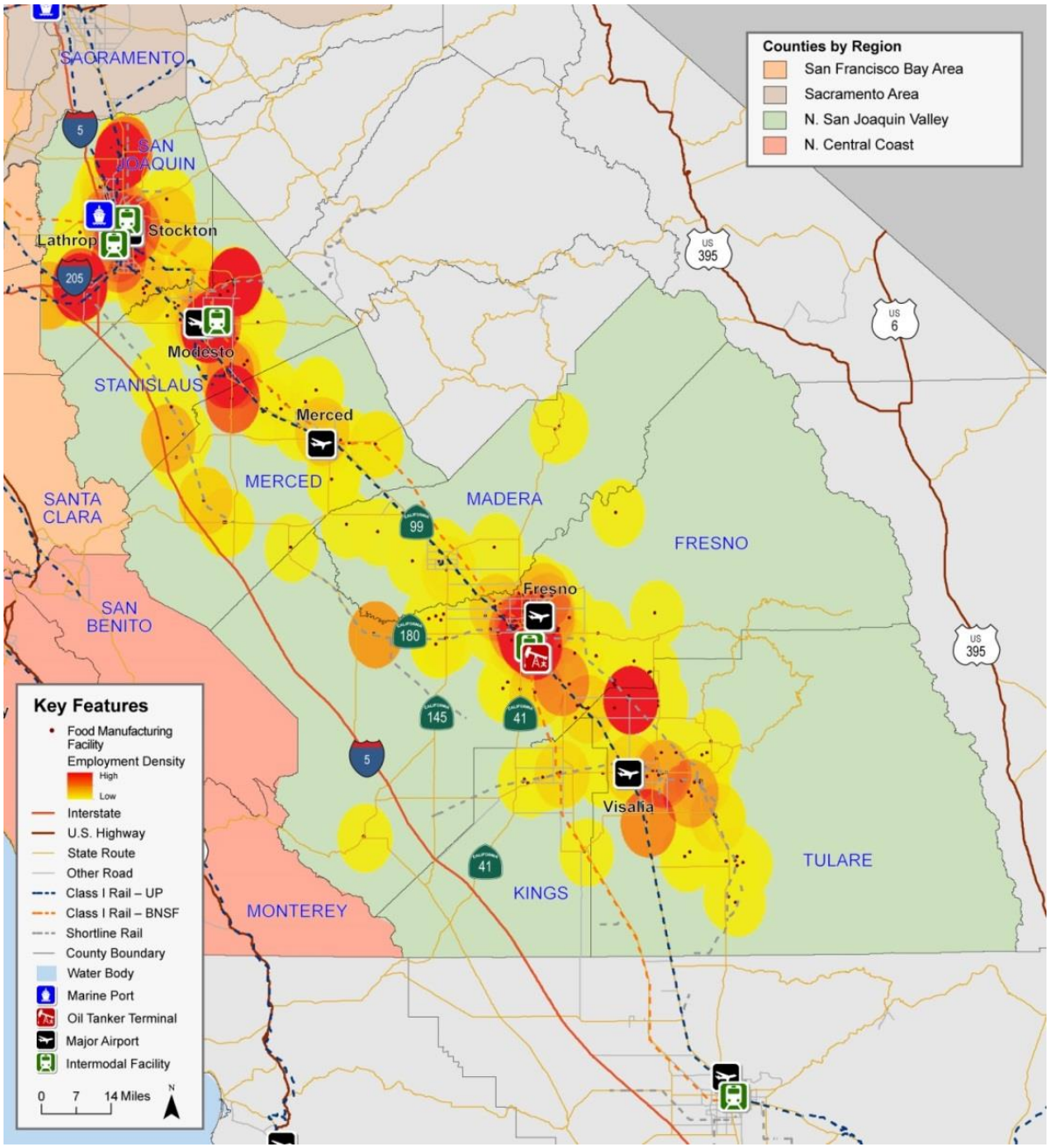
The SJV also is served by the BNSF and UP railroads, and short line railroads including Sierra Northern Railway (SERA), California Northern Railroad (CNR), Stockton, Terminal & Eastern (STE), Central California Traction (CCT), Modesto & Empire Traction Company (MET), San Joaquin Valley Railroad Company (SJVR), and the West Isle Line (WFS). Although coastal ports are the primary conduits for SJV goods, the Port of Stockton, primarily a bulk commodity port, is located within the SJV with extensive rail trackage operated by the CCT and connections to UP and BNSF. Airports in the SJV offer limited commercial passenger airline and air cargo service, and include Fresno-Yosemite International, Merced Regional Airport, Modesto Municipal Airport, and Stockton Metropolitan Airport.

3.3.3 Location of and Employment Density of Key Goods Movement Industries

The top two goods movement producing industries (by BLS employment totals) in the North San Joaquin Valley are food manufacturing facilities and warehousing facilities (see Figures 3.7 and 3.8). Food manufacturing facilities employ 43,937 workers in the North San Joaquin Valley at 326 locations. The majority of these workers and facilities are concentrated along the SR 99 corridor near Fresno, Turlock, Modesto, Stockton, and Lodi, along the I-205 and I-5 corridors near Tracy and Lathrop, along the SR 108 corridor near Oakdale, and in Dinuba near SR 201. Moderate concentrations of facilities and employment exist around Tulare and Visalia near SR 99, SR 198, and SR 65; near Selma along SR 99; around Mendota near SR 180 and SR 33; and around Newman and Gustine near I-5 and SR 33.

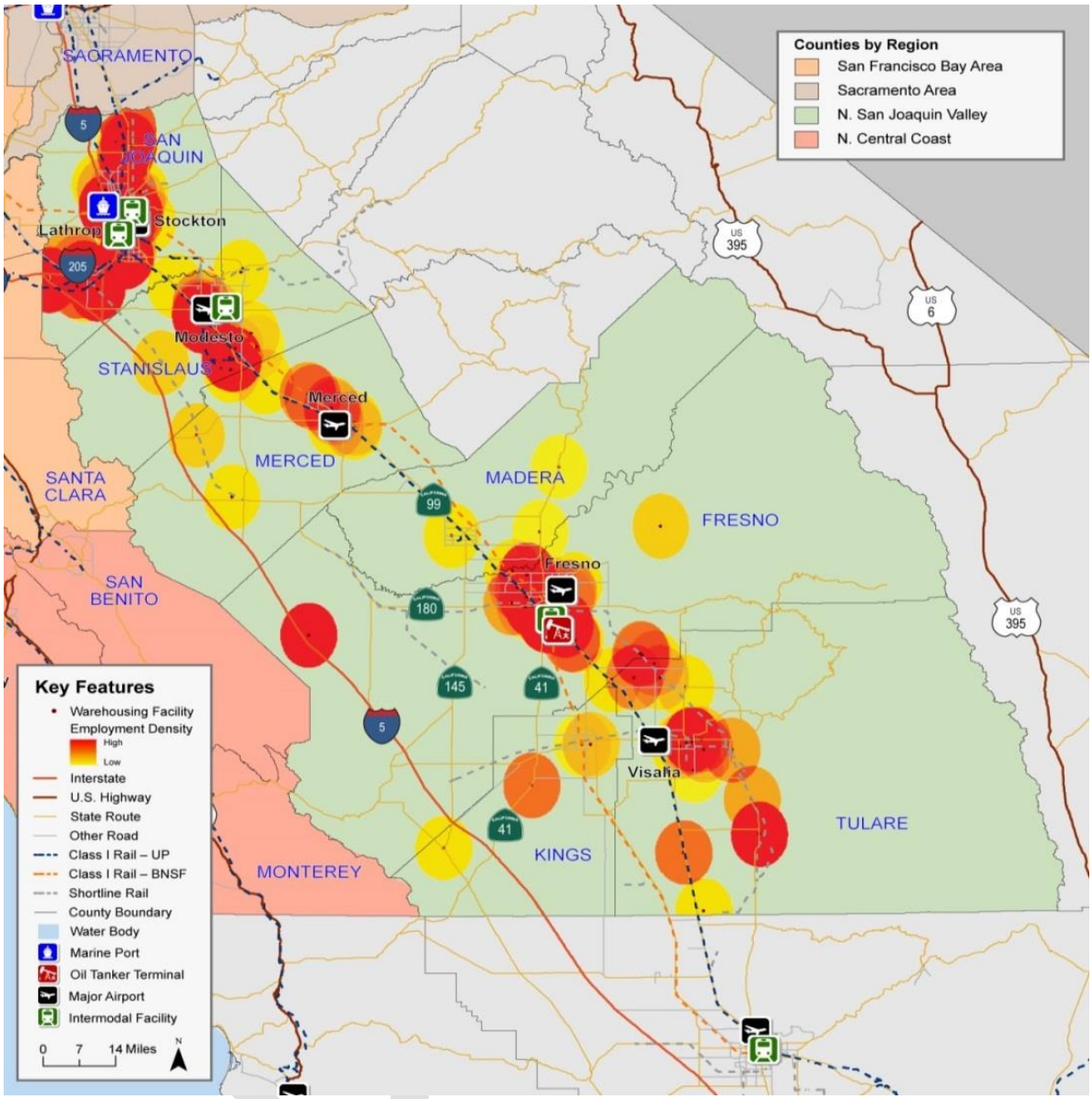
Meanwhile, warehousing facilities employ 10,169 workers in the North San Joaquin Valley at 121 locations. The majority of these workers and facilities are concentrated along the SR 99 corridor near Fresno, Merced, Turlock, Modesto, Stockton, and Lodi; along the I-205 and I-5 corridors near Tracy, Lathrop, and Patterson; around Dinuba near SR 201; around Visalia along SR 198; around Porterville near SR 65; and west of Mendota along I-5. Moderate concentrations of facilities and employment exist north of Delano along SR 99 and southwest of Hanford along SR 41.

Figure 3.7 Location of Food Manufacturing Facilities in the Northern San Joaquin Valley



Source: Dun and Bradstreet, 2014, Analysis by Cambridge Systematics, 2014.

Figure 3.8 Location of Warehousing Facilities in the Northern San Joaquin Valley



Source: Dun and Bradstreet, 2014, Analysis by Cambridge Systematics, 2014.

3.4 Sacramento Region

The Sacramento region, located directly northeast of the Bay Area, consists of the Counties of Sacramento, Yolo, Sutter, Yuba, Placer, and El Dorado; and is home to 2.3 million residents. It is California's fourth largest population center and its governmental center. Situated in the northern portion of the agriculturally rich Central Valley at the confluence of the Sacramento and American Rivers, the region hosts the most inland port of the freight navigable California waterways that reach out to the Bay and the Pacific Ocean. It also is the confluence of key rail and road networks that run north-south (I-5, SR 99) and east-west (I-80). The region is projected to grow at much higher rate than other major population centers in the State, adding another 800,000 residents by 2036 and growing to 1.3 million jobs in the same timeframe. The region

represents about 6 percent of California's total economic activity, with manufacturing, distribution, and agricultural sectors as key industries that rely on goods movement infrastructure in the region.[10]

3.4.1 Goods Movement Flows in the Sacramento Region

In the Sacramento region in 2012, the top commodities by tons moved were gravel, nonmetal mineral products, waste and scrap, cereal grains, and agricultural products, which overall comprised 51 percent of goods moved. Of these, a large percentage of movements, particularly for gravel and waste/scrap, was within the Sacramento region.

In terms of value, the top commodities moved were pharmaceuticals (13 percent), mixed freight (11 percent), electronics (10 percent), machinery (8 percent), and motorized vehicles (7 percent). About 50 percent of the movements were for goods inbound from and outbound to locations outside of the megaregion. Sacramento has less trade in food and agricultural products than the rest of the megaregion, yet these two combined still make up 9 percent of trade by value.

Goods Movement Affected by Drought in the Sacramento Region

The current California drought puts the agricultural industries at great risk and will likely have a significant impact on where certain crops can be grown and how much demand there is on goods movement and warehousing industries. For example, almonds and other tree nuts are water-intensive crops that may shift away from the North San Joaquin Valley to the Sacramento region in order to require less irrigation for the production of these crops.

Another agricultural product that will contribute more to demand for goods movement in this drought-stricken period is salmon. A long-standing practice of hatchery fishing industries has involved trucking salmon smolts past the river dams to where they can swim freely out to the Bay and the ocean. Low water levels in the rivers have necessitated trucking these smolts farther directly to the Bay. 27 million smolts hatched in the Sacramento region are now trucked directly to the Bay, 50 percent above normal.

Sources: The Bay Planning Commission, The California Water Impact Network; and "Salmon Migrate by Truck During California Drought," The Daily Herald, June 15, 2014.

3.4.2 Major Goods Movement Corridors and Key Facilities

The Sacramento region is served primarily by I-5 running north-south, I-80 running east-west. I-505, U.S. 50, and U.S. 99, also serve the population centers of Sacramento and connect to the San Joaquin Valley. Rail lines in the region were originally built by the Southern Pacific (SP), the Western Pacific (WP), and the Sacramento Northern (SN) Railroads. Now consolidated under Union Pacific, the system includes the Martinez Subdivision with service to Oakland, the Fresno Subdivision as a primary route down the San Joaquin Valley, and others. The J. R. Davis Yard at Roseville (commonly referred to as Roseville Yard) serves as UP's major classification and service facility in Northern California. BNSF also has extensive trackage rights over UP's routes and runs intermodal trains between the Port of Oakland and east to the rest of the U.S. The Port of West Sacramento is a bulk export port and Sacramento Airport serves air cargo in the region.

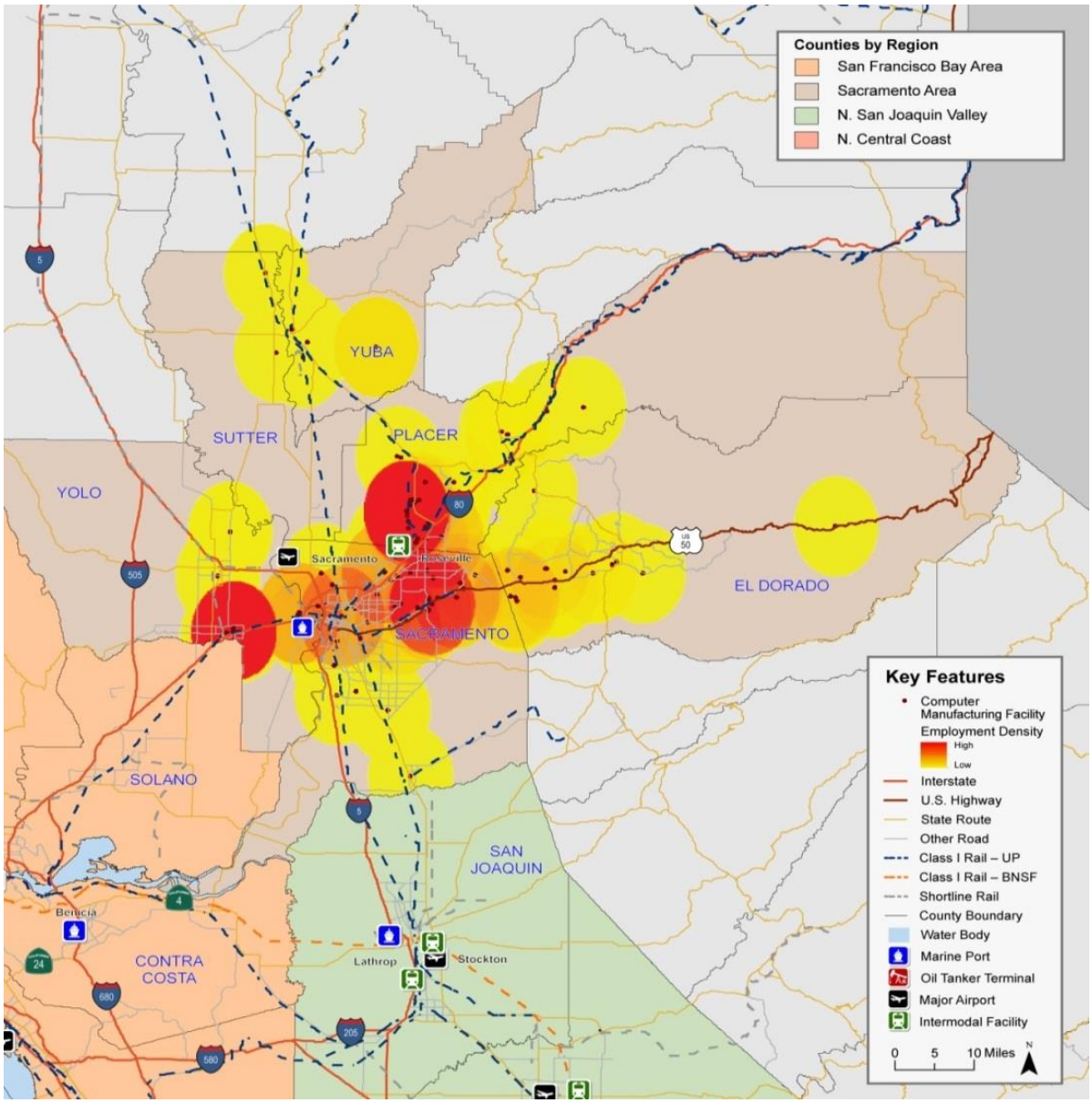
[10] Sacramento Area Council of Governments, Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS) 2035. http://www.sacog.org/2035/mtpscs/.

3.4.3 Location of and Employment Density of Key Goods Movement Industries

The top two goods movement producing industries (by BLS employment totals) in the Sacramento area are computer manufacturing facilities (see Figure 3.9) and wholesale facilities (see Figure 3.10). Computer manufacturing facilities employ 7,799 workers in the Sacramento Area, at 109 locations. The majority of these workers and facilities are concentrated in three locations: Roseville along the I-80 and SR 65 corridors, Rancho Cordova/Folsom along the U.S. 50 corridor, and Davis along the I-80 and SR 113 corridors. Lower concentration of these facilities and workers are found in Sacramento along the I-5 and I-80 corridors.

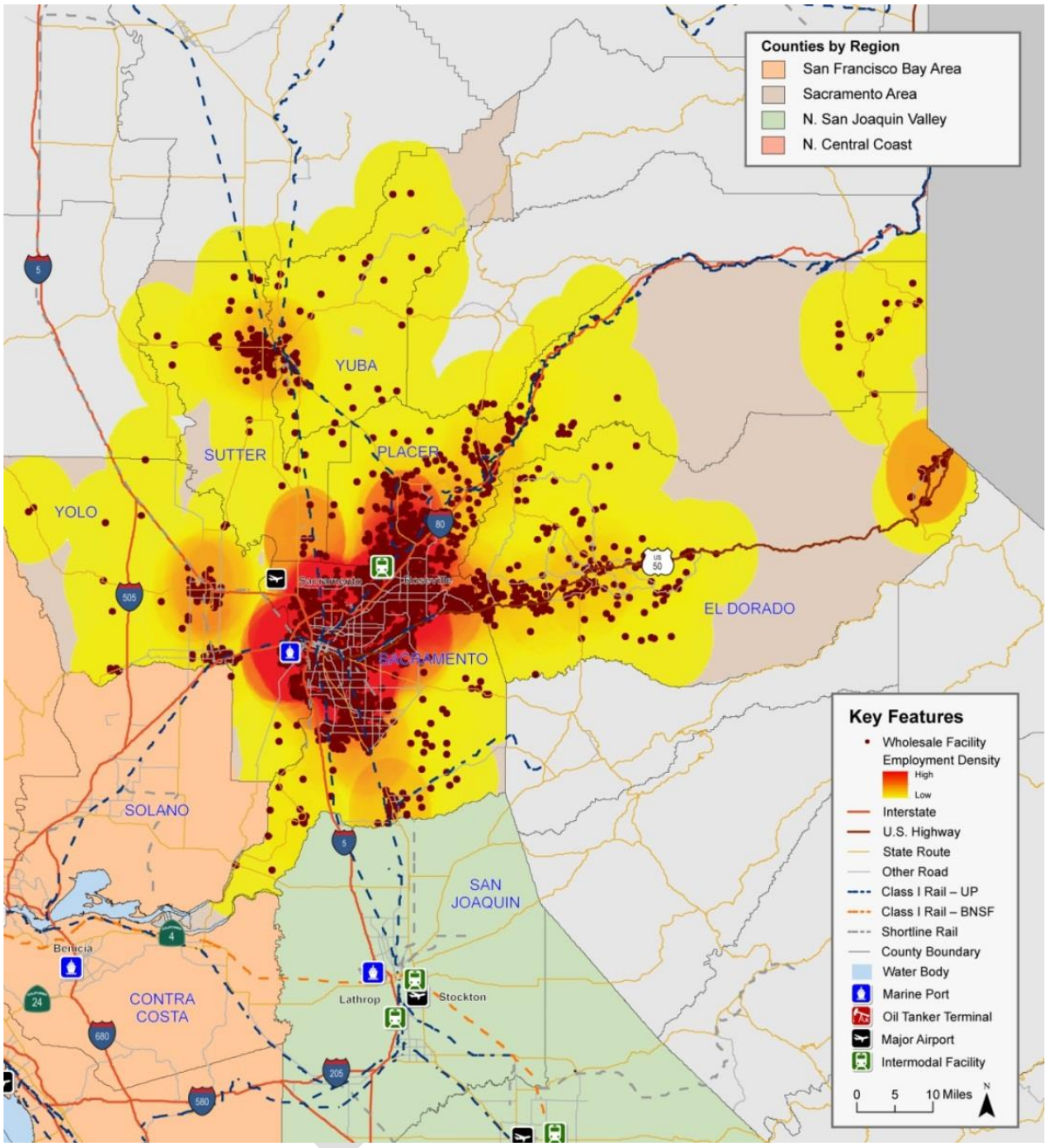
Meanwhile, wholesale facilities employ 22,126 workers in the Sacramento area, at 2,772 locations. These facilities and employment occur in high density throughout Sacramento and out towards Roseville, Folsom, and Elk Grove, along the I-80, I-5, SR 99, U.S. 50, and SR 65 corridors. Yuba City, along SR 99, has a moderate density of these facilities, although only lower density of employment. South Lake Tahoe, along SR 89, has a moderate density of employment, though in only a few facilities. Woodland, along I-5 and SR 113, also has a moderate density of employment and facilities.

Figure 3.9 Location of Computer Manufacturing Facilities in the Sacramento Area



Source: Dun and Bradstreet, 2014, Analysis by Cambridge Systematics, 2014.

Figure 3.10 Location of Wholesaling Facilities in the Sacramento Area



Source: Dun and Bradstreet, 2014, Analysis by Cambridge Systematics, 2014.

4.0 Meeting the Challenges of the Northern California Goods Movement

The Northern California megaregion plays important and varied roles in local, national, and international commerce, and at the same time is home to a large and diverse population. Thus, this area is continuously faced with goods movement-related opportunities and challenges. Although some are unique to the area, many are simultaneously being faced by urban and rural areas nationwide. In order to meet these challenges, multijurisdictional and integrated planning efforts and mega/regional strategies are necessary to comprehensively address goods movement issues. This section summarizes trends, issues, and strategies faced by the major functions of the goods movement system. Table 4.1 summarizes some of these major trends. In the discussion of strategies that follows, several projects are highlighted for each strategy as examples of the types of investments that are needed to implement the strategies.

Table 4.1 Summary of the Trends and Strategies of the Goods Movement System by Functional Area

Function	Trends and Issues	Strategies to Address Trends
Global Gateway	• Growth in high-value exports • Growth in bulk commodity exports • Intensifying port competition • Changing mix of air cargo and uncertain growth • Growth in transloading to rail by consumer goods importers	• Locating/modernizing distribution, transload, and warehousing facilities • Container/intermodal, bulk, and auto terminal improvements • Expansion/modernization of air cargo-handling infrastructure • Freight Intelligent Transportation Systems (ITS) to improve Port of Oakland terminal efficiency
Inter- and Intraregional Corridors	• Growth of international trade flows on shared corridors • Shifting crude supplies • Lack of east-west connectivity • Use of commuter corridors for intraregional cargo movement • Need for greater reliability in advanced supply chains	• Inter- and intraregional corridor improvements to support growth • Eliminate rail bottlenecks and separate at-grade crossings • Develop marine highway and additional rail connections • ITS technologies to provide better system management • Preservation of highway infrastructure and delay reduction
Urban Goods Movement System and Last-Mile Connectors	• Income growth driving consumer demand and e-commerce • Land use conflicts in traditional industrial corridors • Lack of truck parking • Community impacts on last-mile connectors	• Apply technology to truck parking and truck route management • Comprehensive arterial corridor system plans and use of "smart corridors" • Industrial land use preservation • Improve selected rail and roadway connectors

4.1 Challenges and Opportunities of Global Gateways

Locating/Modernizing Distribution, Transload, and Warehousing Facilities

Formerly industrial land in the Bay Area is rising in value and being repurposed as industrial facilities are moving away from these high-cost, dense areas to other parts of the megaregion. This is occurring due to the concurrent pressure of land value changes/ industrial conversions as well as changing needs of industrial businesses. Warehousing and distribution centers formerly located near the Port of Oakland continue to move out of the Bay Area, leading to increasing congestion on I-880, I-238, and I-580 as goods must move by truck to the facility and return for distribution to Bay Area consumers. Projects such as the first phase of the Oakland Global Trade and Logistics Center[11] (see callout), can increase the efficiency of delivery to local consumers and reduce truck vehicle miles traveled. The region also needs modern transload and distribution facilities that connect the road and rail system of the megaregion to the Port of Oakland for the large number of goods moving to domestic destinations. Various inland ports and marine and short-haul rail projects have been proposed in the past. None currently is in service due to the challenges of providing timely and cost competitive service. These concepts should be explored again given today's trends and future forecasts.

Oakland Global Trade and Logistics Center

In April 2011, the Oakland Redevelopment Agency led a joint planning effort, along with the Port, for a master planned development of both the Port and city-owned Oakland Army Base lands. Receiving a $15 million TIGER grant in 2012, the first phase of the plan, currently underway, includes a new rail yard with plans to stage railcars for new and existing customers. The Port Rail Yard will significantly increase rail capacity from approximately 17 rail cars to 200 cars at a time.

Future phases include an intermodal rail terminal, a new bulk marine terminal, 30 acres of truck parking and service areas, 2 million square feet of new warehousing space, and a new recycling center. The new facilities will provide unparalleled multimodal connectivity and a high level of service to tomorrow's logistics providers and industries. Rail, truck, and intermodal transfers will be streamlined to meet the needs of agricultural, manufacturing, and other industries.

As of February 2014, the City and the Port have identified $500 million in funding. For each dollar of investment, the project is forecast to generate $2.16 in value added to the public in the form of lower cost goods, and air quality, traffic, and safety benefits. Through December 2013, 328 local employees have been hired for the project. The project is expected to eventually bring more than $2 billion in each business revenue and wages and salaries to the region, and is projected to create more than 28,000 direct and indirect jobs.

Container/Intermodal, Bulk, and Auto Terminal Development and Modernization

The megaregion's ports need expansion and modernization of its terminal facilities in order to handle increasing traffic. In particular, the Port of Oakland faces potential constraints tied to land availability and deficiencies in cargo-handling equipment. Through the Oakland Global Trade and Logistics Center project, a new intermodal terminal will provide direct rail access and improved and modernized cargo-handling capabilities.

[11] The Port of Oakland, *Oakland Global Project Update,* February 2014, http://www.portofoakland.com/maritime/oab.aspx.

In addition, modernization of existing facilities is needed, such as currently being undertaken by SSA Marine to create the largest container terminal in Northern California, servicing 20 international carriers with 10 post-Panamax cranes.[12] The Port of San Francisco, which experiences access constraints limiting drayage of containerized consumer goods, [13] is working to improve its rail-handling capability for bulk export cargo. Bulk terminals and auto terminals also need expansion and modernization to meet future growth in cargo, in particular the growing export commodities of waste/scrap and nonmetallic minerals, at many Bay Area ports.

The Port of West Sacramento is a bulk export port that serves Northern California's agriculture industry. While the agriculture industry thrives, including the rice exports that the Port primarily serves, other factors have strained the Port, such as declining volumes of other cargo products due to overseas market shifts, competition from other ports, and the need for a deeper channel to accommodate larger ships. The Port and the City of West Sacramento continue to work to address these issues; however, their first priority is financial stability for the Port so it can be an economic asset to the community.[14]

The Port of Stockton is a bulk and break bulk-focused port, however, through the M-580 pilot program, the Port also served as a container transfer point. A challenge the Port has faced in recent years is access to/from its facilities. The Crosstown ramp extension project, currently under construction, will improve the connection between I-5/Crosstown Freeway, the Port of Stockton, and adjacent industrial uses.

Expansion/Modernization of Air Cargo-Handling Infrastructure

Air cargo is projected to grow somewhat in the future, especially in international cargo due to increases in high-tech manufacturing. Expansion is less of a need for the region's airports than for its ports, yet there are some deficiencies in the region's air cargo facilities and connections, specifically a lack of expansion potential and a legacy runway configuration. Particularly for San Francisco, the effective capacity of the airport is limited by the frequency of inclement weather, principally fog that leads to periodic delays and flight cancellations. In 2012, the airport ranked 28th out of 29 major airports for on-time departures and arrivals.[15] Limited cross-bay connections to the East Bay also limit growth at San Francisco, and both Oakland[16] and San Jose are working to increase their ability to serve the region's increasing air cargo needs.

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[12] http://www.ssamarine.com/07182013.html.

[13] "SF Bay Area Containerized Cargo Outlook," prepared by the Tioga Group for the San Francisco Bay Conservation and Development Commission, July 2009, http://www.bcdc.ca.gov/proposed_reg/07-31-2009_containercargo.pdf.

[14] Port of West Sacramento Business Plan, March 2013.

[15] Table 6, Ranking of Major Airport On-Time Departure Performance Year-to-Date through December 2012, http://www.rita.dot.gov/bts/subject_areas/airline_information/airline_ontime_tables/2012_12/table_06.

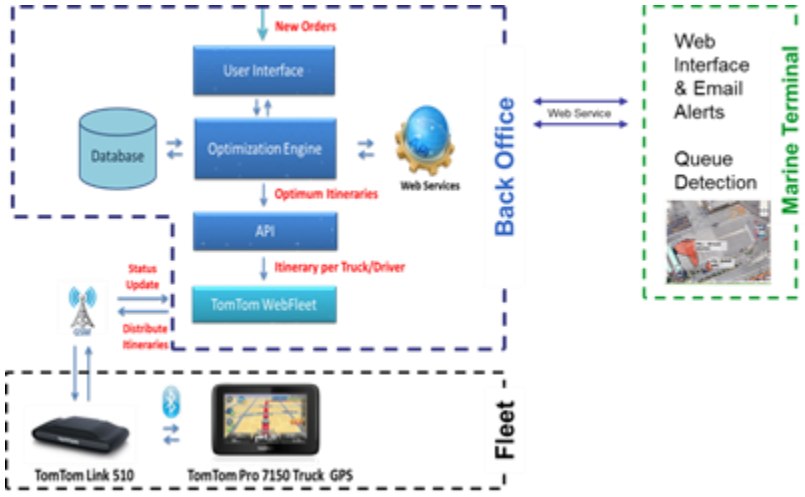
[16] California Air Cargo Groundside Needs Study, 2013.

Freight Advanced Traveler Information Systems (FRATIS)

U.S.DOT Research and Innovative Technology Administration (RITA) – Demonstration Project in Los Angeles and Gateway Cities

The FRATIS Demonstration Project is a private and public collaborative effort funded by U.S.DOT-RITA. Its development is centered on the U.S. DOT's Dynamic Mobility Application bundles, including Freight Dynamic Route Guidance, Freight Real-Time Traveler Information with Performance Measures, and Intermodal Drayage Operations Optimization. The FRATIS applications are designed to work together synergistically to improve terminal visit pretrip planning and dynamic routing around congestion; to arrive at the gate at less congested times; and to promote reductions in missed container trips (i.e., "bobtail" reductions) at the terminals; all supporting reductions in truck travel times and trips, translating directly into regional mobility and air quality improvements. A conceptualization of the testing components is illustrated below.

Currently, this system is being pilot-tested in three locations, including as part of the LA/Gateway project. The FRATIS test includes two primary private sector participants – Port Logistics Group (a Harbor Trucking Association drayage fleet) and Yusen Terminals, Inc. (a marine terminal operator). Two key public sector agencies also are supporting the test –the Los Angeles Metropolitan County Transportation Authority (Metro) and the Gateway Cities Council of Governments. The regional public-private joint goal behind forming this partnership is to reduce truck traffic congestion during peak hours.



Improve Port of Oakland Truck Efficiency through FRATIS

Given the cost impacts of delays at Port of Oakland's terminal gates on the drayage truck industry and subsequently the entire supply chain, it is important to improve the efficiency of marine terminals without costly infrastructure investments. Improving the efficiency of terminal operations can significantly improve the ability for products from throughout the megaregion to access the Port of Oakland. FRATIS (see callout) is a technology solution being developed by the FHWA's Office of Operations with public- and private-sector partners. In its most basic configuration, FRATIS is a web-based software system that provides terminal operators with a "prenotification" of trucks arriving at the Port for a specific load, giving the marine terminal operator a "heads up," allowing them to move that specific container off the stack and into an

easily accessible position. This system is designed to significantly reduce waiting times for truck drayage drivers and improve the overall efficiency and throughput of the terminals.

4.2 Challenges and Opportunities along Inter- and Intraregional Corridors

Interregional routes experience high levels of truck delay often because they also are heavily used commuter routes and/or also serve heavy intraregional traffic. I-580/I-880 (see previous callout) is a particularly strong example of a highway serving multiple functions within the region, which has several bottleneck areas caused by issues such as on-ramps spaced too closely.[17] MTC and its partners in the megaregion will need to monitor these routes and address this growth through a combination of infrastructure projects, technology, and operational improvements to ensure that they continue to meet the shared needs of the megaregion.

Railroad corridors also are an area where growth and increasing congestion are underway. Government intervention and subsidies are often needed to incentivize private investment in multimodal corridors, but these investments can be vital to reducing congestion, air quality issues, and public health concerns by offering a viable modal alternative to truck traffic. Many bottlenecks are on Class I railroads, and so improvement projects will need to be undertaken in conjunction with these railroad operators.

Altamont Corridor (I-580 and UP/ACE[18])

I-580, or the Altamont Corridor, carries the greatest volume of interregional truck traffic within the megaregion, as it is the primary access route from the Bay Area to the I-5 that connects to domestic markets in the east. Currently, there are no major highway alternatives to I-580. The highway connects with I-205 to distribution warehouses in Tracy (south San Joaquin County) that serve the Bay Area (and connect to the Port of Oakland for movement of import containers to the distribution centers); and is the primary route for agriculture exporters in the San Joaquin Valley. Traffic is expected to grow along this already congested corridor, which has the worst areas of high truck delay directionally in the region depending on the time of day. Additionally, trucks are prohibited from traveling on I-580 in Alameda County north of the I-580/I-238 Interchange.

There are modal alternatives –the UP's Oakland/Niles rail subdivisions and the M-580 marine highway pilot project[19] share the corridor. The joint UP/Altamont Corridor Express (ACE), which parallels I-580, currently is a relatively low-volume rail corridor, yet rail traffic could grow if it is used as a reliever route for the Martinez Subdivision. Rail traffic on this line is also expected to grow as a route for bulk cargo moving to the Port of Oakland for export and other types of nonintermodal cargo. There also is potential for using this route as a short-haul rail connection between the Central Valley and the Port of Oakland.

[17] Information from Task 2, Inventory of Facilities with Freight Mobility Issues.

[18] This is the Altamont Corridor Express that shares trackage with UP.

[19] Effective September 1, 2014, the Port of Stockton transitioned the M-580 Marine Highway demonstration project from weekly service to "as-needed" service.

Central Corridor (I-80, UP Central Corridor, and BNSF Route Stockton Subdivision)

I-80 provides connections within the megaregion to Sacramento, and there are agricultural products that move into the Bay Area and the Port of Oakland via this route. Portions of I-80 provide access to the Ports of Richmond and Benicia and the Richmond rail yards for long-haul rail connections. The I-80 highway corridor also serves as a connection between the megaregion and interior U.S. However, this connection is seasonally difficult, and winter weather closures through the Sierra Mountains make this a less used route for long-haul traffic. One of the region's most historically problematic truck bottlenecks is located at the interchange between I-80, I-680, and SR 12. While work has already been done to begin to address this problem, there are later phases of this project that need to be undertaken, including improvement of the westbound truck scales in Cordelia.

The UP Martinez Subdivision and BNSF Stockton Subdivision (which generally follows the alignment of SR 4) are two critical interregional rail routes along this corridor and include the busiest segments of track in the megaregion. Most of the intermodal rail traffic moving on this route is international cargo moving from the Port of Oakland, and this traffic is project to grow noticeably in the future. Additionally, potential expanded passenger rail services and, most recently, crude oil moving from Canada and North Dakota into the region's oil refineries along the northern Contra Costa waterfront, pose safety and efficiency concerns for the megaregion.

The I-5 Corridor and the SR 99 Corridor

The I-5 Corridor is a major north-south interregional corridor that traverses through California, providing vital connections to Northern States as well as down to Mexico. Truck volumes are among the highest in the megaregion in certain areas, especially at the junction with SR 99, and at the junction with I-205, where more than 35,000 trucks daily trucks daily were observed in 2012, according to Caltrans. Within San Joaquin County, I-5 is used for both movement to eastern connectors and northern states, and for local farm and commercial truck trips. Truck parking along the route and lack of STAA route designations, as well congestion in several areas in urban centers (Stockton and Sacramento), are key issues along the route.[20]

SR 99 is a north-south highway stretching almost the entire length of the Central Valley (including Bakersfield, Fresno, Stockton, and Sacramento)While I-5 tends to carry more through truck traffic, SR99's proximity to urban centers make it the route for truck trips moving within the San Joaquin Valley.. It is almost entirely a freeway, and there are plans to complete it to interstate highway standards. Truck volumes on SR 99 are very high, especially in Southern California. At the junction with I-5, truck volumes exceed 13,000 per day in 2012, according to Caltrans. Since it complements I-5, many of the needs on the corridor are similar to that on I-5, which include congestion and operational challenges at Sacramento.[21]

Rail issues in this corridor can be found along the BNSF mainline from Stockton to Bakersfield (the San Joaquin Corridor). This is BNSF's route from Northern California to its TRANSCON corridor via the Tehachapi Pass, and thus must accommodate anticipated intermodal traffic growth from both domestic and international cargo. The capacity needs in this corridor are

[20] Information obtained from the Caltrans I-205/I-5 CSMP and the I-5/SR 99 CSMP.

[21] Caltrans I-5/SR 99 CSMP.

driven by both passenger and freight service expansion and the future operation of passenger service will be influenced by the high speed rail concepts.[22]

Other Megaregion Corridors (I-880, I-680, and state routes)

I-880 and I-680 both have high volumes of truck traffic and provide key connections to the major interregional corridors. I-880 provides important connections to the Port of Oakland, the Oakland International Airport, and major industrial corridors in the inner Bay Area. South of I-580, I-680 has comparable truck volumes to I-880 south, serving truck traffic moving to and from the South Bay and Fremont, with the highest level of truck delay between SR 238 and SR 262. Another key megaregion route is U.S. 101 which, although it has lower truck volumes than I-880, has the highest truck volumes in Santa Clara County and relatively high levels of truck delay. In the North Bay, U.S. 101 is the only connection to the rest of the megaregion infrastructure for the North Bay businesses, including wine and agricultural producers.

East-West Connectivity in the Megaregion

East-west connectivity and capacity also is a pressing issue throughout the San Joaquin Valley. Though interstate/national connectivity is provided via SR 99 and I-5, trucks traveling to or from these highways to other locations within the San Joaquin Valley utilize east-west highway corridors. Many of these are two-lane roadways and are not suitable to carry the heavy traffic/ truck volumes that they experience. In the Bay Area, cross-bay connections such as I-80 and SR 92 linking industries in the East Bay and San Francisco to global gateways and local markets also are heavily congested and limit connectivity and increase transportation costs for industry. There also are limited east-west connections between the Bay Area and Central Valley, with SR 12 and 152 each heavily constrained, putting enormous pressure on I-580.

Eliminating Rail Bottlenecks and Separating At-Grade Crossings

Insufficient capacity on rail lines to accommodate both freight and passenger rail growth, especially along the Martinez Subdivision, will continue to be a major concern for the megaregion. Strategies to help relieve rail bottlenecks can include rail track and signal improvement, tunnel clearance, additional tracks and connectors, and positive train control. Safety and delays at at-grade rail crossings also will continue to be a concern as rail and road volumes rise. Strategies to improve safety and reduce delays at these locations can range from grade separations, consolidations of crossings, and improved signalization along all routes, especially those with the highest risk for accidents and delay.

Additional Marine Highway and Rail Connections

One strategy to handle future goods movement growth is to provide rail and waterway connections to relieve pressure on congested highway corridors. Marine highway and short-haul rail services can create important system redundancy and resiliency, along with diverting truck traffic off of congested corridors. The pilot Marine Highway (M-580) service currently is under suspended operation as a regular barge service for containerized cargo between the Port of Oakland and the Port of Stockton. While current economics do not favor these alternative short

[22] California Statewide Rail Plan, 2013.

haul modes, continuing evaluation should be conducted as congestion continues to increase the costs of inter-regional transportation within the megaregion.

ITS Strategies to Improve Interregional Corridor Freight System Efficiency

ITS is a strategy that can reduce delay, reduce nonrecurring congestion, and improve overall operations of corridors, often on existing infrastructure. The Bay Area has made significant investments in a variety of ITS and operational improvements, including Integrated Corridor Mobility (ICM) strategies along I-80, including Adaptive Ramp Metering (ARM) and Active Traffic Management (ATM). At its heart, ATM strives to actively manage the system in real-time while leveraging advanced simulation models to project traffic conditions into the future 20 minutes. By providing operators in a traffic management center (TMC) with small tailored simulation traffic models with which they can project out in time the impacts of an incident, these operators can better manage the system by not only ensuring the correct first responding vehicles get to the scene, but also by better sharing traveling information to the public as well. Given the large percentage of goods that flow on the highway network in the megaregion, improvements to the general operations and flow of the highway network will have significant benefits for goods movement.

Preservation of Highway Infrastructure

Across the megaregion's highways, roadways, bridges, and local streets, deterioration due to growth in heavy-truck movements is creating a growing need for maintenance and preservation projects. For example, heavy trucks (5+ axles) comprise a significant percent of the total truck volume on I-880, and the percent of heavy trucks as a share of total trucks will likely grow, as the supply chain moves towards increased consolidation (i.e., fewer larger trucks) in the future. Heavy trucks have a greater impact on highway congestion, create unique operational challenges, and create more damage and wear on pavement. Additionally, as manufacturing activity increases in the South Bay (such as the Tesla plant in Fremont), the changing traffic patterns and resultant pavement needs on adjacent roadways should be closely monitored.

Delay Reduction

Delays are increasingly an issue for many corridors in the Bay Area and megaregion. The forecast growth in truck and auto traffic suggests a need to expand capacity, develop additional corridors, or improve existing corridor efficiency. Projects such as truck-only lanes, truck climbing lanes, auxiliary lanes, targeted lane widening and new alignments, and local operational improvements are necessary to reduce congestion and improve reliability for goods traveling through the megaregion.

4.3 Challenges and Opportunities for the Urban Goods Movement System and Last-Mile Connectors

Apply Technology to Truck Parking and Truck Route Management

Lack of truck parking for pick-up/delivery activities is an ongoing problem for urban areas. Studies such as the 2008 *Alameda County Truck Parking Facility and Location Study*, prepared by the Alameda County Congestion Management Agency, have emphasized the shortage of truck parking and looked at various potential sites for truck parking; however, the need to develop additional trucking parking infrastructure throughout the megaregion remains.

Comprehensive Arterial System Planning and Management

The arterial network is the largest single network of transportation infrastructure in many communities. In the megaregion, many local and interregional truck routes are on arterial streets, and there is a need for comprehensive arterial corridor system planning across jurisdictions and coordination with land use planning. "A comprehensive arterial corridor system should consider the need to maintain continuity in truck routes and restrictions, and should provide guidance for all travel modes and Complete Streets[23] implementation. An additional step is "Smart Corridors,"[24] such as the East Bay SMART program,[25] that can be developed along arterial corridors that have either heavy vehicle or transit traffic or are significant for freight and drayage movements for relatively low cost.

Industrial Land Use Preservation

If land use patterns continue to emphasize dense residential and commercial development in the central core of the Bay Area, older industrial space will be converted to these higher value uses, pushing many goods movement-dependent industries to locations on the periphery of the region or out of the region altogether, often in to neighboring regions. For many of these businesses, there will still be a need to access the central core areas, and these emerging development patterns will create a need for trucks to travel longer distances from distribution centers and corporation yards that are far from urban centers in order to make deliveries during limited daytime hours. In order to operate safely and improve efficiency, truckers operate during off-peak hours whenever possible. With more distribution centers located further from the center of the Bay Area, the average trucking distance is likely to increase, often on major interregional commute and goods movement corridors already operating with major congestion. As congestion on interregional and intraregional corridors grows, the ability of trucks to avoid operating during peak periods may lessen if they have to move between a base of operations further from the urban core and key international gateways.

Improve Selected Rail and Roadway Connectors

"Last-mile" connectors are generally arterial corridors critical to pick up and delivery. They provide access to industrial and warehouse facilities and truck amenities, such as gas stations, rest areas, and parking. These arterial roadways are primarily city and county roads that cross jurisdictional boundaries; and although most cities have designated "local truck routes," inconsistencies, such as size and weight restrictions or time-of-day controls, lack of signal coordination, and street design features, hinder the movement of goods on the system.

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[23] The Complete Streets concept is designed to consider the needs of all users in street design features and treatments; however, this consideration often is limited only to passenger travel modes. However, in 2010, Caltrans defined Complete Streets as "a transportation facility that is planned, designed, operated, and maintained to provide safe mobility for **all** users, including… *truckers*." (italics added).

[24] Smart Corridors are advanced signal systems, which offer technology such as transit signal priority, closed-circuit television cameras (CCTV), and Dynamic Message Signs at major decision points (e.g., freeway interchanges).

[25] http://www.smartcorridors.com/accma/index.jsp.

Proactive planning is required to foresee capacity constraints in last-mile connections before they become bottlenecks.

Rail also can serve as a last-mile connector, especially to port facilities. Currently, delays in rail access to the Port of Oakland impact both UP and BNSF operations when entering the Port, which in turn, impact commuter and Amtrak trains. Improving rail connectors, such as through the OHIT project and other improvements to the Martinez Subdivision, is crucial to maintain efficient connections for supply chains and goods movement. As mentioned above, the Crosstown ramp extension project at the Port of Stockton will improve the connection between I-5/Crosstown Freeway, the Port of Stockton, and adjacent industrial uses. The Port of West Sacramento also received Federal funding to have Sierra Northern Railway build a loop track that will enable rail-car switcher and storage operations on port property, thus, reducing grade-crossing delay.[26]

4.4 Meeting Environmental Challenges

California and the megaregion serve as national leaders in the challenge to identify and implement strategies to improve public health and protect infrastructure and the environment by reducing air pollution and greenhouse gases, improving water quality, and preparing for sea level rise and significant weather events. California's air quality standards, for many pollutants, especially Particulate Matter (PM) and ozone, are more stringent than Federal standards, and are designed to provide additional protection for those segments of the population who are most sensitive to the effects of air pollution. The California Air Resources Board (CARB) and its partners are actively seeking to reduce emissions from key sources, especially in areas that do not yet attain national and state standards.

A critical air quality and public health issue in the megaregion is related to impacts of goods movement-related emissions on the health and safety of communities directly adjacent to major facilities. These communities experience high exposure to pollution that contribute to asthma and respiratory ailments, heart disease, and other health problems. Programs addressing these issues include CARB's On-Road Heavy-Duty Diesel Vehicles regulation, and the Maritime Air Quality Improvement Plan (MAQIP) at the Port of Oakland, developed to reduce diesel PM from seaport sources. The Bay Area Air Quality Management District's Community Air Risk Evaluation (CARE) program is an effort that brings together government, communities, and business in an effort to understand and address localized areas of elevated air pollution and its adverse health impacts on communities. Other policies include incentives to replace heavy-duty

Low Emission Locomotive in Roseville, California. Source: The International Railway Journal.

[26] http://www.progressiverailroading.com/intermodal/news/Port-of-West-Sacramento-advances-loop-track-renewable-fuels-facility-31329.

on-road diesel engines and installation of low NO_x engine retrofits in the Bay Area and other parts of California.

Much remains to be done to actively work towards emission reduction beyond simply meeting regulatory standards. In recent years, there has been renewed interest in the use of low-emission, alternative fuels, such as biodiesel and natural gas, including compressed natural gas (CNG) and liquefied natural gas (LNG) for trucking and port operations. The new sources of low-cost natural gas in the U.S. have made natural gas a very competitively priced option for trucking fleets. There also is much research and demonstration projects underway around the country, led by CARB, looking for ways to electrify trucks leading to potential zero-local emission technologies.

Reducing emissions from the diesel locomotive fleet in the megaregion also is important, as locomotives can have a service life of up to 50 years, and older locomotives that predate U.S. Environmental Protection Agency (EPA)-mandated emissions controls make up a large share of emissions attributable to train operations. New, cleaner locomotive technology has been tested in areas such as Roseville, California, where the SD59MX locomotive was rebuilt from an Electro-Motive Diesel SD60M. It began service in 2010 with a range of up to 200 miles from its base at UP's Roseville yard.[27] The Bay Area Air Quality Management District, in partnership with National Railway Equipment Company and Richmond Pacific Railroad Corporation, demonstrated a Tier 4 switcher locomotive in the Richmond Pacific Railroad rail yard in Richmond, California. The demonstration showed that the locomotive achieved lower emissions than U.S. EPA Tier 4 emission requirements.

5.0 CONCLUSIONS

Goods movement is a critical element of the transportation system in the San Francisco Bay Area and the larger Northern California megaregion. Because the markets and the infrastructure systems that comprise the goods movement system extend well beyond county, metropolitan planning organization (MPO), and even megaregion boundaries, the Metropolitan Transportation Commission (MTC), and all of the Northern California transportation agencies need to work together to plan for and advocate on behalf of goods movement needs that affect their citizens and businesses.

With the continuing focus at the national level on rebuilding the U.S. position as a major exporter and manufacturer, investments in the Northern California goods movement system are critical to meeting national economic and trade goals and is worthy of state and Federal support. Aside from the economic linkages among the regions that comprise the Northern California megaregion and that are supported by local goods movement infrastructure, the Northern California goods movement system serves important functions for the state and national economy. Ports and airports in the Bay Area, for example, are leading exporters of a wide range of products, including bulk exports, high-value agricultural and food products, and high-value manufacturing products often linked to activities throughout the megaregion. In addition, the Bay Area continues to be a world leader in high-technology systems development and is applying

[27] Barrow, Keith, "Union Pacific tests low-emission locomotive." *The International Railway Journal*, September 2012, http://www.railjournal.com/index.php/locomotives/union-pacific-tests-low-emissions-locomotive.html.

its technology innovation skills to clean energy products, advanced biomedical and pharmaceutical development, and advanced transportation technology.

Addressing regional issues require working together, and MTC is working to develop partnerships with state and Federal agencies and the private sector to come up with innovative approaches to addressing the goods movement challenges it faces in order to continue to provide high-quality freight transportation to local, regional, state, and national economies that also have co-benefits in terms of providing diverse job opportunities, building a cleaner environment, and creating healthier neighborhoods. The MTC Regional Goods Movement Plan will provide the foundation for ongoing improvements to the goods movement system, and will forge lasting partnerships involving all of the key stakeholders in the Northern California megaregion.