



**METROPOLITAN
TRANSPORTATION
COMMISSION**

The background of the cover is a photograph of a port at dusk or dawn. Several large yellow gantry cranes are visible, with 'PORT OF OAKLAND' and 'ZPMC' written on them. In the foreground, a large number of birds, likely pelicans, are gathered on a rocky shore. The sky is a mix of purple, orange, and blue.

NORTHERN CALIFORNIA MEGAREGION GOODS MOVEMENT STUDY

JUNE 2019





Table of Contents

- Introduction **2**
- Freight Transportation Network & Assets **3**
- Economic Profile for Goods Movement. **4**
- Goods Movement Workforce Challenges **6**
- Cluster Analysis **8**
- Industrial Land Use **10**
- Transportation & Land Use Challenges & Opportunities **12**
- Goods Movement Investment Guide for the Megaregion. **15**
- Conclusion & Next Steps **20**

Introduction

This study describes the underlying structure, challenges and opportunities of goods movement throughout the 19 counties that make up the Northern California Megaregion. For this study, we define Goods Movement as six freight-dependent industry sectors (listed on page 4), four supply chain activities (listed on page 8), and the megaregion's freight transportation network and assets (defined on page 3). Collectively, these employ more than 1.7 million workers in 2017, which accounts for about 30 percent of a total of 5.4 million workers across all industries. This significant share of total employment has remained roughly the same since first measured in 2011, although the distribution between the six freight-dependent industry sectors and the four regions has evolved with the global economy and the megaregion's land use and competitive advantages.

The Northern California Megaregion Goods Movement (MRGM) Study is a partnership between four regional governments: the San Francisco Bay Area Metropolitan Transportation Commission (MTC), the Association of Monterey Bay Area Governments (AMBAG), the Sacramento Area Council of Governments (SACOG) and the San Joaquin County Council of Governments (SJCOG). This study was originally awarded as a Caltrans Sustainable Transportation Planning Grant. The Northern California Megaregion is defined by the 19 counties that comprise the four subregions:

- » **MTC:** Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma
- » **AMBAG:** Monterey, San Benito, Santa Cruz
- » **SJCOG:** San Joaquin
- » **SACOG:** El Dorado, Placer, Sacramento, Sutter, Yolo, Yuba

The goal of this study is provide Northern California Megaregion agencies and stakeholders with the information they need to understand and address their priorities for the freight-dependent industries in their regions and provide the same understanding for the most critical issues that affect multiple regions, or the Megaregion as a whole. While each region has unique priorities, this report provides public and private stakeholders with the necessary information to guide key infrastructure investments, policies and regulations.

This Executive Summary provides information on the Megaregion's freight transportation network and assets, economic indicators for freight-dependent industries, workforce challenges, cluster analysis findings, industrial land use, transportation challenges and opportunities, and the first-ever Northern California Megaregion Investment Guide.



Source: Cambridge Systematics (2019).

Freight Transportation Network & Assets

The Northern California Megaregion has a robust, multimodal freight network consisting of seaports, airports, railroads, and highways that connect regional production and distribution facilities to regional, national, and global markets. These facilities link the Megaregion's economy to international and national trade partners.

The Megaregion serves as a domestic trade gateway to other regions in California and the rest of the U.S. and, being a large population center itself, is dependent on goods movement within the region to provide consumer products, food, and parcels. Strategic transportation investments support clusters of industry, increase productivity, enhance job and labor force accessibility, open up new markets for business, and enhance supply chain activities efficiency.

Additional Strategic investments are needed in freight infrastructure to support supply-chain efficiencies that allow the Megaregion to maintain its' economic competitiveness such as:

- » Highway improvements and connections that support freight movement
- » Cargo handling ports that offer services to meet the needs of particular industries
- » Intermodal facilities that offer truck to rail or rail to barge services
- » Cargo handling airport improvements to accommodate projected increased demand

The Megaregion features a number of **Interstate and non-Interstate highways** that support freight moved by trucks and other commercial vehicles, including Interstate 5 (I-5), I-80, I-280, I-580, I-680, I-880, United States Highway 50 (US 50), US 101, State Highway 92 (SR 92), SR 99, SR 152, SR 12, and SR 4. The Megaregion also has access to Class I rail service via BNSF Railway (BNSF) and Union Pacific Railroad (UP). BNSF's rail network originates in the San Francisco Bay and travels southeast through Stockton down to Barstow, where it splits east (through Needles) and west (to the Ports of Los Angeles and Long Beach). UP's network in the Megaregion provide connections between San Jose, San Francisco, Sacramento, and Stockton, allowing freight to continue towards the Pacific Northwest, Midwest, Southwest, and south towards Los Angeles.

There are five significant **cargo-handling ports** in the Megaregion. These ports offer a variety of services to meet the needs of particular industries.

Port of Richmond:

Currently ranks number one in liquid bulk and automobile tonnage among ports on San Francisco Bay

Port of Stockton:

Features 7 million square feet of U.S. Dept. of Agriculture-approved storage

Port of Oakland:

Ranked among the top 8 ports in the nation and 76th in the world in terms of annual container traffic

Port of West Sacramento:

Specializes in import/export of bulk ag and construction products

Port of Redwood City:

Strategic location between San Francisco and Silicon Valley/San Jose region

There are four significant **intermodal facilities** offering truck-to-rail or rail-to-barge (and vice versa) services to industries. The Stockton Intermodal Facility provides connection to BNSF rail service at the Port of Stockton; the Lathrop Intermodal Facility provides connection to UP rail service, located just south of the Port of Stockton; the Railport Intermodal Yard at the Port of Oakland provides connection to UP rail service; and the Oakland International Gateway Intermodal Facility at the Port of Oakland provides connection to BNSF rail service.

There are also six **cargo-handling airports** within the Megaregion: San Francisco International (SFO), Metropolitan Oakland International (OAK), Norman Y. Mineta San Jose International (SJC), Sacramento International (SMF), Sacramento Mather (MHR), Charles M. Schulz – Sonoma County (STS).

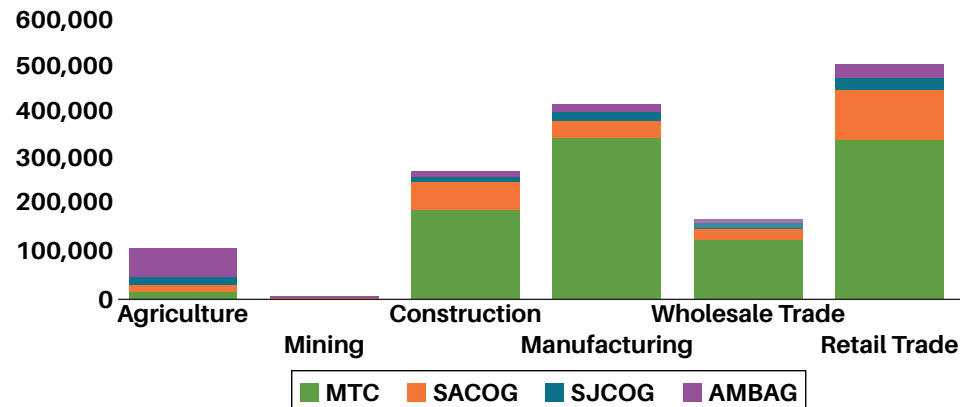
Economic Profile for Goods Movement

Approximately 69 percent of **freight-dependent industry** employment in Northern California Megaregion is concentrated within the MTC region in 2017. Overall, the majority of this sector employment is within the retail trade sector, which employed over half a million people (34 percent). Manufacturing comprises 28 percent of total freight-dependent employment. Notably, the vast majority of employment in the agriculture sector is located in the AMBAG region.

Freight-dependent industries are those that depend on transportation more than any others present in the Megaregion

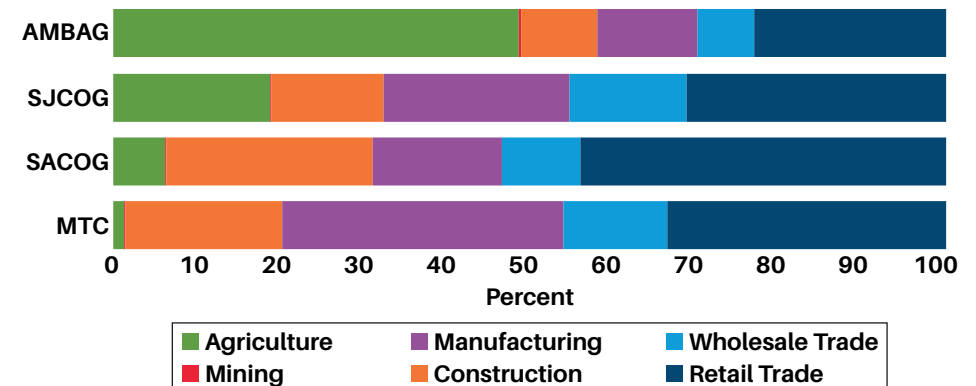
- » Agriculture businesses are engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals.
- » Mining businesses extract naturally occurring mineral solids (i.e., coal and ores), liquid minerals (i.e., crude petroleum), and gases (i.e., natural gas).
- » Construction businesses are engaged in the construction of buildings or engineering projects.
- » Manufacturing businesses are engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products.
- » Wholesale Trade businesses are engaged in wholesaling merchandise, which includes outputs from other sectors.
- » Retail Trade businesses are engaged in retailing merchandise.

Freight-Dependent Industries Employment, 2017



Source: Quarterly Census of Employment and Wages, U.S. Bureau of Labor Statistics, 2017.

Share of Freight-Dependent Industries Employment by Subregion



Source: Quarterly Census of Employment and Wages, U.S. Bureau of Labor Statistics, 2017.

Between 2008 and 2016, only two freight-dependent industries in the Megaregion have increased in employment size: agriculture and retail trade. The remaining sectors have decreased in overall employment. However, it is important to note that both the agriculture and retail sectors are vulnerable to automation, which may lead to limited wage growth and either slowing or declining employment in future years.

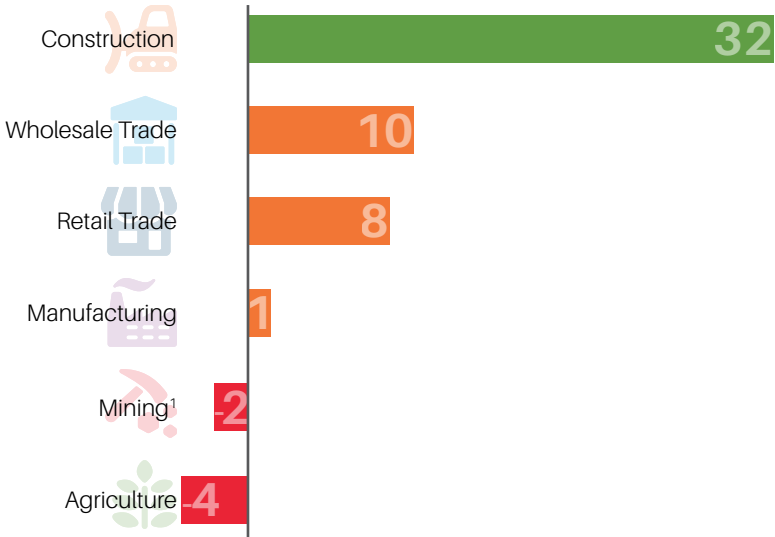


Past and Future Trends

Employment for most freight-dependent industries is expected to increase. Growth in construction employment may accelerate if past and future natural disasters (e.g., fires, earthquakes, flooding) continue to drive rebuilding. Some industries are especially impacted by automation, such as manufacturing and agriculture, may see employment decline but economic output grow.

While four of the six freight-dependent industries have experienced employment losses over the past decade, four are expected to increase their output in the next decade: construction; wholesale trade; retail trade; and manufacturing. Growth in construction employment may even accelerate if past and future natural disasters (e.g., fires, earthquakes, flooding) continue to drive rebuilding. Some sectors that are especially impacted by automation, such as manufacturing and agriculture, may see employment decline but output grow. Conversely, mining and agriculture sectors are expected to experience a decline in job growth, partially a result of technological innovation (i.e., automation) and global market shifts (i.e., decreases in oil production and consumption).

Freight-Dependent Industries Projected Job Growth, 2014-2024



Projected Job Growth, 2014-2024 (in Percent)

Source: California Employment Development Department, January 2018.

¹ Mining employment defined as Extraction Workers (SOC code 47-5000).

Shift Share Analysis

Shift share analysis (which measures how much of regional job change is due to national versus regional / local factors) reveals that, between 2008 and 2016 the Megaregion’s agriculture, and construction industries outperformed national trends overall. The agriculture sector is uniquely strong in the Megaregion, having grown by 20 percent between 2008 and 2016. By contrast, the Megaregion’s manufacturing, and wholesale trade industries are underperforming compared to national trends. These findings suggest that the Megaregion does not have as strong of a competitive advantage in its freight-dependent industries compared to its service sectors.

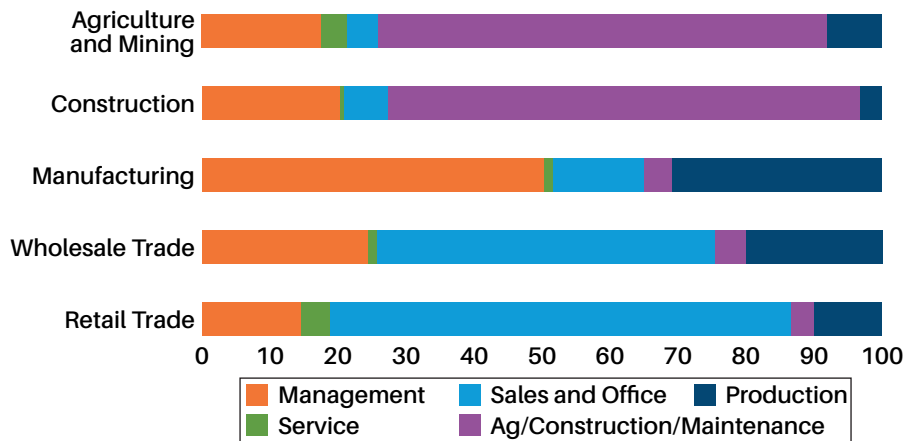
Conducting a shift share analysis for the Northern California Megaregion revealed mixed findings at the macro industry level, with several notable strong and weak industries emerging at the subsector level. **Though variable over time, between 2008 and 2016 the Megaregion’s agriculture, and construction industries outperformed national trends overall.** The agriculture sector is uniquely strong in the Megaregion, having grown by 20 percent between 2008 and 2016. However, the Megaregion’s mining, manufacturing, and wholesale trade industries are underperforming compared to national trends.



Goods Movement Workforce Challenges

Freight-dependent industries employ people in all **occupational categories**. Notably, agriculture/construction/maintenance occupations comprises the highest share of employment in the agriculture & mining (66 percent) and construction (69 percent) freight-dependent sectors in the Northern California Megaregion. Management employment is highest in the manufacturing sector at half of all employees. Sales and office employment is substantial in the retail trade (68 percent) and wholesale trade (50 percent) sectors.

Share of Megaregion Employment by Industry and Occupation



Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates.

Notably, Megaregion employees working in production, transportation, and material moving occupations and agriculture/construction/maintenance occupations, all earn median salaries that are higher than the statewide average. The trends within the management, business, science, and arts occupations vary depending on the subregion; occupations within the MTC region have higher median salaries compared to the state average, while occupations within the remaining three subregions generally have lower median salaries compared to the state average.

Management: Includes management, business, and financial; computer, engineering, and science; education, legal, community service, arts, and media; and healthcare practitioners and technical occupations.

Service: Includes healthcare support; protective service; food preparation and serving related; building and grounds cleaning and maintenance; and personal care and service occupations.

Sales and Office: Includes sales, office, and administrative support occupations.

Production: Includes production, transportation, and material moving occupations.

Agriculture/Construction/Maintenance: Include farming, fishing, and forestry; construction and extraction; and installation, maintenance, and repair occupations.




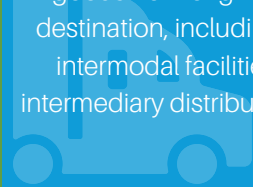

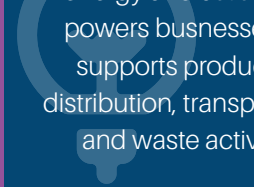
CHALLENGES AND OPPORTUNITIES FOR THE MEGAREGION'S GOODS MOVEMENT OCCUPATIONS:

- » Low-wage workers live and work throughout the Megaregion and **transportation is the largest barrier to their future opportunities**. Relying on transit comes with last-and first-mile gaps and limited fare and schedule coordination. A reliance on transit or difficulty traveling long distances to a low-wage job also creates a barrier to obtaining the training needed to advance to a middle-wage job.
- » **Digital literacy** is imperative for middle-wage jobs and is required at times even to apply for the job (i.e., online applications). Teaching digital literacy and showing low-wage workers how to search for jobs online will help facilitate movement into higher-wage occupations.
- » The primary skills needed to advance to middle-wage jobs from a low-wage job include: basic skills including math, literacy, and GED completion; English language; soft skills such as customer service and communication; **technology and digital literacy**; and high-order skills including instructing, learning strategies, and persuasion. In addition, there are **skills that are important for almost every middle-wage job** but not for the majority of low-wage jobs, including reading comprehension, judgement and decision making, complex problem solving, active learning, and writing.
- » Many employers find that their employees **lack the math and reading abilities** needed for success and advancement in their occupation. Programs geared towards on-the-job use that coordinate with local employers will provide the best benefit.
- » **Paid training programs** for middle-wage occupations are limited and most low-wage jobs do not offer opportunities for employees to build their skills. Training, education, and pathway programs with a close connection between employers and economic development efforts will be most effective toward closing the skills and wage gap. The Megaregion can support programs that provide experience and connections to middle-wage jobs, help workers navigate the job application and interview processes, and help workers network.
- » In order to create opportunities for low-wage workers to move into middle-wage jobs, the Megaregion will need to **work across political boundaries** to: (1) create skills development and training programs utilizing existing programs and educational institutions; (2) ensure training translates to job opportunities by engaging the business community; and (3) create access and support for career navigation and networking.
- » With a **large cohort of older workers beginning to retire**, there may be opportunities for moving into goods movement occupations even if the total number of jobs is declining. However, many retirement-age workers do not or will not have the resources they need to retire, and may hold onto their jobs longer or take an entry-level job at reduced pay. They may also require higher levels of public assistance or direct financial support from family members.
- » Better regional coordination of economic development planning will support broad-based economic growth. **Middle-wage job opportunities will grow in tandem with the economy**.
- » The Megaregion is **underinvesting in industrial lands infrastructure** needs, which threatens middle-wage jobs. Industrial land uses produce a relatively high share of middle-wage jobs.



Cluster Analysis

This cluster analysis describes the evolving employment and economic composition of six freight-dependent industries (agriculture, mining, construction, manufacturing, wholesale trade, and retail trade) and four associated core supply chain activities (distribution, transportation, waste, and energy/utilities). Freight-dependent industries are those that depend on transportation more than others present in the Megaregion, and are most impacted by the efficiency of the core supply chain activities. Distribution, and transportation supply chain activities are highly individualized to meet the needs of a particular firm's supply chain, while waste and energy/utilities activities are universally applicable to not only all freight-dependent industries, but also every business within the Megaregion regardless of sector.

DISTRIBUTION	TRANSPORTATION	WASTE	ENERGY AND UTILITIES
 <p>Refers to the intermediary warehousing, storage, handling, consolidation/deconsolidation, and distribution of goods.</p>	 <p>Represents the movement of goods from origin to final destination, including ports, intermodal facilities, and intermediary distribution hubs.</p>	 <p>Represents the collection, disposal, and remediation of waste generated from production or distribution activities.</p>	 <p>Represents the generation of energy and utilities that powers businesses and supports production, distribution, transportation, and waste activities.</p>

This approach investigates each of the six freight-intensive sectors through the lens of each of the four supply chain activities to describe where goods movement activity takes place within the Northern California Megaregion, allowing an understanding what the supply chain activities look like for each freight-intensive industry and, ultimately, prioritize critical freight transportation investments, policies, and regulations.

Cluster or agglomeration economies—geographic concentrations of interconnected businesses, suppliers, and associated institutions—are considered to increase productivity within the industry and increase regional, national, and global competitiveness. As more firms in related businesses locate near one another, costs of production often decline significantly, as firms have common suppliers, need more specialized workforce, and are more dependent on ancillary expertise to support core businesses. This economic environment is particularly beneficial for freight-dependent industries. Further, understanding where these clusters are located helps public agencies throughout the Megaregion target investment in necessary infrastructure to support freight-dependent industries.

The evaluation of core supply chain activities revealed that certain geographies within the Northern California Megaregion serve multiple aspects of freight-dependent industries. For instance, Stockton is a hub for both distribution and production activities within the agricultural sector, it is also a distribution hub for the mining, wholesale trade, and retail trade sectors. Further, San Jose is a hub for production activities among the construction, manufacturing, wholesale trade, and retail trade sectors in addition to being a hub for distribution activities in all freight-dependent industries except agriculture. San Jose is also a hub for both waste and energy/utilities activities, which benefit all sectors within the Megaregion.

Cluster Analysis Spotlight: Manufacturing Sector

The Northern California Megaregion had over 420,000 people employed in manufacturing in 2017. The MTC region comprised about 83 percent of those jobs, totaling nearly 348,000 jobs. The remaining three agencies comprised smaller shares of manufacturing jobs, but the absolute number of jobs is high relative to other sectors, such as agriculture or mining. Major manufacturing establishments in the Megaregion include Western Digital in Fremont (Alameda County), Chevron Corporation in San Ramon (Contra Costa County), Cisco Systems in San Jose (Santa Clara County), Intel in Santa Clara (Santa Clara County) and Folsom (Sacramento County), Texas Instruments in Santa Clara, and Lockheed Martin in Sunnyvale (Santa Clara County).

The region's manufacturing sector is highly diverse, and utilizes different freight transportation modes to meet individual firm needs. Inputs—which range from raw inputs to pre-manufactured parts that will be assembled into other manufactured products—that can arrive in bulk as imports via barge from the Ports of Oakland, Stockton, and West Sacramento or by rail from the Pacific Northwest, Midwest, or Southwest.

Depending on the origin of the input, the supply chain can include a variety of land, water, and air modes from across the globe.

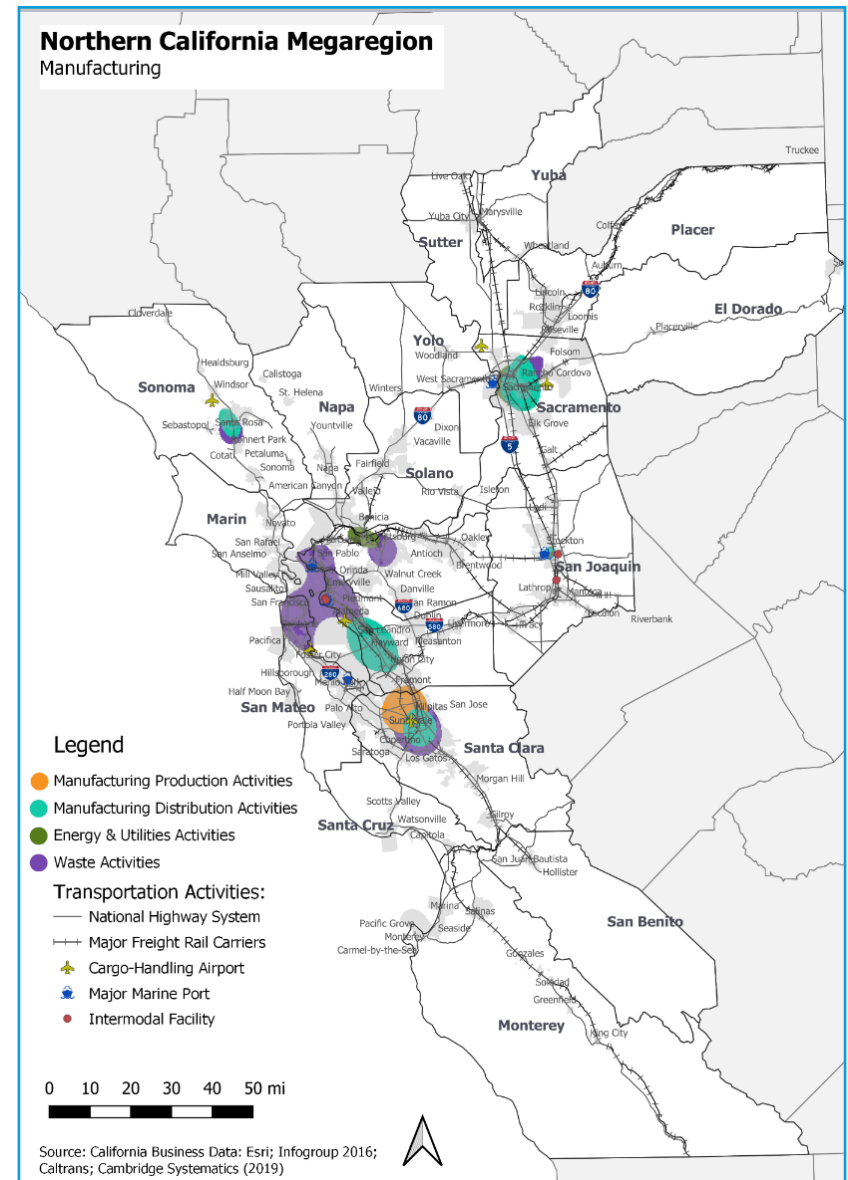
Outputs from the Megaregion's manufacturing firms can be transported by truck (domestic markets), barge (if for export), air (for small, high-value goods), and potentially rail for project cargo or oversize/overweight products that cannot be shipped via truck.

This sector's production activities (in terms of both employment and sales volume) in the Megaregion are concentrated in the Santa Clara County region, specifically in a cluster that captures the neighboring cities of Sunnyvale, San Jose, Milpitas, and Fremont. This sector's distribution activities are concentrated in the San Jose area, Hayward/Union City, Sacramento, and Windsor/Rohnert Park.

MANUFACTURING BUSINESSES IN THE MEGAREGION:

- » Employ an average of **26.3 people** per establishment
- » **68 percent** have fewer than **10 employees**

- » **82 percent** have fewer than **20 employees**
- » **3.4 percent** have **100+ employees**



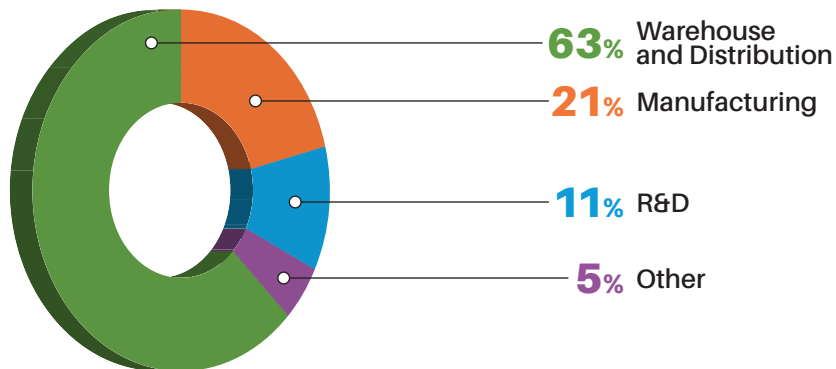
Industrial Land Use

The exponential growth in e-commerce has transformed the real estate market for warehouse and distribution centers, which can be seen in the Megaregion’s industrial land use trends. The Northern California Megaregion currently has 940 million square feet of industrial space. This total includes a variety of industrial building types: warehouse, distribution, truck terminal, refrigeration/cold storage, manufacturing, food processing, showroom, service, and telecom hotel/data hosting, light distribution, light manufacturing, and R&D.

From 2011 to 2018, the average size of warehouse and distribution buildings in the Megaregion had more than tripled to 188,000 square feet. At the same time, the average number of total buildings constructed annually has dropped significantly, signifying a shift to larger consolidated warehouse and distribution centers.

The Megaregion has a very healthy real estate market for distribution and warehousing. The Megaregion has a vacancy rate of less than 4 percent, compared to 3.4 percent in the MTC region, 3 percent in the AMBAG region, 4 percent in the SACOG region, and 5.6 percent in the SJCOG region. The MTC region shows the highest average rents, while the SJCOG region has the lowest average rents.

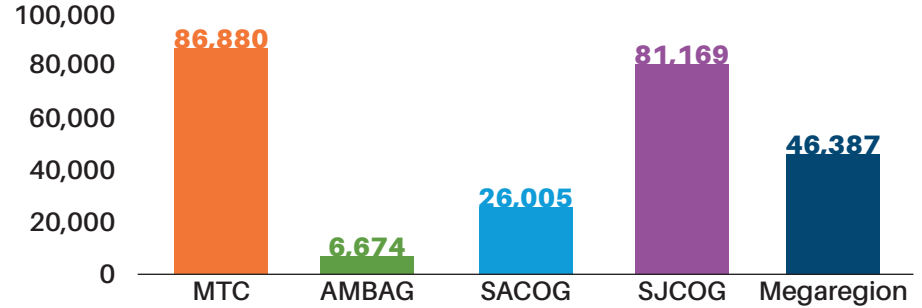
Inventory of Existing Industrial Space in Megaregion, by Type



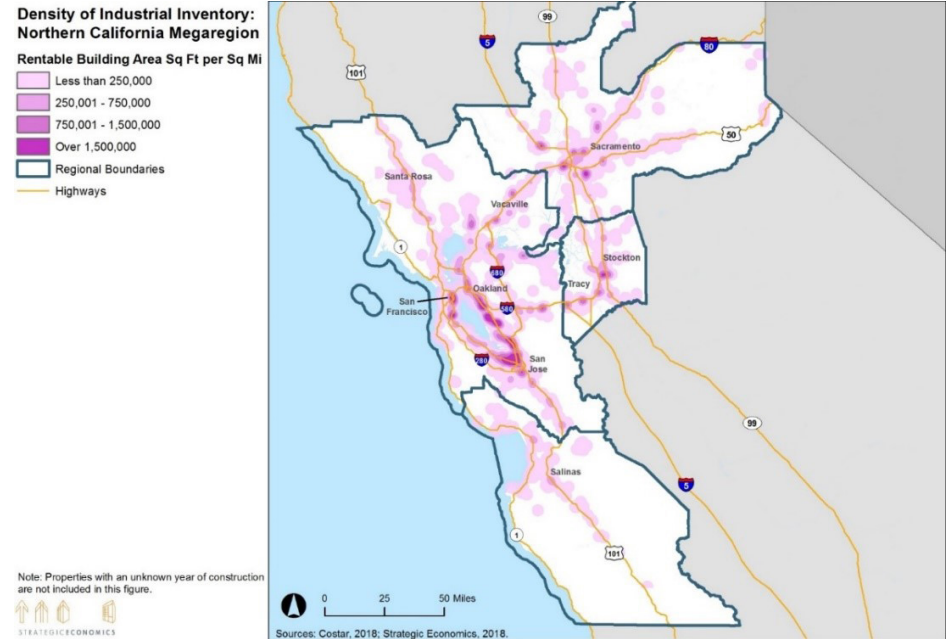
Source: CoStar, 2018; Strategic Economics, 2018.

Total Industrial Inventory in the Megaregion per Square Mile, by Subregion

Rentable Building Area (Sq. Ft.) Per Sq. Mi.



Source: CoStar, 2018; Strategic Economics, 2018.



Source: CoStar, 2018; Strategic Economics, 2018.

REGIONAL HIGHLIGHTS IN INDUSTRIAL LAND USE

- » The **MTC region** contains about two-thirds of the Megaregion's inventory of warehouse and distribution space. Because of the high cost of land and competition from other uses in the inner Bay Area, most new warehouse and distribution development is occurring in the outer Bay Area, affecting the region's ability to effectively move goods by limiting warehouse and distribution facilities from locating near key freight infrastructure (e.g., Port of Oakland) and inhibiting intermediary shipments and last-mile deliveries to consumers and businesses.
- » The **AMBAG region** plays a critical role in providing industrial spaces to serve agricultural activities. However, the industrial market is less active than in other subregions for two reasons: current rental rates in Salinas are not high enough yet to make new development pencil and the price of land in the Monterey region has been rising due to increased competition from other tourism-related uses.
- » The **SJCOG region** is highly specialized in warehouse and distribution uses, with relatively little inventory for R&D and manufacturing. Since 2011, SJCOG has seen the development of more goods movement space per square mile than any of the other subregions, driven primarily by large e-commerce and logistics companies.
- » The **SACOG region** holds nearly 20 percent of the megaregion's total industrial inventory. Though growth has slowed in recent years, brokers report an increasing number of cannabis production and distribution facilities moving into older industrial spaces, contributing to a rise in rents.



Transportation & Land Use Challenges & Opportunities

The Northern California Megaregion has unique challenges to its urban freight movements, though there are many commonalities with respect to the challenges and opportunities facing each area. The Megaregion's challenges and opportunities are manifestations of the complex mix of agricultural production, expanding manufacturing, exploding demand for consumer goods from an increasingly affluent population, and growing export activity at the Port of Oakland.

This mix has generated excessive demand for goods movement on the Megaregion's congested roadway and railways. Moreover, rapidly increasing land costs in some of the most expensive real estate markets in the country have pushed freight-intensive industry further into the regions surrounding the Bay Area, which are relatively less expensive but further from their markets and international shipping hubs. Furthermore, the Bay Area technology industry's insatiable demand for knowledge workers has expanded the peak commuting periods into the off-peak periods when trucks and local deliveries are most active. All of these activities and conditions have surged without significant investments in new roadway, transit, or freight rail capacity.

Understanding these challenges and opportunities helps public agencies and policy makers can leverage possible synergies from infrastructure investments that expand capacity, develop new policies that incentivize more efficient use of existing capacity, and draft regulations that allocate existing and future capacity to sustain economic growth, improve quality of life, and increase equity among Megaregion households.



Challenges

1. The Port of Oakland is a major chokepoint for goods movement, causing truck delays on I-880, I-580, and local roadways providing last-mile access to the Port.
2. Growing trade across the Pacific Rim and increasing barge sizes are putting excess demand on the Port and causing operational inefficiencies.
3. Freight rail transportation is generally underutilized, with the exception of the Union Pacific (UP) Martinez Subdivision. Shifting goods movement from trucking to rail is a common planning strategy for alleviating congestion while increasing freight reliability and sustainability across all four MPOs. However, the lack of east-west rail connections in the central coast region limits the potential for increased rail activity for some markets.
4. Air cargo is underutilized in the study area, with demand projections set to increase. The ability to decrease reliance on trucking for goods movement of high-value, low-weight, and perishable goods, as well as next-day e commerce deliveries, access to airports in the region will be important to facilitate an increase in air cargo.
5. Increasing land values, cheaper labor, and transportation access to Northern and Southern California consumer markets are causing manufacturing and distribution centers to move inland to the San Joaquin Valley. As a result, increased distance to the Port of Oakland is leading to longer trucking times and growing congestion along I-580 and I-880, primarily impacting exports from the San Joaquin Valley.
6. Urban land use is trending toward compact development near transit, especially in the Bay Area, creating redevelopment pressures in industrial areas and leading to conflict between freight and passenger transportation modes.
7. East-west connections between the Central Coast (U.S. 101 corridor) and the Central Valley (I-5 corridor) cannot adequately support increases in heavy-duty truck volumes. Poor connectivity could hinder economic competitiveness of agriculture and related sectors.



Opportunities

These potential next steps are by no means the first or only opportunities to leverage synergies between each region's investments, policies, and regulations. Many of the program investments are most likely already synergistic across regions. As economic growth throughout the Megaregion generates more inter-regional congestion and exacerbates bottlenecks, substantive coordination between MPOs will leverage scarce funding and preserve political capital needed to implement difficult policies and regulations.

1. Develop an understanding of the synergies between regions by mapping investments and bottlenecks throughout the Megaregion, then overlaying them onto a map of interregional freight flows along key interregional highway corridors. Their alignment (or non-alignment) of these investments will indicate gaps, or where upstream investments result in greater volumes of truck or train traffic on the downstream network, which may not yet have sufficient capacity. Even when investments are integrated, their implementation may not be synchronized or sequenced effectively.
2. Some interregional challenges may not be feasible to remedy with capital investments. Therefore, interregional planning could implement policies or regulations across impacted regions, which may resolve downstream bottlenecks or unintended consequences more cost-effectively than capacity investments. Example of potential policies and regulations are highlighted in the adjacent call-out.
3. Land use policies and regulations that restrict industrial development in the Bay Area have contributed to migration of distribution and manufacturing uses to adjoining regions. Coordinating land use policies may benefit from sophisticated land use modeling underway at MTC, which will provide more accurate projections of the transportation impacts from the increasing scarcity and restrictive regulations on industrial land within the Bay Area. This better understanding should improve the type, scale, location and timing of capacity investment throughout the Megaregion.

One example of a coordinated investment could include U.S. 101, a major goods movement corridor that connects agriculture, manufacturing, and distribution facilities along the Central Coast and Napa/Sonoma region to Bay Area consumer markets and intermodal terminals. Investment along this corridor could include coordinating both small- and large-scale projects. For example, unauthorized parking near delivery points, shipping hubs, and harvest areas creates safety hazards, and a lack of critical amenities, such as food, showers, and services are needed for drivers making pick-ups and deliveries throughout the Megaregion. Addressing these challenges reduces interference with tourism from the Bay Area and protects last-mile access from farms, ultimately enabling efficient and reliable shipments of perishable agricultural goods to market, throughout the Megaregion and for export.

Prohibit trucks along the I-205/I-580 corridor during peak periods, but convert HOV lanes to truck only during off-peak.

Implement a PierPASS program at the Port of Oakland and simultaneously develop truck staging areas for drayage trucks.

Initiate a broader study to plan for efficiently locating storage, processing, and transfer facilities within the San Joaquin Valley, which is the biggest agricultural exporter in the world.

Goods Movement Investment Guide for the Megaregion

The final element of this study is the development of three investment strategies intended to initiate more coordinated goods movement planning between the four subregions that comprise the Northern California Megaregion. The investment strategy proposed in this study is focused on achieving **three objectives which the MRGM Study is uniquely positioned to advance:**

- 1. Megaregional Coordination:** Given that the vast majority of the Megaregion's freight-intensive industries operate across multiple subregions, the full success of each subregion's investment strategy depends on the investment strategies in adjacent regions. At present, the coordination between subregions does not appear sufficient or consistent enough to obtain the most effective outcomes. By specifying goals for each bundle, the coordination between individual regions can improve the synergies between investments and timing of construction, as well as minimize and mitigate unintended consequences.
- 2. Funding Competitiveness:** There is a growing trend with federal grant applications for Federal Highway Administration (FHWA) discretionary funding for goods movement (e.g., BUILD, INFRA) that suggests that more applicants are bundling multiple projects to demonstrate a collective strategy that benefits a larger region. This strategy presents a compelling narrative and demonstrates diverse benefits to economic growth, worker equity, and ancillary benefits to safety, environment, and quality of life.
- 3. Climate Resilience:** Over the past decade, California has adopted a statewide Climate Adaptation Strategy and passed the California Global Warming Solutions Act, which are some of the most aggressive climate change strategies in the world. The Megaregion's success at gaining a public consensus for goods movement investments will be enhanced if its investment strategies integrate climate change adaptation and mitigation. These benefits expand as the scale of projects expand by both linking similar projects across regional boundaries and combining projects of different types to reduce carbon emissions.



These objectives are largely unmet at present and if addressed could provide critical advantages to the growth of freight intensive industry throughout the megaregion while mitigating the unintended disbenefits of goods movement on communities, commuters, and the environment. Meeting these objectives, however, will require more than implementing a list of all the goods movement investments each subregion has compiled. To achieve these objectives, we propose three investment strategies.

- » **Bundle #1:** Sustain and Grow Tradable Industry Output
- » **Bundle #2:** Workforce Accessibility and Economic Mobility
- » **Bundle #3:** Value-Added Food Production and Distribution

These strategies function as programs that bundle investments to achieve a better outcome for the Megaregion as a whole than could be achieved by each region pursuing these investment strategies individually. The list of candidate investments, which have been assembled from multiple planning documents and stakeholder engagement, are not critical at this early stage. Rather, the strategy demonstrates how each bundle can achieve the three objectives described above by building narratives around a purpose that all stakeholders will find compelling and will demonstrate a coordinated and comprehensive program to state and federal agencies evaluating grant applications.

The candidate projects and policies in each strategy also includes those that benefit goods movement along a major interregional rail or highway corridor, which public agencies and private stakeholders have suggested but are not included in current RTPs or submitted list of projects for the 2019 update to the California Freight Mobility Plan (CFMP). These strategies are intended as initial organizing structures to launch future partnerships between subregions, Caltrans, and private stakeholders.

The strategies do not propose reallocating funding or finding additional funding sources, nor do they rank projects within a bundle. Unlike the CFMP updates, the strategies do not limit projects based on a five-year implementation timeline. These bundles are not intended to be the only interregional strategies worth considering, nor are they necessarily the most economically potent combinations. Their further study may reveal other combinations that provide greater economic benefits, fewer environmental impacts, higher levels of safety, less conflict between freight and non-freight modes, or more leverage with private sector partners (e.g., developers, railroads, ports, and freight-dependent industries). Nevertheless, these bundles provide a foundation for stakeholders to organize their applications for federal and state funding and coordinate goods movement planning among subregions.



Bundle 1: Sustain and Grow Tradable Industry Output

The goal of this strategy is to expand the economic output of the Megaregion's economy by supporting the freight-intensive "tradable" industry sector. Industries in the tradable sector produce goods and services that are shipped by any mode (e.g., truck, air cargo, ship, rail, pipeline, drone) and further processed or consumed outside the Megaregion, which includes any other part of California, the U.S., North America, or international markets. By contrast, the "local" sector produces goods that are consumed within the Megaregion. Both sectors – tradable and local – are supported by freight-intensive industries, and it is important to note that the Megaregion's vast economy both consumes and exports tradable goods. Although this local consumption is vital to the Megaregion's economic health and quality of life, it does not generate income from outside the region. Tradable sector activities, however, bring new money into the Megaregion, where it is invested and spent in the local economy, supporting more jobs and higher incomes for the Megaregion's households than goods both produced and consumed locally.

Projects that support tradable goods production and shipment include:

- » Improving the Megaregion's rail connectivity to the rest of the nation;
- » Increasing reliability;
- » Increasing port capacity;
- » Easing intermodal bottlenecks; and
- » Reducing supply chain activities congestion between regions including first-to-last mile connectivity between producers, distributors, and ports.

Overall Strategy Objectives

- » **Megaregion Coordination:** Because businesses in these sectors and the nodes that handle their shipments to far flung markets are distributed throughout the Megaregion, the vast majority of export activities cross regional boundaries. The vast majority of investments for this bundle will support trucking that traverses multi-regional highway corridors, multimodal supply chains that transport finished

and intermediate goods between trans-national rail lines, inland ports and the Port of Oakland, and transloading at distribution centers scattered across northern California. A logical next step would be to target specific tradable industries and conduct a rigorous supply chain analysis that would map the flow of raw, intermediate and final goods to determine where the bottleneck are located and the severity of their impediment to more efficient production, distribution and export. Such an analysis should demonstrate an investment strategy that disregards regional boundaries will improve the outcomes by at least an order of magnitude.

- » **Funding Competitiveness:** Conventional knowledge accepts that robust benefit-cost ratios, high percentages of local matching funds, and project readiness are among the top criteria that the Federal Highway Administration (FHWA) applies to evaluate goods movement grant applications for federal discretionary funding (e.g., INFRA, BUILD). However, there is immense value in a compelling narrative that presents an investment package that produces benefits that are greater than the sum of individual projects. Furthermore, this bundle recognizes that the growth in earnings and employment from increased exports of intermediate and finished goods generates greater benefits at a national scale compared to projects that benefit local industries by reducing trade deficits and involving businesses located throughout the U.S.
- » **Climate Resilience:** The potential for this strategy to reduce greenhouse gases depends on the how well projects individually and collectively reduce truck vehicle miles traveled (VMT), reduce overall congestion, divert cargo from truck to rail/ barge modes, and accelerate the substitution of clean technologies into transport and manufacturing of tradable goods. By design, however, these investments are intended to increase the flow of freight through the Megaregion, which would exacerbate climate change unless the strategy integrates mitigation measures into the bundle of investments. Furthermore, an analysis of an increase in tradable industry output for the Megaregion may reveal that this expanded output is due to a proportional reduction in output from industries in other regions or countries that were polluting more per ton of output. Finally, this bundle could integrate climate adaptation into infrastructure capacity projects (e.g., raising the height or relocating a highway that is being widened) or include stand-alone investments that improve resilience of critical infrastructure (e.g., seawalls around ports, undergrounding electric power lines adjacent wild-fire prone industrial facilities).

Bundle 2: Workforce Accessibility and Economic Mobility

The goal of this bundle is to provide the low income, less educated and skilled working age population throughout the Megaregion with livable wage jobs in freight-intensive industries. The investments needed for this bundle are intended to both help the industry sustain and growth demand and ensure the supply of qualified and available workers. This bundle will require two components: 1) infrastructure investments that will retain and attract the businesses that provide these jobs; and 2) policies, programs, and regulations needed to help workers live closer to these jobs, acquire and sustain the necessary skills, and gain access social services to support domestic responsibilities that could interfere with full-time work (e.g., daycare, health care, commuting).

Prioritizing projects that target industries with the greatest potential to generate jobs for low-income, low-skilled workers will require systematic and detailed research using establishment-level data and follow-up engagement with business owners, economic development agencies, and local jurisdictions.



Overall Strategy Objectives

- » **Megaregion Coordination:** It is likely that each region will need to select specific investments and programs that target the most significant workforce challenges they face based on the needs of their industries. Nevertheless, a systematic mapping of the industry clusters with the highest concentration of low-income and low-skilled workers across the Megaregion would be a good start. This overlay would highlight each industry cluster's size, forecasted growth, and proximity to concentrations of disadvantaged workers. This information would give each region a common, data-driven methodology for targeting clusters where public investments would be more likely to benefit employers with larger and more expansive demand for low income workers. Further, sharing curriculum development and training programs among the Megaregion's institutions will facilitate knowledge sharing and enhance its goods movement workforce with the skills needed for critical occupations.
- » **Funding Competitiveness:** This strategy does not include many investments that align with the criteria applied by FHWA to compete for discretionary federal goods movement funding. Nevertheless, other federal departments may have vocational training grants, low income housing assistance programs, and social service programs that support disadvantaged workers. As such, there may be competitive advantages to bundling transportation investments with grant applications for worker housing and job training. In addition, multinational manufacturing companies are expanding their apprenticeship programs in the U.S. to train workers for advanced manufacturing jobs in the highly automated assembly lines. At the state level, California's Department of Industrial Relations launched several apprenticeship programs to help alleviate the shortage of skilled workers in industries such as construction, building trades, clean energy, trucking, and manufacturing.
- » **Climate Resilience:** Similar to the objective of competing for funding assistance, this strategy does advance many investments that will improve the megaregion's climate resiliency. Nevertheless, the waste and energy sectors may provide the exception. The state's most recent climate change policies include aggressive goals to reduce greenhouse gases will greatly expand the demand for skilled clean energy workers. Furthermore, the existing (AB 32) and new legislation (SB 32) will require major investments in the transportation sector to in reducing vehicle emissions. These policies will generate employment opportunities that would require significant new investments from government and private industry.

Bundle 3: Value-Added Food Production and Distribution

The goals of this strategy are to ensure our food supply remains healthy and diverse, more resilient to disruptions (both natural disasters and economic), more accessible and affordable to all households, and provide living wage employment to low income households. Value added food production encompasses a much larger cluster of industry activities than just the agriculture sector, beginning with crop production, processing and possibly manufacturing, distribution; and finally retail sales and consumption (i.e., drinking and dining) within the Megaregion or export to domestic and international markets. The cluster generates high multiplier effects because the industries involved purchase a high share of their inputs from local suppliers and sell an even higher percentage of their output as tradable goods in markets outside the Megaregion.

Overall Strategy Objectives

- » **Megaregion Coordination:** The diversity of industries within the agriculture & food production cluster, as well as the differences between regions, revealed that this cluster may be too disparate to be supported with a single bundle of investments. Therefore, this study identified a subgroup of value added agricultural industries that are not strictly or substantially involved in the tradable goods sector (targeted in Bundle #1) or agricultural industries that employ the largest shares of low-income workers (targeted in Bundle #2). While far from defining clear separations from industries benefiting from the two other investment bundles, these distinctions left a group of industries that are focused on processing, distributing, and selling locally produced foods to the Megaregion's vast consumer market.
- » **Funding Competitiveness:** The same criteria used to evaluate the competitiveness of investments for Bundle #1 would apply to investment targeting value added agriculture industries. Nevertheless, criteria can vary between cycles of federal discretionary funding. It is possible that the next round will re-prioritize or include additional performance measures beyond the standard benefit-cost ratio and percentage of project cost covered with local or private matching funds. Safety, climate resilience, benefits to disadvantage workers, number of new jobs, food safety and access could all be woven into a compelling narrative to show how investments that expand value added agriculture industry.

- » **Climate Resilience:** The focus on "farm-to-table" industrial activity targets smaller, local businesses with investments in the Megaregion's economy as opposed to larger national and international agriculture firms that can usually satisfy demand from a wide geographic area with one plant regardless of where it is located (known as "footloose" firms). Growth as a share of value-added agriculture reduces the carbon footprint of this cluster since most (if not all) of their inputs are grown or processed within the Megaregion. Climate resilience can be applied to select investments that reduce dependence on imported food products and thereby lowering carbon emissions and strengthening local value-added businesses. The strategy for selecting investments, however, requires extensive outreach and coordination among private industry, non-profit organizations, and local and regional planning agencies.



Conclusion & Next Steps

These three investment bundles in particular, and the MRGM Study as a whole, demonstrate the potential for achieving greater and more cost-effective outcomes from collective goods movement planning among all agencies and stakeholders in the Megaregion. These outcomes go far beyond the individual efforts of the four regional MPOs, 19 counties, three Caltrans Districts, hundreds of local jurisdictions, trade associations, advocacy groups, ports, railroads, and tens of thousands of shippers, receivers, and carriers. While even the most optimistic predictions of a collective planning approach may not obtain more than moderate agreement among these stakeholders, further collaboration would improve synergies and mitigate unintended consequences between regions in the short term. If nurtured and sustained, the process could produce significant benefits. This expectation is grounded in three unique characteristics to goods movement that are not shared with other types transportation infrastructure:

- » **More Complexity:** Supply chain activities rely on a vast and diverse network of modes, intermediate nodes, pathways, types of private businesses, and assortment of public agencies. This complexity has been and will continue to increase with the pace and impact of technological innovation as well as the churn from domestic and global economic disruptions, both of which impose uncertainty that confounds local and regional planning.
- » **Greater Scale:** Goods movement is unique in that no other type of transportation extends from neighborhood streets and local markets to global infrastructure and international markets.
- » **Public-Private Partnership:** Private sector participation is essential for achieving a resilient and efficient goods movement network. Not only do shippers, receivers, and carriers depend on the infrastructure, they also own and operate a significant share of it and provide critical funding to public projects. These private stakeholders operate beyond the boundaries of regions and even the Megaregion.



These unique characteristics compel the regions to coordinate their goods movement planning. Some of the Northern California Megaregion's competitors have been more effective at bundling grant applications (e.g., Southern California) and coordinating megaregion-wide goods movement network planning (e.g., South Central Texas). Still, their freight-dependent industries are not as diverse as the Northern California Megaregion's complex mix of agriculture production, expanding manufacturing sector, exploding demand for consumer goods from an increasingly affluent population, crowding out of industrial land uses by the technology sector, and insatiable demand for housing. These challenges, however, come with opportunities, which the Megaregion can seize if public agencies and policy makers coordinate their efforts. These include infrastructure investments that expand capacity along multi-regional corridors, incentivize more efficient use of existing capacity, and implement effective regulations that better manage existing and future capacity to sustain economic growth, improve quality of life, and increase equity among Megaregion households.

More coordinated goods movement planning between the MTC, AMBAG, SACOG, and SJCOG regions can begin with:

- » **Organizing Stakeholders.** Expand the Technical Advisory Committee (TAC) membership to include private industry, persuade regional and local policymakers to provide matching funds for targeted investments, and lead well-coordinated applications for state and federal discretionary funding.
- » **Matching Funds and Establishing Public Private Partnerships.** Coordinate the many projects that are included in each region's Regional Transportation Plan (RTP), advocate for additional projects not included in the fiscally-constrained RTPs, and refine investment strategies to appeal to critical stakeholders - including elected officials, private industry, and other advocates - to increase their likelihood of success.
- » **Preparing Grant Applications.** Bundling multiple projects in federal discretionary funding applications (i.e. INFRA and BUILD) demonstrates a collective strategy that benefits a larger region and the nation as a whole.

A positive harbinger of this Study that bodes well for advancing more collaborative goods movement planning was the high level of expertise, professional respect, and sophisticated understanding of the data and analytics among the study's participants.



