

Appendix K. Future Freight System Scenarios

During the outreach and engagement process, stakeholders voiced concerns about the volume, impact, and conflicts of disruptive trends facing the freight industry. These trends (described in **Chapter 4**) create challenges for making long-term public and private investments in California's freight industry. Robotics and automation will result in changing skillsets necessary for the freight industry. The uncertainty of future conditions in our era requires creative thinking for effective long-range planning. Shifts in societal and/or technological standards may drastically alter freight dynamics and volume. Accurate planning requires an understanding of the impacts to prepare for the "what if" scenario.

The CFAC members recommended developing a Freight Scenario Modeling Technical Advisory Subcommittee to discuss the most relevant trends and identify scenarios for further analysis. Four meetings were held with the Subcommittee to discuss the necessity and importance of evaluating several possible scenarios as the context for the CFMP. The Subcommittee discussed how different trends could impact freight flows from various aspects, such as cargo sourcing, a destination of the cargo, mode and routing, total volume and shipment size (see **Table K.2**).⁴⁶² Based on this guidance, the following scenarios were developed based on the following recommended characteristics:

- Decision making: capture the right decision
- Plausibility: within realistic limits
- Alternatives: no favorites or preferences (unofficial/official)
- Consistency: internal logic is aligned
- Differentiation: structurally different
- Memorability: easy to recall (name helps)
- Challenge: push against established

Scenario Evaluation Methodology and Available Tools

The Subcommittee's selection of the CFMP 2020 scenarios focused on the ability to quantitatively analyze, compare, and contrast differences using available data and tools. The California Statewide Freight Forecasting Model and the California Statewide Travel Demand Model (CS2FDM, 2019) were integrated in 2020. The integrated model is validated for base year 2015 and future base year 2040, and it provides a consistent platform for statewide analysis. The CS2FDM will be the main tool to evaluate these scenarios. This is a transportation model; therefore, the economic elasticity of the supply chain to various factors—such as impacts of immigration or housing policies on population and job market or impacts of trade policies on import and export flows—needs to be evaluated in advance. Economic conditions of each scenario must be studied carefully and translated into basic model indicators such as population, employment, the capacity of facilities, the tonnage of goods to/from ports, a payload of trucks for different commodities, etc.

It is also important to consider available data, technical tools and resources, and the schedule for developing the most relevant alternative future scenarios and their respective analyses. Each scenario includes several elements. These elements are highly correlated and assumed to

generate similar impacts on freight flows. The dynamic nature of the multifaceted freight industry complicates a scenario analysis, as some trends will create contradicting impacts on freight flows. To conduct meaningful analysis, it is important to clearly define the assumptions in each scenario and only change the specified elements with all else remaining constant.

Table K.1: Freight Flow Patterns

How can an event impact Freight Flows?	<ul style="list-style-type: none"> • Impact on sourcing patterns: Where are raw products and WIP sourced from? Are materials sourced in or out of the region?
	<ul style="list-style-type: none"> • Impact on flow destination: Where is the demand located? How are destination locations distributed?
	<ul style="list-style-type: none"> • Impact on routing: How is freight moved within the region? Are there intermediate shipment points or mode switches?
	<ul style="list-style-type: none"> • Impact on flow volume: How will the total volume of freight shipped in and through the region change?
	<ul style="list-style-type: none"> • Impact on value density: How will the product characteristics change? How does the value density change?

Final CFMP 2020 Scenarios

The Subcommittee identified the following three scenarios to analyze:

- Land Use and Workforce Shift
- Trucking Operation on Freight Highway Network
- Emerging Modes in the Multimodal Freight System

The next steps involve clarifying and defining the assumptions and boundaries for each scenario, preparing input data, and identifying the methodology to evaluate each scenario in detail. The baseline assumptions for evaluating all scenarios are Existing Conditions (2015) and Future Baseline Conditions (2040).

The “Future 2040 Baseline Conditions” scenario includes:

- All RTP infrastructure projects
- MPOs’ projections for employment and population
- Historic patterns of household characteristics and industry mix in each region
- Historic growth of the state, national economy, jobs and GDP
- Historic trends of imports and exports from each gateway

The results of the Subcommittee survey were used for the selection process and was shared with all CFAC members at the January 8, 2019, CFAC meeting. The three scenarios recommended by CFAC for analysis are described below.

SCENARIO 1: LAND USE AND WORKFORCE SCENARIO

In this scenario, demand for the freight highway network deviates significantly from historic trends. The evaluation factors include changes in population and job balance for various industry sectors. These changes are anticipated to result in a severe transportation and warehousing workforce shortage in dense, urban areas. Under this scenario, workforces are predicted to migrate to lower density regions where housing is cheaper and more available. Conversely, urban areas may continue to reduce and restrict industrial development and shift wholesale and transport jobs to lower density rural areas. The focus areas may be (**Figure K.1**)⁴⁶³:

- In the Bay Area, the workforce and jobs are shifted from zones with high-median home value in Alameda, Contra Costa, San Mateo, Santa Cruz, and Santa Clara to the northern part of San Joaquin Valley.
- In Southern California, the workforces and jobs are shifted from the densest areas within Los Angeles County to the eastern edge of Los Angeles County, and to the surrounding, more affordable areas in San Bernardino, Riverside, and Northern San Diego Counties.

Input:

- Household candidates for migration were selected using the criteria detailed in **Table K.2**, wherein 25 to 100 percent of the new households (with at least one member working in blue-collar jobs) added between 2015 and 2040 are relocated based on household incomes.⁴⁶⁴
- The new home locations in Traffic Analysis Zones (TAZ) is probabilistically chosen by random drawings from a probability distribution with weights based on the proportion of low-income households (<\$35k). The higher the proportion of low-income households, more likely it is to receive the migrating households.

Table K.2: Classification of Migration Candidates

Home County	Household Income (In 2010 \$\$)	Worker Condition	% of (2015-2040) Moved
Alameda, Contra Costa, San Mateo, Santa Cruz, Santa Clara	HH Income <\$35k	At least one member working within this group	100%
Alameda, Contra Costa, San Mateo, Santa Cruz, Santa Clara	HH Income in (\$35k, \$75k)	At least one member working within this group 2,444	50%
Alameda, Contra Costa, San Mateo, Santa Cruz, Santa Clara	HH income >=\$75k	At least one member working within this group	25%
Los Angeles, Orange	HH income <\$35k	At least one member working within this group	100%
Los Angeles, Orange	HH Income in (\$35k, \$75k)	At least one member working within this group	50%
Los Angeles, Orange	HH income >=\$75k	At least one member working within this group	25%
Medium	Workforce Issues	Changes in housing in California	3
Medium	Workforce Issues	Workforce retraining and education	3
Low	Workforce Issues	Retention of workforce/businesses in California	7
Low	Workforce	Land use changes	14



Figure K.1: The Shift of Workforce and Jobs from Dense, Urban Areas (Orange) to Rural Areas (Blue) (Source: Analysis and map created by Fehr & Peers, 2019; U.S. Census Bureau TIGER Traffic Analysis Zones, 2017; Esri base map, 2019)

Table K.3: Original Home Locations and Changed Home Location of Relocated Households (County Level Stats)

New County Home									
Old Home County	Merced	Sacramento	San Joaquin	Solano	Stanislaus	Yolo	San Bernardino	Riverside	Grand total
Alameda	155	1,050	415	148	185	150			2,103
Contra Costa	76	545	224	70	135	81			1,131
San Mateo	65	421	156	41	78	56			817
Santa Clara	189	1,199	520	186	260	209			2,563
Santa Cruz	22	115	44	18	21	12			232
Los Angeles							18,132	18,755	36,887
Orange							4,183	4,259	8,442
Grand Total	507	3,330	1,359	463	679	508	22,315	23,014	52,175

Table K.3 shows the original and new home locations (county-level changes) of the 52,175 households that would be relocated. ⁴⁶⁵

- The growth in wholesale and transport jobs between 2015 and 2040 in Northern California Counties (Alameda, Contra Costa, San Mateo, Santa Cruz, Santa Clara) and Southern California Counties (Los Angeles, Orange) is reduced by 50 percent.
- These jobs are then apportioned to the beneficiary counties (Merced, Stanislaus, San Joaquin, Sacramento, Solano, Yolo in the north and San Bernardino, Riverside in the south) using a proportion of 2040 jobs before the migration.
- These changes are also reflected in the occupation listing - blue-collar by adjusting the counts by delta (wholesale jobs + transport jobs), assuming all the wholesale and transport jobs fall under the blue-collar category.
- The total number of population and jobs remain as the 2040 Baseline conditions proposed by MPOs. This scenario only shifts the lower income households and transportation jobs
- The import and export distribution from major gateways are also shifted proportionally to these new TAZs since the warehousing capacity at new TAZs has increased and while it is relatively decreased in other TAZs. The total volume of imports and exports via each gateway remains like the 2040 Baseline conditions.

Output

The following metrics would be evaluated for the percentage change at the regional, corridor or statewide level before and after:

- Population by income group
- Employments by industry

- Total VMT/truck VMT
- Volume on selected corridors (I-80, I-580, I-710 and I-605, I-10, I-5)
- Travel time/delay › Emissions/GHG

SCENARIO 2: TRUCKING OPERATIONS ON THE FREIGHT HIGHWAY NETWORK

This scenario assumes a freight highway network that deviates significantly from historic trends. This scenario also anticipates a large-scale impact on the planning and implementation of regional or statewide infrastructure projects or policies that affect trucking operations on the Freight Highway Network. When focusing on delivery, the majority of the costs consist of fuel and wages – both of which are heavily influenced by prevailing market forces.

One solution to reduce the cost and to increase the efficiency is dedicated truck facilities which allow truck platooning and autonomous trucks. Based on previous studies, the use of cooperative adaptive cruise control (CACC) by platooning and autonomous trucks could increase highway capacity and decrease traffic congestion. With 50 percent market penetration, highway capacity could increase by 22 percent, and with 80 percent penetration, it could increase by 50 percent.

This scenario assumes two major truck corridors have dedicated truck lanes between major freight hubs, and these dedicated lanes primarily serve platooning and autonomous trucks. These corridors are shown in **Figure K.2.**⁴⁶⁶

- Truck routes in Northern California, connecting the Ports of Oakland and Stockton with I-580, I-205, I-5 and SR 4.
- Truck routes in Southern California, connecting San Pedro Bay Ports of Long Beach and Los Angeles and the World Logistic Center in Moreno Valley with I-710 and SR 60.

Input

Network change to allow 100 percent platooning and autonomous trucks:

- On the above truck routes, change one of the existing general-purpose lanes to permanently dedicated truck lanes
- Increase the capacity for the new truck only lanes by 50 percent to represent the change of vehicle mix in these lanes
- Decrease the cost of trucking by reducing the travel time by 30 percent

Output

Changes at the regional, corridor or statewide level before and after are anticipated to be measurable in these four categories:

- Travel time/Delay
- Total and Truck VMT/VHT
- Regional traffic volume
- Mode split

SCENARIO 3: EMERGING MODES IN MULTIMODAL FREIGHT SYSTEM

This scenario assumes alternative cargo movers are introduced into the multimodal freight system. The purpose is to evaluate the impact of policies that encourage modal shifts between trucking, maritime, rail, air and other urbanized modes, on the performance and operation of the highway system. This scenario analyzes the anticipated migration to electric trucks, the implementation of drone and robot deliveries, and the introduction of autonomous trucks.

Input

Update Origin-Destination Matrix and shift hours of service:

- The Bay area and Southern California are selected as the dense urban areas.
- 50 percent of light duty trucks that travel less than 10 miles are replaced by another mode of transport; this part of the trip is eliminated from the O/D matrix
- 50 percent of light- and medium- duty trucks that travel 10-50 miles will be replaced with autonomous cargo handling trucks that operate during off-peak periods. To implement this change in the model, 50 percent of trucks that fit this description are shifted to the off-peak period, which represents fewer congestion conditions. See **Figure K.3.** for a map showing the 50-mile buffer area from the Bay area and Southern California.

Output

Following metrics would be evaluated for the percentage change at regional, corridor or statewide level before and after:

- Regional Wide Volume
- Travel Time/ Delay
- VHT/ VMT
- Mode Split

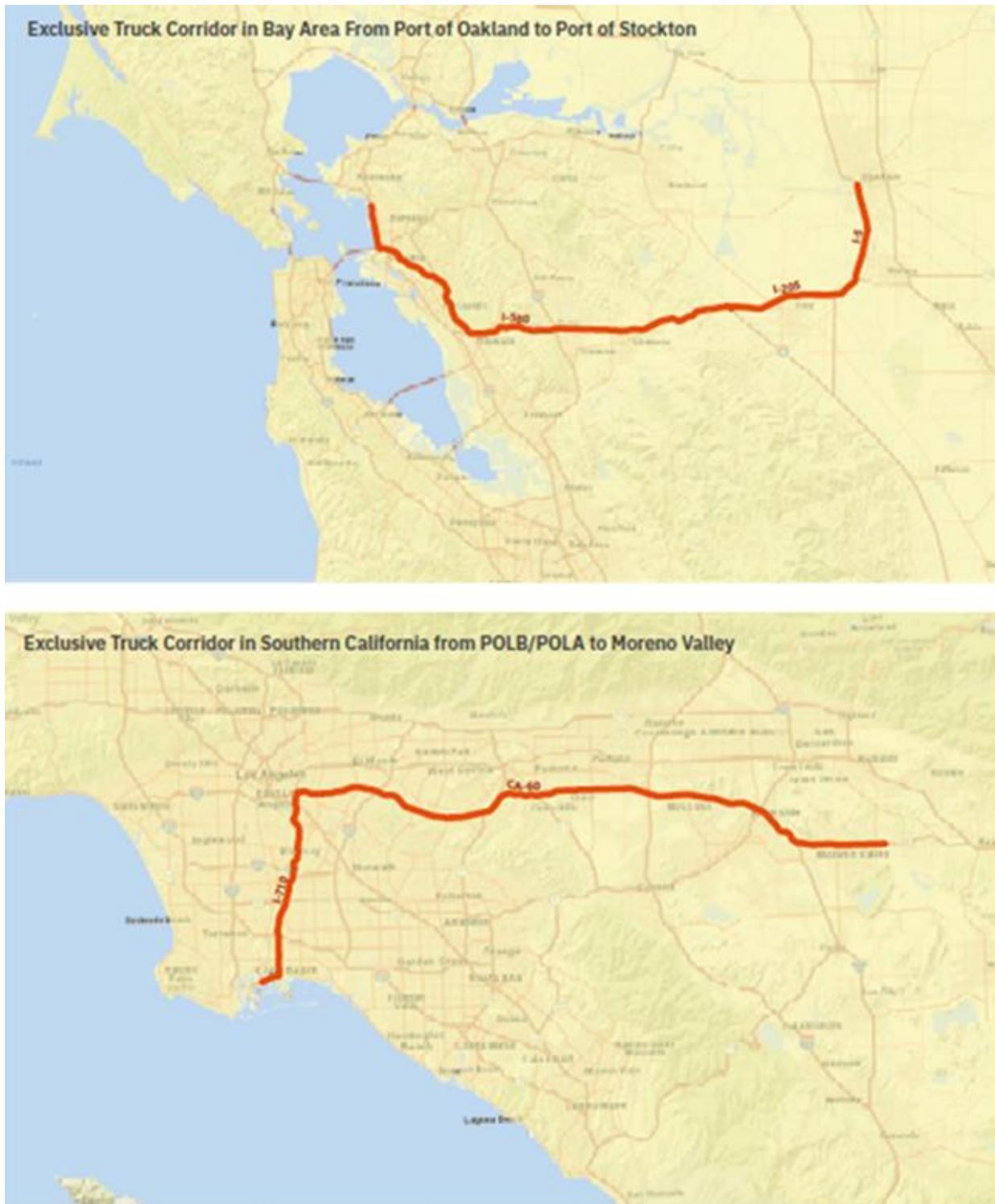


Figure K.2: Truck Routes for Platooning and Autonomous Trucks (Source: The California Department of Transportation)

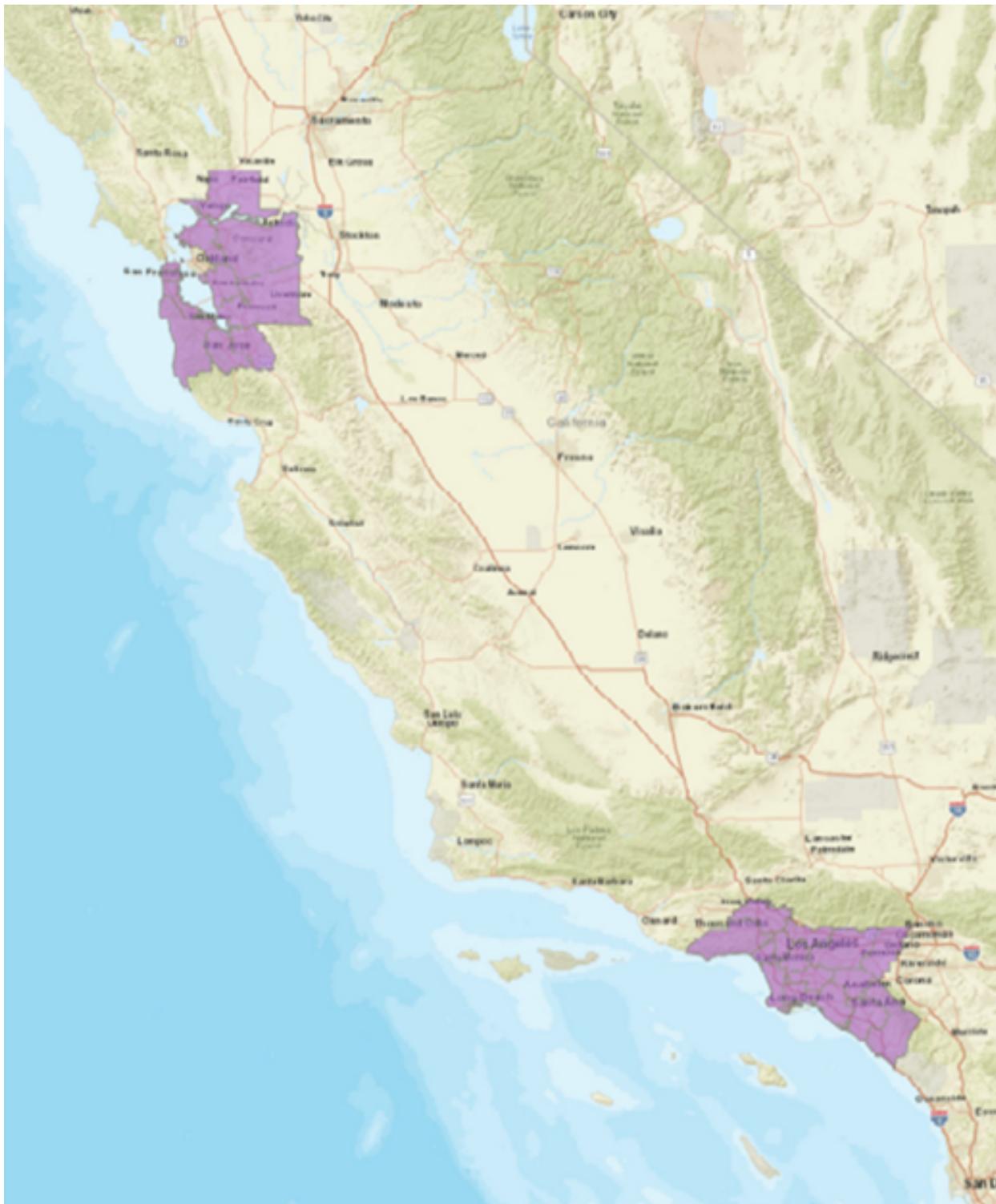


Figure K.3: Defense Urban Areas with Alternative Cargo Movers that Travel Less than 50 Miles (Source: The California Department of Transportation)