pandemic for many years, some other emergency situations may call for rapid adjustments on how food and other essential goods are packaged or repackaged and distributed.

- **Transit is Important for Essential Workers of the Freight Industry** – A survey by Metrolink found that 75% of its riders in 2021 were considered essential workers, and 14% of those riders worked in transportation and logistics. Over 1/3rd of riders had no car and almost half had an annual income of less than $50,000. Metrolink's 2021 COVID-19 Customer Survey was distributed via email to 312,929 Metrolink customers. The survey, which received 10,449 valid responses, was designed to identify riders' evolving needs, including their health and safety concerns.[204] Other transit agencies experienced large declines in ridership during the pandemic but found that essential workers made up a large percentage of its remaining riders. Without public transit options, many essential workers of the freight industry would have to find other more expensive means of travel to work or try to find new employment.

4C. Freight Flows and Forecast

As of the second quarter of 2022, California had a Gross Domestic Product (GDP) of $3.56 trillion[205]. Compared to the top 10 world economies listed in **Table 4.6**[206], California's GDP would approximately rank fifth in the world. California is comprised of 12 percent of the nation's population, accounts for 14 percent of the nation's economic output and continues to be a leading force in the U.S. economy. California's diversified economy and its prosperity are tied to domestic trade, as well as to exports and imports of goods and services through the State's key multi-modal gateways.

In 2021, California's total population was approximately 39.2 million[207]. Population growth remained strong in Central Valley and Southern California, particularly Inland Empire. The Los Angeles-Inland Empire region is home to the second largest consumer market in the U.S. after the Greater Hudson Valley region in New York state. While imported consumer goods pass through the state to other parts of the U.S., most goods stay within the state and are used by California consumers.

In 2021, California exported nearly $175 billion worth of goods, making it the second largest exporter behind Texas[208] . The value of California's exports equals to 10 percent of the nation's overall exports. In 2021, $470 billion of goods entered through California's transportation gateways, making it the largest importer in the nation[209].

Table 4.6: Top World Economies, 2022

Countries	Nominal GDP ($)
United States	$25.04 trillion
China	$18.32 trillion

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Japan	$4.3 trillion
Germany	$4.03 trillion
California*	$3.56 trillion
India	$3.47 trillion
United Kingdom	$3.2 trillion
France	$2.78 trillion
Canada	$2.2 trillion
Russia	$2.13 trillion
Italy	$2 trillion
Source: International Monetary Fund **Source: Gross Domestic Product: Second Quarter 2022, California, Bureau of Economic Analysis, 2022*	

From a global perspective, freight tonnage moving on the nation's transportation network will grow 42 percent in the next three decades, while the value of the freight will increase at a much faster pace[210]. Total freight on all modes (including air, vessel, pipeline, rail, and trucks) is projected to reach 28.9 billion tons while the value is expected to grow to $36.3 trillion[211].

FREIGHT FLOWS AND FORECASTS

Forecasting domestic and international freight flows presents many challenges. Changes in manufacturing locations, global economic forces, competition, new technologies, political dynamics, regulations, trade agreements, the opening of new routes, and labor disputes can each affect freight transportation.

The FHWA in partnership with the Bureau of Transportation Statistics (BTS) developed the Freight Analysis Framework (FAF), a database and analytical tool, to assist transportation planners and engineers in improving the planning, operation, and management of the nation's freight transportation system.

The FAF is a commodity flow database that integrates data from a variety of sources including the Commodity Flow Survey (CFS) data, Census Foreign Trade Statistics, Economic Census data, USDA's Census of Agriculture, Port Import/Export Reporting Service (PIERS), Vehicle Inventory and Use Survey (VIUS), National Highway Planning Network (NHPN), Highway Performance Monitoring System (HPMS), U.S. Energy Information Administration (EIA), and other industrial data. The data is used to depict a comprehensive national picture of freight flows among states and major metropolitan areas by all freight modes. The FAF5 (Version 5) is the most current version of the database, and it is built upon the 2017 CFS; the 2017 CFS contains 132 areas.

FAF5 forecasts are a reasonable exploration of current trends, but do not reflect major shifts in the national economy, future capacity limitations, or changes in transportation costs and technology. Simply stated, the data does offer insight into the economic impact of freight movements on a national scale and does not account for changes in the cost of transportation or advances in technology.

Data is available for the base year of 2017, the recent years of 2018 - 2020, forecasts from 2022 through 2050 in five-year intervals, and at the state level in the historic years of 1997 to 2012 in

five-year intervals. Since the FAF years after 2017 are estimates, the discussion below uses 2023 as the base year to be consistent with the California Freight Mobility Plan's adoption. The 2023 statistics below are forecasts based on the 2017 benchmark and do not reflect data collected during the COVID pandemic. This approach was taken to avoid the data collected during the pandemic, which saw a disruption in global freight flows and would skew any forecasting analysis conducted for this chapter. It is important to note that both the 2023 base year and the 2050 forecast year use 2017 funding that are adjusted to the years 2023 and 2050. This allows for comparing the real value of commodities across all years.

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The FAF5 mode and value calculations are based on the following nine possible freight flows depicted in **Figure 4.20.**

Flow 1: Major World Regions (MWRs) Flows destined for CA (directly)

Flow 2: CA origin flows destined for MWRs (directly)

Flow 3: MWRs International Flows through CA, destined for U.S.

Flow 4: Other State flows through CA, destined for MWRs

Flow 5: CA Intrastate Freight Flows (CA origin and destination)

Flow 6: CA Interstate Flows Destined for Other States (domestic only)

Flow 7: Other State Interstate Flows Destined for CA (domestic only)

Flow 8: MWRs International Flows through Other States Destined for CA
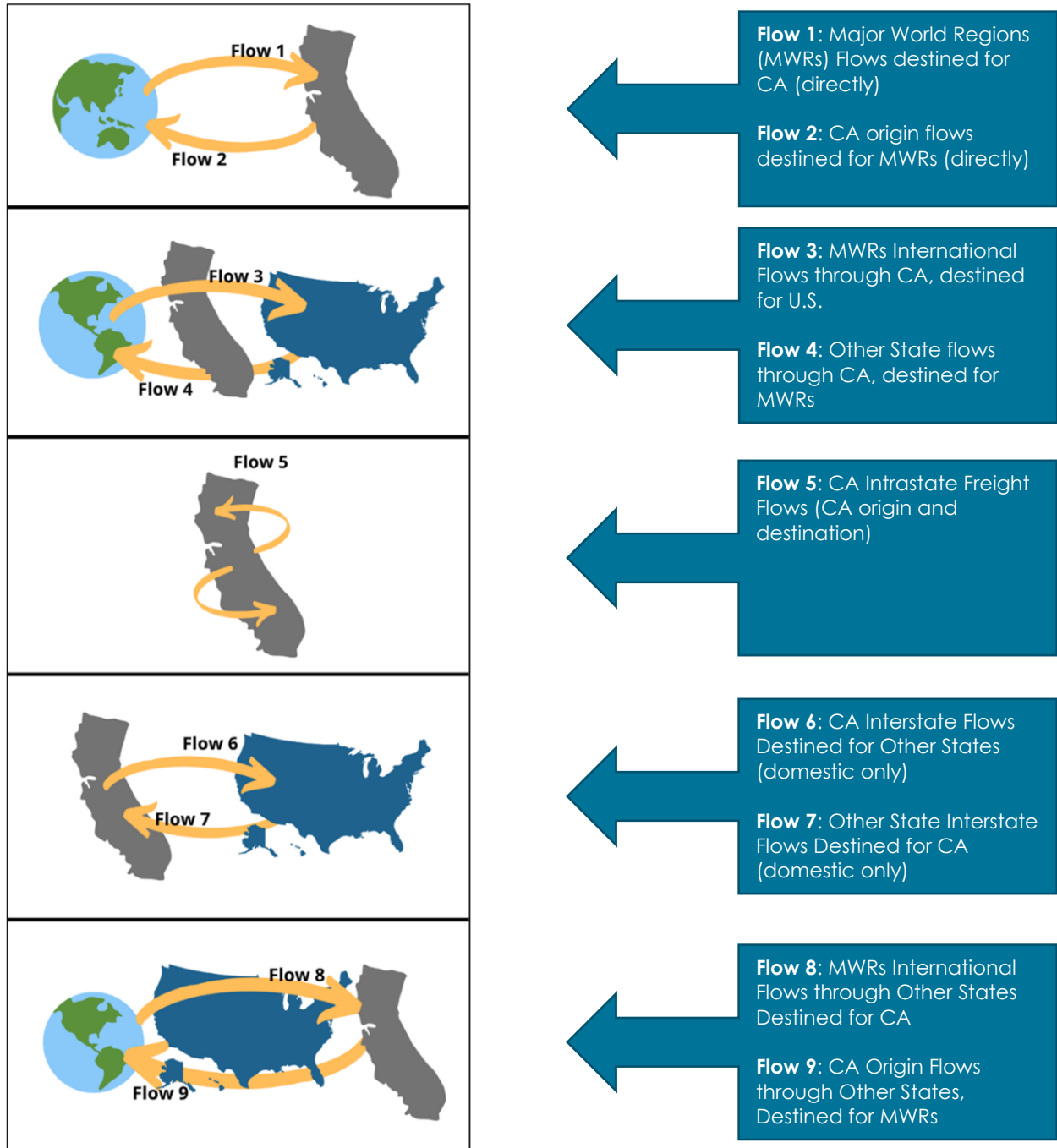
Flow 9: CA Origin Flows through Other States, Destined for MWRs

Figure 4.20: Freight Flows From, To, Within, and Through California (Source: FHWA Freight Analysis Framework, adapted by Caltrans

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COMMODITIES

Before delving into specific flow data for California, it is important to highlight the diverse commodities that are being transported throughout the State. In order to wisely invest transportation funds in meeting freight transport needs and requirements, it is important to understand the type and weight of commodities moving through the transportation system. In addition, some commodities have higher values so, it is important to know which of these items will likely be more time-sensitive and impacted by issues such as congestion.

The following discussion refers to the intrastate, interstate, and international shipments of commodities that have an origin or final destinations in California. Intrastate flows originate in and are destined for California, interstate flows are between other U.S. states and California, and international flows are between MWRs and California.

Table 4.7 shows the top ten commodities listed by weight for intrastate, interstate, and international flows originating from California. The top four 2023 California intrastate freight flows by weight include gasoline, non-metallic mineral products, gravel, and coal-n.e.c accounted for 37 percent of all intrastate commodity flows. Intrastate commodity flows are expected to increase in 2050 by approximately 480,657 kilotons, a 43 percent increase from 2023. The leading intrastate commodities forecasted for 2050 include non-metallic mineral products, gravel, coal-n.e.c, and other foodstuff. These top four commodities comprise 34 percent of all intrastate tonnage, and the top ten commodities represent 62 percent of all 2050 intrastate tonnage.

The top four 2023 interstate commodities by weight include other foodstuffs, other agricultural products, non-metallic mineral products, and plastics/rubber that comprised over 35 percent of the interstate tonnage with California origins and other state destinations. The top ten commodities combined totaled 90,643 kilotons and represented more than 61 percent of the total weight transported. By 2050, the total tonnage is forecasted to increase by 70 percent. Other foodstuffs will continue to be the lead commodity, with plastics/rubber, basic chemics, and other agricultural products rounding out the top four commodities for 2050. In addition, the total share of the top ten commodities by weight will grow to around 62 percent.

In terms of value, the top 10 commodities for intrastate (flow 5), interstate (flow 6), and international (flows 2 and 9) movement of goods destined for California for 2023 and the forecasted year of 2050 are identified in **Table 4.8**.

In 2023, electronics, mixed freight, and pharmaceuticals, and motorized vehicles were the top four California intrastate commodities by value, totaling $585 billion (37 percent of all commodities). The top 10 commodities for this year totaled around $1.019 trillion (64 percent of all commodities). Between 2023 and 2050, California's total intrastate commodity values are expected to increase 81 percent to $2.870 trillion. The top four commodities (electronics, pharmaceuticals, mixed freight, and motorized vehicles) are the same as in 2023, with pharmaceuticals and mixed freight switching their ranking. Their value is projected to increase to approximately $1.177 trillion in 2050.

In 2023, the top ten categories represented over 64 percent of the total intrastate commodity value of shipments; in 2050, it will increase to 69 percent, making them important to consider as freight transportation decisions are made.

Table 4.7: Top Ten Commodities Originating from California by Weight

2023 Top Ten	Weight (kilotons)	Top 10 (%)	All (%)	2050 Top Ten	Weight (kilotons)	Top 10 (%)	All (%)
Intrastate (CA to CA, Flow 5)							
Gasoline	110,523	14%	10%	Nonmetal min. prods.	159,572	16%	10%
Nonmetal min. prods.	106,759	14%	10%	Gravel	153,404	15%	10%
Gravel	101,768	13%	9%	Coal-n.e.c.	118,386	12%	7%
Coal-n.e.c.	93,409	12%	8%	Other foodstuffs	115,709	12%	7%
Crude petroleum	81,791	10%	7%	Gasoline	93,650	9%	6%
Other foodstuffs	76,504	10%	7%	Waste/scrap	81,090	8%	5%
Waste/scrap	54,746	7%	5%	Basic chemicals	72,797	7%	5%
Fuel oils	54,317	7%	5%	Natural sands	70,529	7%	4%
Natural sands	51,769	7%	5%	Mixed freight	64,566	7%	4%
Other ag prods.	48,056	6%	4%	Other ag prods.	63,586	6%	4%
Top Ten Total	**779,642**	**100%**	**69%**	**Top Ten Total**	**993,290**	**100%**	**62%**
All Commodity Total	**1,122,914**	%	%	**All Commodity Total**	**1,603,571**	%	%
Interstate (CA to Other U.S. States, Flow 6)							
Other foodstuffs	24741	27%	17%	Other foodstuffs	36,334	23%	14%
Other ag prods.	10,290	11%	7%	Plastics/rubber	17,345	11%	7%
Nonmetal min. prods.	9,515	10%	6%	Basic chemicals	15,525	10%	6%
Plastics/rubber	7,906	9%	5%	Other ag prods.	14,461	9%	6%
Electronics	7279	8%	5%	Electronics	13,419	9%	5%
Motorized vehicles		8%	5%	Motorized vehicles	13,198	8%	5%
Mixed freight	6,981	8%	5%	Mixed freight	12,971	8%	5%
Basic chemicals	5,760	6%	4%	Misc. mfg. prods.	12,373	8%	5%
Articles-base metal	5,609	6%	4%	Nonmetal min. prods.	11,635	7%	5%
Newsprint/paper	5,474	6%	4%	Textiles/leather	9,953	6%	4%

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	Value	Top 10 (%)	All (%)		Value	Top 10 (%)	All (%)
Top Ten Total	90,643	100%	61%	Top Ten Total	157,214	100%	62%
All Commodity Total	149187	164%	100%	All Commodity Total	254,168	161%	100%
International (CA to MWRs, Flows 2 & 9)							
Coal-n.e.c.	12,982	26%	20%	Waste/scrap	30,027	31%	24%
Waste/scrap	11,659	23%	18%	Coal-n.e.c.	19,099	20%	15%
Other ag prods.	5,330	11%	8%	Other ag prods.	9,153	9%	7%
Other foodstuffs	4,515	9%	7%	Other foodstuffs	9,029	9%	7%
Fuel oils	3,887	8%	6%	Fuel oils	7264	7%	6%
Animal feed	3540	7%	5%	Animal feed	6,773	7%	5%
Basic chemicals	2449	5%	4%	Gasoline	4,539	5%	4%
Gasoline	2,325	5%	4%	Basic chemicals	4,290	4%	3%
Cereal grains	1,785	4%	3%	Motorized vehicles	4,264	4%	3%
Motorized vehicles	1,620	3%	2%	Plastics/rubber	2,858	3%	2%
Top Ten Total	50,092	100%	77%	Top Ten Total	97,297	100%	77%
All Commodity Total	65,247	130%	100%	All Commodity Total	126,265	130%	100%
Source: Freight Analysis Framework Data Tabulation Tool -5							

Table 4.8: Top Ten Commodities Flows Originating from California by Value

2023 Top Ten	Value (millions)	Top 10 (%)	All (%)	2050 Top Ten	Value (millions)	Top 10 (%)	All (%)
Intrastate (CA to CA, Flow 5)							
Electronics	$240,028	24%	15%	Electronics	$433,834	22%	15%
Mixed freight	$134,102	13%	8%	Pharmaceuticals	$317,662	16%	11%
Pharmaceutical	$111369	11%	7%	Mixed freight	$239,462	12%	8%
Motorized vehicles	$99,197	10%	6%	Motorized vehicles	$186003	9%	6%
Textiles/leather	$86,830	9%	5%	Textiles/leather	$171,773	9%	6%
Other foodstuffs	$72,198	7%	5%	Plastics/rubber	$153,833	8%	5%

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Commodity	Value	%	%	Commodity	Value	%	%
Misc. mfg. prods.	$70,806	7%	4%	Misc. mfg. prods.	$150,974	8%	5%
Machinery	$69,388	7%	4%	Machinery	$120,072	6%	4%
Plastics/rubber	$69,254	7%	4%	Other foodstuffs	$112,367	6%	4%
Other ag prods.	$66,153	6%	4%	Precision instruments	$100,676	5%	4%
Top Ten Total	**$1,019,325**	**100%**	**64%**	**Top Ten Total**	**$1,986,655**	**100%**	**69%**
All Commodity Total	**$1,587,334**	**156%**	**100%**	**All Commodity Total**	**$2,870,163**	**144%**	**100%**
Interstate (CA to Other U.S. States, Flow 6)							
Electronics	$206,585	30%	23%	Electronics	$353,604	25%	20%
Textiles/leather	$87,354	13%	10%	Misc. mfg. prods.	$176,893	12%	10%
Misc. mfg. prods.	$71,470	10%	8%	Pharmaceuticals	$175,836	12%	10%
Motorized vehicles	$63,486	9%	7%	Textiles/leather	$172,009	12%	10%
Pharmaceutical	$62,292	9%	7%	Precision instruments	$124,207	9%	7%
Machinery	$57,078	8%	6%	Motorized vehicles	$118,348	8%	7%
Precision instruments	$50,450	7%	6%	Machinery	$105,879	7%	6%
Mixed freight	$34,007	5%	4%	Plastics/rubber	$72,022	5%	4%
Plastics/rubber	$32,492	5%	4%	Chemical prods.	$67,842	5%	4%
Other foodstuffs	$31,050	4%	3%	Mixed freight	$63,674	4%	4%
Top Ten Total	**$696,264**	**100%**	**78%**	**Top Ten Total**	**$1,430,314**	**100%**	**82%**
All Commodity Total	**$891,937**	**128%**	**100%**	**All Commodity Total**	**$1,741,872**	**121%**	**100%**
International (CA to MWRs, Flows 2 & 9)							
Electronics	$47,078	31%	25%	Electronics	$91,745	32%	25%
Machinery	$18,282	12%	10%	Motorized vehicles	$45,523	16%	12%
Precision instruments	$16,659	11%	9%	Machinery	$29,971	10%	8%
Motorized vehicles	$16,447	11%	9%	Precision instruments	$26,294	9%	7%
Other ag prods.	$13,147	9%	7%	Transport equip.	$24,044	8%	6%
Transport equip.	$12,160	8%	6%	Other ag prods.	$22,172	8%	6%
Misc. mfg. prods.	$9,431	6%	5%	Chemical prods.	$12,279	4%	3%
Chemical prods.	$6,511	4%	3%	Other foodstuffs	$12,115	4%	3%
Other foodstuffs	$5,900	4%	3%	Misc. mfg. prods.	$12,090	4%	3%

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Pharmaceutical	$5,187	3%	3%	Plastics/rubber	$11,053	4%	3%
Top Ten Total	**$150,802**	**100%**	**79%**	**Top Ten Total**	**$287,287**	**100%**	**77%**
All Commodity Total	**$192,028**	**127%**	**100%**	**All Commodity Total**	**$371,281**	**129%**	**100%**
Source: Freight Analysis Framework Data Tabulation Tool -5							

Flow 6 (interstate commodities) represents the value of goods originating in California and destined for other U.S. states. In 2023, electronics were among the top ten commodities by value and totaled to approximately $206 billion. The top ten commodities accounted for around 78 percent of the value of all goods destined for other U.S. states from California. The top four commodities, electronics, textiles/leather, miscellaneous manufacturing products, and motorized vehicles add up to approximately 48 percent of the total commodity value.

Between 2023 and 2050, the value of goods originating from California and flowing to other U.S. states is expected to increase 95 percent to $1.742 trillion. The value of electronics is expected to be $354 billion in 2050 and remain the number one commodity.

In 2023, the value of international goods originating in California and destined for MWR totaled approximately $192 billion. Additionally, in 2023, electronics are the top international commodity valued at $47 billion, comprising 31 percent of the top ten and 25 percent of the total commodity value.

Between 2023 and 2050, the value of international commodities is expected to increase from $192 to $371 billion, a 93 percent increase. Electronics is the top commodity for both 2023 and the forecasted year of 2050, comprising 25 percent of all 2050 commodities. California businesses, industries, manufacturers, governments, and residents rely on the transportation system to support the movement of goods into and out of the State.

In 2023, the top interstate commodities (by weight) flowing into California included coal-n.e.c., crude petroleum, other foodstuffs, and cereal grains. These items totaled to 96,353 kilotons, comprised 72 percent of the top ten tonnages, and 49 percent of all commodity tonnage. (**Table 4.9**) Interstate tonnage flowing into California is expected to increase 65 percent between 2023 and 2050. In 2050, it is projected that non-metallic mineral products will overtake cereal grains as the fourth-ranking commodity by weight. Coal-n.e.c. accounts for approximately 40 percent of the top ten commodities and 27 percent of all commodities by weight in 2023. In 2050, coal-n.e.c is expected to hold the number one ranking, comprise 46 percent of the top ten commodities, and comprise 32 percent of all interstate commodities destined for California.

Table 4.9: Top Ten Commodities Destined for California by Weight

2023 Top Ten	Weight (ktons)	Top 10 (%)	All (%)	2050 Top Ten	Weight (ktons)	Top 10 (%)	All (%)
Interstate (USA to CA, Flow 7)							

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Commodity				Commodity			
Coal-n.e.c.	52,714	40%	27%	Coal-n.e.c.	104,350	46%	32%
Crude petroleum	22,946	17%	12%	Crude petroleum	24,736	11%	8%
Other foodstuffs	12,456	9%	6%	Other foodstuffs	17,535	8%	5%
Cereal grains	8,236	6%	4%	Nonmetal min. prods.	15,064	7%	5%
Nonmetal min. prods.	7,629	6%	4%	Plastics/rubber	13,906	6%	4%
Wood prods.	7,429	6%	4%	Basic chemicals	12,565	6%	4%
Newsprint/paper	6,478	5%	3%	Wood prods.	10,182	4%	3%
Plastics/rubber	6,247	5%	3%	Cereal grains	9,960	4%	3%
Milled grain prods.	4,888	4%	3%	Chemical prods.	9,485	4%	3%
Chemical prods.	4,389	3%	2%	Newsprint/paper	8,907	4%	3%
Top Ten Total	133,412	100%	68%	Top Ten Total	226,690	100%	70%
All Commodity Total	195,173	146%	100%	All Commodity Total	322,740	142%	100%
International (MWRs to CA, Flows 1 & 8)							
Coal-n.e.c.	45,939	50%	35%	Waste/scrap	30,105	26%	16%
Waste/scrap	6,644	7%	5%	Coal-n.e.c.	14,599	13%	8%
Other ag prods.	6,288	7%	5%	Other ag prods.	12,064	10%	6%
Other foodstuffs	6,190	7%	5%	Other foodstuffs	10,818	9%	6%
Fuel oils	6,151	7%	5%	Fuel oils	10,137	9%	5%
Animal feed	4,580	5%	4%	Animal feed	9,553	8%	5%
Basic chemicals	4,111	4%	3%	Gasoline	9,353	8%	5%
Gasoline	4,097	4%	3%	Basic chemicals	7,171	6%	4%
Cereal grains	3,838	4%	3%	Motorized vehicles	6,329	5%	3%
Motorized vehicles	3,755	4%	3%	Plastics/rubber	6,280	5%	3%
Top Ten Total	91,593	100%	70%	Top Ten Total	116409	100%	63%
All Commodity Total	130,687	142%	100%	All Commodity Total	185,809	159%	100%

Source: Freight Analysis Framework Data Tabulation Tool -5

In 2023, international commodities flowing into California (both directly and indirectly) from MWRs to other U.S. states accounts for approximately 130,687 kilotons. The top ten commodities

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accounted for approximately 70 percent of all commodity tonnage. Coal-n.e.c. ranks number one in 2023 and is forecasted to rank number two in 2050. In 2023, it accounts for 35 percent of all commodity tonnage. Waste/scrap is forecasted to rank number one in 2050.

The top ten interstate and international commodities destined for California by value are displayed in **Table 4.10**. The value of international commodities destined for California both directly and indirectly (Flows 1 and 8) total $429 billion in 2023. The top commodities included electronics, motorized vehicles, textiles/leather, and machinery. These items comprised 63 percent of the total value and 75 percent of the top ten commodities. Between 2023 and 2050, the value of international commodities with a California destination is forecasted to increase from $455 billion to $884 million. In 2050, electronics, motorized vehicles, and textiles/leather, and machinery are expected to remain in the first four ranks respectfully.

Table 4.10: Top Ten Commodities Destined for California by Value

2023 Top Ten	Value (millions)	Top 10 (%)	All (%)	2050 Top Ten	Value (millions)	Top 10 (%)	All (%)
Interstate (USA to CA, Flow 7)							
Electronics	$64,922	21%	14%	Electronics	$103,560	18%	12%
Misc. mfg. prods.	$40,588	13%	9%	Misc. mfg. prods.	$87,475	15%	11%
Motorized vehicles	$39,551	13%	8%	Textiles/leather	$59,736	10%	7%
Textiles/leather	$35,238	11%	7%	Pharmaceuticals	$57,166	10%	7%
Machinery	$26,262	8%	6%	Motorized vehicles	$55,709	10%	7%
Precision instruments	$25,554	8%	5%	Precision instruments	$50,858	9%	6%
Plastics/rubber	$23,041	7%	5%	Plastics/rubber	$50,854	9%	6%
Other foodstuffs	$21,700	7%	5%	Machinery	$41,246	7%	5%
Pharmaceuticals	$19,528	6%	4%	Chemical prods.	$40,682	7%	5%
Chemical prods.	$18,997	6%	4%	Other foodstuffs	$31,729	5%	4%
Top Ten Total	**$315,379**	**100%**	**67%**	**Top Ten Total**	**$579,015**	**100%**	**64%**
All Commodity Total	**$473,270**	**150%**	**100%**	**All Commodity Total**	**$829,489**	**143%**	**100%**
International (MWRs to CA, Flows 1 & 8)							
Electronics	$142,430	39%	33%	Electronics	$320,042	41%	36%
Motorized vehicles	$66,268	18%	15%	Motorized vehicles	$144,643	19%	16%
Textiles/leather	$40,615	11%	9%	Textiles/leather	$91,599	12%	10%

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Machinery	$22,134	6%	5%	Machinery	$49,368	6%	6%
Misc. mfg. prods.	$20,610	6%	5%	Precision instruments	$44,976	6%	5%
Precision instruments	$19,389	5%	5%	Misc. mfg. prods.	$35,314	5%	4%
Crude petroleum	$14,819	4%	3%	Furniture	$31,255	4%	4%
Furniture	$13,478	4%	3%	Plastics/rubber	$22,296	3%	3%
Plastics/rubber	$11,692	3%	3%	Other ag prods.	$17,350	2%	2%
Other ag prods.	$10,052	3%	2%	Other foodstuffs	$17,192	2%	2%
Top Ten Total	**$361,486**	**100%**	**84%**	**Top Ten Total**	**$774,037**	**100%**	**88%**
All Commodity Total	**$429,313**	**119%**	**0%**	**All Commodity Total**	**$884,109**	**114%**	**100%**

Source: Freight Analysis Framework Data Tabulation Tool -5

These top ten lists show that a commodity ranking high in weight does not necessarily rank high in value. In the competitive world, consideration of volume, weight, and value are crucial to maximizing effectiveness of the freight transportation system. Identifying potential damage and congestion along critical freight corridors due to volume and weight of transported commodities allows for proactive planning, operational design, construction, and maintenance of the national and statewide multimodal freight system.

CALIFORNIA'S DOMESTIC MODE SHIPMENTS

When transporting commodities to, through, or within California, the mode of transportation is considered domestic. **Table 4.11** shows total weight of shipments in 2023 and 2050 (forecasted) by flow (in kilotons), domestic mode, and total value coming into, traveling through, and leaving California.

For example, California domestic-only shipments include all shipments within the State (Flow 5) as well as U.S.-only interstate movements involving the State (Flows 6 and 7). Imports and exports originating from MWR destined for California or originating in California and destined for MWRs are represented by Flows 1 and 2. However, import shipments destined for California can also arrive indirectly through other U.S. states (Flow 8), and exports originating in California can leave the country from other U.S. states (Flow 9). In addition, there are shipments that are not destined for California but pass through the state, entering and exiting our ports as imports and exports (Flows 3 and 4).

From 2023 to 2050, the total tonnage of California domestic mode shipments is expected to increase from 1.3 trillion kilotons (in 2023) to 1.8 trillion kilotons (in 2050). The dollar value associated with these exchanged goods is anticipated to increase to approximately $4.1 trillion. The majority of movements by both weight and value begin and end within California (Flow 5). In 2023, the total number of kilotons transported within California is 958,885 and are forecasted to reach 1,350,627 kilotons by 2050.

Trucking is currently the predominant mode of transportation for the State's freight shipments. By weight, trucks transport the largest amount of goods into, within, and out of the State. This is forecasted to remain the case through 2050. In 2023, pipelines transport the next highest volume of commodities, and it is expected to hold its rank into 2045. In percentage-wise, by weight, both the air and multiple modes and mail categories are expected to increase significantly between 2023 and 2050, perhaps due to growth in demand for e-commerce.

Table 4.11: Domestic and International Shipments by Weight and Value

Mode	2023		2050		Change 2023 to 2050	
	Weight	Value	Weight	Value	Weight	Value
	(ktons)	(million)	(ktons)	(million)	(ktons)	(million)
Flow 1. MWRs to CA						
Truck	5,126	$24,532	9,787	$52,552	91%	114%
Rail	7-	$5	11	$9	74%	77%
Water	104,699	$208,667	137,038	$414,660	31%	99%
Air*	689	$68,745	1,465	$152,161	113%	121%
Multiple**	302	$1,444	611	$3,060	102%	112%
Pipeline	255	$3	671	$8	163%	163%
Other and unknown	14	$338	29	$617	103%	82%
--	-	-	-	-	-	-
Totals	**111,093**	**$303,735**	**149,612**	**$623,067**	**109%**	**255%**
Flow 2. California to MWRs						
Truck	5,507	$17,838	10,962	$36,706	99%	106%
Rail	774	$227	13,2091,154	$421	49%	85%
Water	44,995	- $48,306	- 87,871	- $101,509	- 95%	- 110%
Air*	480	$68,142	914	$123,318	90%	81%
Multiple**	4	$40	10	$77	128%	95%
Pipeline	10	$1	15	$1-	53%	48%
Other and unknown	1,166	$4,109	2,406	$8,500	106%	107%
-	-	-	-	-	-	-
Totals	**52,936**	**$138,662**	**103,332**	**$270,533**	**359%**	**425%**
Flow 3. MWRs Through CA to Other U.S. States						
Truck	2,135	$13,219	4,351	$28,773	104%	118%
Rail	4	$1-	8	$2	92%	-97%

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Water	25,656	$141,664	49,739	$303,003	94%	114%
Air*	251	$21,500	516	$45,312	106%	111%
Multiple**	462	$2,968	927	$6,142	101%	107%
Other and unknown	5	$129	10	$243	83%	88%
-	-	-	-	-	-	-
-	-	-	-	-	-	-
Totals	**28,512**	**$179,482**	**55,551**	**$383,475**	**145%**	**301%**
Flow 4. Other U.S. States, through CA to MWRs						
Truck	1,352	$5,497	2,680	$11,262	98%	105%
Rail	1,212	$248	1,756	$377	45%	52%
Water	26,673	$51,222	52,657	$108,397	97%	112%
Air*	201	$24,816	396	$44,404	98%	79%
Multiple	546	$1,689	1,246	$3,460	128%	105%
Pipeline	424	$84	624	$123	47%	45%
Other and unknown	12,00	$3,392	2,501	$7,091	108%	109%
-	-	-	-	-	-	-
Totals	**31,608**	**$86,949**	**61,861**	**$175,113**	**223%**	**440%**
Flow 5. Within CA						
Truck	756,384	$917,379	1,128,171	$1,579,273	49%	72%
Rail	16,762	$3,187	26,908	$5,158	61%	62%
Water	13,487	$6,809	12,823	6,351	-5%	-7%
Air	26	$1,826	38	3,039	50%	66%
Multiple	7,698	$154,530	14,916	$325,798	94%	111%
Pipeline	164,527	$61,205	167,771	$56,945	-2%	-7%
-	-	-	-	-	-	-
-	-	-	-	-	-	-
Totals	**958,885**	**$1,144,937**	**1,350,627**	**$1,976,563**	**33%**	**58%**
Flow 6. CA to Other U.S. States						
Truck	78,967	$380,688	128,283	$703,968	62%	85%
Rail	5,841	$3,628	9,999	$5,965	71%	64%
Water	18	$22	26	$32	48%	45%
Air	734	$26,020	1,182	$51,624	61%	98%
Multiple	19,365	$247,075	33,368	$494,873	72%	3100%
Pipeline	3,439	$1,655	2,825	$1,187	59 -18%	64 -28%

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-	-	-	-	-	-	-
-	-	-	-	-	-	-
Totals	**108,364**	**$659,089**	**175,684**	**$1,257,648**	**62%**	**91%**
Flow 7. Other U.S. States to CA						
Truck	77,180	$257,156	130,095	$444,576	69%	73%
Rail	20,115	$8,199	27,035	$12,864	34%	57%
Water	22,748	$7,179	24,521	$7,739	8%	08%
Air	121	$20,385	219	$36,267	081%	78%
Multiple	27,050	$171,561	45,967	$310,648	70%	81%
Pipeline	47,959	$8,790	94,903	$17,394	98%	98%
-	-	-	-	-	-	-
-	-	-	-	-	-	-
Totals	**195,173**	**$473,270**	**322,740**	**$829,489**	**65%**	**75%**
Flow 8. MWRs, through Other U.S. States, to CA						
Truck	5,318	$18,853	10,105	$37,303	90%	98%
Rail	6,474	$17,721	11,090	$37,441	71%	111%
Water	$7,042	$34,469	13,409	$69,730	90%	102%
Air	263	$51,908	533	$111,296	103%	114%
Multiple	214	$2,385	418	$4,766	96%	100%
Pipeline	280	$94	636	$208	127%	121%
Other and unknown	3	$146	6	$297	87%	103%
-	-	-	-	-	-	-
Totals	**19,594**	**$125,578**	**36,197**	**$261,042**	**85%**	**108%**
Flow 9. CA, through Other U.S. States, to MWRs						
Truck	5,907	$19,575	11141	$36555	4089%	53587%
Rail	2,887	$3,017	5,437	$6,100	188%	225102%
Water	2,927	$7,716	- 5,172	$16,543	- 77%	114%
Air	271	$22,454	522	$40,372	93%	80%
Multiple	29	$176	56	$324	91%	--84
Pipeline	-	$-	-	$-	-	-
Other and unknown	289	$430	605	$855	109%	353%
-	-	-	-	-	-	-
Totals	**12,310**	**$53,366**	**22,934**	**$100,748**	**86%**	**89%**

Source: Freight Analysis Framework Data Tabulation Tool -5

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CALIFORNIA INTRASTATE FREIGHT FLOWS

Table 4.12 displays the intrastate freight flows between California's six domestic FAF regions, Fresno – Madera, Los Angeles – Long Beach, Sacramento – Roseville, San Diego – Carlsbad – San Marcos, San Jose – San Francisco, and the remainder of California. In 2023, Los Angeles – Long Beach (LALB) was the strongest generator of shipments (427,729 kilotons) and the largest recipient of shipments (432,074 kilotons). Approximately 86 percent of goods originating in the LALB region stay within the LALB region. By 2050, an increase in total shipments of 605,482 kilotons is forecasted from the LALB region.

Table 4.12: California Intrastate Freight (Flow 5)

From	California Regions To	2023 Weight (ktons)	2023 Value (millions)	2050 Weight (ktons)	2050 Value (millions)	Change 2023 to 2050 Weight (ktons)	Change 2023 to 2050 Value (millions)
Fresno - Madera CSA*	Fresno, Madera	9,186	$11,868	13,481	$20,461	47%	72%
	Los Angeles, Long Beach	2,142	$3,678	3,060	$5,875	43%	60%
	Remainder of CA	12,864	$12,574	19,958	$19,957	55%	59%
	Sacramento, Roseville	250	$822	376	$1,283	50%	56%
	San Diego, Carlsbad, San Marcos	206	$455	284	$792	37%	74%
	San Jose, San Francisco, Oakland	2,769	$3,426	4,319	$5,501	56%	61%
Subtotal		**27,417**	**$32,822**	**41,478**	**$53,868**	**51%**	**64%**
Los Angeles - Long Beach CSA	Fresno, Madera	2,556	$4,219	4,011	$7,182	57%	70%
	Los Angeles, Long Beach	365,759	$472,912	514,198	$836,038	41%	77%
	Remainder of CA	16,178	$29,799	25,740	$55,009	59%	85%
	Sacramento, Roseville	5,063	$8,224	7,129	$14,309	41%	74%
	San Diego, Carlsbad, San Marcos	17,879	$40,992	27,251	$77,288	52%	89%
	San Jose, San Francisco, Oakland	20,295	$33,332	27,153	$55,737	34%	67%
Subtotal		**427,729**	**$589,479**	**605,482**	**$1,045,563**	**42%**	**77%**
Remainder of CA	Fresno, Madera	9,731	$9,350	15,686	$16,273	61%	74%
	Los Angeles, Long Beach	36,325	$25,382	41,357	$35,631	14%	40%
	Remainder of CA	110,867	$76,144	159,259	$123,616	44%	62%

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	Sacramento, Roseville	6,563	$6,064	9,199	$9,388	40%	55%
	San Diego, Carlsbad, San Marcos	966	$1,195	1,273	$1,954	32%	64%
	San Jose, San Francisco, Oakland	28,881	$22,542	34,748	$33,210	20%	47%
Subtotal		**193,334**	**$140,676**	**261,521**	**$220,072**	**35%**	**56%**
Sacramento - Roseville CSA	Fresno, Madera	566	$3,273	992	$8,799	75%	169%
	Los Angeles, Long Beach	1,096	$2,809	2,000	$5,102	83%	82%
	Remainder of CA	6,866	$16,706	11,588	$41,000	69%	145%
	Sacramento, Roseville	43,404	$32,603	63,538	$65,515	46%	101%
	San Diego, Carlsbad, San Marcos	282	$887	467	$1,488	66%	68%
	San Jose, San Francisco, Oakland	5,898	$32,999	10,292	$80,267	74%	143%
Subtotal		**58,112**	**$89,277**	**88,876**	**$202,170**	**53%**	**126%**
San Diego - Carlsbad - San Marcos MSA**	Fresno, Madera	148	$246	211	$414	42%	68%
	Los Angeles, Long Beach	9,259	$10,353	13,257	$17,212	43%	66%
	Remainder of CA	1,243	$1,664	1,919	$2,787	54%	67%
	Sacramento, Roseville	55	$489	88	$847	61%	73%
	San Diego, Carlsbad, San Marcos	34,803	$48,243	40,601	$73,885	17%	53%
	San Jose, San Francisco, Oakland	306	$2,511	471	$4,391	54%	75%
Subtotal		**45,815**	**$63,506**	**56,547**	**$99,536**	**23%**	**57%**
San Jose - San Francisco - Oakland CSA	Fresno, Madera	3,592	$4,369	5,982	$7,381	67%	69%
	Los Angeles, Long Beach	17,493	$24,463	29,159	$38,311	67%	57%
	Remainder of CA	17,471	$23,552	26,763	$38,704	53%	64%
	Sacramento, Roseville	8,499	$14,570	12,110	$23,036	42%	58%
	San Diego, Carlsbad, San Marcos	419	$3,820	626	$5,789	50%	52%
	San Jose, San Francisco, Oakland	159,005	$158,404	222,083	$242,132	40%	53%
Subtotal		**206,479**	**$229,177**	**296,723**	**$355,354**	**44%**	**55%**
Grand Totals		**958,885**	**$1,144,937**	**1,350,627**	**$1,976,563**	**41%**	**73%**

* CSA - Combined Statistical Area; ** MSA - Metropolitan Statistical Area; Source: Freight Analysis Framework Data Tabulation Tool 5

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The next largest California shipment generator in 2023 is the San Jose -San Francisco – Oakland (SJSFO) region, with 206,479 kilotons of shipments. By 2050, shipment volume from SJSFO is projected to increase to 296,723 kilotons (44 percent increase). This will also increase value to $355 billion (55 percent increase).

CALIFORNIA'S DOMESTIC INTERSTATE FREIGHT FLOWS

Domestic flows from California to other U.S. states are identified in **Table 4.13** (Flow 6) and domestic flows from other U.S. states to California are represented in **Table 4.14** (Flow 7). In 2023, 33 percent of all domestic commodities by weight (36,251 kilotons) flowed from California **(Table 4.13)** to Nevada, Arizona, and Texas. In 2050, these states are expected to maintain their top 3

rankings, see an increase to 57,086 kilotons, and comprise approximately 32 percent of the total weight of all domestic flows from California to other U.S. states.

Table 4.13: Domestic Freight Flows from California to Other U.S. States (Flow 6)

Other U.S. States	2023 Weight (ktons)	2023 Value (millions)	2050 Weight (ktons)	2050 Value (millions)	Change 2023 to 2050 Weight (ktons)	Change 2023 to 2050 Value (millions)
Alabama	1,214	$10,726	2,291	$20,178	89%	88%
Alaska	73	$878	131	$1,624	80%	85%
Arizona	12,395	$41,369	19,416	$74,073	57%	79%
Arkansas	492	$3,016	883	$5,734	79%	90%
Colorado	2,615	$15,671	4,389	$29,668	68%	89%
Connecticut	408	$6,775	791	$12,938	94%	91%
Delaware	95	$1,190	169	$2,331	79%	96%
Washington DC	34	$876	66	$1,855	95%	112%
Florida	3,012	$38,069	4,804	$66,869	59%	76%
Georgia	2,366	$18,163	4,066	$33,460	72%	84%
Hawaii	1,843	$11,115	3,383	$24,868	84%	124%
Idaho	1,113	$4,702	2,079	$10,082	87%	114%
Illinois	4,371	$25,492	7,168	$50,907	64%	100%
Indiana	2,077	$12,033	3,386	$24,322	63%	102%
Iowa	452	$4,726	735	$9,025	62%	91%

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Kansas	834	$7,265	1,468	$14,099	76%	94%
Kentucky	1,044	$9,045	1,675	$19,517	60%	116%
Louisiana	464	$5,061	810	$11,059	74%	118%
Maine	107	$1,256	183	$2,521	71%	101%
Maryland	1,456	$9,921	2,467	$18,503	69%	86%
Massachusetts	782	$11,666	1,244	$20,046	59%	72%
Michigan	1,544	$12,873	3,106	$27,131	101%	111%
Minnesota	1,230	$10,886	2,049	$21,476	67%	97%
Mississippi	1,052	$8,418	1,682	$15,895	60%	89%
Missouri	4,885	$11,472	8,194	$18,353	68%	60%
Montana	803	$890	1,258	$1,477	57%	66%
Nebraska	5,024	$4,219	6,213	$7,091	24%	68%
Nevada	17,528	$13,715	31,235	$26,791	78%	95%
New Hampshire	162	$2,594	235	$3,891	46%	50%
New Jersey	1,439	$17,165	2,590	$32,544	80%	90%
New Mexico	843	$1,525	1,345	$2,575	60%	69%
New York	1,912	$25,280	3,483	$47,397	82%	87%
North Carolina	1,640	$15,474	3,016	$24,503	84%	58%
North Dakota	574	$994	787	$1,729	37%	74%
Ohio	3,317	$16,778	5,451	$27,194	64%	62%
Oklahoma	2,183	$5,341	3,930	$9,588	80%	80%
Oregon	27,428	$18,148	50,234	$31,332	83%	73%
Pennsylvania	2,248	$17,092	3,867	$30,982	72%	81%
Rhode Island	47	$1,144	82	$1,796	73%	57%
South Carolina	1,247	$6,104	2,312	$11,130	85%	82%
South Dakota	1,705	$916	2,856	$1,673	68%	83%
Tennessee	1,923	$15,500	3,269	$28,350	70%	83%
Texas	12,761	$45,775	24,756	$85,128	94%	86%
Utah	8,017	$13,379	9,214	$25,370	15%	90%
Vermont	48	$702	64	$1,098	32%	56%

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Virginia	969	$5,929	1,829	$10,181	89%	72%
Washington	6,910	$23,587	10,784	$45,604	56%	93%
West Virginia	105	$475	184	$759	75%	60%
Wisconsin	2,315	$10,573	3,301	$16,002	43%	51%
Wyoming	712	$469	1,940	$1,035	172%	121%
Grand Total	**195,173**	**$473,270**	**322,740**	**$829,489**	**65%**	**75%**
Source: Freight Analysis Framework Data Tabulation Tool 5						

INTERNATIONAL FREIGHT FLOWS

Export and Import Flows Destined for California

This section addresses foreign shipments (directly and indirectly) destined for California (Table 4C.10, Flows 1 and 8), and export shipments originating in California and destined (directly and indirectly) for MWRs (Table 4C.13, Flows 2 and 9). MWR goods that are shipped directly to California (or the reverse) are considered direct shipments. Commodities originating in a MWR, passing through California, with a destination of other U.S. states (or the reverse) are considered indirect shipments.

International shipments arrive in California by various modes, however a vast majority of these shipments enter California via cargo ships. In 2023, approximately 111,742 kilotons (86 percent) of the total international (imports) shipments (Flow 1 and 8) to California arrive by ship **(Table 4.14).** By 2050, shipments via cargo ships are expected to be 81 percent of total imports.

Table 4.14: Total Import Flows from Major Regions to California (Flows 1 & 8)

	2023		2050		Change 2023 to 2050	
Major World Regions (International Origins)	**Weight (ktons)**	**Value (millions)**	**Weight (ktons)**	**Value (millions)**	**Weight (ktons)**	**Value (millions)**
Africa	5,835	$3,000	3,086	$3,093	-47%	3%
Canada	13,443	$18,592	25,156	$39,220	87%	111%
Eastern Asia	31,751	$232,470	59,371	$493,412	87%	112%
Europe	9,972	$41,689	16,430	$85,154	65%	104%
Mexico	13,216	$53,287	22,976	$107,010	74%	101%
Rest of Americas	28,909	$15,721	28,377	$20,098	-2%	28%
SE Asia & Oceania	10,344	$50,172	18,876	$113,415	82%	126%
SW & Central Asia	17,218	$14,381	11,539	$22,707	-33%	58%
Total	**130,687**	**$429,313**	**185,809**	**$884,109**	**42%**	**106%**

Import Modes (MWRs to CA)						
Air (include truck-air)	952	$120,653	1,997	$263,457	110%	118%
Multiple modes & mail	516	$3,830	1,029	$7,826	99%	104%
Other and unknown	18	$485	35	$914	101%	88%
Pipeline	535	$97	1,307	$217	144%	122%
Rail	6,481	$17,726	11,101	$37,450	71%	111%
Truck	10,444	$43,385	19,892	$89,855	90%	107%
Water	111,742	$243,137	150,447	$484,390	35%	99%
Total	130,687	$429,313	185,809	$884,109	42%	106%
Source: Freight Analysis Framework Data Tabulation Tool 5						

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Most goods arriving by ship are break bulk (goods that must be loaded individually), or containerized, goods in shipping containers. These goods are transferred to other modes of transportation in order to be distributed throughout California and beyond. As shown in the domestic modes portion of **Table 4.15**, a large shift occurs at the ports where shipments are transferred to trucks, pipelines, and other modes.

Table 4.15: Total Import Flows from Major Regions to California (Flows 1 & 8)

Major World Regions (International Destination)	2023		2050		Change 2023 to 2050	
	Weight (ktons)	Value (millions)	Weight (ktons)	Value (millions)	Weight (ktons)	Value (millions)
Africa	5,783	$2,637	2,999	$2,487	-48%	-6%
Canada	5,586	$1,240	11,227	$1,777	101%	43%
Eastern Asia	28,284	$174,748	52,442	$371,723	85%	113%
Europe	8,418	$30,599	13,287	$62,670	58%	105%
Mexico	8,600	$28,715	14,426	$59,442	68%	107%
Rest of Americas	28,262	$13,680	27,327	$16,495	-3%	21%
SE Asia & Oceania	9,288	$40,172	17,153	$91,550	85%	128%
SW & Central Asia	16,873	$11,943	10,753	$16,924	-36%	42%
Total	**111,093**	**$303,735**	**149,612**	**$623,067**	**35%**	**105%**
Import Mode International Mode						
Air (include truck-air)	689	$68,745	1,465	$152,161	113%	121%
Multiple modes & mail	302	$1,444	611	$3,060	102%	112%
Other and unknown	14	$338	29	$617	103%	82%
Pipeline	255	$3	671	$8	163%	163%
Rail	7	$5	11	$9	74%	77%
Truck	5,126	$24,532	9,787	$52,552	91%	114%
Water	104,699	$208,667	137,038	$414,660	31%	99%
Total	**111,093**	**$303,735**	**149,612**	**$623,067**	**35%**	**105%**
Domestic Mode CA (Intrastate Mode)						
Air (include truck-air)	340	$32,253	711	$71,195	109%	121%
Multiple modes & mail	7,456	$22,347	13,608	$45,702	83%	105%
No domestic mode	42,710	$13,777	27,417	$8,844	-36%	-36%
Other and unknown	14	$338	29	$617	103%	82%
Pipeline	14	$0	37	$0	163%	163%

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Rail	2,341	$3,614	3,722	$6,238	59%	73%
Truck	52,141	$223,058	96,578	$474,465	85%	113%
Water	6,076	$8,349	7,510	$16,006	24%	92%
Total	**111,093**	**$303,735**	**149,612**	**$623,067**	**35%**	**105%**
Source: Freight Analysis Framework Data Tabulation Tool 5						

Time-sensitive shipments of high value are flown into various California international airports, primarily Los Angeles International Airport (LAX). **Table 4.14** illustrates that between 2023 and 2050, international flows from MWRs into California (imports) via air cargo (by weight) are forecast to increase from 952 kilotons to nearly 1,997 kilotons (over 110 percent) and is expected to increase 118 percent in value (from $121 billion to $263 billion).

International freight arriving into California through ground transportation import modes must come from either Mexico or Canada. In 2023, approximately 20 percent combined weight from these border countries (about 26,659 kilotons) is imported into the U.S. by rail and truck. In 2050, the share will reach about 26 percent (to over 48,132 kilotons).

The total value of 2023 outbound shipments from California by all modes to Canada and Mexico is $50.6 billion **(Table 4.17),** and inbound shipments from those countries to California were worth $71.9 billion **(Table 4.14)**. By 2050, overall outbound shipments are projected to grow to $371.3 billion and inbound shipments to $884.1 billion.

California's largest international trading region, both import and export, by weight and value is Eastern Asia – and this trend is forecasted to continue into 2050 **(see Tables 4.14 and 4.17).**

International flows into California by weight are projected to grow from 111,093 kilotons in 2023 to 149,612 kilotons in 2050 **(Table 4.15)**. The value of international shipments arriving directly into California between 2023 and 2050 is projected to increase by 105 percent. As represented in **Table 4.16** (Flow 8), in 2023 and beyond, Texas, Washington, and Michigan lead the U.S. in transported weight of foreign commodities destined for California. Texas, Illinois, and Tennessee lead by value.

Table 4.16: Domestic Flows from MWRs, Through Other U.S. States to CA (Flow 8)

	2023		2050		Change 2023 to 2050	
Other U.S. States	**Weight (ktons)**	**Value (millions)**	**Weight (ktons)**	**Value (millions)**	**Weight (ktons)**	**Value (millions)**
Alabama	31.58	$853.46	65.96	$1,431.35	109%	68%
Alaska	19.17	$4,392.75	37.50	$10,509.31	96%	139%
Arizona	1,068.58	$2,169.56	2,169.84	$4,231.74	103%	95%
Arkansas	0.01	$3.98	0.01	$9.36	135%	135%

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Colorado	0.35	$47.49	0.69	$95.26	94%	101%
Connecticut	0.05	$7.37	0.10	$14.40	98%	95%
Delaware	53.46	$116.13	77.51	$176.04	45%	52%
Florida	864.55	$7,009.27	1,747.61	$14,909.72	102%	113%
Georgia	383.49	$3,159.29	794.19	$7,044.38	107%	123%
Hawaii	38.65	$130.75	74.56	$267.85	93%	105%
Idaho	1,021.55	$359.37	1,745.42	$674.30	71%	88%
Illinois	682.72	$18,400.73	989.18	$37,057.57	45%	101%
Indiana	2.07	$22.82	4.02	$50.48	94%	121%
Iowa	0.00	$0.19	0.01	$0.40	116%	113%
Kansas	0.00	$0.08	0.00	$0.18	121%	125%
Kentucky	35.66	$9,502.21	72.07	$19,996.78	102%	110%
Louisiana	72.43	$160.21	131.03	$316.12	81%	97%
Maine	36.21	$699.31	73.65	$1,362.75	103%	95%
Maryland	196.72	$1,364.72	345.54	$2,477.85	76%	82%
Massachusetts	36.37	$293.71	68.12	$630.98	87%	115%
Michigan	1,829.95	$9,649.16	3,827.19	$21,640.73	109%	124%
Minnesota	0.41	$18.38	0.80	$36.58	94%	99%
Mississippi	6.08	$40.85	10.18	$68.26	67%	67%
Missouri	0.16	$7.46	0.32	$14.75	106%	98%
Montana	1,218.93	$830.84	2,509.38	$1,902.83	106%	129%
Nebraska	0.01	$1.52	0.03	$3.33	96%	120%
Nevada	0.58	$12.41	1.22	$27.46	109%	121%
New Hampshire	0.09	$14.59	0.17	$28.44	96%	95%
New Jersey	1,404.85	$9,140.40	2,821.63	$18,890.43	101%	107%
New Mexico	15.27	$51.57	26.53	$100.83	74%	96%
New York	592.75	$7,253.50	1,188.72	$15,840.94	101%	118%
North Carolina	111.80	$326.90	239.59	$715.77	114%	119%
North Dakota	306.48	$316.52	573.27	$577.14	87%	82%
Ohio	52.20	$668.22	97.24	$1,413.20	86%	111%
Oklahoma	0.04	$3.77	0.08	$8.23	103%	118%
Oregon	407.72	$4,175.77	793.43	$8,217.74	95%	97%
Pennsylvania	359.55	$1,037.36	596.21	$1,834.14	66%	77%
Rhode Island	-	-	-	-	-	-

South Carolina	593.58	$1,907.62	1,227.18	$4,090.90	107%	114%
South Dakota	-	-	-	-	-	-
Tennessee	45.52	$10,403.56	92.77	$22,320.19	104%	115%
Texas	4,385.60	$25,620.62	8,035.19	$51,293.72	83%	100%
Utah	0.55	$52.62	1.12	$112.16	105%	113%
Vermont	2.28	$32.59	3.82	$78.18	68%	140%
Virginia	404.79	$1,236.43	844.22	$2,646.49	109%	114%
Washington	3,310.11	$4,000.31	4,906.77	$7,747.98	48%	94%
Washington DC	1.01	$77.05	2.10	$166.41	107%	116%
West Virginia	-	-	-	-	-	-
Wisconsin	0.46	$4.32	0.81	$7.89	76%	83%
Total	**19,594.39**	**$125,577.74**	**36,197.01**	**$261,041.56**	**85%**	**108%**

Included to the hundredths decimal place to capture the weight and value that did not display during rounding; Source: Freight Analysis Framework Data Tabulation Tool 5

From California to MWRs (**Table 4.17**), Eastern Asia led other world regions in 2023 with $55.7 billion for approximately 29 percent of the total value followed distantly by Europe (22 percent) and Mexico (16 percent) by value. Total export flows are forecasted to increase by 2050 in value by 93 percent and weight by 94 percent.

Table 4.17: Total California Origin Flows to Major World Region (Flows 2 & 9)

Major World Regions (International Destinations)	2023		2050		Change 2023 to 2050	
	Weight (ktons)	Value (millions)	Weight (ktons)	Value (millions)	Weight (ktons)	Value (millions)
Africa	280	$1,191	497	$2,154	77%	81%
Canada	7,560	$20,756	14,201	$37,885	88%	83%
Eastern Asia	20,728	$55,665	32,984	$103,224	59%	85%
Europe	3,592	$41,484	6,283	$80,366	75%	94%
Mexico	11,709	$29,869	22,859	$61,628	95%	106%
Rest of Americas	6,572	$9,576	12,437	$18,730	89%	96%
South East Asia & Oceania	9,613	$19,847	23,441	$40,647	144%	105%
South West & Central Asia	5,193	$13,639	13,562	$26,648	161%	95%
Total	**65,247**	**$192,028**	**126,265**	**$371,281**	**94%**	**93%**

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Export Modes (CA to MWRs)						
Air (include truck-air)	752	$90,596	1,436	$163,690	91%	81%
Multiple modes & mail	34	$215	66	$401	96%	86%
Other and unknown	1,455	$4,538	3,011	$9,355	107%	106%
Pipeline	10	$1	15	$1	53%	48%
Rail	3,661	$3,244	6,592	$6,521	80%	101%
Truck	11,414	$37,413	22,103	$73,261	94%	96%
Water	47,922	$56,021	93,043	$118,053	94%	111%
Total	65,247	$192,028	126,265	$371,281	94%	93%
Source: Freight Analysis Framework Data Tabulation Tool 5						

Regarding exports originating in California and exiting to foreign lands through other states (**Table 4.18**, Flow 9), most of the weight will continue to be transported through Michigan, Texas, and Washington. In 2023, Texas, Michigan, and New York were the leading states in value for this freight flow.

Table 4.18: Domestic Flows from CA, Through Other States, to MWRs (Flow 9)

	2023		2050		Change 2023 to 2050	
Other U.S. States	Weight (ktons)	Value (millions)	Weight (ktons)	Value (millions)	Weight (ktons)	Value (millions)
Alabama	28.60	$53.54	68.57	$93.03	140%	74%
Alaska	249.57	$1,765.11	427.12	$3,221.99	71%	83%
Arizona	393.70	$895.65	632.54	$1,685.70	61%	88%
Arkansas	-	-	-	-	-	-
Colorado	0.12	$11.22	0.25	$27.97	113%	149%
Connecticut	0.73	$0.43	1.15	$0.70	58%	62%
Delaware	3.26	$13.32	6.90	$25.15	112%	89%
Florida	125.31	$2,833.09	258.64	$5,664.43	106%	100%
Georgia	90.38	$898.60	152.04	$1,787.57	68%	99%
Hawaii	47.56	$2,166.95	122.71	$3,997.94	158%	84%
Idaho	0.61	$13.16	1.39	$27.11	129%	106%
Illinois	8.82	$418.89	15.11	$682.19	71%	63%
Indiana	0.90	$292.52	1.92	$466.44	113%	59%
Iowa	-	-	-	-	-	-

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Kansas	0.00	$0.12	0.00	$0.20	68%	62%
Kentucky	34.65	$5,295.52	62.14	$8,535.47	79%	61%
Louisiana	423.86	$142.55	607.09	$210.95	43%	48%
Maine	9.69	$37.57	21.52	$73.92	122%	97%
Maryland	38.85	$620.54	119.78	$2,009.47	208%	224%
Massachusetts	2.65	$18.55	7.24	$38.08	173%	105%
Michigan	2,946.34	$8,204.31	5,552.19	$14,688.50	88%	79%
Minnesota	0.29	$28.34	0.57	$54.69	96%	93%
Mississippi	119.04	$91.46	199.11	$143.26	67%	57%
Missouri	0.00	$0.70	0.00	$1.28	82%	82%
Montana	783.05	$1,565.19	1,454.07	$2,953.28	86%	89%
Nebraska	-	-	-	-	-	-
Nevada	1.75	$167.11	3.66	$392.01	110%	135%
New Hampshire	0.12	$15.85	0.24	$29.78	94%	88%
New Jersey	34.38	$459.35	77.49	$882.38	125%	92%
New Mexico	79.28	$236.23	170.21	$516.32	115%	119%
New York	1,810.14	$7,437.48	3,499.64	$13,050.65	93%	75%
North Carolina	7.93	$82.27	12.30	$151.19	55%	84%
North Dakota	167.54	$295.82	325.31	$584.41	94%	98%
Ohio	38.98	$35.40	111.25	$83.98	185%	137%
Oklahoma	0.00	$0.01	0.00	$0.02	75%	62%
Oregon	21.17	$14.71	25.61	$20.82	21%	41%
Pennsylvania	11.26	$642.72	23.40	$1,259.11	108%	96%
Rhode Island	0.02	$0.03	0.02	$0.05	64%	64%
South Carolina	24.98	$155.13	42.57	$283.24	70%	83%
South Dakota	0.57	$37.64	1.14	$90.23	99%	140%
Tennessee	22.96	$4,420.27	46.88	$8,530.14	104%	93%
Texas	2,522.08	$9,795.72	4,770.90	$20,435.24	89%	109%
Utah	0.21	$13.19	0.38	$25.67	79%	95%
Vermont	38.75	$34.07	61.45	$72.08	59%	112%
Virginia	53.96	$227.59	77.78	$405.45	44%	78%
Washington	2,165.81	$3,846.74	3,970.60	$7,389.47	83%	92%
Washington DC	0.48	$81.41	0.91	$156.70	90%	92%
West Virginia	0.00	$ 0.02	0.00	$0.04	109%	109%

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Wisconsin	0.00	$0.06	0.00	$0.10	45%	57%
Total	12,310.33	$53,366.17	22,933.77	$100,748.40	86%	89%

Included to the hundredths decimal place to capture the weight and value that did not display during rounding
*Undefined: percent increase from a base of 0 is expressed by infinity
Source: Freight Analysis Framework Data Tabulation Tool 5

Forecasted international flows by weight into California (**Table 4.15,** Flows 1 and 8) in the domestic mode show around 47 percent more commodities imported into California than leaving the State for foreign destinations (**Table 4.17**, Flows 2 and 9) in 2050. The weight of California exports is expected to increase much faster than imports destined for California over the forecast period (94 percent versus around 42 percent). However, the value of these imports will increase to $884 billion, while exports will only reach $371 billion. Therefore, a large trade imbalance is forecast to remain in the future.

Exports and Imports Through, Not Destined for, California

This section provides information regarding international shipments that are either destined for or originate within the rest of the U.S. and are heading to or departing from the eight MWRs using California's ports of entry/exit (i.e., through shipments). To a large extent, this can be considered discretionary trade that could go to/from other states without traversing California. This trade is an important component of the California's freight sector as it supports thousands of jobs at seaport, railroad, trucking, transloading, and warehousing facilities. Although these shipments are not destined for California, some processing or repacking of freight containers may occur here. As displayed in **Table 4.19** (flow 3), shipments from MWRs, through California, to the other states are expected to increase in weight by 95 percent from 28,512 kilotons to 55,551 kilotons. Goods from MWRs destined for other states through California imports arriving in waterborne vessels (international modes) are 25,656 kilotons in 2023 and it is expected to climb to 49,739 kilotons by year 2050. It is important to note that some ports, such as the POLB and POLA, compute freight flows specific to their operations and may not be consistent with outputs from the FAF.

Table 4.19: Major World Region Flows Destined for Other U.S. States, Through California (Flow 3)

Major World Regions (International Origins)	2023 Weight (ktons)	2023 Value (millions)	2050 Weight (ktons)	2050 Value (millions)	Change 2023 to 2050 Weight (ktons)	Change 2023 to 2050 Value (millions)
Africa	43	$219	67	$425	56%	94%
Canada	318	$1,390	543	$2,862	71%	106%
Eastern Asia	17,782	$123,561	35,386	$261,023	99%	111%
Europe	1,236	$7,883	2,506	$16,685	103%	112%
Mexico	3,552	$16,692	6,206	$34,848	75%	109%
Rest of Americas	1,416	$1,443	2,411	$2,363	70%	64%

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South East Asia & Oceania	3,684	$22,196	7,432	$54,121	102%	144%
South West & Central Asia	481	$6,097	999	$11,149	108%	83%
Total	**28,512**	**$179,482**	**55,551**	**$383,475**	**95%**	**114%**
International Modes (MWRs to CA)						
Air (include truck-air)	251	$21,500	516	$45,312	106%	111%
Multiple modes & mail	462	$2,968	927	$6,142	101%	107%
Other and unknown	5	$129	10	$243	83%	88%
Rail	4	$1	8	$2	92%	97%
Truck	2,135	$13,219	4,351	$28,773	104%	118%
Water	25,656	$141,664	49,739	$303,003	94%	114%
Total	**28,512**	**$179,482**	**55,551**	**$383,475**	**95%**	**114%**
Domestic Modes (CA to Other U.S. States)						
Air (include truck-air)	237	$17,071	484	$35,872	104%	110%
Multiple modes & mail	7,976	$41,512	15,580	$89,033	95%	114%
Other and unknown	5	$129	10	$243	83%	88%
Rail	3,769	$13,867	6,547	$28,579	74%	106%
Truck	16,292	$106,704	32,717	$229,458	101%	115%
Water	233	$199	213	$290	-9%	46%
Total	**28,512**	**$179,482**	**55,551**	**$383,475**	**95%**	**114%**
Source: Freight Analysis Framework Data Tabulation Tool 5						

Exports from other states traveling through California to MWRs are estimated to increase by over 96 percent from 31,608 kilotons to 61,861 kilotons (**Table 4.20**, Flow 4). Value figures between 2023 and 2050 in the export direction are forecasted to increase by approximately 101 percent from around $86.9 billion to nearly $175.1 billion, while in the reverse direction (**Table 4.15**), an increase in import value of 114 percent from $179.5 billion to $383.5 billion has been forecasted. In terms of value, international movements traveling through California in transit for other states will be approximately 119 percent more than the export flows of other states traveling through California to MWRs by 2050.

Table 4.20: Exports from Other U.S. States, Through CA, to Major World Regions

	2023		2050		Change 2023 to 2050	
Domestic Modes (Other U.S. States to CA)	**Weight (ktons)**	**Value (millions)**	**Weight (ktons)**	**Value (millions)**	**Weight (ktons)**	**Value (millions)**

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Air (include truck-air)	165	$19,468	319	$35,725	93%	84%
Multiple modes & mail	5,546	$13,064	10,906	$27,227	97%	108%
Other and unknown	1,200	$3,392	2,501	$7,091	108%	109%
Pipeline	424	$84	624	$123	47%	45%
Rail	8,492	$8,146	16,474	$17,036	94%	109%
Truck	15,693	$42,548	30,862	$87,300	97%	105%
Water	87	$246	174	$613	101%	149%
Total	31,608	$86,949	61,861	$175,113	96%	101%
International Mode (CA to MWRs)						
Air (include truck-air)	201	$24,816	396	$44,404	98%	79%
Multiple modes & mail	546	$1,689	1,246	$3,460	128%	105%
Other and unknown	1,200	$3,392	2,501	$7,091	108%	109%
Pipeline	424	$84	624	$123	47%	45%
Rail	1,212	$248	1,756	$377	45%	52%
Truck	1,352	$5,497	2,680	$11,262	98%	105%
Water	26,673	$51,222	52,657	$108,397	97%	112%
Total	31,608	$86,949	61,861	$175,113	96%	101%
Major World Regions (Destinations)						
Africa	128	$266	185	$465	45%	75%
Canada	595	$1,482	1,317	$3,091	121%	109%
Eastern Asia	17,978	$46,559	32,475	$93,630	81%	101%
Europe	856	$8,757	1,737	$15,606	103%	78%
Mexico	3,119	$6,925	5,290	$13,957	70%	102%
Rest of Americas	706	$1,597	1,196	$3,245	69%	103%
South East Asia & Oceania	7,330	$18,900	17,333	$40,202	136%	113%
South West & Central Asia	898	$2,463	2,329	$4,916	159%	100%
Total	31,608	$86,949	61,861	$175,113	96%	101%

Source: Freight Analysis Framework Data Tabulation Tool 5

CONCLUSION

California's economy is freight transportation-dependent. Despite California's excellent rail, marine, highway, and air connections to national and international destinations, projected growth in freight, even with currently planned improvements, will strain the capacity of the transportation system and potentially increase community and environmental impacts. Investment in our transportation infrastructure is needed to remain competitive with other states

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and countries that are investing in their transportation networks and reducing impacts to California's environment and communities. Along with the system investments, mitigation, and implementation of best practices will be necessary.

The highway network is the largest component of California's freight network in terms of infrastructure, tonnage shipped, and value shipped. It provides first- and last-mile connections to other modes in addition to supporting California's key industries. Trucks are by far the single most-used mode (between air, train, marine, and pipelines) to move freight. The FAF freight data and forecasts strongly indicate that freight moved on trucks is expected to increase for the foreseeable future since tonnage for trucking is forecast to grow by 47 percent by 2050. The value of shipments is expected to grow over two times as fast as their weight; thus, the cost of trucks delayed by congestion will rise accordingly. Trucks unable to meet shipment schedules will directly affect regional and state economic development and competitiveness. On the other hand, it takes several thousand passenger vehicles passing over a given segment of roadway to do the same damage as one fully loaded, heavy-duty 5-axle truck. Understanding that there will be more truck trips on California highways will inform decision-makers of needed infrastructure improvements, such as strengthening pavement design standards, constructing dedicated truck facilities, shortening pavement maintenance schedules, and effecting modal shifts to avoid highway impacts. Transportation funds should be invested in key freight corridors to address anticipated growth of freight tonnage on California's highways.

Linking State and local transportation investments, especially in freight transportation infrastructure, to economic development is vital for the regional, local, and overall State economy, as well as for keeping businesses in and attracting them to California. Adequate transportation is one of several key factors considered in site location decisions (e.g., utilities, work-force skills, tax structure, equity considerations, environmental, and climate impacts). These factors affect an area's business costs, markets, and overall competitiveness for attracting business investment. All businesses need some level of transportation access to labor, materials, and customers to work and survive. As such, transportation is a factor that influences the ability of local and regional economic development agencies to increase their areas' business attractions, expansions, retentions, and startups. Investments in transportation services and infrastructure may contribute to the economic vibrancy of a region by:

- Reducing business operating costs and increasing business productivity;
- Expanding the size of labor markets;
- Increasing business access to needed labor, supplies, services, and materials; and
- Supporting a desirable and sustainable quality of life for all in the region.

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Chapter 5: Environmental Challenges, Opportunities & Engagement

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