REDUCING SUPPLY FROM CALIFORNIA REFINERIES:

Industries at Risk

INSTITUTE FOR APPLIED ECONOMICS
Los Angeles County Economic Development Corporation

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This research was commissioned by the Western States Petroleum Association.

The LAEDC Institute for Applied Economics provides objective economic and policy research for public agencies and private firms. The group focuses on economic impact studies, regional industry analyses, economic forecasts and issue studies, particularly in workforce development, labor market analysis, transportation and infrastructure.

Every reasonable effort has been made to ensure that the data contained herein reflect the most accurate and timely information possible and they are believed to be reliable.

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Executive Summary

The oil and gas industry is facing changing market conditions as a result of regulatory mandates issued and under consideration in California to meet emissions goals by 2020, 2030 and 2050. These market changes are expected to impact the ability of refinery operations to continue in the state and the available supply of petroleum products.

In this report, the Institute for Applied Economics of the Los Angeles County Economic Development Corporation (LAEDC) conducts a regional dependency study of the refinery industry, evaluating the ripple effect of a potential reduction of supply of refined petroleum products and byproducts in California. The findings are as follows:

Backward Linkages

Backward linkages of the refinery industry trace its purchases of goods and services in its supply chain and its payment of labor income. These are quantified using contribution analysis. The total economic contribution of the refinery and petrochemical industry in California, which includes all indirect and induced activity, is presented in Exhibit ES-1.

Exhibit ES-1
Total Economic Contribution in California 2013
Petroleum Refineries and Petrochemical Products Manufacturing

Employment (jobs):		
Direct	11,847	
TOTAL		173,450
Percent of California Total Employment		*0.8%*
Labor income ($ millions):		
Direct	$ 3,238	
TOTAL		$ 16,211
Percent of California Total Labor Income		*1.2%*
Value added ($ millions):		
Direct	$ 12,914	
TOTAL		$ 33,367
Percent of California Total GDP		*1.6%*

Source: Estimates by LAEDC

- 173,450 direct, indirect and induced jobs
- $16.2 billion in total labor income
- $33.4 billion in value added, accounting for 1.6 percent of state GDP.

Forward Linkages

Many industries are directly dependent on refinery and petrochemical products in their production processes and will be exposed to the risk of cost increases, relocation or closure should there be a reduction in the availability or increase in the prices of these products. *Forward linkages* are the industries that purchase petroleum products as inputs. These primary user industries in turn sell their own goods and services to secondary industries that are similarly dependent and exposed to supply reduction. These two tiers of forward linkages of the refinery and petrochemical industry represent significant economic activity which is at risk, as shown in Exhibit ES-2.

Exhibit ES-2
Economic Activity At Risk from Refinery Supply Reductions

Employment (jobs):		
Primary Industries	1,424,627	
Secondary Industries	940,687	
TOTAL		2,365,314
Percent of California Total Employment		*11.1%*
Labor income ($ millions):		
Primary Industries	$ 100,402	
Secondary Industries	87,058	
TOTAL		$ 187,461
Percent of California Total Labor Income		*14.1%*
Value added ($ millions):		
Primary Industries	$ 175,298	
Secondary Industries	130,562	
TOTAL		$ 305,860
Percent of California Total GDP		*14.4%*

Source: Estimates by LAEDC

- 2.4 million jobs (11.1 percent of state total)
- $187 billion in labor income
- $306 billion in value added, accounting for 14.4 percent of state GDP.

Furthermore, in addition to the refinery industry itself, all twenty-one California manufacturing industries (at the 3-digit NAICS level) are vulnerable and will be most at risk. ❖

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1 Introduction

The oil and gas industry is facing changing market conditions as a result of regulatory mandates issued and under consideration in California to meet emissions goals by 2020, 2030 and 2050. These market changes are expected to impact the ability of refinery operations to continue in the state and the available supply of petroleum products.

The potential reduction of in-state supply of refined petroleum products and byproducts will impact thousands of businesses that depend on these products in their production processes, impacting production costs and leading to higher prices of end products—which themselves may be used in other industries as inputs into production.

In this report, the Institute for Applied Economics of the Los Angeles County Economic Development Corporation (LAEDC) conducts a regional dependency study of the refinery industry, which will evaluate the ripple effect of a potential reduction of supply of refined petroleum products and byproducts in California. The report is presented in three parts.

This introductory section provides a brief overview of the industry in California and a discussion of how it might be impacted.

Section 2 quantifies the direct economic activity associated with the refinery industry in California, such as its direct employment and output, and then estimates the total contribution of the industry through its supply chain. This contribution represents the industry and its *backward linkages.*

Section 3 traces refinery industry products through the industry user chain. A *vulnerability index* is constructed to evaluate each user industry's exposure to refinery products. The top twenty most vulnerable user industries are quantified and their user industries are in turn evaluated for a second tier of vulnerability.

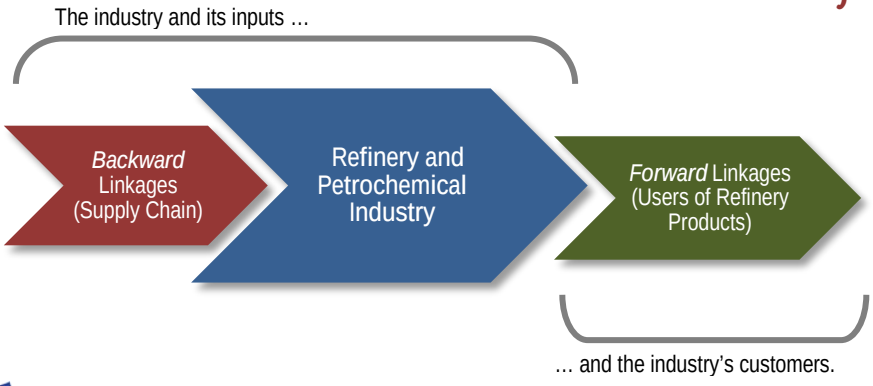
The combination of primary user industries and their secondary user industries that are most vulnerable to potential supply disruptions are quantified, providing an order of magnitude estimate of the economic activity that is at risk from reduction of supply of refined petroleum products based on the *forward linkages* of the refinery industry in California.

Section 4 provides detailed data for each of the top twenty most vulnerable primary user industries and their most vulnerable secondary user industries.

For both tiers of user industries (primary and secondary), employment, labor income, output and direct contribution to GDP are estimated to provide orders of magnitude of the economic activity that is at risk from reduction of supply of refined petroleum products and byproducts.

Detailed tables as referenced in the text can be found in the Appendix. ❖

Backward linkages and forward linkages



The Industry in California

Petroleum refineries are downstream operations in the oil and gas industry. Crude oil in its raw unprocessed form has almost no uses, but the refining of that crude produces highly tradable products consumed domestically and exported to global markets. According to the Energy Information Administration (EIA), global crude oil consumption in 2013 was 90.35 million barrels per day. Byproducts of the refining process include petrochemicals, which are used in the manufacture of a wide variety of different goods.

The petroleum refining industry has a large presence in California. At the end of December 2013, annual operable atmospheric crude oil distillation capacity in California was almost 1.9 million barrels per calendar day (bpcd), ranking third among states and representing 11 percent of total U.S. capacity of 17.7 million bpcd (Exhibit 1-1).

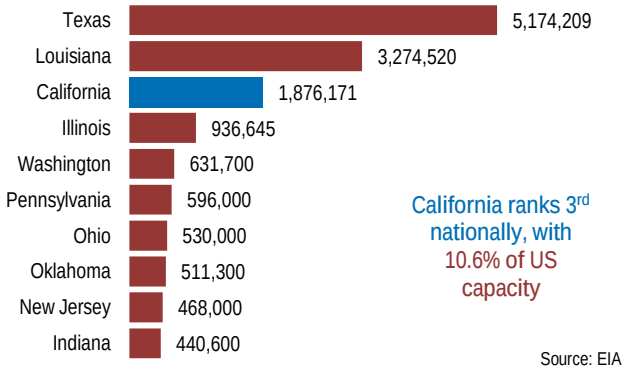
Despite the prominence of the state in terms of the national industry, the number of refineries in California has been decreasing over the years due to the need to reduce emissions, which requires large expenditures on equipment, modifications and upgrades. Operations that are unable to merge or consolidate to fund these investments ceased operations. This has resulted in the closure of older and smaller refining operations that found compliance with the state's strict environmental regulations to be cost prohibitive. There were 18 operable refineries in 2013, less than half of the number of operable refineries in 1983 (Exhibit 1-2).

Although the number of refineries have been declining in both California and the nation as a whole, expansions of existing operations and increases in efficiencies have resulted in increased capacity nationwide (Exhibit 1-3).

However, unlike the national experience, overall operating capacity in California has not seen a consistent upward trend and indeed there has been an overall loss of 420,000 bpcd capacity (a decline of 17.5 percent) since 1984 (Exhibit 1-4).

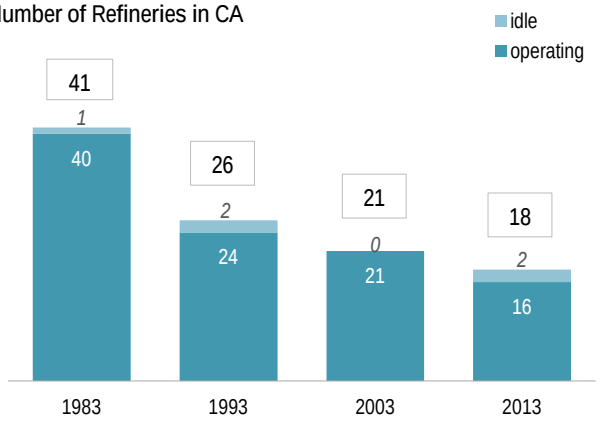
What makes this concerning is that current requirements for fuel consumed in California are so highly specific that consumers at the pump in California are extremely vulnerable to short-term fluctuations in oil prices and supply shocks.

Exhibit 1-1
Crude Oil Distillation Capacity 2014
Annual Operating Atmoshperic (bpcd)



Source: EIA

Exhibit 1-2
Number of Refineries in CA

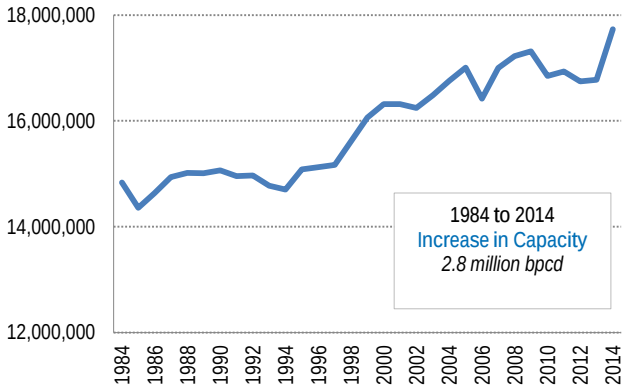


Source: EIA

Each year, California transitions from winter-grade to spring-grade gasoline and from spring-grade to summer-grade gasoline. The cost to manufacture the warmer weather blends is higher than that to manufacture the winter-blend. Regardless of the blend, the cost of manufacturing gasoline to state specifications exceeds that of conventional gasoline used outside of California.

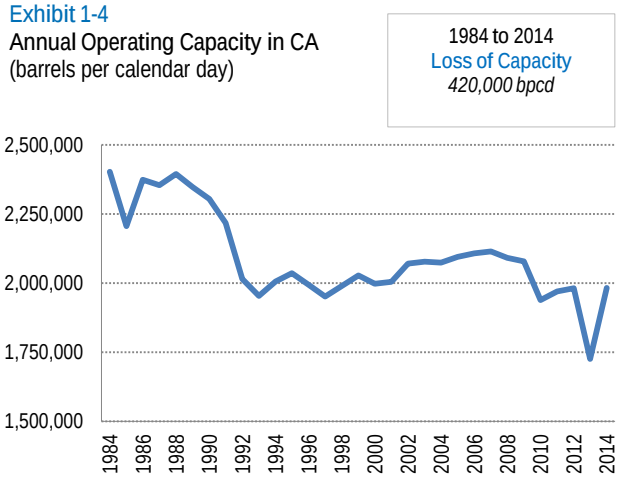
Blendstock transitions also reveal price volatility. Immediately preceding a transition from one seasonal gasoline blend to another, prices will either increase or decrease according to inventory levels; they will rise when inventory is low to delay a badly timed purchase, or will drop to accelerate sales of the current blend if inventory is deemed high.

Exhibit 1-3
Annual Operating Refinery Capacity in U.S.
(barrels per calendar day)



Source: EIA

Exhibit 1-4
Annual Operating Capacity in CA
(barrels per calendar day)



Source: EIA

In the event that capacity is reduced further, and local production cannot meet local demand, additional product must be imported into the area. Costs for petroleum and petrochemical products produced out of state will be higher due to increased shipping costs and costs associated with out of state producers reconfiguring and refitting facilities, a costly and labor-intensive undertaking, which will be required to accommodate California's specific blends of low sulfur gasoline and diesel.

Both industries and individual consumers will feel these additional costs. Dependent industries that use petroleum and petrochemical products as an input in production or are heavily reliant upon these products in the provision of a service, such as transportation industries, may not be able to absorb the increases. Consumers will feel cost increases that cannot be absorbed by the industry at the pump or when they purchase transportation services or petroleum based end products.

California Is Leading the Way…..

These costs are in part due to California's stringent environmental standards. California has long been heralded for its leading role in renewable energy and environmental issues. According to Governor Jerry Brown, "California has the most far-reaching environmental laws of any state and the most integrated policy to deal with climate change of any political jurisdiction in the Western Hemisphere."

Market conditions for refined petroleum products and byproducts produced in-state continue to change as a result of regulatory mandates issued to meet increasingly more ambitious emissions goals. Existing environmental regulations, undertaken as a means for California to achieve its larger 2020, 2030 and 2050 climate change goals, may already be limiting the permitting of new petroleum refining facilities, making any potential increase in oil refining capacity in the future in California highly unlikely. These new changes in the refined petroleum products and byproducts market are expected to further impact the ability of refinery operations to continue in the state.

In his inaugural address for his fourth term as governor of the state of California, Jerry Brown identified three main goals to be achieved by 2030, the second of which included cutting current petroleum use in cars and trucks (an estimated 16 billion plus gasoline gallons equivalent in 2014) by half. Current policy, which will achieve a twenty percent reduction by 2030, already exists; however, additional regulation will be required to reach the fifty percent reduction.

…. But What Is at Risk?

This report focuses on refined petroleum products and byproducts, specifically what is produced through refining. Refined petroleum products include gasoline and diesel, liquefied petroleum gas (LPG), kerosene, jet fuel and fuel oils. Petrochemicals, byproducts of the refining process and generally also produced at

refineries, are used as a feedstock for a wide range of materials including adhesives, detergents, solvents, and fibers, gels, lubricants, plastics and resins.

Additionally, both refined petroleum and petrochemicals are used as an input for a wide variety of consumer products including plastics, cosmetics, pharmaceuticals, wax-based products like packaging or crayons, paints, solvents, asphalt, pesticides and fertilizers (see Exhibit 1-5 for a partial list of products).

The extent of purchases of refinery products made by other industries illustrates the broad reach that these products have throughout the industry chain (see Exhibit 1-6). The top twenty industries purchased more than $24.2 billion worth of products from California's refineries in 2013.

Both end-user consumers and user chain industries will be vulnerable to reductions of the supply of petroleum-based products. Response strategies may include: relocation; input substitution; operational shut-down; price increases; and more. Each of these options will have its own impact on the state's economic activity. The overall potential impact is demonstrated in the sections that follow. ❖

Exhibit 1-5
Petroleum-Based Consumer Products

Medical and Personal		
antihistamines	inhalers	makeup
anesthetics	band aids	perfume
aspirin	latex gloves	contact lenses
cough syrup	syringes	lotion
vitamins	artificial limbs	diapers
Fuel and Lubricant		
gasoline	heating fuel	motor oil
diesel fuel	propane	electricity generation
Chemical Products		
pesticides	fabric softeners	brake fluid
fertilizers	cleaning chemicals	coolant
preservatives	solvents	antifreeze
Teflon	paint	
Synthetic Fabrics and Materials		
polyester	elastic	carpeting
nylon, rayon	shoes	vinyl
	upholstery	styrofoam
Other Products		
PVC pipe	electronics	toys
shingles	plastic containers	helmets
tires	plastic bags	guitar strings
asphalt/ tar	sponges	sports equipment

Compiled by LAEDC

Exhibit 1-6
Top 20 User Industries of California Refinery Products

NAICS	Industry Description	Purchases From CA Refineries ($ millions)
23	Construction	$ 6,500.6
484	Truck Transportation	4,040.4
325	Chemical Manufacturing	3,299.7
481	Air Transportation	3,291.4
111,112,115	Agriculture	824.3
483	Water Transportation	809.0
42	Wholesale Trade	730.4
324	Petroleum and Coal Products Manufacturing	649.8
492	Couriers and Messengers	634.7
482	Rail Transportation	626.1
221	Utilities	518.9
561	Administrative and Support Services	376.3
722	Food Services and Drinking Places	339.8
485	Transit and Ground Passenger Transportation	281.7
622	Hospitals	273.6
541	Professional, Scientific, and Technical Services	226.4
487	Support Activities for Transportation	216.1
551	Management of Companies and Enterprises	209.8
334	Computer and Electronic Product Manufacturing	183.8
333	Machinery Manufacturing	170.3
	Top 20	*$ 24,203.4*
	All Other Industries	*3,365.8*
	Purchases from California Refineries	$ 27,569.1

Source: IMPLAN Data for California; Analysis by LAEDC

2 Identifying Backward Linkages

In his seminal work, *The Strategy of Economic Development* (1958), Albert O. Hirschman introduces the concept of backward and forward linkages to industries. Backward linkages are the industries in the supply chain of a given industry, providing the inputs needed for its output. These are estimated for the refinery industry here using economic contribution analysis. Economic contribution quantifies the portion of a region's economy that can be attributed to an existing industry by tracing its purchases of goods and services in its supply chain, its payment of labor income to regional workers, and the tax revenues generated on its operations and their multiplier impacts. This analysis models what would happen if the industry did not exist in terms of those whose economic activity depends on supplying the industry. A detailed description of our methodology can be found in the Appendix.

Direct Activity

Direct activity associated with the refinery industry is its direct contribution to the economy in terms of employment, labor income and value added. Direct employment includes all individuals whose employment is directly related to refineries. Measured on a job-count basis regardless of the number of hours worked, it includes full-time, part-time, permanent and seasonal employees, contingent workers and the self-employed. Labor income includes all payments these employees receive, such as wages and benefits, and payroll taxes paid on their behalf.

Exhibit 2-1 displays the estimated direct activity associated with the refinery and petrochemical industry in California in 2013, the latest year for which complete data is available.

Exhibit 2-1
Petroleum Refineries and Petrochemical Products Manufacturing
California 2013

		% of CA Total
Employment (jobs):	11,847	0.1%
Labor income ($ billions):	$ 3.2	0.2%
Value added ($ billions):	$ 12.9	0.6%
Output ($ billions):	$ 113.8	3.1%

Source: Estimates by LAEDC

In 2013, the industry in California provided 11,850 jobs. Direct employment in the industry accounted for approximately 0.1 percent of employment in California.

Total direct labor payments, the value of all earnings received by both payroll employees and the self-employed, including benefits such as health insurance and pension plan contributions, was an estimated $3.2 billion in 2013, representing 0.2 percent of total labor income in the state.

In addition to its own direct activity, petroleum refineries and petrochemical products manufacturing establishments generate significant spillover employment and labor income effects that are proportionately among the highest of all industries, consistent with the larger encompassing oil and gas industry. This is a consequence of the productivity of the industry and the high wages paid to industry workers.

The total economic contribution of the industry in California is presented in Exhibit 2-2.

Exhibit 2-2
Total Economic Contribution in California 2013
Petroleum Refineries and Petrochemical Products Manufacturing

Employment (jobs):		
Direct	11,847	
Indirect and Induced	161,604	
TOTAL		173,450
Percent of California Total Employment		*0.8%*
Labor income ($ millions):		
Direct	$ 3,238	
Indirect	12,973	
TOTAL		$ 16,211
Percent of California Total Labor Income		*1.2%*
Value added ($ millions):		
Direct	$ 12,914	
Indirect and Induced	20,452	
TOTAL		$ 33,367
Percent of California Total GDP		*1.6%*
Output ($ millions):		
Direct	$ 113,804	
Indirect and Induced	36,543	
TOTAL		$ 150,347
Percent of California Total Output		*4.1%*

Source: Estimates by LAEDC

It is estimated that the activities related to the refining and petrochemicals industry in California in 2013 supported 173,450 jobs with labor income of just over $16.2 billion in 2013, and generated almost $33.4 billion in value added (approximately 1.6 percent of the state's GDP of $2.1 trillion) on output of $150.3 billion.

Industry Distribution

The total economic contribution is achieved through activity occurring across a wide range of industry sectors via indirect and induced effects. The distribution of the total employment, labor income and output among industry sectors is presented in Exhibit 2-3.

Exhibit 2-3
Total Contribution of Industry By Sector in California 2013
Petroleum Refineries and Petrochemical Products Manufacturing

	Jobs	Labor Income ($ millions)	Output ($ millions)
Ag, forestry, fish & hunting	555	$35	$94
Mining	30,669	4,488	10,594
Utilities	569	90	379
Construction	8,883	638	1,609
Manufacturing	15,529	3,594	119,580
Wholesale trade	13,341	1,072	3,195
Retail trade	13,438	500	1,190
Transportation and warehousing	12,672	1,575	2,815
Information	1,839	258	1,042
Finance and insurance	7,766	548	1,428
Real estate and rental	5,734	160	2,355
Professional, scientific technical	7,726	588	1,092
Management of companies	3,096	385	729
Administrative and waste services	9,441	361	667
Educational services	2,953	128	207
Health and social services	14,059	798	1,304
Arts, entertainment and recreation	3,006	98	220
Accommodation and food services	11,757	327	757
Other services	8,410	379	641
Government	2,010	190	449
Total	173,450	$16,211	$150,347

Source: Estimates by LAEDC

Of the 173,450 jobs supported, just less than 18 percent were in the mining sector (which includes much of the oil and gas industry) and exactly nine percent in the manufacturing sector. However, virtually all industry sectors receive a positive economic impact from activity occurring in petroleum refineries and petrochemical products manufacturing industries, including, health and social services, retail and wholesale trade, transportation and warehousing and accommodation and food services.

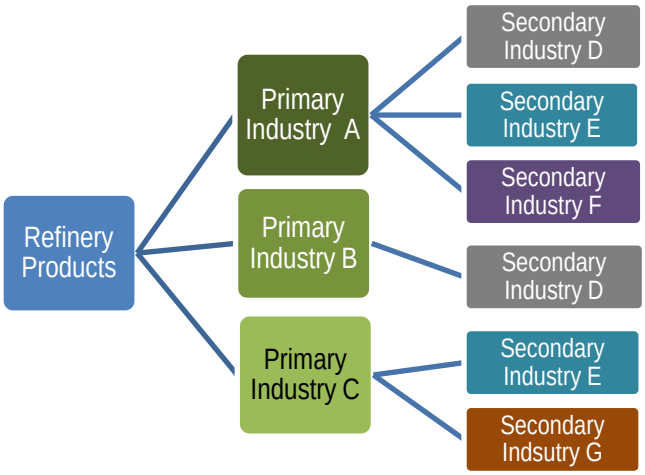
Output of an industry is its gross revenues. Looking at the disaggregation of the total effects of these two industries in terms of output across the different industries, illustrates the varying magnitudes of impact experienced by each industry sector stemming from activity taking place in petroleum refineries and petrochemical products manufacturing. By far, a disproportionately large impact occurs in the manufacturing sector (80 percent of the total impact in terms of output), followed by mining (seven percent), wholesale trade (two percent) and transportation and warehousing (two percent). Together, total output effects in these four industry sectors are valued at $136.2 billion, just under 91 percent of total generated output.

A description of the industry sectors is provided in the Appendix. ❖

3 Identifying Forward Linkages

Hirschman also introduces the concept of forward linkages to industries. *Forward linkages* are those industries that use the output of a given industry in their own production. For example, air transportation uses petroleum products in order to provide its services. The air transportation industry is a user of refinery products and is thus a forward linkage of the refinery industry. In this report, we refer to these first tier user industries as *primary users.*

For those industries that are not particularly vulnerable to refinery products in their supply chain, they may instead be dependent on the output of the primary industries. We refer to these industries as *secondary users.* Although they may not be directly impacted by disruption in availability and price of refinery products, they may well be already affected by the availability and price of the output of primary user industries.



This network of linkages is depicted in the diagram. Refinery products are used as inputs into production of primary industries A, B and C. The dependence of these primary industries is estimated using information about their business model and the market for their goods and services. These are direct forward linkages of the refinery and petrochemical industry. The output of these primary industries is used as inputs in the production of secondary industries D, E, F and G. While these are also forward linkages of the refinery and petrochemical industry, their vulnerability to supply disruptions is felt through their supplying primary industry.

We look at a variety of measures that identify these two tiers of forward linkages of the refinery and petrochemical industry in California. ❖

Constructing a Vulnerability Index

Primary users would be immediately impacted by reductions in the availability or increase in the price of refinery products if they were particularly dependent on them. To measure this dependence, we construct an index of vulnerability.

Hirschman's metric for quantifying a forward link was the share of an industry's output that is allocated to an intermediate input. Supplementing the original indicator suggested by Hirschman, we use three metrics to construct a composite index of vulnerability to input disruptions: (1) intensity of use; (2) trade exposure; and (3) gross operating surplus.

Intensity of Use

Refined petroleum products and petrochemical byproducts as an input of production are traced through the industry user chain to measure each user industry's *intensity of use* compared to its revenues (gross output). This is a measure of how dependent the user industry is on refinery products. Understanding interactions between producers of refined petroleum and petrochemical products across the different industries that use these products as an intermediate good in their own production, is valuable for understanding how these user industries stand to be affected by changes in the price and supply of these goods.

User industries with larger shares of these products as inputs to total industry revenues (gross output) have a larger dependency on them as input in their production. As such, changes in the supply of these inputs will affect them disproportionately more compared to industries whose usage is a smaller share of their gross output.

Exhibit 3-1 lists the top industries that use refined petroleum and petrochemical products in their production in California, with dependency ranked by the share of input value to gross output in 2013.

Exhibit 3-1
Top 20 Industries by Refinery Products Inputs
As a Share of Gross Output

NAICS	Industry	Share of Output
324	Petroleum and Coal Products Manufacturing	38.2%
481	Air Transportation	23.1%
482	Rail Transportation	20.5%
483	Water Transportation	18.5%
484	Truck Transportation	15.5%
492	Couriers and Messengers	9.3%
485	Transit and Ground Passenger Transportation	6.3%
325	Chemical Manufacturing	5.6%
113,114	Forestry, Hunting and Fishing	4.8%
23	Construction	4.5%
212,213	Mining and Mining Support	3.0%
323	Printing and Related Support Activities	2.0%
111,112,115	Agriculture	1.7%
491	Postal Service	1.7%
211	Oil and Gas Extraction	1.7%
487	Support Activities Transportation	1.6%
562	Waste Management and Remediation Srvcs	1.5%
486	Pipeline Transportation	1.4%
327	Nonmetallic Mineral Product Manufacturing	1.4%
221	Utilities	1.3%
	Average of all industries	*2.3%*

Source: IMPLAN Data for California; Analysis by LAEDC

Several industries are combined because they are individually very small but are also quite vulnerable. These include agricultural industries, forestry and hunting, and mining and mining support.

Many of the industries (six of the top ten) with the largest intensity of use measure are in the transportation and warehousing sector: air, rail, water, truck and passenger ground transportation industries and the industry subsector of couriers and messengers. Industries within these subsectors rely heavily on transportation fuels (jet fuel, diesel, gasoline, etc.), which are requisite to the provision of their services.

Both petroleum and coal products manufacturing and chemical manufacturing often use refined petroleum and petrochemicals to produce other end products (petroleum refineries and petrochemical product manufacturing industries have first been backed out from their larger corresponding subsectors so as not to double count, and thereby overstate subsector usage).

Equipment used in forestry, hunting and fishing industries, such as timber harvesters, bunchers and skidders, power generators and ocean vessels require fuel for operation as well.

Materials used in the construction industry, such as asphalt, roofing materials and PVC piping, are produced using refined petroleum and petrochemical products. Additionally, fossil fuels are used to operate heavy machinery including water trucks, bulldozers, excavators, loaders and graders.

Linkages of user industries of refined petroleum and petrochemical products are next evaluated in regards to trade sensitivity.

The full list of refinery product inputs as a share of output for all industries is provided in the Appendix.

Trade Sensitivity

Trade sensitivity or trade exposure provides an indication of an industry's ability to pass potentially higher costs of inputs through to its customers. Commodities traded in the global market must operate within the limitations presented by trade exposure. For example, if production costs increase for firms in California and necessitate price increases, in-state producers will face competition from producers in other states or nations and be unable to protect their market share.

For the composite vulnerability index, *trade sensitivity* is measured by the sum of an industry's domestic and foreign exports as a percentage of its total output. Exhibit 3-2 identifies the top twenty industries in California by their trade sensitivity in 2013.

Industries that export the majority of their output outside the state of California and therefore depend on larger markets for their sales revenue will be particularly vulnerable to changes in input prices. Their ability to increase prices to recover cost increases will be limited given the international competition they face.

It appears that California's manufacturing industries are particularly vulnerable to trade exposure. Seven of the top ten industries with the highest trade intensities are manufacturing industries, including machinery, apparel and transportation equipment.

Exhibit 3-2
Top 20 Industries by Trade Exposure

NAICS	Industry	Exposure
316	Leather and Allied Product Manufacturing	91.1%
333	Machinery Manufacturing	79.3%
315	Apparel Manufacturing	77.6%
336	Transportation Equipment Manufacturing	71.0%
339	Miscellaneous Manufacturing	65.9%
334	Computer and Electronic Product Manufacturing	63.5%
221	Utilities	60.5%
512	Motion Picture / Sound Recording Industries	59.8%
111,112, 115	Agriculture	59.6%
325	Chemical Manufacturing	53.8%
312	Beverage and Tobacco Product Manufacturing	52.7%
533	Lessors of Nonfinancial Intangible Assets	50.3%
313	Textile Mills	50.0%
331	Primary Metal Manufacturing	48.9%
335	Electrical Equipment and Component Mfg	48.0%
519	Other Information Services	45.3%
337	Furniture and Related Product Manufacturing	42.7%
483	Water Transportation	42.7%
332	Fabricated Metal Product Manufacturing	42.3%
314	Textile Product Mills	41.8%
	Average of all industries	*23.5%*

Source: IMPLAN Data for California; Analysis by LAEDC

The list of trade sensitivities for all industries is provided in the Appendix.

Gross Operating Surplus

As an alternative to raising prices of their goods and services, firms in industries that experience increased input costs may instead absorb cost increases through reduction in profits. This capability is necessarily dependent on an industry's typical profit experience. Many industries have extremely thin profit margins and will not be able to absorb costs increases without price increases—which, if they are exposed to trade, may also not be a viable option. Other industries have a significant margin cushion and are less vulnerable to increases in input prices.

Exhibit 3-3 ranks industries by their gross operating surplus as a percentage of total output (essentially, profit margins). The higher this margin, the more likely the user industry will be able to absorb higher input costs. Industries with smaller or even negative gross surplus as a share of total output have no capability to absorb cost increases. If they are also unable to increase the prices of their goods and services, they will face an existential risk.

Exhibit 3-3
Top 20 Industries by Smallest Gross Operating Surplus

NAICS	Industry	Gross Operating Surplus (As % of Total Output)
443	Electronics and Appliance Stores	-38.5%
523	Securities, Contracts, Investments	-7.5%
812	Personal and Laundry Services	-5.7%
453	Miscellaneous Store Retailers	-4.7%
525	Funds, Trusts, and Other Financial Vehicles	-4.4%
316	Leather and Allied Product Manufacturing	-2.9%
315	Apparel Manufacturing	-1.6%
623	Nursing and Residential Care Facilities	-1.6%
813	Religious/Grantmaking/Civic/Professional Orgs	-0.1%
622	Hospitals	0.1%
624	Social Assistance	0.1%
486	Pipeline Transportation	0.2%
811	Repair and Maintenance	0.3%
23	Construction	0.3%
487	Scenic and Sightseeing Transportation	0.4%
484	Truck Transportation	0.6%
324	Petroleum and Coal Products Manufacturing	0.7%
337	Furniture and Related Product Manufacturing	0.8%
492	Couriers and Messengers	0.9%
321	Wood Product Manufacturing	1.0%
	Average of all industries	*2.3%*

Source: IMPLAN Data for California; Analysis by LAEDC

Industries in California, on average, operate close to the margin, with a gross operating surplus of 2.3 percent of total output. Industries that are especially significant and operating at a break-even point include construction, hospitals, repair and maintenance, and pipeline transportation Still, the exhibit lists many industries that experience very small profit margins. These leave very little room for firms to absorb cost increases.

The list of gross operating surplus as a share of total output for all industries is provided in the Appendix.

Composite Index of Vulnerability

The three indicators (intensity of use, trade sensitivity and gross operating surplus) are used to construct an overall composite *vulnerability index*.
As the individual indicators that contribute to this index may be more or less important in determining vulnerability to supply disruptions in the refinery industry, their values are weighted accordingly.

The share of output that must be allocated to the given input product is clearly the most important factor in judging vulnerability. An industry that does not use much petroleum products, for example, is not vulnerable to disruptions in its availability or price. This component is given a 55 percent weight in the composite vulnerability index.

Trade sensitivity is also relatively important as the ability for firms to compete in the global marketplace will determine their viability. This factor is allocated a 30 percent weight in the vulnerability index.

Finally, the share of output captured by gross operating surplus (or profits) is important, but is given a smaller weight of 15 percent in the vulnerability index, reflective of the variability in the indicator across firms within industries and the elasticity of this indicator with respect to revenues. ❖

Primary User Industries

Exhibit 3-4 lists the top 20 vulnerable industries ranked by their corresponding composite index scores, along with their direct economic activity in California. These industries are at immediate risk to disruptions in the availability and price of refinery products.

Together, the primary tier of vulnerable industries provide 1.4 million jobs (6.7 percent of all jobs in California) with labor income of $100.4 billion, and account for $175.3 billion (or 8.3 percent) of state GDP.

A listing of the vulnerability index for all industries is provided in the Appendix. ❖

Exhibit 3-4
Most Vulnerable Primary User Industries of Refinery Products
California 2013

Rank	NAICS	Industry Description	Vulnerability Index	Employment	Labor Income ($ millions)	Output ($ millions)	Value-Added ($ millions)
1	113,114	Forestry, Logging, Fishing, Hunting	9.0	9,471	$ 415.4	954.0	529.2
2	487	Support Activities for Transportation	8.7	99,501	8,068.5	15,453.9	8,355.7
3	492	Couriers and Messengers	8.6	93,312	3,843.2	7,882.9	4,011.1
4	325[1]	Chemical Manufacturing	8.4	71,687	10,634.8	88,238.0	39,909.2
5	481	Air Transportation	8.4	48,211	4,308.5	16,519.0	6,647.0
6	483	Water Transportation	8.4	6,696	595.5	5,050.1	1,321.5
7	484	Truck Transportation	8.4	206,355	12,141.5	30,258.4	12,653.7
8	111,112,115	Agriculture	8.3	501,568	27,070.8	56,885.1	38,918.0
9	482	Rail Transportation	8.1	11,894	1,244.5	3,536.2	1,328.9
10	323	Printing and Related Support Activities	8.0	55,292	2,639.4	8,000.5	3,240.5
11	221	Utilities	7.6	61,496	9,884.6	46,123.6	30,835.5
12	322	Paper Manufacturing	7.6	21,205	1,838.3	9,524.5	2,115.5
13	333	Machinery Manufacturing	7.6	76,985	7,062.6	30,959.4	9,845.6
14	324[1]	Petroleum and Coal Products Manufacturing	7.4	2,146	208.9	2,175.6	237.6
15	321	Wood Product Manufacturing	7.4	25,259	1,251.6	4,636.0	1,333.1
16	326	Plastics and Rubber Products Manufacturing	7.4	45,143	2,733.5	14,831.3	4,283.1
17	212,213	Mining and Support Activities	7.1	25,417	2,404.9	6,277.3	4,003.3
18	331	Primary Metal Manufacturing	7.1	20,399	1,632.4	11,332.9	1,942.9
19	327	Nonmetallic Mineral Product Manufacturing	7.0	32,888	2,037.0	9,110.1	2,958.0
20	313	Textile Mills	7.0	9,702	386.3	2,584.5	828.5
		Average of all industries	*5.5*				
		TOTAL OF TOP 20		1,424,630	100,402.1	370,333.1	175,298.1
		Percent of California Total		*6.7%*	*7.5%*	*10.2%*	*8.3%*

[1] 325 excludes petrochemical products manufacturing; 324 excludes petroleum refineries
Source: IMPLAN Data for California; Analysis by LAEDC

Secondary User Industries

Similar to the analysis for primary industries, the secondary tier of forward-linked industries is also analyzed for their exposure to disruptions in the availability and price of refinery products through their linkages to primary industries.

Primary user industries sell goods and services to other industries for use in their production of goods or provision of services. The extent of purchases of these products made by other industries is shown in Exhibit 3-5. The top twenty secondary industries purchased almost $60 billion worth of products from primary user industries in 2013.

Exhibit 3-5
Top 20 User Industries of Primary Industries
By Purchases from Primary Industries

NAICS	Industry Description	Purchases From Primary Industries ($ millions)
311	Food Manufacturing	$ 19,334.5
23	Construction	9,720.1
334	Computer and Electronic Product Mfg	4,446.2
42	Wholesale Trade	3,768.4
335	Electrical Equipment and Component Mfg	3,464.4
312	Beverage and Tobacco Product Mfg	3,330.9
332	Fabricated Metal Product Mfg	3,255.9
336	Transportation Equipment Manufacturing	1,892.3
519	Other Information Services	1,653.7
339	Miscellaneous Manufacturing	1,563.8
621	Ambulatory Health Care Services	1,487.7
523	Securities, Contracts and Investments	1,026.2
337	Furniture Manufacturing	912.6
211	Oil and Gas Extraction	852.1
445	Food and Beverage Stores	546.0
511	Publishing Industries (except Internet)	521.0
315	Apparel Manufacturing	489.1
452	General Merchandise Stores	400.6
518	Data Processing and Hosting	368.4
624	Social Assistance	294.6
	TOTAL OF TOP 20	$ 59,328.5
	All Other Primary Industries	*2,622.6*
	Purchases from All Other Primary Industries	$ 61,951.1

Source: IMPLAN Data for California; Analysis by LAEDC

Exhibit 3-6 provides the intensity of use of primary products for the top twelve secondary industries.

Exhibit 3-6
Top 12 User Industries of Primary Industries
By Purchases as a Percent of Industry Output

NAICS	Industry	% of Output Purchased from Primary Industries
335	Electrical Equipment / Component Mfg	31.8%
311	Food Manufacturing	23.4%
337	Furniture and Related Product Mfg	13.8%
312	Beverage and Tobacco Product Mfg	11.8%
332	Fabricated Metal Product Mfg	10.5%
316	Leather and Allied Product Mfg	8.3%
211	Oil and Gas Extraction	7.2%
314	Textile Product Mills	7.0%
315	Apparel Manufacturing	6.8%
339	Miscellaneous Manufacturing	6.2%
23	Construction	5.8%
443	Electronics and Appliance Stores	5.2%
	Average of all Secondary Industries	*3.9%*

Source: IMPLAN Data for California; Analysis by LAEDC

These twelve industries represent approximately 25 percent of all secondary industries. The secondary industry most dependent on primary industries is electrical equipment and component manufacturing, allocating almost 32 percent of its revenues to the purchase of primary products for use in production. Food manufacturing is also very dependent on primary industries, allocating 23.4 percent of its revenues for primary products.

The average of all industries is 3.9 percent, suggesting that many industries are not dependent on vulnerable primary industries at all, and thus will not be at risk for disruption of availability or price of refinery and petrochemical products.

Constructing an Average Vulnerability Index for Secondary Industries

A complete list of secondary and primary industries is provided in Exhibit A-6 in the Appendix. Entries are shown for those secondary industries with a vulnerability index of 7.0 or greater for each primary industry. The exhibit offers a visual display of the extent to which many industries depend on the output generated by primary user industries (those that are especially vulnerable to disruption in the availability or price of refinery products). For example, water transportation services are used by thirteen listed industries, and printing products and services are used by sixteen.

These secondary user industries are exposed to the refinery and petrochemical industry through the primary user industries. As such, their own vulnerability depends on the vulnerability of the primary industry.

While the vulnerability indices shown in the exhibit are constructed in the same manner as those for primary industries, the *overall* vulnerability of each secondary industry will depend on the mix of primary industries on which they depend—and the vulnerability indices of those primary industries. To produce an index more reflective of a secondary user industry's exposure to refinery products, each entry in a column in Exhibit A-6 is multiplied by the primary industry's vulnerability index, and the resulting values are averaged across each row to develop an average vulnerability index for each secondary industry.

Of the forty-four secondary industries listed, the top twenty-five percent, or eleven industries, ranked by their average vulnerability index, are deemed to be vulnerable to disruptions in the availability or price of refinery products.

The overall direct economic activity in California associated with these eleven vulnerable secondary industries is shown in Exhibit A-6.

Together, the secondary tier of vulnerable industries provide 940,690 jobs (4.4 percent of all jobs in California) with labor income of $87.1 billion, and accounting for $130.6 billion (or 6.2 percent) of state GDP. ❖

Exhibit 3-7
Most Vulnerable User Industries of Primary Products by Average Vulnerability Index
California 2013

Rank	NAICS	Industry Description	Average Vulnerability Index	Employment	Labor Income ($ millions)	Output ($ millions)	Value-Added ($ millions)
1	316	Leather and Allied Product Manufacturing	7.1	4,719	164.8	620.3	148.8
2	312	Beverage and Tobacco Product Mfg	6.9	51,125	4,166.2	28,325.9	5,582.0
3	315	Apparel Manufacturing	6.9	56,266	2,497.1	4,233.9	2,446.8
4	337	Furniture and Related Product Mfg	6.7	36,811	1,872.7	6,628.1	1,951.5
5	311	Food Manufacturing	6.6	179,461	10,084.7	82,638.9	16,200.8
6	335	Electrical Equipment and Component Mfg	6.6	30,857	2,609.7	10,905.2	3,415.7
7	339	Miscellaneous Manufacturing	6.3	93,902	8,491.4	25,379.6	12,080.4
8	334	Computer and Electronic Product Mfg	6.3	239,700	36,498.3	162,131.9	57,562.1
9	314	Textile Product Mills	6.3	10,096	446.6	1,803.8	644.2
10	336	Transportation Equipment Manufacturing	6.2	103,697	11,397.6	49,393.9	16,358.1
11	332	Fabricated Metal Product Manufacturing	6.2	134,047	31,078.4	8,829.7	11,171.4
		TOTAL		940,690	87,058.9	406,140.1	130,561.8
		Percent of California Total		*4.4%*	*6.5%*	*11.2%*	*6.2%*

Source: IMPLAN Data for California; Analysis by LAEDC

4 Detailed Industry Sheets

The following pages provide detailed data for each vulnerable primary and secondary user industry.

Primary Industries

For each of the top twenty vulnerable primary industries, we provide an industry description as detailed in the North American Industry Classification System (NAICS) in its sourcebook, *North American Industry Classification System*, published by the U.S. Office of Management and Budget (2013).

We quantify the industry in terms of employment, labor income, industry output and its contribution to state GDP. These metrics are an indication of the activity that is at risk.

We outline the products that each industry produces and sells in California, and list the industries that purchase its products. This provides an indication of the breadth and width the primary industry through its own user chain. Finally, we list the vulnerable secondary industries to the primary industry according to their vulnerability index.

Secondary Industries

Vulnerable secondary industries are determined through their average vulnerability index, as described above. Many of these industries are dependent on more than one, and sometimes many, vulnerable primary industries.

For each of the secondary industries deemed to be vulnerable, we provide an industry description from the NAICS sourcebook.

As with primary industries, we quantify the industry in terms of employment, labor income, industry output and its contribution to state GDP. Again, these metrics are an indication of the activity that is at risk. Lastly, we list the vulnerably primary industries from which the secondary industry purchases its inputs according to their vulnerability index to the primary industry.

Industries are shown in the following sequence:

Primary Industry:

FORESTRY, HUNTING AND FISHING (NAICS 113, 114)

Vulnerability Index: 9.0

Industry Description

Forestry, hunting and fishing include two subsectors (1) forestry and logging and (2) fishing, hunting and trapping. Industries in the forestry and logging subsector grow and harvest timber on a long production cycle (i.e., of 10 years or more). Long production cycles use different production processes than short production cycles, which require more horticultural interventions prior to harvest, resulting in processes more similar to those found in the crop production subsector.

Consequently, production involving production cycles of less than 10 years, are classified in the crop production subsector. Industries in the fishing, hunting and trapping subsector harvest fish and other wild animals from their natural habitats and are dependent upon a continued supply of the natural resource.

The harvesting of fish is the predominant economic activity of this subsector and it usually requires specialized vessels that, by the nature of their size, configuration and equipment, are not suitable for any other type of production, such as transportation.

What Is At Risk?

This industry provides almost 9,500 jobs in California, with average annual wages and benefits of $43,860.

9,470 jobs

$ 415 million
Labor Income

$ 954 million
Industry Output

$ 529 million
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by the forestry, hunting and fishing industry in California are shown in Exhibit 4-1.

Exhibit 4-1
Products of the Forestry, Hunting and Fishing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Forest, timber and forest nursery products	$ 243.8	32.6
Logs and roundwood	369.8	49.4
Fish	132.9	17.7
Wild game products, pelts and furs	2.3	0.4
Total Industry Sales in California	$ 748.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries this Primary Industry Sell To

Exhibit 4-2 lists the user industries in California of this industry's goods and services.

Exhibit 4-2
Top 20 User Industries of California Forestry, Hunting and Fishing

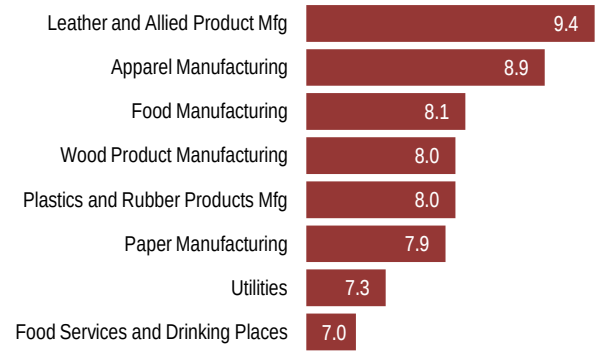
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
321	Wood Product Manufacturing	$ 268.3
311	Food Manufacturing	103.1
722	Food Services and Drinking Places	75.1
221	Utilities	69.9
326	Plastics and Rubber Products Manufacturing	65.2
322	Paper Manufacturing	22.3
325	Chemical Manufacturing	16.8
339	Miscellaneous Manufacturing	13.9
312	Beverage and Tobacco Product Manufacturing	9.5
315	Apparel Manufacturing	6.1
323	Printing and Related Support Activities	4.2
445	Food and Beverage Stores	3.9
337	Furniture and Related Product Manufacturing	2.8
115	Support Activities for Agriculture and Forestry	2.7
721	Accommodation	2.3
713	Amusement, Gambling, and Recreation Industries	1.9
622	Hospitals	1.6
611	Educational Services	1.6
316	Leather and Allied Product Manufacturing	1.4
623	Nursing and Residential Care Facilities	1.4
	Top 20	*$ 674.1*
	All Other Industries	*74.7*
	Total Industry Sales in California	$ 748.8

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-3.

Exhibit 4-3
Forestry, Hunting and Fishing
Most Vulnerable User Industries
(Vulnerability Index ≥7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

SUPPORT ACTIVITIES FOR TRANSPORTATION (NAICS 487, 488)

Vulnerability Index: 8.7

Industry Description

This primary industry is comprised of two subsectors: (1) scenic and sightseeing transportation; and (2) support activities for transportation—the latter being by far the largest contributor. Industries in Scenic and Sightseeing Transportation utilize transportation equipment to provide recreation and entertainment. These activities have a production process distinct from passenger transportation carried out for the purpose of other types of for-hire transportation. This process does not emphasize efficient transportation; in fact, such activities often use obsolete vehicles, such as steam trains, to provide some extra ambience.

Industries in the Support Activities for Transportation subsector provide services which support transportation. These services may be provided to transportation carrier establishments or to the general public. This subsector includes a wide array of establishments, including air traffic control services, marine cargo handling, and motor vehicle towing. Te subsector is separated by type of mode serviced (air, rail, water and road). The subsector also includes freight transportation arrangement and packing and crating services.

What Is At Risk?

This industry provides almost 100,000 jobs in California with average annual wages and benefits of $81,090.

99,500 jobs

$ 8.1 billion
Labor Income

$ 15.5 billion
Industry Output

$ 8.4 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-4.

Exhibit 4-4
Products of the Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Support activities for transportation, and scenic and sightseeing transportation	$ 10,929.6	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-5 lists the user industries in California of this industry's goods and services.

Exhibit 4-5
Top 20 User Industries of Support Activities for Transportation

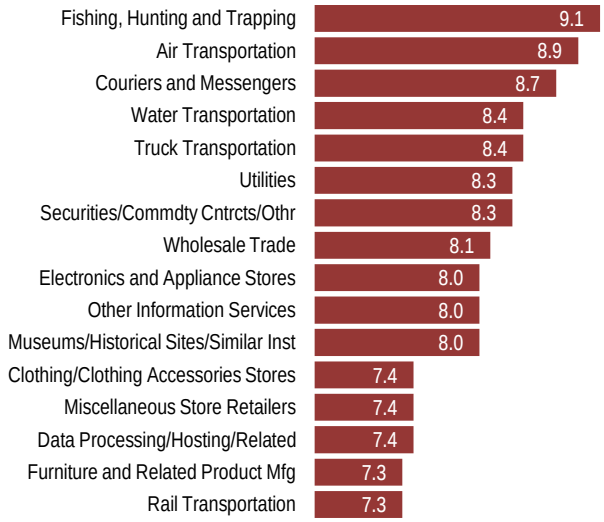
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
42	Wholesale Trade	$ 1,811.1
481	Air Transportation	1,654.3
484	Truck Transportation	1,266.1
492	Couriers and Messengers	601.1
541	Professional, Scientific, and Technical Services	580.3
519	Other Information Services	380.8
483	Water Transportation	346.3
523	Securities, Contracts, Investments	295.3
221	Utilities	227.7
511	Publishing Industries (except Internet)	152.4
512	Motion Picture and Sound Recording Industries	138.2
452	General Merchandise Stores	119.1
518	Data Processing, Hosting, and Related Services	119.0
454	Nonstore Retailers	108.8
621	Ambulatory Health Care Services	100.8
561	Administrative and Support Services	96.2
448	Clothing and Clothing Accessories Stores	87.8
533	Lessors of Nonfinancial Intangible Assets	81.1
524	Insurance Carriers and Related Activities	64.4
624	Social Assistance	61.7
	Top 20	*$ 8,292.7*
	All Other Industries	*2,636.9*
	Total Industry Sales in California	$ 10,929.6

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-6.

Exhibit 4-6
Support Activities for Transportation
Most Vulnerable User Industries
(Vulnerability Index **≥7.0**)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

COURIERS AND MESSENGERS (NAICS 492)

Vulnerability Index: 8.6

Industry Description

Industries in this subsector provide intercity, local, and/or international delivery of parcels and documents (including express delivery services) without operating under a universal service obligation. These articles may originate in the U.S. but be delivered to another country and can be described as those that may be handled by one person without using special equipment. This allows the collection, pick-up, and delivery operations to be done with limited labor costs and minimal equipment. Sorting and transportation activities, where necessary, are generally mechanized. The restriction to small parcels partly distinguishes these establishments from those in the transportation industries. The complete network of courier services establishments also distinguishes these transportation services from local messenger and delivery establishments in this subsector. This includes the establishments that perform intercity transportation as well as establishments that, under contract to them, perform local pick-up and delivery. Messengers, which usually deliver within a metropolitan or single urban area, may use bicycle, foot, small truck, or van.

What Is At Risk?

This industry provides 93,300 jobs in California with average annual wages and benefits of $41,190.

93,310 jobs

$ 3.8 billion
Labor Income

$ 7.9 billion
Industry Output

$ 4.0 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-7.

Exhibit 4-7
Products of the Couriers and Messengers Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Couriers and messengers	$ 6,405.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-8 lists the user industries in California of this industry's goods and services.

Exhibit 4-8
Top 20 User Industries of Couriers and Messengers

NAICS	Industry Description	Purchases From This CA Industry ($ millions)
42	Wholesale Trade	$ 1,672.8
484	Truck Transportation	1,059.4
487	Scenic and Sightseeing Transportation	722.9
541	Professional, Scientific, and Technical Services	349.7
519	Other Information Services	349.0
523	Securities, Contracts, Other Investments	271.1
511	Publishing Industries (except Internet)	140.6
512	Motion Picture / Sound Recording Industries	127.9
518	Data Processing, Hosting, and Related Services	108.5
452	General Merchandise Stores	92.0
454	Nonstore Retailers	90.1
561	Administrative and Support Services	89.0
621	Ambulatory Health Care Services	82.9
533	Lessors of Nonfinancial Intangible Assets	77.0
493	Warehousing and Storage	74.8
448	Clothing and Clothing Accessories Stores	72.6
483	Water Transportation	63.7
524	Insurance Carriers and Related Activities	57.0
624	Social Assistance	56.7
622	Hospitals	51.8
	Top 20	*$ 5,609.7*
	All Other Industries	*796.1*
	Total Industry Sales in California	$ 6,405.8

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-9.

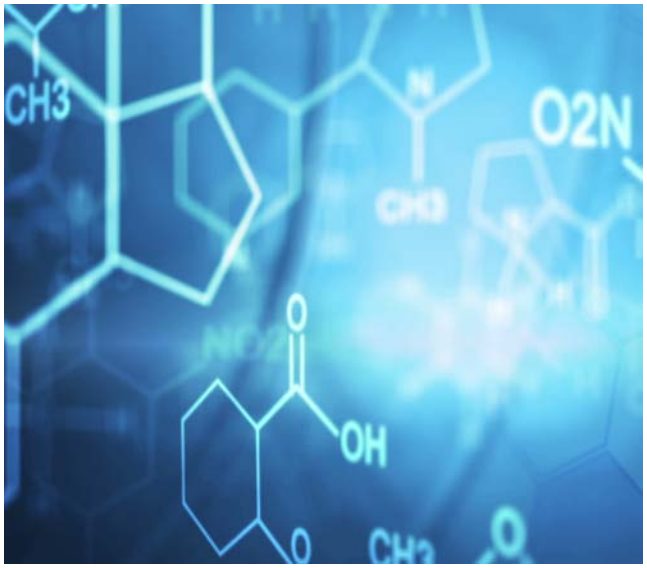
Exhibit 4-9
Couriers and Messengers
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)

Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

CHEMICAL MANUFACTURING (NAICS 325*)

Vulnerability Index: 8.4



Industry Description

This subsector is based on the transformation of organic and inorganic raw materials by a chemical process and the formulation of products. This subsector distinguishes the production of basic chemicals that comprise the first industry group from the production of intermediate and end products produced by further processing of basic chemicals that make up the remaining industry groups.

** For the purposes of this report, this industry has been modified to remove Petrochemical Manufacturing (NAICS 32511) to avoid double-counting.*

What Is At Risk?

This industry provides almost 72,000 jobs in California with average annual wages and benefits of $148,350.

71,690 jobs

$ 10.6 billion
Labor Income

$ 88.2 billion
Industry Output

$ 39.9 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-10.

Exhibit 4-10
Products of the Chemical Manufacturing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Industrial gases	$ 912.9	5.9
Synthetic dyes, basic organics and inorganics	2,342.2	15.2
Plastics, resins, synthetic rubbers, fibers	1,318.6	8.6
Fertilizer and agricultural chemicals	1,282.6	8.3
Pharmaceuticals, medicines, biological prods	4,958.7	32.2
Paints, coatings, adhesives	1,534.8	10.0
Detergents, polish, toilet preparations	1,468.8	9.5
Other chemical products	1,579.3	10.3
Total Industry Sales in California	$ 15,398.0	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-11 lists the user industries in California of this industry's goods and services.

Exhibit 4-11
Top 20 User Industries of Chemical Manufacturing

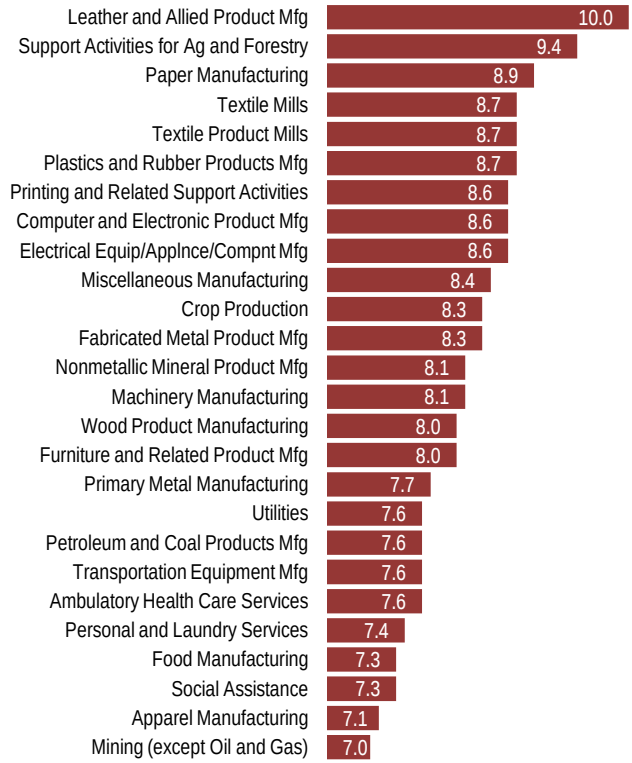
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
622	Hospitals	$ 1,692.7
621	Ambulatory Health Care Services	1,487.7
334	Computer and Electronic Product Manufacturing	1,415.9
326	Plastics and Rubber Products Manufacturing	962.6
23	Construction of Buildings	860.3
541	Professional, Scientific, and Technical Services	501.8
111	Crop Production	380.4
332	Fabricated Metal Product Manufacturing	370.2
115	Support Activities for Agriculture and Forestry	319.3
339	Miscellaneous Manufacturing	276.2
311	Food Manufacturing	232.0
561	Administrative and Support Services	219.0
812	Personal and Laundry Services	177.0
322	Paper Manufacturing	170.7
333	Machinery Manufacturing	159.2
551	Management of Companies and Enterprises	145.5
221	Utilities	143.5
336	Transportation Equipment Manufacturing	134.7
323	Printing and Related Support Activities	121.5
623	Nursing and Residential Care Facilities	61.7
	Top 20	*$ 8,878.2*
	All Other Industries	*5,519.7*
	Total Industry Sales in California	$ 15,398.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-12.

Exhibit 4-12
Chemical Manufacturing
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

AIR TRANSPORTATION (NAICS 481)

Vulnerability Index: 8.4

Industry Description

Industries in this subsector provide air transportation of passengers and/or cargo using aircraft, such as airplanes and helicopters. The subsector distinguishes scheduled from nonscheduled air transportation. Scheduled air carriers fly regular routes on regular schedules and operate even if flights are only partially loaded.

Nonscheduled carriers often operate during nonpeak time slots at busy airports. These establishments have more flexibility with respect to choice of airport, hours of operation, load factors, and similar operational characteristics. Nonscheduled carriers provide chartered air transportation of passengers, cargo, or specialty flying services.

Specialty flying services establishments use general-purpose aircraft to provide a variety of specialized flying services.

What Is At Risk?

This industry provides more than 48,200 jobs in California with average annual wages and benefits of $89,370.

48,210 jobs

$ 4.3 billion
Labor Income

$ 16.5 billion
Industry Output

$ 6.6 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-13.

Exhibit 4-13
Products of the Air Transportation Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Air transportation services	$ 4,657.6	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-14 lists the user industries in California of this industry's goods and services.

Exhibit 4-14
Top 20 User Industries of Air Transportation

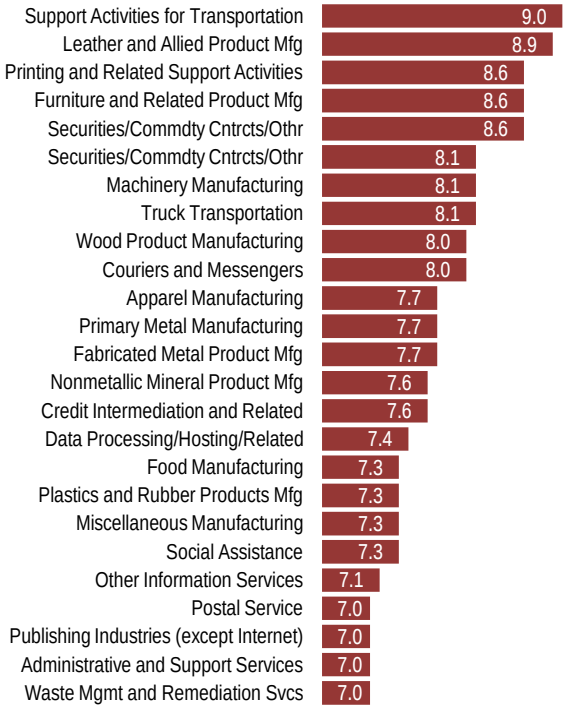
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
541	Professional, Scientific, and Technical Services	$ 739.6
42	Wholesale Trade	330.3
561	Administrative and Support Services	278.4
523	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	234.4
334	Computer and Electronic Product Manufacturing	179.3
519	Other Information Services	178.3
23	Construction of Buildings	175.8
621	Ambulatory Health Care Services	165.6
311	Food Manufacturing	141.9
484	Truck Transportation	118.9
511	Publishing Industries (except Internet)	112.4
521	Monetary Authorities-Central Bank	108.4
518	Data Processing, Hosting, and Related Services	104.3
524	Insurance Carriers and Related Activities	98.1
531	Real Estate	94.0
522	Credit Intermediation and Related Activities	92.9
611	Educational Services	88.4
325	Chemical Manufacturing	73.5
333	Machinery Manufacturing	71.2
332	Fabricated Metal Product Manufacturing	69.6
	Top 20	*$ 3,455.3*
	All Other Industries	*1,202.3*
	Total Industry Sales in California	$ 4,657.6

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-15.

Exhibit 4-15
Air Transportation
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)

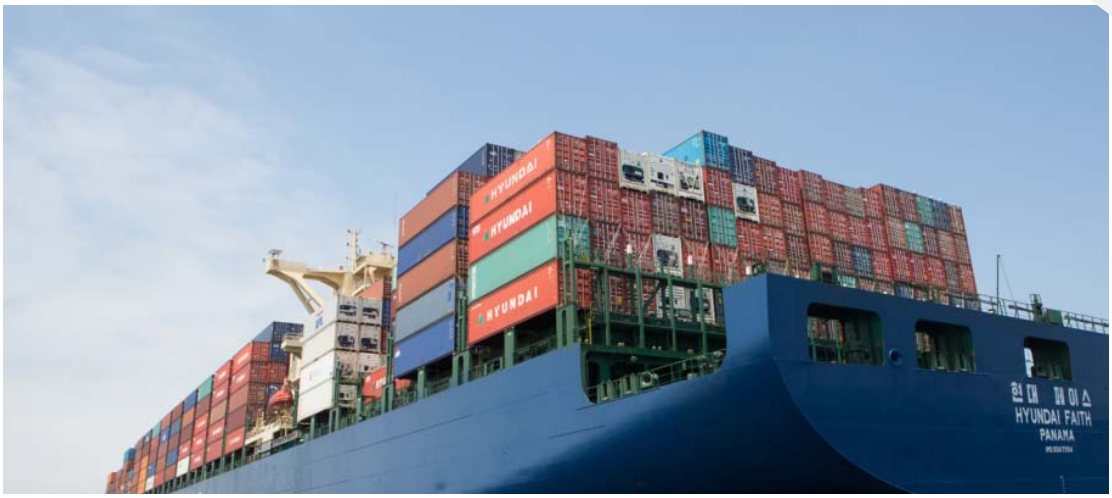


Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

WATER TRANSPORTATION (NAICS 483)

Vulnerability Index: 8.4



Industry Description

Industries in this subsector provide water transportation of passengers and cargo using watercraft, such as ships, barges and boats. The subsector is organized into two groups: (1) one for deep sea, coastal and Great Lakes; and (2) one for inland water transportation. This split typically reflects the difference in equipment used.

What Is At Risk?

This industry provides 6,700 jobs in California with average annual wages and benefits of $88,940.

6,700 jobs

$596 million
Labor Income

$5.1 billion
Industry Output

$1.3 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-16.

Exhibit 4-16
Products of the Water Transportation Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Water transportation service	$ 1,081.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-17 lists the user industries in California of this industry's goods and services.

Exhibit 4-17
Top 20 User Industries of Water Transportation

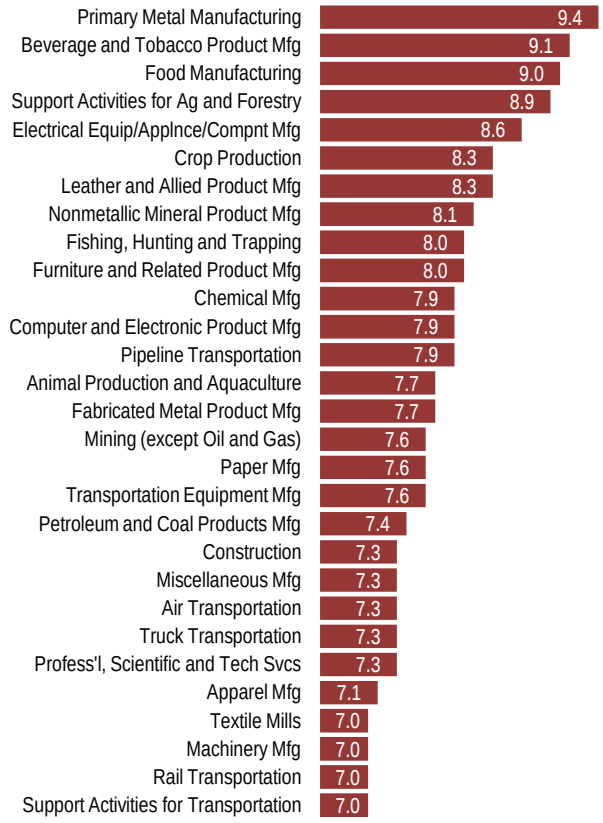
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
311	Food Manufacturing	$ 311.8
23*	Construction of Buildings	205.2
541	Professional, Scientific, and Technical Services	132.1
334	Computer and Electronic Product Manufacturing	44.2
312	Beverage and Tobacco Product Manufacturing	35.7
325	Chemical Manufacturing	35.2
327	Nonmetallic Mineral Product Manufacturing	29.7
112	Animal Production and Aquaculture	26.6
331	Primary Metal Manufacturing	24.8
722	Food Services and Drinking Places	17.8
111	Crop Production	17.7
336	Transportation Equipment Manufacturing	7.9
332	Fabricated Metal Product Manufacturing	7.9
484	Truck Transportation	7.9
335	Electrical Equipment, Appliance, and Component Manufacturing	7.3
621	Ambulatory Health Care Services	6.4
491	Postal Service	6.0
339	Miscellaneous Manufacturing	6.0
622	Hospitals	5.9
221	Utilities	5.5
	Top 20	*$ 941.8*
	All Other Industries	*140.1*
	Total Industry Sales in California	$ 1,081.8

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-18.

Exhibit 4-18
Water Transportation
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)

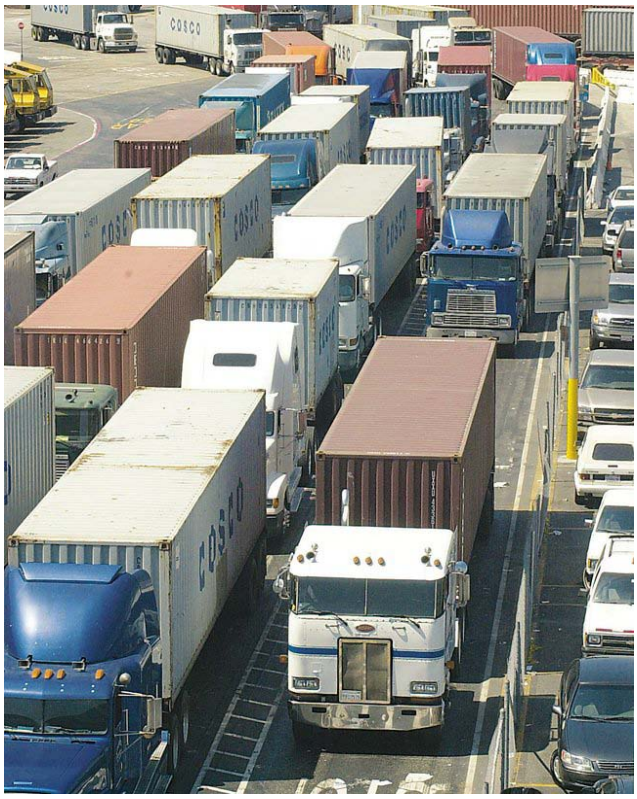


Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

TRUCK TRANSPORTATION (NAICS 484)

Vulnerability Index: 8.4



Industry Description

Industries in this subsector provide over-the-road transportation of cargo using motor vehicles, such as trucks and tractor trailers. The subsector is subdivided into general freight trucking and specialized freight trucking This distinction reflects differences in equipment used, type of load carried, scheduling, terminal, and other networking services. General freight transportation establishments handle a wide variety of general commodities, generally palletized, and transported in a container or van trailer. Specialized freight transportation is the transportation of cargo that, because of size, weight, shape, or other inherent characteristics require specialized equipment for transportation. Each of these industry groups is further subdivided based on distance traveled. Local trucking establishments primarily carry goods within a single metropolitan area and its adjacent nonurban areas. Long distance trucking establishments carry goods between metropolitan areas.

What Is At Risk?

This industry provides more than 206,000 jobs in California with average annual wages and benefits of $58,840.

206,360 jobs

$ 12.1 billion
Labor Income

$ 30.3 billion
Industry Output

$ 12.7 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-19.

Exhibit 4-19
Products of the Couriers and Messengers Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Truck transportation services	$ 15,813.7	100.0
Total Industry Sales in California	$ 15,813.7	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-20 lists the user industries in California of this industry's goods and services.

Exhibit 4-20
Top 20 User Industries of Truck Transportation

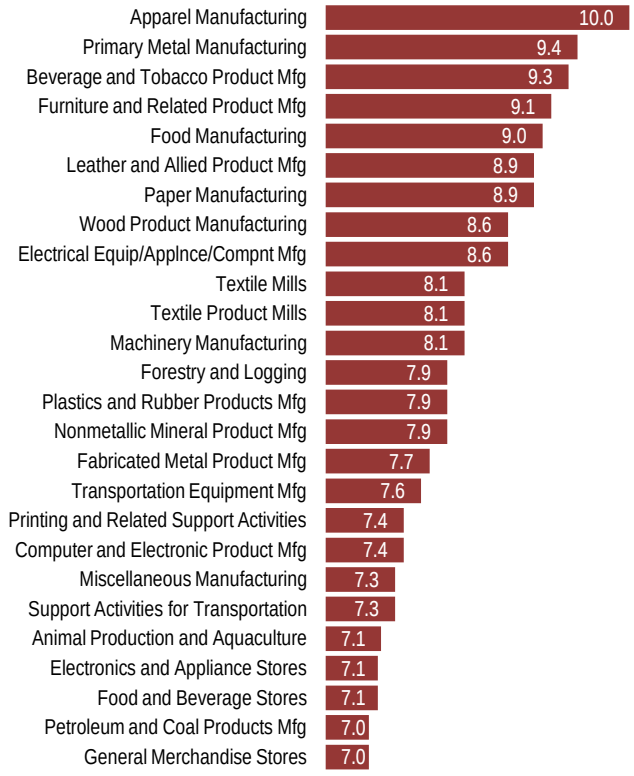
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
23	Construction of Buildings	$ 2,392.9
311	Food Manufacturing	2,307.6
334	Computer and Electronic Product Manufacturing	1,06.5
42	Wholesale Trade	515.1
325	Chemical Manufacturing	490.2
312	Beverage and Tobacco Product Manufacturing	436.5
541	Professional, Scientific, and Technical Services	401.0
452	General Merchandise Stores	400.6
336	Transportation Equipment Manufacturing	356.5
722	Food Services and Drinking Places	339.6
333	Machinery Manufacturing	314.0
332	Fabricated Metal Product Manufacturing	290.3
445	Food and Beverage Stores	286.5
331	Primary Metal Manufacturing	250.8
327	Nonmetallic Mineral Product Manufacturing	227.3
454	Nonstore Retailers	180.7
339	Miscellaneous Manufacturing	175.2
322	Paper Manufacturing	174.5
326	Plastics and Rubber Products Manufacturing	159.5
112	Animal Production and Aquaculture	156.7
	Top 20	*$ 10,924.1*
	All Other Industries	*4,889.6*
	Total Industry Sales in California	$ 15,813.7

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-21.

Exhibit 4-21
Truck Transportation
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

AGRICULTURE
(NAICS 111, 112, 115)

Vulnerability Index: 8.3

Industry Description

Agriculture includes three subsectors (1) crop production, (2) animal production and aquaculture and (3) support activities for agriculture and forestry. Industries in the Crop Production subsector grow crops mainly for food and fiber.

Industries in the Animal Production and Aquaculture subsector raise or fatten animals for the sale of animals or animal products and/or raise aquatic plants and animals in controlled or selected aquatic environments for the sale of aquatic plants, animals, or their products.

Industries in the Support Activities for Agriculture and Forestry subsector provide support services that are an essential part of agricultural and forestry production which may be performed by the agriculture or forestry producing establishment or conducted independently as an alternative source of inputs required for the production process for a given crop, animal, or forestry industry.

What Is At Risk?

This industry provides more than 500,000 jobs in California with average annual wages and benefits of $53,970.

501,570 jobs

$ 27.1 billion
Labor Income

$ 56.9 billion
Industry Output

$ 38.9
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-22.

Exhibit 4-22
Products of the Agriculture Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Oilseeds and grains	$ 1,366.7	7.1
Vegetables and fruit	2,054.8	10.7
Tree nuts, greenhouse, nurseries	1,148.3	6.0
Cotton, sugarcane, all other crops	1,792.3	9.3
Beef cattle	3,032.7	15.8
Dairy cattle and milk products	5,212.5	27.1
Poultry and egg products	1,106.6	5.7
All other animal products	370.2	1.9
Support activities for ag and forestry	3,166.8	16.5
Total Industry Sales in California	$ 19,250.9	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-23 lists the user industries in California of this industry's goods and services.

Exhibit 4-23
Top 20 User Industries of Agriculture

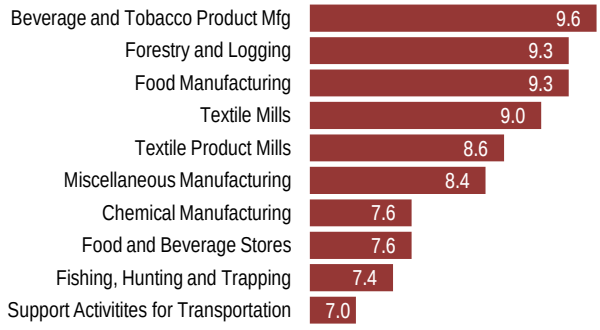
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
311	Food Manufacturing	$ 12,660.1
312	Beverage and Tobacco Product Manufacturing	773.8
23	Construction of Buildings	380.1
113	Forestry and Logging	129.8
561	Administrative and Support Services	91.4
339	Miscellaneous Manufacturing	61.0
325	Chemical Manufacturing	59.1
541	Professional, Scientific, and Technical Services	48.9
445	Food and Beverage Stores	42.2
722	Food Services and Drinking Places	29.9
313	Textile Mills	23.4
441	Motor Vehicle and Parts Dealers	19.9
713	Amusement, Gambling, Recreation Industries	9.8
611	Educational Services	8.9
531	Real Estate	8.5
454	Nonstore Retailers	7.3
448	Clothing and Clothing Accessories Stores	5.9
444	Building Material and Garden Supplies Dealers	4.1
446	Health and Personal Care Stores	3.4
42	Wholesale Trade	3.1
	Top 20	*$ 14,370.6*
	All Other Industries	*4,880.3*
	Total Industry Sales in California	$ 19,250.9

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-24.

Exhibit 4-24
Agriculture
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

RAIL TRANSPORTATION (NAICS 482)

Vulnerability Index: 8.1

Industry Description

Industries in this subsector provide rail transportation of passengers and/or cargo using railroad rolling stock. The railroads in this subsector primarily either operate on networks, with physical facilities, labor force, and equipment spread over an extensive geographic area, or operate over a short distance on a local rail line.

What Is At Risk?

This industry provides almost 12,000 jobs in California with average annual wages and benefits of $104,630.

11,890 jobs

$ 1.2 billion
Labor Income

$ 3.5 billion
Industry Output

$ 1.3 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-25.

Exhibit 4-25
Products of the Rail Transportation Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Rail transportation	$ 6,405.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-26 lists the user industries in California of this industry's goods and services.

Exhibit 4-26
Top 20 User Industries of Rail Transportation

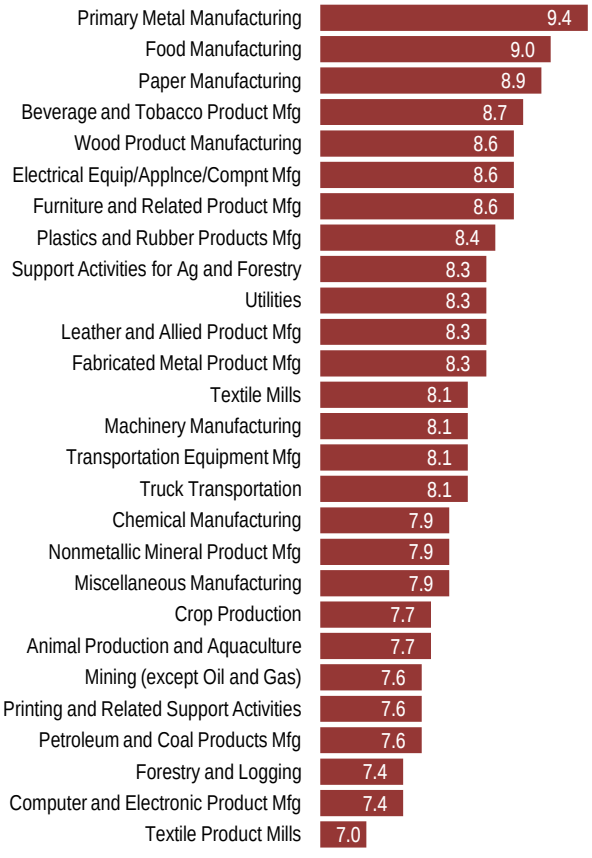
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
311	Food Manufacturing	$ 415.7
484	Truck Transportation	180.6
23	Construction of Buildings	179.3
325	Chemical Manufacturing	170.7
331	Primary Metal Manufacturing	156.3
327	Nonmetallic Mineral Product Manufacturing	119.6
322	Paper Manufacturing	77.2
334	Computer and Electronic Product Manufacturing	76.2
221	Utilities	67.8
326	Plastics and Rubber Products Manufacturing	63.5
332	Fabricated Metal Product Manufacturing	52.8
722	Food Services and Drinking Places	51.5
541	Professional, Scientific, and Technical Services	51.5
312	Beverage and Tobacco Product Manufacturing	46.0
531	Real Estate	33.4
336	Transportation Equipment Manufacturing	32.4
112	Animal Production and Aquaculture	28.8
321	Wood Product Manufacturing	27.4
333	Machinery Manufacturing	24.6
335	Electrical Equipment, Appliance, and Component Manufacturing	19.8
	Top 20	*$ 1,875.2*
	All Other Industries	*362.5*
	Total Industry Sales in California	$ 2,237.7

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-27.

Exhibit 4-27
Rail Transportation
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)

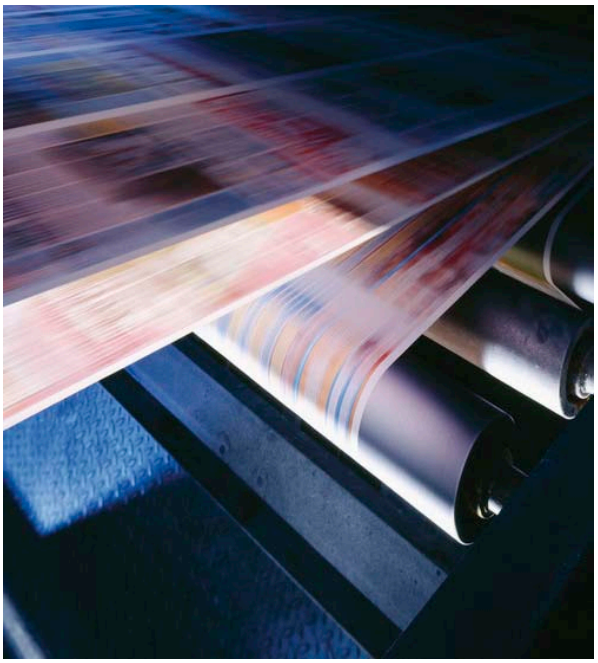


Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

PRINTING AND RELATED SUPPORT ACTIVITIES (NAICS 323)

Vulnerability Index: 8.0



Industry Description

Industries in this subsector print products, such as newspapers, books, labels, business cards, stationery, business forms, and other materials, and perform support activities, such as data imaging, platemaking services, and bookbinding. The support activities included here are an integral part of the printing industry, and a product (a printing plate, a bound book, or a computer disk or file) that is an integral part of the printing industry is almost always provided by these operations.

What Is At Risk?

This industry provides almost 55,300 jobs in California with average annual wages and benefits of $47,740.

55,290 jobs

$ 2.6 billion
Labor Income

$ 8.0 billion
Industry Output

$ 3.2 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-28.

Exhibit 4-28
Products of the Printing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Printed materials	$ 3,142.9	91.2
Printing support services	301.4	8.8
Total Industry Sales in California	$ 3,444.3	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-29 lists the user industries in California of this industry's goods and services.

Exhibit 4-29
Top 20 User Industries of Printing Activities

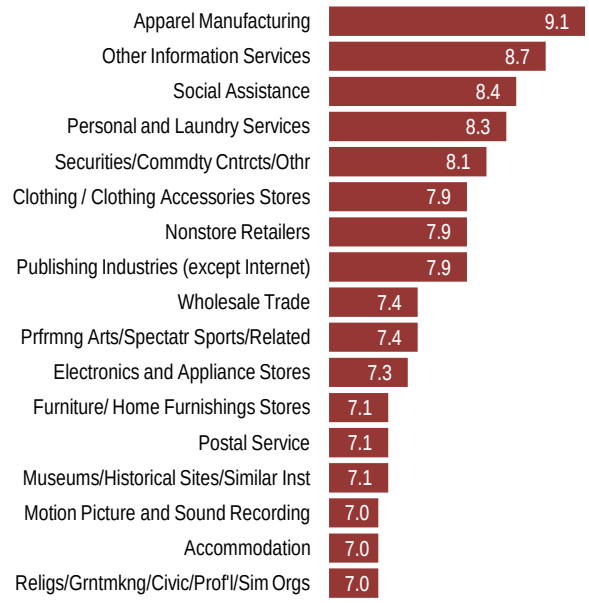
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
519	Other Information Services	$ 745.5
541	Professional, Scientific, and Technical Services	420.2
511	Publishing Industries (except Internet)	408.7
42	Wholesale Trade	271.3
523	Securities, Contracts, and Other Investments	225.4
524	Insurance Carriers and Related Activities	158.4
561	Administrative and Support Services	85.8
621	Ambulatory Health Care Services	83.7
624	Social Assistance	79.8
325	Chemical Manufacturing	78.5
512	Motion Picture and Sound Recording Industries	75.9
551	Management of Companies and Enterprises	57.3
812	Personal and Laundry Services	43.6
622	Hospitals	42.7
611	Educational Services	38.6
454	Nonstore Retailers	35.8
722	Food Services and Drinking Places	33.8
721	Accommodation	32.3
813	Religious, Grantmaking, Civic, Professional Orgs	29.9
448	Clothing and Clothing Accessories Stores	28.9
	Top 20	*$ 2,977.3*
	All Other Industries	*467.0*
	Total Industry Sales in California	$ 3,444.3

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-30.

Exhibit 4-30
Printing and Related Support Activities
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

UTILITIES
(NAICS 221)

Vulnerability Index: 7.6

Industry Description

Industries in the Utilities subsector provide electric power, natural gas, steam supply, water supply, and sewage removal through a permanent infrastructure of lines, mains, and pipes. Establishments are grouped together based on the utility service provided and the particular system or facilities required to perform the service.

What Is At Risk?

This industry provides 61,500 jobs in California with average annual wages and benefits of $160,740.

61,500 jobs

$ 9.9 billion
Labor Income

$ 46.1 billion
Industry Output

$ 30.8 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-31.

Exhibit 4-31
Products of the Utilities Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Electric power generation	$ 6,560.7	36.9
Electricity transmission and distribution	5,518.4	31.1
Natural gas distribution	3,490.5	19.7
Water, sewage and other systems	2,190.1	12.3
Total Industry Sales in California	$ 17,759.7	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-32 lists the user industries in California of this industry's goods and services.

Exhibit 4-32
Top 20 User Industries of Utilities

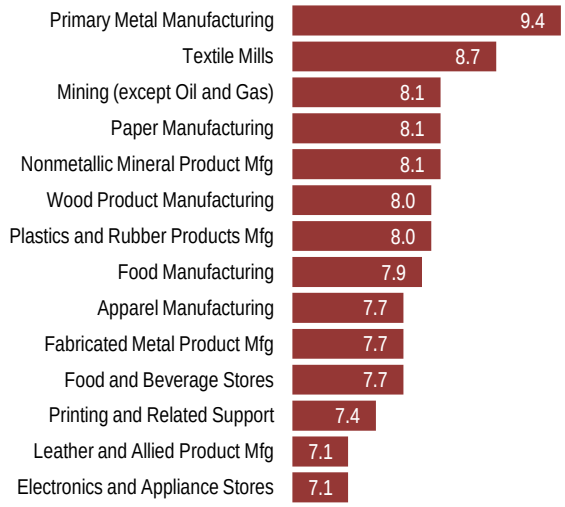
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
531	Real Estate	$ 1,540.2
611	Educational Services	721.7
311	Food Manufacturing	643.5
334	Computer and Electronic Product Manufacturing	593.2
325	Chemical Manufacturing	575.9
722	Food Services and Drinking Places	476.4
42	Wholesale Trade	420.0
23	Construction of Buildings	299.2
541	Professional, Scientific, and Technical Services	270.9
327	Nonmetallic Mineral Product Manufacturing	248.7
332	Fabricated Metal Product Manufacturing	229.2
551	Management of Companies and Enterprises	222.8
445	Food and Beverage Stores	217.3
622	Hospitals	216.1
111	Crop Production	208.0
312	Beverage and Tobacco Product Manufacturing	170.0
721	Accommodation	167.7
331	Primary Metal Manufacturing	165.0
336	Transportation Equipment Manufacturing	129.6
621	Ambulatory Health Care Services	119.6
	Top 20	*$ 7,653.9*
	All Other Industries	*10,105.8*
	Total Industry Sales in California	$ 17,759.7

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-33.

Exhibit 4-33
Utilities
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

PAPER MANUFACTURING (NAICS 322)

Vulnerability Index: 7.6

Industry Description

Industries in this subsector make pulp, paper, or converted paper products. The manufacturing of these products is grouped together because they constitute a series of vertically connected processes. More than one is often carried out in a single establishment. There are essentially three activities. The manufacturing of pulp involves separating the cellulose fibers from other impurities in wood or used paper. The manufacturing of paper involves matting these fibers into a sheet. Converted paper products are made from paper and other materials by various cutting and shaping techniques and includes coating and laminating activities.

What Is At Risk?

This industry provides 21,200 jobs in California with average annual wages and benefits of $86,690.

21,200 jobs

$ 1.8 billion
Labor Income

$ 9.5 billion
Industry Output

$ 2.1 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-34.

Exhibit 4-34
Products of the Paper Manufacturing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Wood pulp	$ 12.5	0.2
Paper from pulp	375.9	6.6
Paperboard from pulp	178.2	3.1
Paperboard containers	4,231.5	73.8
Paper bags and coated and treated paper	508.8	8.9
Stationery products	83.2	1.5
Sanitary paper products	161.3	2.8
All other converted paper products	180.4	3.1
Total Industry Sales in California	$ 5,731.9	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-35 lists the user industries in California of this industry's goods and services.

Exhibit 4-35
Top 20 User Industries of Paper Manufacturing

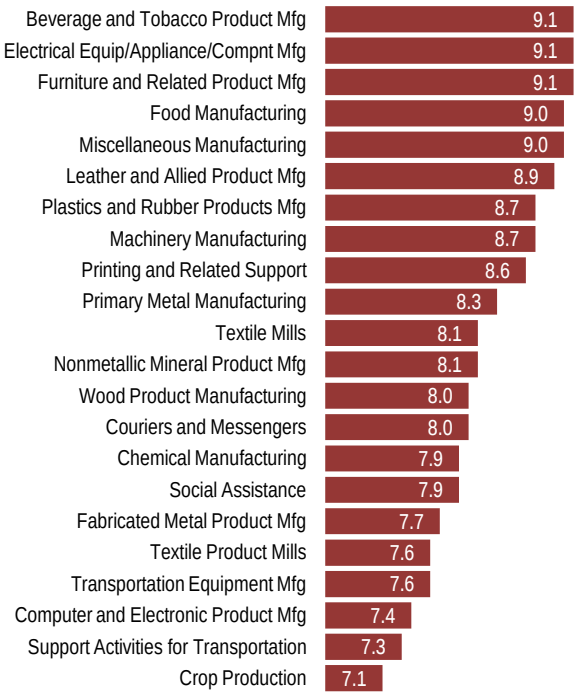
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
311	Food Manufacturing	$ 1,392.7
325	Chemical Manufacturing	471.3
312	Beverage and Tobacco Product Manufacturing	366.6
334	Computer and Electronic Product Manufacturing	234.1
23	Construction of Buildings	219.7
339	Miscellaneous Manufacturing	191.9
323	Printing and Related Support Activities	185.2
42	Wholesale Trade	184.8
326	Plastics and Rubber Products Manufacturing	184.7
541	Professional, Scientific, and Technical Services	155.4
722	Food Services and Drinking Places	151.3
332	Fabricated Metal Product Manufacturing	128.8
333	Machinery Manufacturing	117.0
336	Transportation Equipment Manufacturing	104.4
622	Hospitals	94.0
621	Ambulatory Health Care Services	89.9
337	Furniture and Related Product Manufacturing	84.6
327	Nonmetallic Mineral Product Manufacturing	79.9
335	Electrical Equipment and Component Manufacturing	76.0
561	Administrative and Support Services	56.3
	Top 20	*$ 4,436.4*
	All Other Industries	*1,295.5*
	Total Industry Sales in California	$ 5,731.9

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-36.

Exhibit 4-36
Paper Manufacturing
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

MACHINERY MANUFACTURING (NAICS 333)

Vulnerability Index: 7.6

Industry Description

Industries in this subsector create end products that apply mechanical force, for example, the application of gears and levers, to perform work. Some important processes for the manufacture of machinery are forging, stamping, bending, forming, and machining that are used to shape individual pieces of metal. Processes, such as welding and assembling are used to join separate parts together. Although these processes are similar to those used in metal fabricating establishments, machinery manufacturing is different because it typically employs multiple metal forming processes in manufacturing the various parts of the machine. Moreover, complex assembly operations are an inherent part of the production process.

What Is At Risk?

This industry provides almost 77,000 jobs in California with average annual wages and benefits of $91,740.

76,980 jobs

$ 7.1 billion
Labor Income

$ 31.0 billion
Industry Output

$ 9.9 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-37.

Exhibit 4-37
Products of the Machinery Manufacturing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Agriculture, construction, mining machinery mfg	$ 190.8	8.3
Industrial machinery	197.2	8.5
Commercial and service industry machinery	530.3	23.0
HVAC and commercial refrigeration eqpmt	421.9	18.3
Metalworking machinery	103.1	4.5
Engine, turbine and power transmission eqpmt	117.2	5.1
Other general purpose machinery	749.9	32.5
Total Industry Sales in California	$ 2,310.3	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-38 lists the user industries in California of this industry's goods and services.

Exhibit 4-38
Top 20 User Industries of Machinery Manufacturing

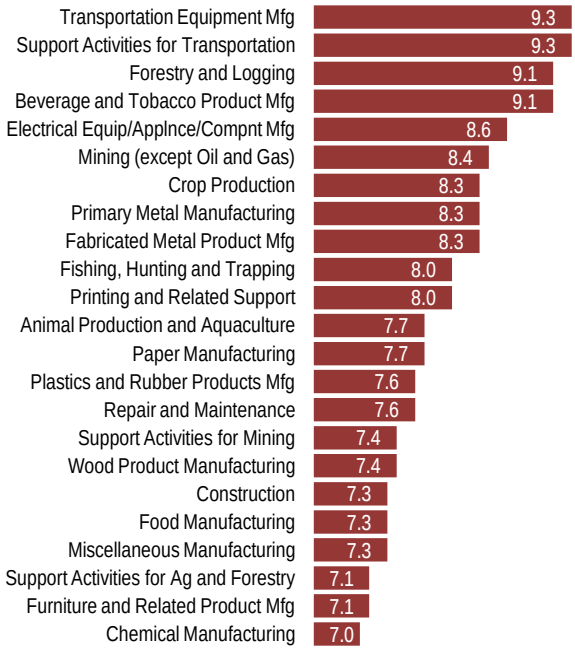
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
23	Construction of Buildings	$ 504.0
312	Beverage and Tobacco Product Manufacturing	339.1
487	Support Activities for Transportation	98.1
336	Transportation Equipment Manufacturing	80.8
561	Administrative and Support Services	69.4
611	Educational Services	64.7
111	Crop Production	54.0
541	Professional, Scientific, and Technical Services	47.2
332	Fabricated Metal Product Manufacturing	43.6
334	Computer and Electronic Product Manufacturing	40.3
112	Animal Production and Aquaculture	35.7
811	Repair and Maintenance	30.0
562	Waste Management and Remediation Services	29.9
812	Personal and Laundry Services	22.0
311	Food Manufacturing	19.3
531	Real Estate	18.0
325	Chemical Manufacturing	15.9
551	Management of Companies and Enterprises	15.7
517	Telecommunications	15.1
339	Miscellaneous Manufacturing	13.0
	Top 20	*$ 1,555.6*
	All Other Industries	*754.7*
	Total Industry Sales in California	$ 2,310.3

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-39.

Exhibit 4-39
Machinery Manufacturing
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

PETROLEUM AND COAL PRODUCTS MANUFACTURING (NAICS 324*)

Vulnerability Index: 7.4

Industry Description

The Petroleum and Coal Products Manufacturing subsector is based on the transformation of crude petroleum and coal into usable products. The dominant process is petroleum refining that involves the separation of crude petroleum into component products through such techniques as cracking and distillation.

In addition, this subsector includes establishments that primarily further process refined petroleum and coal products and produce products, such as asphalt coatings and petroleum lubricating oils. However, establishments that manufacture petrochemicals from refined petroleum are classified in Industry 32511, Petrochemical Manufacturing.

** For the purposes of this report, this industry has been modified to remove Petroleum Refineries (NAICS 32411) to avoid double-counting.*

What Is At Risk?

This industry provides more than 2,100 jobs in California with average annual wages and benefits of $97,320.

2,150 jobs

$ 209 million
Labor Income

$ 2.2 billion
Industry Output

$ 238 million
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-40.

Exhibit 4-40
Products of the Petroleum and Coal Products Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Asphalt paving mixtures and blocks	$ 317.9	13.7
Asphalt shingles and coating materials	698.1	30.1
Petroleum lubricating oil and grease	1,196.4	51.6
All other petroleum and coal products	105.1	4.5
Total Industry Sales in California	$ 2,317.5	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-41 lists the user industries in California of this industry's goods and services.

Exhibit 4-41
Top 20 User Industries of Petroleum and Coal Products

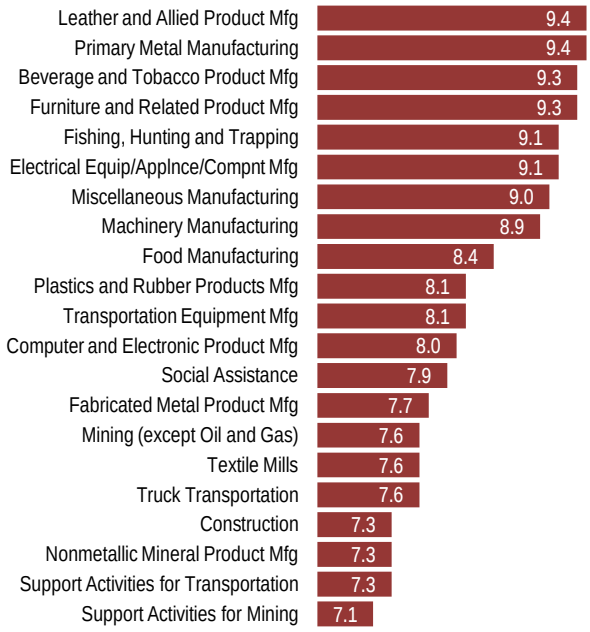
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
23	Construction of Buildings	$ 1,009.1
311	Food Manufacturing	196.6
335	Electrical Equipment, Appliance, Component Mfg	102.4
334	Computer and Electronic Product Manufacturing	98.0
312	Beverage and Tobacco Product Manufacturing	89.0
339	Miscellaneous Manufacturing	65.3
333	Machinery Manufacturing	59.0
484	Truck Transportation	40.4
331	Primary Metal Manufacturing	34.8
325	Chemical Manufacturing	34.6
336	Transportation Equipment Manufacturing	30.1
42	Wholesale Trade	26.0
326	Plastics and Rubber Products Manufacturing	23.6
337	Furniture and Related Product Manufacturing	17.9
332	Fabricated Metal Product Manufacturing	17.5
327	Nonmetallic Mineral Product Manufacturing	16.8
561	Administrative and Support Services	15.3
624	Social Assistance	14.6
213	Support Activities for Mining	11.8
722	Food Services and Drinking Places	11.2
	Top 20	*$ 1,910.9*
	All Other Industries	*406.6*
	Total Industry Sales in California	$ 2,317.5

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-42.

Exhibit 4-42
Petroleum and Coal Products Manufacturing
Most Vulnerable User Industries
(Vulnerability Index **≥ 7.0**)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

WOOD PRODUCT MANUFACTURING (NAICS 321)

Vulnerability Index: 7.4

Industry Description

Industries in the Wood Product Manufacturing subsector manufacture wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (i.e., mobile homes), and prefabricated wood buildings. The production processes of the Wood Product Manufacturing subsector include sawing, planing, shaping, laminating, and assembling of wood products starting from logs that are cut into bolts, or lumber that then may be further cut, or shaped by lathes or other shaping tools. The lumber or other transformed wood shapes may also be subsequently planed or smoothed, and assembled into finished products, such as wood containers. The subsector includes establishments that make wood products from logs and bolts that are sawed and shaped, and establishments that purchase sawed lumber and make wood products. With the exception of sawmills and wood preservation establishments, the establishments are grouped into industries mainly based on the specific products manufactured.

What Is At Risk?

This industry provides more than 25,000 jobs in California with average annual wages and benefits of $49,550.

25,260 jobs

$ 1.3 billion
Labor Income

$ 4.6 billion
Industry Output

$ 1.3 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-43.

Exhibit 4-43
Products of the Wood Products Manufacturing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Sawmills and preserved wood product	$ 1,079.9	31.8
Veneer, plywood and engineered wood product	411.0	12.1
Millwork, windows and doors	1,310.6	38.6
Wood containers and pallets	294.8	8.7
Other wood product manufacturing	301.4	8.9
Total Industry Sales in California	$ 3,397.7	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-44 lists the user industries in California of this industry's goods and services.

Exhibit 4-44
Top 20 User Industries of Wood Products

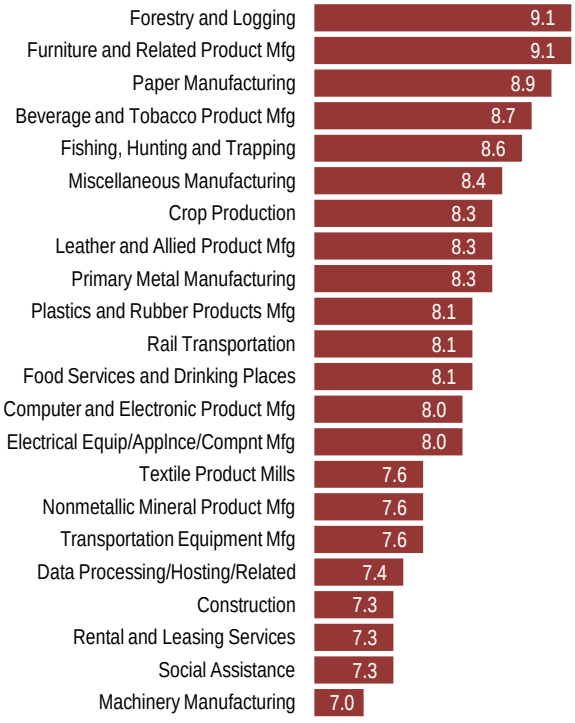
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
23	Construction of Buildings	$ 1,507.1
531	Rental and Leasing Services	283.1
337	Furniture and Related Product Manufacturing	126.3
334	Computer and Electronic Product Manufacturing	118.5
722	Repair and Maintenance	66.5
42	Wholesale Trade	58.4
111	Crop Production	57.8
482	Rail Transportation	39.2
445	Food and Beverage Stores	37.0
518	Data Processing, Hosting, and Related Services	36.6
339	Miscellaneous Manufacturing	29.6
336	Transportation Equipment Manufacturing	26.5
541	Management of Companies and Enterprises	22.8
327	Nonmetallic Mineral Product Manufacturing	22.7
312	Beverage and Tobacco Product Manufacturing	22.4
322	Paper Manufacturing	21.6
532	Lessors of Nonfinancial Intangible Assets	20.2
326	Plastics and Rubber Products Manufacturing	16.6
624	Performing Arts, Spectator Sports Industries	15.6
454	Nonstore Retailers	14.4
	Top 20	*$ 2,542.8*
	All Other Industries	*854.9*
	Total Industry Sales in California	$ 3,397.7

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-45.

Exhibit 4-45
Wood Product Manufacturing
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

PLASTICS AND RUBBER PRODUCTS MANUFACTURING (NAICS 326)

Vulnerability Index: 7.4

Industry Description

Industries in this subsector make goods by processing plastics materials and raw rubber. The core technology employed by establishments in this subsector is that of plastics or rubber product production. Plastics and rubber are combined in the same subsector because plastics are increasingly being used as a substitute for rubber; however the subsector is generally restricted to the production of products made of just one material, either solely plastics or rubber.

What Is At Risk?

This industry provides more than 45,000 jobs in California with average annual wages and benefits of $60,550.

45,140 jobs

$ 2.7 billion
Labor Income

$ 14.8 billion
Industry Output

$ 4.3 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-46.

Exhibit 4-46
Products of the Plastics and Rubber Products Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Plastics packaging materials, unlaminated film	$ 1,665.5	19.2
Laminated / unlaminated sheets and shapes	606.1	7.0
Plastics pipes and pipe fittings	817.4	9.4
Polystyrene, urethane and other foam products	1,101.2	12.7
Plastics bottles	1,033.8	11.9
Other plastics products	2,824.1	32.6
Tires, hoses, belts and other rubber products	614.4	7.1
Total Industry Sales in California	$ 8,662.4	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-47 lists the user industries in California of this industry's goods and services.

Exhibit 4-47
Top 20 User Industries of Plastics and Rubber Products

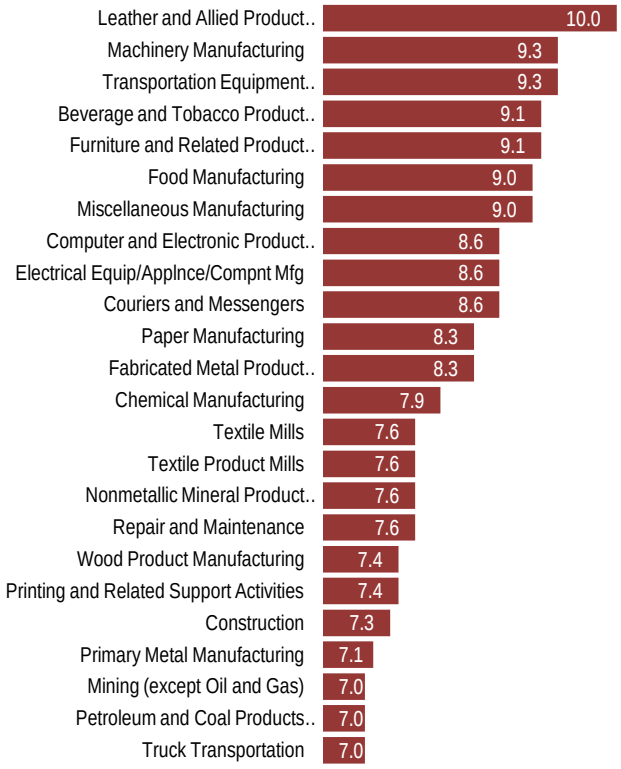
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
23	Construction of Buildings	$ 1,562.4
334	Computer and Electronic Product Manufacturing	841.1
311	Food Manufacturing	776.6
312	Beverage and Tobacco Product Manufacturing	544.5
325	Chemical Manufacturing	524.9
42	Wholesale Trade	335.6
722	Food Services and Drinking Places	314.4
336	Transportation Equipment Manufacturing	300.4
339	Miscellaneous Manufacturing	287.6
337	Furniture and Related Product Manufacturing	279.8
621	Ambulatory Health Care Services	233.4
333	Machinery Manufacturing	223.8
541	Professional, Scientific, and Technical Services	205.9
811	Repair and Maintenance	201.2
332	Fabricated Metal Product Manufacturing	105.9
622	Hospitals	73.6
445	Food and Beverage Stores	72.6
322	Paper Manufacturing	60.3
335	Electrical Equipment and Component Mfg	57.6
517	Telecommunications	56.3
	Top 20	$ 7,057.9
	All Other Industries	*1,604.6*
	Total Industry Sales in California	$ 8,662.4

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-48.

Exhibit 4-48
Plastics and Rubber Products Manufacturing
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

MINING AND MINING SUPPORT (NAICS 212, 213)

Vulnerability Index: 7.1

Industry Description

Mining and mining support includes two subsectors, (1) Mining (except oil and gas) and (2) support activities for mining. Industries in the mining (except Oil and Gas) subsector primarily engage in mining, mine site development, and beneficiating (i.e., preparing) metallic minerals and nonmetallic minerals, including coal. It includes ore extraction, quarrying, and beneficiating (e.g., crushing, screening, washing, sizing, concentrating, and flotation), customarily done at the mine site. Industries in the Support Activities for Mining subsector group establishments primarily providing support services, on a contract or fee basis, required for the mining and quarrying of minerals and for the extraction of oil and gas. Establishments performing exploration (except geophysical surveying and mapping) for minerals, on a contract or fee basis, are included in this subsector. Exploration includes traditional prospecting methods, such as taking core samples and making geological observations at prospective sites.

What Is At Risk?

This industry provides 24,400 jobs in California with average annual wages and benefits of $94,620.

24,420 jobs

$ 2.4 billion
Labor Income

$ 6.3 billion
Industry Output

$ 4.0 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-49.

Exhibit 4-49
Products of the Mining and Mining Support Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Coal mining	$ 1.7	0.1
Metal ore mining	156.0	5.6
Stone mining and quarrying	453.3	16.2
Sand, gravel and other nonmetallic mining	648.7	23.2
Support activities for oil and gas	1,484.2	53.1
Metal and other minerals services	52.8	1.9
Total Industry Sales in California	$ 2,796.6	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-50 lists the user industries in California of this industry's goods and services.

Exhibit 4-50
Top 20 User Industries of Mining and Mining Support

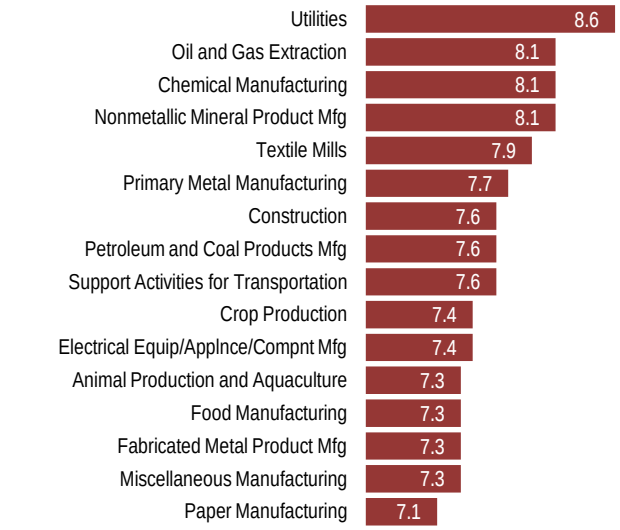
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
211	Oil and Gas Extraction	$ 852.1
23	Construction of Buildings	584.4
487	Scenic and Sightseeing Transportation	366.8
327	Nonmetallic Mineral Product Manufacturing	286.9
325	Chemical Manufacturing	88.7
331	Primary Metal Manufacturing	69.3
541	Professional, Scientific, and Technical Services	43.8
324	Petroleum and Coal Products Manufacturing	20.5
221	Utilities	17.9
111	Crop Production	16.9
311	Food Manufacturing	8.2
335	Electrical Equipment and Component Manufacturing	8.2
332	Fabricated Metal Product Manufacturing	7.9
339	Miscellaneous Manufacturing	7.6
336	Transportation Equipment Manufacturing	6.6
531	Real Estate	5.0
334	Computer and Electronic Product Manufacturing	3.5
112	Animal Production and Aquaculture	2.7
322	Paper Manufacturing	2.2
551	Management of Companies and Enterprises	1.7
	Top 20	*$ 2,401.1*
	All Other Industries	*395.5*
	Purchases from California Firms in Industry	$ 2,796.6

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-51.

Exhibit 4-51
Mining and Mining Support
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

PRIMARY METAL MANUFACTURING (NAICS 331)

Vulnerability Index: 7.1

Industry Description

Industries in the Primary Metal Manufacturing subsector smelt and/or refine ferrous and nonferrous metals from ore, pig or scrap, using electrometallurgical and other process metallurgical techniques. Establishments in this subsector also manufacture metal alloys and superalloys by introducing other chemical elements to pure metals. The output of smelting and refining, usually in ingot form, is used in rolling, drawing, and extruding operations to make sheet, strip, bar, rod, or wire, and in molten form to make castings and other basic metal products.

What Is At Risk?

This industry provides 20,400 jobs in California with average annual wages and benefits of $80,020.

20,400 jobs

$ 1.6 billion
Labor Income

$ 11.3 billion
Industry Output

$ 1.9 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-52.

Exhibit 4-52
Products of the Primary Metal Manufacturing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Iron and steel and ferroalloy products	$ 3,438.4	58.5
Steel wire	153.6	2.6
Aluminum products and processes	891.3	15.2
Nonferrous metal products and processes	533.5	9.1
Ferrous and nonferrous metal foundries	861.0	14.6
Total Industry Sales in California	$ 6,405.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-53 lists the user industries in California of this industry's goods and services.

Exhibit 4-53
Top 20 User Industries of Primary Metals

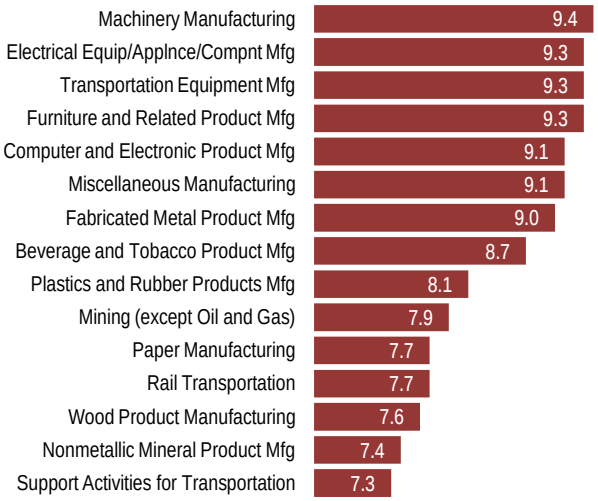
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
332	Fabricated Metal Product Manufacturing	$ 1,949.7
333	Machinery Manufacturing	905.9
336	Transportation Equipment Manufacturing	729.0
334	Computer and Electronic Product Manufacturing	363.9
335	Electrical Equipment, Appliance, and Component Manufacturing	219.4
23	Construction of Buildings	199.3
339	Miscellaneous Manufacturing	149.1
337	Furniture and Related Product Manufacturing	112.0
312	Beverage and Tobacco Product Manufacturing	101.0
541	Professional, Scientific, and Technical Services	59.8
482	Rail Transportation	30.3
562	Waste Management and Remediation Services	27.1
326	Plastics and Rubber Products Manufacturing	25.1
327	Nonmetallic Mineral Product Manufacturing	19.6
531	Real Estate	19.0
811	Repair and Maintenance	13.3
42	Wholesale Trade	10.9
561	Administrative and Support Services	10.6
532	Rental and Leasing Services	9.1
713	Amusement, Gambling, and Recreation Industries	8.6
	Top 20	*$ 5,034.6*
	All Other Industries	*843.1*
	Purchases from California Firms in Industry	$ 5,877.7

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-54.

Exhibit 4-54
Primary Metal Manufacturing
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

NONMETALLIC MINERAL PRODUCT MANUFACTURING (NAICS 327)

Vulnerability Index: 7.0

Industry Description

This subsector includes establishments that transform mined or quarried nonmetallic minerals, such as sand, gravel, stone, clay, and refractory materials, into products for intermediate or final consumption. Processes used include grinding, mixing, cutting, shaping, and honing. Heat often is used in the process and chemicals are frequently mixed to change the composition, purity, and chemical properties for the intended product. Refractory materials are heated and then formed into bricks or other shapes for use in industrial applications.

The Nonmetallic Mineral Product Manufacturing subsector includes establishments that manufacture products, such as bricks, refractories, ceramic products, and glass and glass products, such as plate glass and containers. Also included are cement and concrete products, lime, gypsum and other nonmetallic mineral products including abrasive products, ceramic plumbing fixtures, statuary, cut stone products, and mineral wool. The products are used in a wide range of activities from construction and heavy and light manufacturing to articles for personal use.

What Is At Risk?

This industry provides almost 33,000 jobs in California with average annual wages and benefits of $61,940.

32,890 jobs

$ 2.0 billion
Labor Income

$ 9.1 billion
Industry Output

$ 3.0 billion
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-55.

Exhibit 4-55
Products of the Nonmetallic Mineral Manufacturing Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Clay products, including pottery and ceramics	$ 379.6	5.0
Glass and glass products	1,398.9	18.5
Cement and ready-mix concrete	2,774.4	36.6
Concrete pipe, brick, block and other products	1,448.0	19.1
Lime and gypsum products	453.4	6.0
Other nonmetallic mineral products	1,117.5	14.8
Total Industry Sales in California	$ 7,571.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-56 lists the user industries in California of this industry's goods and services.

Exhibit 4-56
Top 20 User Industries of Nonmetallic Mineral Products

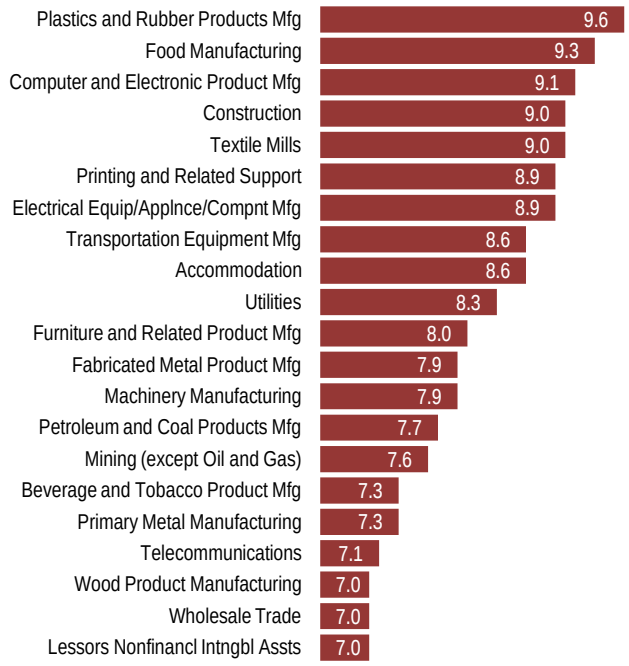
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
23	Construction of Buildings	$ 4,347.8
312	Beverage and Tobacco Product Manufacturing	576.1
541	Professional, Scientific, and Technical Services	205.3
334	Computer and Electronic Product Manufacturing	185.8
722	Food Services and Drinking Places	168.2
311	Food Manufacturing	125.4
325	Chemical Manufacturing	91.1
333	Machinery Manufacturing	76.9
336	Transportation Equipment Manufacturing	74.4
621	Ambulatory Health Care Services	71.5
335	Electrical Equipment and Component Manufacturing	64.7
324	Petroleum and Coal Products Manufacturing	60.3
518	Data Processing, Hosting, and Related Services	54.6
331	Primary Metal Manufacturing	39.0
531	Real Estate	38.6
561	Administrative and Support Services	34.1
326	Plastics and Rubber Products Manufacturing	33.9
321	Wood Product Manufacturing	32.3
332	Fabricated Metal Product Manufacturing	28.2
517	Telecommunications	28.1
	Top 20	*$ 6,336.4*
	All Other Industries	*1,235.5*
	Purchases from California Firms in Industry	$ 7,571.8

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-57.

Exhibit 4-57
Nonmetallic Mineral Product Manufacturing
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

Primary Industry:

TEXTILE MILLS
(NAICS 313)

Vulnerability Index: 7.0

Industry Description

Industries in this subsector group establishments that transform a basic fiber (natural or synthetic) into a product, such as yarn or fabric that is further manufactured into usable items, such as apparel, sheets, towels, and textile bags for individual or industrial consumption. The further manufacturing may be performed in the same establishment and classified in this subsector, or it may be performed at a separate establishment and be classified elsewhere in manufacturing. The main processes in this subsector include preparation and spinning of fiber, knitting or weaving of fabric, and the finishing of the textile.

What Is At Risk?

This industry provides 9,700 jobs in California with average annual wages and benefits of $39,810.

9,700 jobs

$ 386 million
Labor Income

$ 2.6 billion
Industry Output

$ 829 million
Contribution to GDP

What this Primary Industry Sells

The products and services that are sold by this industry in California are shown in Exhibit 4-58.

Exhibit 4-58
Products of the Textile Mill Industry

Commodity	Sales in California ($ millions)	% of Industry Sales
Fiber filaments, yarn and thread	$ 85.9	7.5
Fabrics and machine embroidery	248.4	21.8
Finished textiles and fabrics	731.1	64.3
Coated fabric coating	72.4	6.4
Total Industry Sales in California	$ 6,405.8	100.0

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Use this Industry's Products?

Exhibit 4-59 lists the user industries in California of this industry's goods and services.

Exhibit 4-59
Top 20 User Industries of Textile Mills

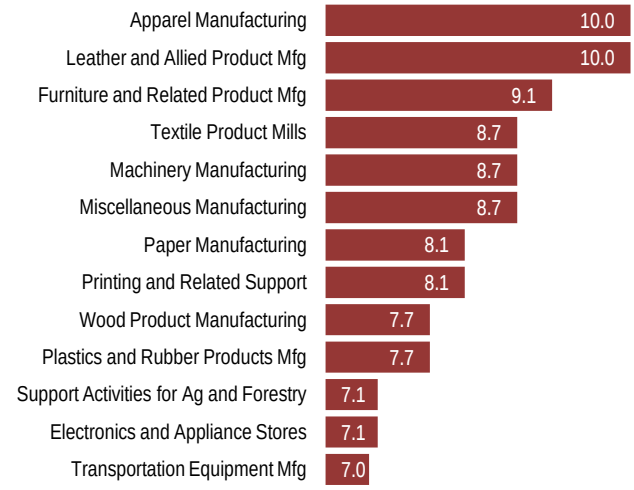
NAICS	Industry Description	Purchases From This CA Industry ($ millions)
315	Apparel Manufacturing	$ 315.4
339	Miscellaneous Manufacturing	243.3
314	Textile Product Mills	79.0
337	Furniture and Related Product Manufacturing	72.2
322	Paper Manufacturing	32.5
333	Machinery Manufacturing	21.6
321	Wood Product Manufacturing	20.4
713	Amusement, Gambling and Recreation Industries	19.6
454	Nonstore Retailers	17.3
336	Transportation Equipment Manufacturing	15.2
326	Plastics and Rubber Products Manufacturing	14.0
448	Clothing and Clothing Accessories Stores	14.0
512	Motion Picture and Sound Recording Industries	11.7
316	Leather and Allied Product Manufacturing	11.6
444	Building Material and Garden Supplies Dealers	9.7
42	Wholesale Trade	9.2
323	Printing and Related Support Activities	8.2
446	Health and Personal Care Stores	8.1
811	Repair and Maintenance	6.9
541	Professional, Scientific, and Technical Services	5.4
	Top 20	*$ 935.1*
	All Other Industries	*202.7*
	Purchases from California Firms in Industry	$ 1,137.8

Source: IMPLAN Data for California; Analysis by LAEDC

Which Industries Are Most Vulnerable to Disruptions in this Industry?

Although large purchases from this industry may be important, a secondary user industry's vulnerability depends on the three component metrics of the composite vulnerability index: (1) total purchases of these products as a share of total output; (2) trade intensity; and (3) gross operating surplus as a share of output. Secondary industries with a vulnerability index of 7.0 or greater to this primary industry are shown in Exhibit 4-60.

Exhibit 4-60
Textile Mills
Most Vulnerable User Industries
(Vulnerability Index ≥ 7.0)



Source: IMPLAN Data for California; Analysis by LAEDC

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Secondary Industry:

LEATHER AND ALLIED PRODUCT MANUFACTURING (NAICS 316)

Average Vulnerability Index: 7.1

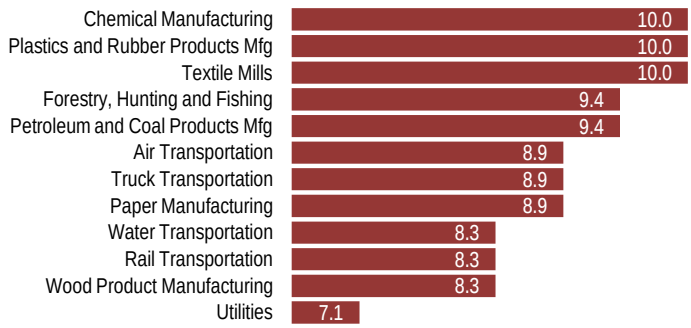
Industry Description

Establishments in this subsector transform hides into leather by tanning or curing and fabricating the leather into products for final consumption. It also includes the manufacture of similar products from other materials, including products (except apparel) made from "leather substitutes," such as rubber, plastics, or textiles. Rubber footwear, textile luggage, and plastics purses or wallets are examples of "leather substitute" products included in this group. The products made from leather substitutes are included in this subsector because they are made in similar ways leather products are made (e.g., luggage). They are made in the same establishments, so it is not practical to separate them.

What Is At Risk?

This industry is dependent on 12 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of thie Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

4,720 jobs

$ 165 million
Labor Income

$ 620 million
Industry Output

$ 149 million
Contribution to GDP

Secondary Industry:

BEVERAGE AND TOBACCO PRODUCT MANUFACTURING (NAICS 312)

Average Vulnerability Index: 6.9

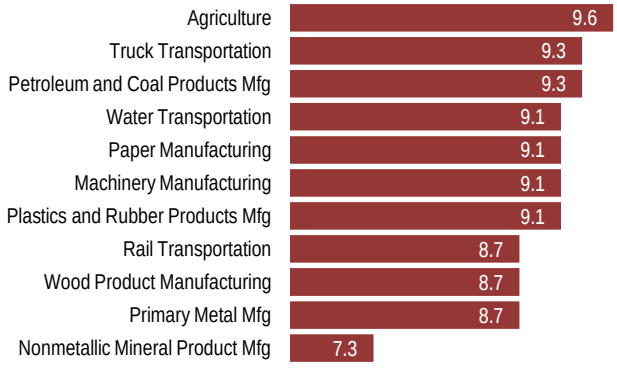
Industry Description

Industries in this subsector manufacture beverages and tobacco products. The industry group, Beverage Manufacturing, includes three types of establishments: (1) those that manufacture nonalcoholic beverages; (2) those that manufacture alcoholic beverages through the fermentation process; and (3) those that produce distilled alcoholic beverages. Ice manufacturing, while not a beverage, is included with nonalcoholic beverage manufacturing because it uses the same production process as water purification.

What Is At Risk?

This industry is dependent on 11 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

51,130 jobs

$ 4.2 billion
Labor Income

$ 28.3 billion
Industry Output

$ 5.6 billion
Contribution to GDP

Secondary Industry:

APPAREL MANUFACTURING (NAICS 315)

Average Vulnerability Index: 6.9

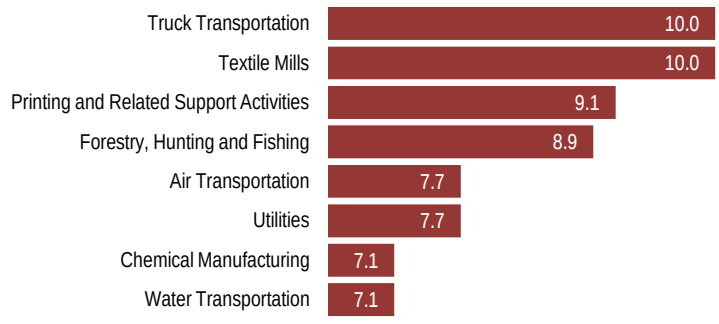
Industry Description

Industries in this subsector group establishments with two distinct manufacturing processes: (1) cut and sew (i.e., purchasing fabric and cutting and sewing to make a garment), and (2) the manufacture of garments in establishments that first knit fabric and then cut and sew the fabric into a garment. The Apparel Manufacturing subsector includes a diverse range of establishments manufacturing full lines of ready-to-wear apparel and custom apparel: apparel contractors, performing cutting or sewing operations on materials owned by others; jobbers performing entrepreneurial functions involved in apparel manufacture; and tailors, manufacturing custom garments for individual clients are all included. Knitting, when done with the production of complete garments, is classified here.

What Is At Risk?

This industry is dependent on eight of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

56,270 jobs

$2.5 billion
Labor Income

$4.2 billion
Industry Output

$2.4 billion
Contribution to GDP

Secondary Industry:

FURNITURE AND RELATED PRODUCT MANUFACTURING (NAICS 337)

Average Vulnerability Index: 6.7

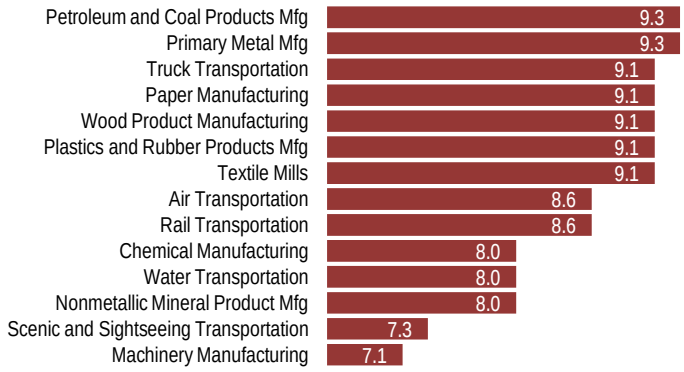
Industry Description

Industries in this subsector make furniture and related articles, such as mattresses, window blinds, cabinets, and fixtures. The processes used in the manufacture of furniture include the cutting, bending, molding, laminating, and assembly of such materials as wood, metal, glass, plastics, and rattan. However, the production process for furniture is not solely bending metal, cutting and shaping wood, or extruding and molding plastics. Design and fashion trends play an important part in the production of furniture. The integrated design of the article for both esthetic and functional qualities is also a major part of the process of manufacturing furniture. Design services may be performed by the furniture establishment's work force or may be purchased from industrial designers.

What Is At Risk?

This industry is dependent on 14 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

36,810 jobs

$1.9 billion
Labor Income

$6.6 billion
Industry Output

$2.0 billion
Contribution to GDP

Secondary Industry:

FOOD MANUFACTURING (NAICS 311)

Average Vulnerability Index: 6.6

Industry Description

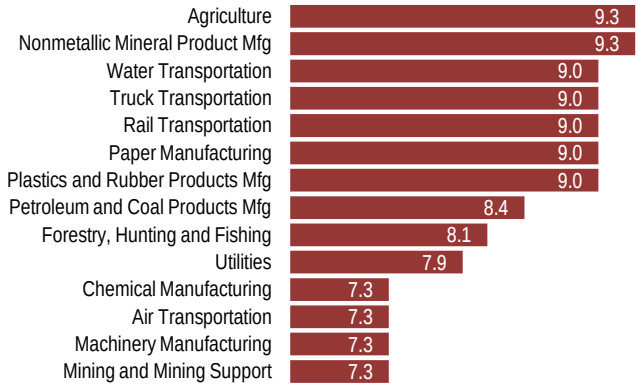
Industries in this subsector transform livestock and agricultural products into products for intermediate or final consumption. The industry groups are distinguished by the raw materials (generally of animal or vegetable origin) processed into food products.

The food products manufactured in these establishments are typically sold to wholesalers or retailers for distribution to consumers, but establishments primarily engaged in retailing bakery and candy products made on the premises not for immediate consumption are included.

What Is At Risk?

This industry is dependent on 14 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

179,460 jobs

$ 10.1 billion
Labor Income

$ 82.6 billion
Industry Output

$ 16.2 billion
Contribution to GDP

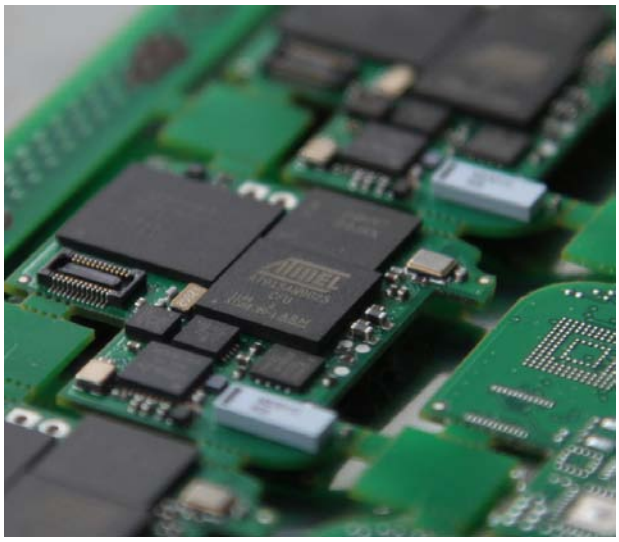
Secondary Industry:

ELECTRICAL EQUIPMENT AND COMPONENT MANUFACTURING (NAICS 335)

Average Vulnerability Index: 6.6

Industry Description

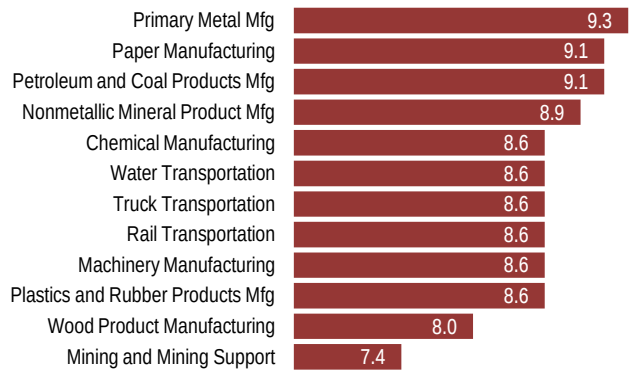
Industries in this subsector manufacture products that generate, distribute and use electrical power. Electric Lighting Equipment Manufacturing establishments produce electric lamp bulbs, lighting fixtures, and parts. Household Appliance Manufacturing establishments make both small and major electrical appliances and parts. Electrical Equipment Manufacturing establishments make goods, such as electric motors, generators, transformers, and switchgear apparatus. Other Electrical Equipment and Component Manufacturing establishments make devices for storing electrical power (e.g., batteries), for transmitting electricity (e.g., insulated wire), and wiring devices (e.g., electrical outlets, fuse boxes, and light switches).



What Is At Risk?

This industry is dependent on 12 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

30,860 jobs

$ 2.6 billion
Labor Income

$ 10.9 billion
Industry Output

$ 3.4 billion
Contribution to GDP

Secondary Industry:

MISCELLANEOUS MANUFACTURING (NAICS 339)

Average Vulnerability Index: 6.3

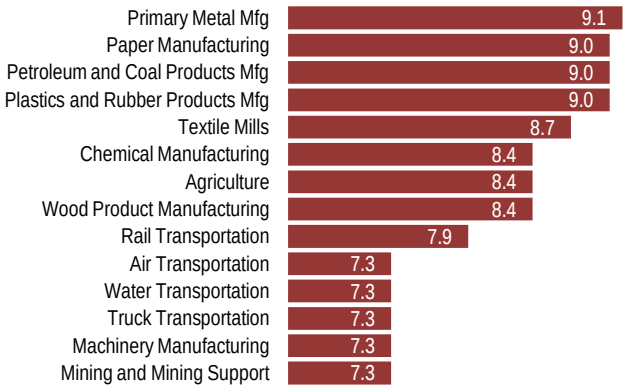
Industry Description

Industries in this subsector make a wide range of products that cannot readily be classified in specific NAICS subsectors in manufacturing. Processes used by these establishments vary significantly, both among and within industries. For example, a variety of manufacturing processes are used in manufacturing sporting and athletic goods that include products such as tennis racquets and golf balls. The processes for these products differ from each other, and the processes differ significantly from the fabrication processes used in making dolls or toys, the melting and shaping of precious metals to make jewelry, and the bending, forming, and assembly used in making medical products.

What Is At Risk?

This industry is dependent on 14 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

93,900 jobs

$ 8.5 billion
Labor Income

$ 25.4 billion
Industry Output

$ 12.1 billion
Contribution to GDP

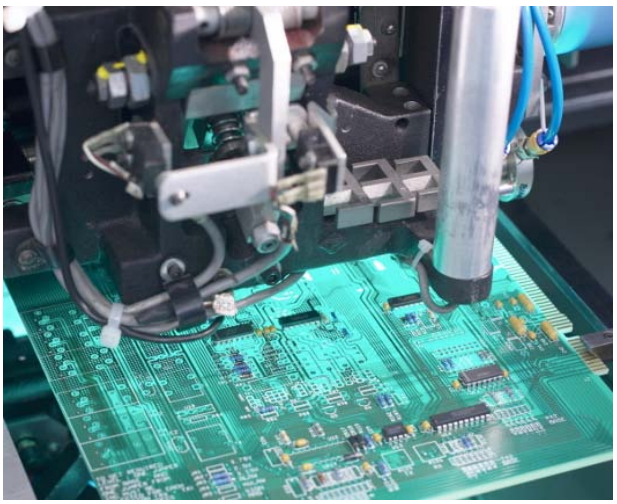
Secondary Industry:

COMPUTER AND ELECTRONIC PRODUCT MANUFACTURING (NAICS 334)

Average Vulnerability Index: 6.3

Industry Description

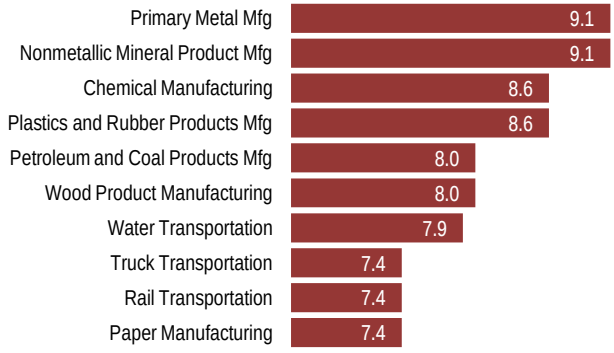
Industries in this subsector group establishments that manufacture computers, computer peripherals, communications equipment, and similar electronic products, and establishments that manufacture components for such products. Their manufacturing processes are fundamentally different from the manufacturing processes of other machinery and equipment. The design and use of integrated circuits and the application of highly specialized miniaturization technologies are common elements in the production technologies of the computer and electronic subsector.



What Is At Risk?

This industry is dependent on ten of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index for this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

239,700 jobs

$ 36.5 billion
Labor Income

$ 162.1 billion
Industry Output

$ 57.6 billion
Contribution to GDP

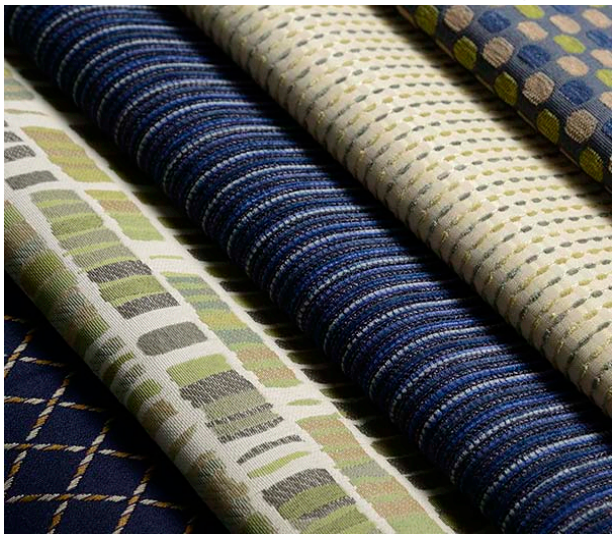
Secondary Industry:

TEXTILE PRODUCT MILLS (NAICS 314)

Average Vulnerability Index: 6.3

Industry Description

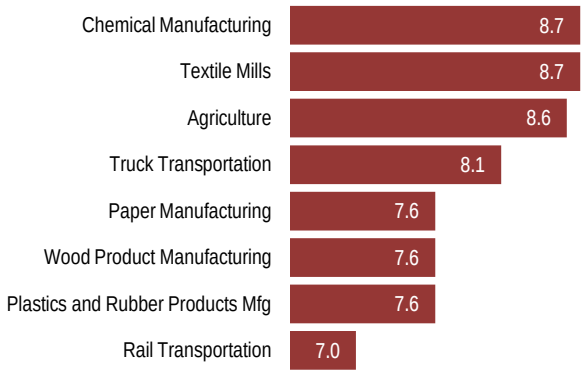
Industries in this subsector group establishments that make textile products (except apparel). With a few exceptions, processes used in these industries are generally cut and sew (i.e., purchasing fabric and cutting and sewing to make nonapparel textile products, such as sheets and towels).



What Is At Risk?

This industry is dependent on eight of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index for this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

10,100 jobs

$ 447 million
Labor Income

$ 1.8 billion
Industry Output

$ 644 million
Contribution to GDP

Secondary Industry:

TRANSPORTATION EQUIPMENT MANUFACTURING (NAICS 336)

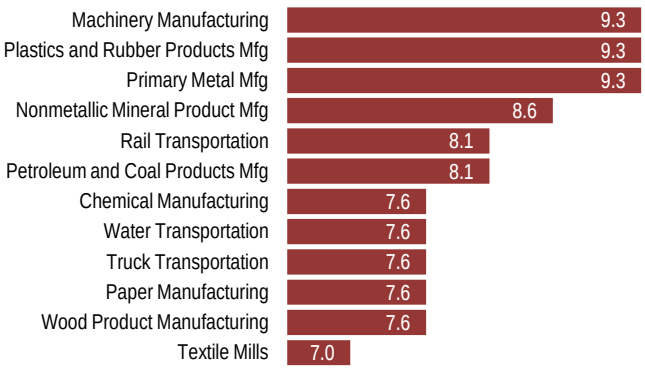
Average Vulnerability Index: 6.2

Industry Description

Industries in the Transportation Equipment Manufacturing subsector produce equipment for transporting people and goods. Transportation equipment is a type of machinery. Establishments in this subsector utilize production processes similar to those of other machinery manufacturing establishments - bending, forming, welding, machining, and assembling metal or plastic parts into components and finished products. However, the assembly of components and subassemblies and their further assembly into finished vehicles tends to be a more common production process in this subsector than in the Machinery Manufacturing subsector.

What Is At Risk?

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

103,700 jobs

$ 11.4 billion
Labor Income

$ 49.4 billion
Industry Output

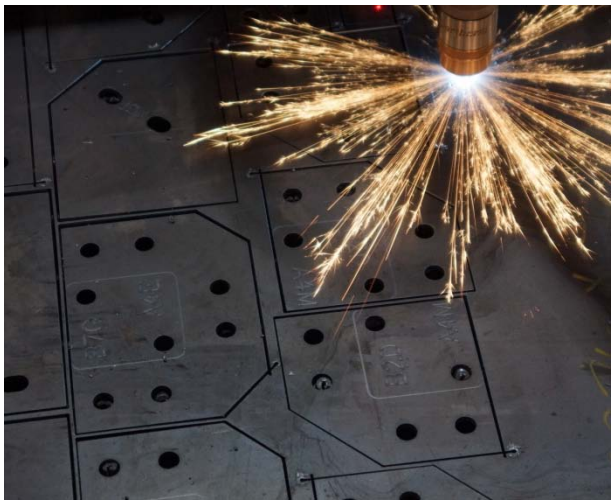
$ 16.4 billion
Contribution to GDP

Secondary Industry:

FABRICATED METAL PRODUCTS MANUFACTURING (NAICS 332)

Average Vulnerability Index: 6.2

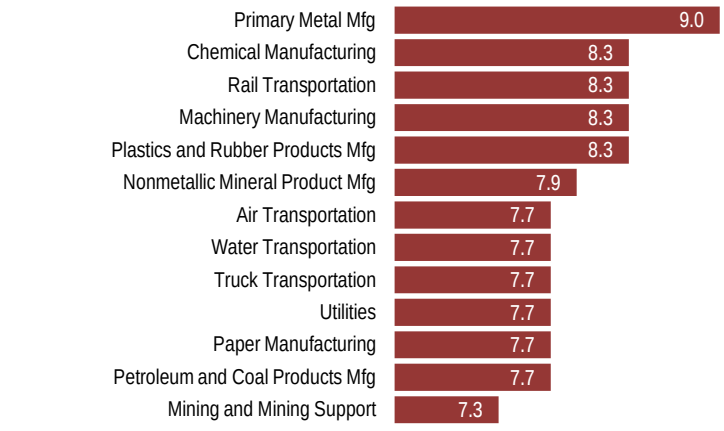
Industries in this subsector transform metal into intermediate or end products, other than machinery, computers and electronics, and metal furniture, or treat metals and metal formed products fabricated elsewhere. Important fabricated metal processes are forging, stamping, bending, forming, and machining, used to shape individual pieces of metal; and other processes, such as welding and assembling, used to join separate parts together. Establishments in this subsector may use one of these processes or a combination of these processes.



What Is At Risk?

This industry is dependent on 13 of the top 20 most vulnerable primary-user industries of refinery products:

Vulnerability Index of this Secondary Industry by Primary Industry



Source: IMPLAN Data for California; Analysis by LAEDC

134,050 jobs

$ 8.8 billion
Labor Income

$ 31.1 billion
Industry Output

$ 11.2 billion
Contribution to GDP

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Appendix

Detailed Tables

Exhibit A-1
Purchases from California Refineries by Industry

NAICS	Industry Description	$ millions
23	Construction	$ 6,500.6
484	Truck Transportation	4,040.4
325	Chemical Manufacturing	3,299.7
481	Air Transportation	3,291.4
483	Water Transportation	809.0
42	Wholesale Trade	730.4
324	Petroleum and Coal Products Manufacturing	649.8
492	Couriers and Messengers	634.7
482	Rail Transportation	626.1
221	Utilities	518.9
111	Crop Production	509.1
561	Administrative and Support Services	376.3
722	Food Services and Drinking Places	339.8
485	Transit and Ground Passenger Transportation	281.7
112	Animal Production and Aquaculture	274.2
622	Hospitals	273.6
541	Professional, Scientific, and Technical Services	226.4
487	Scenic and Sightseeing Transportation	216.1
551	Management of Companies and Enterprises	209.8
334	Computer and Electronic Product Manufacturing	183.8
333	Machinery Manufacturing	170.3
311	Food Manufacturing	153.1
562	Waste Management and Remediation Services	143.5
323	Printing and Related Support Activities	137.6
532	Rental and Leasing Services	127.1
721	Accommodation	126.5
326	Plastics and Rubber Products Manufacturing	124.6
211	Oil and Gas Extraction	124.4
812	Personal and Laundry Services	123.0
621	Ambulatory Health Care Services	116.5
212	Mining (except Oil and Gas)	114.3
327	Nonmetallic Mineral Product Manufacturing	108.8
713	Amusement, Gambling, and Recreation Industries	99.5
491	Postal Service	99.4
623	Nursing and Residential Care Facilities	98.3
813	Religious, Grantmaking, Civic, Professional Orgs	88.2
332	Fabricated Metal Product Manufacturing	85.0
445	Food and Beverage Stores	82.4
624	Social Assistance	81.7
322	Paper Manufacturing	79.5
531	Real Estate	78.2
811	Repair and Maintenance	76.7
493	Warehousing and Storage	65.6
611	Educational Services	63.5
522	Credit Intermediation and Related Activities	61.7
336	Transportation Equipment Manufacturing	53.4
454	Nonstore Retailers	50.8
441	Motor Vehicle and Parts Dealers	50.7
521	Monetary Authorities-Central Bank	50.3
213	Support Activities for Mining	46.5
331	Primary Metal Manufacturing	43.5
452	General Merchandise Stores	43.3
448	Clothing and Clothing Accessories Stores	40.9
312	Beverage and Tobacco Product Manufacturing	40.5
519	Other Information Services	39.8
321	Wood Product Manufacturing	39.5
114	Fishing, Hunting and Trapping	28.6
444	Building Material and Garden Supplies Dealers	28.3
486	Pipeline Transportation	27.0
711	Performing Arts, Spectator Sports and Related	26.4
511	Publishing Industries (except Internet)	25.7
517	Telecommunications	24.7
446	Health and Personal Care Stores	23.6
523	Securities, Contracts and Other Investments	20.7
339	Miscellaneous Manufacturing	19.1
518	Data Processing, Hosting, and Related Services	18.9
335	Electrical Equipment, Appliance Manufacturing	17.6
453	Miscellaneous Store Retailers	15.4
442	Furniture and Home Furnishings Stores	14.0
313	Textile Mills	13.6
512	Motion Picture and Sound Recording Industries	13.2
443	Electronics and Appliance Stores	11.1
451	Sporting Goods, Hobby and Book Stores	10.7
113	Forestry and Logging	10.7
712	Museums, Historical Sites, and Similar Institutions	9.7
447	Gasoline Stations	9.4
337	Furniture and Related Product Manufacturing	8.9
315	Apparel Manufacturing	7.8
515	Broadcasting (except Internet)	6.6
524	Insurance Carriers and Related Activities	6.2
533	Lessors of Nonfinancial Intangible Assets	4.7
314	Textile Product Mills	3.9
316	Leather and Allied Product Manufacturing	0.6
525	Funds, Trusts, and Other Financial Vehicles	*0.4*
	Total Purchases	*$ 27,569.1*

Source: IMPLAN Data for California; Analysis by LAEDC

Exhibit A-2
All Industries by Inputs of Refinery Products as a Percentage of Output

NAICS	Industry	Refinery Inputs as % of Output
324	Petroleum and Coal Products Manufacturing	38.2%
481	Air Transportation	23.1%
482	Rail Transportation	20.5%
483	Water Transportation	18.5%
484	Truck Transportation	15.5%
492	Couriers and Messengers	9.3%
485	Transit and Ground Passenger Transportation	6.3%
325	Chemical Manufacturing	5.6%
113/4	Forestry, Logging, Fishing, Hunting	4.8%
23	Construction	4.5%
212/3	Mining and Support Activities	3.0%
323	Printing and Related Support Activities	2.0%
111/2/5	Agriculture	1.7%
491	Postal Service	1.7%
211	Oil and Gas Extraction	1.7%
487	Support Activities for Transportation	1.6%
562	Waste Management and Remediation Services	1.5%
486	Pipeline Transportation	1.4%
213	Support Activities for Mining	1.4%
327	Nonmetallic Mineral Product Manufacturing	1.4%
221	Utilities	1.3%
326	Plastics and Rubber Products Manufacturing	1.2%
321	Wood Product Manufacturing	1.0%
322	Paper Manufacturing	1.0%
721	Accommodation	0.9%
532	Rental and Leasing Services	0.9%
493	Warehousing and Storage	0.7%
712	Museums, Historical Sites, and Similar Institutions	0.7%
713	Amusement, Gambling, and Recreation Industries	0.7%
623	Nursing and Residential Care Facilities	0.7%
333	Machinery Manufacturing	0.6%
313	Textile Mills	0.6%
812	Personal and Laundry Services	0.6%
622	Hospitals	0.6%
561	Administrative and Support Services	0.5%
331	Primary Metal Manufacturing	0.5%
551	Management of Companies and Enterprises	0.4%
42	Wholesale Trade	0.4%
722	Food Services and Drinking Places	0.4%
813	Religious, Grantmaking, Civic, Professional Orgs	0.4%
445	Food and Beverage Stores	0.4%
522	Credit Intermediation and Related Activities	0.3%
624	Social Assistance	0.3%
332	Fabricated Metal Product Manufacturing	0.3%
441	Motor Vehicle and Parts Dealers	0.3%
611	Educational Services	0.3%
314	Textile Product Mills	0.3%
448	Clothing and Clothing Accessories Stores	0.3%
442	Furniture and Home Furnishings Stores	0.2%
444	Building Material and Garden Supplies Dealers	0.2%
811	Repair and Maintenance	0.2%
454	Nonstore Retailers	0.2%
451	Sporting Goods, Hobby and Book Stores	0.2%
446	Health and Personal Care Stores	0.2%
443	Electronics and Appliance Stores	0.2%
453	Miscellaneous Store Retailers	0.2%
452	General Merchandise Stores	0.2%
311	Food Manufacturing	0.2%
335	Electrical Equipment and Component Manufacturing	0.2%
447	Gasoline Stations	0.2%
312	Beverage and Tobacco Product Manufacturing	0.2%
337	Furniture and Related Product Manufacturing	0.2%
521	Monetary Authorities-Central Bank	0.2%
621	Ambulatory Health Care Services	0.1%
518	Data Processing, Hosting, and Related Services	0.1%
334	Computer and Electronic Product Manufacturing	0.1%
336	Transportation Equipment Manufacturing	0.1%
315	Apparel Manufacturing	0.1%
316	Leather and Allied Product Manufacturing	0.1%
711	Performing Arts, Spectator Sports and Related	0.1%
339	Miscellaneous Manufacturing	0.1%
541	Professional, Scientific, and Technical Services	0.1%
511	Publishing Industries (except Internet)	0.1%
519	Other Information Services	0.1%
517	Telecommunications	0.0%
531	Real Estate	0.0%
523	Securities, Contracts and Other Investments	0.0%
515	Broadcasting (except Internet)	0.0%
533	Lessors of Nonfinancial Intangible Assets	0.0%
512	Motion Picture and Sound Recording Industries	0.0%
524	Insurance Carriers and Related Activities	0.0%
525	Funds, Trusts, and Other Financial Vehicles	0.0%
	Average of All Industries	*2.3%*

Source: IMPLAN Data for California; Analysis by LAEDC

Exhibit A-3
All Industries by Trade Exposure as a Percentage of Output

NAICS	Industry	Trade Exposure as % of Output
316	Leather and Allied Product Manufacturing	91.1%
333	Machinery Manufacturing	79.3%
315	Apparel Manufacturing	77.6%
336	Transportation Equipment Manufacturing	71.0%
339	Miscellaneous Manufacturing	65.9%
334	Computer and Electronic Product Manufacturing	63.5%
221	Utilities	60.5%
512	Motion Picture and Sound Recording Industries	59.8%
111/2/5	Agriculture	62.1%
325	Chemical Manufacturing	53.8%
312	Beverage and Tobacco Product Manufacturing	52.7%
533	Lessors of Nonfinancial Intangible Assets	50.3%
313	Textile Mills	50.0%
331	Primary Metal Manufacturing	48.9%
335	Electrical Equipment and Component Manufacturing	48.0%
519	Other Information Services	45.3%
337	Furniture and Related Product Manufacturing	42.7%
483	Water Transportation	42.7%
332	Fabricated Metal Product Manufacturing	42.3%
314	Textile Product Mills	41.8%
311	Food Manufacturing	39.3%
711	Performing Arts, Spectator Sports and Related	38.6%
326	Plastics and Rubber Products Manufacturing	36.3%
113/4	Forestry,Logging,Fishing,Hunting	37.8%
487	Support Activities for Transportation	30.6%
531	Real Estate	29.2%
322	Paper Manufacturing	28.2%
323	Printing and Related Support Activities	27.2%
624	Social Assistance	27.2%
515	Broadcasting (except Internet)	27.2%
42	Wholesale Trade	24.2%
511	Publishing Industries (except Internet)	23.7%
443	Electronics and Appliance Stores	22.8%
212/3	Mining and Support Activities	23.6%
448	Clothing and Clothing Accessories Stores	19.9%
481	Air Transportation	19.6%
541	Professional, Scientific, and Technical Services	17.7%
321	Wood Product Manufacturing	16.4%
492	Couriers and Messengers	16.3%
327	Nonmetallic Mineral Product Manufacturing	15.4%
445	Food and Beverage Stores	14.8%
523	Securities, Contracts, and Other Investments	14.5%
621	Ambulatory Health Care Services	14.2%
482	Rail Transportation	13.7%
812	Personal and Laundry Services	13.6%
454	Nonstore Retailers	11.9%
713	Amusement, Gambling, and Recreation Industries	11.6%
551	Management of Companies and Enterprises	11.5%
484	Truck Transportation	9.5%
453	Miscellaneous Store Retailers	9.0%
811	Repair and Maintenance	8.6%
813	Religious, Grantmaking, Civic, Professional Orgs	8.2%
211	Oil and Gas Extraction	7.8%
518	Data Processing, Hosting, and Related Services	7.3%
712	Museums, Historical Sites, and Similar Institutions	6.5%
493	Warehousing and Storage	6.5%
532	Rental and Leasing Services	6.0%
562	Waste Management and Remediation Services	5.7%
486	Pipeline Transportation	5.7%
525	Funds, Trusts, and Other Financial Vehicles	5.6%
561	Administrative and Support Services	5.6%
522	Credit Intermediation and Related Activities	5.5%
451	Sporting Goods, Hobby and Book Stores	5.5%
517	Telecommunications	4.9%
722	Food Services and Drinking Places	4.5%
521	Monetary Authorities-Central Bank	4.4%
611	Educational Services	3.5%
446	Health and Personal Care Stores	3.4%
442	Furniture and Home Furnishings Stores	3.3%
721	Accommodation	3.1%
324	Petroleum and Coal Products Manufacturing	2.7%
524	Insurance Carriers and Related Activities	2.5%
491	Postal Service	0.6%
622	Hospitals	0.1%
447	Gasoline Stations	0.1%
444	Building Material and Garden Supplies Dealers	0.1%
23	Construction	0.0%
485	Transit and Ground Passenger Transportation	0.0%
623	Nursing and Residential Care Facilities	0.0%
441	Motor Vehicle and Parts Dealers	0.0%
452	General Merchandise Stores	0.0%
	Average of All Industries	*25.0%*

Source: IMPLAN Data for California; Analysis by LAEDC

Exhibit A-4
All Industries by Gross Operating Surplus as a Percentage of Output

NAICS	Industry	Surplus as % of Output
443	Electronics and Appliance Stores	-38.5%
523	Securities, Contracts and Other Investments	-7.5%
812	Personal and Laundry Services	-5.7%
453	Miscellaneous Store Retailers	-4.7%
525	Funds, Trusts, and Other Financial Vehicles	-4.4%
316	Leather and Allied Product Manufacturing	-2.9%
315	Apparel Manufacturing	-1.6%
623	Nursing and Residential Care Facilities	-1.6%
813	Religious, Grantmaking, Civic, Professional Orgs	-0.1%
113	Forestry and Logging	0.1%
622	Hospitals	0.1%
624	Social Assistance	0.1%
486	Pipeline Transportation	0.2%
811	Repair and Maintenance	0.3%
23	Construction of Buildings	0.3%
487	Scenic and Sightseeing Transportation	0.4%
484	Truck Transportation	0.6%
324	Petroleum and Coal Products Manufacturing	0.7%
337	Furniture and Related Product Manufacturing	0.8%
492	Couriers and Messengers	0.9%
321	Wood Product Manufacturing	1.0%
712	Museums, Historical Sites, and Similar Institutions	1.2%
331	Primary Metal Manufacturing	1.7%
611	Educational Services	1.7%
446	Health and Personal Care Stores	1.9%
322	Paper Manufacturing	2.0%
481	Air Transportation	2.0%
491	Postal Service	2.5%
482	Rail Transportation	2.5%
113/4	Forestry, Logging, Fishing, Hunting	2.7%
447	Gasoline Stations	3.0%
522	Credit Intermediation and Related Activities	3.7%
621	Ambulatory Health Care Services	4.0%
311	Food Manufacturing	5.4%
452	General Merchandise Stores	5.6%
312	Beverage and Tobacco Product Manufacturing	6.1%
323	Printing and Related Support Activities	6.7%
332	Fabricated Metal Product Manufacturing	6.8%
114	Fishing, Hunting and Trapping	6.8%
115	Support Activities for Agriculture and Forestry	6.9%
335	Electrical Equipment and Component Manufacturing	7.4%
551	Management of Companies and Enterprises	7.9%
485	Transit and Ground Passenger Transportation	7.9%
722	Food Services and Drinking Places	8.3%
524	Insurance Carriers and Related Activities	8.3%
333	Machinery Manufacturing	8.4%
314	Textile Product Mills	8.7%
444	Building Material and Garden Supplies Dealers	8.9%
327	Nonmetallic Mineral Product Manufacturing	9.0%
336	Transportation Equipment Manufacturing	9.6%
451	Sporting Goods, Hobby and Book Stores	9.9%
326	Plastics and Rubber Products Manufacturing	9.9%
211	Oil and Gas Extraction	9.9%
445	Food and Beverage Stores	10.1%
515	Broadcasting (except Internet)	10.4%
213	Support Activities for Mining	10.9%
442	Furniture and Home Furnishings Stores	10.9%
518	Data Processing, Hosting, and Related Services	11.7%
493	Warehousing and Storage	12.2%
334	Computer and Electronic Product Manufacturing	12.2%
541	Professional, Scientific, and Technical Services	12.5%
441	Motor Vehicle and Parts Dealers	12.7%
561	Administrative and Support Services	12.8%
339	Miscellaneous Manufacturing	13.5%
483	Water Transportation	14.0%
711	Performing Arts, Spectator Sports, and Related Industries	14.8%
42	Wholesale Trade	15.8%
313	Textile Mills	15.8%
562	Waste Management and Remediation Services	16.1%
112	Animal Production and Aquaculture	17.0%
448	Clothing and Clothing Accessories Stores	17.1%
521	Monetary Authorities-Central Bank	17.2%
721	Accommodation	17.7%
713	Amusement, Gambling, and Recreation Industries	18.2%
111/2/5	Agriculture	19.3%
212/3	Mining and Support Activities	20.5%
111	Crop Production	24.6%
519	Other Information Services	27.0%
221	Utilities	28.2%
511	Publishing Industries (except Internet)	29.8%
532	Rental and Leasing Services	30.0%
454	Nonstore Retailers	30.3%
325	Chemical Manufacturing	32.3%
212	Mining (except Oil and Gas)	35.9%
517	Telecommunications	37.3%
533	Lessors of Nonfinancial Intangible Assets	42.9%
512	Motion Picture and Sound Recording Industries	55.8%
531	Real Estate	67.0%
	Average of All Industries	*10.2%*

Source: IMPLAN Data for California; Analysis by LAEDC

Exhibit A-5
All Industries by Vulnerability Index

NAICS	Industry Description	Index
113/4	Forestry, Logging, Fishing, Hunting	9.0
487	Scenic and Sightseeing Transportation	8.7
492	Couriers and Messengers	8.6
325	Chemical Manufacturing	8.4
481	Air Transportation	8.4
483	Water Transportation	8.4
484	Truck Transportation	8.4
111/2/5	Agriculture	8.3
221	Utilities	8.1
482	Rail Transportation	8.1
323	Printing and Related Support Activities	7.4
324	Petroleum and Coal Products Manufacturing	7.4
486	Pipeline Transportation	7.3
212/3	Mining and Support Activities	7.1
327	Nonmetallic Mineral Product Manufacturing	7.0
333	Machinery Manufacturing	7.0
211	Oil and Gas Extraction	6.9
321	Wood Product Manufacturing	6.9
326	Plastics and Rubber Products Manufacturing	6.9
485	Transit and Ground Passenger Transportation	6.9
812	Personal and Laundry Services	6.9
23	Construction	6.7
491	Postal Service	6.7
313	Textile Mills	6.4
322	Paper Manufacturing	6.4
42	Wholesale Trade	6.4
443	Electronics and Appliance Stores	6.3
493	Warehousing and Storage	6.3
623	Nursing and Residential Care Facilities	6.3
712	Museums, Historical Sites, and Similar Institutions	6.3
624	Social Assistance	6.1
331	Primary Metal Manufacturing	6.0
532	Rental and Leasing Services	5.9
561	Administrative and Support Services	5.9
813	Religious, Grantmaking, Civic, Professional Orgs	5.9
445	Food and Beverage Stores	5.7
551	Management of Companies and Enterprises	5.7
562	Waste Management and Remediation Services	5.7
713	Amusement, Gambling, and Recreation Industries	5.7
622	Hospitals	5.6
315	Apparel Manufacturing	5.4
316	Leather and Allied Product Manufacturing	5.4
332	Fabricated Metal Product Manufacturing	5.4
721	Accommodation	5.4
522	Credit Intermediation and Related Activities	5.3
811	Repair and Maintenance	5.3
312	Beverage and Tobacco Product Manufacturing	5.1
335	Electrical Equipment and Component Manufacturing	5.1
722	Food Services and Drinking Places	5.0
311	Food Manufacturing	4.9
337	Furniture and Related Product Manufacturing	4.9
453	Miscellaneous Store Retailers	4.9
314	Textile Product Mills	4.7
336	Transportation Equipment Manufacturing	4.7
441	Motor Vehicle and Parts Dealers	4.7
621	Ambulatory Health Care Services	4.7
334	Computer and Electronic Product Manufacturing	4.6
446	Health and Personal Care Stores	4.6
611	Educational Services	4.6
339	Miscellaneous Manufacturing	4.4
454	Nonstore Retailers	4.4
711	Performing Arts, Spectator Sports, and Related Industries	4.4
448	Clothing and Clothing Accessories Stores	4.3
447	Gasoline Stations	4.1
444	Building Material and Garden Supplies Dealers	3.9
451	Sporting Goods, Hobby and Book Stores	3.9
541	Professional, Scientific, and Technical Services	3.9
512	Motion Picture and Sound Recording Industries	3.6
442	Furniture and Home Furnishings Stores	3.4
452	General Merchandise Stores	3.4
518	Data Processing, Hosting, and Related Services	3.4
519	Other Information Services	3.4
523	Securities, Contracts and Other Investments	3.4
511	Publishing Industries (except Internet)	3.3
531	Real Estate	3.3
533	Lessors of Nonfinancial Intangible Assets	3.3
515	Broadcasting (except Internet)	3.1
525	Funds, Trusts, and Other Financial Vehicles	2.9
521	Monetary Authorities-Central Bank	2.6
524	Insurance Carriers and Related Activities	1.9
517	Telecommunications	1.6

Source: IMPLAN Data for California; Analysis by LAEDC

Exhibit A-6

Vulnerability Indexes of Secondary User Industries of Top Twenty Vulnerable Primary Industries

NAICS	Secondary User Industries	113, 114	487	492	325	481	483	484	111,112, 115	482	323	221	322	333	324	321	326	212, 213	331	327	313
	Vulnerability Index of Primary Industry →	*9.0*	*8.7*	*8.6*	*8.4*	*8.4*	*8.4*	*8.4*	*8.3*	*8.1*	*8.0*	*7.6*	*7.6*	*7.6*	*7.4*	*7.4*	*7.4*	*7.1*	*7.1*	*7.0*	*7.0*
211	Oil and Gas Extraction																	8.1			
23	Construction						7.3							7.3	7.3	7.3	7.3	7.6		9.0	
311	Food Manufacturing	8.1			7.3	7.3	9.0	9.0	9.3	9.0		7.9	9.0	7.3	8.4		9.0	7.3		9.3	
312	Beverage and Tobacco Product Mfg						9.1	9.3	9.6	8.7			9.1	9.1	9.3	8.7	9.1		8.7	7.3	
314	Textile Product Mills				8.7			8.1	8.6	7.0			7.6			7.6	7.6				8.7
315	Apparel Manufacturing	8.9			7.1	7.7	7.1	10.0			9.1	7.7									
316	Leather and Allied Product Manufacturing	9.4			10.0	8.9	8.3	8.9		8.3		7.1	8.9		9.4	8.3	10.0				
332	Fabricated Metal Product Mfg				8.3	7.7	7.7	7.7		8.3		7.7	7.7	8.3	7.7		8.3	7.3	9.0	7.9	
334	Computer and Electronic Product Mfg				8.6		7.9	7.4		7.4			7.4		8.0	8.0	8.6		9.1	9.1	
335	Electrical Equip/Appliance/Compnt Mfg				8.6		8.6	8.6		8.6			9.1	8.6	9.1	8.0	8.6	7.4	9.3	8.9	
336	Transportation Equipment Manufacturing				7.6		7.6	7.6		8.1			7.6	9.3	8.1	7.6	9.3		9.3	8.6	7.0
337	Furniture and Related Product Mfg		7.3		8.0	8.6	8.0	9.1		8.6			9.1	7.1	9.3	9.1	9.1		9.3	8.0	9.1
339	Miscellaneous Manufacturing				8.4	7.3	7.3	7.3	8.4	7.9			9.0	7.3	9.0	8.4	9.0	7.3	9.1		8.7
42	Wholesale Trade		8.1	8.7							7.4									7.0	
442	Furniture and Home Furnishings Stores										7.1										
443	Electronics and Appliance Stores		8.0	7.7				7.1			7.3	7.1									7.1
445	Food and Beverage Stores							7.1	7.6			7.7									
448	Clothing and Clothing Accessories Stores		7.4	7.3							7.9										
452	General Merchandise Stores							7.0													
453	Miscellaneous Store Retailers		7.4	7.1																	
454	Nonstore Retailers										7.9										
486	Pipeline Transportation						7.9														
491	Postal Service					7.0					7.1										
493	Warehousing and Storage			7.1																	
511	Publishing Industries (except Internet)					7.0					7.9										
512	Motion Picture and Sound Recording										7.0										
517	Telecommunications																			7.1	
518	Data Processing, Hosting and Related Svcs		7.4	7.1		7.4										7.4					
519	Other Information Services		8.0	8.3		7.1					8.7										
522	Credit Intermediation and Related					7.6															
523	Securities/Commdty Cntrcts/Othr Financl		8.3	8.6		8.6					8.1										
532	Rental and Leasing Services															7.3					
533	Lessors of Nonfinancial Intangible Assets			7.0																7.0	
541	Professional, Scientific andTech'l Svcs						7.3														
561	Administrative and Support Services					7.0															
562	Waste Management and Remediation SVcs					7.0															
621	Ambulatory Health Care Services				7.6																
624	Social Assistance			7.3	7.3	7.3					8.4		7.9		7.9	7.3					
711	Performing Arts, Spectator Sports and Related										7.4										
712	Museums, Historical Sites and Similar Inst		8.0	8.3							7.1										
721	Accommodation										7.0									8.6	
722	Food Services and Drinking Places	7.0														8.1					
811	Repair and Maintenance													7.6			7.6				
812	Personal and Laundry Services				7.4						8.3										

Source: IMPLAN Data for California; Analysis by LAEDC

Industry Definition

For the purposes of this report, the refinery and petrochemical industry is defined as a combination of:

NAICS 32411: Petroleum refineries
Establishments in this industry are primarily engaged in refining crude petroleum into refined petroleum. Petroleum refining involves one or more of the following activities: (1) fractionation; (2) straight distillation of crude oil; and (3) cracking.

NAICS 32511: Petrochemical manufacturing
Establishments in this industry are primarily engaged in manufacturing acyclic (i.e., aliphatic) hydrocarbons such as ethylene, propylene, and butylenes made from refined petroleum or liquid hydrocarbons and/or manufacturing cyclic aromatic hydrocarbons such as benzene, toluene, styrene, xylene, ethyl benzene, and cumene made from refined petroleum or liquid hydrocarbons.

Methodology

Backward Linkages

Economic contribution analysis is used to describe that portion of a region's economy that can be attributed to an existing industry. Contribution analysis (available in the *Oil and Gas in California: The Industry and It's Economic Contributio*n) measures the value of the industry in terms of its *backward linkages*-its purchases of goods and services in its supply chain, its payment of labor income to regional workers, and the tax revenues generated on its operations and multiplier impacts. This analysis models what would happen if the industry did not exist in terms of those whose economic activity depends on supplying the industry.

The primary economic contribution to California's economy of petroleum refineries and petrochemical products manufacturing is the expenditure of millions of dollars towards goods and services from regional vendors. This injection of funds circulates from the initial recipients to the owners and employees of establishments that help supply the goods and services that the industry purchases.

The industry also spends billions of dollars every year for the wages and benefits of its employees and contract workers. These workers, as well as the employees of all the industry's suppliers, spend a portion of their incomes on groceries, rent, vehicle expenses, healthcare, entertainment, and so on. The recirculation of the original expenditures multiplies the initial spending through these indirect and induced effects.

The extent to which the initial expenditures multiply is estimated using economic models that depict the relationships between industries (such as oil production and its suppliers) and among different economic agents (such as industries and their employees).

These models are built upon actual data of expenditure patterns that are reported to the U.S. Bureau of Labor Statistics, the U.S. Census Bureau and the Bureau of Economic Analysis of the U.S. Department of Commerce. Data is regionalized so that it reflects and incorporates local conditions such as prevailing wages rates, expenditure patterns, and resource availability and costs.

The magnitude of the multiplying effect differs from one region to another depending on the extent to which the local region can fill the demand for all rounds of supplying needs. For example, the automobile manufacturing industry has high multipliers in Detroit and Indiana since these regions have deep and wide supplier networks, while the same industry multiplier in Phoenix is quite small. In another example, the jobs multiplier for the construction industry is higher in, say, Arkansas, than in California because the same amount of spending will purchase fewer workers in Los Angeles than in Little Rock.

Multipliers can also differ from year to year as relative material and labor costs change and as the production "recipe" of industries change. For example, the IT revolution significantly reduced the job multiplier of many industries (such as manufacturing, accounting, architecture and publishing) as computers replaced administrative and production workers.

The metrics used to determine the value of the economic contribution are employment, labor income, value-added and the value of output. *Employment* includes full-time, part-time, permanent and seasonal employees and the self-employed, and is measured on a job-count basis regardless of the number of hours worked. *Labor income* includes all income received by both payroll employees and the self-employed, including wages and benefits such as health insurance and pension plan contributions. *Value-added* is the measure of the contribution to GDP made by the industry, and consists of compensation of employees, taxes on production and gross operating surplus. *Output* is the value of the goods and services produced. For most industries, this is simply the

revenues generated through sales; for others, in particular retail industries, output is the value of the services supplied.

Estimates are developed using software and data from IMPLAN Group, LLC which traces inter-industry transactions resulting from an increase in demand in a given region. The economic region of interest is the state of California, and the activity is reported for 2013, the most recent year for which a complete set of data is available. Estimates for labor income, value-added and output are expressed in 2013 dollars to maintain consistency with the reported industry activity.

The total estimated economic contribution includes *direct*, *indirect* and *induced* effects.

Direct activity includes the materials purchased and the employees hired by the industry itself. *Indirect effects* are those which stem from the employment and business revenues motivated by the purchases made by the industry and any of its suppliers. *Induced effects* are those generated by the spending of employees whose wages are sustained by both direct and indirect spending. ❖

Forward Linkages

Another prism through which the industry can be viewed is its *forward linkages*—the extent to which its products are incorporated into the manufacturing and service delivery operations of the rest of the economy. In the case of the refinery industry, for example, those industries which are highly dependent on transportation fuels, such as trucking, aviation and construction industries, and manufacturing industries dependent on petroleum byproducts in the production of their own products, such as plastics manufacturers and medical device manufacturers.

Understanding these linkages is important in evaluating how cost increases in oil and gas industry products might ripple through the manufacturing and service delivery chains.

In this report, refinery and petrochemical products are traced through the industry user chain and each *primary* user industry's *intensity of use* compared to its as a share of revenues, which represents a measure of the user industry's dependency on refined and petrochemical products. An industry that primarily depends on oil and gas inputs for production will be affected to a greater extent than other, less reliant industries.

This dependency is evaluated against the user industry's gross operating surplus, which points to the industry's ability to absorb higher costs of inputs.

Lastly, each user industry's *trade sensitivity* will be estimated to provide an indication of its ability to pass the higher costs of inputs through to its customers.

The combination of these measures provides the basis for a *vulnerability indicator*. The composite index is derived as discussed in the text.

For the top twenty user industries by vulnerability indicator, employment, labor income, output and direct contribution to GDP are estimated to provide orders of magnitude of the economic activity that is at immediate risk from disruption of supply of refined petroleum products and byproducts.

Primary user industries produce their own goods and services that are purchased by *secondary* user industries. Secondary user industries will be identified for the top twenty (by vulnerability index) primary user industries of oil and gas industry products. For each of these secondary user industries, vulnerability indicators will be estimated (as described above), and employment, labor income, output and direct contribution to GDP will be estimated to provide orders of magnitude of the economic activity that is at risk for this secondary round of users.

The metrics used to determine orders of magnitude for primary and secondary user industries are employment, labor income, value-added and the value of output as described above.

The data used to conduct this analysis is the Industry Economic Accounts produced by the Bureau of Economic Analysis of the Department of Commerce (specifically, the Make and Use tables) as estimated and aggregated by the IMPLAN Group, LLC in its latest software release for the 2013 calendar year. The economic region of interest is the state of California. Estimates for labor income and output are expressed in 2013 dollars to maintain consistency with the reported industry activity. ❖

Study Authors

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Vice President, Economic and Policy Analysis

Dr. Cooper leads the Institute for Applied Economics whose work involves research in regional issues such as economic impact studies, regional industry analysis and forecasts, workforce development analysis, and issue studies related to the *L.A. County Strategic Plan for Economic Development.* Her fields of expertise include development economics, environmental economics, regional analysis and urban sustainability.

Prior to joining the LAEDC, Dr. Cooper was a co-founder of a start-up company in Hong Kong concentrating on equity transactions software and computer accessories manufacturing, which expanded production into the special economic zone of Shenzhen, China and distributed products throughout the United States and Asia. With her business partner, she also established the first authorized Apple Computer retailer in China. She has been a lecturer at California State University, Long Beach and at the Pepperdine Graziadio School of Business and Management.

Dr. Cooper is a citizen of the United States and Canada. She earned a Bachelor of Arts in Economics from Carleton University in Ottawa, Canada, and a Ph.D. in Economics from the University of Southern California. With funding from the National Science Foundation, she earned a Graduate Certificate in Environmental Sciences, Policy and Engineering. Her current research includes industry cluster determination and performance in the regional economy and workforce development issues.

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In her current capacity as an Economist with the LAEDC Institute for Applied Economics, Ms. Sedgwick develops subject-specific information and data interpretation for economic impact, demographic, transportation, industry and issue studies. She performs research, data collection and organization, analysis and report preparation. Her work focuses on demographics, industry clusters and workforce development in the form of occupational analysis. Ms. Sedgwick is also conducts geospatial analysis and has experience working with IMPLAN.

Ms. Sedgwick joined the LAEDC team in June of 2008 as an Economic Research Assistant for the Kyser Center for Economic Research. In that role she assisted both Economic Research and the Consulting Practice of the LAEDC with data collection and research, and was responsible for the *Business Scan* containing a collection of Los Angeles County economic indicators; the annual *L.A. Stats*, containing the most frequently requested statistics for Los Angeles and its surrounding counties; and was a regular contributor to the weekly economic newsletter, *e-Edge.*

Before joining the LAEDC, Ms. Sedgwick managed an industrial and steel supply company located in the Inland Empire. There she identified and targeted a diverse customer base, and analyzed product and customer patterns in the local industrial market to successfully increase revenues.

A Southern California native, Ms. Sedgwick received her Bachelor of Arts in Economics from the University of Southern California (USC) with a minor in Architecture. She has been a member of the national and the Los Angeles Chapter of the National Association for Business Economics (NABE) since 2008.

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Somjita Mitra joined the Institute for Applied Economics as an Economist in June 2013. She is involved in planning, designing and conducting research and analysis for consulting clients and local businesses and governments, as well as for LAEDC's internal departments. Her focus is in regional analysis, economic impact studies and the industrial and occupational structure of local economies.

Before joining the LAEDC, Dr. Mitra was an Economist for a local economic research and litigation consulting company evaluating economic damages, estimating lost profits, identifying key economic issues and developing necessary analytical and empirical frameworks. Prior to this, Dr. Mitra was a Project Director for a consumer research firm in Los Angeles where she managed projects that identified and analyzed key market issues for small, local firms as well as multinational corporations.

Dr. Mitra received her Bachelor of Arts in Economics and Political Science from the University of California, Los Angeles and her Master of Arts in Politics, Economics and Business as well as her Ph.D. in Economics from Claremont Graduate University. Dr. Mitra enjoys volunteering in the local community and is actively involved in both women's welfare and animal rescue organizations. ❖

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