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# Encouraging Mode Shift from Truck to Rail for California Produce

A Research Report from the University of California Institute of Transportation Studies

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*September 2018*

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<b>16. Abstract</b> California is one of the largest producers of perishable produce in the world. This sector supports a large transportation industry that handles the exports of these goods. Starting from the 1950's, the export of produce has gradually shifted modes from rail to truck. This project builds on the initial work from the "Rail and the California Economy" project by examining the potential of shifting the movement of perishable produce in California from truck to rail. The final report provides a review of the state of the California rail system in terms of perishable produce transport and where there have been recent increases in rail modal share; analyzes and discusses the societal costs of trucking; outlines how PPPs can relate to rail and provides examples of rail PPP in California such as the highly successful Colton Crossing project; and proposes a location in Monterey County where government support through a PPP could result in lasting beneficial changes. In summary, although rail is currently a very small player in the transport of California perishable produce exports, increasing its modal share would be beneficial to the citizens of the state by reducing a number of negative externalities. Public entities should consider different ways, such as PPP, to encourage this growth. In areas where the private sector has already invested significant moneys, some modal shifts for certain crops have already occurred.			
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# Encouraging Mode Shift from Truck to Rail for California Produce

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UNIVERSITY OF CALIFORNIA INSTITUTE OF TRANSPORTATION STUDIES

September 2018

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## Executive Summary

California is one of the largest producers of perishable produce in the world, including citrus, green vegetables, stone fruits, nuts and legumes. This sector supports a large transportation industry that handles the exports of these goods. Starting from the 1950's, the export of produce has gradually shifted modes from rail to truck. While utilizing trucking has been cheaper for growers, shippers, and buyers, it has generated a number of negative externalities, particularly in the field of public health and infrastructure maintenance. Through the use of one type of contractual relationship, the public-private partnership or PPP, the state could use small amounts of public funds to influence or “nudge” private industries to diversify their mode share to include rail by funding different types of rail infrastructure for growers and shippers. This could in turn reduce the negative effects of trucking.

California produces about 25 million tons of perishable produce per year. In the most recent year available from the Surface Transportation Board (STB) Carload Waybill Sample (2013), approximately only 3% of this produce was exported on rail. However, this share has begun to increase due to efforts in private industry to monetize this space, with total rail tonnage exceeding one million for the first time in decades starting in 2012. Much of this is due to the modest success of companies in the San Joaquin Valley aggregating crop exports onto rail unit trains. Either with intermodal containers or traditional boxcar carloads, these trains travel as a single unit across the country with an agreed upon travel time. Success has revolved around schedule reliability of unit trains and the selection of perishable goods that are not as time sensitive (e.g. spoilage) and are more immune to the vibrations of rail travel. One such crop, oranges from Fresno, Tulare, and Kern counties, had its rail share increase from 2% to over 9% from 2007 to 2011. Mode choice is also influenced by the price of diesel that can drastically affect the price of trucking, in addition to the high turnover of long-haul truck drivers.

This report investigates the negative effect of trucking in four different categories: greenhouse gases, air pollutants, crashes, and pavement damage. Applying a quantity that approximated about 10% of the annual export crop and previously completed peer-reviewed research, these negative effects amounted to over \$30 million dollars per year. Increased greenhouse gases, valued by the current rate set in the California cap-and-trade market, was the largest contributor at \$14 million, followed by the reduced cost of truck crashes at \$12 million. Crashes are significant because truck crashes tend to be more severe than their automobile counterparts due to increased weight and the presence of external diesel fuel tanks. Health costs from air pollution (particularly particulate matter) and pavement damage were both smaller costs but still both over \$2 million dollars. The critical point is that most of these costs are born by the public at large, not any distinct individual entity, and as a result there is no one other than public agencies that have the means or desire to be a champion against the negative effects.

Public-private partnerships (PPP) have been utilized as way for governments to streamline the bidding and construction process of large infrastructure projects. However, in the field of freight rail PPP has been utilized on projects that stay in either the public or private domain, utilizing private and public funding as well as coordination during the design and construction process. Within California there have been large scale projects that have had varying levels of success using this technique. The Alameda Corridor in Los Angeles, a rail line connecting the container ports to major rail yards in the interior, removed a very large number of grade crossings while reducing emissions. However, usage of the corridor has stagnated due to changes in freight logistics, causing financial concerns for the public owner. Conversely, the Colton Crossing project in the Inland Empire, which eliminated a very congested at-grade rail junction, has had significant positive effects in terms of reduced delays to vehicles and trains, creating emissions reductions as well. The PPP process also enabled the public sector (Caltrans) to help with planning and the project ended up completed under budget as a result.

This type of relationship where both the private and public sectors provide substantial contributions can be extended into the arena of perishable produce transport. Monterey County is the largest produce producer in California but has a virtual 100% trucking modal share. It has been suggested by local consortiums of government that the construction of rail intermodal facilities to accommodate the transport of produce on rail would reduce risk, improve resilience, and reduce emissions. In this instance, public funding and political backing to support the construction of these facilities might be effective to nudge this particular growing region into increasing their rail mode share, which would in turn have positive benefits to the public at large.

In summary, although rail is currently a very small player in the transport of California perishable produce exports, increasing its modal share would be beneficial to the citizens of the state by reducing a number of negative externalities. Public entities should consider different ways, such as PPP, to encourage this growth. In areas where the private sector has already invested significant moneys, some modal shifts for certain crops have already occurred.

## Introduction

Throughout the period post-World War II, the interstate transport of goods within the United States gradually transitioned from railroads to trucks. A number of different factors contributed to this change including labor costs, fuel costs, regulation, and subsidized infrastructure. Excluding materials that are transported by pipeline, in 2015 trucking moved approximately 82% of the US cargo by weight and 80% of the cargo by value according to the Bureau of Transportation Statistics. By contrast, rail's percentages were 12.1% and 3.3% respectively, reflecting that most goods still transported on trains were of low value. Nevertheless, while logistical and infrastructure challenges do exist, there are often significant benefits to society at large from increasing the modal share of rail. Due to the enormous dual advantages of coupled box cars and steel wheel on railroad efficiency, the amount of energy required to move one ton of cargo one mile (a "ton-mile") on rail is only one-quarter of the energy required by a large semi-trailer or just 14% of the energy required by a single-unit truck (Nahlik, Kaehr, Chester, Horvath, & Taptich, 2016). This translates into a much smaller amount of transport-related greenhouse gases and diesel air pollution, in addition to improved safety from the reduction in truck crashes and reduced highway infrastructure maintenance. However, these societal benefits, aside from appearing in the California cap-and-trade market, are not necessarily reflected in company profits. For example, the effects from a reduction in one type of pollutant, PM2.5, may eventually result in lower health care insurance costs due to reductions in asthma, lung disease, and emergency room visits but these changes are very slow and hard to discern. To have societal benefits fully emerge, it is sometimes effective to nudge private agents to make decisions that promote the public good. One way to do so is through the public-private partnership, or PPP, which consists of a broad range of funding mechanisms where public agencies work with private companies to complete a project or initiate a service that may remain in the public or private sphere. One of the common outcomes of a PPP relationship is the realization of social benefits or a reduction in social costs from economic activities, especially in transportation.

This report examines one particularly relevant type of cargo for California, perishable produce, and how a movement from truck to rail would benefit the state. California is by far the largest producer of fruits and vegetables in the United States, and the predominant domestic source of a large diverse set of crops ranging from almonds and walnuts, to garlic, artichokes, and peaches. According to the most recent state agricultural report, the top 10 perishables produced in 2017 by value were three nut categories (almonds, walnuts, and pistachios), grapes, tomatoes, oranges, strawberries, lettuce, lemons and peaches. As this report will document, the transport of perishables used to be dominated by rail but now is almost entirely transported by truck. After examining data from National Agricultural Statistical Service (NASS) and Surface Transportation Board (STB) Carload waybill sample, analysis revealed that just over 3% of perishable exports leave the state on rail with nearly 90% on a truck.

The report will first review the state of the California rail system in terms of perishable produce transport and where there have been recent increases in rail modal share. This will be followed by discussion of the societal costs of trucking. The third section will outline how PPP can relate to rail and provide examples of rail PPP in California such as the highly successful Colton Crossing project. Lastly, the authors will propose a location in Monterey County where government support through a PPP could result in lasting beneficial changes.

## Rail and the Perishable Market

The California market for perishable produce accounts for 20.8 billion dollars a year, producing about 25 million tons of fruits, vegetables, and potatoes. Trucking has long been the dominant mode for the transportation of these products; as shown in Figure 1(a) in 2013 only 3.4% of the perishables were distributed on rail. While the total production of perishables has remained nearly constant throughout the past 10 years, mode share for rail has experienced an upward trend since 2009. By the year 2012, over a million tons were transported on rail, in contrast to only 710,000 tons in 2006. The origin of the rail transported perishables from 2003 to 2013 are shown in blue in Figure 1(b). The analysis of waybill data revealed that the origin of perishables transported on rail is mainly from the San Joaquin and Imperial Valleys.

Figure 1. (a) Perishable production in California in tons, tons transported on rail and the mode share of train from 2005 to 2013. (b) California Counties that registered perishable products transported on rail (in blue) from 2003 to 2013.

(a)

Year	Production [TON]	Rail [TON]	Share [%]
2005	25,277,173	800,520	3.2%
2006	25,204,629	710,444	2.8%
2007	24,923,572	730,924	2.9%
2008	28,166,519	782,380	2.8%
2009	22,689,994	806,964	3.6%
2010	25,618,338	961,928	3.8%
2011	25,071,203	990,728	4.0%
2012	25,094,700	1,000,136	4.0%
2013	27,252,731	936,500	3.4%



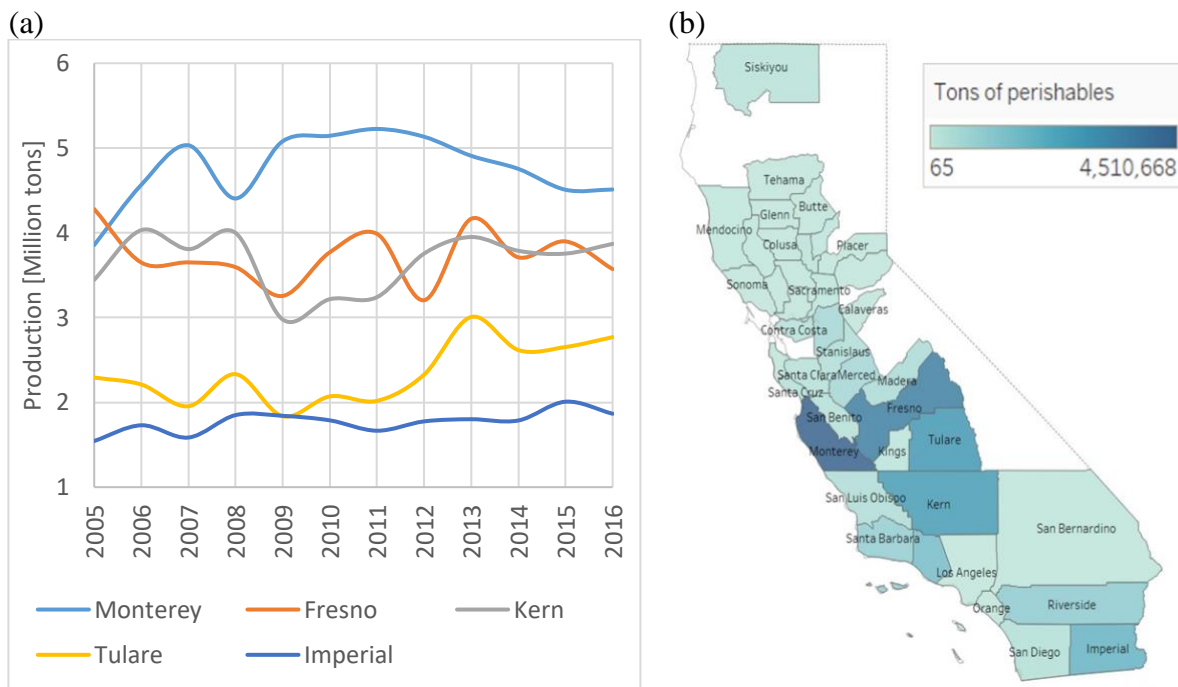
Source: NASS and STB Carload waybill sample.

While rail tonnage of perishables has increased in recent years, this trend varies by regional geography and perishable produce type. The counties of Monterey, Fresno, Kern, Tulare, and Imperial account for over 60% of total perishables in California, shown in

Figure 2 (a) and

Figure 2 (b). Monterey County, with a production of nearly 5 million tons of produce in 2013, does not transport virtually any perishable produce on rail. However, in 2013, Fresno Kern, and Tulare Counties, located in the San Joaquin Valley, together produced 11.1 million tons of perishables, and transported 712,000 tons of those on rail, which accounted for 76% of the total perishables transported from California on rail in 2013. The top four produce types utilizing rail transportation were carrots, oranges, mixed vegetables, and potatoes.

Figure 2. (a) Production of perishables in California – Top 5 counties. (b) Production of perishables in California counties 2016.

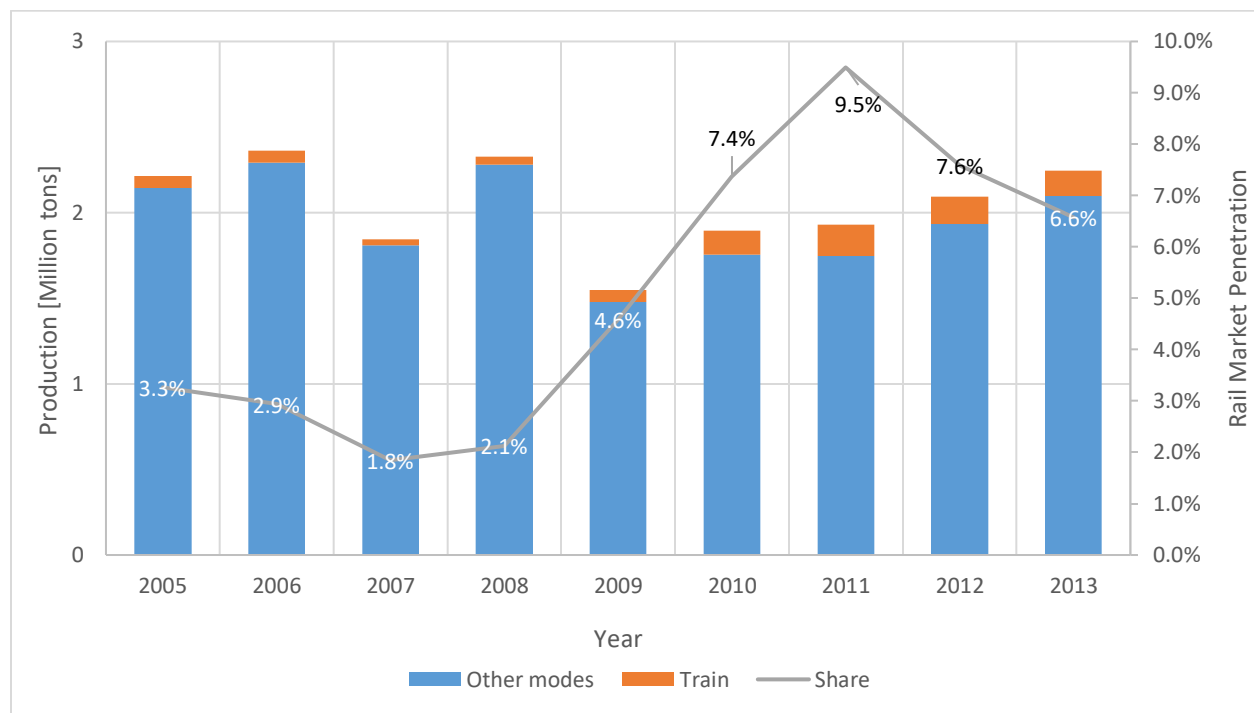


Source: NASS.

Citrus fruit, specifically oranges, have had one of the largest shifts toward rail due to their durability and lack of spoilage in transport. Orange production in the San Joaquin Valley is approximately two million tons a year. In 2008, the Railex Corporation, now part of the Union Pacific railroad, opened a dedicated facility in Delano, California that would serve as a depot for produce exports from Fresno, Kern, and Tulare counties. Before the opening of this facility, the market penetration of rail transportation for oranges was about 2%. As shown in Figure 3, from

2008 to 2011, transportation of oranges on rail experienced a constant increase in mode share reaching 9.5% of the total oranges produced in the region, only decreasing with the decline of diesel prices after 2012. Railex was able to make rail transport more attractive by employing a number of strategies that could be summarized by making the transport from grower to wholesaler all-inclusive. First and most important was the utilization of a unit train with time to the New York terminal in Rotterdam, NY guaranteed by Union Pacific and CSX. The reliability of this schedule made rail nearly as fast as trucking. Second, Railex offered to pick up produce from the growers as part of the purchase order. Lastly, on the New York end Railex had direct relationships with grocery stores and wholesalers who would pick up directly from the Rotterdam terminal with a wholesale “grocery list.” This service was successful to the point that Union Pacific purchased the operation outright in January of 2017 (Union Pacific Acquires Railex LLC Assets, 2017).

Figure 3 Rail Market penetration – Oranges.



Source: NASS and STB Carload waybill sample.

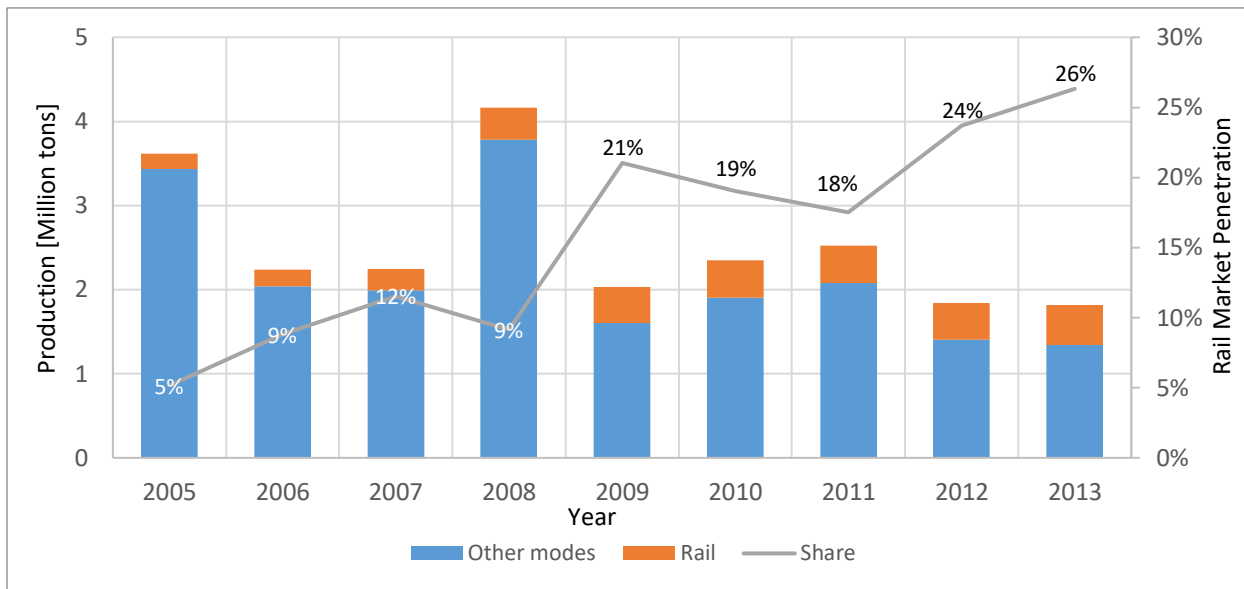
Within the same region of the San Joaquin Valley, the production of all vegetables<sup>1</sup> also averages two million tons a year. In 2009 market penetration for rail jumped from 9% to 21% for this produce type, also possibly as a result of the new Railex depot. This trend is similar to the one experienced with oranges but has continued to increase to 26% in 2013, as shown in Figure 4.

<sup>1</sup> Products with Standard Transportation Commodity Code (STCC) 013.

The top five vegetable categories transported on rail have been carrots, mixed vegetables, cantaloupes<sup>2</sup>, onions and celery, shown in

Figure 5. The increase in tons of carrots and mixed vegetables on rail are the primary drivers of the increase in rail market penetration, suggesting that rail system is capable of transporting more delicate vegetables.

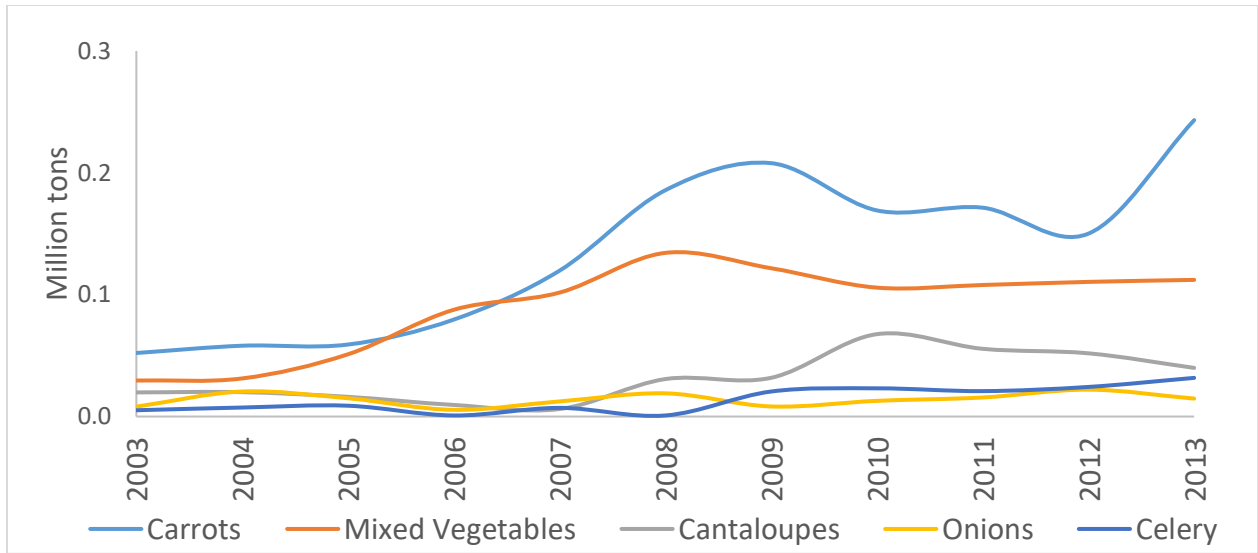
Figure 4. Rail market penetration - Vegetables.



Source: NASS and STB Carload waybill sample.

Figure 5. Top 5 vegetables transported on trains.

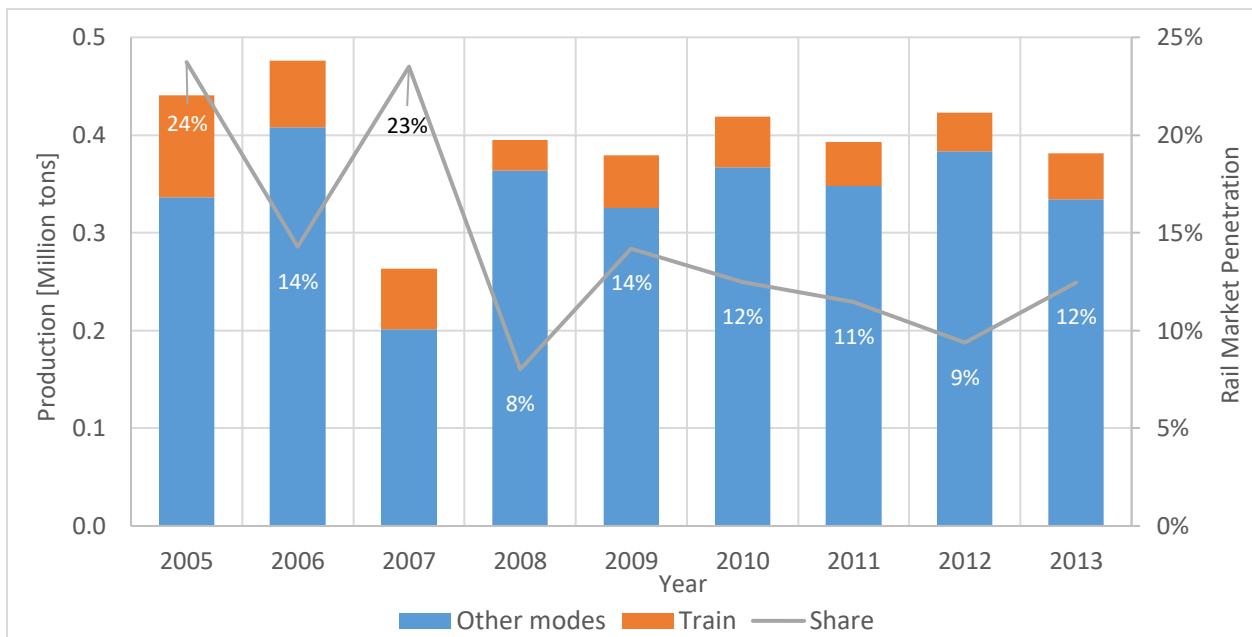
<sup>2</sup> Includes cantaloupes, melons and muskmelons, exc. Watermelons.



Source: NASS and STB Carload waybill sample.

Not all produce types in the San Joaquin Valley region have experienced rail mode share increases similar to oranges or vegetables. Transport of potatoes in Fresno, Kern, and Tulare counties have actually experienced a slight decline in the rail mode share from 2009 to 2013 as shown in Figure 6. Nevertheless, the market share for potatoes on rail was still 11.2% in 2013, much higher than the overall 3.4% rail mode share from California.

Figure 6 Rail market penetration - potatoes.



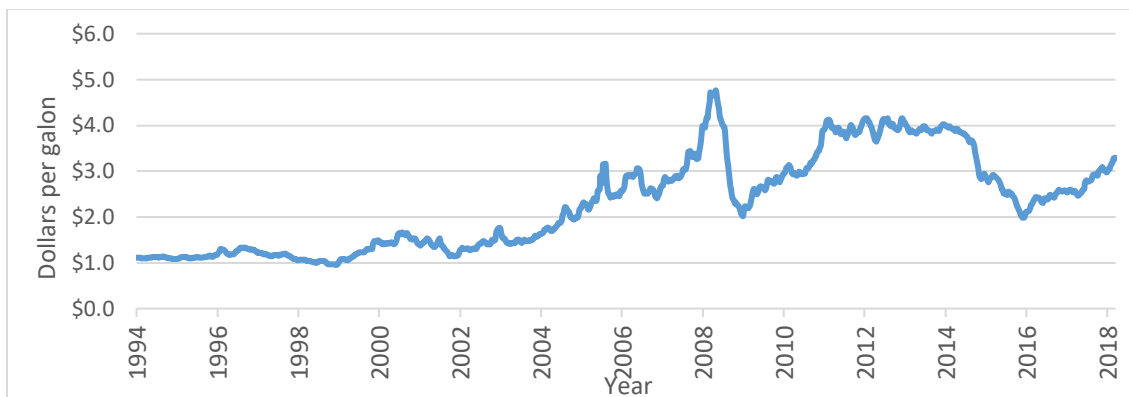
Source: NASS and STB Carload waybill sample.



## Fuel Costs

One of the most critical factors that has driven rail mode share is the variability in diesel prices since 2000. Historically, fuel prices have been relatively low as compared to labor costs, except during the oil crises of the 1970's. However, from 2000 to 2008, diesel prices rose steadily to nearly \$5 per gallon. In the same year, the price dropped to \$2 in less than six months, driven by the economic crisis of 2008. Climbing again, from 2011 to 2014, there was a nearly stable period where the cost per gallon was quite high at approximately \$4, but again in 2016 prices dropped significantly to 2008 crisis levels. Since then, diesel prices have increased steadily for the third time, reaching over \$3 by June 2018 as shown in Figure 7. As a consequence, diesel price fluctuation increases uncertainty over the real operating cost of trucks; when diesel prices rise over \$4 dollars, the increase in fixed fuel cost begins to make rail transport much more attractive. However, variability and uncertainty in fuel prices pose a challenge to private ventures, such as Railflex/UP, that serve rail perishable traffic.

Figure 7. Weekly U.S No 2 Diesel Retail Prices.



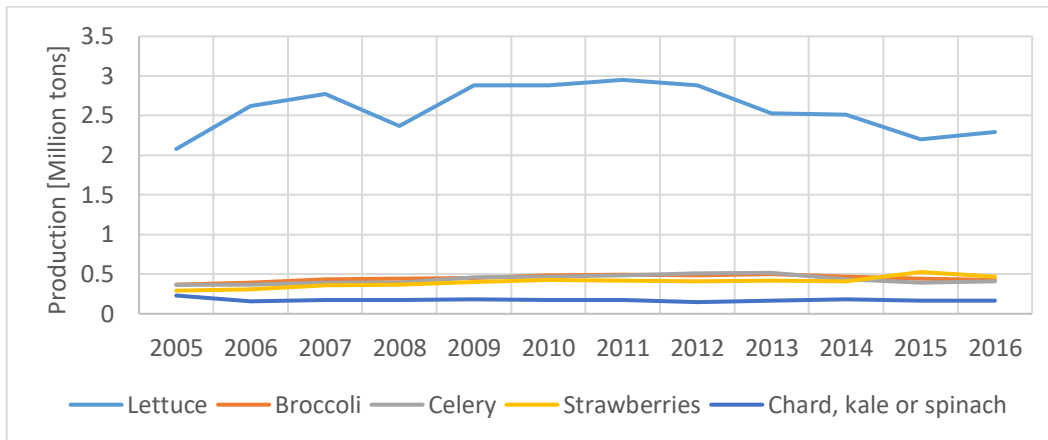
Source: Energy Information Administration.

## Summary of Existing Rail Analysis

Rail is currently a small player in the transport of California produce. However, early efforts in the San Joaquin Valley reveal that there is the potential for rail infrastructure to capture a significant transportation mode share for California perishable produce. As mentioned previously, Monterey County produces over five million tons of perishables per year, and almost all of these perishables are transported on trucks. Figure 8 shows the top five perishables produce in Monterey county; lettuce is the dominant perishable with nearly 2.5 million tons a year. Two of the primary barriers for shifting the transport of green vegetables such as lettuce from trucks to rail are physical damages and spoilage, particularly in regard to vegetable bag salads. However, as shown by the vegetable rail market penetration in the San Joaquin Valley, there is an

opportunity for the Salinas Valley to shift some of their produce exports from trucks to trains. By reaching the same rail market penetration for vegetables as already seen in the San Joaquin Valley, Monterey County could transport over a million tons of perishables on rail.

Figure 8. Tonnage of perishable production in Monterey – Top 5 products.

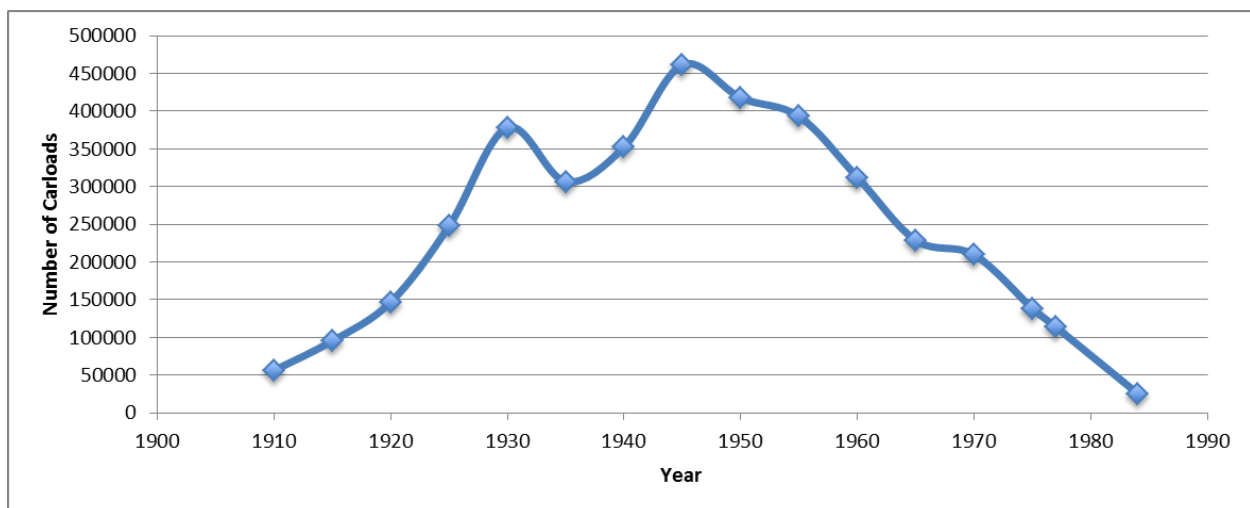


Source: NASS

## The Social Costs of Trucking

Currently, within the space of perishable produce transport in California virtually all produce leaves on a truck. Although rail once dominated this type of transport, improved road infrastructure, an unbalanced regulatory environment, and the costs of both fuel and labor drove the market almost exclusively to the truck mode. Figure 9 shows the total tonnage carried by the Pacific Fruit Express (PFE), the largest refrigerated-car (“reefer”) rail transport company until its closure by Southern Pacific in 1984.

Figure 9. PFE Carloads by Year.

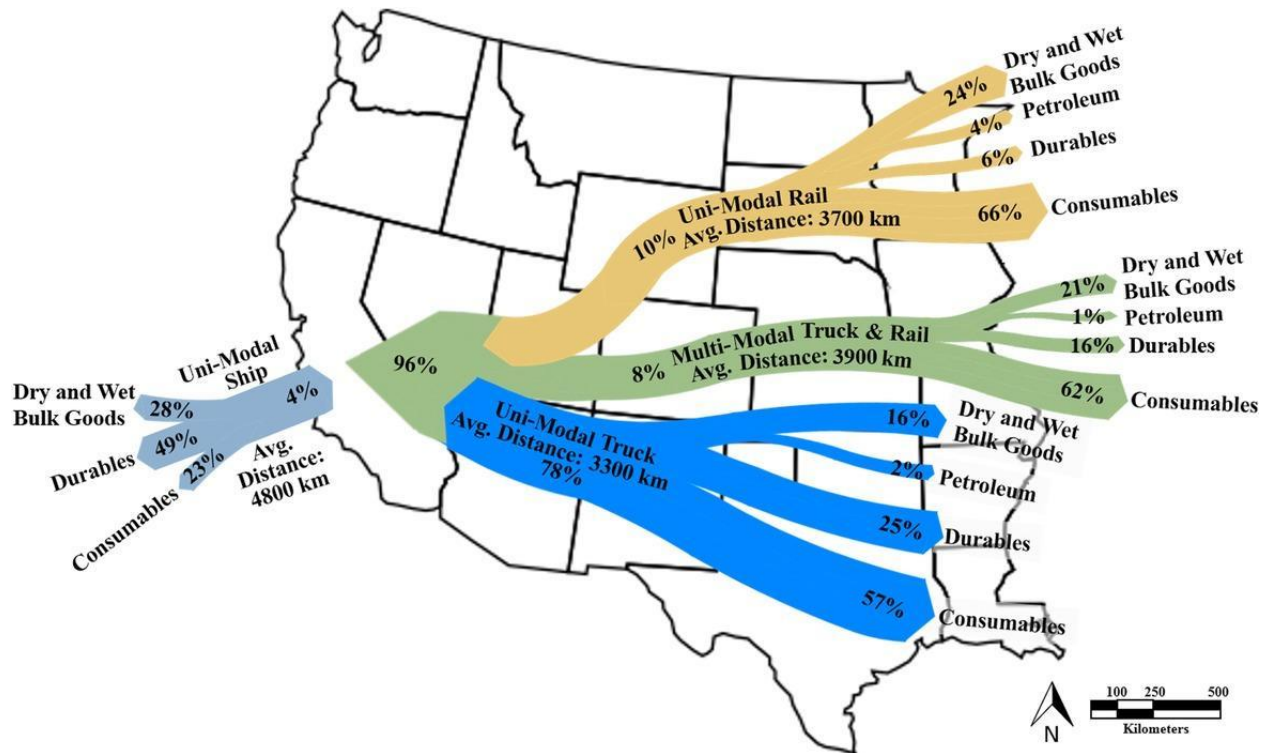


Source: (Thompson, Church, & Jones, 2000)

Nevertheless, the movement from rail to truck has brought with it significant social costs in four major arenas, increased greenhouse gases, air pollution, pavement wear, and truck crashes. All of these costs would be reduced by a modal shift from truck to rail in the transport of perishable produce. The reader should remember, however, that many of these benefits are realized as the trip gets longer. All rail trips will require additional “first mile” “last mile” journeys which are almost always on a truck, and the longer the main “trunk” trip length gets, the less these additional trips will offset the gains from rail. One would note that in the intermodal space, these types of three-part trips are common. Many long-haul trucking companies such as Schneider and J.B. Hunt have long-standing relationships with intermodal rail carriers for portions of their long-haul trips.

Figure 10 shows that while across all goods 10% leaves California on rail alone, an additional 8% will use a multi-modal approach (Nahlik, Kaehr, Chester, Horvath, & Taptich, 2016). Although all rail movements typically utilize trucking for the first mile/last mile, multi-modal in this case implies using both truck and rail for significant distances during the long-haul segment.

Figure 10. California Exports.



Source: (Nahlik, Kaehr, Chester, Horvath, & Taptich, 2016)

## A Harvest Season Scenario

The next portion of this section will assess the four categories of social costs described above. The baseline for calculations will cover a large move of produce during one harvest season: 100 days, 1,000 trips per day, 2,000 miles per trip (Sacramento to Chicago), 50,000 lbs of cargo per truck (25 tons). This equates to 2.5 million tons, 200 million miles driven or five billion ton-miles. The 2.5 million tons is approximately 10% of the annual exports and is a value consistent with what other studies such as the AMBAG report on the utilization of rail from Salinas Valley have suggested (AMBAG, 2011).

### *Greenhouse gases*

At the May 2018 auction, the price of a carbon credit for the California/Quebec/Ontario cap-and-trade program was \$14.50 per metric ton [tonne], equivalent to \$16 per US ton (California Cap-and-Trade Program May 2018 Joint Auction #15, 2018). As part of a larger life cycle assessment research effort by Facanha & Horvath (2007) and revised by Nahlik, Kaehr, Chester, Horvath, & Taptich (2016), researchers have been able to compare greenhouse gas output by mode. Their results are in Table 1. Not that this is for operation only, not vehicle manufacturing.

Table 1. Greenhouse Gases by Mode

Type	Description	Grams (g) of CO2 per ton-mile
Medium Truck	Classes 6 & 7 Weights 19,000 – 33,000 lbs	387.4 grams
Heavy Truck	Class 8 Weights above 33,000 lbs	251.7 grams
Freight rail	Class 1 freight rail	52.8 grams

Comparing the two modes, freight rail is nearly five times as efficient in the production of greenhouse gases per ton-mile as a large Class 8 semi-trailer, and over seven times as efficient as a medium truck. Moving 1,000 ton-miles would create a cost difference in terms of carbon credits of approximately \$2.88. Our five billion ton-mile baseline would balloon this estimate to \$14.4 million dollars in extra greenhouse gas costs by moving cargo by truck over rail.

## Air Pollution

The same research by Nahlik, Kaehr, Chester, Horvath, & Taptich (2016) also looked at different quantities of air pollutants being emitted by mode. This space will examine three of pollutants most well-known and most well understood by the public, nitrogen oxides, sulfur oxides, and particulate matter (PM2.5) particles the differences in emissions per ton-mile is shown in Table 2.

Table 2. Selected Pollutants by mode

Type	Milligrams (mg) of NOx per ton-mile	Milligrams (mg) of SOx per ton-mile	Milligrams (mg) of PM2.5 per ton-mile
Medium Truck	2.8	3.7	110.2
Heavy Truck	2.1	2.4	62.4
Freight rail	0.77	30.8	3.3
Difference Heavy to Rail	1.33	-28.4	59.1

Due to the efficiencies from rolling resistance of steel wheels on steel rails, dramatically less fuel is required per mile, resulting in the lower values for nitrogen oxides and particulate matter. Rail does have significantly higher amount of sulfur oxides because it has historically not been subject to EPA ultra-low sulfur diesel [ULSD] requirements that has applied to cars and trucks since 2007. In 2014 the EPA began to phase in ULSD in rail as well.

As opposed to the dollar value of greenhouse gases which is set by the State of California, there are different models that attempt to quantify the price of these pollutants by assessing their health care impacts. Two such models are the APEEP (Muller, 2011) and the BenMAP EPA GIS (Fann, Fulcher, & Hubbell, 2009) (Fann, Baker, & Fulcher, 2012). This research will consider the more conservative APEEP model which quantifies results by county, shown in Table 3. Similar to the example for greenhouse gases, this table will consider the baseline move of five billion ton-miles. The values from the APEEP model are for the California average to include rural areas.

Table 3. Health Care Costs of Selected Pollutants

Pollutant	Difference in kilograms	APEEP cost per kilogram	Total Costs
NOx	6,650	\$0.50	\$3,300
SOx	-142,000	\$6.5	-\$923,000
PM2.5	295,500	\$11.36	\$3,355,400

Totals	-	-	\$2,435,700
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The conclusions from Table 3 are that the five billion truck miles could generate over a million dollars in associated health care costs, mostly from the effects of PM2.5 in diesel fumes.

*Pavement Damage*

As stated by Gillespie & Karamihas (1994), “heavy trucks are a primary source of road damage due to the stresses imposed by heavy axle loads.” Pavement damage is not only a situation where virtually all of the damage is created by trucks (Garber & Hoel, 2002), but the cost is paid for by the public at large through fuel taxes, not just the trucking sector. Conversely, while increased rail use would in turn increase track maintenance costs, the railroads themselves along with company shareholders, not the taxpayers, carry these costs.

As roadway maintenance can be very expensive, there is extensive literature on damage caused by trucks. This research will consider literature based on the equivalent single axle load (ESAL), which is 18,000 pounds on a single axle with two tires. The average large 53’ semi-trailer has five axles, including one drive axle, and equates to 1.09 ESALs. Three different studies, conducted by Zhao & Wang (2015), Murillo-Hoyos, Ahmed, & Labi (2014), and Bai, et al. (2010) all arrived at ranges between \$0.01 and \$0.05 per ESAL per mile. Disparities in these estimates, as pointed out by Anani & Madanat (2010) are related to the interpretation of roadway maintenance. Some studies only consider the ability to perform simple pavement overlay, while others assume more complex maintenance activities. As such, we will use \$0.01 per ESAL per mile, the most conservative estimate to allay any fears by researchers concerning overestimation. Our harvest season mileage of 200 million miles would simply add approximately  $1.09 \times 20,000,000 \times 0.01 = \$2.18$  million dollars of pavement wear.

*Costs of Truck Crashes*

The final category of social costs, truck crashes, is not surprisingly quite significant. As shown in a recent Caltrans DRISI publication “Quick Clearance for Major Traffic Incidents,” in terms of time to open all freeway lanes a majority of the worst crashes in Caltrans Districts 3, 4 and 6 involved large semi-trailers. In all three districts the absolute worst crash involved a semi-trailer and took over 15 hours to clear. Semi-trailers are quite heavy and usually do significant damage to anything they impact including other cars and utility poles, as well as having external fuel tanks that are likely to leak in a crash and cause a hazardous waste clean-up situation. Any movement from truck to rail would reduce costs from truck collisions.

The California Statewide Integrated Traffic Records System Database (SWITRS) holds a record of every crash per county, which can be divided by the total number of vehicle-miles driven to get crashes per million miles, known as a crash rate. The average for California is 1.17 crashes per million miles, with values ranging from 0.51 in rural counties such as Modoc to as high as 1.75 in Los Angeles. Zaloshnja & Miller (2007) found an average cost of \$91,000 per crash involving a

semi-trailer (including costs from injuries and fatalities), and Hagemann, et al. (2013) added that nationwide average delay costs from freeway congestion associated with a truck crash were an additional \$13,000 for a total of \$104,000. The \$91,000 estimate was presented in 2005 dollars, so the value of that portion of cost could be considerably higher today. Nevertheless, for the 200 million miles used as the baseline, that equates to 234 crashes using the California average. Halving that value to account for the substantial rural mileage still results in 117 crashes worth \$12.2 million dollars. This number could be much higher if any of these crashes resulted in severe injury or fatality.

According to the FRA data, in 2015 within California there were only 97 train accidents of all types (collisions between trains, derailments etc.) and 148 highway vs. rail crashes. By contrast, the California Traffic Accident Surveillance and Analysis System (TASAS) reported over 150,000 crashes between vehicles for the most recent year available (2013), and this only includes crashes that were reported to police or insurance. Increased rail volume could result in more crashes, but the amount would still be negligible compared to vehicle crashes.

## Summary

The summation of the four costs, based on the 100 days of harvest, is as follows:

- Greenhouse Gases: \$14.4 million
- Air Pollution: \$2.4 million
- Pavement Wear: \$2.2 million
- Crashes: \$12.2 million

The total sums to \$31.2 million dollars per year, a fairly large sum considering that this only considers 10% of the existing export crop. Many more trucks than represented in this example actually leave the state every day filled with perishable produce, and if a significant portion of this cargo could be nudged to rail transport, the public could see significant savings.

## PPP as a Tool in Transportation

Public Private Partnerships (PPP) are contractual relationships between a public agency and a private sector entity to participate and share the responsibilities in the delivery of a public service or public improvement (Institute & PPIAF, 2012). Although the use of PPP in the United States has been recently embraced as a politicized phenomenon to build large infrastructure projects, a more general form of partnership between the private and public sectors has existed for many years in the transportation industry. In this instance, the specific term public private partnership was not necessarily used, the integration of private and public financing to provide public projects and services was often practiced in various forms of financing arrangements such as subsidies, franchises, and tax reliefs (PPIAF, 2009).

While the size of the PPP market is still relatively small considering the size of the US transportation economy, the role of PPPs continues to grow (Gabreil & Devlin, 2015). PPPs can help projects meet their financial targets with increased efficiency while lowering costs and risks for the public agencies. PPP should be considered as a viable alternative especially when public sector agencies are unable to achieve development and management targets due to budgetary and technical constraints. In certain circumstances it can enable governments to utilize additional capital and management resources from the private sector to deliver large public projects, including for the focus of this report, freight rail infrastructure and services (Schneider & Davis).

The PPP contract holds the private partner responsible for paying the unknown future costs of completing projects and can allow the private partner to have full decision-making power and control of the project in completing them. In other words, a PPP relies on transferring risks from the public to the private sector in order to potentially realize efficiency gains. For example, the “design-build” (DB) arrangement transfers both design and construction risk to the contractor, which incentivizes the private partner to minimize costs as they are typically only paid in a lump sum. The “design-build-operate-maintain” (DBOM) model adds private entity responsibilities after construction, in terms of the operation and maintenance of the asset, encouraging the private partner to select building methods and materials that minimize operations and maintenance costs. Some PPPs include a private finance component. Under the “design-build-finance-operate-maintain” (DBFOM) structure, the private party is also responsible for a portion of the project’s financing and is generally paid through revenues directly related to the project itself (e.g., tolls or user fees) while the public sector retains ownership. This incentivizes the private partner to reach the operations phase as early as possible to begin paying back investors (AECOM, 2007).

PPPs can enhance the accountability for the long-term infrastructure projects. These partnership arrangements can allow public-sector partners to focus on the demands of their jurisdiction while the private partners run and manage project needs more directly. In a PPP, many responsibilities and performance expectations are detailed out, allowing public sector to closely monitor and enforce required services. Additionally, PPPs can significantly reduce costs and increase efficiencies compared to traditional infrastructure initiatives. PPPs can also involve direct incentives to the private contractors for on-time delivery and performance-based contracting, and because pay is often directly impacted by the project’s completion, private-funding partners can reduce the cost of a project by optimizing the design, management, and construction process. These strategies can help deliver a product in a timely manner, thereby reducing the amount of money that needs to be borrowed by public sector (AECOM, 2007) (Schneider & Davis) (Delmon, 2009).

## Financing Details

Financing mechanisms vary by project and the type of PPP. In some projects, the public sector pays for construction, improvement, operation and maintenance of an asset using public funds



from taxes, direct user fees, or grants from multiple levels of government. In others, the public sector seeks to attract the private sector to finance part or all of a project with private resources that may come from direct user fees or tolls, funds borrowed from private capital markets or private equity. Additionally, other innovative financing tools such as Transportation Infrastructure Finance and Innovation Act (TIFIA) federal credit assistance, private activity bonds and state infrastructure banks can provide access to low-interest or tax-exempt debt to private sector entities for transportation projects.

However, it is important to note that PPPs are a financing tool, not a new source of funding. Project funding is still derived from the public or the users. What a PPP can do is reduce the cost of a project by optimizing the design, management, and construction process and reduce the amount of money borrowed by public sector. A PPP projects allow the public sector to pre-finance a project by monetizing future costs or revenues, but taxpayers still ultimately have to repay their portion of the debt (Federal Transit Administration, 2018).

## Successful PPP Freight Transportation Projects in the United States

Within the United States there have been a number of cases of major freight projects that have demonstrated the use of public-private partnerships to leverage scarce public resources and expedite needed transportation projects.

### *Alameda Corridor*

The Alameda Corridor is a 20-mile stretch of rail cargo “expressway” between the ports of Los Angeles and Long Beach and the rail yards near downtown Los Angeles. As the Port of LA-LB grew to become the busiest container port in the country, in no small part due to the enormous international trade with the Pacific Rim nations, the existing transportation infrastructure was not sufficient to accommodate rapidly increasing cargo volumes. In the communities surrounding the port, traffic delays at rail grade crossings were becoming increasingly onerous.

The Alameda Corridor Transportation Authority (ACTA) represented by the cities, ports, and the LA County Metropolitan Transportation Authority (MTA), was formed in 1989 to manage the design and construction of the new Alameda Corridor. The project involved a consolidation of 4 original rail lines in LA County to the port with nearly 50 new bridges and the elimination of 200 at-grade crossings. Construction began in April 1997 and took five years to complete at a cost of \$2.4 billion, funded through a mix of public and private sources, including a \$400 million 30-year loan by the federal government, another \$400 million by the ports through the purchase of rights-of-way, and a \$735 million in revenue bonds by ACTA. The loans, grants, and bonds were to be repaid by user fees from railroads. In this instance of PPP, the final facility remained owned by the ACTA. It is noted that due to changes in international freight logistics, the Alameda Corridor remains somewhat underutilized and continues to have issues with bond repayment (Uranga, 2016)

## *Colton Crossing*

The Colton Crossing was a grade separation and flyover construction project at the location where the Union Pacific's main line crossed over the BNSF main line in Southern California. This formerly at-grade junction had long been recognized as one of the busiest railway junctions in California, with both freight and passenger movements. The existing junction was causing extensive delay to local streets. In this instance, although the completed flyover project would be owned by the private sector, the public service was to remove the at-grade junction, reducing local pollution by the trains as well as vehicles that formerly had to wait at grade crossings. Local officials were particularly interested in lowering vehicle delay (HDR, n.d.).

The Colton Crossing flyover project was a collaborative effort between the California Department of Transportation (Caltrans), City of Colton, San Bernardino Association of Governments (SANBAG), and the two freight railroads. With the contract signed in 2011, the 1.4-mile concrete flyover was initially estimated to cost \$202 million and to take up to three years to complete. However, it was completed on August 2013, eight months ahead of schedule and at a cost of \$93 million, more than \$100 million under budget. The project received \$34 million from federal grants, \$41 million taxpayer-approved State Proposition 1B funds, and \$18 million from BNSF and Union Pacific (Jin, 2013).

The public sector acted as a facilitator and mediator in discussions between the competing freight railroads. Ultimately, Caltrans' cooperation in granting a small amount of freeway right-of-way allowed for a design that greatly reduced both construction time as well as the overall cost of the project. Furthermore, collaboration from Caltrans and the railroads allowed for the applications for both federal grant funding and state funding to run smoothly.

Figure 11. Public and Private Financing for Colton Crossing.



Photo source: Caltrans.

### *Heartland Corridor and National Gateway*

Both of the major east-coast railroads, Norfolk Southern (NS) and CSX, have recently engaged in PPP to expand capacity for new international cargo opportunities. This has generally taken the form of combining public and private funding to make infrastructure improvements on sections of track between major East Coast ports and Chicago. The most important improvement was to modify existing tunnels to accommodate double-stack containers. Again, similar to the Colton Crossing, although the railroads retained ownership of the infrastructure, there were significant public contributions and input to represent improvements to the public good (e.g. emissions reduction).

### *Heartland Corridor*

The Norfolk Southern Railway (NS) Heartland Corridor from Virginia to Ohio has long served as a prime rail corridor for moving freight from the East Coast to the Midwest markets. However, double-stacked container trains had to travel a longer route via Pennsylvania or Tennessee due to insufficient terminal clearances along the mainline route. To improve mobility and increase freight capacity, the Heartland Corridor Project's double-stack clearance phase focused on providing a double-stacked container train route from the Ports of Virginia through West Virginia, Eastern Kentucky and into Columbus, Ohio (FHWA - Center for Innovative Finance Support, n.d.).

Begun in 2007, the three-year clearance project was a public-private partnership between NS, the Federal Highway Administration, and state agencies from Virginia, West Virginia, and Ohio.

The improvements consisted of raising the height of 28 tunnels and removing 24 overhead obstacles in the Appalachian Mountains to accommodate double-stacked container trains. The double-stack clearance phase alone cut 250 miles off the old route and reduced the traveling time from three days to two. Creating a shorter and efficient route resulted in a decrease in highway congestion, fuel consumption and greenhouse gas emissions (Railway Technology, n.d.).

Of the \$350 million total project cost, over \$190 million was spent on the clearance project. The federal government provided about \$83 million through the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) fund and the states of Virginia and Ohio provided total of about \$11 million. As an essential funding partner, the Norfolk Southern Railway provided a matching fund of about \$98 million (Railway Technology, n.d.) (FHWA - Center for Innovative Finance Support, n.d.).

### *National Gateway*

The National Gateway Initiative was the companion project sponsored by CSX along with the federal government and the states of Maryland, Ohio, Pennsylvania and West Virginia to increase the freight capacity between the East Coast and the Midwest. The National Gateway Project was very similar the Heartland Corridor Project where the goal of both projects involves multiple clearance upgrades to allow a double-stack capability. Early studies for the Gateway estimated that each double-stack intermodal train could replace up to 280 trucks, freeing up highway capacity for approximately 1,100 cars, cut 20 million tons of CO2 emissions, and create a notable amount of long-term jobs in freight logistics (FHWA).

Starting in 2008, the National Gateway Initiative was divided into three segments/phases that involved a total of 61 double stack clearances and construction or expansion of several intermodal terminals. The technical engineering associated with each phases range from bridge replacements to tunnel removals around sensitive areas to coordination of freight and commuter trains on a daily basis (AREMA, 2013).

An estimated cost of \$850 million, the PPP project was covered by combination federal, state, and private funds, including a \$98 million TIGER Grant. The partnerships of over 300 public and private sectors included mix of rail companies, transportation logistics suppliers, shippers and local chambers of commerce. Early involvement and cooperation at every level with defined objectives, set deadlines, and planned deliverables have resulted in a successful completion for first phase of the project to date (Railway Techonology, 2016).

### *Airline Incentive Programs*

The above examples involve PPP's to support capital projects that increase the efficiency of rail and truck movements, and ultimately enable better and more cost-effective freight services. In some cases, however, the challenge is to induce the private sector to initiate new services in order to test their viability in the market place. The best recent examples of this form of PPP (interpreting the term broadly) are to be found in air transport. In airport incentive programs,

airports fund market studies, offer reduced landing fees, provide traffic guarantees, or engage in joint marketing initiatives to support the launch of new nonstop routes (Ryerson, 2016). These programs provide incentives for carriers the opportunity to test and develop new markets at a lower financial risk. Once the services have been established in the market, it is hoped that the carrier will continue them after the incentives end.

## Conclusions

The regional freight rail system has benefited from PPP relationships to respond to increased economic competition, constrained highway corridors, environmental challenges, and rising infrastructure project costs. However, this type of arrangement still faces a variety of issues and challenges between public and private entities due to a project's inherent risks and uncertainties. Risks are often associated with operations and maintenance costs, political and government issues, loss of project control, environmental concerns, and delays caused by legal issues. When, as is the case here, projects are predicated on diverting traffic from a competing mode, there are additional risks related to demand response and response from the competing mode. Also, as noted earlier, diesel fuel price volatility is another source of uncertainty in rail-truck competition for California produce traffic.

The role of government is crucial in helping to resolve some of these issues in cooperation with the railroads and other stakeholders. Each project should thoroughly assess and define possible risks during the negotiations. In drafting PPP contracts and legal documents, public agencies and private entities need to ensure procedures and requirements are clearly defined. This includes establishing clear maintenance and inspection requirements as well as quality standards to ensure the project quality. The PPP agreement should also define the project process including roles and responsibilities. Clearly establishing responsibilities can ensure the project stays on schedule and without conflict. However, it is equally important to incorporate flexibility in the PPP contract and to allow for changes to the requirements so that the acceptable state of practice at a given time is applied, not one that is outdated and potentially detrimental to the public interest. Recognizing this challenge, public agencies should balance the trade-off between strict contract provisions and flexibility for negotiation and inspection to ensure no requirements become impractical due to technological advancement or policy changes. Overall, by engaging in a PPP with the private sector, public entities can successfully advocate for services that improve the public good. As shown by the Colton Crossing project, these types of contractual relationships have already proven to be successful in California.

## Monterey County PPP

Combining all of the previous topics, this report will discuss an example of opportunity by outlining a technical study that examined the potential for a new intermodal produce terminal in Monterey County. During the 2005-2011 period, the increase in fuel prices and the inability to

get reliable truck drivers caused the local growing association in the Salinas Valley to fund two studies to gauge local interest in moving some produce to rail and to see how UP would respond (the Salinas Valley is UP territory). In response, the Association of Monterey Bay Area Governments (AMBAG) published the Salinas Valley Truck to Rail Intermodal Feasibility Study (2011). This report had two key findings:

1. Using intermodal rail will provide an alternative transportation option allowing the produce industry to remain competitive.
2. By taking a certain portion of trucks moving produce from this region (Salinas Valley), significant emissions reductions will be realized.

Looking at these points, the authors of the study stressed the benefit of having multiple modes available is an effective way to reduce risk. The report revealed that there was reasonable demand for about 180-200 domestic refrigerated containers per day in Salinas/Monterey growing region, about 10% of the overall produce export tonnage equaling nearly 140 million truckload miles or *over three billion ton-miles*. Switching to intermodal containers traveling on rail as opposed to truck would not harm certain products, specifically broccoli and iceberg lettuce. The authors cited a transport savings to the East Coast of five to ten percent after examining truck and UP rate schedules. At the time of the AMBAG study, the cost of building a dedicated intermodal ramp with cold storage in the Salinas Valley was estimated to be 20 million dollars. The conclusion of the report was that “this is the right time to move forward with the use of rail for the shipment of agricultural products from the Salinas Valley region.” UP was very willing to begin moving this new cargo as well.

At this time, six years later, there appears to be little movement on this effort other than a call by AMBAG for a pilot project. Without much input from stakeholders, one can surmise that the cost of permitting and construction was not enough to move against existing inertia, particularly with the sharp drop in fuel costs in 2013. While an intermodal ramp in the Salinas Valley has generated some enthusiasm, a special champion with funding will be necessary for the project to move forward or have the project influenced by external changes such as diesel costs returning to over four dollars per gallon. This type of situation is a perfect example of where a PPP style partnership could bring a project to fruition. Similar to the financing of the Colton Crossing project, if a consortium of governments (State of California, AMBAG, FRA) was willing to provide seed money with matching funds from Union Pacific (Colton had funds from UP and BNSF), this project could move beyond the exploratory phase. Given the sizable benefits from moving perishable freight from truck to rail, this project would seem like an excellent choice for the PPP partnership. Many of challenges that are sometimes brought up by growers, such as damage from the vibration of the train, have been dispelled by the AMBAG report for many different products grown in Monterey County.

## Conclusions

Rail has long been a part of California's transportation history as far back as the opening of the First Transcontinental Railroad in 1868. As California became one of the leading agricultural states (and the actual leader in many types of produce), the transport of exported perishables became a significant market. Rail dominated this market through the 1950's but has largely ceded it to trucking since then resulting in only a 3% modal share of perishable produce transport today. Nevertheless, it has been shown that there is latent demand for rail transport, as shown by the gains made from the Railex depot/UP Food Train in the Central Valley. Furthermore, by virtue of greater efficiency in energy use and ability to transport larger quantities, rail has been shown to have a much lower environmental footprint as well as reducing stress on existing highway infrastructure. The quandary is how to "nudge" California agriculture to increase the modal share of rail for the public good. One obvious way is through the invisible hand of fuel prices; rail quickly becomes very desirable when the cost of diesel approaches \$4.50 or \$5 per gallon, but this phenomenon is largely out of the hands of the government. However, financial partnerships or PPP's between the public and private sectors may also be an alternate way of providing resources for growers to work with railroads. Already, there has been success with PPP in the rail space, and California should continue to explore and seek out preferred projects for public support. The AMBAG study showed that growers from one of the state's most lucrative agricultural counties and the primary producer of its green vegetables had already studied one potential solution. There are undoubtedly more projects that are waiting to be proposed. Moreover, recent experience with airline incentive programs suggests that capital investments to support use to rail for transporting produce might be combined with other nudges such as traffic guarantees and marketing programs. With public dollars and public planning support, the export of California perishable produce could become more multimodal, more resilient, and more environmentally friendly.

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