6. Modeling Sustainable Trucking Practices

Introduction

Trucking is a major activity in Fontana and the Inland Empire. Fontana's location near the intersection of I-10 and I-15 makes it a major crossroads for long-haul transportation and also a destination for many short-haul trips to the city's logistic and distribution warehouses. Previous chapters described economic benefits of leveraging this industry in Fontana, but there are externalities associated with increased heavy vehicle movement.

This chapter focuses on the air quality impact of trucking in the City of Fontana and the costs and benefits Fontana can expect to see from future electrification of truck fleets. Results from the Southern California Area Government's (SCAG) Heavy-Duty Truck Model (HDTM) are used to identify truck routes and flows in Fontana both now and in the future. The HDTM is then used to develop a model to estimate the particulate matter emissions from trucks in Fontana. This model is used to assess the operating and capital costs of fleet electrification to Fontana-based logistics companies as well as benefits to Fontana residents of investment in electrification strategies for reducing truck emissions.

The results of this analysis are displayed in Figure 6.01. Adoption of electric heavy-duty trucks in Fontana will yield an annual fuel savings of nearly $50,000,000 and a reduction in PM2.5 emissions by over 10,000 lbs per year. Policies to assist in electrification strategies and reduce truck emissions are proposed based on these results.

Figure 6.01: Yearly Modeled Difference in Cost and Local Emissions Based on Conversion to Electric Vehicle Truck Fleet

	2035 No Adoption	2035 EV Adoption	Difference
Average Annual Fuel Equivalent Cost	$ 75,754,583	$ 26,007,295	-34.33%
Local Air Pollution from Trucks (lbs PM2.5 / year)	61,101	49,656	-18.73%

Truck Trips in Fontana

The Ports of Los Angeles and Long Beach handle nearly 17 million twenty-foot equivalent units of intermodal container traffic per year. Over a third of these containers are moved by truck less than 80 miles to the Inland Empire (Yanity, 2019). The City of Fontana is situated by the intersection of the I-10 and I-15 freeways and the Ontario Airport, making it a major destination for transportation logistics and distribution.

Reliance on trucks to power the growing goods industry has unchecked externalities, however. This most noticeably came to national attention in October, 2021 when backups at the Ports highlighted bottlenecks within container transportation and distribution. (TheZvi, 2021). Even when containers were more efficiently stacked there was a shortage of trucks and available warehouse space to move goods out of the Ports in a timely manner. These delays drive up the costs of truck transportation, as do port fees, fuel prices, newer vehicles, and congestion delays. Many of these costs are borne not only by operators in the industry, but also by road users and local residents. Travel times on major thoroughfares are predicted to increase throughout Southern California (Yanity, 2019). And mobile source emissions, specifically diesel trucks, are a significant factor of air pollution that has been linked to accelerating climate change and negative health impacts (see Chapter 5 for more discussion).

We use the Southern California Area Government's (SCAG) Heavy-Duty Truck Model (HDTM) to quantify the impact of trucking on air quality and propose solutions for more sustainable mobility. The HDTM is a travel demand model that has been tested and calibrated to forecast transportation impacts and maintain air quality compliance in the Southern California region ("2016 Regional Travel Demand Model and Model Validation," 2020). It is part of a larger, passenger travel demand model to fully identify not only truck trips but also measure their impact on the existing road network and congestion.

Within the model heavy-duty trucks are classified by their weight and fuel type. We follow the the classification scheme used by the SCAG HDTM in our analyses and define trucks as Light-Heavy (8,500 to 14,000 lbs. gross vehicle weight), Medium-Heavy (14,001 to 33,000 lbs. gross vehicle weight) and Heavy-Heavy (over 33,000 lbs. gross vehicle weight) ("2016 Regional Travel Demand Model and Model Validation," 2020). A more detailed breakdown of these vehicle classes, including fuel efficiency, fleet mix of diesel and gas powered vehicles, and daily vehicle miles traveled can be found in Figure 6.02.

Figure 6.02: Truck Classes in the SCAG HDTM

Vehicle Class	Vehicle Description	Fuel Efficiency (mpg)	Fleet Mix Diesel Power	Vehicle Miles Traveled	
				2021	2030
Light-Heavy	Full-size pick-up trucks, very large passenger vans, panel trucks, small enclosed delivery trucks	8.5	1%	16%	15%
Medium-Heavy	City delivery trucks, rental trucks, single-axle vans, tow trucks, garbage collection trucks	6.0	92%	13%	13%
Heavy-Heavy	Single and double long-haul semi-tractor trailer rigs	6.0	100%	71%	72%
All	-	-	-	263,409	296,480

Source: "2016 Regional Travel Demand Model and Model Validation" 2020; Chambers and Schmitt 2015; Reinhart 2016.

Note: Fleet Mix Diesel Power indicates the share of vehicles that are diesel powered. The remainder are gasoline powered.

Additionally, the HDTM forecasts trips within the following time periods:

- AM Peak: 6:00 AM – 9:00 AM
- Mid-day: 9:00 AM - 3:00 PM
- PM Peak: 3:00 PM - 7:00 PM
- Evening: 7:00 PM – 9:00 PM
- Night: 9:00 PM – 6:00 AM

SCAG used these time periods to calibrate the model to match factors of observed truck movements. For this study the time of day results are aggregated to return daily estimates.

The HDTM is an activity-based model, indicating that it uses disaggregate trip data to predict truck flows through the region. Trips from outside the SCAG region (external trips) are generated and distributed based on supply chain models while those within the region. Internal trips, which represent the majority of vehicle miles in the region, are based on trip rates (number of trips per employee or household) for different land uses/industry sectors (SCAG 2020).

These internal trip rates are described in Figure 6.03, which displays how Light-Heavy trucks are more likely to make trips to individual households while heavier vehicles are more likely to go to warehouses and other transportation/utility land uses. Each distribution model relies on an additional series of gravity models that SCAG developed from GPS surveys.

Figure 6.03: Modeled Truck Trip Rates and Trip Ends within the SCAG Region

Category	Light-Heavy Trip Rate	Medium-Heavy Trip Rate	Heavy-Heavy Trip Rate	Percent of Trip Ends
Households	0.0146	0.0046	0.0072	15%
Agriculture, Mining, and Construction	0.0739	0.0716	0.0658	10%
Retail	0.0667	0.0666	0.0708	16%
Government	0.0301	0.0153	0.0151	2%
Manufacturing	0.0612	0.0654	0.0924	14%
Transportation/Utility	0.153	0.1759	0.31	26%
General Warehouse	0.1436	0.1651	0.2917	3%
High Cube Warehouse	0.1463	0.1682	0.2964	2%
Wholesale	0.0902	0.0954	0.1296	12%
Other	0.0095	0.0111	0.0151	1%

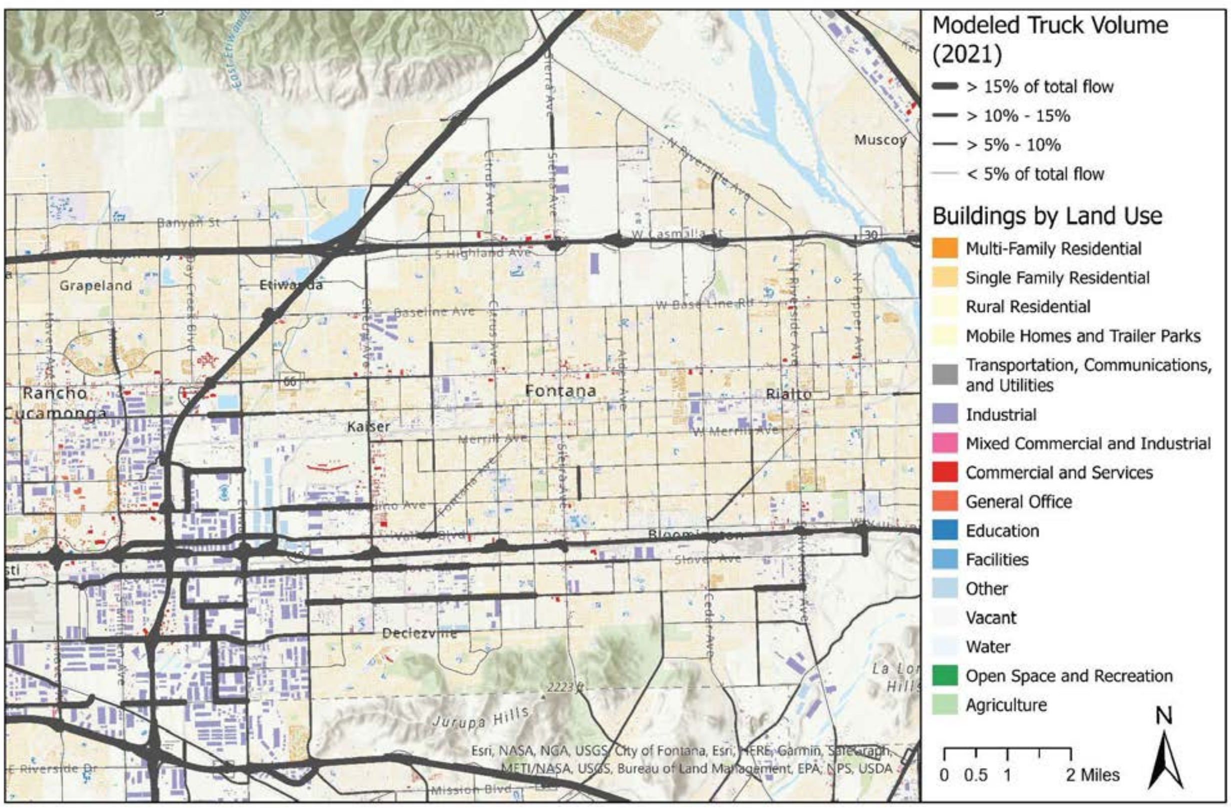
Source: "2016 Regional Travel Demand Model and Model Validation" 2020.

Following trip generation and distribution, truck trips are assigned to the network. As seen in Figure 6.04, the majority of truck movement in Fontana and the surrounding region is on freeways. There is also significant activity on freeway ramps and local access roads near industrial land uses. Most streets within the city of Fontana do not experience as heavy truck traffic as the I-10, I-15, and SR-210 freeways. However, truck movement through the city is present. The City of Fontana has already developed a Truck Route Map to prioritize collector streets that operators should use for travel between freeways and local destinations ("Local Truck Routes" 2004). By following the Truck Route Map there should be fewer emissions near sensitive locations (residential units, educational facilities, etc.), less wear and tear on local roads, and improved safety outcomes for vulnerable road users (see next chapter). However, the process used to identify these routes is unclear and the mechanism forcing operators to adhere to these routes may not be strong enough to maintain compliance (*ARTICLE X. - TRUCK ROUTES Sec. 17-426* n.d.).

The modeled results for the current year (2021) and a future year (2030) were provided on request by SCAG. The shared data included a full geospatial network of the SCAG region with the following factors per road segment, per vehicle class, and per time of day:

- Length (miles)
- Facility type
- Number of lanes
- Posted Speed (miles per hour)
- Free-flow Travel Time (minutes)
- Congested Travel Time (minutes)
- Flow (number of vehicles)

Figure 6.04: Modeled Truck Volumes in Fontana and Surrounding Areas



Source: Author generated from data provided by SCAG.

Using these results we calculated the speed of congested traffic and vehicle miles traveled within the SCAG region, and more specifically within the City of Fontana. These metrics were used to estimate particulate matter emissions from heavy-duty vehicles.

Estimated Particulate Matter from Heavy-Duty Trucks

Trucks are responsible for a range of different pollutants, including both greenhouse gasses and particle emissions. Although all have adverse impacts, we focus specifically on PM2.5 in this study. We do this for two reasons. First is the significant role it plays in public health, described in detail in the environmental chapter. Second, is because PM2.5 can be traced directly to a source, such as a construction site, fire, or heavy-duty diesel truck.[1] This means that PM2.5 represents pollution that has significant localized impacts to Fontana and the contribution of this pollution from trucking can be quantified with reasonable accuracy. Therefore, PM2.5 emissions provide the best indication of how the trucking industry could be impacting communities in Fontana. On the same token, it acts as a good metric for quantifying the benefits Fontana could see from electrification over the coming years.

There are already regional mandates to curtail the air quality impacts of trucking. The California Air Resources Board's (CARB) Advanced Clean Trucks rule is designed to help California move towards an electrified, zero-emission truck fleet. To reach state emissions goals truck sales for Light-Heavy, Medium-Heavy, and Heavy-Heavy classes will be required to be electric (see Chapter 2). The South Coast Air Quality Management District's (SCAQMD) more recent Warehouse Indirect Source Rule (Rule 2305), requires warehouses larger than 100,000 square feet to reduce diesel particulate matter emissions both onsite and from heavy-duty trucks that originate at these locations (South Coast Air Quality Management District 2021). Facility operators can move into compliance by completing actions such as increasing solar panels, building zero-emissions charging, and replacing internal combustion engine vehicles (both on-site and on-road) to zero-emissions or near-zero emissions (see Chapter 2).

Major operators in the Inland Empire are also independently working to phase electric vehicles into trucking fleets. In this study we focus specifically on the Port of Long Beach's Clean Air Action Plan (Starcrest Consulting Group, LLC 2021), which established in 2017 a goal of transitioning on-road trucks to zero-emissions by 2035. In meeting this goal they set

[1] Note that tailpipe emissions are not the only particle emissions trucks give off. Particulate matter from tire deterioration, breaks, and other mechanical parts of the vehicles contribute to impact of these vehicles as well. However, we are not considering them here because we expect them to remain relatively constant between EVs and traditional trucks.

out an implementation timeline based on the zero-emissions vehicles sales target mandated by CARB's Advanced Clean Truck regulation.

Methodology

We developed scenarios to calculate total emissions for both the current trucking activity with an entirely traditional fleet (assuming all internal combustion engines (ICE)) and in the future with some degree of electrification. To do this, we used the same base equation, changing the inputs for each scenario. The equation is as follows:

$$Total\ PM\ 2.5 = \sum_{\substack{road\\segment}} \sum_{\substack{truck\\class}} \sum_{\substack{time\\period}} \sum_{\substack{fuel\\type}} VMT * emission\,rate_{fuel} * percent\ fuel * speed\ factor * EV\ Factor$$

Where:

- VMT is the total vehicle miles traveled for a particular truck class, road segment, time period, and fuel type
- Emission rate (g/mile) is the PM2.5 rate for a given fuel type (diesel or gasoline) and vehicle class
- Percent fuel is the percentage of trucks for a particular vehicle class that use that fuel
- Speed factor is an adjustment factor of emissions based on the average speed of vehicles for a segment and time period
- EV factor is the percentage of trucks projected to be EV for a given truck class (zero in the base scenario where no trucks are EV).

The vehicle miles traveled (VMT) were calculated directly from the SCAG HDTM. Each road segment contains a length (in miles) and a value for the number of vehicles that flowed on it over a time period. The road length and the vehicles were multiplied together to identify the VMT.

The emission rates are identified in Figure 6.05, which summarizes the PM2.5 emissions in grams per mile from each class of vehicle. The values of percent diesel and percent gas are the split of vehicles per class that operate on diesel and gas power. These unitless values are defined in Figure 6.02 in the column Fleet Mix Diesel Powered, where only 1% of Light-Heavy trucks are diesel powered, while 92% of Medium-Heavy and 100% of Heavy-Heavy trucks are diesel powered.

The speed factor is another unitless parameter that scales the emission rates based on the speed of the vehicle. A study by Outapa, Kondo, and Thepanondh (2016) demonstrated that vehicles emit more particulate matter at slower speeds, so we use their speed factor to scale the emissions rate based on the SCAG HDTM modeled average speed. As seen in Figure 6.06, vehicles traveling at free-flow emit the base level of PM2.5, while vehicles traveling at slower speeds emit up to 55% more particulate matter.

Figure 6.05: Emissions Rates (in grams per mile) for Heavy-Duty Vehicles

Pollutant	Fuel	Light-Heavy	Medium-Heavy	Heavy-Heavy
VOC	gas	1.510	3.050	3.628
	diesel	0.195	0.339	0.500
CO	gas	13.515	23.720	28.560
	diesel	0.874	1.360	2.752
NOX	gas	2.827	3.929	4.892
	diesel	3.243	5.590	10.091
PM2.5	gas	0.044	0.049	0.049
	diesel	0.082	0.129	0.227
PM10	gas	0.050	0.060	0.061
	diesel	0.089	0.140	0.246

Source: “Average In-Use Emissions from Heavy-Duty Trucks”, 2008.

Figure 6.06: Speed Factors for PM2.5 Emissions

Speed (mph)	0 - 12	12 - 19	19 - 25	25 - 31	31 - 37	37 - 44	44 - 50	> 50
PM2.5 Scale Factor	1.554	1.394	1.219	1.131	1.079	1.044	1.018	1.000

Source: Outapa, Kondo, and Thepanondh, 2016.

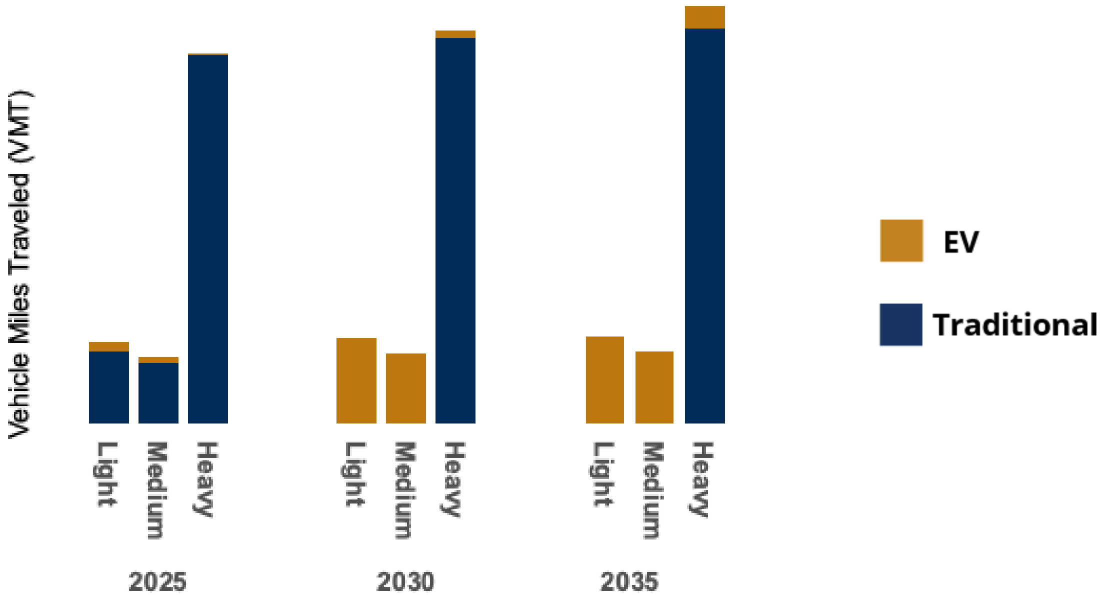
The last parameter is the EV factor, which is a unitless percentage that determines how many vehicle miles in the EV adoption scenario are traveled with no-emission electric vehicles, thereby reducing the total PM2.5 emissions. For the base scenario, this value is 1, as we assume there are no additional EV vehicles replacing existing vehicles in the truck fleet. For the EV adoption scenario we assumed the following: in 2025 an additional 3% of the fleet will be electric, in 2030 an additional 30% of the fleet will be electric, and in 2035 an additional 90% of the fleet will be electric. These adoption rates come from the Port of Long Beach Electrification Plan, which states that these benchmarks need to be reached in order to perform operations within an environmentally sustainable regime. (Starcrest Consulting Group, LLC 2021). Additionally, we note that the adoption rate for electric trucks is not equal across vehicle classes. Currently, the technology for electrification of Heavy-Heavy trucks does not exist, so their conversion to more sustainable power will be slower than that of Light-Heavy trucks (Smith et al. 2020). Thus, we assume that by 2030 the electric adoption rate for Light-Heavy trucks will be 25%, for Medium-Heavy trucks will be 18%, and for Heavy-Heavy trucks will be 2% (Heid et al. 2017). We assume this growth will be exponential because of the immense investment within the trucking industry and the external pressure from mandates such as the Port of Long Beach Electrification Plan, Executive Order N-79-20 (a mandate that all ports move to zero-emission drayage fleets by 2035), and California's Advanced Clean Trucks (ACT) regulation.

Scenarios

We developed two scenarios to test PM2.5 emissions reductions from electric vehicle adoption. For each scenario we modeled emissions in the years 2025, 2030, and 2035. For each scenario the results are compared against a Base Scenario where there is no adoption and all vehicle miles traveled are by traditional ICE trucks. The first scenario is the EV Adoption Scenario, where electric trucks are adopted at the existing ratios per vehicle class (Heid et al. 2017) in an attempt to meet the 3%, 30%, and 90% targets set by the Port of Long Beach. However, as seen by Figure 6.07, the current market prediction for Heavy-Heavy truck adoption will not reach the necessary thresholds to meet the Port's targets. By 2030 only 28.8% of all heavy-duty trucks will be electric, and by 2035 there is only a slight increase to 31.9%.

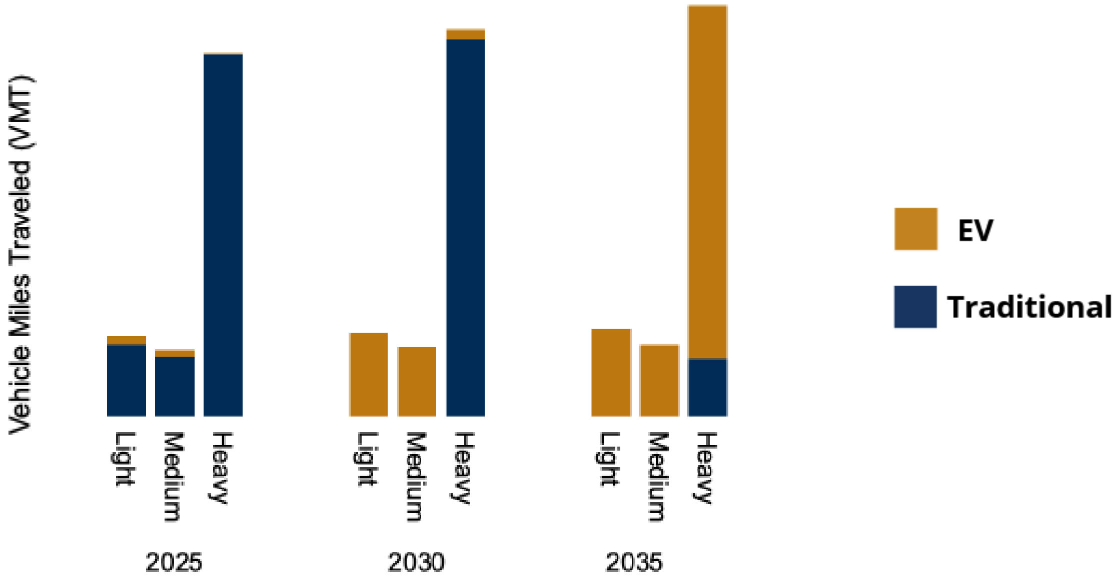
The second scenario, the Advanced EV Adoption Scenario, tests the impacts of increased investment in Heavy-Heavy truck electrification. To meet the 2035 target set by the Port of Long Beach it would require 62% of Heavy-Heavy trucks to electrify (Figure 6.08). As displayed in Figures 6.02, 6.07, and 6.08, the Heavy-Heavy truck class represents the greatest share of vehicle miles traveled on the road, and as displayed in Figure 6.03, is the heaviest emitter of PM2.5 amongst the truck classes. Therefore, in this scenario we assume there is market intervention to increase the share of Heavy-Heavy electric vehicles and meet the Port of Long Beach's adoption targets.

Figure 6.07: Vehicle Miles Traveled by Weight Class (No Market Intervention)



Source: SCAG HDTM; Heid et al. 2017; "Fueling the Future Fleet: Assessment of Public Truck Charging and Fueling Near the Port of Long Beach" 2021.

Figure 6.08: Vehicle Miles Traveled by Weight Class (Market Action Taken)



Source: SCAG HDTM; Heid et al. 2017; "Fueling the Future Fleet: Assessment of Public Truck Charging and Fueling Near the Port of Long Beach" 2021.

Results

The emissions reductions from the EV Adoption Scenario and the Advanced EV Adoption Scenario, compared to the Base Scenario with all traditional ICE trucks, can be seen in Figure 6.09. Without intervention there will be reductions in PM2.5 emissions, assuming electric vehicles are adopted at market rates. Reductions in emissions from electric truck adoption will overcome any increased emissions that occur from growth in vehicle miles traveled (the SCAG HDTM assumes increased travel demand in the future). However, emissions reductions will be significantly improved if market intervention occurs to increase the adoption of Heavy-Heavy electric trucks

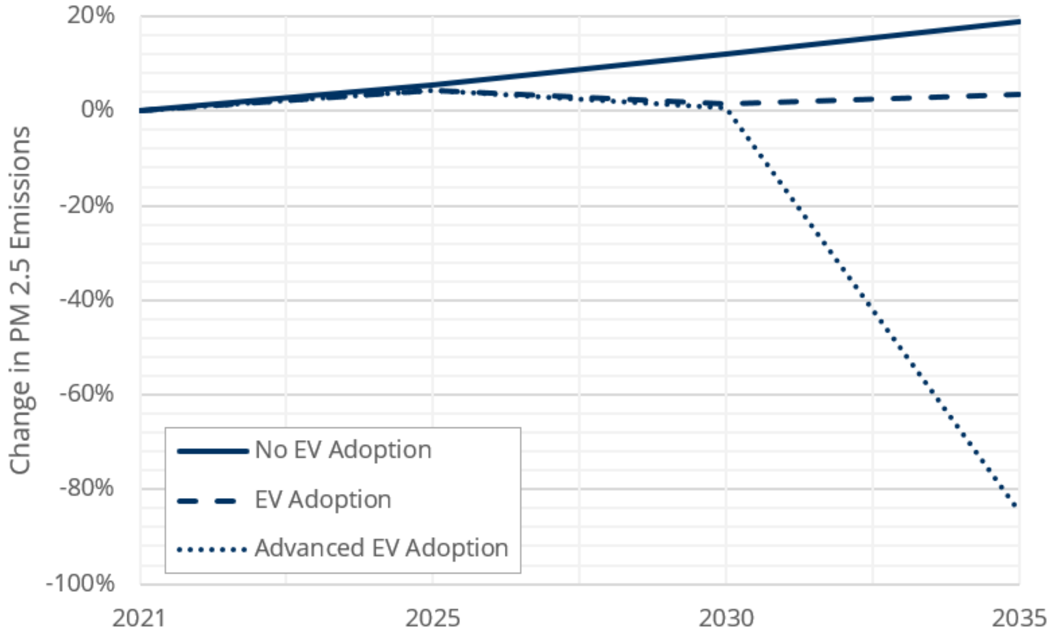
Figure 6.09: Modeled PM2.5 Emissions Reductions from Heavy-Duty Vehicles

Vehicle Class	EV ADOPTION PM2.5 Emissions Reduction			ADVANCED EV ADOPTION PM2.5 Emissions Reduction		
	2025	2030	2035	2025	2030	2035
Light-Heavy	11%	100%	100%	11%	100%	100%
Medium-Heavy	9%	94%	100%	9%	100%	100%
Heavy-Heavy	0%	2%	6%	0%	2%	86%
All	1%	9%	13%	1%	10%	87%

Source: Author generated from data provided by SCAG. The base scenario assumes linear growth of vehicle miles traveled and no adoption of electric vehicles. The EV adoption scenario takes the base scenario values, but with adoption rates of electric vehicles in 2025 (3%), 2030 (30%), and 2035 (90%).

This data is displayed again in Figure 6.10 to highlight the importance of Heavy-Heavy truck emissions mitigation. The prioritization of Heavy-Heavy electric vehicles leads to a significant decrease in PM2.5 emissions. The overwhelming majority of PM2.5 emissions are from Heavy-Heavy vehicles. This is partly because these trucks have the most vehicle miles traveled in Fontana but also due to the higher particulate matter emissions rates and slower speeds of these vehicles. Slower adoption of these electric vehicles limits the total impact of emissions reduction.

Figure 6.10: Modeled PM2.5 Emissions From All Heavy Trucks



Source: Author generated from data provided by SCAG. The solid line represents a scenario with no EV adoption, while the dashed lines indicate different EV adoption scenarios.

Electric Conversion Cost Analysis

One of the largest expenditures for traditional trucks is the annual cost of fuel. The following cost analysis shows that by converting to electric trucks, money will be saved in terms of fuel costs.

To estimate the capital and operational expenditures for both traditional and battery-electric trucks several assumptions needed to be made. Our assumptions for the basic cost values are summarized in Figure 6.11. For the purpose of this study, we assume the cost to invest in new trucks to be negligible, and set the value to $0.00. There is a lot of uncertainty in estimating the projected price of fuel, but the price of diesel tends to stay between $3.00 and $4.00 annually (AAA 2021). Also for the purpose of this study, we chose the most recent annual average from 2020 of $3.35. The estimated fuel economy is an estimated average of 6.5 miles per gallon (Williams, n.d.).

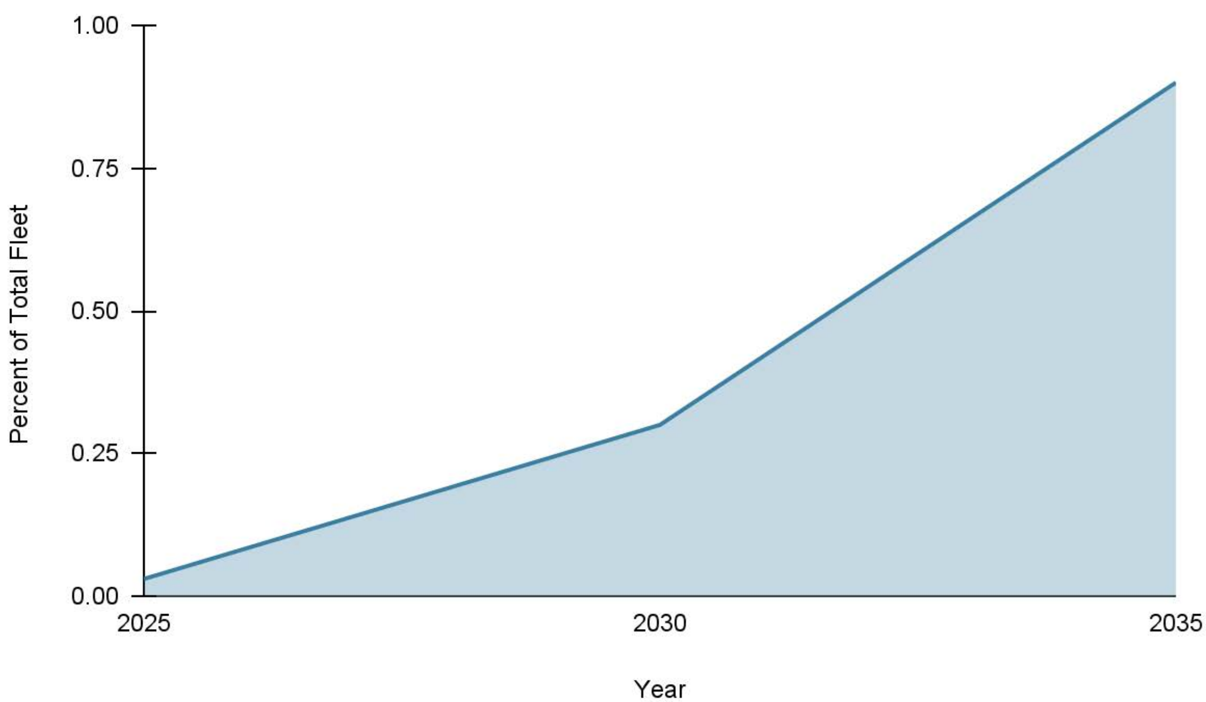
Figure 6.12 is for visualizing the EV adoption rates from Figure 6.07 and 6.08, based on the POLB (Starcrest Consulting Group, LLC 2021) study and projected adoption rates by truck class. These rates were also used to estimate the VMT for potential electric trucks shown in Figure 6.13.

Figure 6.11: Traditional Truck Cost Assumptions

Traditional Truck Cost	$ 0.00
Diesel Fuel (2021 USD/gal)	$ 3.35
Diesel Fuel Economy[1] (miles per equivalent gallon)	6.5

Source: Author generated $0 truck cost as an assumption. Diesel fuel cost from AAA Gas Prices, 2021. Fuel economy estimate from (Williams, n.d.)

Figure 6.12: EV Adoption Rates



Source: "Fueling the Future Fleet, 2021.

We used the SCAG travel model to estimate VMT for trucks in Fontana for 2021 and 2030. With this model we also estimated annual VMT for battery-electric trucks for the years 2025, 2030, and 2035, as summarized in Figures 6.07 and 6.08. These EV adoption rates were used to estimate the daily VMT for the projected EV fleets based on the POLB (Starcrest Consulting Group, LLC 2021) study.

In order to estimate the capital and operational costs of electric trucks, we needed to find a mile per gallon equivalent for electricity consumption by truck class. A study estimated the per truck capital cost for electrification as well as the fuel economy in equivalent miles per gallon (Vijayagopal and Rousseau 2021). Figure 6.13 summarizes those estimates to be used for the average annual fuel costs in our study.

Figure 6.13: Traditional and Battery Electric Truck Assumptions Summary Table

	Light	Medium	Heavy
Estimated Purchase Price	$ 151,900	$ 396,500	$ 500,000
Fuel Economy (miles per gallon equivalent)		18.9	

Source: Vijayagopal and Rousseau 2021.

Another significant investment that will need to be made for truck electrification to be feasible is the purchase and installation of chargers. Current estimates suggest an average capital cost of $82,000 per DC Fast Charger (Nicholas 2019). For simplicity, we assumed all of Fontana's possible truck fleets would charge overnight, summarized in Figure 6.14. This is a rough estimate, but studies indicate that there are several different strategies that can be implemented to reduce the required number of chargers required (Furnari et al. n.d.).

Figure 6.14: Total Truck Charger Infrastructure Investment by Year

Year	Projected Fleet Size	Capital Cost
2025	229	$ 18,742,867
2030	2,062	$ 168,685,807
2035	4,811	$ 393,600,216
Average Annual Capital Cost		**$ 581,028,891**

To estimate the annual cost of fuel the equation below was applied. We then took the average of the three vehicle classes to find the average annual cost of fuel, as summarized in Figure 6.15. A similar process was used for battery-electric trucks, but using the fuel economy equivalents instead.

$$Annual\,Cost = Fuel\,Cost * \frac{Daily\,VMT}{Fuel\,Economy} * 365\,days$$

Figure 6.15: Projected Capital and Operating Expenses for Traditional and Electric Trucks

	Traditional Trucks	Electric Trucks
Average Annual Capital Expenditures until 2035 (2021 USD)	$ 0	$ 204,436,459
Average Annual Fuel Equivalent Cost (2021 USD)	$ 75,754,583	$ 26,007,295*

*Annual fuel and charger equivalent cost at 90%

Although the initial investment until 2035 for adopting electric vehicles is high, that value would essentially go to $0, as significant additional capital investment for new trucks won't be necessary once 90% of the fleet is converted. It is also still less than the average annual fuel expenditures for traditional trucks.

Policy Recommendations

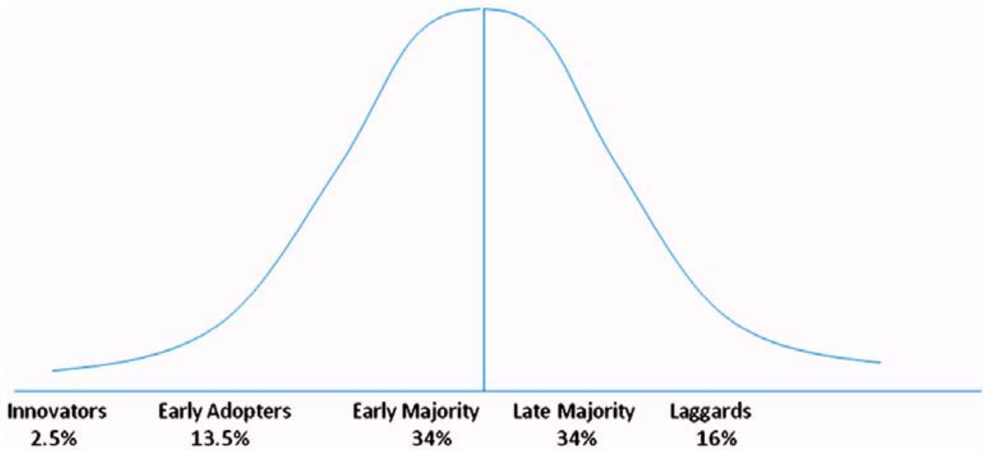
From this analysis, there are a number of policy recommendations to be made for the City of Fontana to help maximize their benefit from an electrifying truck fleet mix.

Recommendation 6.1: Incentivize Heavy-Heavy truck fleet conversion

A large part of our findings point to the importance of electrifying heavy trucks over 33,000 lbs. gross vehicle weight. This size category, Heavy-Heavy, makes up the largest percentage of vehicle miles travelled for trucks in Fontana, and thus an outsized proportion of the PM2.5 emissions as well. However, technical limitations make this size category the slowest for companies to adopt into their fleets (Smith et al. 2020; Heid et al. 2017). Any technology will have innovators and early adopters who take on the technology before the majority of the customer base, as shown in Figure 6.16.

Incentivizing current Fontana-based companies to convert these fleets more quickly, as well as attracting logistics companies that are already willing to be innovators and early adopters in this change, would have an outsized benefit to the health and well-being of residents of the City. Companies partnered with CALSTART, a leading organization seeking to ensure an efficient and effective transition to electric freight vehicles, would be a good place to begin when looking for companies willing to collaborate on this issue. These include numerous major manufacturers and logistics companies (Heartquist n.d.).

Figure 6.16: Adoption Curves for New Technologies



Source: Rogers 1983.

Recommendation 6.2: Leave charger allocation to be addressed by the private sector
The range capability of the trucks mean that optimizing specific charging locations will be less important. Generally current truck stop locations should be able to transition to electric charging services without significant impacts to efficiency, particularly when on-demand charging becomes more comparable to traditional fuels in terms of recharging times. However, a number of points should be taken into account when considering the future of charging infrastructure in Fontana. One is the benefit of slower overnight charging. Electric charging will place strains on the electricity infrastructure in any case, but the instantaneous load is reduced by ensuring as much of the charging as possible is done more slowly and at off-peak hours (Mao, Zhang, and Zhou 2019). Ensuring that Fontana-based logistics companies are preparing to add this infrastructure to their sites will be a useful step in minimizing the impact on the utilities systems. This is particularly important in the short-term, as on-demand charging times are currently too long to be practical. However, in the future it will be critical to support on-demand charging to provide service for the nearly one third of trucks that are independently owned and do not have a home yard (Starcrest Consulting Group, LLC 2021).

A second point to consider is ensuring the long-term vitality of Fontana's truck stops. This will be reinforced by the rapid and smooth adoption of these types of charging stations at their locations, which could encourage the continued overnight use of these businesses by truckers into the coming decades. Providing support through providing adequate infrastructure and policy to meet the changing needs of these companies will be important and the transition to zero-emission vehicles begins.

Recommendation 6.3: Engage with community to identify an updated network of truck routes

Establishing a new network of truck routes is essential to mitigating the impacts of diesel particulate emissions within Fontana. The City may not have control over the thousands of trucks that pass through Fontana each day on I-10 and I-15, but it can restrict the exposure of its residents to the vehicles that do travel to and from logistics centers in the City.

The City of Fontana's existing truck route designates specific streets that heavy-duty vehicles can travel on to access the freeway from logistics centers (City of Fontana 2004). However, this map does not appear to have been updated since 2004 and it is unclear how these routes were originally identified by the City. A more recent version of the Truck Routes Map was provided directly by the City, but was not publicly accessible online. Additionally, enforcement of the routes as dictated by the current City ordinance and by the proposed Industrial Commerce Center Sustainability Standards Ordinance does not appear strong enough to hold facility operators accountable for improper truck movements (City of Fontana 2004) (see Chapter 3).

A strong model for developing an improved truck routing map comes from the work done by the City of Oakland and the Port of Oakland (City of Oakland and Port of Oakland 2019). The West Oakland Truck Management Plan (TMP) was approved in 2019 following almost two years of extensive public engagement. Stakeholder participation was included from the start of the planning process, allowing West Oakland residents to envision and comment on scenarios and solutions. This engagement was essential for City and Port staff to identify areas of concern and best prioritize where to focus reducing disruptions from truck circulation and parking.

The TMP also outlined a five year implementation schedule which directly assigns activities, including enforcement, to the City of Oakland and the Port of Oakland. Many of the proposed strategies for truck routing are similar to those proposed by the City of Fontana in the Industrial Commerce Center Sustainability Standards Ordinance, including improved route signage and updated parking regulations. However, the City and Port of Oakland acknowledge that full operation will require active oversight and activity, not just reliance on facility operator compliance. Required strategies for truck routing also includes:

- Improved training for issuing tickets, including consideration of increase fees
- Conducting traffic enforcement spot-checks
- Using urban design to promote use of truck routes

For each task the TMP outlines the expected goals, which can then feed back to the community engagement process to further hold the City and the Port accountable.

The City of Fontana should also engage in critical public engagement when redesigning their truck route map. Similar to the TMP, this should start before any plans are made to collect community input, and continue through plan adoption and implementation. This can include:

- Developing period briefings to key Community Based Organizations
- Publishing annual reports and regular updates on the status of the truck route map and facility operator compliance with regulations
- Continuous outreach to truck drivers to educate them on new regulations and obtain feedback on implementation

Recommendation 6.4: Focus on regional problems and solutions through a "Future Fleet Fontana" incubator

A major consideration in addressing pollution is the regional nature of the problem. A significant portion of the VMT in Fontana comes from trucks passing through that are owned by companies and individuals based outside Fontana. As mentioned above, actors in the LA and Inland Empire areas already exist that are seeking to address electrification. Fontana should seek to advocate for itself at the regional level and position itself as an innovator in this space in order to maintain a competitive advantage moving forward and ensure the well-being of its community. Forming an incubator to look specifically into positioning Fontana as a regional leader in clean air and electrification could be an effective step to take moving forward. We propose calling this incubator “Future Fleet Fontana.” Identifying Fontana’s needs, resources, community feedback, and value adds and organizing these materials to engage with regional partners and raise funds are critical steps that could benefit from a dedicated initiative on the part of the City.

Current regional initiatives to be aware of include the Port of LA and Long Beach’s drayage electrification plans, SCAG’s study into the infrastructure needs to zero-emissions technologies, and the Los Angeles Clean Tech Incubator, which is looking to identify potential electric heavy truck charging locations in the area around the Ports (Starcrest Consulting Group, LLC 2021). They are looking into funding and business models to help ensure zero-emissions trucking is financially feasible for relevant stakeholders as well. These plans generally involve a plethora of partnering organizations and represent spaces Fontana could become involved in.

Recommendation 6.5: Capitalize on federal and state funding sources for electrification

The City of Fontana does not have to rely entirely on its own budget to plan for truck electrification and emissions reduction. There are federal and state funding sources to assist in electrification, as shown in Figure 6.17. The City should develop applications to one or multiple of the following sources to capitalize on the resources available for completing work that is in the best interest of the City.

If these funding sources cannot be accessed by the City, Fontana should encourage and work with private companies who are interested in electrification. Some smaller logistics facility operators may not be aware of these opportunities and the City can serve as a liaison for accessing and utilizing this funding.

Figure 6.17: Federal and state funding sources for truck electrification

Name	Description
Diesel Emissions Reduction Act (DERA)	The federal Environmental Protection Agency (EPA) has an annual budget up to $100 million earmarked for diesel emissions reductions. Grant awardees have used the funding to electrify trucks, buy zero-emission school buses, and install electric charging parking spaces.
Low or No Emissions Vehicle Program (Low-No)	A competitive grant that funds state and local purchase or lease of zero-emission and low-emission transit buses and supporting facilities. Although city transit is not a major source of emissions, electrification of these heavy-duty vehicles could be a good image for the City as it pursues bigger emissions reductions strategies.
Truck Loan Assistance Program	Provides financing for small-business fleet owners (10 or fewer trucks) to upgrade their fleets with newer trucks. This loan can overcome potential issues of high adoption costs for smaller operators and can be particularly beneficial for local Fontana businesses.
Hybrid & Zero-Emission Truck &	Makes purchases of zero-emission and near-zero-emission vehicles more affordable by providing point-of-sale vouchers. A strong program for the

Bus Voucher Incentive Project (HVIP)	City of Fontana, small facility operators, and even organizations outside of the industry (i.e. a church shuttle bus).
Carl Moyer Program	An air quality standards attainment program that can contribute to advancement of zero and near-zero emissions truck adoption.
Volkswagen Environmental Mitigation Trust	Funding provided by Volkswagen to mitigate excess NOX caused by the company's illegal emissions testing defeat devices. The trust has $423 million available, much on a first-come-first-serve basis, that includes funding for zero-emission Heavy-Heavy trucks, school buses, and vehicle infrastructure (charging stations).

Recommendation 6.6: Invest in and promote alternative solutions

As mentioned above, our findings show significant harmful emissions continuing throughout the transition to zero emissions trucking fleets, and this is without accounting for emissions caused by private vehicles. Based on this, it is our recommendation not to rely solely on technological innovation to address this issue. We have compiled a number of additional solutions that can be considered to reduce emissions. While many of these are beyond the scope of the research we have performed on Fontana specifically, they have been extensively studied at the industry level and thus are included here.

- **Further reducing truck idling is a straightforward and effective way of reducing emissions already being acted upon by the City.** The Industrial Commerce Center Sustainability Standards Ordinance proposal reducing the idling time cap to 3 minutes is a very clear move in the right direction. Ensuring that drivers are in compliance will be a key factor in ensuring the efficacy of these regulations. Due to the difficulty of enforcement, changing driver behavior and "culture" around idling is crucial to the success of these programs. The signage required by the ordinance is a good place to start, however studies show that going beyond this to increase the number of instances drivers are reminded of these policies are consistently more effective at further reducing idling. This includes stickers, "leakage" (i.e. word of mouth, peer pressure, etc), and workshops and outreach.
- Urban trees have been noted as a potential solution to the ill effects of emissions. However, a meta-analysis of research in this area reveals there is not a straightforward relationship between urban trees, air quality, and respiratory health (Eisenman et al. 2019). Urban vegetation's ability to mitigate PM emissions depends on complex interactions of a variety of variables. Depending on particular locations, densities of vegetation, wind conditions, and so forth, urban trees can potentially

exacerbate air quality problems, or simply move them from one location to another. Beyond this, issues related to pollen from the trees themselves can have health implications as well. The ultimate findings of the meta-analysis are that the best way to mitigate emissions is to reduce their production. **While urban trees may have a variety of uses, there is not consistent evidence to suggest reducing air quality related illness is one of them.** City of Fontana beautification strategies or efforts to reduce heat island effects could still rely on trees (Hamstead and Coseo 2020), but their placement along truck routes does not appear to have a significant (or possibly even beneficial) impact.

- **Road pricing is another incredibly important tool for mitigating system-wide emissions in the Inland Empire.** SCAG has studied strategies for road pricing extensively and found it to be an important aspect of addressing the region's emissions, transportation performance problems, and transportation funding gaps (SCAG n.d.). While implementation would generally be at the regional level, Fontana should seek to become involved to the greatest extent possible in initiatives like this around implementing these strategies. Fontana bears much of the externalized costs associated with congested traffic in the Inland Empire, and this is one of the most promising ways of addressing these externalities as well as providing opportunities for Fontana to begin recouping the outsized costs it has been bearing.
- **Although trucks are the dominant mode in Southern California, investment in short-haul, intermodal freight rail may be the best solution to eliminating emissions from the transportation logistics industry.** Rail has an inherent energy efficiency advantage over trucks, requiring between a third and a fifth of the energy per ton-mile compared to trucking. While this carries obvious emissions advantages, it will remain relevant post-electrification as a way of reducing strain on the power grid. It also has the advantage of addressing the growing congestion problems in the Inland Empire. Several studies, including current interest from the Port of Long Beach and the Port of Los Angeles, have determined that freight rail is operationally feasible and efficient (Yanity 2019). However, it is not yet cost-effective. The main rail operators in the region (UP and BNSF) make their profits from long-haul trains and have historically not invested in this space. As projects like the Alameda Corridor discuss potential expansion and capital investments sponsored by the proposed Build Back Better Plan are planned, these regional solutions could use support from cities that are also invested in goods movement.

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