

APPENDIX A

ECONOMIC ANALYSIS

FOR THE

PROPOSED 2016 STATE

STRATEGY FOR THE

STATE IMPLEMENTATION

PLAN

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Introduction

The economic analysis of the Proposed 2016 State Strategy for the State Implementation Plan (State SIP Strategy) includes the estimated Statewide costs and benefits of all proposed measures through 2031. While this section focuses on the direct costs and benefits of the State SIP Strategy, a full macroeconomic analysis is included in the Mobile Source Strategy¹ which was released on May 16, 2016.

The economic analysis of the State SIP Strategy includes the estimated Statewide costs and benefits of all proposed measures under State and federal jurisdiction, including those affecting passenger vehicles, heavy-duty trucks, locomotives, commercial ships, equipment used for goods movement, construction and mining, fuels, and consumer products. The combination of measures is designed to provide a pathway to attain ozone and fine particulate matter (PM2.5) standards, support regulatory efforts to set new engine standards, ensure equipment durability, increase zero-emission vehicle penetration, establish cleaner fuel requirements, and expedite the deployment of cleaner technologies, primarily through incentive funding. It is important to note that the total Statewide costs reflected in this section represent cumulative costs incurred through 2031 with individual measures implemented from 2016 through 2031.

The proposed State SIP Strategy measures will result in reduced emissions of oxides of nitrogen (NOx), reactive organic gases (ROG), and PM2.5. As outlined in the Mobile Source Strategy, the proposed State SIP Strategy measures will also help achieve the goals of on-going planning efforts, including California's Climate Change Scoping Plan, the Short Lived Climate Pollutant Plan, and the California Sustainable Freight Action Plan.

¹ The macroeconomic analysis for the Mobile Source Strategy will include all measures in the State SIP Strategy that claim emission reductions, with the exception of the Consumer Products measure which is not considered a mobile source measure. The Mobile Source Strategy is available at: <http://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.htm>

Benefits

The State SIP Strategy is anticipated to deliver Statewide environmental benefits that include estimated emission reductions of 206 tons per day (tpd) of NO_x, 87 tpd ROG, and 2 tpd PM_{2.5} in 2031. In addition to the primary criteria emission reduction benefits, the State SIP Strategy is also anticipated to result in co-benefit reductions of greenhouse gases (GHG). Table 1 presents the anticipated emission reductions benefits of the State SIP Strategy. The investments made to deploy cleaner technology vehicles, equipment, and fuels under the State SIP Strategy will also provide broad social and health benefits to Californians, including fewer illnesses and reduced medical expenses, fewer lost work and school days, and reduced impacts on California ecosystems. These important benefits, while potentially economically significant, are not quantified in this analysis.

The benefits achieved through the State SIP Strategy are part of California's comprehensive strategy to achieve lasting emissions reductions in the mobile source sector. ARB's strategic vision for the sector is based on the principle that economic prosperity and environmental sustainability can be achieved together. Undertaking the transformative actions outlined in the State SIP Strategy will continue California's long and successful legacy of building a world-class economy in concert with innovative and effective environmental and public health policies. Innovations in clean vehicles, fuels, and equipment provide an opportunity for California to continue to leverage its position as a leader in the high-tech, green economy resulting in deep emissions reductions across the state.

Proposed measures in the State SIP Strategy may also result in emission reductions outside of California as vehicles and equipment subject to the proposed measures may also operate outside the State. These emission reductions, and any resulting benefits, including those to human and ecosystem health, are not quantified in this analysis. The emission reductions presented in Table 1 account for the estimated emission reduction benefits to California as a result of implementing the State SIP Strategy.

Table 1: Statewide Emission Reduction Benefits

Proposed Measure	2031			
	NOx (tpd)	ROG (tpd)	PM2.5 (tpd)	GHG (MMTCO2e)
On-Road Light-Duty				
Advanced Clean Cars 2	2	0.8	<0.1	7
Lower In-Use Emission Performance Assessment	NYQ	NYQ	NYQ	NYQ
Further Deployment of Cleaner Technologies	5	16	<0.1	5
Total Category Reductions	7	17	<0.1	12
On-Road Heavy-Duty				
Lower In-Use Emission Performance Level	NYQ	NYQ	NYQ	NYQ
Low-NOx Engine Standard – California Action	24	--	--	--
Low-NOx Engine Standard – Federal Action	28	--	--	--
Medium and Heavy-Duty GHG Phase 2	NYQ	NYQ	NYQ	6
Advanced Clean Transit	0.5	<0.1	<0.1	0.3
Last Mile Delivery	1	<0.1	<0.1	0.4
Innovative Technology Certification Flexibility	NYQ	NYQ	NYQ	NYQ
Zero-Emission Airport Shuttle Buses	NYQ	NYQ	NYQ	NYQ
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles	3	0.4	--	<0.1
Further Deployment of Cleaner Technologies	11	1	--	0.3
Total Category Reductions	68	2	<0.1	7
Off-Road Federal and International Sources*				
More Stringent National Locomotive Emission Standards	44	2	0.7	NYQ
Tier 4 Vessel Standards	25	--	--	--
Incentivize Low Emission Efficient Ship Visits	NYQ	NYQ	NYQ	NYQ
At-Berth Regulation Amendments	1	0.1	<0.1	0.1
Further Deployment of Cleaner Technologies	38	NYQ	NYQ	NYQ
Total Category Reductions	108	2	0.7	0.1
Off-Road Equipment				
Zero-Emission Off-Road Forklift Regulation Phase 1	2	0.2	<0.1	1
Zero-Emission Off-Road Emission Reduction Assessment	NYQ	NYQ	NYQ	NYQ
Zero-Emission Off-Road Worksite Emission Reduction Assessment	NYQ	NYQ	NYQ	NYQ
Zero-Emission Airport Ground Support Equipment	<0.1	<0.1	<0.1	<0.1
Small Off-Road Engines	4	36	<0.1	<0.1
Transport Refrigeration Units Used for Cold Storage	NYQ	NYQ	NYQ	NYQ
Low-Emission Diesel Requirement	8	NYQ	1	NYQ
Further Deployment of Cleaner Technologies	17	20	NYQ	NYQ
Total Category Reductions	31	56	1	1
Consumer Products				
Consumer Products Program	--	10	--	--
Total Category Reductions	--	10	--	--
Total Expected Emission Reductions	206	87	2	20

* Quantification of emission reductions are based on current growth forecasts, which are undergoing review.

Vision Model Assumptions

A key component in estimating the economic impact of the State SIP Strategy is the change in the composition of the vehicle fleet over time. Vision 2.1², a comprehensive modeling tool for analyzing both upstream and downstream emissions specific to mobile sectors and fuel production activity, is used to estimate turnover such that the emissions profile of the future fleet of light-duty vehicles, heavy-duty vehicles, locomotives, ships, and off-road vehicles will achieve the goals of the State SIP Strategy. The most recent version of Vision, Version 2.1, incorporates updated ARB inventory work, including EMFAC2014³, and reflects currently adopted policies. Vision model assumptions utilized for estimating emission reductions are outlined in Table 2.

² Vision Scenario Planning <http://www.arb.ca.gov/planning/vision/vision.htm>

³ Mobile Source Emissions Inventory: <http://www.arb.ca.gov/msei/categories.htm>

Table 2: Vision Assumptions

Measure	Assumptions
On-Road Light-Duty	
Advanced Clean Cars 2	<p>Assumed combined LDA/LDT2 ZEV/PHEV sales increase from 18 percent to 40 percent between 2025 and 2030, and reach 100 percent by 2050.</p> <p>Assumed MDV ZEV/PHEV sales beginning in 2025, ramping up to 10 percent by 2030, and reach 50 percent by 2050.</p> <p>Assumed increased fuel efficiency (~2.9 percent per year) for gasoline vehicles starting 2025.</p> <p>Assumed new SULEV NOx standard phased in between 2025 and 2030 for gasoline LDAs. 100 percent SULEV20 sales by 2030.</p>
On-Road Heavy-Duty	
Low-NOx Engine Standard—California Action	Assumed combined LDA/LDT2 ZEV/PHEV sales increase from 18 percent to 40 percent between 2025 and 2030.
Low-NOx Engine Standard—Federal Action	Assumed MDV ZEV/PHEV sales beginning in 2025, ramping up to 10 percent by 2030.
Medium and Heavy-Duty GHG Phase 2	Assumed increased fuel efficiency (~2.9 percent per year) 2025 to 2035 for gasoline vehicles.
Advanced Clean Transit	Assumed new SULEV NOx standard phased in between 2025 and 2030 for gasoline LDAs. 100 percent SULEV20 sales by 2030
Last Mile Delivery	Assumed combined LDA/LDT2 ZEV/PHEV sales increase from 18 percent to 40 percent between 2025 and 2030.
Off-Road Federal and International Sources	
More Stringent National Locomotive Emission Standards	Assumed remanufacturing of the locomotive fleet such that 95 percent of line-haul locomotive activity is represented by Tier 4 and Tier 5 locomotives by 2031 with phase-in starting in 2023. The Tier 5 emission standard was represented in the model by increasing the Tier 5 locomotive distribution in the total tier distribution by ~4.0 percent per year over the baseline distribution starting in 2025 with an equal reduction in the Tier 4 distribution.
Tier 4 Vessel Standards	Assumed new main and auxiliary engines will achieve a 70 percent reduction in NOx starting with calendar year 2025. No reductions to PM were assumed.
At-Berth Regulation Amendments	Assumed At-Berth Regulation expanded to include some of the following vessel types: auto, bulk cargo, general cargo, roro and tankers. Reductions start in 2022 at 10 percent compliance and ramp up to 50 percent by 2032.
Off-Road Equipment	
Zero-Emission Off-Road Forklift Regulation Phase 1	Assumed electrification of diesel and LSI forklifts less than 65 HP starts in 2028 through natural and accelerated turnover and nearly 2/3 of the targeted population will be electrified by 2035.
Zero-Emission Airport Ground Support Equipment	Assumed all new sales of belt loaders, baggage tugs, and cargo tractors are electric-powered starting 2023.
Fuel	
Low-Emission Diesel Requirements	Assumed 50 percent of the diesel pool is renewable by 2030. Assumed NOx and PM benefits for non-SCR equipped vehicles -13 percent NOx reduction and 25 percent PM reduction. Also assumes an overall ~14 percent reduction in diesel carbon intensity.

Cost of Defined State Measures

Some proposed measures rely on existing technologies. Many measures, however, encourage the development of new technologies, accelerating reductions of NO_x, ROG, and PM_{2.5} across mobile sectors. Encouraging and incentivizing the development of zero and near-zero emission technologies may change the way vehicles, fuels, and mobile equipment are manufactured, distributed and consumed. Proposed measures that accelerate deployment of existing technologies or incentivize new technologies may result in an economic impact as costs and benefits change over time.

The direct cost of each proposed State SIP Strategy measure is estimated using inputs from stakeholders, feasibility studies, and academic research. For most measures, direct costs represent the incremental cost of zero and near-zero emission technologies over their conventional counterparts. Changes in operating and maintenance (O&M) costs are also calculated, often generating savings as a result of implementing more fuel efficient technologies. O&M costs are calculated using estimates of energy consumption, fuel savings, and maintenance costs on an annual basis. For measures in the early stages of development, staff estimates direct costs by multiplying a cost per ton estimate by the anticipated emission reduction associated with the proposed measure.⁴

Proposed measures implemented at the federal and international level are also included in the State SIP Strategy. As these measures affect vehicles that may only spend a fraction of their useful life operating in California (e.g., trucks and locomotives with interstate routes), the costs and impacted vehicle populations are estimated differently from California-only measures. Cost estimates for these measures include the incremental and annual O&M costs that may be incurred for each piece of equipment or vehicle impacted by the proposed measure. The impacted population is the portion of the total federal fleet estimated to spend any time in California. For the macroeconomic modeling of federal measures in the updated Mobile Source Strategy, measure costs will be applied at the federal level and the California portion of costs will be estimated. In modeling a federal truck measure, for instance, the incremental cost of an advanced technology truck would be applied nationally across all trucks that spend any time in California. The macroeconomic model would then estimate the impact of this cost on industrial sectors in California and the California economy. The updated Mobile Source Strategy will include a detailed explanation on the treatment of proposed federal and international measures and the estimation of their impact on the California economy.

The initial cost estimates in this analysis will be updated and modified as proposed measures develop and move through the regulatory process. Each measure containing a regulatory action will also be subject to the Administrative Procedure Act regulatory

⁴ Measures requiring the use of a cost per ton NO_x estimate include Further Deployment of Cleaner Technologies of Off-Road Federal and International Sources, and Further Deployment of Cleaner Technologies of Off-Road Equipment. The cost of the Consumer Products Program was estimated using a cost per ton ROG reduction.

process⁵ providing additional opportunity for public input including participation in public workshops where the distribution of potential costs and benefits on California businesses, consumers, and the economy will be discussed.

Estimated Costs and Cost-Savings

To achieve the emission reductions outlined by the State SIP Strategy, staff has estimated the incremental cost of zero and near-zero emission technologies compared to less efficient technologies that are currently in use. Generally, consumers and businesses will face higher prices for capital equipment that meet more stringent air quality standards. However, the prices of new technologies are likely to decline over time due to learning-by-doing as measures are fully implemented.⁶

The majority of measures will lead to capital purchases by businesses and consumers in California. The analysis assumes that consumers and businesses will purchase new equipment through incentive programs and as current capital equipment retires. Industry purchases are assumed to be financed, with payments spread out, or amortized, over the lifetime of the equipment. The rate of capital turnover for heavy-duty vehicle and equipment measures is assumed to be constant, while light-duty vehicles and federal and international sources have year-by-year estimates of population turnover.

Tables 3 through 8 present the estimated direct costs of each proposed measure with a quantified emission reduction benefit in the State SIP Strategy. The incremental capital costs represent the cost of zero and near-zero emission technologies over their conventional counterparts. This cost differential is used to calculate the capital costs over a vehicle or equipment population generated by the Vision model. Annual O&M costs represent the per-unit operating costs of capital equipment, including fueling or charging, conventional fuel savings, maintenance, and in some measures the cost savings of a mid-life engine rebuild. O&M costs and savings are not presented for some measures due to data limitations⁷ or for measures still in the early stages of development for which costs and savings estimates are still being determined.

Tables 3 through 8 also include the total cost of each proposed measure through 2031. The total cost includes annual O&M costs, when applicable, for each year from the measure start date through 2031 and amortized capital costs. Capital costs are

⁵ The Administrative Procedure Act requirements are designed to provide stakeholders the opportunity to participate in the regulatory process for regulations adopted by the Office of Administrative Law. For more information on this process, visit: http://www.oal.ca.gov/regular_Rulemaking_Process.htm

⁶ U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards Health and Environmental Impacts Division Air Benefit and Cost Group (C439-02). *Final Ozone NAAQS Regulatory Impact Analysis*. Vol. EPA-452/R-08-003. Research Triangle Park, NC: 2008.

⁷ The Further Deployment of Cleaner Technologies measures are still in concept phase; staff is unable to identify any operating costs and/or savings at this point.

amortized over the lifetime of the equipment assuming a 5 percent interest rate.⁸ The total direct cost includes amortized capital payments and annual O&M costs from the start of the proposed measure through 2031. Additional O&M and capital costs may be incurred after 2031, but those costs are not included in this analysis.

For some measures, direct costs are estimated using a cost-per ton approach. Modeling of the Further Deployment of Cleaner Technologies for Federal and International Sources measure, the Further Deployment of Cleaner Technologies for Off-Road Equipment measure, and the Consumer Products Program rely on cost per ton estimates. The Economic Impact Analysis of the Mobile Source Strategy will include the detailed methodology for calculating the cost per ton for federal and international sources and off-road equipment, while staff estimated the cost per ton ROG estimates for Consumer Products.

There are estimated cost savings to businesses and consumers due to reduced consumption of conventional fuels and less-frequent maintenance resulting from State SIP Strategy measures. In some cases, entire measures have been estimated to have net savings during implementation, where annual cost savings grow to exceed incremental capital costs. The proposed Zero-Emission Airport Ground Support Equipment measure in Table 6 provides net savings, as the annual O&M savings exceed the incremental capital cost beginning in the first year of use.

Table 3 presents the costs for the on-road light-duty measures in the State SIP Strategy. On-road light-duty measures contribute approximately 63 percent of the total direct costs of the strategy. Regulating the light-duty sector has a direct impact on consumer motor vehicle expenditures, as the analysis assumes the cost is passed to consumers through an increase in the purchase price of new vehicles. In this analysis, there is a small cost to consumers purchasing motor vehicles as a result of motor vehicle manufacturers' requirement to meet the LEV III⁹ criteria pollutant standard. However, consumers will have reduced operating costs for LEV III vehicles (relative to the fuel costs of conventional vehicles) increasing overall household savings for consumers. The incremental price of zero and near-zero emission technology is expected to decline after the implementation of the on-road light-duty measures proposed in the State SIP Strategy, and the net effect on household spending is projected to be negligible.

⁸ As an illustrative example, assume an advanced technology truck has an incremental cost above its conventional counterpart of \$1,000. In this analysis, the \$1,000 is financed with 5 percent annual interest and the payments are equally divided over the 12 year lifetime of the truck. Thus each year, this truck would incur an amortized capital payment of \$113.

⁹ Background information on Low-Emission Vehicle Program (LEV III) can be accessed at: <http://www.arb.ca.gov/msprog/levprog/leviii/leviii.htm>

Table 3: Estimated Total Direct Costs of Measures: On-Road Light-Duty Vehicles

Source Category	Measure	Implementation	Incremental Capital Unit Cost	Annual O&M Cost (Savings)	Population	Total Cost of Control Measure Through 2031 (Amortized)
On-Road Light-Duty	Advanced Clean Cars 2	2026-2030	\$8,000-\$10,000	(\$2,000)	1-1.5M	\$10B
	Lower In-Use Emission Performance Assessment	Ongoing	n/a	n/a	n/a	n/a
	Further Deployment of Cleaner Technologies	2016-2031	\$14,500	n/a	2,000,000	\$29B

Proposed measures affecting on-road heavy-duty vehicles are geared toward increasing the use of near-zero and zero-emission technologies throughout California. Costs attributed to this source category are roughly 12 percent of the total costs, and include the introduction of low-NOx technologies, zero and near-zero purchase requirements for transit buses and delivery trucks, and incentive programs encouraging early penetration of zero and near-zero technologies in the truck transportation sector. Staff anticipates that the reduced maintenance costs and fuel savings expected from the adoption of more efficient heavy-duty technologies will help recoup the incremental capital costs over conventional alternatives. Table 4 presents the costs for on-road heavy-duty measures.

Table 4: Estimated Total Direct Costs of Measures: On-Road Heavy-Duty Vehicles

Source Category	Measure	Implementation	Incremental Capital Unit Cost	Annual O&M Cost (Savings)	Population	Total Cost of Control Measure Through 2031 (Amortized)
On-Road Heavy-Duty	Lower In-Use Emission Performance Level	2017-2026	n/a	n/a	n/a	n/a
	Low-NOx Engine Standard-California Action	2023-2027	\$1,500	n/a	500,000	\$650M
	Low-NOx Engine Standard-Federal Action ¹⁰	2024-2027 (U.S. EPA)	\$1,500	n/a	1,000,000	\$1.2B
	Medium and Heavy-Duty GHG Phase 2	2018+	n/a	n/a	n/a	n/a
	Advanced Clean Transit	2018-2040	\$20,000-\$650,000	(\$22,000) - \$38,000 ¹¹	6,000	\$95M
	Last Mile Delivery	2020-2050	\$30,000-\$90,000	n/a	26,000	\$850M
	Innovative Technology Certification Flexibility	2016-2031	n/a	n/a	n/a	n/a
	Zero-Emission Airport Shuttle Buses	2023	n/a	n/a	n/a	n/a
	Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles	2016-2023	n/a	n/a	30,000	\$280M
	Further Deployment of Cleaner Technologies	2016-2031	\$50,000	n/a	120,000	\$4.4B

¹⁰ The cost of this federal action applies to the population of trucks that may visit California, but are not necessarily based in the state. Costs and benefits of this measure will accrue outside of California, but these benefits are not quantified in this analysis.

¹¹ The O&M cost estimates for Advanced Clean Transit reflects the value of Low Carbon Standard Fuels credits at \$100 per credit.

Federal and international mobile source measures, which include emission reduction strategies for locomotives and ocean-going vessels, account for 15 percent of the total cost. Equipment standards in the off-road federal and international source categories require coordination between ARB, federal agencies, and international. This international and federal coordination increases the level of uncertainty surrounding the costs of achieving the emission reductions outlined in these measures. The transition to more efficient technologies in the rail and water transportation sector is estimated to generate higher demand for rail and vessel manufacturers, as well as higher demand for urea manufacturing. Rail and water transportation are anticipated to see slightly higher production costs, but public incentives may be available to supplement the cost of the required capital investments to achieve the emissions reductions. Estimated costs for federal and international sources are presented in Table 5.

Table 5: Estimated Total Direct Costs of Measures: Off-Road Federal and International Sources

Source Category	Measure	Implementation	Incremental Capital Unit Cost	Annual O&M Cost (Savings)	Population	Total Cost of Control Measure Through 2031 (Amortized)
Off-Road Federal & International Sources	More Stringent National Locomotive Emission Standards*	2023+	\$250,000 - \$1,000,000	(\$75,000) - \$21,000	8,500	\$ 2.6B
	Tier 4 Vessel Standards*	2020-2025	\$475,000	\$150,000	1,200	\$1.3B
	Incentivize Low Emission Efficient Ship Visits	2017-2018	n/a	n/a	n/a	n/a
	At-Berth Regulation Amendments ¹²	2022-2032	\$110M total ¹³	n/a	n/a	\$88M
	Further Deployment of Cleaner Technologies*	2016-2031	n/a	n/a	n/a	\$5.1B

¹² The cost of these federal and international actions applies to the source populations that may visit California, but are not necessarily based in the state.

¹³ No incremental capital unit cost is available for this proposed measure, but ARB staff assumes that the total incremental cost will be a capital cost.

The cumulative costs of the off-road equipment source measures, presented in Table 6, account for less than 1 percent of total State SIP Strategy costs. Off-road equipment affected by these proposed measures will realize significant savings with the transition away from conventional technologies. Electrifying airport ground support equipment will cost over \$4 million in capital expenditures, but will generate an annual O&M savings of \$5 million for air carriers and ground handling companies, allowing regulated entities to recoup up-front capital costs within the first year of equipment operation.

Table 6: Estimated Total Direct Costs of Measures: Off-Road Equipment

Source Category	Measure	Implementation	Incremental Capital Unit Cost	Annual O&M Cost (Savings)	Population	Total Cost of Control Measure Through 2031 (Amortized)
Off-Road Equipment	Zero-Emission Off-Road Forklift Regulation Phase I	2023-2035	\$13,000	(\$8,000)	7,000	(\$170M)
	Zero-Emission Off-Road Emission Reduction Assessment	--	n/a	n/a	n/a	n/a
	Zero-Emission Off-Road Worksite Emission Reduction Assessment	--	n/a	n/a	n/a	n/a
	Zero-Emission Airport Ground Support Equipment	2023	\$8,000	(\$9,000)	600	(\$40M)
	Small Off-Road Engines	2022-2032	\$40-\$75	(\$20)	100,000	(\$2M)
	Transport Refrigeration Units Used for Cold Storage	2020+	n/a	n/a	n/a	n/a
	Further Deployment of Cleaner Technologies	2016-2031	n/a	n/a	n/a	\$800M

The Low-Emission Diesel fuel measure presented in Table 7 accounts for 10 percent of the total State SIP Strategy costs. The use of Low-Emission Diesel in on and off-road

vehicles and off-road equipment will reduce emissions of NOx, PM, and life cycle GHG. Renewable hydrocarbon diesel, also known as renewable diesel, is expected to be the primarily fuel used to meet the Low-Emission Diesel measure, which would require that diesel fuel providers sell steadily increasing volumes of Low-Emission Diesel until it comprises 50 percent of total diesel sales by 2031. Importers and producers of Low-Emission Diesel qualify for Low Carbon Fuel Standard (LCFS) credits under the California LCFS.¹⁴ Consumers may face a slight increase in diesel fuel prices as low-Emission Diesel displaces a portion of diesel consumption.

Table 7: Estimated Total Direct Costs of Measures: Fuels

Source Category	Measure	Implementation	(Average) Incremental Cost	Annual O&M Cost (Savings)	Volume	Total Cost of Control Measure Through 2031
Fuels	Low-Emission Diesel Requirement	2023-2031	\$1.22/gallon	n/a	4.9 billion gallons	\$6B

¹⁴ More information on the Low Carbon Fuel Standard can be accessed at: <http://www.arb.ca.gov/fuels/lcfs/lcfs.htm>

The proposed Consumer Products measure includes a wide variety of consumable goods including deodorants, hair spray, cleaning products and other products. The cost of this measure accounts for less than 1 percent of the State SIP Strategy, and is expected to reduce ROG at the cost of \$3.61 per pound as outlined in Table 8. Consumers may pay slightly more for some products subject to formulation requirements, depending on the extent to which manufacturers pass along their costs to consumers.

Table 8: Estimated Direct Total Costs of Measures: Consumer Products

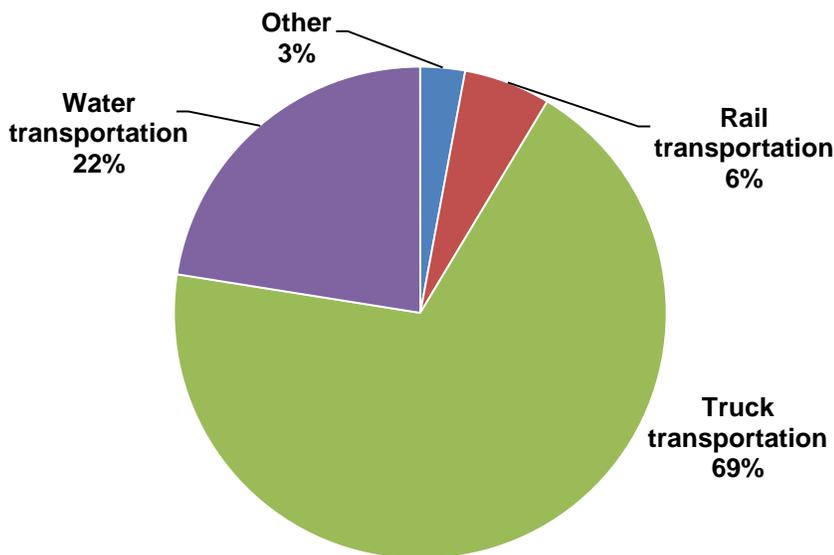
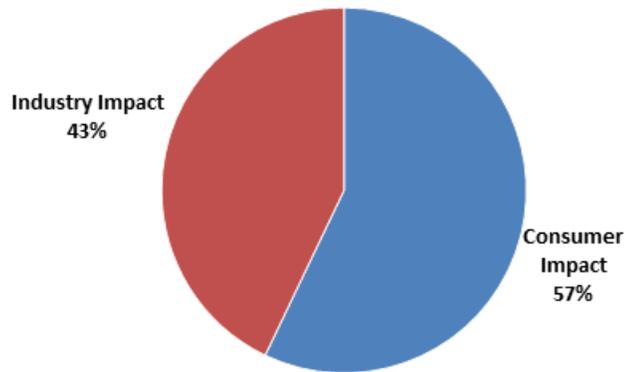
Source Category	Measure	Implementation	Incremental Unit Cost	Annual O&M Cost (Savings)	Population Range	Total Cost of Control Measure Through 2031
Consumer Products	Consumer Products Program	2020-2023	\$3.60/lb (ROG)	n/a	n/a	\$105M

Distribution of Costs

The direct costs presented in Figure 1 and Figure 2 estimate the expenditures that may be incurred by California businesses, governments, and individuals to meet the requirements of the proposed control measures. The industry share of direct costs is displayed in Figure 2. Heavy-duty trucks and industrial equipment owned by businesses represent the majority of regulated mobile sources. Industry¹⁵ is estimated to be responsible for 43 percent of the total cost, as industrial fleets

turnover to cleaner technologies. The breakdown of the industry impact can be seen in Figure 2, where truck transportation accounts for the majority of estimated costs. Meeting the goals of the State SIP Strategy requires a significant shift in the heavy-duty truck fleet through 2031, along with a more comprehensive suite of measures.

Figure 1: Share of Total Costs, 2016-2031



Measures that affect consumer spending account for 57 percent of the total direct costs in the State SIP Strategy. Many individuals in California may be able to take advantage of incentive programs and enjoy annual cost-savings from the increased fuel efficiency

¹⁵ Affected industries are identified at the 3-digit NAICS level. For this analysis, industries incurring an increase in production cost include truck transportation, rail transportation, water transportation, scenic and sightseeing transportation and support activities, commercial and industrial machinery and equipment rental and leasing, and fruit and vegetable preserving and specialty food manufacturing.

of improved light-duty technologies.

Incentive programs identified in the State SIP Strategy may benefit consumers purchasing light-duty vehicles, as well as owners of heavy-duty trucks and other off-road equipment. The incentive programs are anticipated to encourage accelerated turnover of conventional vehicles as well as the development and deployment of a variety of cleaner engine technologies regulated under the further deployment of cleaner technologies measures.

Conclusion

Over the life of the strategy, from 2016 through 2031, the total direct cost of the proposed measures is estimated as \$62 billion. These cost estimates represent the costs borne in California for the State SIP Strategy, and are not inclusive of costs and benefits that accrue outside the state or beyond 2031. The annual average cost after implementation is estimated at \$6 billion, which is less than 1 percent of projected California GDP in 2031.¹⁶ In the context of the California economy, the anticipated economic impacts of the State SIP Strategy are small and are not expected to impose a noticeable impact on the California economy.

The proposed measures will also achieve significant emissions reduction benefits. Through 2031, the State SIP Strategy is anticipated to result in estimated emission reductions of approximately 206 tons per day NOx, 87 tons per day ROG, and 2 tons per day PM2.5. As a co-benefit, the measures will also result in significant GHG reductions. In addition, unquantified environmental, societal, and health benefits can result from implementation of the State SIP Strategy, resulting in the continued growth in the well-being of Californians and the California economy.

¹⁶ Projection using REMI forecasting functionality, adjusted for the Department of Finance Confirming Forecast dated January 2016.