Cost-Benefit Analysis and Distributional Impacts of Used Oil Management Policy Scenarios

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1. Introduction

Background

California Senate Bill (SB) 546 (Lowenthal, Chapter 353, Statutes of 2009) directed the California Department of Resources Recycling and Recovery (CalRecycle) to submit a report to the Legislature based on a comprehensive life cycle assessment of used lubricating and industrial oil management process from generation through collection, transportation and re-use alternatives. As part of this overall study, CalRecycle and the stakeholders felt the need to conduct a comprehensive economic assessment to inform the life cycle analysis. Such a two-pronged approach was deemed necessary in order for CalRecycle to develop recommendations to the Legislature for policy changes that may be necessary to promote increased collection and responsible management of used oil in California.

The economic study for this process consisted of two parts — the first was a detailed spreadsheet model of the lubricating and industrial oil market in California and other related regions that was used to analyze how different policy scenarios would affect the used oil market via changes in estimated collection, management, and disposition through 2030. This spreadsheet model, called the Direct Impacts Model, is discussed under separate cover. The second part of the economic study used information from this spreadsheet model to conduct a comprehensive cost-benefit analysis (CBA) and subsequent distributional analysis focusing on employment impacts, to understand the implications of these potential policy scenarios on the California economy and various affected sectors. This study presents the findings of the CBA and distributional impacts analyses part of the economic study.

Overview of the Approach Used for Cost-Benefit Analysis and REMI Modeling

The CBA used changes in physical flows for various used oil related products from the direct impacts model (DIM) as inputs in order to model the changes in costs and benefits to various entities involved in or affected by the used oil market.

The changes in flows were then converted to costs and benefits using unit cost and benefit parameter estimates collected from extensive research and stakeholder inputs. These conversions are discussed in detail in the following sections in this report.

In addition, results from the CBA were then used with a customized version of the Regional Economic Models, Inc. (REMI) Policy Insight Plus (PI+) model to estimate the distributional impacts for the scenarios arising from the changes in total costs and benefits.

2. Approach to Estimating Revenues and Costs for Different Groups

The following sections describe the methodologies used to estimate the costs and benefits for the various groups of entities affected by the proposed scenarios for the used oil management system.

Virgin Lube Producers

Lubricating and industrial oil manufacturers include facilities that primarily produce the base oil used to create finished lubricating and industrial oils. Finished lubricating and industrial oils include base oils as well as various additives and are sometimes produced at the same facilities that produce the base oils (e.g., Chevron) or other specialty manufacturers (e.g., Quaker State). Table 2.1 below provides a summary of the key cost assumptions used as inputs for entities affected by changes in the virgin lube sector of the market. These inputs are used in conjunction with the results from the direct impacts model (DIM), as discussed below.

Table 2.1: Virgin Lube Production Cost Assumptions

Cost Element	Cost
Automotive Lubricating Oil Prices ($/gal)	$9.05
Industrial Oil Prices ($/gal)	$4.96[a]
Marginal Costs of Production — Automotive Lubricating Oils ($/gal)	$2.04
Marginal Costs of Production — Industrial Oils ($/gal)	$2.30

Notes:

[a] Industrial oil price shown represents lower bound estimate

Sources: CBA Assumptions; National Oil and Lube News; Solomon Associates, LLC; copyrighted Kline data

Virgin oil sold by these producers falls within two groups — automotive lubricating oils for transportation and industrial oils used in various manufacturing sectors. In 2011, automotive lubricating oils accounted for about 60 percent (123.3 million gallons) of the total lubricant oil sold, while industrial oil accounted for the remaining 40 percent (83.9 million gallons) of the total.

The impact of a given scenario on the operational costs and revenues for these producers was calculated based on the incremental gallons of virgin lube oil sold, as modeled in the DIM, and multiplied by the relevant marginal costs of production and product prices. The marginal costs of production were obtained from Solomon.[1] The automotive lube marginal cost of production ($2.04/gallon) was based on API Group II/III base oils manufactured by hydroprocessing complexes, while industrial oil marginal costs ($2.30/gallon) correspond to the cost of production for API Group I base oils manufactured by solvent-based refining processes. According to Solomon, the newer technology of hydroprocessing requires significantly less operating expenses than the solvent-based plants. While this advantage in hydroprocessing plants is partially offset

[1] Email communication with Solomon Online. May 28, 2013.

by somewhat lower raw material costs for solvent plants, the overall impact is that the marginal cost of production for Group II/III base oil manufacturers are lower than those for producing Group I base oils. The automotive lube price of $9.05/gallon was obtained from National Oil and Lube News publications.[2] This price corresponds to the average price paid in bulk for the largest-volume-brand by operators owning less than 30 stores (although large branded oil change operators pay lower prices).

For industrial oils, a range of industrial oil prices for various industrial oil types were provided by Kline. This price data is copyrighted and could not be directly included in the Cost-Benefit Analysis (CBA). The various types of industrial oils were first matched to the 14 industrial oils analyzed in the direct impacts model (DIM). Using Kline's range of prices, this analysis then calculated both a low and high weighted average industrial oil price (weights being equal to the quantities of different industrial oil types in the baseline), which the model user can select from a drop-down menu in the CBA.

The lower price ($4.96) reflects the average of the minimum price for each type of the 14 used oils in the DIM, weighted by the amount of each type of industrial oil sold in 2011. The higher value ($10.19) was calculated using the same methodology, with the exception that the median price for each industrial oil type was used to calculate an average, rather than the minimum value. Because the industrial oils types included in this study are diverse and have widely varying prices, the default average price used in the analysis correspond to the low end of the range in order to provide a conservative estimate for the CBA.

The modeling approach assumes that an increase in re-refined lubricating oil recovered leads to a corresponding displacement in virgin lube sales in California, especially for those that are made using Group I and possibly some Group II base oils (Solomon).[3] The displacement is considered a net loss for virgin producers and ignores the possibility of increased exports to other states or increased production of other petroleum products.

Used Oil Generators

This study focused on three broad groups of used oil generators:

1. Do-It-Yourselfers (DIY)
2. Non-DIY — broken down into industrial generators of lubricating oil and commercial oil change generators
3. Industrial Oil generators.

DIYs

The Do-It-Yourselfer (DIY) category refers to non-commercial users of lubricating oils who cause the oil to become used and who typically perform the act of changing their oil themselves.

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[2] National Oil and Lube News. 2012. Available at: www.noln.net/features/feature1-1_0912.php.

[3] Rerefining Used Lubrication and Industrial Oils Effects on Virgin Crude Oil Refining. Contractor's Report Produced HSB Solomon Associates, LLC, Dallas, Texas, May 2013.

While it is hard to get comprehensive data on either the entire DIY universe or the amount of oil purchased or recycled by DIYs, there is evidence that the overall impact of DIY oil is relatively small in the context of total lubricating oil used or used oil generated in the state.

According to CalRecycle's prior research, in 2004, about 150.5 million gallons of lubricating oil was sold in the state, of which about 18.3 million gallons were purchased by DIYs (roughly 12 percent of the total).[4] In terms of oil collected from DIYs, roughly 7.7 million gallons were collected from them in 2004, which translates to about 42 percent of the oil sold to DIYs. However, adjusting for oil loss during use (31 percent of oil is lost during engine use) collection rates were estimated to be between 60 and 80 percent of all DIY oil, according to the CalRecycle study. Collection rates increased by about 2 percent from FY 2002-2003 to FY 2004-2005. While these estimates are not directly used in this cost-benefit analysis (CBA), it provides some background on the level of DIY activity in the state from a historical perspective.

In terms of actual number of DIYs in California, again, reliable data are hard to come by. According to CalRecycle (2005), roughly 60 percent of California households were DIYs in 1987, prior to the beginning of the Used Oil Program. By 1995, that figure had decreased to about 25 percent of all households and by 2000 it was estimated to be only about 18 percent. While more recent data are scarce and not entirely reliable, anecdotal evidence and discussions with personnel in local jurisdictions involved in interactions with DIYs suggest that the number of DIY households has been decreasing steadily in recent years.[5]

Urban and suburban areas generally have a much lower percentage of DIY households than more rural areas of the state. For example, San Francisco County had about 4 percent DIYs in 2005 while more rural counties such as Glenn, Tehama, and Trinity in Northern California have the highest percentage of DIY households in the state at about 48 percent in 2005. The more populous Los Angeles County was estimated to have about 14 percent DIY households in 2005. Figure 2.1, extracted from CalRecycle's report, shows the declining trends in DIY households with projected declines in more recent years. There is no reason to believe these projections for more recent years have not been realized.

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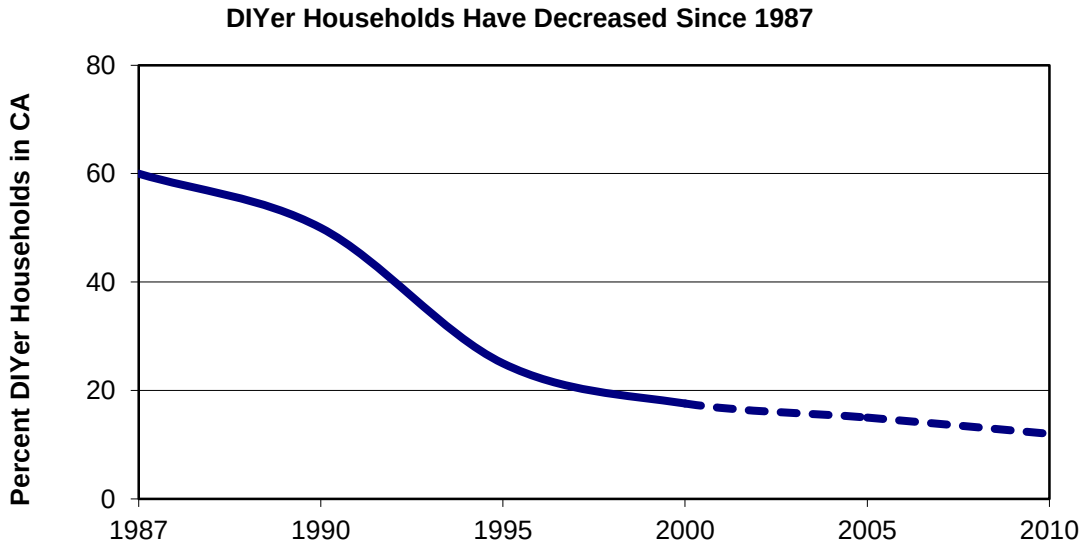
[4] At-Home-Mechanic (Do-it-Yourselfer) Used Oil and Used Oil Filter Collection. FY 2004-2005 Data Analysis. CalRecycle, 2005.

[5] DIY workshop organized by CalRecycle, attended by representatives from various local jurisdictions who are involved in the management of DIY oil. April 30, 2013.

Figure 2.1: Trends in DIY Households in California



Source: CalRecycle DIY Report, 2005

In terms of DIY uncollected oil, the CalRecycle (2005) study also suggested that the percentage of uncollected oil could have been between 20-40 percent of oil sold to DIYs, or about 3.7 to 7.3 million gallons in 2004. And according to more recent CalRecycle data used by UC Santa Barbara in the Material Flow Analysis, uncollected oil from the DIYs has been estimated at about 4.1 million gallons on average from 2007 to 2011, or roughly 30 percent of the DIY oil sold.[6] There is, therefore, a strong indication that the amount of uncollected, collectable DIY oil has held somewhat steady at about 3 million to 4 million gallons per year in recent years.

Table 2.2 provides a summary of the key inputs used to estimate the costs for DIYs in this study in conjunction with the results from the direct impacts model (DIM).

[6] CalRecycle Used Oil MFA data. 2012.

Table 2.2: Used Lubricating Oil DIY Generators Assumptions

DIY Fuel Cost inputs	
U.S. Gas Price 2011 (million BTU/Gallon) (2011$)	$28.70
U.S. Forecasted Gas Price 2030 (million BTU/Gallon) (2011$)	$30.73
U.S. Gas Price Real Growth Rate	0.4%
2011 California Average Regular Gas Price ($/gallon)	$3.82
DIY Time Cost Inputs	
DIY Mileage	6.0
Miles Per Gallon	20.4
Median California Household Income (2007-2011)	$61,632
Cost of Time (Value of Leisure) ($/Hour) (2011$)	$14.82
Median Household Income Growth Rate	1.60%
Hours/Trip	0.50
Number of Trips	
Trips per DIY per Year	3
Gallons of Used Oil/Trip	4
Percentage of Trips Exclusively for Oil Drop-Off	60%
Trips Exclusively for Oil Drop-off	2
DIY Incentive	
Baseline Percentage DIY Incentive Payment Collected	5%
Scenario Percentage DIY Incentive Payment Collected	5%
DIY Expenditures	
Percentage of DIYs Who Return Used Oil to Auto Part Stores	75%
Average DIY Expenditure per Trip on Other Goods (2004$)	$0.0
Average DIY Expenditure per Trip on Other Goods (2011$)	$0.0

Sources: CBA Assumptions; EIA Annual Energy Outlook 2013; CalRecycle DIY Report 2002; U.S. Census State & County Quick Facts; DIY Survey in Orange County, California 2013; U.S. Department of Transportation Guidance; FHWA Table VM-1; Household Hazardous Waste Study, The Redhill Group. 2012; Lawrence Livermore National Laboratory 2008.

The incremental used oil collected from DIYs under the scenarios was assumed to involve a cost to DIYs to bring the oil to collection centers. These additional travel costs were then partially offset by the increased incentives collected by DIYs under a given scenario.

The costs to DIYs of returning used oil to collection centers were calculated as the sum of their gasoline costs, time costs, and any additional expenditures at auto parts stores (currently assumed to be zero), for all trips taken by DIYs. Their gasoline costs were based on 2011 real gasoline prices, and projected forward using the growth rate determined by the Energy Information Administration for modeling years out to 2030.[7] Average mileage per trip was assumed to be six

[7] EIA Annual Energy Outlook. 2013. Available at: http://www.eia.gov/forecasts/aeo/er/pdf/tbla3.pd.

miles round-trip[8] and average fuel efficiency was assumed to be 20.4 miles per gallon.[9] Total motor fuel cost per trip was then calculated as mileage/MPG*gasoline cost ($/gallon).

DIY time cost was assumed to be the cost of forgone leisure time used to bring the oil to a collection center. The calculation of average cost of leisure time was based on the approach recommended in U.S. Department of Transportation (DOT) guidance for calculating a value for cost of time.[10] California's median household income for 2007-2011[11] was estimated to be $63,632 and was projected forward through model year 2030 at the projected median income growth rate of 1.6 percent provided by U.S. DOT. To obtain the time cost per trip the calculated time value (e.g., $14.82 per hour in 2011) was multiplied by 0.5 hours, which was the assumed amount of time required by the DIY to drive to and from the collection center to drop off their used oil.

Expenditures at auto parts stores are a likely third component of DIY costs. Spending at automotive parts stores are an optional input into the model. Though one study conducted by Cal Poly San Luis Obispo suggested that DIYs spend an additional $13 per trip when visiting an auto parts store to drop off their used oil, discussions with stakeholders for this study indicated that there was no strong evidence suggesting DIYs consistently spend additional money while dropping off their used oil. In addition, CalRecycle arranged several informal and non-random sample surveys to aid in the data collection for this cost-benefit analysis (CBA).

These informal surveys were conducted in Orange County to collect anecdotal data on DIY behavior in order to determine whether there is any indication of incidental spending at the time of oil drop off. While these surveys had extremely small and non-random samples, results indicated that there may be some incidental spending during oil drop off but there was no reliable data to estimate what those amounts might be. In order to be conservative, this CBA assumes no additional incidental spending by DIYs at auto parts stores.[12]

The total of the above-described costs are then multiplied by the incremental number of trips taken. The incremental number of trips is a function of the total incremental gallons of oil collected for a given year (estimated by the direct impacts model), divided by the average amount of oil dropped off per trip to a collection center, which was estimated at four gallons/trip. Gallons/trip was updated from 2.7 in the draft report to four gallons/trip in this final version,

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[8] DIYs and Used Oil Disposal: Initial Results and Recommendations. 2002.

[9] FHWA Highway Policy Statistics. VM-1 table. 2010. Average MPG of light duty vehicles. Available at: http://www.fhwa.dot.gov/policyinformation/statistics/2010/vm1.cfm .

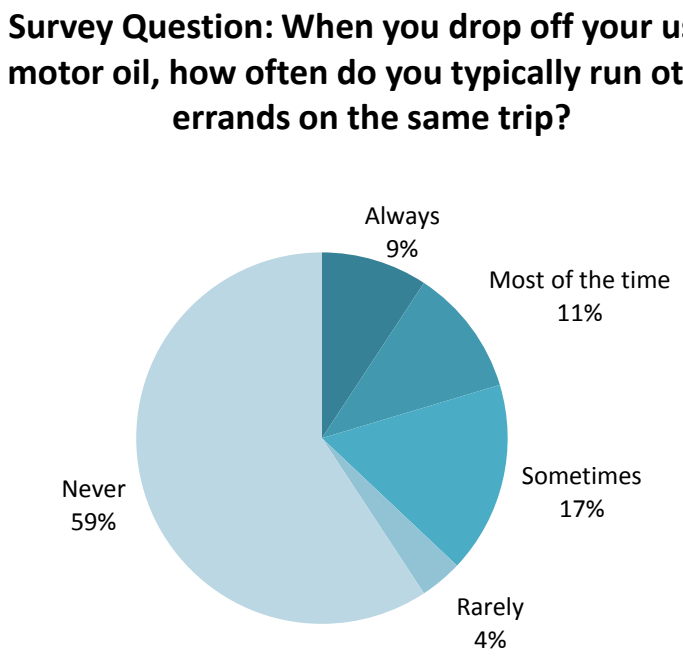
[10] Cost of time value based on DOT guidance for calculating Personal Local Travel (p. 12). Available at: http://www.dot.gov/sites/dot.dev/files/docs/vot_guidance_092811c_0.pdf.

[11] US Census. State & County Quick Facts. http://quickfacts.census.gov/qfd/states/06000.html.

[12] In prior iterations of this CBA, the additional spending assumption tended to have fairly large impact on the costs of the policy and on the attractiveness of being a collection center for DIY oil. Given that there is very little actual data on these incidental spending, this appears to be an important area for future research for the state. To the extent that DIY oil is an important factor in improving the used oil management system, it would be important to understand the specifics of DIY behavior and how that could contribute to attracting more oil collection centers and thereby improving the used oil management system in the state.

based on information collected from the DIY workshop and subsequent surveys conducted in Orange County.[13] Costs to DIYs also depend on whether these resulting trips can all be assumed to be solely for the purpose of dropping off their used oil, or if these trips are meant to include running multiple errands (in which case, not all of the trip-related costs should be attributed to dropping off used oil). This is another area where there is no reliable data to comprehensively determine DIY behavior. Discussions with local jurisdictions involved with DIY oil collection (through the DIY workshop) suggested that about 60 percent of DIYs do take trips for the sole purpose of dropping off their oil because they are less inclined to run multiple errands while carrying a hazardous waste in their automobiles (see Figure 2.2 below). Thus the default assumption in the cost-benefit analysis (CBA) is that 60 percent of the trips by DIYs are solely for the purpose of dropping off their used oil. Results for the DIY scenario discussed below tests the sensitivity of this assumption on the overall costs to the DIY sector.

Figure 2.2: Orange County Survey Results: Trips for Dedicated Oil Drop Off



Source: Used Oil Survey in Orange County California, 2013

DIYs receive a benefit in the form of incentive payments, which are calculated based on incremental gallons collected from DIYs and the incentive amount shown in the direct impacts model. Historical data collected by CalRecycle suggests that very few DIYs actually claim the incentive when they drop off their used oil and most of the incentive payments benefit the CCCs (discussed further in the discussion of used oil collection centers). Thus, based on discussions with CalRecycle, the cost-benefit analysis currently assumes that only 5 percent of the DIYs actually collect the incentive and the remaining 95 percent are collected by the CCCs.

[13] Orange County DIY Survey Results. Conducted April 2013.

Non-DIY

Non-DIY generators of used lubricating oil are broken out into two categories: Do-It-For-Me (DIFMs), and industrial generators. Note that for purposes of this analysis "DIFMs" refer to those consumers changing their oil at service stations or quick lube shops, while "DIFM generators" refer to those quick lube shops and service stations who perform the actual oil change. Thus, DIFM generators are entities that perform the service of changing lubricating oils for vehicles that they do not own, and includes businesses such as Jiffy Lube, Sears, Midas, Costco, among others. Industrial generators are commercial users of lubricating oils that typically perform the act of changing their oil themselves. This population includes entities such as rental car companies (e.g., Hertz), municipal governments, and agricultural establishments, among others. Based on a study by Lawrence Livermore National Laboratory (LLNL 2008), this analysis determined that DIFM generators accounted for 54 percent of non-DIY lubricating used oil collected and industrial generators accounted for the remaining 46 percent of non-DIY lubricating used oil collected.[14]

Table 2.3: Used Lubricating Oil non-DIY Generators Assumptions

Service Station/Quick Lube shops	
Oil Change Rate Charged by Quick Lube Shops (2011$)	$37
Cost of Goods for Oil Change (2011$)	$16
Quick Lube Hourly Wage (2011$)	$10
Oil change Length of Time	0.50
Cost of Oil Change to Quick Lube Shops (2011$)	$21
Auto Parts Store	
Percentage of DIY Oil Dropped Off to Auto Parts Stores	75%
Average DIY Expenditure Per Trip on Other Goods (2011$)	$0
CCC Incentives	
Baseline Percentage of Incentives Uncollected by DIY	95%
Scenario Percentage of Incentives Uncollected by DIY	95%
On-site Generator Percentage of Incentive Collected	100%

[14] Improving Used Oil Recycling in California, LLNL for CIWMB, 2008. The breakdown in the amount of collected non-DIY lubricating oil between industrial generators and DIFM generators was based on a study by LLNL (2008), which outlines the flow of oil from the point of sale until it is sold as a recycled product. Based on figures from the study, in 2006, Industrial generators and DIFM generators accounted for 63.0 million gallons and 73.7 million gallons of lubricating oil sold, respectively, or 46 percent and 54 percent of the total non-DIY lubricating oil sold (136.7 million gallons). The study also shows that industrial generator's used oil was collected at a rate of 69 percent (37.6 million gallons of used oil), while DIFM used oil was collected at a rate of 69 percent (43.5 million gallons of used oil). Thus, it was determined that industrial generators are responsible for about 46 percent of collected non-DIY lubricating used oil (37.6/81.1) while DIFM generators are responsible for about 54 percent of collected non-DIY lubricating used oil (43.5/81.1). This breakdown is not available from any of the data sources used in the direct impacts model or elsewhere in this study, hence the LLNL study was deemed to be the most useful for this breakdown.

CCC Feedstock Payments	
Payment from Haulers to CCCs	$0.30

Source: CBA Assumptions; LCA MFA data; Regional Breakdown of Fast Lube Operator's Survey, 2011.

The incremental amount of non-DIY used oil collected was divided among the DIFM generators and industrial generators. For purposes of this analysis, an increase in the amount of non-DIY oil collected was assumed to come almost entirely from the industrial generators, as the changes in incentives were unlikely to affect either DIFM behavior or the majority of DIFM generators' behavior. Thus, this analysis assumed that 98 percent of the incremental non-DIY lubricating oil collected would come from the industrial generator population. The other 2 percent would come from the small segment of DIFM generators (such as rural service stations) that may be collecting used oil but find it too expensive to have small volumes of oil collected by haulers. The cost-benefit analysis assumes that the changes in the incentive amounts under the scenarios for the incremental non-DIY oil would then entice this small portion of the population to have their oil collected from their locations.

The impact of a scenario on DIFMs was calculated as the sum of the fuel costs, time costs, and oil change costs for all oil changes. The following describes the methodology to calculate the costs associated with new oil changes, though the analysis assumed that incremental non-DIY oil does not imply a need for new oil changes.[15] DIFM time costs were calculated as the sum of the travel costs to and from the DIFM generator (0.5 hours) and the time required to complete the oil change (0.5 hours). Fuel costs were calculated using the same methodology as for the DIYs discussed above. The cost of an oil change is the rate charged by typical quick lube shops ($37).[16] The total DIFM cost was then multiplied by the total number of trips, which is a function of the incremental oil collected from DIFMs and the average drain cycle of light-duty vehicles in 2011 as shown in the direct impacts model.

The costs for industrial generators were assumed to be the incremental costs of changing their own vehicle fleet's oil, but as is the case for DIFMs, the analysis assumes that an increase in oil collected from non-DIY generators does not imply an increase in non-DIY oil. Rather, the increase in collection from industrial generators is the result of industrial generators having their oil collected under the policy scenario instead of storing their oil or disposing of it improperly. The cost to change the oil was assumed to be the sum of the cost of goods ($16) and one-half hour of labor at a wage rate of $10 (0.5 hours*$10 = $5), or about $21 per oil change.[17] The incremental number of oil changes required for industrial generators is a function of the incremental gallons collected from industrial generators and the average drain cycle of heavy duty vehicles.

An additional source of revenue for industrial generators is payment for their used oil. Research and discussion with independent haulers suggested used oil generators with large volumes of oil hauled from their premises receive a payment for their used oil, which is listed as the price of

[15] Costs of DIFM oil changes are used in the section on Additional Scenarios below to estimate the level of tax needed to remove the incentive for DIY oil changes and convert them to DIFMs.

[16] Regional Breakdown of Fast Lube Operator's Survey. 2011.

[17] Regional Breakdown of Fast Lube Operator's Survey. 2011.

used oil in the direct impacts model (assumed to be $0.30/gallon). Conversely, used oil generators with small volumes hauled away are likely to incur a cost for having their oil picked up. Because of lack of California-specific data, an average cost of $0.88/gallon for hauling small volumes of used oil was calculated based on published hauling rates of three Massachusetts companies for handling 55-gallon drums of oil.[18] For purposes of this analysis, we assume that 95 percent of industrial volumes are large and 5 percent are small volumes, using the material flow analysis data from the life cycle analysis study.

Industrial generators are eligible to receive the incentive for non-DIY lube oil. Unlike for DIYs, the cost-benefit analysis (CBA) assumed that industrial generators accept the non-DIY incentive 100 percent of the time, for all incremental industrial generators responsibly managing their used oil under a given scenario analyzed in this cost-benefit analysis. While there is likely a small percentage of small agricultural industrial generators who would likely not accept the incentive, analysis of Used Oil Flows data showed that agricultural generators make up only about 2 percent of all used lubricating oil collected, and many of these are likely larger farms with large volumes of used oil. Thus, this analysis makes the simplifying assumption that all incremental industrial generators would claim the incentive.

An additional group of affected generators are those DIYs converting to DIFMs as the result of a policy change. The conversion from DIYs to DIFMs is an external input to the direct impacts model (DIM). The DIM currently assumes that 18 percent of all light-duty vehicle oil is sold to DIYs in the baseline. If the percentage of light-duty vehicle oil drops below 18 percent under the scenario, this implies that the percentage sold to non-DIYs increases, and thus was interpreted as DIYs converting to DIFMs. The biggest cost to the new DIFM is the cost of an oil change ($37) charged by a service station, less the cost of changing the oil themselves—which was assumed to be the costs of parts ($16). DIFMs will also incur additional costs in the form of waiting for the oil change to be completed, assumed to be one-half hour.

Used Industrial Oil Generators

Industrial oil generators include users of industrial oils who cause the oil to become used, whether it is collected or not. This group includes entities such as waste management and industrial firms (i.e. metalworking, masonry, etc.). According to Section 48616 of the Public Resources Code, industrial oils may include hydraulic fluids, metal working fluids, and general utility greases. Relative to automotive engines, these uses generally allow lower grade oils for operation.[19]

Table 2.4 below shows the categories of industrial oils shown in the DIM and CBA and their relative shares in the total volumes of industrial oil.

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[18] Massachusetts Department of Environmental Protection. 2012. Statewide Contract FAC53, Category 1, Hazardous Waste Collection and Disposal. Available at: http://www.mass.gov/dep/recycle/reduce/fac53c1.pdf. Calculation of price paid to used oil haulers is found on the Haulers sheet in the "Amount paid by generators to haulers per gallon for hauling away small volumes."

[19] Improving Used Oil Recycling in California, LLNL for CIWMB, 2008.

Table 2.4: Categories of Industrial Oils Modeled in the Cost-Benefit Analysis

Industrial Oil	Percent of Total in 2010
Other Process Oils	28.7%
Marine	14.3%
White Oils	10.2%
Other Industrial	9.9%
Hydraulic Fluids-Non-Synthetic	9.2%
Electrical Process Oils	7.7%
Railroad	5.5%
MWF Removal	4.2%
Other Industrial Engine Oil	2.2%
MWF Forming	2.2%
Greases	1.8%
MWF Other	1.7%
Hydraulic Fluids-Synthetic	1.3%
Natural Gas	1.1%

Source: CBA Assumptions; Direct Impacts Model; Kline

Under Scenario 3 and Scenario 4, the industrial oil generator incentive is increased from $0.00 to $0.40. It was assumed that all industrial oil generators recycling their incremental used oil under the policy scenario would claim the incentive. Industrial oil generators are also paid the price of used oil per gallon (as shown in the direct impacts model) by haulers, and the analysis assumes that 100 percent of the industrial oil collected are large volumes.

Used Oil Collection Centers

Used oil collection centers consist of three main groups: Government Household Hazardous Waste (HHW) facilities, Certified Collection Centers (CCCs), and Non-Certified Collection Centers. Government HHW facilities are those which are managed by government entities who collect household hazardous waste, including used oil (lubricating and industrial). They may also collect hazardous waste from small commercial generators. CCCs consist of service centers as well as retail-only centers, and must accept lubricating oil from the public.

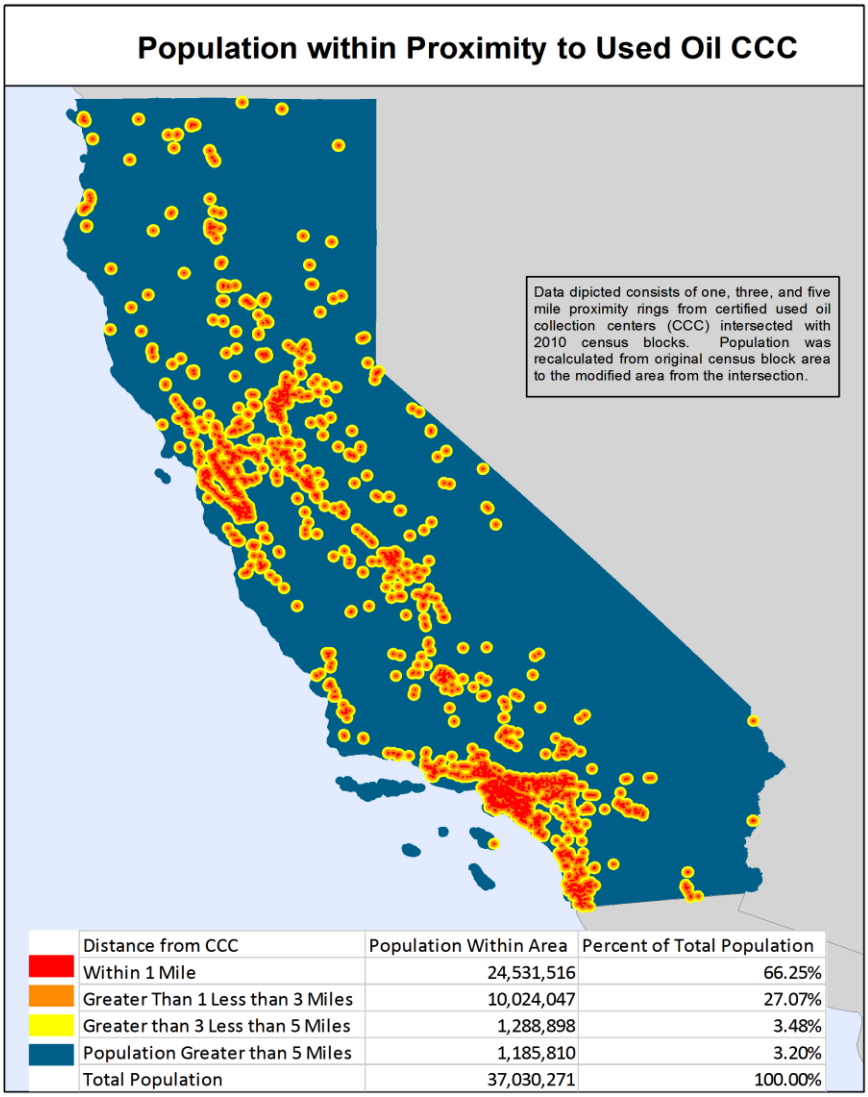
They may also be entities generating non-DIY oil onsite, such as the DIFM generators described above, like Jiffy Lube. Non-certified collection centers include facilities that collect oil but who are not associated with the CalRecycle Certified Collection Center program. Among all used oil collection centers, the CCCs are the main focus in this cost-benefit analysis, though the non-certified centers are also affected within the DIFM generator category. Taken as a group, collection centers are an important link in the used oil management system because they facilitate responsible collection and are likely to play an important role in improving future collection rates.

According to the most recent data available, California had about 3,300 CCCs, or roughly 1 per 11,500 people. [20] This ratio is about 8 1/2 times higher than the minimum statute requirement of 1 center per 100,000 people. Additionally, as Figure 2.3 below shows, roughly 97 percent of the population lives within a five-mile radius of a CCC. Thus, there appears to be an adequate number of existing CCCs in the state to meet the increased demand for oil collection under the scenarios modeled in this study.[21]

[20] Oil Recycling and Claims Automation System (2012). Data received via email communication with CalRecycle staff December 2012.

[21] There may be some pockets of used oil generators, particularly in remote rural areas where access to CCCs may be limited. Analyzing such geographic disparities was beyond the scope of this study.

Figure 2.3: California CCCs by Location



Distance from CCC	Population Within Area	Percent of Total Population
Within 1 Mile	24,531,516	66.25%
Greater Than 1 Less than 3 Miles	10,024,047	27.07%
Greater than 3 Less than 5 Miles	1,288,898	3.48%
Population Greater than 5 Miles	1,185,810	3.20%
Total Population	37,030,271	100.00%

Source: CalRecycle

Table 2.5 below provides a summary of the key inputs used to estimate the costs for used oil collection locations, in conjunction with the results from the direct impacts model.

Table 2.5: Used Oil Collection Center Assumptions

Service Station/Quick Lube shops	
Oil Change Rate Charged by Quick Lube Shops (2011$)	$37
Cost of Goods for Oil Change (2011$)	$16
Quick Lube Hourly Wage (2011$)	$10
Oil Change Length of Time	0.50
Cost of Oil Change to Quick Lube Shops (2011$)	$21
Auto Parts Store	
Percentage of DIY Oil Dropped Off at Auto Parts Stores	75%
Average DIY Expenditure per Trip on Other Goods (2011$)	$0
CCC Incentives	
Baseline Percentage of Incentives Uncollected by DIY	95%
Scenario Percentage of Incentives Uncollected by DIY	95%
On-site generator Percentage of Incentive Collected	100%
CCC Feedstock Payments	
Payment from Haulers to CCCs	$0.30

Source: Regional Breakdown of Fast Lube Operator's Survey

Collection centers receive both DIY lubricating used oil and non-DIY lubricating used oil (from DIFMs). There are two types of collection centers in particular for which costs and benefits were analyzed: service stations/quick lube shops, and auto parts stores. Service stations/quick lube shops incur costs through parts and labor required for additional oil changes. The cost of an oil change ($21) is the sum of the cost of goods ($16) and one-half hour of labor (0.5*$10) for the service station.[22] The price charged for an oil change is assumed to be $37. As discussed in the previous section, it is assumed that no new oil changes are necessary as a result of a change in oil collected, under the scenarios currently considered.

A study of DIYs in Orange County found that 73 percent of DIYs return their used oil to an auto supply store.[23] Auto parts stores are assumed to not incur additional costs as a result of increased oil drop-offs. As discussed in the DIY section, prior CalRecycle studies indicated that auto parts stores may receive additional revenue from DIY spending on automotive parts and accessories at their stores when they drop off used oil. Based on discussions with stakeholders and anecdotal survey data, however, the cost-benefit study assumes that there is no additional spending as a result of incremental oil dropped off by DIYs.

Under the current conditions, the biggest advantage of being a CCC appears to be that CCCs receive a benefit in the form of incentives uncollected by those providing the used oil, with the

[22] Regional Breakdown of Fast Lube Operator's Survey. 2011.

[23] "Household Hazardous Waste Study". The Redhill Group. June 2012.

amount of incentives collected being a function of the incremental gallons of used oil collected. DIYs are assumed to collect only 5 percent of the incentives, and the cost-benefit analysis assumes CCCs retain the remaining 95 percent of the incentive amounts. DIFM generators (sometimes referred to as onsite generators) are assumed to collect 100 percent of the non-DIY incentives.

Collection centers also receive an incremental benefit in payment received from haulers for their used oil, which was set equal to the price of used oil, as given by the direct impacts model.

Used Oil Haulers

Haulers are licensed hazardous waste transporters. As of 2010, there were approximately 100 companies that hauled used oil in in the state of California. Some of the recyclers have affiliations with specific transporters. For instance, both Evergreen Oil and DeMenno/Kerdoon operate hauling services (DeMenno/Kerdoon is associated with Asbury Environmental Services) which are the primary transporter of used oil to the facilities. These two entities combined accounted for more than 50 percent of the 83 million gallons of used oil hauled in 2010. See Table 2.6 for a breakdown of the top haulers in the state, accounting for more than 75 percent of used oil hauled in California.

Table 2.6: Largest Used Oil Haulers in California in 2010, by Volume Collected

Facility Name	Total Gallons	Percentage of Oil Hauled
Asbury Environmental Services-Compton	27,399,920	32.8%
Evergreen Environmental Services (Newark)	16,814,857	20.2%
Pan Pacific Petroleum	3,664,164	4.4%
Elite Oil Transport	3,446,023	4.1%
Clean Tech Environmental	2,354,838	2.8%
Espinoza Trucking, Inc.	2,048,094	2.5%
American Oil Company	2,046,209	2.5%
Rio Express Corporation	1,907,445	2.3%
J.B. Trans Services, Inc (dba) All Phase Env.	1,826,408	2.2%
Fremouw Environmental Services	1,348,355	1.6%
Golden Eagle Oil Refinery	1,243,297	1.5%
Total	**64,099,610**	**76.8%**

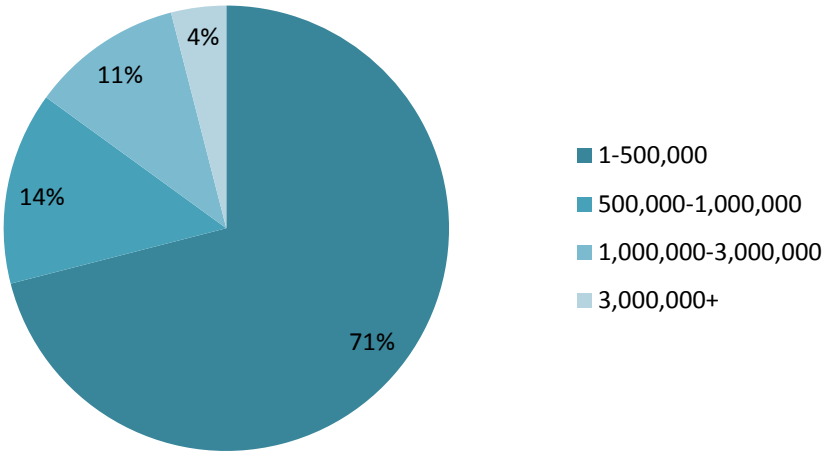
Source: CBA Assumptions; CalRecycle MFA data, 2012

There are several certified independent companies which have a choice of where to take their used oil[24] (LLNL 2008). These independent carriers may take their oil out of state if out-of-state facilities pay more for the used oil than in-state facilities. Many of these are either smaller firms or firms in which hauling used oil is a small part of their operation. In 2011, a little more than 70 percent of firms hauling used oil in California collected less than 500,000 gallons. See Figure 2.4 for a breakout of haulers by volume of oil collected. As a group, haulers are probably the most

[24] Lawrence Livermore National Laboratory study for CalRecycle, 2008.

susceptible to higher costs because the independent ones tend to be small and vulnerable to drastic changes in the used oil market.

Figure 2.3: 2010 Volume of Used Oil Collected by California Haulers (Gallons)



Source: CalRecycle MFA data, 2012

Table 2.7 below summarizes the operating cost assumptions for haulers that are used in the cost-benefit analysis.

Table 2.7: Used Oil Hauler Assumptions

Payment for feedstock	
Amount Paid by Generators to Haulers per Gallon for Hauling Away Small Volumes	$0.88
Amount Paid to Generators by Haulers per Gallon for Hauling Away Large Volumes	$0.30
Percentage of CCCs That Handle Small Volumes	0%
Percentage of CCCs That Handle Large Volumes	100%
Payment to CCCs	$0.30
Percentage of Industrial Generators That Handle Small Volumes	5%
Percentage of Industrial Generators That Handle Large Volumes	95%
Average Value Haulers Pay to Industrial Generators	$0.24
Percentage of Industrial Oil Generators That Handle Small Volumes	0%
Percentage of Industrial Oil Generators That Handle Large Volumes	100%
Average Value Haulers Pay to Industrial Oil Generators	$0.30
Operation Costs	
Truck Operation Costs ($/gallon)	$0.20
Rail Operation Costs ($/gallon)	$0.30
Revenue	
Recyclers Payment to Haulers ($/per gallon)	$0.75

Export Mode	
Percentage Moved by Truck	8%
Percentage Moved by Rail	92%

Source: CBA Assumptions; CalRecycle material flow analysis data; confidential industry source; Massachusetts Department of Environmental Protection

As discussed above in the non-DIY section, haulers were assumed to be paid $0.88[25] per gallon by industrial generators for hauling away small volumes of used oil, and were assumed to pay generators/collection centers $0.30/gallon (the price of used oil in the direct impacts model) for hauling away large volumes of used oil. Both used lubricating oil hauled from collection centers and used industrial oil hauled from industrial oil generators were assumed to be supplied in large volumes, and thus haulers were modeled as paying $0.30 per gallon for those amounts as well.

For the purposes of this analysis, all in-state hauling was assumed to be performed by trucks. Operation costs for trucks are assumed to range from $0.10-$0.20 per gallon of used oil.[26] The model user can choose whether to evaluate costs at "Low" or "High" from the drop-down on the Recyclers sheet. The payment received by haulers from recyclers for used oil was estimated to be $0.55-$0.75 per gallon.

Out-of-state hauling was assumed to be performed by both rail and truck. The split of used oil hauled by rail versus truck was calculated using export statistics from CalRecycle's material flow analysis data. The export data was analyzed using specific bins with ranges in gallons exported (i.e., 100-500, 500-1500, etc.) and the count for the number of exports which fall into each of these ranges.

The analysis assumed that smaller export volumes (less than 4,000 gallons) would be transported by trucks, while larger volumes (greater than 4,000 gallons) would travel by rail. From these assumptions, it was determined that about 8 percent of exported oil would be hauled by trucks (small amounts), while the remaining 92 percent would be exported by rail (large amounts). Because of the lack of reliable data on this rail/truck split for out-of-state hauling volumes, the Sensitivity Analysis section below shows the impact on overall costs of varying this assumption.

To obtain operation costs, these export amounts by mode were then multiplied by operational costs for trucks and rail. Truck and rail operation costs were approximated based on information obtained from a confidential source and these estimates can be updated with new data if needed.

The current analysis assumed that no new purchase of trucks would be required to handle the increased amount of oil collected. Based on discussion with an independent hauler, the current fleet appears to operate at 80 percent capacity and the carrying capacity per truck was estimated to be about 3,500 gallons.[27] Thus, each truck was estimated to currently be carrying about 2,800 gallons of used oil per trip on average. With about 96.3 million gallons of used oil currently

[25] Massachusetts Department of Environmental Protection. 2012. Statewide Contract FAC53, Category 1, Hazardous Waste Collection and Disposal. Available at: http://www.mass.gov/dep/recycle/reduce/fac53c1.pdf.

[26] Range estimated from point estimates received from various sources, including some confidential data and stakeholder inputs.

[27] Email communications with independent hauler operating in California. February 2013.

collected for in-state recycling (all assumed to be hauled by trucks) and 14 million gallons exported (8 percent of which was assumed to be hauled by trucks, or 1.2 million gallons), our analysis estimated that about 35,000 truck trips annually are necessary to haul all used oil (97.5 million gallons/2,800 gallons per trip). Assuming 20 percent underutilized capacity implies about 700 gallons of capacity unused per trip, and this means that about 24.5 million gallons of truck capacity is currently unused. Therefore the increase in amount of used oil collected as modeled under various scenarios is well within the remaining 20 percent capacity.[28]

Used Oil Recyclers

Our analysis focuses on three categories of used oil recycled products: re-refined base lube stock, recycled fuel oil, and marine distillate oil. Re-refiners produce re-refined base oil from used lubricating and industrial oil. The process includes vacuum distillation and either solvent extraction or hydrotreating, with co-products including asphalt flux and light fuels. Evergreen is the only re-refinery operating within the state.

Marine distillate oil (MDO) facilities produce light distilled fuel commonly referred to as marine diesel oil. DeMenno Kerdoon/World Oil is the only such producer operating in the state. The MDO process commonly includes atmospheric and vacuum distillation, and co-products include asphalt flux and light fuels.

Recycled fuel oil (RFO) facilities produce heavy non-distilled fuel. There is minimal to no processing, though a small amount of de-watering and coarse filtration may occur, and no co-products are produced. Producers of RFO include Evergreen, DeMenno Kerdoon/World Oil, and Veolia.

Table 2.8: Used Oil Recyclers Capital Expenditure Assumptions

	Low			High		
	RFO	MDO	Re-refined	RFO	MDO	Re-refined
$/Gallon of Capacity	$0.15	$0.85	$2.00	$0.50	$1.45	$3.00

Source: CBA Assumptions; Safety-Kleen SEC IPO registration filing; Confidential Industry Source; NORA 2013.

Capital expenditures for used oil recyclers were obtained from stakeholder input, public documents on company financials, and confidential sources. Low and high estimates were developed in the cost-benefit model, and the user is able to choose whether to evaluate costs at low or high estimates on the Recyclers worksheet. RFO estimates were received from NORA, with the low estimate corresponding to $/gallon for building a 10 million gallon facility and high estimate corresponding to the $/gallon required to build a 2 million gallon facility.[29]

[28] Some stakeholders have pointed out that the level of truck capacity underutilization assumed in this study may be simplistic. While it is possible that the information obtained from one independent hauler, which is what this assumption is based on, is not representative of the entire hauling industry, the lack of actual data for a bigger section of the hauling segment precludes this cost-benefit analysis from using any other assumption.

[29] Email communication with Jack Waggener from NORA. February 5, 2013.

Re-refinery capital expenditure estimates were obtained from Safety-Kleen's IPO Registration Document.[30] The low estimate corresponds to a newly built 50 million gallon capacity re-refinery, while the high estimate corresponds to a 30 million gallon re-refinery capacity expansion. The general approach is to base the low unit cost estimates on larger facilities (i.e., new capacity built) because of economies of scale and to base the high unit cost estimates on scenario outcomes where there is a need to expand existing facilities (and hence could involve less economies of scale related cost advantages). However, this does not imply that the total cost for capacity expansion would be higher than for new construction. Costs are dependent on total capacities and in most situations new construction will cost more than capacity expansion, all else equal.

Point estimates of capital expenditures for marine distillate oil (MDO) were received from a confidential source, and a range was estimated based on these figures. For all products, capital expenditures are spread out over a two-year construction period, with one-third spent in Year 1 and the remainder spent in Year 2.[31]

Table 2.9: Used Oil Recyclers Operation Cost Assumptions

$/gallon	Low			High		
	RFO	MDO	Re-refined	RFO	MDO	Re-refined
Collection	$0.15	$0.15	$0.15	$0.25	$0.25	$0.25
Transportation	$0.10	$0.10	$0.10	$0.20	$0.20	$0.20
O&M (Fixed and Variable)	$0.10	$0.20	$0.40	$0.15	$0.35	$0.65
Total Operating Cost	$0.35	$0.45	$0.65	$0.60	$0.80	$1.10
Feedstock	$0.30	$0.30	$0.30	$0.30	$0.30	$0.30
Total Production Cost	$0.65	$0.75	$0.95	$0.90	$1.10	$1.40

Source: CBA Assumptions; Range estimated from point estimates received from various sources, including some confidential data and stakeholder inputs.

Production costs are applicable for increased capacity utilization at existing facilities or new capacity expansions, if needed (though as discussed, direct impacts model results do not predict the need for new capacity). Production costs include transportation, collection, O&M of facility, and cost of obtaining the feedstock.[32] Only O&M costs are assumed to be different between the three types of recyclers, with re-refineries having the highest O&M costs and recycled fuel oil the lowest (see Table 2.9 above). The model user can choose to evaluate costs under "High" or "Low" cost assumptions.

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[30] United States Securities and Exchange Commission Form S-1. Safety-Kleen, Inc.

[31] The list of scenarios analyzed in this cost-benefit analysis does not include any with the need for new capacity construction. Hence, the cost assumptions discussed here currently not used in any calculations. They are presented in this section so that future analyses can evaluate scenarios with new construction or capacity expansion, if such a need is deemed necessary.

[32] Operating costs are presented in a range from a low and high, using information obtained from confidential data sources. Model users can change whether a low or high estimate is selected.

The model assumes that recycled products displace other products at a 1:1 ratio by volume. For instance, a 2 million gallon increase in re-refined base oil production was assumed to have a 2 million gallon displacement of virgin lube production. This modeling choice was based on simplifying assumptions because of the lack of data on estimating other displacement assumptions and to be consistent with the life cycle assessment study. The relationship between marine distillate oil and diesel and between recycled fuel oil and residual fuel are also modeled using this simplifying assumption. Revenues for these displaced products are based on the product prices, as given by the direct impacts model (DIM). Given a lack of data on production costs for these displaced products (such as diesel and residual fuel), production costs are assumed to be the same as the product they displace.[33]

Manufacturer's fees, subsidies, and incentives were calculated based on the changes in gallons recovered, as modeled by the DIM, and the fee/subsidy/incentive amount. The incremental change was calculated as the amount of the fee/subsidy/incentive for each gallon collected under the scenario, net of the amount of the fee for each gallon collected under the baseline.

Program Administrative Costs for State and Local Jurisdictions

State Government Unit Costs

The estimated unit costs of state operation of the Used Oil Recycling Program were calculated based on State of California expenditure summaries for the years 2009 through 2011. The calculated average unit cost is $0.055/gallon of used oil sold in the state and thereby managed by the state. The data are summarized in Table 2.10 below.

Table 2.10: Estimated Unit Costs of State Operations ($/gal managed) ("direct" costs excl. state-funded local government costs) for the Used Oil Recycling Program

Year	Total Lube and Industrial Oil Sales (million gal)	State Operation Expenditures (in thousands)	State Ops $/Gal Lube and Industrial Oil Sales
2009	228.7	$11,576	$0.051
2010	233.0	$14,064	$0.060
2011	261.0	$14,267	$0.055
Average			**$0.055**

Source: Based on CalRecycle sales data, on recovery data reported in the UC Santa Barbara material flow analysis (2013), and on the Governor's budget for the used oil recycling fund, CalRecycle Used Oil Recycling Fund Condition Statement.

[33] In theory, production costs for displaced products are likely to be slightly higher on the margin, but these differences are assumed to be small and negligible for estimating *total* costs for all recyclers under a given scenario.

Unit Cost of Managing and Recycling Used Oil by Jurisdictions in California

The unit cost of managing and recycling used oil by local jurisdictions (net of the value of oil) was estimated using expenditures reported by local jurisdictions to CalRecycle for three recent fiscal years (2009 through 2011) and the corresponding quantities of used oil in the CalRecycle databases. The expenditures consist of those reported by jurisdictions under the State's old funding program, Oil Recycling and Claims Automation System (ORCA) and its predecessor program Oil Recycling Payment Program Online (OPPO) and from in-kind expenditures reported by the jurisdictions.

The quantities of used oil are those reported and compiled for DIY (curbside, agriculture, temporary events, non CCCs, household hazardous waste collection centers, marinas) and for DIFM (Certified Collection Centers, industrial generators, filter crushers). The average total expenditures and quantities of oil recycled, respectively, over the three-year period were approximately $14.2 million and 26 million gallons per year (shown in the last column in Table 2.11 below). The calculated average unit cost of used oil recycled is approximately, $0.55/gallon, as shown in Table 2.11 below.

Table 2.11: Estimated Unit Cost of Used Oil Programs Managed by Local Jurisdictions

	FY 2009/10	FY 2010/11	FY 2011/12	Annual 3 Years
Total Expenditures [a]	$10,149,048	$11,413,687	$21,076,071	**$14,212,935**
Total Gallons of Used Oil Managed [b]	25,608,404	26,807,811	25,243,628	**25,886,614**
Average Unit Cost ($/gal.)	$0.40	$0.43	$0.83	**$0.55**
Number of Reporting Jurisdictions	222	213	222	**219**

Notes:

[a] Sources: 2012 data from CalRecycle's Oil Recycling and Claims Automation System (ORCA) and Oil Recycling Payment Program Online (OPPO) and in-kind expenditures reported to CalRecycle by local jurisdictions.

[b] Total DIY (curbside, agriculture, temporary events, non CCC's, HHW, marinas) and DIFM (CCC's, industrial generators, filter crushers).

Costs of Programs at the State and Local Levels

In order to implement these unit costs for different scenarios and estimate the total incremental costs, the ICF and CalRecovery team developed a rating and quantification scheme to estimate the costs of used oil management and recycling at the state and local jurisdictional level for each of the scenarios selected in the study for cost-benefit modeling and analysis. The development of the rating system consisted of identifying key responsibilities (e.g., key tasks and work required) of the state and of the local jurisdictions for implementing the conditions and requirements of each scenario. Then, the relative level of effort was estimated based on the perceived degree of change from the status quo in terms of complexity of the scenario; quantities of potentially additional collected and recycled used oil; need for new or modified services, methods, policies, and regulations; and other factors depending on the particular scenario. The relative costs of achieving the goals under each scenario were then estimated for the state and local jurisdictions based on the perceived level of effort to plan and implement the required programs. A rating

range of low to high was used to value the level of effort and, therefore, cost of implementing the scenarios. The key responsibilities and relative costs for each scenario of the study are shown in Table 2.12 below.

Table 2.12: Costs/Responsibilities at State & Local Levels

No.	Scenario Description	STATE		LOCAL	
		Elements	Relative Cost (High, Med, Low)	Elements	Relative Cost (High, Med, Low)
Sn1 & Sn1b	Adjust DIY recycling incentive payment across a reasonable range	A. State staff effort to change amount of fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Low	A. Could require local effort if jurisdictions decide or need to increase means of collection and storage of used oil.	Low to Medium
Sn2 & Sn2b	Adjust "industrial" and "on-site" recycling incentive payment across a reasonable range	A. State staff effort to change amount of fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Low	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low

No.	Scenario Description	STATE		LOCAL	
		Elements	Relative Cost (High, Med, Low)	Elements	Relative Cost (High, Med, Low)
Sn3 & 3b	Include industrial oils in the incentive program and enhance collection opportunities for industrial oil users	A. State staff effort to create and monetize the fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Medium	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low
Sn 4 & 4b	"Market Based"	A. State staff effort to create and monetize the fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Medium	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low

No.	Scenario Description	STATE		LOCAL	
		Elements	Relative Cost (High, Med, Low)	Elements	Relative Cost (High, Med, Low)
Sn5	Adjust the differential between the manufacturer's fee paid on virgin lube vs. re-refined lube	A. State staff effort to change amount of fee. B. Incremental state staff administration of fee is zero unless significant increase in number of facilities or haulers which require permits.	Low	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low
Sn6	Adjust re-refining incentive across a reasonable range	A. State staff effort to change amount of fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Low	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low

No.	Scenario Description	STATE		LOCAL	
		Elements	Relative Cost (High, Med, Low)	Elements	Relative Cost (High, Med, Low)
Sn7	Create distillate fuel incentive and analyze across a reasonable range	A. State staff effort to create incentive and monetize the fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in no. of facilities or haulers which require permits.	Med	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low
Sn8	Create non-distillate fuel incentive and analyze across a reasonable range	A. State staff effort to create and monetize the fee. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Med	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low

No.	Scenario Description	STATE		LOCAL	
		Elements	Relative Cost (High, Med, Low)	Elements	Relative Cost (High, Med, Low)
Sn9	Impacts of tiered fee structure	A. State staff effort to change amount of the fees. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Low	A. Should have little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Low
Sn10	Impacts of tiered incentive structure	A. State staff effort to change amount of the fee and incentive amount. B. Incremental change associated with state staff administration of fee is likely small unless significant increase in number of facilities or haulers which require permits.	Low	A. Should be no or little incremental cost effect since this scenario affects businesses. Local impact would be number and capacity of facility permits.	Zero to Low

Source: CalRecovery Cost Estimation, 2013.

The relative cost ratings shown in Table 2.12 were used to monetize the cost of state and local government by assuming a percentage increase in the unit costs of managing oil. Table 2.13 below shows the values used to convert these rankings into $/gallon costs of managing oil in California. State costs are modeled to apply to all oil in the system (virgin products and recovered), while local costs are applicable to recovered oil only.

Table 2.13: Converting Ordinal Rankings into Incremental Government Cost Estimates

State			Local		
Ranking	**Percentage Increase**	**Quantified Estimate ($/gallon)**	**Ranking**	**Percentage Increase**	**Quantified Estimate ($/gallon)**
Zero	0%	$0.055	Zero	0%	$0.55
Zero to low	2.5%	$0.056	Zero to low	1%	$0.56
Low	5%	$0.058	Low	2%	$0.56
Low to Medium	10%	$0.061	Low to Medium	3%	$0.57
Medium	15%	$0.063	Medium	4%	$0.57
Medium to High	20%	$0.066	Medium to High	5%	$0.58
High	25%	$0.069	High	6%	$0.58

Source: CalRecovery Cost Estimation, 2013.

Approach to Estimating Environmental Benefits

Benefits Transfer for Air Pollution Emissions

The benefits transfer method was used to account for the benefits attributable to changes in air emissions arising from the various used oil scenarios. Ideally, original valuation studies would have been conducted to determine the monetized impact of changes in emissions in California attributable to scenarios modeled in this cost-benefit analysis. The benefits transfer method allows for non-market resources to be valued appropriately—when primary valuation studies are not an option because of time and resource constraints—by adapting values from a study site to a policy site. The benefits transfer approach has been used in an array of regulatory and policy analysis situations by government entities at the federal and state levels.

Government agencies including the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, and the U.S. Forest Service began publishing benefits transfer-type values for use in project evaluations and planning in the early 1970s and the method has been more widely adopted in cost-benefit analysis since that time. In addition, natural resource economists Randall Rosenberger and John Loomis began to formalize the theory, protocol, and approaches to conduct benefits transfer in the early 1990s.[34] Additionally, the 2009 Economic Report of the President discusses a number of U.S. Environmental Protection Agency clean air regulations that employ benefits transfer estimation procedures.[35]

Rosenberger and Loomis described the benefits transfer method and how it should be applied. In general, benefits transfer can be done in one of two ways: point value transfer or function transfer. Function transfer takes a statistical model from one policy context and applies it to another. Point value transfer takes a measure of marginal impact from a study site and applies it to a policy site. Rosenberger and Loomis provided more in-depth descriptions of the two benefit transfer methods:

> Function transfers are more technically oriented than value transfers. They entail the transfer of functions or statistical models that define relationships between vectors of data collected at a study site… The category of function transfers may be categorized as demand (or benefit or WTP) functions' or meta-regression analysis functions. Function transfers are generally considered to perform better than value transfers… This increased accuracy is because function transfers may be tailored to fit some of the characteristics of the policy site.
>
> Value transfers, on the other hand, are invariant to differences between the study site and the policy site. Value transfer is the direct application of original research summary statistics (such as per unit measures of willingness to pay (WTP), measures of elasticity, or other measures of marginal effects) to a policy site. There are essentially three approaches to conducting value transfers, including transfers of

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[34] Rosenberger, R. and J. Loomis. 2003. Benefits Transfer (Chapter 12). In Champ, P, K. Boyle and T. Brown (eds) A Primer on Nonmarket Valuation. Kluwer Academic Publishing. Dordecht.

[35] Economic Report of the President. 2009. U.S Government Printing Office. p. 115. Available at: http://www.gpo.gov/fdsys/pkg/ERP-2009/pdf/ERP-2009.pdf.

point estimates, transfers of measures of central tendency, and transfers of administratively-approved estimates.[36]

In the context of the CalRecycle used oil study, the point value transfer approach was selected for its relative ease of implementation as compared to function transfer. A point value transfer works well in this context because the values transferred fit most closely into the category of "administratively approved estimates" since they were created for use in government regulatory analyses. In addition, a function transfer was not feasible in this study because of limitations in the availability of studies from which data and functions could be drawn and the complexities of attempting to match a function from a source to the policy context in California.

Rosenberger and Loomis identified a number of steps in the process of conducting a point estimate transfer that are relevant to the current study. These steps are quoted below:

Step 1: Define the policy context. This definition should include various characteristics of the policy site, what information is needed, and in what units.

Step 2: Locate and gather original research outcomes. Conduct a thorough literature review, and obtain copies of potentially relevant publications.

Step 3: Screen the original research studies for relevance. How well does the original research context correspond to the policy context? Are the point estimates in the right units, or can they be adjusted to the right units? What is the quality of the original research?

Step 4: Select a point estimate or range of point estimates. This point estimate or range of point estimates should have the best fit out of the candidate estimates.

Step 5: Transfer the point estimate or range of point estimates. Aggregate the point estimate to the policy site context by multiplying it by the total number of units, providing a total value estimate for the good or service at the policy site.

In steps 2 and 3, the analysis performed a detailed review of relevant studies and government publications to determine the best source of point estimates. After careful analysis of a variety of sources for transfer values, the analysis chose to use point estimates sourced from an EPA Regulatory Impact Analysis as well as CO_2 values from a U.S. intergovernmental panel report on the social cost of carbon.

The EPA analysis focused its analysis on monetizing the morbidity and mortality impacts of air pollution, and incorporated the latest research into the dose-response relationships of the air pollutants in question. The intergovernmental panel report on the social cost of carbon evaluated changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services affected by climate change.

The analysis considered whether California-specific air pollution transfer values would be appropriate, but made the determination that the most authoritative values available were those calculated by EPA for the United States as a whole. Because the benefit values chosen for this

[36] Rosenberger, R. and J. Loomis. 2003. Benefits Transfer (Chapter 12). In Champ, P, K. Boyle and T. Brown (eds) A Primer on Nonmarket Valuation. Kluwer Academic Publishing. Dordecht.

analysis were sourced from national level studies, they may not exactly match the California context in terms of demographics and subsequent health impacts. However, the point values selected represent the most scientifically sound estimates available to this CBA analysis. Original $-per-ton benefit (BPT) values for $PM_{2.5}$, VOC, SO_2, and NO_x were obtained from the regulatory impact analysis for the Petroleum Refineries NSPS.[37] Values for CO_2 emissions were obtained from a separate EPA study on the Social Cost of Carbon.[38] These values were adjusted from 2007$ to 2012$ using the GDP deflator and converted to $/kg to be consistent with the physical units used in the life cycle assessment outputs.

In order to apply the point values sourced from these studies, it was necessary to adjust the original value to account for changes in income, convert to a common dollar year, and then, in order to match the units output from the life cycle assessment (LCA), convert to $/kg units. The following discussion outlines the steps that were taken to make the necessary adjustments.

Adjustments to Point Value Estimates of Benefits and Transferring the Estimates

Dollar years were adjusted to 2012 dollars using the GDP deflator series from the Federal Reserve Economic Data (FRED).[39] The original per-ton benefits values from the petroleum refineries regulatory impact analysis were in 2006 dollars. To convert these values to 2012$, the original values were multiplied by the ratio of the 2012 GDP deflator to the 2006 GDP deflator.

Next, the values were converted from $/ton to $/kg. This step was taken so that the emissions values obtained from LCA (in kilograms) would be compatible with the transferred emission values. A conversion factor of 907.2 kg/short ton was used to arrive at the $/kg values.

The emissions values were next adjusted to account for income elasticity and the analysis year. The analysis year is the year in which the emissions occur in the original source. An EPA memorandum provided guidance on how to adjust willingness to pay (WTP) values for changes in income growth.[40] This adjusts both the analysis year and for income growth. The subscript A in the equation below indicates the original estimated value from the EPA regulatory impact analysis in the original analysis year (2017). The subscript B in the equation indicates the adjusted California value in a new analysis year (from 2011-2016 and 2017-2030).

$$WTP_B = WTP_A \text{ X } (Income_B/Income_A)^{\text{WTP elasticity}}$$

This formula does not account for potential differences in WTP to reduce the risk of premature death or morbidity among different age groups. Because the EPA source estimates did not make

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[37] Regulatory Impact Analysis for the Petroleum Refineries NSPS. April 2008. http://www.epa.gov/ttn/ecas/regdata/RIAs/finalpetroleumrefineriesnspsria43008.pdf.

[38] Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866: Interagency Working Group on Social Cost of Carbon, United States Government. February 2010.

[39] Federal Reserve Economic Data. GDP Deflator Series. http://research.stlouisfed.org/fred2/series/USAGDPDEFAISMEI.

[40] Memorandum: Updating Income Elasticity Estimates in EPA's BenMAP Air Pollution Benefits Estimation System. March 31, 2012. http://www.epa.gov/ttn/ecas/regdata/Benefits/IncomeElasticityUpdate_Recommendationswithappendices.pdf.

this distinction, the analysis determined that it would not be incorporated into this study. The income values used were national estimates of per capita GDP and included both historical data and projected data to 2030. A single estimate for the income elasticity of willingness to pay (WTP) to avoid pollution was chosen for these calculations. The selected elasticity, 0.65, is sourced from the EPA guidance memo and represents the central estimate for income elasticity for avoiding premature mortality. The set of income elasticity estimates from the EPA guidance memo are presented in Table 2.14 below.

Table 2.14: Income Elasticity Estimates

Health Endpoint	Low Estimate	Central Estimate	High Estimate
Minor Health Effects	0.06	0.3	0.7
Severe and Chronic Health Effects	0.38	0.68	1.25
Premature Mortality	0.2	0.65	1.44

Source: EPA and Industrial Economics Memorandum: Updating Income Elasticity Estimates in EPA's BenMAP Air Pollution Benefits Estimation System, 2012.

The benefit estimates transferred from EPA regulatory impact analyses combine health endpoints together into one estimate of the benefit per ton for reducing a type of pollutant. For this reason, it would not be possible to adjust benefit values by health endpoints, such as minor health effects, severe and chronic health effects, and premature mortality. The analysis determined that the best course of action in this circumstance was to use a central estimate for premature mortality of 0.65 because this elasticity estimate falls roughly in the middle of the estimated range of elasticities from 0.06 to 1.44. Generally, as income-elasticity-of-WTP increases, the adjusted WTP increases. The resulting estimates of the $/kg and $/ton values for each pollutant are presented in Table 2.15 below.

Table 2.15: Benefit Transfer Values for Air Emissions

Pollutant	2015		2020		2025		2030	
	$/kg	$/ton	$/kg	$/ton	$/kg	$/ton	$/kg	$/ton
$PM_{2.5}$	$408.45	$370,543	$430.30	$390,366	$457.13	$414,704	$482.56	$437,776
VOCs	$1.22	$1,109	$1.29	$1,169	$1.37	$1,242	$1.44	$1,311
SO_2	$48.66	$44,140	$51.26	$46,501	$54.45	$49,400	$57.48	$52,149
NO_X	$7.87	$7,144	$8.30	$7,526	$8.81	$7,995	$9.30	$8,440
CO_2	$0.04	$45	$0.05	$51	$0.05	$57	$0.06	$62

Source: EPA NSPS RIA for Petroleum Industry, 2008; Interagency Working Group on Social Cost of Carbon, 2013.

After each of these necessary adjustment steps was made, the estimated benefits were multiplied by the estimated changes in emissions of the criteria pollutants in question. This yielded an estimate of the total benefit attributable to each policy scenario and these results are presented for each scenario in the Results section below.

Categories of Pollutants Not Monetized in the Benefits Transfer

Emissions to land and water are important considerations in the used oil management system, particularly in the context of improper disposal of used oil and policies that could potentially reduce improper disposal and their resultant environmental effects. However, they are not easily monetized through the benefits transfer methodology that has been applied to the air emissions. Since air is relatively homogenous compared to water and land, transferred benefit per ton values can adequately account for the impacts of air pollution due to criteria pollutants.

Valuing the impact of emissions to land and water are much more reliant on modeling within the specific environment in which the emissions occur. Because of this increased difficulty in modeling land and water emission impacts, we have not included these potentially significant benefit streams in this analysis, consistent with prior EPA approaches.[41]

Changes in air emissions of heavy metals, namely lead, are modeled through the life cycle assessment process. Previous research has shown these emissions to be a primary source of impacts in the used oil management system, particularly with combustion of recycled fuel oil.[42] However, suitable benefit values from sources such as the EPA are not available for lead and hence are excluded from this analysis.

Lead is a criteria pollutant regulated under the Clean Air Act, and the benefits of reduced emissions are monetized in the Regulatory Impact Analysis (RIA) for the Lead National Ambient Air Quality Standard (NAAQS). However, the monetized impacts of lead exposure are only based on the effect of IQ loss on lifetime earnings. The regulatory impact analysis calls out a number of unquantifiable health effects of lead including other neurobehavioral and physiological effects, premature mortality, hypertension, non-fatal coronary heart disease, non-fatal strokes, and several others.

These health effects are non-monetized because of a lack of consensus and/or because there is an association between the health effect and lead but there is a lack of empirical data to calculate benefits. Because of these issues identified with the best potential source for benefit values for lead, the present analysis determined that these values would not be suitable for transfer and use in the cost-benefit analysis.[43]

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[41] The life cycle assessment study accompanying this cost-benefit analysis, however, reports out actual physical emission changes for all relevant pollutants not included in the monetized benefits transfer. Refer to the life cycle assessment study report for more details.

[42] Boughton and Horvath (2004).

43 Regulatory Impact Analysis of the Proposed Revisions to the National Ambient Air Quality Standards for Lead. October 2008. Chapter 5. http://www.epa.gov/ttn/ecas/regdata/RIAs/finalpbria.pdf.

Distributional Impacts: REMI Modeling

REMI Policy Insight Plus v1.4 was used in the economic modeling portion of the used oil study to measure the wider macroeconomic impacts of the various scenarios analyzed in this study. Thus, the purpose of the REMI modeling exercise was not to model the direct effects on the policy changes on the used oil market, which is done through the direct impacts model and the subsequent cost-benefit analysis discussed here, but to assess the secondary impacts of those changes on the wider economy due to the interdependencies across economic sectors.

The REMI model is a well-established, peer reviewed structural economic modeling, forecasting and policy analysis tool that has been used by numerous national, regional, state, and city governments, as well as universities, nonprofit organizations, public utilities, and private consulting firms since its creation in 1980. While the REMI model was primarily developed for the U.S. economy, over time the modeling platform has been used in other countries in Europe and Asia, using publicly available data sources (such as national I-O matrices).

The REMI model consists of thousands of simultaneous equations that represent fundamental relationships between key economic and social variables and yield response estimates. The model also contains a five-block structure that represents the entire macro-economy: Output and Demand, Labor and Capital Demand, Population and Labor Supply, Compensation, Prices, and Costs and finally, Market Shares.[44]

REMI is particularly well suited for analyzing the secondary impacts in this study because of three key attributes:

1. It provides a dynamic modeling framework with the capability to analyze short and long term impacts.
2. Hybrid computable general equilibrium (CGE) with high-level of sector granularity: includes features of CGE modeling and input-output modeling techniques along with detailed econometrically estimated relations across sectors.
3. Flexible modeling framework and range of output options: model is able to accommodate a range of input types and produces a variety of economic and demographic output options

First, the model is capable of producing results on a year-by-year basis throughout the 20-year modeling timeframe (through 2030) in this study. This dynamism is critical to accurate forecasting as many policies or impacts of the various used oil scenarios will have different impacts over time and thus it is necessary to capture both the short- and long-term impacts.

In addition to being a dynamic modeling framework, another advantage of the REMI model is that it is able to assess distributional impacts. In this case, outputs were reported for various regions in California and the rest of the United States. This granularity was particularly useful for this study because it allowed for the analysis of how policies could affect certain regions or industries disproportionately.

And lastly, the model is flexible enough that it can provide a wide variety of output options for a range of policy scenarios.

[44]REMI PI+ V 1.3 Model Equations, Regional Economic Models Inc, 2011.

In this study, REMI was used to model the macroeconomic and distributional impacts of the various used oil scenarios on different sectors and regions that are not captured by the modeling performed in the life cycle assessment LCA) and cost-benefit analysis (CBA). Because REMI is a dynamic regional economic impact model, it allows for a second-stage analysis to be conducted that uses outputs from the direct impacts model and CBA as inputs and provides projections of the distributional impacts of the used oil policy scenarios being analyzed. The REMI model provided the ability to forecast impacts over time, across industry sectors, and among regions. In this study, the analysis modeled impacts through 2030 and across five regions.

REMI can produce a wide variety of economic and demographic outputs. Some of the outputs that can be evaluated from REMI results include overall employment levels, employment by industry sector, value added output, output by sector, changes in income, and population or demographic shifts. In this study, the analysis focused on analyzing the impacts to employment and value added output.

The specific REMI model configuration used for this study included 70 industry sectors that roughly correspond to three-digit NAICS classification. The model included the following five regions: San Francisco Bay Area; Southern California; Northern California (rest of state); neighboring states of Oregon, Nevada, Utah, and Arizona; and the rest of the United States

The counties of California are divided into the three regions according to the organization in Table 2.16.

Table 2.16: Organization of California Counties into REMI Regions

NorCal		SoCal	Bay Area
• Alpine	• Mono	• Imperial	• Alameda
• Amador	• Nevada	• Kern	• Contra Costa
• Butte	• Placer	• Los Angeles	• Marin
• Calaveras	• Plumas	• Orange	• Monterey
• Colusa	• Sacramento	• Riverside	• Napa
• Del Norte	• San Benito	• San Bernardino	• San Francisco
• El Dorado	• San Joaquin	• San Diego	• San Mateo
• Fresno	• Shasta	• San Luis Obispo	• Santa Clara
• Glenn	• Sierra	• Santa Barbara	• Santa Cruz
• Humboldt	• Siskiyou	• Ventura	• Solano
• Inyo	• Stanislaus		• Sonoma
• Kings	• Sutter		
• Lake	• Tehama		
• Lassen	• Trinity		
• Madera	• Tulare		
• Mariposa	• Tuolumne		
• Mendocino	• Yolo		
• Merced	• Yuba		
• Modoc			

The location of used oil facilities, refiners, and re-refiners in California was the primary determinant in establishing the three California regions in the model configuration. The California regions also differ along other parameters, for example, Northern California is more rural and has a lower population than the San Francisco Bay Area and Southern California.

Inputs to the REMI model for each scenario were derived from the outputs of the cost-benefit analysis (CBA) and the direct impacts model. Changes in incremental revenue, incremental costs, incentives, fees, and net costs generally serve as the inputs to REMI. For example, the scenarios modeled in REMI included the following outputs from the CBA as inputs:

- Net costs for virgin automotive lube producers, virgin industrial oil producers, net costs for re-refineries, recycled marine distillate oil producers, recycled fuel oil producers, asphalt flux producers, diesel producers, and residual fuel producers.
- DIY incentive payments received.
- Industrial oil generators incentive payments.
- Industrial generators of used lubricating oil incentive payments.
- CCC revenue from selling used oil to haulers to export to out of state re-refineries.
- CCC collection of unclaimed DIY and non-DIY incentive payments.
- Hauler revenue from selling used oil recyclers.
- Incremental revenue for truck and rail shipment of used oil out of state for re-refining.

In general, the outputs from the CBA are transferred to REMI inputs by applying them to industry sectors and spreading the value among the regions in California according to the distribution of population or industry concentration in the regions. Not all outputs from the CBA were used as inputs to REMI. For example, the value of DIY time is not incorporated as an input to REMI.

3. Cost-Benefit Analysis Results

Results in this study are discussed in the context of the scenarios in the direct impacts model and subsequently analyzed in the cost-benefit and distributional framework discussed above. Note that, where applicable, these scenarios were run with the recycler's cost module assuming "high" costs, and thus should be considered the upper bounds in terms of operation costs for recyclers and haulers. This choice was made in order to be conservative with the modeling assumptions. Additionally, the model was run using the lower bound for industrial oil price, again to be conservative in modeling assumptions. These inputs can be varied by model users in the cost-benefit analysis model spreadsheet.

This report also includes monetized environmental benefits based on the latest emissions estimates from the life cycle assessment modeling. Additionally, the sensitivity scenarios in which the elasticity of supply is varied in the DIM are not included in the results discussion in this section, but are separately discussed later in this report.

For scenarios where there were significant job gains as output from the REMI model, regional and sector breakouts are provided to demonstrate the variation in impacts across the three California regions. For scenarios that have relatively small job impacts in the REMI model, regional and sector breakouts are not provided because those impacts may be within the range of modeling error in REMI.

Scenario #1: $0.40 Increase in DIY Incentive to $0.80 in 2014

Scenario 1 raises the incentive given to DIYs by $0.40, setting the incentive at $0.80 in 2014 and beyond. This scenario increases used oil collection by 1.6 million gallons, reducing uncollected collectable DIY used oil from 3.4 million to 1.8 million gallons in 2030, with corresponding increases in the amount of lube oil collected.

The CBA modeling assumes only 5 percent of the incentive amount is collected by the DIYs, and the remaining 95 percent of the incentive is retained by the collection centers. The collection centers retain the majority of the incentive because of the requirement that those returning used oil must ask for their incentive payment and the assumption that not many of the DIYs do so.

Scenario #1 CBA Results

The following tables and charts present the results of the cost-benefit analysis for this scenario.

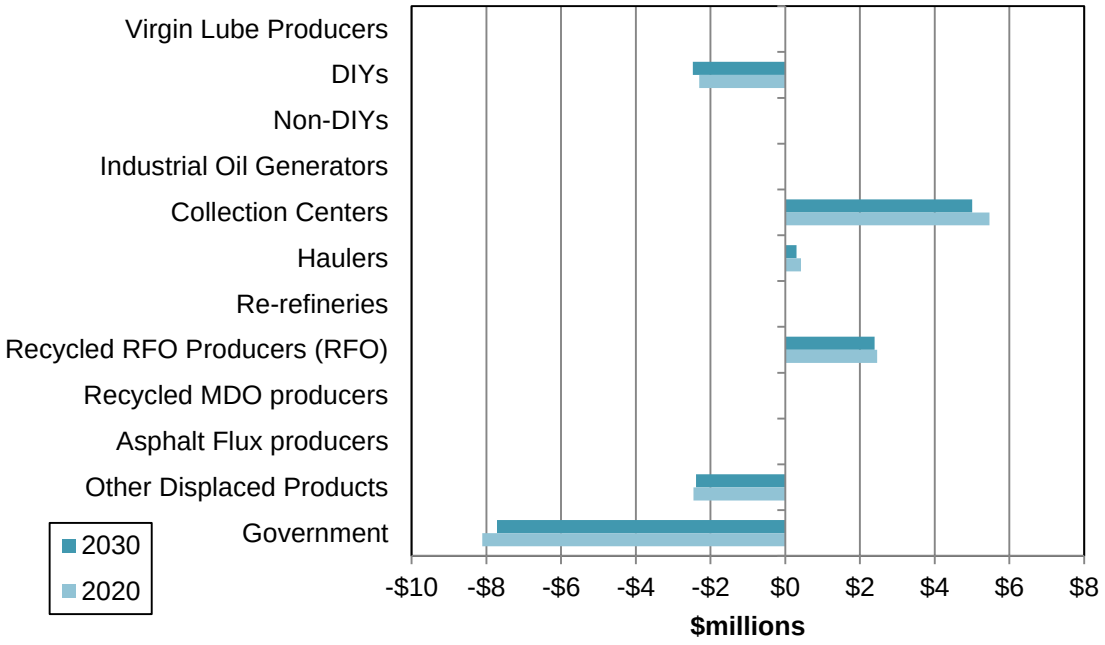
Table 3.1: Scenario 1 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.0	$0.0	$0.0	$0.0
DIYs	-$2.2	-$2.3	-$2.4	-$2.5
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	$5.7	$5.5	$5.2	$5.0
Haulers	$0.4	$0.4	$0.4	$0.3
Re-refineries	$0.0	$0.0	$0.0	$0.0

	2015	2020	2025	2030
Recycled RFO Producers (RFO)	$2.6	$2.5	$2.4	$2.4
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.0	$0.0	$0.0	$0.0
Other Displaced Products	-$2.6	-$2.5	-$2.4	-$2.4
Government	-$8.4	-$8.1	-$7.9	-$7.7
Total	**-$4.4**	**-$4.5**	**-$4.7**	**-$4.9**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.1: Scenario 1 Cost Results in 2020 and 2030



This scenario leads to annual costs of about $4 million to $5 million/year over the course of the modeling period.

DIYs incur slightly above $2 million costs per year due to increases in DIY trips to recycle their used oil. DIY costs are primarily composed of the value of lost leisure time and an increase in travel costs. These costs are partially offset by the increased DIY oil incentive they receive on used oil brought to the collection centers. Note that this offsetting amount is only applicable for 5 percent of the incremental oil recycled, with the remaining 95 percent being collected by the collection centers.

The impact on DIYs was evaluated using the assumption that 60 percent of DIYs take the trip solely for the purpose of exchanging their used oil. Changing this assumption to 100 percent increased overall costs to DIYs by $1.3 million, or 72 percent higher costs.

Collection centers have a net cost saving due to their increased incentive collection, as well as the greater quantities of DIY oil collected under the scenario. The majority of the entities collecting DIY oil are likely auto parts stores, as research has shown that about 75 percent of DIY oil that is returned is brought to auto parts stores.[45]

The increased used oil collected flows towards recycled fuel oil production, according to the direct impacts model and, as a result, displacing residual fuel oil production.

Public sector costs increase due to the higher amount of the incentive payment and increased DIY oil collected. They also incur administrative costs for managing the system under the new program, modeled as "Low" for state government and "Low to Medium" for local government under this scenario.

Table 3.2 below presents the total costs, total monetized benefits and the net benefits for Scenario 1.

Table 3.2: Scenario 1 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	-$4.4	-$4.5	-$4.7	-$4.9
Monetized Benefits	$0.2	$0.2	$0.2	$0.1
Net Benefits	**-$4.2**	**-$4.3**	**-$4.5**	**-$4.8**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding.

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding.

This scenario produces air emission benefits of $200,000 in 2015 and $100,000 in 2030. The largest magnitude of emission benefits in this scenario arise predominantly from a reduction in sulfur dioxide.

Under the assumptions used in this cost-benefit analysis, the net benefits of this scenario are thus between -$4.2 million and -$4.8 million, in 2015 and 2030, respectively, implying an overall net cost to the state due to higher DIY incentives.

Scenario #1 REMI Results and Distributional Impacts

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

[45] "Household Hazardous Waste Study". The Redhill Group. June 2012.

Table 3.3: Scenario 1 Job Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	102	86	72	60
NorCal	19	16	13	11
SoCal	70	61	51	42
Bay Area	13	9	8	7
Neighboring States	10	5	4	5
Rest of U.S.	64	32	32	16
Grand Total	**176**	**123**	**108**	**81**

Note: Totals may not add due to independent rounding

Table 3.4: Scenario 1 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	$8	$8	$7	$7
Neighboring States	$1	$1	$1	$1
Rest of U.S.	$5	$2	$4	$4
Grand Total	**$14**	**$11**	**$12**	**$12**

Note: Totals may not add due to independent rounding

Under this scenario, California had an increase of roughly 100 jobs in 2015, while the rest of the United States gained around 75 jobs in 2015.

These job gains were primarily attributable to the CCCs collecting larger volumes of DIY used oil and receiving higher incentive payments on all oil collected. The benefit to CCCs was modeled as an increase in the exogenous final demand for services at CCCs. The CCCs retain the majority of the incentive payments, because 95 percent of the incentives are assumed to go uncollected by DIYs bringing in their used oil. The job changes were distributed primarily to Southern California, which gained approximately 70 percent of the jobs in California. Northern California gained approximately 18 percent of the jobs and the Bay Area gained the remaining 12 percent of the jobs.

Value added output was less than $10 million/year for California. In the rest of the United States and in neighboring states value added output was minimal.

Scenario #2: $0.40 Increase in Non-DIY Lube Incentive to $0.56 in 2014

Scenario 2 increases the incentive payment for recycling non-DIY lube oil from $0.40 to $0.56 in 2014. This scenario impacts the incentive payments to industrial generators as well as rural Do-It-For-Me (DIFM) generators. Under this scenario estimated used oil collection increases by 12.1 million gallons in 2030, reducing uncollected collectable non-DIY oil from 15.1 to 3.0 million gallons, with corresponding increases in recovered products, according to the direct impacts model.

The majority of incremental non-DIY oil is projected to come from industrial generators, while a small amount comes from smaller, rural DIFM generators. Existing industrial oil generators are assumed to collect the incentive payment 98 percent of the time, while those industrial generators coming under the used oil management system due to the higher incentives are all assumed to collect their incentives. Two percent of the non-DIY oil is assumed to come from DIFM generators or onsite generators. These are small, informal collection centers that were collecting DIFM oil before and not turning it in. They may be burning collected oil in their diesel trucks but now decide to bring it in and collect the incentives.

In this scenario industrial generators providing large volumes of used oil are paid for their used oil, while industrial generators with smaller volumes pay for the used oil to be hauled away.

Scenario #2 CBA Results

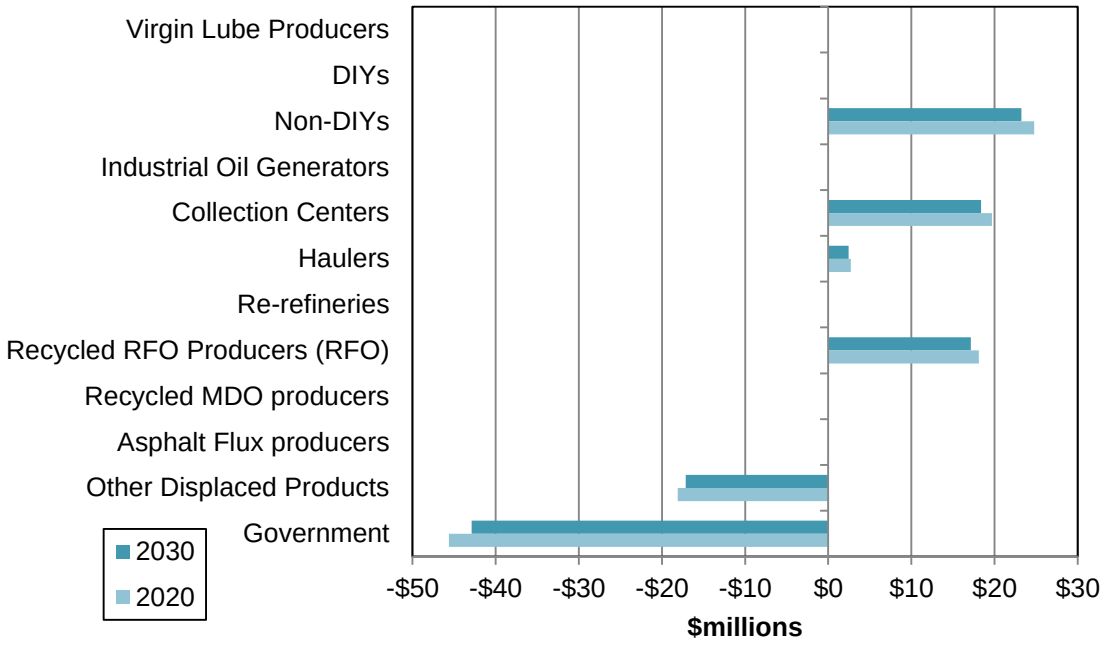
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.5: Scenario 2 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.0	$0.0	$0.0	$0.0
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$25.6	$24.8	$24.0	$23.2
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	$20.4	$19.7	$19.0	$18.4
Haulers	$2.8	$2.7	$2.6	$2.5
Re-refineries	$0.0	$0.0	$0.0	$0.0
Recycled RFO Producers (RFO)	$18.7	$18.1	$17.6	$17.1
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.0	$0.0	$0.0	$0.0
Other Displaced Products	-$18.7	-$18.1	-$17.6	-$17.1
Government	-$47.1	-$45.6	-$44.2	-$42.9
Total	**$1.6**	**$1.5**	**$1.3**	**$1.2**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding.

Figure 3.2: Scenario 2 Cost Results in 2020 and 2030



This scenario leads to minimal incremental changes in costs. The scenario leads to an annual net cost savings of about $1 million/year over the course of the modeling timeline.

Within the various sectors, however, the costs and cost savings vary considerably. Non-DIYs have a significant net cost saving of about $23 million to $25 million per year, due to the largest group of non-DIY generators (i.e., industrial generators) collecting a higher incentive amount on a higher number of gallons collected from them. Additionally, industrial generators with large volumes of used oil receive payments for the value of their oil, which adds to their cost savings.

Collection centers also have a net cost saving of approximately $18 million to $20 million per year largely due to a higher incentive levels, as well as from more non-DIY oil properly disposed under the scenario by the small segment of DIFM.

The increased used oil flows towards recycled fuel oil production (estimated by the direct impacts model) which displaces residual fuel production.

Government costs increase due to the higher level of the incentive payments and increased quantity of non-DIY oil collected. The public sector also incurs administrative costs for managing the system under the new program, modeled as “Low” for state government and “Zero to Low” for local government.

Table 3.6 below presents the total costs, total monetized benefits and the net benefits for this scenario.

Table 3.6: Scenario 2 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	$1.6	$1.5	$1.3	$1.2
Monetized Benefits	$1.5	$1.6	$1.6	$1.6
Net Benefits	**$3.1**	**$3.1**	**$3.0**	**$2.8**

Note: Totals may not add due to independent rounding

This scenario produces air emissions benefits of about $1.5 million per year. In 2030 this benefit was made up primarily by benefits due to reductions in SO_2 ($3.7 million), CO_2 ($400,000), NO_x ($300,000), and VOCs ($50,000). These emissions reductions were offset by $PM_{2.5}$ emissions. This scenario produced a smaller reduction in $PM_{2.5}$ emissions than was observed in the baseline, so the monetized impacts of $PM_{2.5}$ increased—i.e., (dis)benefits—by about $2.8 million in 2030.

Under the assumptions used in the cost-benefit analysis, the net benefits for this scenario are therefore approximately $3 million/year for the entire modeling period, driven largely by the significant amounts of used oil coming under the management system from non-DIY generators and the associated economic activities surrounding it (e.g., increased business and leftover incentives benefiting the CCCs). The non-DIY segment of the used oil market in California thus appears to be a promising area for increasing the collection and management of used oil under SB 546.

Scenario #2 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.7: Scenario 2 Job Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	702	728	674	638
NorCal	121	128	121	115
SoCal	463	472	436	410
Bay Area	118	128	117	113
Neighboring States	69	54	47	47
Rest of U.S.	432	256	112	16
Grand Total	**1,203**	**1,038**	**833**	**701**

Note: Totals may not add due to independent rounding

Table 3.8: Scenario 2 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	$65	$81	$85	$87
Neighboring States	$7	$6	$7	$7
Rest of U.S.	$39	$22	$14	$2
Grand Total	**$111**	**$109**	**$106**	**$96**

Note: Totals may not add due to independent rounding

In this scenario, a higher incentive amount for non-DIY lubricating oil, coupled with larger collection rates of lubricating oil from industrial generators and some Do-It-For-Me (DIFM) generators led to approximately 780 additional jobs in California, 70 jobs in neighboring states, and 430 jobs in the rest of the United States in 2015. Jobs in the rest of the United States declined steadily from this early peak through the end of the modeling period. This decline may have been due to a drop in population in the rest of the United States while California and neighboring states gained in population under this scenario. The California job gains were distributed predominantly to Southern California, which gained approximately 65 percent of the jobs in the state. Northern California and the Bay Area each gained about 17 percent of the California jobs.

The job gains occurred because the industrial generators of used lubricating oil are assumed to always collect the non-DIY recycling incentive and receive a payment for large volumes of used oil from haulers. Receiving additional revenue through the retained incentive and sales of used oil to haulers may impact jobs by improving the profitability of industrial generators and pass through those entities to other sectors.

Job increases in the rest of the United States may have occurred as a secondary effect of the increase in exported used oil for re-refining outside of California. These jobs are likely occurring in secondary industries rather than in the re-refining sector.

Table 3.9 shows detailed sectoral job impacts for this scenario, highlighting the sectors with the largest job gains.

Table 3.9: Scenario 2 Employment Impacts by Sector (California only)

Sector	2015	2020	2025	2030
Repair and maintenance (quick lube and auto repair CCCs)	181	165	149	135
Retail Trade	58	52	44	39
State and Local Government	58	72	73	71
Construction	41	43	31	26
Used Oil Haulers	39	36	31	28
Other Sectors	325	360	346	339
Total	**702**	**728**	**674**	**638**

Note: Totals may not add due to independent rounding

Quick lube and auto repair shops (CCCs) have the largest job gains in 2015 because of their increased role in collection of industrial generators of lubricating oil.

The retail sector, construction, and state and local governments saw some secondary job impacts in this scenario. Used oil haulers gained jobs because of the greater demand for shipments of used oil.

Scenario #3: $0.40 Increase in Industrial Oil Incentive to $0.40 in 2014

Scenario 3 increases the industrial oil incentive from $0.00 to $0.40 in 2014. The increased incentive leads to an increase in used oil collection by 9.1 million gallons, reducing uncollected collectable industrial oil from 25.8 million to 16.7 million gallons in 2030, with corresponding increases in recovered products, both obtained from the direct impacts model. Used oil exports increased by 2.1 million gallons under this scenario and recycled fuel oil increased from 2.1 million gallons to 9.7 million gallons.

Industrial oil generators, who had previously received no incentive for their used oil, are assumed to claim the incentive 100 percent of the time when recycling used oil.

Scenario #3 CBA Results

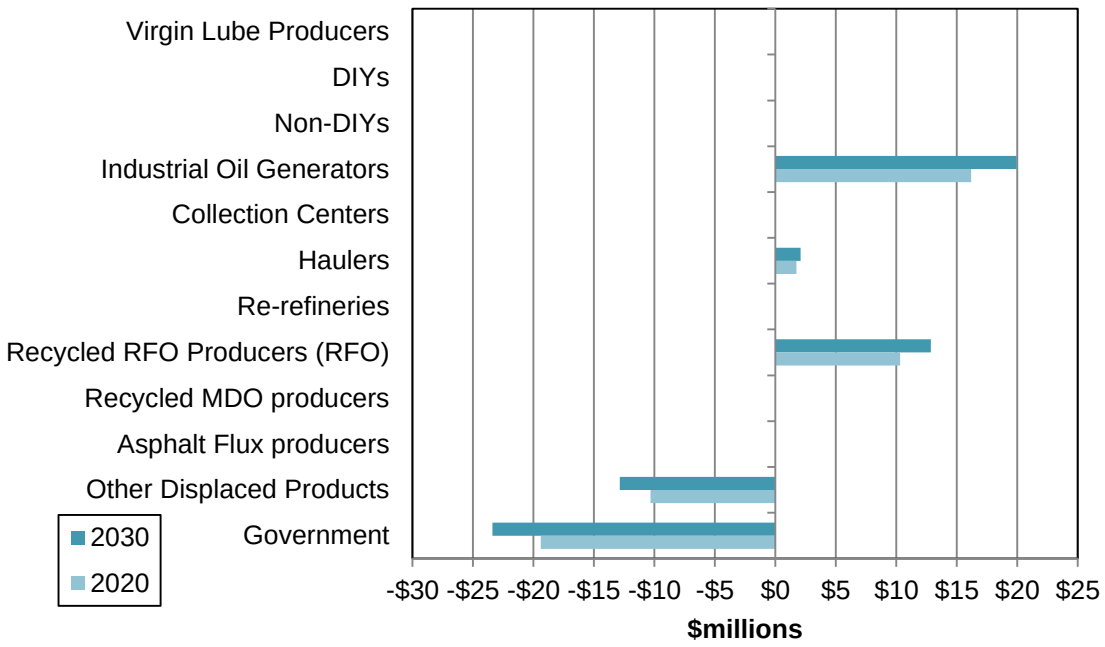
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.10: Scenario 3 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.0	$0.0	$0.0	$0.0
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$14.8	$16.2	$17.9	$20.0
Collection Centers	$0.0	$0.0	$0.0	$0.0
Haulers	$1.6	$1.8	$1.9	$2.1
Re-refineries	$0.0	$0.0	$0.0	$0.0
Recycled RFO Producers (RFO)	$9.4	$10.3	$11.5	$12.9
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.0	$0.0	$0.0	$0.0
Other Displaced Products	-$9.4	-$10.3	-$11.5	-$12.9
Government	-$17.9	-$19.4	-$21.2	-$23.4
Total	**-$1.6**	**-$1.5**	**-$1.4**	**-$1.3**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.3: Scenario 3 Cost Results in 2020 and 2030



This scenario leads to minimal cost impacts, with an annual net cost of about $1.5 million/year over the course of the modeling timeline. Net benefits (discussed below) range from about -$1 million in 2015 to no net benefit in 2030.

Industrial oil generators have a net cost saving of about $15 million to $20 million per year, due to the introduction of the incentive on the used oil they recycle. Additionally, large industrial oil generators receive more revenue on their incremental oil collected because they are paid for large shipments of used oil.

The increased used oil flows towards recycled fuel oil (RFO) production which generates revenue for the producers, and displaces residual fuel production, which sees a reduction in revenue of equal magnitude to that gained by RFO producers.

Public sector costs increase due to the higher amount of the incentive payment and increased quantity of non-DIY oil collected. Government agencies also incur administrative costs for managing the system under the new program. These costs are modeled as “Medium” for state government and “Zero to Low” for local government under this scenario.

Table 3.11 below presents the total costs, total monetized benefits, and the net benefits for this scenario.

Table 3.11: Scenario 3 Estimated Cost-Benefit Analysis Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	-$1.6	-$1.5	-$1.4	-$1.3
Monetized Benefits	$0.8	$0.9	$1.1	$1.2
Net Benefits	**-$0.8**	**-$0.5**	**-$0.3**	**-$0.1**

Note: Totals may not add due to independent rounding

This scenario produces air emissions benefits of about $1.0 million per year. In 2030, this benefit was made up primarily by benefits due to reductions in SO_2 ($2.8 million), CO_2 ($300,000), NO_x ($200,000), and VOCs ($50,000). These emissions reductions were offset by $PM_{2.5}$ emissions. This scenario produced a smaller reduction in $PM_{2.5}$ emissions than was observed in the baseline, so the monetized impacts of $PM_{2.5}$ increased—i.e., (dis)benefits—by approximately $2.1 million in 2030. Emissions benefits were positive in each year and increased slightly through the modeling period.

Thus, under the assumptions used in the cost-benefit analysis, the overall effects of this scenario are virtually negligible. While there are some significant beneficiaries among the affected groups (i.e., the industrial oil generators), the high administrative costs in managing the incremental oil recovered negates those impacts.

Scenario #3 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.12: Scenario 3 Jobs Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	305	432	456	478
NorCal	38	53	59	64
SoCal	189	260	268	278
Bay Area	78	119	129	136
Neighboring States	58	65	68	73
Rest of U.S.	448	384	336	240
Grand Total	**811**	**881**	**860**	**791**

Note: Totals may not add due to independent rounding

Table 3.13: Scenario 3 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	$32	$53	$65	$76
Neighboring States	$6	$7	$9	$11
Rest of U.S.	$41	$38	$40	$40
Grand Total	**$79**	**$98**	**$114**	**$127**

Note: Totals may not add due to independent rounding

This scenario led to about 300 to 500 jobs in California during the modeling period. These jobs primarily arose because of increased collection of incentives by industrial oil generators and transportation of used oil in-state and for export. The California jobs occur mostly in Southern California, where approximately 60 percent of the jobs occur, compared to approximately 12 percent in Northern California and 25 percent in the Bay Area.

In the rest of the United States, job increases range from about 300-500 in this period, out of which about 50-100 are in the immediate neighboring states, driven largely by the increases in the out-of-state refining.

Value added output was on the order of $30 million to $75 million per year in California, and showed an increase throughout the modeling period. The rest of the U.S. and neighboring states maintained fairly consistent levels of value-added output over time, with a slight uptick occurring in neighboring states towards the latter part of the timeframe.

Thus, while this scenario may not lead to significant costs or benefits for the state, it does seem to have the potential to support some jobs, albeit less than 1,000 in the state. Results from the REMI modeling corroborates what was apparent in the cost-benefit results above—that the high level of program administrative costs mask some of the benefits accruing to affected sectors (in this case, industrial oil generators), but the policy could be effective in not only reducing uncollected oil, but could also provide ancillary benefits through small job creation effects.

Table 3.14 below shows the detailed job sector impacts for this scenario, highlighting those sectors with the largest job gains.

Table 3.14: Scenario 3 Employment Impacts by Sector (California only)

Sector	2015	2020	2025	2030
Retail	43	49	47	46
State and local government	28	46	54	61
Construction	25	33	30	26
Used Oil Haulers	21	22	22	22
Professional, Scientific, and Technical Services	21	35	39	43
Other Sectors	167	247	264	280
Total	**305**	**432**	**456**	**478**

Note: Totals may not add due to independent rounding

Among the individual sectors, retail establishments see the largest job gains in this scenario. This impact is likely a secondary effect because auto parts stores are not directly involved in the recycling of industrial oils, so these impacts are not occurring at auto parts stores that are acting as CCCs. Used oil haulers gained jobs because of a greater volume of used industrial oil flowing into the recycling system, creating increased demand for hauling services. State and local government, construction, and professional, scientific, and technical services all experienced secondary job gains as a result of this scenario.

Scenario #2&3: $0.40 Increases in Non-DIY Lube and Industrial Oil Incentives in 2014

Scenario 2&3 combines the effects of Scenario 2 and Scenario 3 by increasing the incentives for non-DIY and industrial oil recycling by $0.40/gallon. Because this scenario combines the effects of 2 and 3 the overall cost impacts are essentially the cumulative impacts of the two scenarios.

This scenario increased used oil collection by 21.2 million gallons, of which 12.1 million gallons come from the non-DIY market segment and the remaining 9.1 million gallons is from the industrial oil generators. This scenario was modeled using methodologies similar to those used for Scenarios 2 and 3.

Scenario #2&3 CBA Results

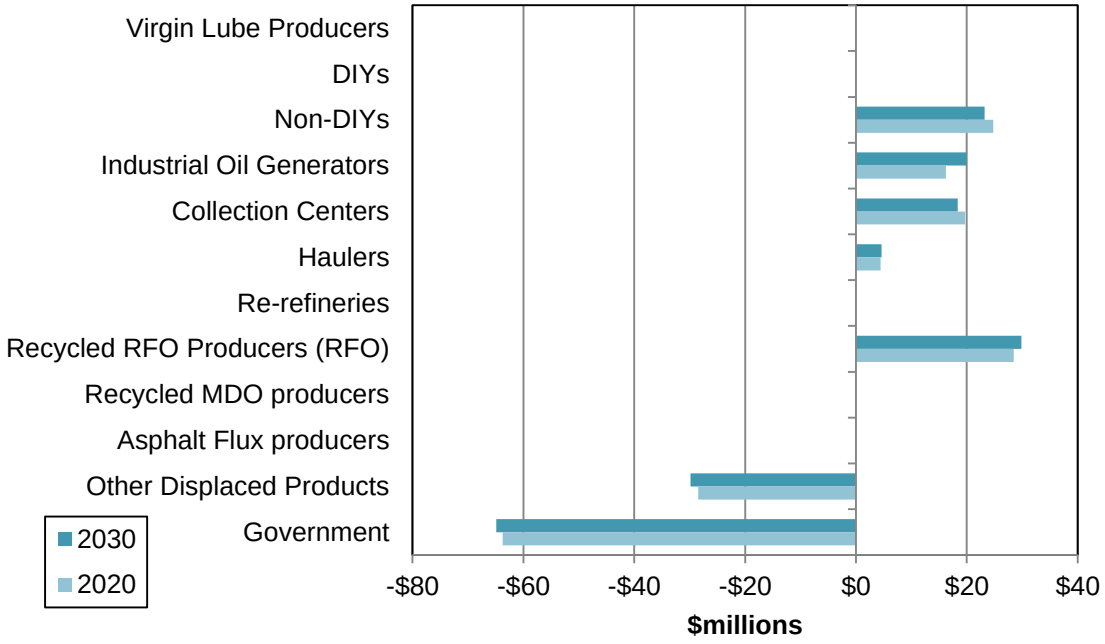
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.15: Scenario 2&3 Cost Estimates by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.0	$0.0	$0.0	$0.0
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$25.6	$24.8	$24.0	$23.2
Industrial Oil Generators	$14.8	$16.2	$17.9	$20.0
Collection Centers	$20.4	$19.7	$19.0	$18.4
Haulers	$4.4	$4.5	$4.5	$4.6
Re-refineries	$0.0	$0.0	$0.0	$0.0
Recycled RFO Producers (RFO)	$28.1	$28.4	$29.0	$29.9
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.0	$0.0	$0.0	$0.0
Other Displaced Products	-$28.1	-$28.4	-$29.0	-$29.9
Government	-$63.8	-$63.7	-$64.1	-$64.9
Total	**$1.3**	**$1.4**	**$1.3**	**$1.3**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.4: Scenario 2&3 Cost Results in 2020 and 2030



This scenario led to an annual net cost savings of about $1 million/year over the course of the modeling horizon. Non-DIYs had a net cost saving of about $23 million to $25 million per year. Industrial generators of used lubricating oil collected a higher incentive amount on the increased gallons collected. Additionally, large industrial generators of used lubricating oil received more revenue on their incremental oil collected because haulers pay them when picking up large loads of oil.

Collection centers had a net cost saving largely due to a higher incentive amount, as well as slightly more DIY oil brought in under the scenario which led to increased retained incentives.

Industrial oil generators had a net cost saving of about $15 million to $20 million per year, due to the higher incentives. Additionally, large industrial oil generators received more revenue on their incremental oil collected because of the payments received from haulers picking up used oil. Haulers had a net cost saving of about $4.5 million per year as a result of increased collections, both through in-state transportation and exports out-of-state. The increased used oil that is collected in this scenario flows towards recycled fuel oil production which displaces residual fuel production.

Public sector costs increase significantly due to the higher amount of the incentive payment and increased non-DIY oil collected. They also incur administrative costs for managing the system under the new program, modeled as "Medium" for state government and "Zero to Low" for local government.

Table 3.16 below presents the total costs, total monetized benefits and the net benefits for this scenario.

Table 3.16: Scenario 2&3 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	$1.3	$1.4	$1.3	$1.3
Monetized Benefits	$2.2	$2.5	$2.7	$2.8
Net Benefits	**$3.6**	**$3.8**	**$4.0**	**$4.1**

Note: Totals may not add due to independent rounding

This scenario produces air emissions benefits of about $2 million to $3 million per year. In 2030 this benefit was made up primarily by benefits due to reductions in SO_2 ($6.4 million), CO_2 ($700,000), NO_x ($600,000), and VOCs ($100,000). These emissions reductions were offset by $PM_{2.5}$ emissions. This scenario produced a smaller reduction in $PM_{2.5}$ emissions than was observed in the baseline, so a $PM_{2.5}$ impact of approximately -$5 million (dis) benefit occurred in 2030. Emissions benefits were positive in each year and increased slightly through the modeling period.

Net benefits for this scenario were thus positive and ranged from approximately $3.5 million to $4 million per year throughout the modeling period. The positive net benefit was realized primarily through the benefit of avoided air emissions and avoided costs in each modeling year. Again, the high level of program administrative costs negated some of the cost savings for affected groups, which have the potential to be significant for non-DIY and industrial oil generators under the modeling assumptions for this scenario.

Scenario #2&3 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.17: Scenario 2&3 Jobs Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	1,001	1,148	1,115	1,087
NorCal	155	177	175	172
SoCal	655	729	697	672
Bay Area	191	242	243	243
Neighboring States	128	120	114	117
Rest of U.S.	896	672	496	336
Grand Total	**2,025**	**1,940**	**1,725**	**1,540**

Note: Totals may not add due to independent rounding

Table 3.18: Scenario 2&3 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	$96	$132	$147	$159
Neighboring States	$13	$13	$15	$17
Rest of U.S.	$81	$68	$58	$46
Grand Total	**$190**	**$213**	**$220**	**$222**

Note: Totals may not add due to independent rounding

The job impacts for this scenario are roughly equal to the cumulative impacts of Scenarios 2 and 3. For this scenario, California had about 1,000 additional jobs in 2015 while the rest of the United States saw over another 1,000 job gains in 2015, out of which neighboring states accounted for about 130 jobs. In 2030, the increase in jobs was approximately 1,090 in California, 340 for the rest of the United States (excluding neighboring states), and about 120 in neighboring states.

Of the job gains in California in 2015, approximately 65 percent occurred in Southern California, and 15 percent occurred in the Bay Area. This distribution stayed mostly constant through the modeling period with Southern California gaining a slightly smaller percentage of jobs in 2030 and those jobs gains shifting to the Bay Area. Scenario 2&3 showed the largest increase in jobs of any scenario because it combined the impacts of increased collection of both non-DIY lube oil and industrial oil.

Because this scenario increased the collected quantity of non-DIY lube and industrial oil the non-DIY generators and industrial oil generators both collected higher amounts as incentive payments. These impacts likely passed through the sectors immediately involved in the used oil sector and impacted other industries secondarily through job gains and value added output.

Table 3.19 shows the detailed job sector impacts for this scenario, highlighting the sectors with the largest job gains.

Table 3.19: Scenario 2&3 Employment Impacts by Sector (California only)

Sector	2015	2020	2025	2030
Repair and Maintenance (quick lube and auto repair CCCs)	184	170	155	142
Retail Trade	100	102	91	84
State and Local Government	85	116	124	127
Construction	66	75	58	47
Used Oil Haulers	60	58	54	52
Other Sectors	506	627	633	635
Total	**1,001**	**1,148**	**1,115**	**1,087**

Note: Totals may not add due to independent rounding

Quick lube shops, in their role as collection centers, saw the largest job gains in 2015 because of the higher incentive amount that they collect as well as an increased quantity of DIFM oil returned for collection. Used oil haulers also saw an increase in jobs in each year because of increased demand for hauling industrial oil. Other sectors such as retail, state and local government, and construction saw secondary effects from increased flows of used oil into the collection and recycling system.

Scenario #4: $0.40 Increase Price Paid for Used Oil in 2014

Scenario 4 increases the price paid for used oil by $0.40/gallon in 2014 and each year thereafter. This scenario increased used oil collection by 21.2 million gallons, reducing uncollected collectable non-DIY oil from 15.1 million gallons to 3.0 million gallons, and reducing uncollected collectable Industrial Oil from 25.8 million gallons to 16.7 million gallons, with corresponding increases in recovered products, obtained from the direct impacts model.

With the price of used oil increased from $0.30 to $0.70 per gallon, the amount haulers paid to collection centers /large generators for used oil increased, with a corresponding increase in the amount charged by haulers to recyclers for used oil.

Scenario #4 CBA Results

The following tables and charts present the results of the cost-benefit analysis for this scenario.

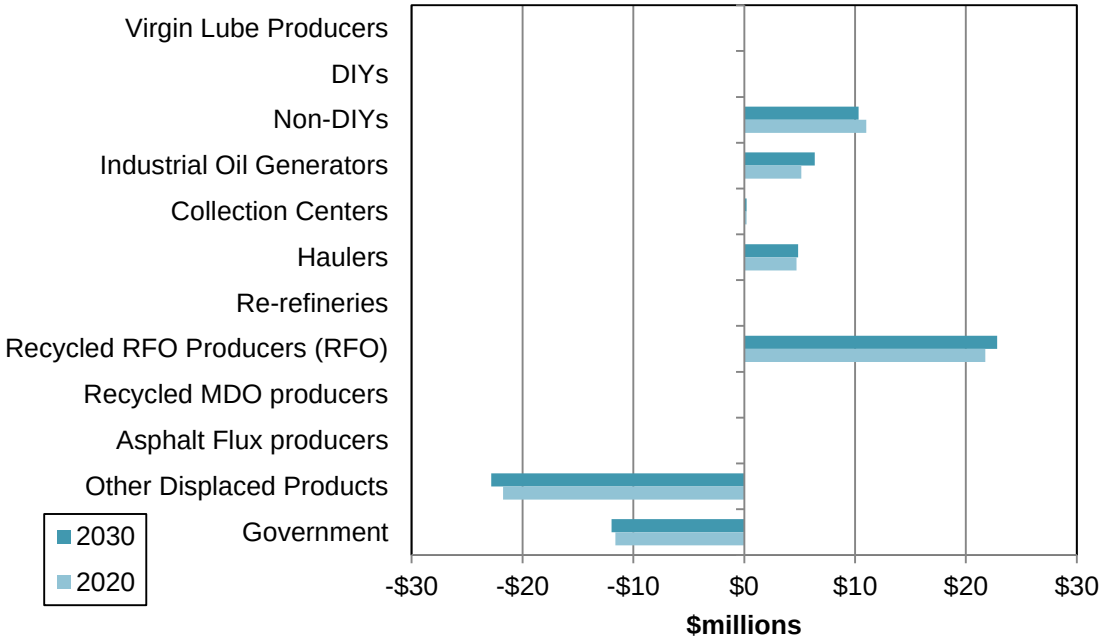
Table 3.20: Scenario 4 Cost Estimates by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.0	$0.0	$0.0	$0.0
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$11.4	$11.0	$10.7	$10.3
Industrial Oil Generators	$4.7	$5.2	$5.7	$6.4

	2015	2020	2025	2030
Collection Centers	$0.2	$0.2	$0.2	$0.2
Haulers	$4.7	$4.7	$4.8	$4.9
Re-refineries	$0.0	$0.0	$0.0	$0.0
Recycled RFO Producers (RFO)	$21.5	$21.8	$22.2	$22.8
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.0	$0.0	$0.0	$0.0
Other Displaced Products	-$21.5	-$21.8	-$22.2	-$22.8
Government	-$11.6	-$11.6	-$11.8	-$12.0
Total	**$9.4**	**$9.5**	**$9.6**	**$9.8**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.5: Scenario 4 Cost Results in 2020 and 2030



This scenario led to an annual net cost savings of about $9 million to $10 million/year over the course of the modeling horizon. Non-DIYs had a net cost saving of about $10 million to $11 million per year, because large industrial generators received higher payment amounts from haulers for their oil collected, as well as from increased collection rates. Haulers had a net cost saving of about $4 million to $5 million per year as a result of increased collections, both in-state and exporting out-of-state. The increased used oil collected flows towards recycled fuel oil production, which displaced residual fuel production.

Public sector costs increased due to the significantly larger used oil volumes collected and the costs associated with administering a significantly larger used oil management program.

Administrative costs for managing the system under the new program were modeled as "Medium" for state government and "Zero to Low" for local government. It is worthwhile noting, however, that government costs were relatively lower under this scenario compared to the previous four scenarios, as there was no change in the incentive payment amounts.

Table 3.21 below presents the total costs, total monetized benefits and the net costs associated with this scenario.

Table 3.21: Scenario 4 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	$9.4	$9.5	$9.6	$9.8
Monetized Benefits	$2.2	$2.5	$2.7	$2.8
Net Benefits	**$11.6**	**$11.9**	**$12.2**	**$12.6**

Note: Totals may not add due to independent rounding

This scenario produces air emissions benefits of about $2 million to $3 million per year. In 2030 this benefit was made up primarily by benefits due to reductions in SO_2 ($6.4 million), CO_2 ($700,000), NO_x ($600,000), and VOCs ($100,000). These emissions reductions were offset by higher $PM_{2.5}$ emissions. This scenario produced a smaller reduction in $PM_{2.5}$ emissions than was observed in the baseline, so a $PM_{2.5}$ (dis)benefit of approximately -$5 million occurred in 2030. Emissions benefits were positive in each year and increased slightly through the modeling period.

Thus, under the modeling assumptions used in this cost-benefit analysis, this scenario has the potential to produce one of the most significant net benefits for the state's used oil management program. Increased price for used oil has the potential to benefit different groups of entities associated with the used oil value chain.

Adding the monetized emissions benefits estimated to occur under these modeling conditions, could imply the overall net benefits could be the largest among the scenarios modeled under this exercise. Increased collection of used oil would imply that program administrative costs would necessarily have to be higher, but at $11 million to $12 million/year, these higher costs do not appear to be as high as program administrative costs under some of the other scenarios that involve higher incentive payments.

Scenario #4 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.22: Scenario 4 Jobs Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	153	244	249	240
NorCal	10	26	29	30
SoCal	109	160	162	153
Bay Area	34	58	58	57
Neighboring States	63	60	56	60

Rest of U.S.	400	320	240	240
Grand Total	**616**	**624**	**545**	**540**

Note: Totals may not add due to independent rounding

Table 3.23: Scenario 4 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	$16	$32	$38	$42
Neighboring States	$7	$8	$9	$10
Rest of U.S.	$37	$30	$30	$28
Grand Total	**$60**	**$70**	**$77**	**$80**

Note: Totals may not add due to independent rounding

Scenario 4 led to about 150 jobs in California in 2015 and 240 jobs in 2030. These jobs primarily arose because of increased recycling of used oil in the state and due to higher exports. The largest job gains in the state occurred in Southern California, which gained 71 percent of the California jobs in 2015 as compared to 22 percent in the Bay Area and 7 percent in Northern California.

In the rest of the United States (excluding the neighboring states), job gains ranged from 400 in 2015 down to about 240 in 2030, while neighboring states gained about 60 jobs in each year. These impacts resulted from increased out-of-state re-refining.

Table 3.24 below presents detailed job sector impacts for this scenario, highlighting the sectors with the largest job gains.

Table 3.24: Scenario 4 Employment Impacts by Sector (CA only)

Sector	2015	2020	2025	2030
Used Oil Haulers	83	80	75	71
Auto Parts Stores (CCCs) and Other Retail	24	28	26	23
Administrative and Support Services	17	23	23	24
Professional, Scientific, and Technical services	10	20	21	22
Ambulatory Health Care Services	9	12	13	13
Other Sectors	10	81	91	87
Total	**153**	**244**	**249**	**240**

Note: Totals may not add due to independent rounding

The sectors that saw the largest benefit in terms of job gains in California were used oil haulers and auto parts stores and other retail. In-state and export hauling saw the largest gain in jobs because of increased demand for hauling used oil with larger quantities of used oil being returned for recycling under this scenario. Waste management services gained jobs because of sales of used oil feedstock for re-refining out of California.

CCCs and other retail establishments saw some gains because of retained incentives from collection of used oil and increased demand for other retail services. Sectors such as manufacturing, real estate, and rental leasing gained secondary jobs because of increased economic activity in the used oil sector.

Scenario #5: $0.10 Decrease in Re-Refined Lube Oil Fee to $0.02 in 2014

Scenario 5 reduces the re-refined lubricating oil fee by $0.10 to $0.02/gallon, starting in 2014. Under this scenario the amount of used oil collected did not change in the direct impacts model. However, the scenario increased re-refined oil from 21.3 million gallons to 22.5 million gallons in 2030, while reducing exports from 14.0 million gallons to 13.1 million gallons, reducing marine distillate oil from 43.2 million gallons to 43.0 million gallons, and reducing recycled fuel oil from 2.1 million gallons to 1.0 million gallons in 2030.

Because this policy scenario is aimed at the re-refining sector and does not change quantities of used oil collected, the scenario did not have any effect on the behavior of used oil generators or collection centers.

Scenario #5 CBA Results

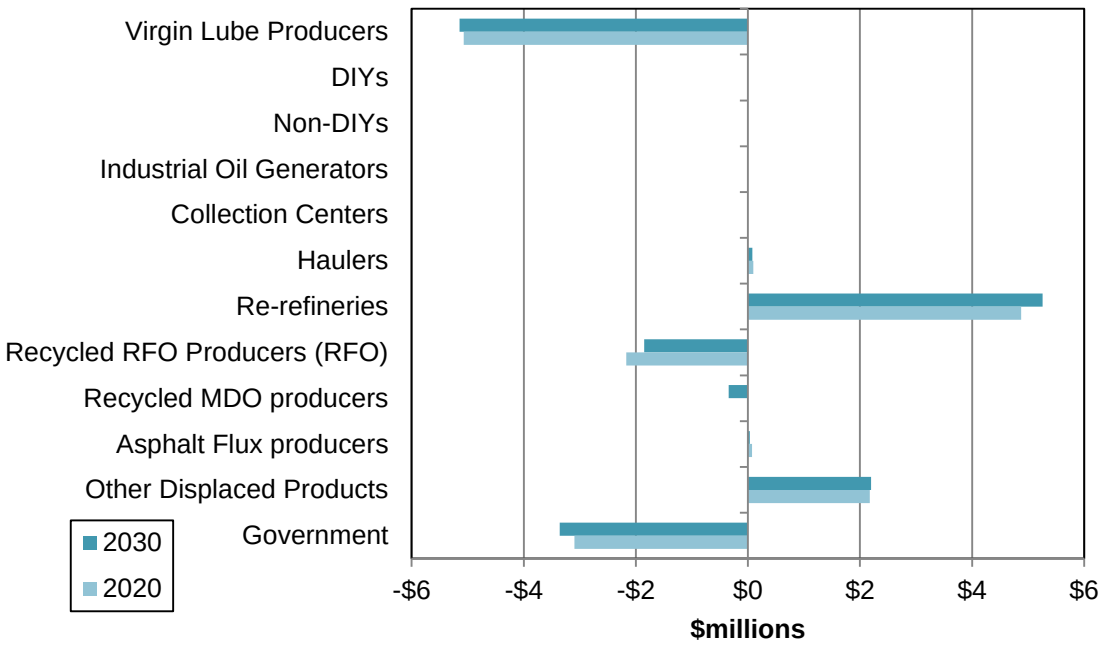
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.25: Scenario 5 Cost Estimates by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	-$5.1	-$5.1	-$5.1	-$5.1
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	$0.0	$0.0	$0.0	$0.0
Haulers	$0.0	$0.1	$0.1	$0.1
Re-refineries	$4.7	$4.9	$5.0	$5.3
Recycled RFO Producers (RFO)	-$2.0	-$2.2	-$2.3	-$1.9
Recycled MDO Producers	$0.0	$0.0	$0.0	-$0.3
Asphalt Flux Producers	$0.1	$0.1	$0.1	$0.0
Other Displaced Products	$2.0	$2.2	$2.3	$2.2
Government	-$3.1	-$3.1	-$3.2	-$3.4
Total	**-$3.3**	**-$3.1**	**-$3.0**	**-$3.1**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.6: Scenario 5 Cost Results in 2020 and 2030



This scenario led to annual net costs of about $3 million/year over the course of the modeling period. The increased used oil flowed towards higher re-refined lube oil, which was modeled to be $0.10 per gallon less expensive to produce. The increased flow led to a corresponding decrease in virgin lube products produced, as those products were still subject to a fee of $0.24/gallon and were relatively more expensive than the re-refined products under this scenario. Displacement of virgin lube was based on a 1-1 displacement ratio, consistent with the preliminary results from the Solomon research. A decrease in marine distillate oil and recycled fuel oil was modeled to have a corresponding increase in other displaced products such as diesel and residual fuel oil production.

Public sector administrative costs increased by about $3 million/year, due to decreased fee collection. Administrative costs for managing the system under the new program also increased, modeled as "Low" for state government and "Zero to Low" for local government.

Table 3.26 below presents the total costs, total monetized benefits and the net benefits for this scenario.

Table 3.26: Scenario 5 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	-$3.3	-$3.1	-$3.0	-$3.1
Monetized Benefits	$0.6	$0.8	$0.8	$0.8
Net Benefits	**-$2.7**	**-$2.4**	**-$2.2**	**-$2.3**

Note: Totals may not add due to independent rounding

Under this scenario, since there is no increase in actual used oil collected, the environmental benefits were less than $1 million in each modeling year. In 2030, this benefit was made up

primarily by benefits due to reductions in $PM_{2.5}$ ($800,000) and CO_2 ($100,000). These emissions benefits were offset by slight increases in emissions of NO_x and SO_2 which produced a negative benefit.

Thus, changes in disposition routes under oil collection volumes appear to have less net benefits for the state under the modeling assumptions used in this cost-benefit analysis.

Scenario #5 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.27: Scenario 5 Jobs Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	-24	-18	-21	-23
NorCal	-4	-3	-4	-4
SoCal	-14	-10	-12	-13
Bay Area	-6	-5	-5	-6
Neighboring States	-5	-6	-5	-5
Rest of U.S.	-32	-10	0	0
Grand Total	**-61**	**-34**	**-26**	**-28**

Note: Totals may not add due to independent rounding

Table 3.28: Scenario 5 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($MM)

Region	2015	2020	2025	2030
California	-$3	-$3	-$3	-$3
Neighboring States	-$1	-$1	-$1	-$1
Rest of U.S.	-$3	-$4	$0	-$1
Grand Total	**-$8**	**-$8**	**-$4**	**-$5**

Note: Totals may not add due to independent rounding

California, neighboring states, and the rest of the United States were projected to lose some jobs in each year of the modeling period. However, given that there is no change in used oil collection, these minor job impacts are likely to be within the bounds of modeling approximation.

Scenario #6: $0.10 Increase in Re-Refined Base Oil Production Incentive from $0.02/gallon to $0.12/gallon

Scenario 6 increased the incentive for re-refined base oil production by $0.10/gallon, setting the incentive at $0.12 per gallon. This scenario did not change the amount of used oil collected. However, the scenario increased re-refined oil from 21.3 million gallons to 22.2 million gallons in 2030, while reducing exports from 14.0 million gallons to 13.1 million gallons, and recycled fuel oil recovered from 2.1 million gallons to 1.0 million gallons in 2030. This scenario did not affect the quantity of marine distillate oil recovered.

The scenario did not have any effect on the behavior of used oil generators or collection centers because the policy was aimed at the re-refining sector and did not change the quantity of used oil collected.

Scenario #6 CBA Results

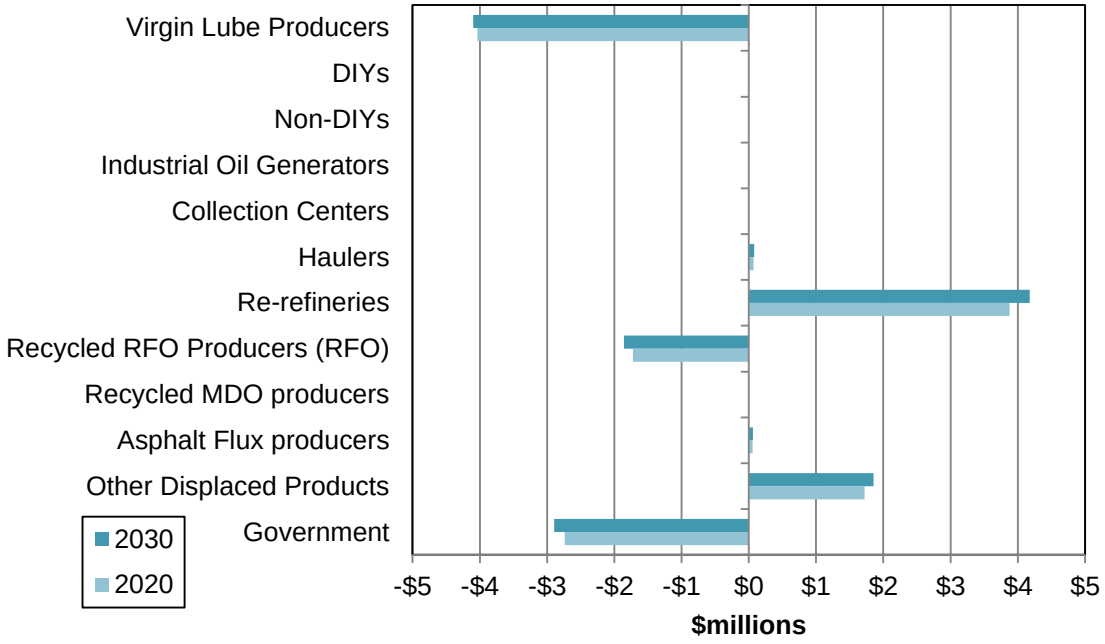
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.29: Scenario 6 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	-$4.0	-$4.0	-$4.1	-$4.1
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	$0.0	$0.0	$0.0	$0.0
Haulers	$0.0	$0.1	$0.1	$0.1
Re-refineries	$3.8	$3.9	$4.0	$4.2
Recycled RFO Producers (RFO)	-$1.6	-$1.7	-$1.8	-$1.9
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.1	$0.1	$0.1	$0.1
Other Displaced Products	$1.6	$1.7	$1.8	$1.9
Government	-$2.7	-$2.7	-$2.8	-$2.9
Total	**-$2.9**	**-$2.8**	**-$2.7**	**-$2.7**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.7: Scenario 6 Cost Results in 2020 and 2030



This scenario led to an annual net cost of about $2.5 million to $3 million/year over the course of the modeling horizon. Among the largest impacts, re-refiners had a net cost saving as a result of greater re-refinery production and the increases in the incentive on re-refined lubes. The increase in re-refined oil recovered led to a corresponding decrease in virgin lube production. Re-refineries also earned $0.10/gallon more for each gallon produced. A decrease in marine distillate oil and recycled fuel oil was modeled to have a corresponding increase in diesel and residual fuel oil production, respectively.

Public sector costs increased slightly due to the higher amount of the incentive payment. They also incurred administrative costs for managing the system under the new program, modeled as "Low" for state government and "Zero to Low" for local government.

Table 3.30 below presents the total costs, monetized total benefits and the net benefits for this scenario.

Table 3.30: Scenario 6 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	-$2.9	-$2.8	-$2.7	-$2.7
Monetized Benefits	$0.5	$0.6	$0.7	$0.7
Net Benefits	**-$2.5**	**-$2.2**	**-$2.0**	**-$1.9**

Note: Totals may not add due to independent rounding

Monetized net benefits were minimal under this scenario (less than $1million/year). In 2030, this benefit was made up primarily from benefits due to reductions in $PM_{2.5}$ ($700,000) and CO_2

($100,000). These emissions benefits were offset by slight increases in emissions of NO_x and SO_2 which produced a negative benefit in 2030.

Scenario #6 REMI Results

This scenario led to very little changes in job impacts for all regions (fewer than five jobs). These job impacts are likely within the bounds of modeling error and are therefore not presented here. Because this scenario only impacts producers of virgin products and recycled product producers, the effects largely offset each other in the REMI model. The overall slightly negative effect on the petroleum refining industry may cause slight job losses, but these are likely to be insignificant. Job changes in other scenarios are largely driven by changes in the used oil collection system which is unaffected in this scenario and therefore does not contribute to changes in jobs.

Scenario #7: $0.10 Incentive for Recovered Marine Distillate Oil/Light Fuel

Scenario 7 creates a $0.10 per gallon incentive for recovered marine distillate oil/light fuel. This scenario did not change the amount of used oil collected. However, the scenario increased marine distillate oil from 43.2 million gallons to 43.6 million gallons in 2030, while reducing exports from 14.0 million gallons to 13.2 million gallons and reducing recycled fuel oil from 2.1 million gallons to 1.4 million gallons in 2030. Asphalt flux also increased slightly from 25.4 million gallons to 25.6 million gallons in 2030.

The scenario did not have any effect on the behavior of used oil generators or collection centers.

Scenario #7 CBA Results

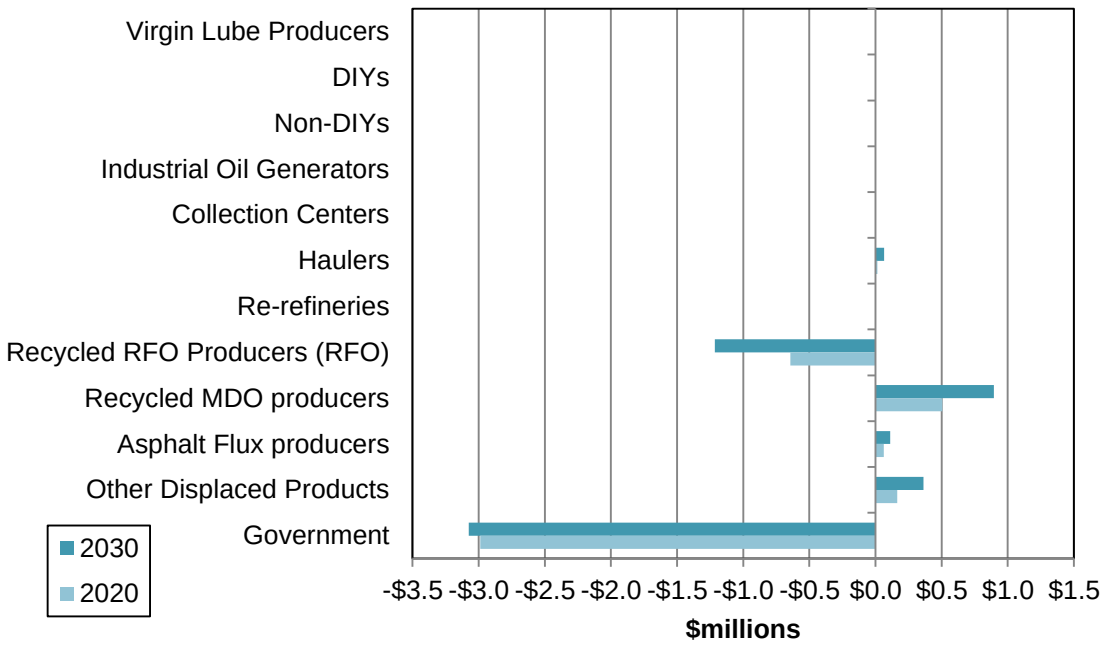
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.31: Scenario 7 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.0	$0.0	$0.0	$0.0
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	$0.0	$0.0	$0.0	$0.0
Haulers	$0.0	$0.0	$0.0	$0.1
Re-refineries	$0.0	$0.0	$0.0	$0.0
Recycled RFO Producers (RFO)	-$0.5	-$0.6	-$0.9	-$1.2
Recycled MDO Producers	$0.4	$0.5	$0.7	$0.9
Asphalt Flux Producers	$0.0	$0.1	$0.1	$0.1
Other Displaced Products	$0.1	$0.2	$0.3	$0.4
Government	-$3.0	-$3.0	-$3.0	-$3.1
Total	**-$2.9**	**-$2.9**	**-$2.9**	**-$2.9**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.8: Scenario 7 Cost Results in 2020 and 2030



This scenario led to annual net costs of about $3 million/year over the course of the modeling horizon. The majority of this cost occurred for the government sector. Public sector costs increased due to the payment of higher incentive amounts. Government also incurred administrative costs for managing the system under the new program, modeled as "Medium" for state government and "Zero to Low" for local government.

Marine distillate oil (MDO) had a net cost saving as a result of greater production spurred on by the addition of a subsidy. The increase in MDO recovered led to a corresponding decrease in recycled fuel oil production. A decrease in recycled fuel oil was modeled to have a corresponding increase in residual fuel oil production (hence the other displaced products are on net positive).

Table 3.32 below presents the total costs, total monetized benefits and the net benefits for this scenario.

Table 3.32: Scenario 7 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	-$2.9	-$2.9	-$2.9	-$2.9
Monetized Benefits	$0.1	$0.1	$0.2	$0.3
Net Benefits	**-$2.8**	**-$2.8**	**-$2.7**	**-$2.6**

Note: Totals may not add due to independent rounding

Monetized net benefits were minimal under this scenario (less than $1 million/year). In 2030 the emissions benefits were primarily made up of benefits due to reductions in PM2.5 ($400,000). These emissions benefits were offset by slight increases in emissions of NOx and SO2 which produced a negative benefit in 2030 of approximately $100,000.

Scenario #7 REMI Results

Similar to Scenario 6 results above, the job impacts due to this scenario are negligible and are considered to be likely within the bounds of modeling error in REMI.

Scenario #8: $0.10 Incentive for Recycled Fuel Oil

Scenario 8 implemented a $0.10 incentive for recycled fuel oil production. This scenario did not have any effect on the used oil collected or managed in California.

Scenario #9: Reduce Fee on Virgin Base Oil ($0.24 to $0.16/gallon) and Increase Fee on Re-refined Base Oil ($0.12 to $0.16/gallon)

Scenario 9 implements a reduction in the fee on virgin base oil production from $0.24 per gallon to $0.16 per gallon. At the same time, the fee on re-refined lube oil increases from $0.12 per gallon to $0.16 per gallon, to equalize fees on both virgin and re-refined base oil.

This scenario did not change the amount of used oil collected and maintained the same quantity of total product recovered as observed in the baseline. However, the distribution of recovered products changed slightly in 2030. There was no change in the quantity of marine distillate oil recovered. Used oil exports increased slightly from 14.0 million gallons to 14.8 million gallons. Re-refined oil recovered decreased from 21.3 million gallons to 20.3 million gallons. Asphalt flux recovered also decreased from 25.4 million gallons to 25.3 million gallons, while recycled fuel oil recovered increased from 2.1 million gallons to 3.4 million gallons.

Scenario #9 CBA Results

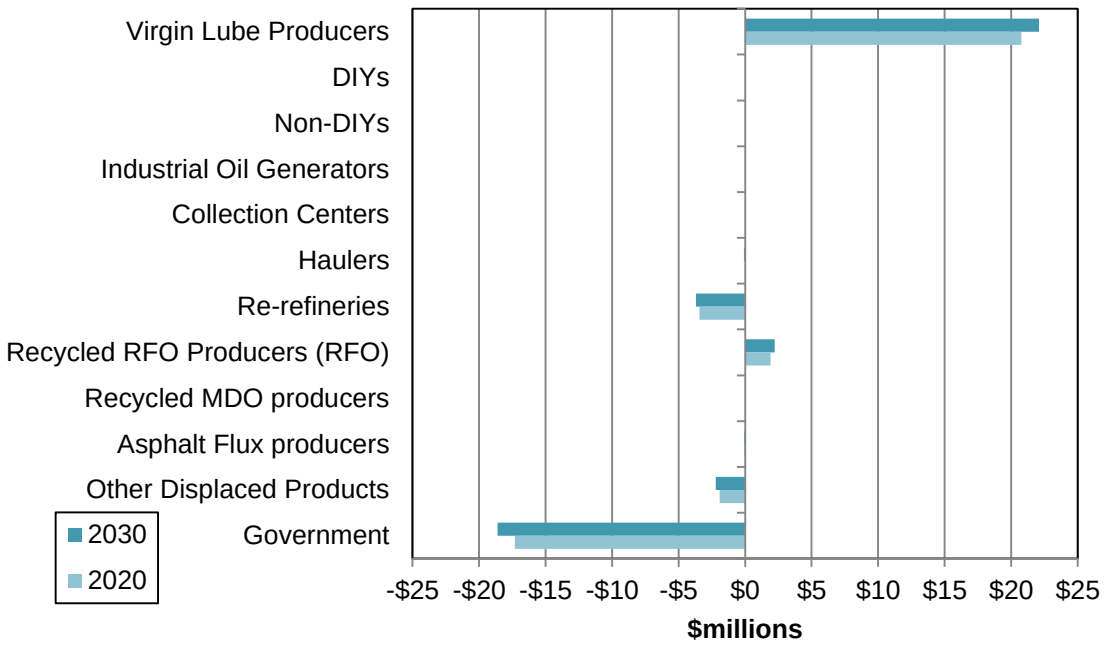
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.33: Scenario 9 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$20.4	$20.8	$21.3	$22.1
DIYs	$0.0	$0.0	$0.0	$0.0
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	$0.0	$0.0	$0.0	$0.0
Haulers	$0.0	$0.0	$0.0	-$0.1
Re-refineries	-$3.3	-$3.4	-$3.5	-$3.7
Recycled RFO Producers (RFO)	$1.9	$1.9	$2.1	$2.2
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	-$0.1	-$0.1	-$0.1	-$0.1
Other Displaced Products	-$1.9	-$1.9	-$2.1	-$2.2
Government	-$16.9	-$17.3	-$17.9	-$18.6
Total	**$0.1**	**$0.0**	**-$0.2**	**-$0.4**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.9: Scenario 9 Cost Results in 2020 and 2030



This scenario led to minimal annual net costs over the course of the modeling timeline, though there were some significant cost savings for the virgin producers. With the change in the fee structure, virgin lube producers received a larger financial gain than the other entities. This large gain for virgin lube producers was offset by increased costs for government, assumed to be collecting one-third less in production fees than in the baseline scenario. However, the government sector was also assumed to collect a slightly higher fee from the production of re-refined lube oil and paid a small subsidy to re-refining of base oil. Therefore, the costs to government do not exactly equal the benefit that virgin lube producers see. The public sector costs were affected by increased administrative costs for implementing this new tiered fee structure as well. These costs were modeled as "Low" for state and local government.

Re-refineries incurred a small loss as a result of the $0.04 per gallon increase in the fee they paid under this scenario. This led to a slight decrease in the quantity of re-refined oil produced. The increased product recovery flowed towards recycled fuel oil production, which displaced residual fuel production as a result.

Table 3.34 below presents the total costs, monetized total benefits and the net benefits for this scenario.

Table 3.34: Scenario 9 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	$0.1	$0.0	-$0.2	-$0.4
Monetized Benefits	-$0.6	-$0.6	-$0.7	-$0.9
Net Benefits	**-$0.5**	**-$0.6**	**-$0.9**	**-$1.2**

Note: Totals may not add due to independent rounding

The net benefits of this scenario were negative, and on the order of about $1 million towards the end of the modeling timeline. The negative net benefit of this scenario was a combination of slightly increased costs and slightly reduced monetized benefits due to higher overall emissions.

In each year there were negative environmental benefits of less than $1 million. In 2030, the emissions (dis)benefits were made up primarily of increases in $PM_{2.5}$ (-$900,000) and increases in CO_2 (-$100,000).

Scenario #9 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.35: Scenario 9 Jobs Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	31	30	23	25
NorCal	2	3	2	2
SoCal	17	16	13	13
Bay Area	12	11	8	10
Neighboring States	4	3	5	7
Rest of U.S.	48	48	32	16
Grand Total	**83**	**81**	**60**	**48**

Note: Totals may not add due to independent rounding

Table 3.36: Scenario 9 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	$7	$8	$8	$8
Neighboring States	$0	$0	$1	$2
Rest of U.S.	$6	$4	$8	$4
Grand Total	**$13**	**$12**	**$17**	**$14**

Note: Totals may not add due to independent rounding

Under the modeling conditions used for this cost-benefit analysis, scenario 9 produced about 80 jobs in 2015. This number declined to about 50 jobs in all regions by 2030. Within California, few jobs were gained under this scenario. The largest fraction of job gains was in Southern California, which gained 55 percent of jobs in 2015, followed by the Bay Area with 39 percent of jobs and Northern California with 6 percent of jobs. Because the cost and benefit impacts of this scenario were predominantly focused in the virgin lube refining sector, there were minimal jobs created through secondary effects or the DIY and collection center pathways.

Scenario #10: Impacts of Tiered Incentive Structure

Scenario 10 reverses the existing tiered incentive system by reducing the DIY used lube oil incentive to $0.16 per gallon (from $0.40 per gallon) and eliminating the $0.02 incentive for re-refined base oil recovery. Under this scenario the lube oil collected decreases by 1 million gallons and the uncollected collectable DIY oil increases by 1 million gallons. This causes a reduction of 0.7 million gallons in used oil exports as well as a decline in re-refined oil recovered from 21.3 million gallons to 21.2 million gallons and a drop in recycled fuel oil recovered from 2.1 million gallons to 1.4 million gallons.

Scenario #10 CBA Results

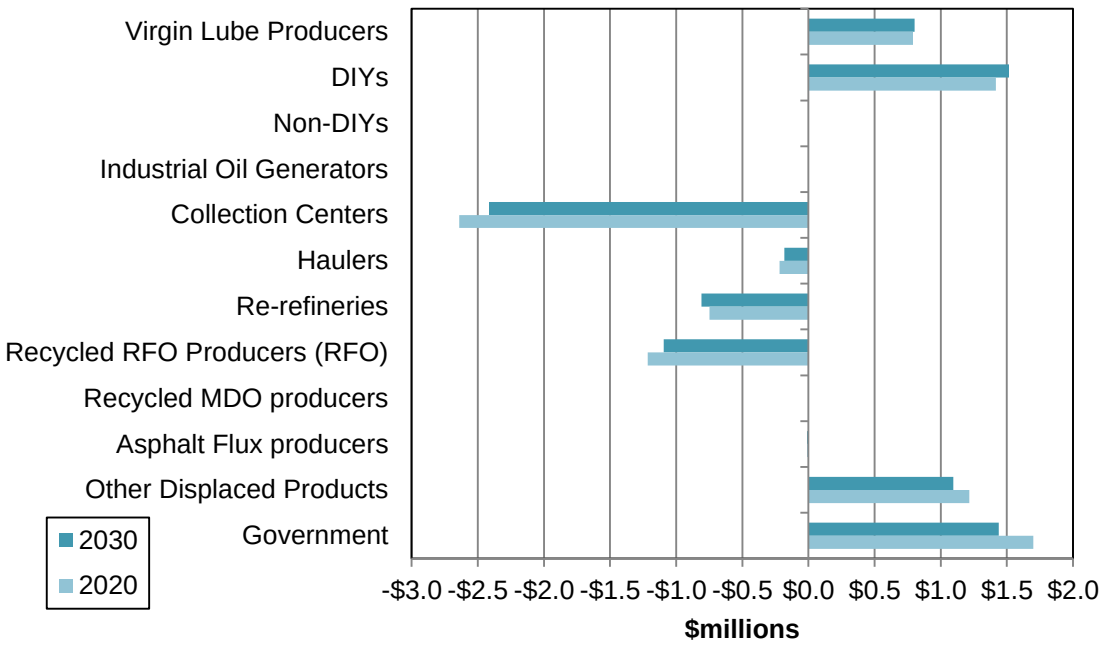
The following tables and charts present the results of the cost-benefit analysis for this scenario.

Table 3.37: Scenario 10 Estimated Costs by Year ($millions)

	2015	2020	2025	2030
Virgin Lube Producers	$0.8	$0.8	$0.8	$0.8
DIYs	$1.4	$1.4	$1.5	$1.5
Non-DIYs	$0.0	$0.0	$0.0	$0.0
Industrial Oil Generators	$0.0	$0.0	$0.0	$0.0
Collection Centers	-$2.8	-$2.6	-$2.5	-$2.4
Haulers	-$0.3	-$0.2	-$0.2	-$0.2
Re-refineries	-$0.7	-$0.7	-$0.8	-$0.8
Recycled RFO Producers (RFO)	-$1.2	-$1.2	-$1.2	-$1.1
Recycled MDO Producers	$0.0	$0.0	$0.0	$0.0
Asphalt Flux Producers	$0.0	$0.0	$0.0	$0.0
Other Displaced Products	$1.2	$1.2	$1.2	$1.1
Government	$1.8	$1.7	$1.6	$1.4
Total	**$0.2**	**$0.3**	**$0.3**	**$0.3**

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

Figure 3.10: Scenario 10 Cost Results in 2020 and 2030



Among the affected groups, collection centers experience the largest magnitude of cost, as they were the biggest beneficiaries of the uncollected DIY incentives under the baseline. Haulers, re-refiners, and recycled fuel oil producers all experienced some costs on the order of about $1 million or less. Because these entities depend on the used oil collection system, they are affected when there is less used oil flowing into the system, as is the case under this scenario.

Of the entities that gain, DIYs see the largest impact with about $1.5 million gained in year 2030. Because the incentive for DIY oil is lower in this scenario, fewer DIYs take trips to drop off their oil at collection centers. They therefore avoid incurring the travel and time costs of those trips.

Government benefits in this scenario because of lower costs for administering the incentive program and also the reduction in incentives it is paying out. Other displaced products and virgin lube producers also benefit slightly because of a slight increase in production.

Table 3.38 present the total costs, total monetized benefits and the net benefits for this scenario.

Table 3.38: Scenario 10 Estimated CBA Results by Year ($millions)

	2015	2020	2025	2030
Estimated Costs	$0.2	$0.3	$0.3	$0.3
Monetized Benefits	-$0.2	-$0.2	-$0.2	-$0.2
Net Benefits	**$0.0**	**$0.1**	**$0.2**	**$0.1**

Note: Totals may not add due to independent rounding

Scenario 10 generates very little by way of net benefits during this modeling period. In each year, there were slight negative environmental benefits of less than $1 million. In 2030, the emissions (dis)benefits were made up primarily of negative benefits due to increases in SO_2 (-$300,000) and

increases in CO_2 and NO_x (-$100,000 combined). These negative emissions benefits were offset by slight decreases in emissions of $PM_{2.5}$ which produced a positive benefit in 2030 of approximately $200,000.

Scenario #10 REMI Results

The following discussion highlights the distributional impacts for this scenario, focusing mainly on job impacts.

Table 3.39: Scenario 10 Jobs Impacts for California, Neighboring States, and the Rest of the U.S.

Region	2015	2020	2025	2030
California Total	-67	-60	-59	-63
NorCal	-12	-10	-8	-8
SoCal	-46	-41	-41	-43
Bay Area	-9	-9	-10	-12
Neighboring States	-7	-9	-5	-3
Rest of U.S.	-64	-32	0	0
Grand Total	**-138**	**-101**	**-64**	**-66**

Note: Totals may not add due to independent rounding

Table 3.40: Scenario 10 Value Added Output for California, Neighboring States, and the Rest of the U.S. ($millions)

Region	2015	2020	2025	2030
California	-$5	-$5	-$6	-$7
Neighboring States	-$1	-$1	-$1	-$1
Rest of U.S.	-$4	-$4	-$2	-$2
Grand Total	**-$10**	**-$10**	**-$9**	**-$10**

Note: Totals may not add due to independent rounding

Scenario 10 resulted in about 140 job losses across all regions in 2015 and about 65 job losses in 2030. These job impacts are largely due to the costs that collection centers and haulers incur in this scenario (and hence reduced business activity for these entities in REMI). The reduction in incentive levels for DIY oil means that collection centers are retaining less for each gallon of oil they collect, and there is less oil being returned to collection centers. Additionally, since there is a decline in the amount of oil collected there is reduced demand for used oil haulers, which also reduces jobs. The majority of job losses in California occurred in Southern California, which lost about 70 percent of the statewide total. Northern California and the Bay Area each lost about 15 percent of the California jobs.

4. Additional Considerations Potentially Relevant for Used Oil Management Sector in California

The cost-benefit analysis also considered a number of additional scenarios and considerations that may affect the used oil management system in the state. While these situations were not modeled comprehensively like those discussed above, the following sections present the data related findings related to these aspects.

Testing Requirements for Exported Oil

Under SB 546, loads of used oil exported out of California (out-of-state exports) must be tested and comply with standards for the following characteristics:

- Flash Point
- PCBs
- Halogens

The standard cost of laboratory analysis of used oil for the three characteristics was estimated to be approximately $400 per sample based on standard analytical turnaround time (1 to 2 weeks). The unit cost for expedited ("rush") analytical turnaround would be 2 to 2.5 times higher (e.g., for 24-hour turnaround).

The annual cost of testing used oil exported out of California was estimated based on CalRecycle's records and compilation of used oil data performed by the UC Santa Barbara life cycle assessment team. To estimate the cost of testing, numbers and volumes (gallons) of loads of used oil were first analyzed over a period of several years (2007-2011).

The analysis identified that some loads were transported by truck (i.e., small-volume loads, less than about 8,500 gallons), and some by rail (i.e., large-volume loads, greater than about 8,500 gallons). Consequently, costs of testing were categorized according to whether the shipment of exported used oil was a small- or large-volume shipment. Since the five-year historical data (2007-2011) for quantities of exported used oil exhibited a consistent downward trend for that period of time, testing costs were estimated using data for 2011.

The analysis yielded 615 gallons as representative of a small-volume shipment, which would serve as a "load" under the meaning of SB 546. In case of large-volume shipments, the representative volume of a load was assumed to be 20,000 gallons, which corresponds to the capacity of a small rail tank car and thus the "load" of used oil that would be tested for the SB 546 characteristics.

Using the assumed testing cost of $400 per sample, the annual testing costs are those shown in Table 4.1 below. The unit cost varies by volume of load. The composite unit cost of testing is about $0.07 (rounded to the nearest $0.01) per gallon of used oil when the total estimated testing costs are spread over the total volume of exported oil.

Table 4.1: Estimated Annual Cost of Testing of Out-of-State Exported Oil[a,b]

	Small Volume Loads via Truck	Large Volume Loads via Rail Tank Car	Total
Gallons of Oil	663,937	8,304,000	8,967,937
Number of Loads	1,079	415	NA
Estimated Volume of Load Tested (gal.)[c]	615	20,000	NA
Estimated Total Testing Cost ($)	$431,600	$166,100	$597,700
Estimated Unit Cost of Testing ($/gal.)	**$0.65**	**$0.02**	**$0.07**

Notes:
[a] Based on shipments for 2011.
[b] Some values have been rounded.
[c] The estimated representative volume of small-volume loads is calculated from total gallons of small-volume loads of used oil shipped divided by total number of small-volume shipments. The representative volume of large-volume loads is assumed to be that of a 20,000-gallon rail tank car filled to capacity.

Permitting Costs Associated with Capacity Expansion for Used Oil Disposition

This section discusses the costs of permitting a facility in California under the current conditions and presents some hypothetical cost savings if the time required to obtain relevant permits could be reduced to one-half.

Two options were identified for modeling and analysis: Option A is an expansion of an existing 10 million gallon/year re-refining facility; Option B is the permitting of a new 20 million gallon/year re-refining facility.

Permitting Costs

Baseline costs of permitting (i.e., assuming the status quo) for Option A are estimated to be $250,000 each for the environmental impact assessment under the California Environmental Quality Act (CEQA) and for acquisition of environmental permits. Baseline costs of permitting for Option B are estimated to be $1 million each for the environmental impact assessment under CEQA and for acquisition of applicable environmental permits (e.g., air permit, etc.).

The assumed costs of the environmental analysis and of the obtaining all applicable permits are shown in Tables 4.2 and 4.3, below.

Table 4.2: Summary of CEQA and Permitting Costs and Other Key Assumptions for Expansion of Existing Facility under Complex Scenario No. 1. (Option A Low Estimate)

	Assumptions	
	Baseline Estimate	Revised Estimate
Capacity (gallons)	10,000,000	-
Years to Complete Permitting Process	2	1
Ratio of Reduction in Permitting Costs	-	0.5
Environmental Impact Analysis (CEQA) Costs	$250,000	$125,000
Cost of Obtaining all Permits[a]	$250,000	$125,000

Notes:
[a] Including local air district permit (authorities to construct and to operate), regional water quality control board waste discharge permit, hazardous waste permit, etc.

Table 4.3: Summary of CEQA and Permitting Costs and Other Key Assumptions for for New Re-refining Facility under Complex Scenario No. 1 (Option B High Estimate)

	Assumptions	
	Baseline Estimate	**Revised Estimate**
Capacity (gallons)	20,000,000	-
Years to Complete Permitting Process	10	5
Ratio of Reduction in Permitting Costs	-	0.5
Environmental Impact Analysis (CEQA) Costs	$1,000,000	$500,000
Cost of Obtaining all Permits[a]	$1,000,000	$500,000

Note:
[a] Including local air district permit (authorities to construct and to operate), regional water quality control board waste discharge permit, hazardous waste permit, etc.

The CEQA and permitting costs noted in the tables above are based on first-hand experience permitting solid waste management projects, knowledge of costs for CEQA EIR processes for other waste management projects, and informal queries to a company that performs CEQA analyses and prepares analysis and documentation for air and other types of permits for various types of facilities in California.

Converting DIYs to DIFMs through Lubricating Oil Tax

An additional calculation was conducted to determine the level of tax that would need to be levied on Do-It-Yourself (DIY) oil purchases in order to bring the cost of a DIY oil change in line with that of a Do-It-For-Me (DIFM) oil change. Note that in order to perform these calculations, this scenario simplifies the behavioral responses of DIY and DIFM oil changers and assumes that there could be a one-for-one correspondence between the two. In reality, there are likely to be countervailing factors that might complicate such a simple comparison.

Enacting a tax on DIY oil changes to bring the total cost of a DIY oil change in line with a DIFM oil change would give an incentive to DIYs to shift to DIFM and subsequently divert more used oil into the DIFM management stream, where it is most likely to be managed properly.

In order to determine what the optimal tax would be to effect this change, this scenario models the costs of both a DIY oil change and a DIFM oil change and takes the difference between those values to be the level of taxation needed to cause DIYs to become indifferent between a DIY and DIFM oil change. This analysis does not account for the fact that some DIYs may ascribe non-monetary value to changing their own oil and would be unlikely to switch to DIFM in the presence of a tax on DIY oil.

Table 4.4: Calculation of Cost of DIY and DIFM Oil Changes

Cost Component	DIY oil change (no return)	DIY oil change (oil return)	DIFM oil change
Time Travelling per Trip (hours)	0.0	0.5	0.5
Time Spent on/During Oil Change (hours)	0.5	0.5	0.5
Value of Time ($/hour)	$14.80	$14.80	$14.80
Value of Time Costs ($/trip)	$7.40	$14.80	$14.80
Gasoline Costs ($/trip)	$0.00	$1.20	$1.20
Total Trip Costs ($/trip)	$7.40	$16.00	$16.00
Cost of Oil Change ($)	$16.40	$16.40	$36.70
Incentive Payment Received ($)	$0.00	$0.50	$0.00
Total Cost of an Oil Change	$23.80	$30.70	$52.60
Gallons per Drain Cycle	1.25	1.25	1.25
Oil Change Costs $/gallon	**$19.00**	**$25.50**	**$42.10**

The cost components of the DIY oil change and the DIFM oil change are normalized to an oil change cost per gallon of lubricating oil. This analysis uses the same cost and time assumptions as were presented in Table 2.2 of this document. The costs of a DIY oil change are composed of the cost of the oil and time costs for the DIY to perform the oil change. DIYs who return their used oil ("oil return" column in Table 4.4) incur additional costs in the form of time costs to travel to the CCC for oil drop-off and the cost of gasoline to travel to the CCC, while receiving a benefit in the form of an incentive payment for their used oil (assuming they collect the incentive).

The cost of a DIFM oil change is composed of the time cost of traveling to the oil change location, time waiting while the oil is changed, the cost of gasoline to travel to the oil change location, and the cost of having the oil changed. This calculation shows that a DIY oil change costs approximately $19.00 per gallon of oil when not returning the used oil, and approximately $25.50 when returning the used oil. A DIFM oil change costs approximately $42.10 per gallon of oil.

A tax on DIY oil changes when used oil is not returned would therefore have to be about $23 in order for the cost of a DIY oil change to equal the cost of an average DIFM oil change. In a situation where the used oil is returned by the DIY, the tax would have to be equal to about $16.60. Thus, under the simplistic assumptions used in this example, a tax of about $17 - $23/gallon could equalize the costs of DIY and DIFM oil changes and theoretically make a consumer indifferent between the two options.

5. Sensitivity Analyses

Sensitivity Analysis #1: Changes in Elasticity Assumptions

The direct impacts model (DIM) report conducted sensitivity analyses for Scenarios 1, 2, 3, 2&3, 4 and 10 to examine the effects of varying the model's elasticity of supply assumption for used oil. In each scenario, this analysis was conducted by reducing the elasticity of supply from 0.2 to 0.02 for the class of used oil generators targeted by the recycling incentive policy. The net costs for each scenario and its sensitivity analysis are shown in Table 5.1.

Table 5.1: Net costs for Scenario and Sensitivity Analyses in 2020 and 2030 ($millions)

	2020			2030		
Scenario #	Simple Scenario	Sensitivity Scenario	Difference ($MM)	Simple Scenario	Sensitivity Scenario	Difference ($MM)
1	-$4.5	-$2.6	2.0	-$4.9	-$2.7	2.22
2	$1.5	-$1.1	-2.6	$1.2	-$1.3	-2.42
3	-$1.5	-$2.9	-1.4	-$1.3	-$3.1	-1.75
2&3	$1.4	-$2.6	-4.0	$1.3	-$2.9	-4.14
4	$9.5	-$1.8	-11.3	$9.8	-$2.0	-11.77
10	$0.3	-$0.9	-1.2	$0.3	-$1.0	-1.35

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to rounding

With the exception of Scenario 1, the sensitivity analyses show that a decrease in the elasticity of supply of used oil implies a higher cost of the policy. As discussed in the DIM report, a decrease in the elasticity of supply corresponds to a proportional decrease in the volume of used oil products recovered.

For most scenarios, used oil corresponds to a net cost saving for all entities—excluding government— combined. Thus, a substantial decrease in the amount of used oil managed leads to a corresponding decrease in cost savings. For Scenario 1, the estimated costs for DIYs were higher than any cost savings received from the policy, so a decrease in the quantity of used oil recycled resulted in a decrease in costs. Scenario 4, which modeled a change in the price of used oil from $0.30 per gallon to $0.70 per gallon, showed a relatively large decrease in cost savings, as the decrease in used oil managed represented a large decrease in hauler profits.

Note that if government administrative costs of managing the policies were removed from these calculations, the costs of the policies changed in proportion with the change in the elasticity of supply. That is, a one-tenth value for elasticity of supply implied roughly one-tenth increase in the aggregate cost of the policy for all other affected entities.

Sensitivity Analysis #2: DIY Assumptions

In scenarios where DIYs returned oil to a collection center, such as Scenario 1, the cost-benefit analysis assumed that 60 percent of DIYs bring their oil to a collection center in trips that are

solely for the purpose of returning used oil. This assumption was based on an informal survey of DIYs undertaken in Orange County by local personnel responsible for used oil collection in that area. Changing this assumption to 100 percent, all else equal, increased overall costs to DIYs by $1.3 million, or 72 percent higher than costs under the original assumption.

Sensitivity Analysis #3: Rail and Truck Exports

In response to stakeholder feedback on the split of exports using rail versus truck, we conducted a sensitivity analysis on the proportion of used oil exported by the two modes. The sensitivity was run on Scenario 4, for which there is a relatively large amount of used oil recovered and for which haulers have a relatively high level of activity. Our results from this analysis are presented in Table 5.2:

Table 5.2: Scenario 4 Net Costs in 2030 Under Varying Rail and Truck Export Assumptions ($millions)

	Haulers		Overall	
Rail/Truck Split for Exported Used Oil	Net Costs*	% Change from Default	Net Costs*	% Change from Default
92/8 Split (Default Assumption)	$4.9	--	$9.8	--
50/50 Split	$5.0	2.0%	$9.9	1.0%
8/92 Split	$5.2	6.1%	$10.1	3.1%

Notes: Negative values imply costs and positive values imply cost savings; Totals may not add due to independent rounding

This sensitivity analysis showed that adjusting the assumptions results in relatively small effects on haulers specifically and on overall net costs generally. Changing the default assumption so that 50 percent of exported used oil is hauled by rail and 50 percent is hauled by truck increases net costs for haulers by 2 percent and overall net costs by 1 percent. Under an extreme case in which 8 percent is hauled by rail and 92 percent is hauled by truck, net costs for haulers increases by about 6 percent, while overall net costs increase by roughly 3 percent. The results are approximately the same for all years modeled under this scenario.

6. Conclusion

The following table summarizes the net benefit estimates for all the scenarios analyzed in this CBA.

Table 6.1: Net Benefits for Cost-Benefit Analysis Scenarios ($ millions)

		2015	2020	2025	2030
Scenario 1	Estimated Costs	-$4.4	-$4.5	-$4.7	-$4.9
	Monetized Benefits	$0.2	$0.2	$0.2	$0.1
	Net Benefits	**-$4.2**	**-$4.3**	**-$4.5**	**-$4.8**
Scenario 2	Estimated Costs	$1.6	$1.5	$1.3	$1.2
	Monetized Benefits	$1.5	$1.6	$1.6	$1.6
	Net Benefits	**$3.1**	**$3.1**	**$3.0**	**$2.8**
Scenario 3	Estimated Costs	-$1.6	-$1.5	-$1.4	-$1.3
	Monetized Benefits	$0.8	$0.9	$1.1	$1.2
	Net Benefits	**-$0.8**	**-$0.5**	**-$0.3**	**-$0.1**
Scenario 2&3	Estimated Costs	$1.3	$1.4	$1.3	$1.3
	Monetized Benefits	$2.2	$2.5	$2.7	$2.8
	Net Benefits	**$3.6**	**$3.8**	**$4.0**	**$4.1**
Scenario 4	Estimated Costs	$9.4	$9.5	$9.6	$9.8
	Monetized Benefits	$2.2	$2.5	$2.7	$2.8
	Net Benefits	**$11.6**	**$11.9**	**$12.2**	**$12.6**
Scenario 5	Estimated Costs	-$3.3	-$3.1	-$3.0	-$3.1
	Monetized Benefits	$0.6	$0.8	$0.8	$0.8
	Net Benefits	**-$2.7**	**-$2.4**	**-$2.2**	**-$2.3**
Scenario 6	Estimated Costs	-$2.9	-$2.8	-$2.7	-$2.7
	Monetized Benefits	$0.5	$0.6	$0.7	$0.7
	Net Benefits	**-$2.5**	**-$2.2**	**-$2.0**	**-$1.9**
Scenario 7	Estimated Costs	-$2.9	-$2.9	-$2.9	-$2.9
	Monetized Benefits	$0.1	$0.1	$0.2	$0.3
	Net Benefits	**-$2.8**	**-$2.8**	**-$2.7**	**-$2.6**
Scenario 9	Estimated Costs	$0.1	$0.0	-$0.2	-$0.4
	Monetized Benefits	-$0.6	-$0.6	-$0.7	-$0.9
	Net Benefits	**-$0.5**	**-$0.6**	**-$0.9**	**-$1.2**
Scenario 10	Estimated Costs	$0.2	$0.3	$0.3	$0.3
	Monetized Benefits	-$0.2	-$0.2	-$0.2	-$0.2
	Net Benefits	**$0.0**	**$0.1**	**$0.2**	**$0.1**

Notes: Negative Net Benefits imply net costs and positive values imply net benefits.
For details about the scenario descriptions, refer to the DIM and/or CBA reports.
Numbers may not add due to individual rounding

Table 6.2: Job Impacts of Cost-Benefit Analysis Scenarios

		2015	2020	2025	2030
Scenario 1	California Jobs	102	86	72	60
	Rest of U.S.	74	37	36	21
	Total Jobs	**176**	**123**	**108**	**81**
Scenario 2	California Jobs	702	728	674	638
	Rest of U.S.	501	310	159	63
	Total Jobs	**1203**	**1038**	**833**	**701**
Scenario 3	California Jobs	305	432	456	478
	Rest of U.S.	506	449	404	313
	Total Jobs	**811**	**881**	**860**	**791**
Scenario 2&3	California Jobs	1001	1148	1115	1087
	Rest of U.S.	1024	792	610	453
	Total Jobs	**2025**	**1940**	**1725**	**1540**
Scenario 4	California Jobs	153	244	249	240
	Rest of U.S.	463	380	296	300
	Total Jobs	**616**	**624**	**545**	**540**
Scenario 5	California Jobs	-24	-18	-21	-23
	Rest of U.S.	-37	-17	-5	-5
	Total Jobs	**-61**	**-34**	**-26**	**-28**
Scenario 6	**No significant job impacts**				
Scenario 7	**No significant job impacts**				
Scenario 9	California Jobs	31	30	23	25
	Rest of U.S.	52	51	37	23
	Total Jobs	**83**	**81**	**60**	**48**
Scenario 10	California Jobs	-67	-60	-59	-63
	Rest of U.S.	-71	-41	-5	-3
	Total Jobs	**-138**	**-101**	**-64**	**-66**

Note: the Rest of U.S. category includes California's neighboring states and the rest of the U.S.

Tables 6.1 and 6.2 above summarize the net benefits and the overall job impacts, respectively, for the different scenarios analyzed in this cost-benefit analysis (CBA).

For each scenario we used a variety of assumptions that can be adjusted within the CBA that can impact the model outputs, as described in the methodology section. For each scenario, it estimated the costs to each relevant sector, the monetized benefits occurring due to emissions changes, and the REMI model subsequently analyzed the job impacts in California and the rest of the United States.

Of the scenarios modeled in the CBA, scenario 4 resulted in the largest magnitude of net benefits. Across all scenarios, the net benefits in 2030 ranged from -$4.8 million (Scenario 1) to $12.6

million (Scenario 4). The distribution of costs and avoided costs varied considerably across entities in the scenarios and largely depended on the entities targeted by the policy scenario. Estimated costs for 2030 ranged from -$4.9 million in Scenario 1 to slightly less than $10 million cost savings in Scenario 4.

Given the modeling assumptions used here, Scenario 4 has the potential for the most significant cost savings (and net benefits) for the state's used oil management program. Increased price for used oil has the potential to benefit different groups of entities associated with the used oil value chain. Adding the monetized benefits for this scenario could lead to overall net benefits that are among the largest of the scenarios analyzed here. Increased collection of used oil also implied higher program administrative costs for the state, but these costs were generally lower than some of the other scenarios that included higher incentive payments.

Monetized emission benefits observed in each scenario varied, ranging from -$900,000 (Scenario 9) to $2.8 million (Scenarios 2&3, 4). Emissions benefits were largely dependent on the type of policy instrument put in place for each scenario and which sector was most impacted by the policy. In Scenario 9, the fee on virgin lube oil production was assumed to be rolled back, which, under the assumptions used in this cost-benefit analysis (CBA), created more output in that sector and consequently more air emissions than in the baseline. There is, therefore, a corresponding (dis)benefit from emissions. In scenarios 2&3 and 4, the price and subsidy incentives direct used oil towards less polluting recovery pathways, so there were reduced air emissions and higher benefits than in the baseline.

In many scenarios, the costs incurred by one sector were offset by avoided costs for another sector (i.e., transfers). This led to some scenarios having minimal net benefits. For example, in scenario 5, the costs to virgin lube producers and the avoided costs to re-refiners largely offset each other, as did the costs to producers of recycled fuel oil and marine distillate oil and the avoided costs to producers of other displaced products. In this scenario, the net costs arose from the government costs for administering the program and a loss of fees that the government formerly collected. While some individual sectors gained under this scenario, overall the net benefits were negligible.

In a number of scenarios for which the used oil collection system was affected by the policy instrument giving a greater incentive to recycle used oil, the CBA showed positive net benefits. This occurred in scenarios 2&3 and 4. This result is largely a reflection of the greater financial incentives that the sectors involved in used oil recycling experienced and may indicate that policy incentives that bolster the used oil recycling system may be preferable to other options.

The job impacts of each scenario are also worth considering when determining optimal policy solutions for the used oil sector. In scenarios where the used oil collection system was utilized to a greater degree, there were generally more job gains. This occurred because of increased demand for services such as at collection centers, auto parts stores, quick lube shops, and used oil haulers. In a few scenarios there were significant job gains, such as scenarios 2&3 which produced 2,025 total jobs in 2015 nationally (including those in California and the rest of the United States). In other scenarios, such as scenario 9, where the fees on virgin lube oil production were rolled back, there were job gains of only 83 total jobs in California and the rest of the United States. Because this scenario focused narrowly on the refining sector, it did not engage many entities and therefore generated few jobs in the state and country.

7. References

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8. Appendix A

This Excel spreadsheet (MS Excel 2.23 MB) is the Cost Benefit Model that was created in support of the Used Oil Life Cycle Assessment Project that was conducted by CalRecycle pursuant to Senate Bill 546 (SB 546, Lowenthal 2009).

This model provides the underlying data and economic relationships between the affected entities in the California used oil management system as well as the valuation of emissions to the environment.

These spreadsheets are not included in this document but can be downloaded from the CalRecycle website.