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**Indirect Economic Impacts of
Low-Emission Vehicle Standards for
Heavy-Duty Vehicles**

Final Report

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ABSTRACT

This study analyzes the indirect economic impacts that could result from the implementation of potential low-emission standards for California-based heavy-duty vehicles (HDVs). It only addresses issues that could arise if the California Air Resources Board (ARB) adopts California-only emission standards that are more stringent than national emission standards. The implementation of such regulations could result in motor carrier operators registering new HDVs outside of California, causing a potential negative impact on California's economy and frustrating efforts to reduce emissions. In addition, firms could decide to delay their purchases of new HDVs and instead refurbish their existing fleet or purchase used HDVs. Effective state regulation of emissions from HDVs is compounded by the flexible provisions of the International Registration Plan, a registration agreement between the states which allows interstate operators to base HDVs in the state of their choice provided that they have an established place of business and accrue a portion of their fleet mileage in that state.

This report not only analyzes the potential economic impacts of possible regulations, but also develops potential economic incentive concepts to reduce the likelihood that HDV operators will move their base operations outside of California if new regulations are adopted.. A focus group and case studies were conducted, along with a survey of HDV operators, in order to achieve these objectives. In addition, this report includes an analysis of legal issues at the federal, state, and local level that could prevent the CARB from adopting economic incentives that may mitigate the impacts of the regulations.

Among the different economic incentive concepts considered, four were chosen for inclusion in a simulation model that analyzed potential economic impacts of the regulations: rebates, tax incentives, an emission-based registration fee system, and an emission credit trading system. In the absence of more stringent national standards for on-road HDVs, the results of this study support the adoption of an emission-based registration fee system under which HDV operators would be charged fees based on the emission contributions of their HDVs. Such a system could be applied to both in-state and out-of-state vehicles, thereby eliminating the incentive for operators to relocate outside of California while encouraging the purchase and use of low-emission HDVs.

INTRODUCTION

California, with its unique air pollution problems, has long led the nation in the regulation of mobile source emissions from automobiles and other light-duty vehicles. With nonattainment of pollution standards still a significant problem in many of its urban areas, however, the state has been forced to look to tighter emission controls for heavy-duty vehicles (HDVs) in order to comply with the Clean Air Act and its amendments. According to the California Air Resources Board (ARB), diesel powered HDVs contribute 20 percent of total statewide emissions of oxides of nitrogen (NO_x), a major precursor to smog formation. This percentage is expected to increase over the next decade as existing regulations reduce emissions from other vehicle classes.¹ As such, the ARB is considering a more stringent HDV emission performance standard based on diesel technology.

Attempting to regulate HDV emissions using the traditional method of setting a performance standard presents the state with a serious dilemma: the regulation could cause a number of considerable inefficiencies and side-effects. Many of these unintended consequences result because the standard would only apply to HDVs purchased and registered in California. These consequences might include:

- A loss of vehicle purchases and registrations as HDV operators seek to avoid substantially higher new vehicle costs by purchasing and registering vehicles outside the state where less stringent federal emission standards apply. The International Registration Plan (IRP), which governs where HDVs register, would permit this practice as it allows for considerable flexibility in state of registration.
- Failure to realize decreased NO_x emission levels if HDV operators purchase and register new federal standard HDVs out-of-state and continue to drive the same routes in California with these vehicles.
- A loss of some of the administrative functions of interstate, California-based HDV operators, as part of these functions must be located in the same state where the vehicles are registered. In some extreme cases, HDV operators could decide to relocate their entire operation outside of the state, causing a loss of jobs and economic activity.
- The loss of business from intrastate California-based firms to interstate firms as the now higher cost intrastate firms cannot compete or choose to downsize.

¹*Update on the Feasibility of Reducing Oxides of Nitrogen and Particulate Matter Emissions from Heavy-Duty Vehicles*, California Air Resources Board, July 1993.

- The delay of the purchase of the low-emission vehicles by engine rebuilding and purchasing of used vehicles. These expenditures by HDV operators may actually raise emission levels by keeping older HDVs on the road.

Two factors account for many of these problems: (1) the nature of trucking as interstate commerce and (2) the HDV registration agreement between the states called the International Registration Plan (IRP). The commerce clause of the U.S. Constitution prohibits states from regulating interstate commerce. As a result, one state cannot develop state regulations that somehow prohibit the movement of goods from one state to another. In addition, the IRP, designed to diminish the importance of the state of registration, sets flexible rules that allow each state to collect registration revenues for each vehicle operating in the state based on each state's registration fee schedule and the percent of the fleet's mileage accrued in that state. As a result, each state receives the same registration fees regardless of where the vehicle is registered. This flexibility solves the problem of operators registering trucks in states with low registration fees, but at the same time makes it more difficult for California to introduce cost-effective HDV engine standards.

These problems were recognized in the Federal Implementation Plan (FIP) that the U.S. Environmental Protection Agency proposed for South Coast, Ventura, and Sacramento on February 14, 1994. Low-emission HDVs were mandated by the FIP and what are referred to as one-stop, two-stop regulations were to be imposed to protect intrastate carriers while reducing emission contributions of HDVs. The FIP states that "Tighter emission standards only on California registered trucks could impose a cost burden on California shipping firms that would not exist for shippers based outside the state." The one-stop, two-stop regulations restricted interstate truck travel, limiting these trucks to one stop in the FIP area, and not more than two total stops in the state per trip. Legislation eliminated disputed provisions of the Clean Air Act that lead to promulgation of the FIP.

The State Implementation Plan (SIP), California's own plan for bringing its nonattainment areas into compliance with the federal ozone standard, calls for a national 2.0 gram per brake horsepower hour (g/bhp-hr) NO_x standard in 2004. A national emission standard for heavy-duty engines and vehicles is essential for California's emission control program to be fully effective. On July 11, 1995, heavy-duty engine manufacturers, the U.S. Environmental Protection Agency, and the ARB signed a Statement of Principles agreeing to set a national new engine standard comparable to what is called for in the SIP. For the additional emission reductions necessary in California before 2004, the Air Resources Board directed its staff to investigate and pursue other means of achieving reductions. This study addresses issues that could arise if the ARB implements a California-only emission standard that is more stringent than a national emission standard. However, if the California and national standards are equivalent, the issues discussed in this study are not applicable.

The ARB commissioned this study in order to examine whether economic incentives could be designed that would alter HDV operators' behavior such that they would be less likely to utilize the flexible provisions of the IRP in order to avoid purchasing low-emission HDVs. This

report presents our research, results and conclusions in three major parts spanning eleven chapters. Part One provides a series of six chapters that cover a variety of background issues and subjects. Part Two includes two chapters that present the results of a focus group, case studies and a survey designed to collect information from HDV operators on their operations and potential reactions to various alternative regulations. Part Three presents three chapters that introduce a simulation model that analyzes the consequences of alternative regulatory strategies and presents the conclusions and recommendations of the study.

Chapter 1 provides an overview of several basic issues that shape the problem under study, including the contribution of HDVs to California's pollution problem, trends in the number and travel of HDVs, the cost of low-emission HDVs, and the basics of the HDV regulatory structure. Approximately one million HDVs, more than half of which are not based in California, are estimated to operate in the state. While overall NO_x emissions have been decreasing for HDVs, their contributions to on-road mobile source NO_x emission levels are projected to increase from 42 percent in 1994 to 57 percent in 2010.² HDV travel, which was growing in the six percent per year range, has recently dropped off to one to two percent.³ Low-emission HDVs are projected to cost an additional \$5000 to \$15000.⁴

Chapter 2 reviews the International Registration Plan (IRP) which governs where trucks are registered. Since California cannot regulate emissions on trucks not sold or registered in the state, these rules condition the problem. The IRP allows operators to register a fleet of vehicles in any state where the fleet accrues miles as long as an office is maintained with a person capable of conducting the operation of the fleet along with a publicly listed telephone number in the fleet registrant's name. If operational records are not stored at the site they must be made available or auditor's travel paid for. Also included in this section is a discussion of the IRP enforcement practices of California, Nevada, Oregon, and Arizona.

Chapter 3 provides a discussion of the California relocation issue. From a trucking firm's point of view, the relocation decision is extremely complex, requiring the comparison of a variety of factors, some of which are one-time and others which are recurring, some which are intangible and others that more concrete, and some which are a matter of necessity and others which are a matter of taste. Despite an abundance of attention to the issue of out-migration and how to inhibit it, little empirical evidence exists that California is experiencing abnormal out-migration or that it is caused by overregulation. U.S. Bureau of the Census data show that

²*Ibid*, p. 5.

³*Truck Kilometers of Travel on the State Highway System, 1977-1992*, California Department of Transportation, July 1994.

⁴*Technical Feasibility of Reducing NO_x and Particulate Emissions From Heavy-Duty Engines*, Acurex Environmental Corporation, April 30, 1993.

California trucking establishments accounted for 10.3 percent of U.S. trucking receipts in 1992, down only one tenth of a percent from a 10.3 percent share in 1987.

Chapter 4 examines thirteen variables that define segments of the trucking industry that may be relevant to the analysis of the impacts of the regulations and economic incentives designed to mitigate adverse impacts. Interstate versus intrastate is considered to be an important dichotomy because it reflects the ability of operators to base new vehicles outside of California. The number of HDVs is important because the cost of setting up a new base state is a fixed cost offset by the incremental per vehicle cost of new vehicles only at firms with a certain number of HDVs.

Chapter 5 examines federal and state restrictions that the ARB faces in attempting to implement alternative regulatory strategies. Implementing a tax clearly presents a greater obstacle to implementation than do fees. Judicial interpretation of the interstate commerce clause of the U.S. Constitution would be unlikely to determine that California could force interstate firms to participate in a more stringent HDV regulation. The IRP, however, could conceivably be used to at least require interstate firms to pay their fair share of the cost of an emission rebate program.

Chapter 6 examines economic incentives that could be used to mitigate regulatory impacts. These incentives can be used in combination with the more traditional performance standards or by themselves. Economic incentives discussed include rebate measures, tax and fee measures, trading measures, loan measures, and operating cost measures.

Chapter 7 presents the results of the focus group and case studies that were conducted to gain insight into how different types of trucking operators would respond to more stringent state emission standards for HDVs. On June 28, 1994, the study team convened a focus group of eight truck operators, including six for hire carriers and two private carriers. The group expressed concern about the financial impact a low-emission HDV regulation could have on their industry. After the focus group was conducted, the study team conducted five follow up case studies to gauge the reactions of smaller to mid-size trucking firms that were under represented in the focus group. In both the focus group and case studies, three options were mentioned most often as a means to deal with increased operating costs: 1) raising rates, 2) delaying vehicle replacements, and 3) re-basing vehicles out-of-state.

Chapter 8 reviews the methodology and results of an exploratory survey of HDV operators. This survey was developed to complement information obtained in the case studies on potential reactions of HDV operators to a low-emission regulation. The survey asked firms to rank the impact of different economic incentive measures and regulatory cost scenarios on their decision to relocate or remain in the state. While not statistically significant, the results from the survey did indicate that smaller trucking firms may be more heavily impacted by a low-emission HDV regulation than larger ones. Moreover, the findings indicate that the relocation process is a complex one depending on a myriad of factors and that firms would not decide to move

outside of the state based solely on a comparison of operating costs with and without a regulation.

Chapter 9 describes the simulation model developed to measure the impacts of a low-emission HDV regulation. The model was developed in two parts. Part 1 of the model was a microsimulation model of how different firms would react on a case by case basis. Part 2 of the model covers the entire California trucking industry, and measures the macroeconomic impacts of the regulation, the number of new vehicles meeting the regulation purchased, the effectiveness of different economic incentive measures, and estimates the cost of these measures to the state government.

Chapter 10 presents and describes the results of the simulation model. These results demonstrate that a command and control approach without adopted economic incentives could cause unintended results and as a result may not significantly reduce emission levels for HDVs. Rebates were shown to be ineffective unless they approach total purchase costs, which would lead to high costs to the government. On the other hand, the model demonstrated that an emission-based registration fee (fee-bate system) is a reasonably efficient approach and would cause higher introduction of cleaner HDVs. The fee-bate system rewards or penalizes operators based on the emissions of each of their HDVs with higher fees for higher emitting vehicles.

Chapter 11 provides the conclusions and recommendations of the study. Successful regulatory design requires that the regulation be economically efficient, equitable, legally viable and reasonable from an administrative cost standpoint. Emission-based registration fees and emission trading schemes have a potential economic efficiency advantage over engine standards (with or without rebates or tax credits) because they link the payment to the level of pollution while both allowing and encouraging polluters to consider more cost-effective methods to reduce their emissions. On the other hand, performance standards are more readily enforceable and ensure real emission reductions. Equity concerns do not favor taxes and rebates because either the large costs of the low-emission HDVs must be borne by the public or the intrastate firms. Rebates may be the only program that ARB can institute without seeking outside approval, although funding would be a serious issue. Transaction costs for trading schemes may be quite high.

1 HDV EMISSIONS, TRAVEL AND REGULATIONS

Much of California's major urban areas are in violation of clean air standards and heavy-duty vehicles (HDVs) are a major contributor to this problem. As a result, the California Air Resources Board (ARB) is evaluating low-emission standards for heavy-duty vehicles and/or engines. These "low-emission" HDVs would be required to meet a more stringent emission standard, based on diesel technology. While alternative-fuel HDVs will have a role in California's emission reduction strategy, diesel and gasoline engines are expected to be the dominant technologies for meeting a more stringent oxides of nitrogen (NO_x) emission standard. The ARB is concerned that if these requirements are significantly more stringent than the standards for "49-state" vehicles, this could result in the registration of trucks that would otherwise be registered in California to other states and the relocation of California-based trucking operations to locations outside the state and other reactions by operators that are unintended and counterproductive. As a result, the ARB is interested in examining economic incentive programs that might mitigate inefficient or unintended effects of any proposed regulations.

To fully appreciate and understand the problems and concerns that have convinced the ARB that HDV low-emission regulations should be examined, it is useful to begin by examining the basic issues. This chapter covers each of these issues with the expressed aim of demonstrating the critical concerns that will condition the framework to be employed in analyzing the present problem.

The key issues include:

- HDV emission contributions;
- HDV emission control standards and trends;
- HDV travel trends;
- The number of HDVs;
- State regulation of HDVs; and
- Regulatory costs.

1.1 HDV EMISSION CONTRIBUTIONS

With passage of the California Clean Air Act of 1988, new air quality attainment standards were established to improve the state's air quality. Since mobile sources, such as passenger cars, trucks, buses and other motorized vehicles, produce about 60 percent of all ozone emissions and over 90 percent of all carbon monoxide emissions, the state has adopted an extensive mobile source emissions control program.⁵ All HDVs currently contribute more than 40 percent of the NO_x emissions caused by all on-road mobile sources in California, while

⁵From a document entitled, *Mobile Source Emission Reduction Credits: Guidelines for the Generation and Use of Mobile Source Emission Credits*, prepared by the California Air Resources Board, February 1994, pg. 8.

diesel powered HDVs account for 20 percent of the total statewide NO_x emissions inventory.⁶ This program was further strengthened last November when the California Air Resources Board (ARB) adopted the California State Implementation Plan to comply with federal requirements under the Clean Air Act Amendments of 1990.

According to the ARB, HDV emissions for NO_x are predicted to decline through 2000 due to more stringent regulations; however, these emissions are projected to increase from 2000 to 2010 due to increased vehicle miles traveled (VMT) for heavy-duty diesel trucks. In addition, the relative contribution of HDVs to mobile source NO_x emissions is predicted to remain constant through the year 2000.⁷ Exhibit 1-1 shows HDV (not including urban buses) emissions for California for selected years. As indicated by the data, diesel powered HDVs contribute significantly more NO_x than gasoline powered vehicles by about a 3:1 margin. The emission data indicate that NO_x emissions have decreased in recent years, due to older, dirtier vehicles being retired and replaced by newer, cleaner vehicles. While HDVs remain a significant contributor to mobile source emissions, it is important to note that this trend seems to have improved in recent years, as evidenced by Exhibit 1-1. Emissions of NO_x, as a precursor to photochemical smog formation, are a primary environmental concern raised by HDV operation in and upwind of heavily urbanized areas.

1.2 HDV EMISSION CONTROL STANDARDS AND TRENDS

Heavy-duty truck emissions have been regulated since 1970.⁸ However, in terms of percentage reduction for uncontrolled emissions levels, the emissions from HDVs have been less regulated than the emissions from other mobile sources. On a per mile basis, diesel HDV emissions are significantly higher than for automobiles due to large engine sizes and diesel combustion parameters.⁹

ARB is responsible for setting emission standards for heavy-duty engines that are sold as new in California, and the U.S. Environmental Protection Agency sets emission standards for new

⁶From a document entitled, *Update on the Feasibility of Reducing Oxides of Nitrogen and Particulate Matter Emissions from Heavy-Duty Vehicles*, prepared by the California Air Resources Board, July 1993.

⁷California Emission Trends, 1975-2010, California Air Resources Board, October 1993, pp. 7-8.

⁸White, Lawrence J.; *The Regulation of Air Pollutant Emissions from Motor Vehicles*; American Enterprise Institute for Public Policy Research; Washington, D.C.; 1982.

⁹Guensler, Randall, Daniel Sperling, and Paul Jovanis; *Uncertainty in the Emission Inventory for Heavy-Duty Diesel-Powered Truck*, Institute of Transportation Studies, University of California, Davis, 1991.

Exhibit 1-1
California Heavy-Duty Vehicle Emission Inventory (tons/day)

	TOG		ROG		CO		NO _x		PM	
Year	Gasoline Powered	Diesel Powered	Gasoline Powered	Diesel Powered	Gasoline Powered	Diesel Powered	Gasoline Powered	Diesel Powered	Gasoline Powered	Diesel Powered
1987	110.3	72.3	105.0	71.2	1,667.8	222.2	151.9	487.5	8.7	98.7
1989	99.9	81.6	94.6	79.6	1,521.9	270.9	165.5	542.1	9.7	111.5
1990	85.3	91.5	80.7	89.2	1,333.2	316.1	164.9	603.0	9.8	126.7
1991	79.6	84.9	75.2	82.9	1,220.1	319.9	165.3	580.0	9.9	114.8
1993	61.6	86.2	57.5	84.1	971.5	341.6	166.0	527.3	10.1	89.2

Source: Predicted California Vehicle Emissions, Average Annual Planning Inventory, Emission Inventory Branch,
California Air Resources Board

Note: Data does not include Urban Buses

Key:

TOG: Total Organic Gases

ROG: Reactive Organic Gases

CO: Carbon Monoxide

NO_x: Oxides of Nitrogen

PM: Particulate Matter

non-California heavy-duty engines. Federally certified heavy-duty vehicles may be based in California as a result of relocation by the vehicle's owner or as a result of sale of the vehicle to an in-state operator.

The ARB has set standards for emissions from heavy-duty diesel engines since 1973. Emission standards for hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NO_x), and particulate matter (PM) have been periodically revised during the intervening years, and the emission test procedure itself was changed in 1985. The ARB recently promulgated emission standards for new HD engines. Exhibit 1-2 lists the emission standards for new California heavy-duty diesel engines, while Exhibit 1-3 shows the California and Federal CO and NO_x standards for heavy-duty gasoline engines.

The ARB is also in the earliest stages of an analysis of the feasibility of setting a NO_x standard (as low as 2.0 grams per brake horsepower hour (g/bhp-hr) for future HDV engines). Conventional HDDs are not likely to be able to meet such a standard without major modifications, but natural gas fuel and propane gas fuel heavy-duty engines may be able to comply.

The U.S. EPA is responsible for setting heavy-duty engine emission standards for engines that are sold outside of California. Federal smoke opacity limits for heavy-duty diesel engines were first adopted by the U.S. EPA beginning with the 1973 model year while current smoke opacity limits have been in place since the 1975 model year (Federal Register 66290, December 20, 1993). Standards for HC, CO and NO_x were introduced for the 1974 model year. PM standards for heavy-duty diesel engines were first adopted by the U.S. Environmental Protection Agency for the 1988 model year (Federal Register 66290, December 20, 1993). Exhibit 1-4 lists the emission standards for new heavy-duty diesel engines sold outside of California. The Federal exhaust standards are measured using essentially the same test procedure used by California.

Exhibits 1-2 and 1-4 show that the Federal standards were generally a year or more behind California standards, but that the Federal and California standards for HC and CO are the same after 1988.

EXHIBIT 1-2
CALIFORNIA EXHAUST EMISSION STANDARDS FOR HEAVY DUTY DIESEL ENGINES
(grams per brake horsepower-hour)

Model Year ¹	Total Hydrocarbons	Non-Methane Hydrocarbons ²	Carbon Monoxide	Oxides of Nitrogen	HC + NO _x ³	Particulates
1973-74	--	--	40	--	16	--
1975-76	--	--	30	--	10	--
1977-79	-- 1.0	--	25 25	-- 7.5	5 --	-- --
1980-83	1.0 --	-- --	25 25	-- --	6.0 5.0	-- --
1985	0.5	--	25	--	4.5	--
1985-86	1.3	--	15.5	6.0	--	--
1987-89	1.3	--	15.5	6.0	--	0.6
1990	1.3	1.2	15.5	6.0	--	0.6
1991-93	1.3	1.2	15.5	5.0	--	0.25
1994-1997	1.3	1.2	15.5	5.0	--	0.1
1998 and Subsequent	1.3	1.2	15.5	4.0 ⁴	--	0.1

¹The steady-state procedure was used through 1984 and the transient procedure has been used since 1985.

²Manufacturers may choose to certify to the total HC or the non-methane HC standard.

³Manufacturers had the option of certifying to separate HC and NO_x standards or to a combined HC + NO_x standard in 1977-79.

⁴The 4.0 standard for Oxides of Nitrogen was adopted in June 1995.

Source: Energy and Environmental Analysis, Inc.

EXHIBIT 1-3 CO AND NO _x EMISSION STANDARDS FOR HEAVY-DUTY GASOLINE-POWERED VEHICLES (gram/brake horsepower-hour)					
	GVWR in pounds	California		Federal	
		CO	NO _x	CO	NO _x
1987	8,501-14,000	14.4	10.6	14.4	10.6
	Over 14,000	37.1	10.6	37.1	10.6
1988-1989	8,501-14,000	14.4	6.0	14.4	10.6
	Over 14,000	37.1	6.0	37.1	10.6
1990	8,501-14,000	14.4	6.0	14.4	6.0
	Over 14,000	37.1	6.0	37.1	6.0
1991-1995	8,501-14,000	14.4	5.0	14.4	5.0
	Over 14,000	37.1	5.0	37.1	5.0
1996-1998	8,501-14,000	Medium-Duty Vehicle Standards		14.4	5.0
	Over 14,000	37.1	5.0	37.1	5.0
1998 and later	8,501-14,000	Medium-Duty Vehicle Standards		14.4	4.0
	Over 14,000	37.1	4.0	37.1	4.0

Source: 1987-1996: *Update on the Feasibility of Reducing Oxides of Nitrogen and Particulate Matter Emissions from Heavy-Duty Vehicles*, prepared by the California Air Resources Board, July 1993.

1998 and later: Chris Lieske, Office of Mobile Sources, U.S. Environmental Protection Agency and Krista Fregoso, California Air Resources Board, telephone communications, September 1995.

EXHIBIT 1-4 FEDERAL EXHAUST EMISSION STANDARDS FOR HEAVY DUTY DIESEL ENGINES (grams per brake horsepower-hour)						
Model Year ¹	Hydrocarbons	Carbon Monoxide	Oxides of Nitrogen	HC + NO _x	Particulate Matter	Smoke (Opacity)
1970-73	--	--	--	--	--	Accel. 40% Lug 20%
1974-78	--	40	--	16	--	Accel. 20% Lug 15% Peak 50%
1979-83	1.5 --	25 25	-- --	10 5	-- --	Same
1984 ²	1.3 0.5	15.5 15.5	10.7 9.0	-- --	-- --	Same
1985-87	1.3	15.5	10.7	-- --	-- --	Same
1988-90	1.3	15.5	6.0	--	0.60	Same
1991-93	1.3	15.5	5.0	--	0.25	Same
1994-97	1.3	15.5	5.0	--	0.10	Same
1998 and Subsequent	1.3	15.5	4.0	--	0.10	Same

¹The steady-state procedure was used through 1984 and the transient procedure has been used since 1985.

²Manufacturers had the option of certifying to separate HC and NO_x standards or to a combined HC + NO_x standard in 1977-79.

Source: Energy and Environmental Analysis, Inc.

1.3 HDV TRAVEL TRENDS

NO_x emissions for HDVs are expected to decrease through 2000 and increase from 2000 to 2010.¹⁰ However, the trend for HDVs does not take into account the potential California heavy-duty engine standards for new vehicles. The expected increase in emissions is a function of projected growth in HDV travel and to a lesser extent, increased congestion. Truck travel has been increasing, partly to service the California population which is growing at a rate of two percent per year.¹¹ Exhibit 1-5 shows annual vehicle miles traveled (VMT) by 3-, 4-, and 5-axle trucks on the California state highway system from 1977 to 1992. The data indicate that while truck travel has been increasing, this growth seems to have slowed somewhat in recent years. For 5-axle trucks, VMT increased by 10.50 percent from 1986 to 1987, before leveling off and averaging 5.67 percent from 1987 to 1990. From 1990 to 1991, the rate fell to 0.21 percent, rising to 1.88 percent from 1991 to 1992. In the case of 3- and 4-axle trucks, from 1988 to 1992, VMT increased by an average of 3.75 percent for 3-axle trucks, and for 4-axle trucks, by 1.75 percent. From 1990 to 1991, VMT for these two truck types actually declined. While truck travel has been increasing, Caltrans' data seem to indicate that this growth has leveled off somewhat from a few years ago when it was observed that overall VMT appeared to be increasing about six to eight percent for all truck sizes compared to five percent for light-duty vehicles.¹²

¹⁰California Emission Trends, 1975-2010, California Air Resources Board, October 1993, pp. 7-8.

¹¹Center for Continuing Study of California Economy; California Population Characteristics: Regional Market Update and Projections; Palo Alto, California 1989.

¹²Guensler, Randall, Daniel Sperling, and Paul Jovanis, Uncertainty in the Emissions Inventory for Heavy-Duty Diesel-Powered Trucks, Institute of Transportation Studies, University of California Davis, 1991.

Exhibit 1-5

Annual Vehicle Miles Traveled on the California State Highway System, 1977-1992, in Millions

Year Ending	3-Axle Trucks	Percent Change	4-Axle Trucks	Percent Change	5-Axle Trucks	Percent Change
1977	743.2	N/A	347.2	N/A	3051.7	N/A
1978	799.3	7.5%	374.2	7.8%	3399.4	11.4%
1979	796.3	-0.4%	398.0	6.4%	3626.2	6.7%
1980	840.5	5.6%	413.7	3.9%	3862.1	6.5%
1981	910.9	8.4%	417.3	0.9%	4178.5	8.2%
1982	915.2	0.5%	411.4	-1.4%	4176.4	0.0%
1983	957.4	4.6%	438.9	6.7%	4382.6	4.9%
1984	980.7	2.4%	449.8	2.5%	4855.9	10.8%
1985	1033.1	5.3%	474.9	5.6%	5081.8	4.7%
1986	1078.2	4.4%	495.3	4.3%	5333.1	4.9%
1987	1170.8	8.6%	536.9	8.4%	5892.7	10.5%
1988	1239.5	5.9%	555.2	3.4%	6216.8	5.5%
1989	1293.3	4.3%	579.7	4.4%	6617.1	6.4%
1990	1310.5	1.3%	601.7	3.8%	6970.2	5.3%
1991	1266.3	-3.4%	564.1	-6.3%	6985.0	0.2%
1992	1286.4	1.6%	565.0	0.2%	7116.3	1.9%

Source: Truck Kilometers of Travel on the State Highway System, 1977-1992,
California Department of Transportation, July 1994

Note: Kilometers have been converted into miles using 1 mile = 1.6093 kilometers

N/A: Not Available

1.4 NUMBER OF HDVs

The California Energy Commission (CEC) has developed a database which provides a May 1993 snapshot of California Department of Motor Vehicle (DMV) Registrations by Gross Vehicle Weight (GVW), fuel type, and vintage. The CEC's tabulation of DMV data shows a total of 441,529 HDV registrations in California, as indicated in Exhibit 1-6.

EXHIBIT 1-6 CALIFORNIA ENERGY COMMISSION TABULATION OF HDV REGISTRATION DATA FOR MAY 1993				
GVW Class	Total Registrations	Percent of Total Registrations	Percent Diesel	Percent Gasoline
8,501-14,000	90,525	20%	29%	71%
14,001-33,000	254,432	56%	43%	57%
Over 33,000	105,572	24%	97%	3%
Total	441,529			

Medium-HDVs (14,000-33,000 GVW) make up the largest number of registrations, at 56 percent. Note that the percentage of gasoline HDVs drops considerably from medium-HDVs to heavy-HDVs (Over 33,000 GVW), while the percentage of diesel HDVs increases dramatically.

DMV historical data can also be used to estimate how the HDV population has changed over time. The DMV produces the *Gross Report* that provides a snapshot of their Vehicle Registration database. Registrations for vehicles over 6,000 lbs. unladen weight are shown in Exhibit 1-7, based on DMV's Gross Reports for January 1 of each calendar year. Unfortunately, the Gross Report does not indicate GVW, and thus can not be adequately compared with the CEC data tabulation, which shows registrations by weight class. However,

EXHIBIT 1-7
DMV GROSS REPORT REGISTRATION DATA FOR VEHICLES OVER
6,000 LBS. UNLADEN WEIGHT

Calendar Year	Total Registrations
1993	405,627
1992	400,431
1991	403,138
1990	404,081
1989	402,539
1988	382,767
1987	348,090
1986	332,036
1985	321,339

if unladen weight is used as a proxy for GVW, then the data indicate that the California HDV population increased 26 percent from 1985 to 1993.

The CEC data tabulation can also be compared to the results of the 1992 Truck Inventory and Usage Survey (TIUS), which is conducted by the U.S. Census Bureau every five years. TIUS is derived from a random sample of 3,950 vehicles that represent the total population of 7.1 million trucks, including light-duty vehicles, registered in the state for 1992. According to TIUS, 959 thousand vehicles were registered in California with an average weight (unladen weight plus average weight of load carried) over 6,000 lbs, 385 thousand vehicles over 10,000 lbs, and 274 thousand vehicles over 14,000 lbs. The CEC, however, has estimated 360 thousand vehicles with a GVW over 14,000 lbs, as shown in Exhibit 1-6. Given that the CEC data is an actual tabulation, while the TIUS is based on a random sample which is then aggregated using a weighting variable, the CEC data would appear more accurate than the TIUS data. The one year difference between TIUS and the CEC data (e.g. 1992 vs. 1993) is not expected to produce a difference of almost 100 thousand vehicles.

The TIUS data should be interpreted with caution for two reasons. First, TIUS does not include vehicles owned by federal, state, and local governments. Second, California is under sampled in the 1987 TIUS. While the TIUS sample for the entire U.S. consisted of 104,606 trucks of which 2,916 (2.8 percent) were registered in California, the TIUS reports that share of these trucks registered in California was 11 percent. Figures on the number of trucks in the United States and the total sample are not yet available for the 1992 TIUS.

Due to the flexible provisions of the International Registration Plan (IRP), which sets the rules involving where HDV operators register their vehicles, as well as the nature of the trucking industry, many of the trucks operating in California may not in fact be base plated in California. According to the ARB, out-of-state HDVs contribute 20 percent of heavy-duty VMT for the State. DMV has data that measures the total number of IRP/Prorate vehicles based in other states and paying fees to operate in California is shown in Exhibit 1-8.

Interestingly, a comparison of Exhibit 1-8 with Exhibit 1-7 indicates that more out-of-state HDVs operate in California than in-state HDVs. An effective emission reduction strategy would need to consider the emission contributions of these out-of-state vehicles due to their significant numbers. Currently, ARB is sponsoring a study that will estimate HDV population and usage patterns in the State. The results of this study should prove useful in determining the number of HDVs that are based both in California and outside of California, as well as their respective VMT.

Both Exhibits 1-6 and 1-7 show that the number of HDVs has been increasing in California. Combining the CEC data with the DMV's data on out-of-state HDVs, in 1993, the total number of HDVs operating in California was just over 1 million. Out-of-state vehicles have been increasing at a higher rate than in-state vehicles, which can be attributed to the fact that, as more states participated in the IRP, vehicles that had been operating under reciprocity agreements in California were now operating within the framework of the IRP. These vehicles,

EXHIBIT 1-8 NON-CALIFORNIA BASED HDVS	
Calendar Year	Total Number of HDVs
1993	561,168
1992	494,037
1991	448,259
1990	480,023
1989	367,952
1988	439,989
1987	341,324
1986	344,182
1985	378,065

Source: California DMV Estimated Out-of-State Fee Paid Vehicle Registrations.

while possibly traveling in California but not included in the IRP, were added to the database once their respective states joined the IRP. Note that this study involves the decision as to where HDV operators register their trucks and thus involves the concern that more trucks will be registered outside the state to avoid more stringent emissions standards. The IRP will be discussed in detail in Chapter 2.

1.5 STATE REGULATION OF HDVs

Over the years, the fifty States and the District of Columbia have developed a relatively complex set of laws and regulations governing the operation of heavy-duty motor vehicles (particularly those with potential gross vehicle weights above 26,000 pounds) and the taxes paid by the operators of these vehicles. The basic goals of these laws and regulations are to assure that:

- vehicles are operated safely;
- vehicle weights are limited to control pavement damage and bridge stresses; and
- operators pay highway taxes that are roughly comparable to their vehicles' appropriate share of the total cost of building and maintaining the highway system.

Although all States share these basic goals, each State has developed its own set of rules and regulations for achieving these goals, influenced to varying degrees by differences in the States' economies, population density, topography and soil conditions, legal history, and priorities of highway officials. The result is a set of regulations that have many similarities across States but that almost always differ in their particulars.¹³ Components of this system include:

- **Vehicle registration.** Registration provides the States with a means of keeping track of vehicles, and in most States, registration fees are the second most important source of revenues. In most States, registration fees increase rapidly with some measure of vehicle weight (most commonly, gross vehicle weight) as a way of obtaining an appropriate share of revenue from the heaviest vehicles. In addition, many states over the years have had agreements that allow sharing of registration (and fuel tax) receipts. These agreements have important implementation

¹³A detailed summary of all relevant Federal and State regulations is contained in the *Motor Carrier Advisory Service*, a loose-leaf volume published by the American Trucking Associations and updated monthly.

for vehicle registration. The following chapter discusses these agreements in detail.

- ***Fuel taxes.*** In most states, fuel taxes are the most important source of revenue from heavy-duty vehicles. For heavy-duty vehicles, fuel-tax liability is based on fuel *consumption* (not purchases) in each State, as estimated via a *fuel-use reporting* system.
- ***Weight-distance taxes*** (and other "third-structure" taxes). Weight-distance taxes are an important source of revenue in several States that impose them. The tax is normally imposed on in-state mileage at a rate determined by registered weight (or, in Oregon, registered weight and axle configuration).
- ***Fuel-use permits*** required of vehicles subject to fuel-use reporting.
- ***Registration of operating authority*** (of carriers) with the State public utilities commission.
- ***Temporary operating permits*** for vehicles not registered to operate in a State.
- ***Divisible load permits*** for routine operation at high weight limits that are allowed by State law but that are higher than the standard Federal limits (20,000 pounds on a single axle, 34,000 pounds on a tandem axle, and 80,000 gross vehicle weight).
- ***Nondivisible load permits*** for operation with a nondivisible load that exceeds the State's normal height, width, length or weight limits. These permits may be issued for a single trip or for an extended period of time. Varying operating restrictions apply, and the route used may have to be approved by the permitting office.
- ***Carrier permits*** required for the transport of *hazardous waste* or *radioactive materials*.
- ***Safety inspections*** of randomly selected vehicles and drivers passing a weigh station. Vehicles that have no defects may receive a Commercial Vehicle Safety Alliance (CVSA) 90-day sticker. Inspectors may skip any vehicle that has a non-expired sticker (though inspectors may choose to reinspect vehicles with valid stickers).

In addition to the above State requirements, the Federal government imposes: a fuel tax; a use tax on heavy vehicles with registered weights over 55,000 pounds; and excise taxes on trucks, trailers and tires.

1.6 REGULATORY COSTS

An important part of the regulatory process is determining the compliance costs. For HDVs, low-emission regulations would require purchasing new vehicles that are more expensive than conventional diesel vehicles. Exhibits 1-9 and 1-10 illustrate these costs for medium and heavy HDVs with a conventional diesel engine meeting current NO_x emission specifications and an alternative engine configuration that would have significantly lower emissions of NO_x. The emissions that can be achieved by these technologies, as well as the year in which these technologies will be available, are shown in Exhibit 1-11 for Diesel Engines. Alternative fuel vehicle emissions would be on the order of 2.0 grams per brake horsepower hour (g/bhp-hr) for 1997 and 1.0 by 2001 for NO_x.¹⁴ It should be noted that these figures are to be used only as estimates in an effort to illustrate the anticipated costs of a low-emission HDV regulation.

Based on Exhibit 1-9, compliance costs for a medium HDV, as calculated based on the total net present value (NPV) vehicle cost, would range from a net savings of about \$500 for a compressed natural gas (CNG) engine for the low cost range case to a high of approximately \$15,000 for a direct injection (DI) diesel with exhaust gas recirculation (EGR) and a catalyst trap for the high cost range case. These figures that seem to indicate a net benefit are largely a result of fuel cost savings from diesel to CNG. For this engine type, Exhibit 1-9 shows that operating and maintenance costs are lower than for the baseline diesel engine. Based solely on the NPV capital cost, compliance costs vary from about \$6,000 for the low cost scenario to \$10,000 for the high cost range case. For the DI diesel with EGR, the increase in the NPV capital cost is less than for CNG in this case by about \$1,300.

Exhibit 1-10 provides an estimate of compliance costs for heavy HDVs (over 33,000 GVW). Based on the difference between the NPV vehicle cost for the baseline and the alternative engine configurations, compliance costs are lowest for the DI diesel with a NO_x catalyst, at about \$14,000 for the low cost range, and highest for the DI diesel with exhaust gas recirculation (EGR), at \$20,000 under the same scenario. When only the NPV capital costs are analyzed, the compliance costs are slightly lower, at about \$14,000 for the DI with EGR and \$9,000 for the DI diesel with a NO_x catalyst for the low cost scenario.

¹⁴*Technical Feasibility of Reducing NO_x and Particulate Emissions from Heavy-Duty Engines*, Acurex Environmental Corporation, April 30, 1993.

EXHIBIT 1-9 MEDIUM HDV VEHICLE COSTS (14,000 - 33,000 GVW) 1992 Dollars						
Configuration	Cost Range	Purchase Price	NPV ^{1,2} Capital Cost	NPV Annual O/M ³ Costs	NPV Periodic Lifetime Costs ⁴	Total Vehicle NPV Cost
Baseline (Diesel)	LOW	\$70,000	\$71,085	\$52,759	\$7,016	\$130,860
	HIGH	\$70,000	\$71,085	\$79,514	\$7,373	\$157,972
Direct Injection Diesel with Exhaust Gas Recirculation and Catalyst Trap	LOW	\$70,000	\$77,686	\$55,240	\$7,016	\$139,942
	HIGH	\$70,000	\$79,920	\$84,593	\$7,373	\$171,886
Compressed Natural Gas Lean Burn Spark-Ignition	LOW	\$70,000	\$77,686	\$45,143	\$7,517	\$130,346
	HIGH	\$70,000	\$81,240	\$73,995	\$7,873	\$163,068

¹Net Present Value. All NPV costs shown assumes a discount rate of 10% and vehicle lifetime of 12 years.

²Capital Costs include engine and exhaust differential costs and sales tax.

³Operating and maintenance costs. Includes insurance, fuel costs, and routine maintenance costs. Annual vehicle miles traveled is assumed to be 25,000 miles.

⁴Includes one engine rebuild at 250,000 miles and tire replacement every 100,000 miles.

Note: Truck is assumed to be single-unit truck with 2-axles/double rear tires used within urban area for hauling moderate loads over short distances.

Source: *Technical Feasibility of Reducing NOx and Particulate Emissions From Heavy-Duty Engines*, Acurex Environmental Corporation, April 30, 1993.

EXHIBIT 1-10
HEAVY HDV VEHICLE COSTS (OVER 33,000 GVW)
1992 Dollars

Configuration	Cost Range	Purchase Price	NPV ^{1,2} Capital Cost	NPV Annual O/M ³ Costs	NPV Periodic Lifetime Costs ⁴	Total Vehicle NPV Cost
Baseline (Diesel)	LOW	\$90,000	\$91,395	\$88,139	\$12,731	\$192,265
	HIGH	\$90,000	\$94,442	\$94,076	\$13,468	\$202,005
Direct Injection Diesel with Exhaust Gas Recirculation and Catalyst Trap	LOW	\$90,000	\$106,120	\$93,858	\$12,731	\$212,708
	HIGH	\$90,000	\$109,369	\$101,052	\$13,488	\$223,909
Direct Injection Diesel with/Diesel Engine NO _x catalyst	LOW	\$90,000	\$100,535	\$93,403	\$12,731	\$206,668
	HIGH	\$90,000	\$104,089	\$101,389	\$13,448	\$218,965

¹Net Present Value. All NPV costs shown assumes a discount rate of 10% and vehicle lifetime of 12 years.

²Capital Costs include engine and exhaust differential costs and sales tax.

³Operating and Maintenance Costs. Includes insurance, fuel costs, and routine maintenance costs. Annual vehicle miles traveled is assumed to be 40,000 miles.

⁴Includes one engine rebuild at 375,000 miles and tire replacement every 100,000 miles.

Note: Truck is assumed to be over-the-road vehicle intended for long distance freight.

Source: *Technical Feasibility of Reducing NO_x and Particulate Emissions From Heavy-Duty Engines*, Acurex Environmental Corporation, April 30, 1993.

EXHIBIT 1-11 PROJECTIONS OF HEAVY-DUTY <u>DIESEL</u> ENGINE EMISSION CONTROL TECHNOLOGIES AND YEAR OF AVAILABILITY			
Year Available	Technology	Emission Rate (g/bhp-hr)	
		NO _x	PM
1999	EGR & Oxidation Catalyst	3.0	0.10
	EGR & Catalytic Trap	3.0	0.10
2000	Lean NO _x Catalyst	3.0	0.10
2002	Lean NO _x Catalyst	2.0	0.05
	EGR & Lean NO _x Catalyst	2.0	0.05
	EGR & Catalytic Trap	2.0	0.05

Source: *Technical Feasibility of Reducing NO_x and Particulate Emissions From Heavy-Duty Engines*, Acurex Environmental Corporation, April 30, 1993.

2 THE INTERNATIONAL REGISTRATION PLAN (IRP)

Since California will only be able to directly regulate emissions on HDVs registered in the state, the rules that govern where operators register their vehicles will be a primary determinant of the overall long-term success of more stringent emission regulations. This set of registration rules are the subject of this chapter. Over the years, there have been *reciprocal* agreements among states to recognize registrations in one state as being valid in another, and there have been *proration* and *apportionment* agreements for sharing a vehicle's registration fee among states on the basis of mileage traveled by state. The most successful of these agreements is the International Registration Plan (IRP) set up in 1973 by the American Association of Motor Vehicle Administrators in order to allow interstate carriers to pay registration fees based on mileage accrued in each state. In 1994, forty-five states and two Canadian provinces belonged to this plan, and the Intermodal Surface Transportation Efficiency Act of 1991 requires that all 48 contiguous states join by September 30, 1996. California entered into the IRP on January 1, 1985.

As this chapter will demonstrate, the IRP has important implications in terms of how motor carriers can register their vehicles. The IRP allows motor carriers to base their vehicles in any state provided that the firm has an established place of business and its vehicle fleet accrues mileage in that state. Additionally, the IRP requires that operational records be made available for auditors, but these records need not be stored in the same state as the base registration state. These concepts are discussed in further detail in this section.

The IRP requires carriers to register every vehicle in the state in which the vehicle is officially based and to submit annual reports detailing each vehicle's total mileage and miles traveled in each state. Motor carriers submit IRP applications to register each vehicle in the fleet only to the base jurisdiction (state). These applications contain information on vehicles in that carriers fleet, including declared jurisdictional weights (Schedule A) and a schedule of fleet mileage (Schedule B). Schedule A is shown for California in Exhibit 2-1, while Schedule B is shown in Exhibit 2-2. Each IRP member state is owed a portion of its annual registration fee, based on the fraction of total mileage operated in that state. The total of all such fees is paid to the base state, which then credits the accounts of all other states appropriately. According to the IRP, only one license plate and cab card may be issued per vehicle. This cab card contains information on how the vehicle has been apportioned. Motor carriers must register vehicles that correspond to the following definition, as set forth in Section 204 of the IRP:

"Apportionable Vehicle" means any vehicle used for the transportation of persons for hire or designed, used or maintained primarily for the transportation of property and 1) is a power unit having two axles and a gross vehicle weight or registered gross vehicle weight in excess of 26,000 pounds; or 2) is a power unit having three or more axles, regardless of weight; or 3) is used in combination, when the weight of such combination exceeds 26,000 pounds gross vehicle weight.

EXHIBIT 2-1:

☐ ☒ this box if there is a name and/or address change being reported.

CALIFORNIA APPORTIONED FLEET REGISTRATION APPLICATION SCHEDULE A

NAME OF REGISTRANT (PRINT OR TYPE)				MAILING ADDRESS				FLEET NO.				LICENSE YR.				ACCOUNT NO.															
BUSINESS ADDRESS (WHEN FLEET IS USED)								CITY								STATE								ZIP CODE							
CITY								COUNTY								STATE								ZIP CODE							
NAME OF AUTHORIZED COMPANY EMPLOYEE TO CONTACT AT BUSINESS ADDRESS								AREA CODE								TELEPHONE NO. LISTED AT BUSINESS ADDRESS								<input type="checkbox"/> Owner/Operator							
CITY								STATE								AREA CODE								TELEPHONE							

DECLARED JURISDICTIONAL WEIGHTS ☒ Box and enter weights below or on reverse as applicable. ☐ Maximum weight all jurisdictions ☐ Maximum weights all jurisdictions except as indicated below. Check box A next to vehicle listing and enter equipment numbers and weights on reverse for vehicles to be registered at weights other than listed below.

AL	AK	AZ	AR	BC	CO	CT	DE	FL	GA	ID	IL
IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO
MT	NE	NY	NH	NJ	NM	NY	NC	ND	OH	OK	OR
PA	SC	SD	TN	TX	UT	VT	VA	WA	WY	WI	WY

A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
WEIGHT EXCL. PM.	CALIF. TITLE LICENSE NO.	PRIOR PLATE/STATE	BASE STATE PLATE NO.	EQUIPMENT NUMBER	MAKE	VEHICLE IDENTIFICATION NUMBER	TYPE	UNLADEN WEIGHT	GROSS WEIGHT	COMB GROSS WEIGHT	FACTORY LIST PRICE	LATEST PURCHASE PRICE	DATE OF PURCHASE (MONTH & YEAR)	CA CODE FOR # MONTHS	FEE ON OWNER/OPERATOR NAME	TOTAL FEE					
<input type="checkbox"/>																					
<input type="checkbox"/>																					
<input type="checkbox"/>																					
<input type="checkbox"/>																					
<input type="checkbox"/>																					

TYPE (COLUMN NO. 7)			FUEL (COLUMN NO. 10)			FIELD OFFICE ONLY		
TT - Truck Tractor	ST - Semi Trailer	TX - Taxi	D - Diesel	G - Gas	P - Propane	<input type="checkbox"/> Vehicle Identifications Verified	<input type="checkbox"/> FMVSS Verified	<input type="checkbox"/> BT442UF Verified (attached)
TR - Tractor	FT - Full Trailer					<input type="checkbox"/> REG 147 (attached)		
TK - Single Truck	BS - Bus							
RT - Road Tractor	CG - Converter Gear							
BOTH SIDES MUST BE FILLED IN			NO BOTH REGISTRATION REQUESTED			NO OF POWER VEH. IN FLEET		
NO BOTH REGISTRATION REQUESTED			NO OF TRAILERS IN FLEET			TOTAL NO. OF VEH. IN FLEET		

DECLARATION: The undersigned declares, under penalty of perjury, that the information on this Application and Schedules is true and correct.

REQUIRED SIGNATURE _____ TITLE _____

CITY _____ STATE _____ DATE _____

SELF ISSUE PERMIT ISSUED <input type="checkbox"/> YES <input type="checkbox"/> NO	TOTAL 100% CALIFORNIA FEES
REG. 475 ISSUED <input type="checkbox"/> YES <input type="checkbox"/> NO	CALIFORNIA MILEAGE PERCENTAGE
DATE EXPIRES _____	CALIFORNIA APPORTIONED DOLLARS
The signature of an agent, who is not a bona fide employee of the business, must be authorized in writing. An owner, partner, or corporate officer must complete the authorization prior to the agent affixing his signature on the application.	CALIFORNIA PENALTY
	IRP JURISDICTION FEES
	COUNTY FEES—PER VEHICLE
	APPORTIONED FEE—\$1 PER APPLICATION
	INDICIA FEE—\$2 PER VEHICLE
	REFLECTORIZED PLATE FEE—\$1 PER VEHICLE
	GRAND TOTAL

The undersigned hereby appoints _____ as the agent authorized to sign this Proration Application for the 19 _____ licensing year.

OWNER'S NAME, PARTNERSHIP NAME, OR CORPORATION NAME _____ SIGNATURE _____ TITLE _____

EXHIBIT 2-1 (Continued)

DECLARED JURISDICTIONAL WEIGHTS—Enter equipment numbers and jurisdictional weights here only for vehicles to be qualified at different weights from those shown on the front of the form.

EQ # _____

AL	AB	AZ	AR	BC	CO	CT	DE	FL	GA	ID	IL
IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO
MT	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR
PA	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY

EQ # _____

AL	AB	AZ	AR	BC	CO	CT	DE	FL	GA	ID	IL
IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO
MT	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR
PA	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY

EQ # _____

AL	AB	AZ	AR	BC	CO	CT	DE	FL	GA	ID	IL
IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO
MT	NE	NV	NH	NJ	NM	NY	NC	ND	QH	OK	OR
PA	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY

EQ # _____

AL	AB	AZ	AR	BC	CO	CT	DE	FL	GA	ID	IL
IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO
MT	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	OR
PA	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY

2.1 REGISTRATION REQUIREMENTS

In order to claim a certain jurisdiction as a base jurisdiction, a carrier must meet three criteria: 1) The carrier must have an established place of business, 2) the carrier's fleet must accrue mileage in the jurisdiction and 3) the carrier must maintain fleet operational records for the fleet within the jurisdiction or make these records available. These three criteria, which constitute the three part test used to determine a carrier's base jurisdiction, are further delineated below.

Established Place of Business

In order to be allowed to register fleet vehicles in a certain state, the IRP requires carriers to have an "established place of business." The specific definition of an established place of business, from Section 218 of the IRP, is a "physical structure owned, leased, or rented by the fleet registrant."

This physical structure also must have a street address and the following two items: a telephone with a publicly listed phone number and an individual that "conducts the fleet registrants business." Operational records may be maintained at such a facility, but the carrier also has the option of keeping these records elsewhere. As a minimum, then, a carrier could rent out an office and hire an individual that would be familiar with how the fleet operates and could perform such tasks as dispatching vehicles and tracking the fleet. The definition of a "fleet registrants business" is not specifically defined in the IRP but most state DMVs and Public Utility Commissions (PUCs) contacted for this study confirmed that the individual answering the phones could not simply be a secretary but instead should be able to perform duties related to how the fleet is being operated.

Mileage Requirement

This requirement is fairly straightforward, as a registrant's fleet must accrue mileage within the base jurisdiction. In registering a fleet, a carrier must indicate how mileage is estimated to be accrued for registrant's fleet. Carriers must use Schedule B, a standardized IRP form, in estimating this mileage. Schedule B is shown in Exhibit 2-2 for California.

The IRP does not, however, state that each vehicle in the fleet must accrue mileage within the base jurisdiction to be registered in that jurisdiction. As an example, if a carrier lost a certain route to a competitor and thus needed to change how the fleet was routed, the carrier would not be penalized. Yet this provision, while not requiring carriers to prove that each vehicle accrues miles in the base jurisdiction, is not intended to allow carriers to improperly register their vehicles in a certain jurisdiction.

EXHIBIT 2-2:

CALIFORNIA APPORTIONED FLEET—MILEAGE SCHEDULE
SCHEDULE B


DMV
A Public Service Agency

NAME OF REGISTRANT (PRINT OR TYPE)				DATE FILED				LICENSE YEAR			
ACCOUNT NO.				FLEET NO.				<input type="checkbox"/> Original Application <input type="checkbox"/> Renewal Application <input type="checkbox"/> Amended <input type="checkbox"/> State Addition			
SCHEDULE OF FLEET MILEAGE FOR PERIOD JULY 1, 19____ THROUGH JUNE 30, 19____ DO NOT COMBINE THE MILES OF ANY TWO OR MORE JURISDICTIONS ENTER AN X (AS <input type="checkbox"/>) IN THE BOX IN FRONT OF EACH JURISDICTION FOR WHICH YOU ARE APPLYING FOR APPORTIONED REGISTRATION											
JURISDICTION	EST	MILEAGE	PERCENT	JURISDICTION	EST	MILEAGE	PERCENT	JURISDICTION	EST	MILEAGE	PERCENT
<input type="checkbox"/> AL (Alabama) (1)				<input type="checkbox"/> MB (Manitoba)				<input type="checkbox"/> OH (Ohio) (1)			
<input type="checkbox"/> AK (Alaska) (P)				<input type="checkbox"/> MD (Maryland) (1)				<input type="checkbox"/> OK (Oklahoma) (1)			
<input type="checkbox"/> AB (Alberta) (1)				<input type="checkbox"/> MA (Massachusetts)				<input type="checkbox"/> ON (Ontario)			
<input type="checkbox"/> AZ (Arizona) (1)				<input type="checkbox"/> MX (Mexico)				<input type="checkbox"/> OR (Oregon) (1)			
<input type="checkbox"/> AR (Arkansas) (1)				<input type="checkbox"/> MI (Michigan) (1)				<input type="checkbox"/> PA (Pennsylvania) (1)			
<input type="checkbox"/> BC (Brit. Columbia) (P)				<input type="checkbox"/> MN (Minnesota) (1)				<input type="checkbox"/> PE (Prince Ed. Is.)			
<input type="checkbox"/> CA (California) (1)				<input type="checkbox"/> MS (Mississippi) (1)				<input type="checkbox"/> PQ (Quebec)			
<input type="checkbox"/> CO (Colorado) (1)				<input type="checkbox"/> MO (Missouri) (1)				<input type="checkbox"/> RI (Rhode Island)			
<input type="checkbox"/> CT (Connecticut) (1)				<input type="checkbox"/> MT (Montana) (1)				<input type="checkbox"/> SK (Saskatchewan)			
<input type="checkbox"/> DE (Delaware)				<input type="checkbox"/> NE (Nebraska) (1)				<input type="checkbox"/> SC (South Carolina) (1)			
<input type="checkbox"/> DC (Dist. Columbia)				<input type="checkbox"/> NV (Nevada) (1)				<input type="checkbox"/> SD (South Dakota) (1)			
<input type="checkbox"/> FL (Florida) (1)				<input type="checkbox"/> NF (Newfoundland)				<input type="checkbox"/> TN (Tennessee) (1)			
<input type="checkbox"/> GA (Georgia) (1)				<input type="checkbox"/> NB (New Brunswick)				<input type="checkbox"/> TX (Texas) (1)			
<input type="checkbox"/> ID (Idaho) (1)				<input type="checkbox"/> NH (New Hampshire) (1)				<input type="checkbox"/> UT (Utah) (1)			
<input type="checkbox"/> IL (Illinois) (1)				<input type="checkbox"/> NJ (New Jersey)				<input type="checkbox"/> VT (Vermont) (1)			
<input type="checkbox"/> IN (Indiana) (1)				<input type="checkbox"/> NM (New Mexico) (1)				<input type="checkbox"/> VA (Virginia) (1)			
<input type="checkbox"/> IA (Iowa) (1)				<input type="checkbox"/> NY (New York) (1)				<input type="checkbox"/> WA (Washington) (1)			
<input type="checkbox"/> KS (Kansas) (1)				<input type="checkbox"/> NC (North Carolina) (1)				<input type="checkbox"/> WV (West Virginia) (1)			
<input type="checkbox"/> KY (Kentucky) (1)				<input type="checkbox"/> ND (North Dakota) (1)				<input type="checkbox"/> WI (Wisconsin) (1)			
<input type="checkbox"/> LA (Louisiana) (1)				<input type="checkbox"/> NT (Northwest Terr.)				<input type="checkbox"/> WY (Wyoming) (1)			
<input type="checkbox"/> ME (Maine)				<input type="checkbox"/> NS (Nova Scotia)							
TOTAL ACTUAL FLEET MILES									A		
TOTAL ESTIMATED FLEET MILES									E		
TOTAL ACTUAL MILES PLUS EST'D MILES									C		

(1) = IRP (P) = Private

TYPE OF OPERATION

State of Incorporation _____

CAL PUC-T No. _____

California B.E. fuel Tax No. _____

Canadian Province Authority No. _____

I.C.C. Permit No. _____

☐ Produce ☐ Grain ☐ Livestock ☐ Logs ☐ Ore
☐ Other _____
☐ Private Carrier ☐ Haul for Hire ☐ Rental Company ☐ Household Goods

— IMPORTANT —

CLEARLY MARK ALL ESTIMATED MILEAGE BEING REPORTED BY ENTERING AN "E" IN THE COLUMN MARKED "EST". ADD ALL ACTUAL MILES AND ENTER TOTAL IN BOX "A", ADD ALL ESTIMATED MILES AND ENTER TOTAL IN BOX "E". ENTER COMBINED TOTAL IN BOX "C". THE REVERSE SIDE OF THIS FORM MUST BE COMPLETED FOR ALL ESTIMATED MILES SHOWN..

Check one or both boxes:

☐ Mileages shown are actual miles ☐ Mileages shown are estimated

(AUTHOR/LS SIGNATURE)

DATE

(AREA CODE)

(FULL PHONE NUMBER)

EXHIBIT 2-2 (Continued)

LISTED BELOW ARE THE JURISDICTIONS IN WHICH MILES HAVE BEEN ESTIMATED AND REPORTED FOR THIS FLEET OF VEHICLES

WHY MILES WERE ESTIMATED: _____

HOW ESTIMATED MILES WERE DETERMINED: _____

Under the provisions of the IRP, the base jurisdiction is required to audit 25 percent of its carriers every four years. Thus, each motor carrier is audited every four years. Upon being audited, the carrier would need to back up their mileage figures with Individual Mileage Vehicle Reports (IVMR). These reports must include the following information:

- 1) Date of trip (starting and ending);
- 2) Trip origin and destination;
- 3) Route of travel and/or beginning and ending odometer or hubometer reading of the trip;
- 4) Total trip miles;
- 5) Mileage by jurisdiction;
- 6) Unit number or vehicle identification number; and may include, at the discretion of the base jurisdiction, the following additional information:
- 7) Vehicle fleet number;
- 8) Registrant's name
- 9) Trailer number; and
- 10) Driver's signature and/or name.

Item number 5 is of particular relevance in that this information will be used to verify how many miles the vehicle traveled in each jurisdiction.

Operational Records

Earlier versions of the IRP had required carriers to maintain their records within their base jurisdiction. Larger carriers noted that this provision would force them to incur additional costs since records were often kept in one central location for a carriers' entire fleet. As a result, the provision was changed to give carriers numerous options in making these records available. If audited, the carrier can send these records to the base jurisdiction or can pay for the per diem and travel expenses of such auditors to conduct the audit where the records are located. As an example, Ryder maintains a base jurisdiction in each state, yet maintains their records at their headquarters location in Miami, Florida. When audited, Ryder compensates the auditors for per diem and travel expenses.

This provision implies that, if changing their base jurisdiction, carriers would not need to change the location of their records. Rather, they could instead keep the records in one

location and set up an office in another jurisdiction as long as the fleet accrued miles in that jurisdiction.

Payment of Registration Fees

Motor carriers pay these fees according to the percentage of miles driven by the fleet in a jurisdiction. The base jurisdiction collects all the fees for other states and then distributes these fees accordingly. As an example, if a carrier's fleet accrued 30 percent of its miles in California, 40 percent in Nevada, and 30 percent in Arizona, the carrier would pay 30 percent of California's registration fees, 40 percent of Nevada's fees, and 30 percent of Arizona's fees.

Documentation Required to Base in California

In order for a carrier to base its vehicles in California, the following documentation is required:

Registrant —

- Photocopy of rent receipts or mortgage payments which indicate the business address.
- Photocopy of telephone company billing which indicates the business address.

Owner-Operator —

- California driver license number(s) issued to the owner-operator and driver(s).
- *Rent receipts or mortgage payments.
- *Telephone company billing.

*If unable to produce rent receipts and telephone billing in the owner-operator's name, a statement of facts, stating the owner-operator resides at that address and signed by the person whose name appears on the receipts is required.

Registration Agent or Service Bureau

A registration agent or service bureau is an individual hired to prepare and file any application required for a fleet of vehicles that travels on an interstate basis. Fleet records may be maintained at the agent's place of business. This individual cannot be designated as a company employee.

Relevant IRP Definitions

Fleet—means one or more apportionable vehicles.

Owner-Operator—Person who leases equipment and driver to another registrant and operates under the authority of another registrant.

Registrant—Has ICC, PUC and Fuel Tax Permits issued in their name, not operating under the authority of another registrant.

2.2 ENFORCEMENT OF IRP

As noted by Novella Crouch at the California Department of Motor Vehicles (DMV), the IRP is a "loosely formed coalition" which can allow for carriers to abuse its privileges. The IRP clearly states that its intent is to maximize carrier efficiency by reducing some of the regulatory costs associated with the industry. Yet enforcement of the IRP remains an important issue in determining the minimum requirements for carriers to change their base jurisdiction. What follows is a brief summary of conversations with IRP officials in California, Nevada, Oregon, and Arizona.

Novella Crouch, California DMV

Ms. Crouch, who heads the IRP division of the California DMV, noted that the IRP does not restrict carriers from moving their fleet. The DMV currently collects mileage figures from California motor carriers and, with fee modules, determines how much should be paid to each jurisdiction. She noted that, because California has adopted its own safety standards, motor carriers with California registered vehicles (i.e. California license plates) must comply with these standards instead of the Federal standards. California's safety standards are more stringent than federal standards, which implies that purchase costs for HDVs in California may already be higher than in other states.

"Base state shopping," which refers to carriers establishing a base state in response to regulatory and taxation issues, is a problem that the IRP does not enable states to prevent. As long as a carrier runs routes into and out of a state other than California, and complies with other IRP regulations, the carrier can declare a base jurisdiction outside of California. In addition, a carrier can have multiple base jurisdictions. Ms. Crouch was not aware of motor carriers which only accrue a small percentage of miles in California yet use California as their base state.

Charles Rabb, California DMV

Mr. Rabb is the head of the audit division of the IRP and manages a staff of 14 auditors. He stated that, from an auditors perspective, the issue of leaving the state was not an issue. He pointed out that California collects the same amount of money regardless of where a carrier

chooses to declare its base jurisdiction. After an audit is completed, the base state sends the results to other states in which the carrier has apportioned vehicles. If the audit shows that fees were either under- or overestimated then California will take action to insure that the funds are either collected or refunded.

Dee Cook, IRP Division of Oregon Public Utility Commission (PUC)

Ms. Cook noted that Oregon does have a problem with carriers falsely claiming Oregon as their base jurisdiction. When the PUC receives a new application, officials will check the phone number to make sure that it is publicly listed in the carrier's name. Officials then dial this number and check that the person answering the phone conducts business related to how the fleet operates. A physical location check also takes place to verify the address given on the application. Ms. Cook noted that her office will keep track of those carriers who may be erroneously based in Oregon and then write a letter to these carriers to see if they conduct business in Oregon. If not, the IRP will send a cancellation letter to the motor carrier stating that its vehicles will not be renewed.

Teri Belanger, Nevada DMV

According to Ms. Belanger, among the information required by her division for new applicants are rent receipts or property deeds and telephone receipts. In questionable circumstances, her office would investigate by sending people to the site, but this does not occur on a regular basis. Unlike Oregon, Nevada does not make as rigorous a check of minimum base state requirements. As a point of comparison, officials do not dial the phone number to verify that the person answering the phone was familiar with the registrant's business. Nevada has had a few examples of carriers based in the state that should have been based elsewhere.

Arlen Daugherty, Arizona DMV

Ms. Daugherty noted that the state does not physically check an address upon receiving a new application. When an audit occurs, however, the physical location could be checked, but only if records were kept at that same location or were sent to the location. She pointed out that Yuma, Arizona, is located on the California border and, as such, many trucking firms which operate their fleet out of Yuma may not accrue a large percentage of their miles in Arizona. Unlike California, Arizona has also adopted the Federal safety standards. Arizona is also economically deregulated, and does not monitor how freight is being moved.

2.3 COSTS ASSOCIATED WITH REREGISTERING VEHICLES: ANNUAL PROPERTY TAXES AND ONE-TIME EXCISE TAXES

Due to one-time excise taxes and/or annual property taxes, HDV operators could be faced with additional costs if they chose to reregister their vehicles outside of California. In initial conversations with various state DMV officials, some officials noted that states may impose either an excise or property tax on HDVs based in the state. These taxes would be based on the value of the HDV¹⁵ and could range from two to four percent of the book value of the HDV, on average. Assuming that states bordering California do impose these taxes, motor carriers could choose to establish a new base jurisdiction not by reregistering their existing fleet but by registering new vehicles in the new jurisdiction and "phasing out" those HDV that are based in their existing jurisdiction. This section presents information on these taxes applied to motor carriers, based on conversations with state DMV and/or Public Utility Commission (PUC) officials in Oregon, Nevada, and Arizona, who were queried as to whether or not the state had property or excise taxes. The first section provides an overview of property or excise taxes. The second details the results of conversations with state DMV and/or PUC officials in Oregon, Nevada, Arizona.

2.3.1 Overview of Excise and Property Taxes

According to the Motor Carrier Advisory Service (MCAS), published by the American Trucking Association (ATA), approximately 30 states impose some sort of property tax on HDVs, as shown in Exhibit 2-3. Property taxes can either be set by an individual county within the state or by the state itself, but are generally not set by both, and are usually charged on an annual basis, while excise taxes occur as a one-time fee. It should be noted that the important issue in this analysis is whether or not these taxes are being charged in addition to licensing fees. In some cases, these taxes could be prorated based on in-state mileage, while in others, these taxes could be imposed solely on carriers based within the jurisdiction. Prorated fees would not be expected to influence the decision to relocate, since these fees would be charged regardless of where the carrier is based. If, however, the state imposes property or excise taxes beyond the prorated registration fee, then a carrier may have a disincentive to relocating within the state.

¹⁵HDV in this case refers to trucks or tractors but does not refer to trailers being hauled. In other words, the value of an entire tractor-trailer combination would not be considered when estimating property or excise taxes.

Exhibit 2-3: Jurisdictions that Impose Property Tax on HDV's¹

- Alabama
- Alaska
- Arkansas
- California
- Colorado
- Connecticut
- District of Columbia
- Georgia
- Illinois
- Indiana
- Kansas
- Kentucky
- Maine
- Maryland
- Massachusetts
- Mississippi
- Missouri
- Montana
- Nebraska
- New Hampshire
- North Carolina
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Utah
- Virginia
- Washington
- West Virginia

¹This exhibit is based the Motor Carrier Advisory Service, published by the American Trucking Association (ATA). Property taxes vary widely by state and, in fact, property taxes may already be embedded in a State's registration fee. Each state would need to be contacted if precise information about how property or excise taxes are applied is to be obtained.

2.3.2 Results of Interviews with State DMV/PUC Officials

This section includes the results of conversations with state DMV/PUC officials.

Oregon

Oregon does not have a sales tax, but instead imposes a prorated weight fee. According to Dee Cook, the Oregon constitution requires a referendum for the state legislature to impose a sales tax. In addition, motor vehicles registered in Oregon are exempt from personal property taxes. HDVs registered in Oregon are subject to a minimal one-time \$10 to \$15 titling fee per vehicle. HDV registration fees are based solely on the weight of the vehicle, and are prorated based on mileage accrued in Oregon. Whether or not a carrier's HDVs are based in Oregon has no bearing on the registration fees paid to the state. Payment is based solely on the percentage of total fleet mileage accrued in Oregon. As a result, carriers would not be subject to any significant vehicle-specific fees when relocating their fleet outside of California into Oregon.

Nevada

Nevada imposes a "privilege" or property tax based on the value of the HDV. Calculating the tax involves three steps. First, the manufactured suggested retail price (MSRP) is obtained for the HDV. If the MSRP is not available, then Nevada law allows the DMV to calculate the base value of the vehicle based on 85 percent of the original purchase price. For example, if a carrier paid \$80,000 for a HDV, the base value would be \$68,000. If the vehicle is used, then a depreciated value of the vehicle is calculated. For the second step, the base (or depreciated, if the vehicle is used) value of the vehicle is multiplied by 35 percent to obtain the taxable value. The third step involves multiplying the taxable value of the vehicle by 4 percent. Put succinctly, the tax amounts to about 1.4 percent (35 percent multiplied by 4 percent) of the value of the HDV.

This tax is imposed on HDVs registered under proration or full license in Nevada. In other words, carriers that base vehicles in another state yet have vehicle fleets that accrue mileage in Nevada are subject to this tax. The prorated privilege tax, combined with the prorated registration fee, comprise the licensing fee for all motor carriers that accrue mileage in Nevada, regardless of where their fleet is based.

Arizona

Arizona's prorated registration fee is composed of three items: a use fee, a weight fee, and a licensing fee. All three fees apply to both Arizona and non-Arizona based vehicle fleets, and are prorated based on mileage accrued by the fleet in Arizona. The registration fee is \$12.00, and the weight fee varies by the size of the vehicle. Prorated weight fees range from \$7.50 to \$918.00 (the maximum GVW allowed in Arizona is 80,000 lbs). The prorated use fee depends on the age of the vehicle and is based on the GVW. The state also calculates a

prorated value tax based on the factory list price of the vehicle. A factor of approximately 2 percent is used, however, a precise estimate of the factor used was not available from Arizona DMV officials. The factor is multiplied by the factory list price to obtain the value tax. Vehicles not based in Arizona are also subject to this tax. Arizona DMV officials use the higher of the two prorated fees (e.g. the use fee and the value tax), and then, combined with the weight and licensing fees, calculate the total registration fee.

2.3.3 Conclusion

While some states impose property taxes on HDVs, the states bordering California do not, based on our conversations with state DMV/PUC officials. Exhibit 2-4 shows the main components of apportioned registration fees for California, Oregon, Nevada, and Arizona. As a direct result, motor carriers reregistering their vehicles in these states would not be faced with additional property or excise taxes beyond the costs they currently face. The main cost components for these carriers in this situation would probably not be vehicle related but would instead depend on a variety of economic factors such as salaries, the availability of office space, office rental prices, and the cost of living. The importance of these and other relocation costs are being analyzed as part of the simulation model developed for this report.

Exhibit 2-4: Apportioned Registration Fee Components			
California	Nevada	Oregon	Arizona
Weight fee - based on unladen vehicle weight	Weight fee - based on Gross Vehicle Weight	Weight fee - based on Gross Vehicle Weight	Use Fee or Value tax, whichever is higher
	Property tax on 1.4 percent of value of vehicle	Weight-Mile Tax	Weight Fee
			Licensing Fee

3 THE CALIFORNIA RELOCATION ISSUE

The relocation decision is one of the most complex in all of business. In deciding whether or not to relocate in order to avoid regulatory costs, a firm must weigh these costs against multiple factors, including the cost of living, rental costs, the regulatory climate, employee costs, and other important costs at an alternative location. This section describes the relocation decision as it relates to the California trucking industry, and then discusses California's experience with industry out-migration. Despite popular belief that California is suffering from abnormally high net out-migration caused in part by over regulation, there is little or no empirical support for this claim.

One purpose of this section is to explain the relocation decision process. As discussed in Section 2, the flexible provisions of the IRP imply that a trucking firm would not face significant regulatory obstacles to relocating. However, many firms could choose to retain their operations in California but maintain a satellite office out-of-state and purchase and base state all of their vehicles out-of-state, thereby avoiding a low-emission HDV regulation and avoiding the costly and uncertain relocation decision.

3.1 THE RELOCATION DECISION

Operating costs provide an indication of the cost of conducting business in California. When deciding whether or not to relocate operations out-of-state, a firm would calculate the cost of doing business in California and would then estimate these costs for an out-of-state location with similar physical characteristics. This information could be used to measure the potential cost savings in relocating. For example, the square foot costs for facilities with the same building specifications and utility requirements could be used as a basis for comparison. A list of non-HDV related operating costs might include the following:

- Business related costs, including:
 - rent costs;
 - building insurance costs;
 - heating costs (if applicable);
 - utility costs (e.g., electricity);
 - property taxes; and
- Personnel costs, which are affected by the following items:
 - housing costs, including rentals; and
 - cost-of-living.

The above costs would be expected to vary by location, e.g., these costs would be different outside of the state. The proposed emission regulations in California will add to the capital

and operating cost for rolling stock of local companies. As a direct result, California-based carriers will be at a further cost disadvantage vis-a-vis competitors in other states.

With respect to the trucking industry, it would appear that any carrier based in the state would be subject to the new regulations. This should not cause fleet relocation per se, as carriers could simply establish a new base jurisdiction outside of the state and base new vehicles in this new jurisdiction while maintaining an older fleet of vehicles in California. If motor carriers headquartered and/or with sizeable local fleets in California are subject to extra purchasing costs, then relocation is a possibility, since California is already considered by many to be a high cost location. However, it is unlikely that this regulation alone would cause a significant number of firms to relocate their entire operations, especially given the less dramatic option of rebasing vehicles in another state and leaving the rest of their operation intact.

In deciding whether to move its operations out-of-state, a carrier would quantify recurring and one-time costs, and a comparison would be made against the current site and one or more alternative locations in another state. Recurring costs include the following:

1. Payroll
 - Wages
 - Benefits
 - Recruiting and training
 - Workweek differential
 - Overtime
 - Shift premium
 - Unemployment insurance
 - Workers' compensation
2. Occupancy
 - Base rent
 - Operating expenses
3. Electric power
4. Transportation
 - Inbound
 - Outbound
5. Taxes
 - Income
 - Franchise

- Ad valorem
- Intangible property
- Sales/use
- Fees

One time costs include the following:

1. Real Estate
 - Site acquisition and preparation
 - Building construction or retrofit
 - Soft costs (e.g., architect fees)
 - Existing space disposition
2. Furniture/fixtures/equipment
 - Disposition
 - Acquisition
 - Computer design and installation
 - Telephone
 - Moving
3. Temporary duplicate operations
 - Space
 - Personnel
4. Employee Related
 - Relocation
 - Separation
 - Replacement
 - Temporary assignments
5. Program management
 - Staff
 - Vendor services
 - Travel

6. Offset of economic development incentives

- Tax abatement
- Tax credits
- Loans
- Grants
- Pre-employment training
- Other

In order to conduct a comprehensive analysis of relocation possibilities, a firm would need to collect cost or other information on each item listed above that falls into these two categories. To be justifiable from a business economic perspective, annual savings in the destination area must be significantly large to recoup one-time relocation costs within a reasonable timeframe. Typically, a payback of its one-time relocation costs in less than three and a half years is desirable. The hurdle rate¹⁶ should be set at 15 percent and, in a discounted cash flow analysis, an 8 percent cost of funds rate should be used.

Other factors may be considered by businesses when deciding whether or not to relocate. In particular, the climate may be an important consideration, particularly for firms located in California. If the firm chooses to relocate and most of its employees decide not to move with the firm, then training costs will be incurred, along with the opportunity costs resulting from lost output due to time spent on training that could instead be spent on production. In evaluating a new location, the quality of local schools may also be a factor, along with job opportunities for employees' spouses, and educational (college, post-graduate) opportunities as well. For example, a firm's location in California may be accessible to a major university while a particular location outside of the state may not have this feature.

3.2 REASONS STATED FOR INDUSTRY OUT-MIGRATION

In preparing this report, we analyzed pertinent studies and articles written about the state's business climate to uncover reasons for the out-migration of firms. While many of these studies covered manufacturing in particular, many of their conclusions are relevant to the transportation industry. In every study of California's out-migration the same themes appear:

- 1) California's business costs are higher:
 - Higher wages than in other states
 - Higher real estate and land costs

¹⁶In the field of relocation, "hurdle rate" is a term used to measure the operating cost differential between two locations. If current costs lie above the hurdle rate, then relocation would be justified from a financial sense in that the firm would achieve significant cost savings to cover the high one-time relocation costs.

- Higher energy costs
 - Higher costs for materials
- 2) Poor Business Climate:
- State and Local governments adversarial
 - Environmental laws and regulations are too harsh
 - Quality of life is declining
 - Crime is a perceived problem
 - Public education is lagging

The consensus which emerges from the studies and articles is that:

- Business costs are the most significant factor in firms leaving the state
- Quality of life, although mentioned as a determinant of firm relocation, was not a major factor
- Adverse business climate, encompassing many issues from environment to insurance, is very important to the business community, although difficult to quantify
- Although a competent work force is important, training, per se, is not a dominant factor in relocation decisions.

The results of a survey by Bules and Associates in 1992 is presented in Exhibit 3-1. It measured the perceptions of top managers of 1035 companies that had either moved to, or expanded their facilities in, locations outside California between 1980 and 1991.

According to the survey, the cost of doing business was the most important issue and was cited by 66 percent of respondents. Governmental issues ranked next highest in importance and were cited by about 50 percent of the respondents. The relative importance of labor issues (other than labor costs) among all the other factors also was important and was consistent with the findings of other surveys in that the significance of labor quality and availability were roughly about the same as concerns about access to markets.

EXHIBIT 3-1: Causes of Industry Migration from California

<i>Rank</i>	<i>Factor</i>	<i>Percent That Each Factor Was Identified In Not Selecting California</i>		
		<i>Expansions</i>	<i>Relocations</i>	<i>Overall</i>
	Direct Business Costs			66
1	Labor Costs	60	54	58
2	Real Estate Costs	42	46	42
	Other Business Climate			62
3	State Government	47	50	50
4	Local Government	48	50	50
5	Environmental Laws & Regulations	49	45	47
7	Labor Availability	32	11	20
8	Labor Quality	25	14	17
	Business Requirements			44
6	Access to Markets	28	18	24
11	Product Requirements	9	12	10
	Quality of Life			23
9	Housing Costs	9	20	14
10	Personal Taxes	11	15	13
12	Traffic Congestion	8	16	8

3.3 CURRENT EFFORTS TO RETAIN AND ATTRACT FIRMS

There have been two initiatives undertaken by the state to deal with the problems of out-migration: The Ueberoth Commission and the Assembly Democratic Economic Prosperity Team. In April 1992 the Council on California Competitiveness, known as the Ueberoth Commission, released its findings and recommendations in a report titled, "California's Jobs and Future". The Assembly Democratic Economic Prosperity Team (ADEPT) was formulated in December 1991 to improve the California economy and business climate. ADEPT has embodied the "inclusive and collaborative" model of problem solving aimed at establishing a synergistic relationship between the public and private sectors, and the legislative and executive branches.

The recommendations of both commissions tended to conform to the same conclusions, with considerable overlap. The improvements needed for the state related to the following common objectives:

- 1) Improving Government Efficiency and Attitude
 - There is a need to "reinvent government" in such a manner as to allow government employees to recognize the importance of continuous quality improvements and to empower employees to make decisions ensuring quality at each level of service provision and management.
- 2) Workers Compensation
 - Both commissions note the importance of workers' compensation reform in improving the business climate. As a result legislation has been enacted to improve the workers compensation situation and lower costs in the state.
- 3) Strategic Planning
 - Both commissions focused on the need for California to undertake a strategic planning process for economic development similar to processes common in the business world. This consensus was found in the 1993 enactment of AB 761, the Economic Development Strategic Planning Act of 1993.
- 4) Capital Availability
 - Both commissions agreed that California must make more capital available for investment purposes in the state to create jobs and opportunities. This has resulted in improvements in tax policy, especially

regarding capital recovery for new investments and tax credits for environmental mitigations.

5) Regulatory Reform

- There has been recognition for the need to streamline the regulatory process, especially in the area of the environment. The legislative leadership is aware of this need. Hearings have been held which have identified the 12 most raised problems relating to regulatory activities. The Legislature is reviewing the list of regulatory issues with the view of eventually making changes to alleviate or mitigate the problems.¹⁷

6) Defense Conversion

- California has been hit hard by defense facility closures, which have come concurrent with the recent recession. The California Defense Conversion Council is taking a leading role in developing a strategic plan for California conversion activities. These surplus military facilities have the potential for conversion to economically viable uses, replacing the defense jobs lost.

3.4 EVIDENCE THAT RELOCATION IS NOT A SIGNIFICANT TREND

Despite the focus on California's alleged problem with out-migration of firms as evidenced by the various initiatives, it is not at all clear that such a trend exists and if it does that it is due to a deteriorating "business environment." For example, according to the Economic Development Corporation, nearly 400 businesses and 66,000 jobs have left Southern California since 1990. Companies have left California for states with lower regulatory costs, including Arizona, Nevada, New Mexico and Oregon.¹⁸ Some observers attribute part of this trend to what they characterize as excessive regulatory costs, although this trend towards relocating outside California has subsided during the past two years.¹⁹ These purported trends, however, have not been substantiated by empirical studies. Consider the following excerpts from a recent study of California manufacturing competitiveness.

¹⁷Council on California Competitiveness, California's Jobs and Future, April 23, 1992, p.31.

¹⁸John S. DeMott, "California's Economic Crisis," in *Nation's Business*, July 1993, pp. 16-22.

¹⁹*Washington Post*, February 21, 1995, page A8.

"The high growth in manufacturing employment in the state from the early 1970's to 1990 ran counter to the trend in the total U.S. where employment stagnated due to high automation and sustained increases in labor productivity. The high growth is attributed to the general rapid increase in the state's population and economic output. The leveling off of this general growth and the substantial reduction in defense procurement has resulted in a decline of approximately 15 percent in manufacturing employment since 1990. This decline is much sharper than any witnessed over the past two decades and comes as a sizeable shock to the state which has been accustomed to sustained growth in manufacturing employment until now. Much of this decline has been attributed to out-migration of firms and, perhaps conveniently, attributed to an unfriendly business environment in the state."

"In order to place the recent declines in the state's manufacturing employment in proper perspective, it is instructive to examine the trends in total manufacturing employment in California versus the trends in the total United States. This share has declined from about 10.7 percent in 1990 to about 9.8 percent in 1994, a 8.4 percentage decline in share contrasted to the 15 percent decline in actual employment. Although California has experienced a sharp employment decline in manufacturing over the past few years, almost half of it is simply in line with the U.S. total decline--a result of the continued high increase in labor productivity in manufacturing and the recent recession."

"It is appropriate to calculate how much of the absolute decline in manufacturing employment in the state in recent years is explained by the decline in defense spending especially in the procurement of hardware and weapons systems."

"In order to measure the total employment effects (direct and indirect) of reductions in defense expenditures we may use employment multipliers which are obtained from calculations based on input-output tables. Applying the multiplier to this job loss we derive a total of direct and indirect jobs lost in manufacturing of 208,000. It will be noted that this job loss is slightly larger than the net job loss in manufacturing for the same period of approximately 200,000. Thus, except for the effects of the defense cutback, manufacturing employment would not have declined. This result is in spite of the fact that manufacturing employment has stagnated in the total U.S. for the last several decades due to its steep increases in labor productivity, and actually declined by 5.3 percent between 1990 and 1994."

"These results are not symptomatic of a "sick" manufacturing sector, but rather portend a healthy recovery after the defense cutbacks "bottom out." Neither do they support serious concerns about out-migration of manufacturing firms and an "unfriendly business environment."

The notion that the California trucking industry is in decline also appears to be somewhat uncertain. A variety of mostly anecdotal evidence has been used to argue the declining trucking industry thesis. For example, during the last two years, the California Trucking Association (CTA) has lost 10 percent of its membership due to trucking companies moving out of California.²⁰ From 1990 to 1992, the California trucking industry employment dropped by 6 percent as approximately 57,000 jobs were lost; since 1989, 970 for hire carriers have gone out of business in California.²¹ These regulations could thus be a contributing factor to a growing trend of manufacturing and distribution operations leaving the state.²²

On the other hand, recently released census data does not appear to support any significant downward trend in the California trucking industry. Exhibit 3-2 provides data on the number and revenues of California and U.S. trucking establishments. Between 1987 and 1992 the number of motor freight establishments in California actually grew 233 from 10,851 to 11,084, while revenues rose from 10.7 billion to 14.9 billion. California's share of all U.S. trucking establishments did drop slightly from 10.6 to 10.0 percent, but California's share of revenues dropped only a very small amount from 10.4 to 10.3 percent of U.S. revenues. The revenue picture was not uniform, however, as California's local trucking firms (without storage) increased their share of U.S. revenues from 13.0 percent to 13.5 percent while non-local trucking lost ground, dropping from 8.0 percent to 6.7 percent. Overall, these data do not support the conclusion that there is any significant exodus of trucking establishments or revenues from the state.

²⁰Letter from Bryan Porter of Arthur Bauer & Associates to Jonathan Skolnik of JFA detailing notes of meeting with Stephanie Williams, California Trucking Association. The meeting occurred on March 25, 1994.

²¹California Trucking Association, *California Trucking Essentials*, (fact sheet) 1995

²²Letter from Dennis J. Donovan of The Wadley-Donovan Group, Ltd., to Thomas Kornfield of JFA.

Exhibit 3-2: California Share of the U.S. Trucking Industry, 1987 and 1992.

Standard Industrial Classification		U.S.	California	Percent	U.S.	California	Percent
(SIC) Code	# of Establishments	1987	1987	CA	1992	1992	CA
42	Motor Freight Transportation and Warehousing	102,703	10,851	10.6%	110,908	11,084	10.0%
4212	Local trucking without storage	45,893	4,836	10.5%	49,870	4,897	9.8%
4213	Trucking, except local	37,742	3,092	8.2%	40,821	2,962	7.3%
4214	Local Trucking with storage	5,804	1,066	18.4%	4,512	765	17.0%
4215	Courier services, except by air	5,954	741	12.4%	5,966	836	14.0%
422	Public warehousing and storage	7,232	1,113	15.4%	9,718	1,624	16.7%
423	Trucking terminal facilities	78	3	3.8%	21	0	0.0%

Standard Industrial Classification		U.S.	California	Percent	U.S.	California	Percent
(SIC) Code	Revenues, Millions	1987	1987	CA	1992	1992	CA
42	Motor Freight Transportation and Warehousing	103,043	10,714	10.4%	143,794	14,882	10.3%
4212	Local trucking without storage	20,518	2,672	13.0%	33,554	4,532	13.5%
4213	Trucking, except local	60,809	4,874	8.0%	78,358	5,274	6.7%
4214	Local Trucking with storage	3,737	798	21.4%	4,191	886	21.1%
4215	Courier services, except by air	12,658	1,560	12.3%	19,334	2,921	15.1%
422	Public warehousing and storage	5,255	N.A.	0.0%	8,330	1,269	15.2%
423	Trucking terminal facilities	66	N.A.	0.0%	27	0	0.0%

Sources: 1987 Census of Transportation, Geographic Area Series, Volume TC87-A-1, Table 1, U.S. Department of Commerce, Bureau of the Census, November 1989.
1992 Census of Transportation, Communications, and Utilities, Geographic Area Series, Volume UC92-A-1, Table 1, U.S. Department of Commerce, Bureau of the Census, March 1995.
N.A.: Not Available

4 STRATIFICATION ISSUES

In order to analyze and model the reactions of HDV operators to low-emission vehicle standards and associated economic incentives it is necessary to categorize or divide the population of HDV operators into subgroups or strata. The variables along which the HDV operators are stratified are extremely important and should reflect the factors that are most important in determining the impacts on HDV operators and their potential reactions to the regulatory alternatives. HDV operators within a particular strata should react in a fairly homogeneous fashion.

Note that selecting the proper strata, therefore, requires an understanding of the determinants of the problem and thus begs the questions to be answered. As such, preliminary research on the likely reaction to low-emission standards is a crucial input to the development of the stratification scheme. This section analyzes the usefulness of various stratification schemes, and identifies which schemes are best suited for analyzing potential impacts of a low-emission HDV regulation.

4.1 PRELIMINARY CLASSIFICATION SCHEME

Based on the analysis of the IRP in Chapter 2, carriers would have three main options if low-emission vehicle standards are promulgated: compliance, delay, and non-compliance. Compliance means expending additional funds for more expensive low-emission vehicles. Delay strategies include rebuilding engines and other strategies for prolonging vehicle life, as well as downsizing. If the non-compliance option is chosen, then motor carriers would face an array of available options, illustrated in Exhibit 4-1. The potential responses depend on whether or not the carrier operates inter- or intrastate and, for interstate firms, whether or not the carrier has already established multiple base states. The carriers that fall into this latter category could choose not to comply with the regulations simply by registering their new vehicles outside of California. This exhibit assumes that carriers will not reregister existing vehicles or relocate the entire firm due to the high costs of such options and the low likelihood that firms would follow such a strategy solely due to the unavoidable costs of this regulation.

4.2 POTENTIAL STRATIFICATION VARIABLES

Stratification presents an important and difficult issue to be addressed in this study. Operators of HDVs may be divided into many different categories relevant to how they would be impacted by and react to low-emission vehicle standards. These include:

- Number of HDVs operated;
- Size of firm;
- Interstate versus intrastate operation;

EXHIBIT 4-1: NONCOMPLIANCE COSTS BY TYPE OF HDV OPERATOR

Type of HDV Operator	Type of Cost		
	Cost of Interstate Operating Authority	Cost of Establishing Mileage Accrual in the New Base State	Cost of Setting up a Non-California Base State
Interstate with Multiple Base States	N.A.	N.A.	N.A.
Interstate with Single California Base State	N.A.	N.A.	Cost of office space, telephone, person with ability to conduct fleet registrant's business and recordkeeping cost ²
Intrastate	Small cost of filing form with I.C.C.	Cost of developing routes and/or business operations in the new base state ¹	Cost of office space, telephone, person with ability to conduct fleet registrant's business and recordkeeping cost ²

¹Carriers could potentially accrue miles without developing business although such "fake trips" would be outside the spirit of the IRP and could result in risk of expulsion by the new base state.

²Recordkeeping cost can consist of actual recordkeeping cost or travel and per diem cost for auditor or cost of transporting records to the base state.

N.A.: Not Applicable

- Type of carrier;
- Type of commodity;
- Type of HDV;
- Fleet miles by jurisdiction;
- Age of HDVs currently in use;
- Whether vehicles are owned or leased;
- Fleet GVW;
- Firm headquartered in state;
- Engine/fuel type; and
- Location within state.

This section includes a description of how each potential strata listed applies to the study. The section and chapter conclude with some stratification variables chosen for the simulation model developed for this study.

Number of HDVs Operated

This category would facilitate an analysis of how many HDVs each motor carrier operated. HDVs are currently defined by the ARB as those vehicles with a gross vehicle weight (GVW) of over 14,000 lbs. Determining the number of HDVs operated would allow for an analysis of how a carrier would be affected by emission control regulations. Future demand for new vehicles could be anticipated by applying heavy-duty vehicle attrition rates to a carrier's current fleet size. In addition, the costs of the regulation would be directly proportional to the number of current HDVs. As an example, if emission control technology is projected to cost \$1,000 per vehicle, a carrier with 1,000 trucks would face costs of \$1,000,000 while a carrier with 100 trucks would face costs of \$100,000.

Size of Firm

Motor carriers can be grouped by size according to operational revenues, capital equipment, net profits, or number of employees. Additionally, the number of HDVs operated by a carrier could be used as a proxy for the size of the firm, although such a measure ignores the non-transportation revenues of captive carriers. Size is an important consideration when analyzing the impacts of emission regulations. In looking at each size group, analyses of other aspects would be facilitated because firms that have the same size would have more similarities than large and small firms. One would expect that larger firms would react differently to emission standards than smaller firms. The estimated costs for larger firms would be higher, yet these firms may also have the ability to absorb increased capital costs better than smaller firms.

Interstate Versus Intrastate Operation

As indicated in the discussion of the International Registration Plan (IRP), how motor carriers operate their fleet has important implications for assessing regulatory impacts. Interstate carriers already possess the ability to avoid purchasing low-emission HDVs by registering

vehicles in another of their base states or by establishing a new base jurisdiction in areas where vehicles in their fleet already accrue mileage. These carriers would register their vehicles in accordance with the IRP and as such have a distinct advantage over intrastate carriers. This latter group would not possess the same mobility as interstate carriers, would need to apply for interstate authority, and may need to establish new routes outside of California in order to rebase their vehicles outside of the state.

Type of Carrier

The type of business that the carrier operates is an important consideration when developing a comprehensive stratification scheme. One important distinction is between for-hire carriers, private carriers, and government-owned vehicles. While the first two types of carriers own their own fleets, distinctions exist between whether or not their services are offered to others. For-hire carriers include those carriers that transport freight for other companies from a specific origin to a destination. Within the for-hire category, carriers could be further broken down into two categories: truckload and less-than-truckload. Less-than-truckload carriers, because they consolidate shipments of multiple shippers, tend to have different operating constraints and travel patterns.

Private carriers, on the other hand, transport their own goods. Examples of private carriers include WalMart, Ace Hardware, Kraft Foods, Coca Cola, all of which carry their own goods to market. In both cases, regulatory costs could be passed onto consumers. For-hire carriers could increase shipping rates to cover increased regulatory costs while private carriers could pass on these costs in the form of increased prices for their products. Note, however, that Coca Cola might face the same increased costs as other soda makers while small versus large for hire-carriers might face disparate regulatory impacts.

Within the same market niche, however, private carriers might react differently to regulations due to market conditions. Consider the case of Coca Cola again. Suppose that, due to low-emission regulations, Coca Cola needs to invest in more expensive vehicles to upgrade their California fleet while their competitors (e.g. Pepsico) would not incur these additional costs if their fleets were not California-based. As a result, Coca Cola might be unable to pass off these additional costs in the form of higher soda prices due to the potential loss of market share to competitors that would not have increased shipping costs.

Certain HDVs belong to government and quasi-governmental agencies. It is extremely unlikely that these vehicles would be rebased outside of California or that their owners would relocate. Government vehicles are operated by governments at all different levels from the federal government to state, local, and county governments, school districts, and other special taxing districts. Quasi-government agencies include utilities such as electric, telephone, and gas companies.

Type of Commodity

The type of commodity transported would apply primarily to for-hire carriers. Grouping carriers according to this category would allow for an analysis of specific industry segments. Carriers that transport agricultural products could thus be treated separately from carriers that haul chemical products. As this example indicates, stratifying by the type of commodity hauled provides important information on the specific motor carrier being analyzed. Different products also denote different operating patterns, primarily long- vs. short-haul. Agricultural products (especially citrus) are often carried cross-country while cement is carried over short distances. These distinctions in how freight is moved are important when determining a carrier's suitability for interstate commerce. The following categories, taken from the 1992 Truck Inventory and Usage Survey (TIUS) represent a sample of the different commodities hauled by for-hire carriers:

- Farm products;
- Live animals;
- Animal feed;
- Mining products;
- Processed foods;
- Logs and other forest products;
- Lumber and other forest products;
- Textile mill products;
- Building materials;
- Furniture or hardware;
- Paper products;
- Chemicals;
- Petroleum;
- Plastics and/or rubber;
- Primary metal products;
- Fabricated metal products;
- Machinery;
- Transportation Equipment;
- Glass products;
- Miscellaneous products of manufacturing;
- Industrial waste water;
- Scrap, refuse, or garbage;
- Mixed cargoes;
- Craftsman's equipment;
- Recyclable products;
- Hazardous waste; and
- Passengers.

Type of HDV

The equipment type of an HDV may also be an important consideration. One would expect emission control technology could vary by the type of vehicle being operated (e.g., armored trucks versus a chassis truck). In the absence of data on the commodity being hauled, data on the type of HDV being operated could help group carriers into similar categories. As is the case with the type of commodity being hauled, this grouping would allow for an analysis of travel patterns (long vs. short-haul) and would also permit an assessment of interstate suitability. Transportation Technical Services groups HDVs as follows:

- Armored;
- Auto Rack;
- Cement;
- Chassis;
- Flatbed;
- Horse Van;
- Livestock;
- Logging;
- Open Top;
- Reefer;
- Tank;
- Tow Truck; and
- Van.

The 1992 TIUS uses the following categories:

- Pickup;
- Mini-van;
- Panel or van;
- Utility;
- Station wagon;
- Multistop or step van;
- Platform with added devices;
- Low boy or depressed center;
- Basic platform;
- Livestock truck;
- Insulated nonrefrigerated van;
- Insulated refrigerated van;
- Drop-frame van;
- Open-top van;
- Basic enclosed van;
- Beverage;
- Public utility;
- Winch or crane;
- Wrecker;
- Pole or logging;
- Auto transport;
- Service truck;
- Yard tractor;
- Oilfield truck;
- Grain body;
- Garbage hauler;
- Dump truck;
- Tank truck (liquids or gases);
- Tank truck (dry bulk);
- Concrete mixer; and
- Other

Fleet Miles by Jurisdiction

In analyzing how many miles the fleet accrues per jurisdiction, one could obtain an estimate as to how much of a carrier's business was conducted inside California. Although the IRP does not have a specific minimum mileage requirement, fleet mileage can be used to distinguish between carriers that operate primarily in California and others that operate mainly in other jurisdictions. Carriers that travel fewer miles in California may be more likely to change their base state. For trucking firms that accrue a high percentage of their miles in California, establishing a new base state may not be politically feasible.

Age of HDVs

- Vehicle age can be used to calculate what percentage of a given carrier's fleet will be retired in one year, two years, three years, etc. Theoretically, a carrier could establish a base state outside of California and, as the vehicles in the fleet were retired, these vehicles could be replaced by trucks purchased outside of California that do not meet California standards.

Vintage is important for how many vehicles will need to be replaced, and thus what the cost of the regulation would be to the carrier.

Owned Versus Leased Vehicles

Because vehicle owners and not vehicle lessors must comply with California emission regulations, distinguishing between these two groups could be potentially important. A carrier which leases vehicles would not be directly affected by low-emission standards, although lease prices would likely increase as a result. Carriers which own their vehicles would need to either comply with California regulations or consider establishing a new base jurisdiction.

Fleet GVW

How the vehicles are grouped within a fleet could indicate what portion of the fleet are not within the scope of the analysis (e.g., light- and medium-duty vehicles). In addition, different types of operations could also be identified based on the composition of a carrier's fleet. Classifying based on GVW is also important since regulatory costs would vary by the size of the vehicle. On a separate note, truck size as measured by GVW can be a determinant of a carrier's suitability for interstate commerce, with larger trucks more suitable than smaller trucks.

Firm Headquartered in State

Where the firm is located can have a direct impact on the decision to establish a new base state. If a firm's headquarters is in California, the firm would have more difficulty in moving their fleet than a firm located outside of the state. A California firm may have to consider relocation costs, which a non-California-based firm would not have to consider.

Engine/Fuel Type

The engine determines the type of fuel used and there are two types of engines: gasoline (otto-cycle) and diesel. With appropriate modifications, alternative fuels can be used in either the otto-cycle or diesel-cycle engines. Engine type is important because emission levels are a function of the engine type, which determines which fuel is used. Moreover, the cost of emissions controls may vary by engine type as well. As such, analysis of the impact of standards might need to segregate on engine type, especially if the compliance costs vary substantially by engine type.

Location Within State

This category would be independent of whether or not the firm is headquartered in California. By considering where a fleet is housed within the state, a determination can be made as to the potential reaction by motor carriers to low-emission regulations. A carrier located in San Francisco might have more difficulty in moving the fleet outside of the state than a carrier in

the Lake Tahoe region. Carriers could also be grouped according to geographic location (e.g. north vs. south).

Travel patterns may also vary by the location of the fleet within the state. For example, carriers located in large metropolitan areas may run more north/south routes than carriers located in less populated areas, whose fleet may tend to travel in east/west patterns.

4.3. CONCLUSIONS

Based on the analysis of the IRP and the potential individual stratification variables, at least three critical variables have been identified: 1) interstate vs. intrastate; 2) number of HDVs; and 3) type of carrier. The interstate variable (with interstate further broken down between operators with single and multiple base states) has already been identified as extremely important in terms of the costs of noncompliance. The number of HDVs is of similar importance because it will be a primary determinant of compliance costs. The type of carrier is an important variable because of the difference in behavior by government-owned trucks, its relation to the ability to pass along costs, and the differences in establishing business outside of California. The addition of a fourth variable, possibly commodity carried, type of vehicle, or average GVW might also be considered. This variable would likely help in grouping carriers by travel patterns and/or likelihood of establishing business outside California.

5 FEDERAL AND STATE LEGAL CONSTRAINTS

This section describes several legal issues associated with the design of market-based pricing and other financial incentives that could be used to reduce vehicle travel and emissions, especially for heavy-duty diesel trucks. Most important is the analysis of whether the state of California has the authority to implement alternative economic incentives and how difficult implementation would be. A much more detailed analysis of the legal and institutional issues will need to be performed prior to the implementation of any of these measures. This section is intended to highlight those issues which will most likely influence the ARB, the state legislature, and the general public concerning future adoption and implementation of economic incentives and market-based pricing measures.

In implementing its emissions control program, the ARB has adopted several different strategies for encouraging compliance. One is to implement what Professor Martin Wachs calls a "command and control" system of regulation that imposes regulatory requirements that individuals and companies must meet and maintain.²³ Tailpipe auto emission standards, for example, represent one type of command and control regulations to achieve air quality objectives. These uniform standards apply to all members of a class of people, group of firms that are regulated, or technology, and provide a measurable performance standard which must be met in order to comply with the regulation.

With this initial regulatory framework in place, the ARB has adopted a second strategy of encouraging compliance through the use of mobile source emission credits (referred to as mobile source credits). Mobile source credits are created when reductions in emissions from mobile sources exceed reductions required by federal, state and local laws. They can provide industries flexibility in meeting emissions requirements. These credits can also be designed to achieve "extra" reductions when used in conjunction with a "budget" or "cap". Emitters achieve credits for approved emission reductions or other activities which they can in turn utilize to offset increases in emissions associated with economic growth or in-lieu of obtaining emission reductions from industrial sources. Examples of mobile source credits include the retrofit of heavy-duty vehicles (such as diesel trucks and urban buses) and engines to low-emission configurations, accelerated retirement of old, high emitting vehicles, the use of low-emission buses, and the early introduction of zero-emission vehicles.

A third compliance strategy is the use of market-based control measures which include incentives to encourage a particular activity or performance standard where the marketplace determines the most cost-effective and efficient method of reducing emissions. Examples of such measures are incentives to purchase or produce low- or zero-emission vehicles, tax rebate and credit trading programs, fleet incentives, and fuel conversion incentives.

²³From introductory remarks made by Dr. Martin Wachs, UCLA Professor of Urban Planning at a UCLA-sponsored symposium on The Transportation, Land Use, Air Quality Connection, held at Lake Arrowhead, CA, October 18-20, 1992.

One type of strategy which has not been adopted is the use of *market-based pricing* measures designed to reduce travel and related vehicle emissions. These measures, through the establishment of prices that reflect social costs (e.g., health prevention programs, vehicle inspection and maintenance programs, administrative costs, etc.) would require individuals and companies to pay fees based on vehicle use, peak hour travel, or type and level of vehicle emissions. The ARB has funded a study evaluating the impact market-based pricing may have for improving air quality. The study, which is due to be completed this year, will evaluate smog-based emission fees, congestion pricing, parking supply and pricing, and at-the-pump charges.

5.1 MARKET-BASED PRICING: THE CONCEPT

During the last ten to 15 years, interest in market-based pricing as a way of reducing vehicle travel and vehicle emissions has grown considerably. This interest, primarily by transportation planners and some elected officials, has been prompted by the recognition that people often make choices based on the relative cost of a product or service. This is important, for example, when people decide on the type and size of car to buy, whether to drive or fly to a vacation destination, or decide to rent or buy a home. Airlines also set fares to encourage non-business travelers to make trips on weekends, and both telephone and electric companies offer discounts to individuals who use their services during off-peak periods. As Martin Wachs has written, "varying prices of goods and services to influence choices is the most basic characteristic of market-like approaches to public policy making."²⁴

This approach in using market-like mechanisms for achieving transportation planning goals has been reflected in proposed regulatory strategies including the following:

Higher Gas Taxes. Californians today pay 18 cents per gallon in state gasoline and diesel fuel taxes. After adjusting for inflation, today's 18 cents per gallon is equivalent to about 4 cents per gallon in 1967 dollars--or 43 percent less than the 7 cents per gallon charged at that time. One reason is that the gas tax is based on the number of gallons purchased and not the value of the sales. The growth in the sale of motor vehicle fuels is essentially flat, about one to 2 percent annually, typically well below the rate of economic growth. The stagnant nature of the fuel tax is compounded by the better fuel economy of today's vehicle fleet, which allows motorists to drive more miles per gallon of fuel.²⁵

²⁴*Ibid.*, pg. 1.

²⁵Data furnished by the Metropolitan Transportation Commission and included in the *Final Report of the Transportation Consensus Project, A Joint Venture of Californians for Better Transportation and California's Transportation Agencies*, January 1995, pg. 4.

This strategy would increase gas taxes paid at the gas pump to help recoup from highway users some of the social costs which motor vehicles impose on society. Higher gas taxes would, in theory, encourage use of alternative transportation modes, discourage unnecessary vehicle trips, and produce revenue to pay for transportation programs and improvements.

Congestion Pricing. This regulatory strategy is based on charging users more who use the transportation system during peak hours when the facilities are more congested and charge users less when transportation facilities are less congested during off-peak periods. The Federal Highway Administration has approved a demonstration project sponsored by a group headed by the Metropolitan Transportation Commission (MTC) to implement a pilot project on the San Francisco-Oakland Bay Bridge. To date, MTC has been unable to secure legislative approval for the demonstration program. However, the concept is to promote policy goals of increased mobility and improving air quality at the same time it generates revenues to maintain the Bay Bridge and to subsidize local transit operations.

Toll Roads. Tolls, like the gas tax, are a user fee and have been used successfully to fund a broad range of projects throughout the country. The state of California currently has several private toll road *demonstration* projects underway to demonstrate that private capital can be used to successfully underwrite the cost of public transportation improvements. In addition, three local toll roads are now being developed by a local agency in Orange County. Tolls are also currently used to fund improvements and maintenance on the state's Bay Bridges.

Vehicle Registration Fees. In general, annual vehicle registration fees for commercial vehicles consist of three components: a \$28 basic registration fee, a weight fee based on the unladen weight of the vehicle, and a vehicle license fee based upon the economic value of the vehicle depreciated over an 11 year period. The fees, however, are not designed to reward socially responsible behavior of highway users nor do they offer any economic signals regarding state policy toward motor vehicles. Alternative fees could be based upon annual vehicle miles traveled (VMT), pollutant emissions, or energy efficiency. Fees would be higher on motor vehicles driven more often, considered gross polluters or gas guzzlers, while fees would be lower for vehicles driven less often, fuel efficient or equipped with cleaner engines.

A VMT-based registration fee was recently endorsed as one option for raising funds to address the short- and long-term need for investing in California's transportation infrastructure. The endorsement was published in the "Transportation Consensus Project Report," a document prepared by Californians For Better Transportation and the state's regional transportation

planning agencies. Caltrans and the California Transportation Commission provided technical assistance to this effort.

A variation of the emissions-based registration fee concept is now being implemented under a five year pilot program in San Diego and Ventura Counties. Under Senate Bill (SB) 2050 adopted by the legislature last year, motorists in the two counties would be required to display a pollution index rating sticker on their vehicle. (See Health & Safety Code Section 43705.) The rating would be assigned based on the vehicle's type of emission control technology. Based on the index rating, the county air district would assign an annual pollution mileage threshold. The number of miles traveled and emission levels would then be tracked through the biennial smog check. If a vehicle exceeds the mileage threshold, it would be required to have a smog check every 12 months rather than every 24 months, and make any repairs needed. However, vehicle owners that exceed the assigned mileage threshold would not be fined other than having to undergo a smog check every year rather than every two years.

Finally, the California Energy Commission (CEC) has recently initiated an effort to analyze the economic and environmental costs associated with the use of feebates (a combination of fee and rebate) and pay-at-the-pump insurance. As part of the CEC study, a consumer feebate program would offer financial incentives that would add to or subtract from the initial purchase price of light-duty fleet vehicles. Interest in feebates has been prompted in part from legislation introduced by state Senator Gary Hart known as DRIVE+.²⁶ The proposal would have authorized the state to provide sales tax deductions to buyers of cars, light-duty trucks, and medium-duty vehicles that produce fewer emissions than average.

The adoption of these and other market-based pricing measures are likely to be extremely controversial since they would require people to pay potentially higher fees for use of the transportation system. In addition, since these measures would require changes in state law, the remainder of this paper discusses the legal and implementation issues associated with adopting pricing measures.

5.2 LEGAL ISSUES

Over time, the California Legislature has adopted a number of transportation-related taxes and fees to support the state's transportation system. Tolls remain in the realm of demonstration projects. The way in which these pricing measures may be used depends, in part, on whether they are categorized as taxes or fees under the California State Constitution and under statutory law.

²⁶DRIVE+ stands for "Demand-based Reductions In Vehicle Emissions (Plus Improvements in Fuel Economy).

Existing Transportation Taxes and Fees

Existing transportation taxes and fees which have been adopted by the Legislature are described below.

Motor Vehicle Fuel License Tax. The gasoline excise tax, established under Revenue & Tax Code Section 7301, is levied on distributors of motor vehicle fuels (gasoline) and is used to fund a number of state and local transportation programs. The tax is currently \$0.18 per gallon.

Motor Fuel Use Tax. The diesel tax is paid for by customers at the fuel pump. Established under Revenue & Tax Code Section 8601, the tax revenues are deposited in the Highway Users Tax Account and the Transportation Tax Fund (Revenue & Tax Code Section 9302). The tax is currently \$0.18 per gallon.

Both the Motor Vehicle Fuel License Tax and the Motor Fuel Use Tax were increased by voter approval of Proposition 111 in 1990. These ballot measures permitted the state to raise the fuel tax from \$0.09 per gallon to its current level of \$0.18 per gallon. In addition, motor vehicle fuel taxes were redefined as user fees. The increase occurred with a nickel increase in 1990 followed by a one penny increase in 1991, 1992, 1993, and 1994.

It should also be noted that under Section 8651.8 of the Revenue & Tax Code, ethanol and methanol containing not more than 15 percent gasoline or diesel fuel is also subject to the fuel use tax. However, since these alcohol-based fuels have approximately one-half of the BTU (British Thermal Unit) value of gasoline, the fuel tax is one-half the rate for gasoline (as specified in Section 8651), or currently \$0.09 per gallon.

Local Motor Vehicle Fuel Tax. Under Revenue & Tax Code Section 9501, counties may impose a countywide motor vehicle fuel tax to fund local transportation programs as authorized under Article XIX of the California Constitution. Currently, no county has chosen to impose this tax.

This tax is levied in increments of one cent per gallon or, in the case of compressed natural gas, one cent per 100 cubic feet. The current allowable tax rate is \$0.18. Prior to implementation of the tax, a proposal to impose the fuel tax must be approved by the county Board of Supervisors, a majority of the city councils of the cities having a majority of the population in the incorporated areas of the county, and a majority of the voters.

Local Sales Tax for Transportation. Authorized under Revenue & Tax Code Sections 7251 and 7285, a majority of voters in 18 counties have agreed to increase the countywide sales tax by as much as one percent to fund local

transportation programs. In November 1992, a taxpayers group in Santa Clara County filed suit challenging voter approval of Measure A, a measure increasing the county sales tax by one-half percent for transportation improvements. The legal action now pending before the California Supreme Court (Santa Clara County Local Transportation Authority v. Guaridino) challenges the validity of the sales tax, arguing that the measure required a two-thirds affirmative vote, as specified under Article XIII A of the California Constitution, rather than a simple majority vote. A decision by the court is expected this spring.

Vehicle License Fee. The Vehicle License Fee for trucks consists of three components: a \$28 registration fee, a fee determined by the weight of the vehicle, and a fee equal to 2 percent of the value of the vehicle (see Revenue & Tax Code Section 10701). For automobiles, the weight fee is not applied. A portion of the revenues are distributed to both cities and counties by formula, while the remaining funds are allocated to fund specific programs and to replace lost property tax revenues.

Local Vehicle License Fee. Revenue & Tax Code Section 11101 allows counties which have adopted a general plan providing for a network of county expressways and funding the first phase of construction from a county bond issue totaling at least \$70 million, may impose a county vehicle license fee not to exceed \$10 per vehicle. Revenue generated from the fee is used for construction of the expressway system.

The legislature has also authorized counties to increase vehicle registration fees for specific transportation-related programs. For example, counties may establish a Service Authority for Freeway Emergencies (SAFE) program by imposing a one dollar registration fee to fund the installation of roadside emergency call boxes (see Streets & Highway Code Sections 131.1 and 2250-2559). Counties may also impose a one dollar fee for the removal of abandoned vehicles (See Vehicle Code Sections 22170 and 9250.7). Finally, a one dollar fee can be levied for auto theft and drunk driving prevention programs.

Air District Fees to Implement the California Clean Air Act. Air pollution control districts are authorized under state law to increase motor vehicle registration fees of up to \$4 per vehicle to fund air pollution improvement programs. These funds may be used for local feeder bus or shuttle service to rail or ferry stations, the purchase or lease of clean fuel vehicles, measures for promoting rail-bus integration, and for employer-based and other trip reduction programs. The authority to levy this fee is found under Section 44220-44247 of the Health & Safety Code.

AB 1107 Funds. The San Francisco Bay Area Rapid Transit District (BART) 1/2 percent sales tax was originally imposed in 1970 to assist in the funding of

the construction and operation of the rail system. In 1977, Assembly Bill (AB) 1107 was enacted to continue the sales tax with the provision that 25 percent of the revenues be divided between AC Transit and San Francisco Muni.

Tolls. Under the California Toll Bridge Authority Act (Streets & Highway Code Section 30000), Caltrans and other authorized agencies may impose tolls on transportation facilities, including bridges, highway crossings, tunnels, subways, underpasses, and overpasses. Specific bridges around the state which may levy tolls include the San Francisco-Oakland Bay Bridge, the San Mateo-Hayward and Dumbarton Bridges, the Carquinez and Benicia Bridges over the Carquinez Straits, the Antioch Bridge, the San Diego-Coronado Bridge, and the San Francisco-Oakland Rapid Transit Tube (operated by the Bay Area Rapid Transit District, BART).

In 1989, the Legislature adopted AB 680 which authorized the construction of four privately-funded demonstration toll road projects around the state. One of these projects, State Route 91 in Orange County, is now under construction in southern California.

There has also been considerable interest around the state in the development of high occupancy vehicle (HOV) lanes. It has also been suggested that future HOV lanes could be used as toll facilities. According to Caltrans, there are currently 260 centerline miles of HOV lanes statewide. The longest segment, approximately 30 centerline miles, exists on Highway 101 between DeLa Cruz Boulevard in Santa Clara County extending north to Whipple Avenue in San Mateo County. There has been interest in the use of a dedicated truck way as part of the Alameda Street Corridor Project, which is designed to improve truck and rail access to the Port of Los Angeles and the Port of Long Beach.

Differences Between Taxes and Fees

There are a number of different procedural requirements associated with the adoption and implementation of taxes and fees in California. The way in which funds are generated from each of these revenue sources also varies considerably.

Whether a charge is categorized as a tax or a fee depends upon the ability of the public agency to impose the charge, as well as its amount related to the benefits received or burdens imposed. In addition, the way in which funds are approved and ultimately used will differ depending on whether the charge is a tax or fee.

Fees are used to reimburse a public agency for a service provided. In addition, a relationship must exist between the individual who pays the fee and the benefits that are to be derived from the payment.

This distinction is important because under Article XIII A (Proposition 13) of the California Constitution, increases in state taxes must be approved by two-thirds of each house of the legislature. However, any new tax imposed for a specific purpose adopted by a city, county or special district, requires the approval of two-thirds of the registered voters within the affected jurisdiction. Under Proposition 62, taxes imposed for general purposes must be approved by a majority vote. Finally, Article XIII B (the Gann Initiative) also places limits on the growth in government spending.

As mentioned earlier, Proposition 111 designated motor vehicle fuel taxes as user fees but required a two-thirds vote of the legislature for passage. Motor vehicle tax revenues were exempted from Article XIII B. On the other hand, fees can be imposed by a city or county and are not subject to voter approval under either Proposition 13 or Proposition 62. However, the revenues generated must be used to compensate a public agency for the benefit conferred or burden created.

In general, transportation pricing measures would be easier to adopt if designed as fees rather than taxes, provided that a defensible relationship for the fee can be established and that restrictions on the use of the funds are acceptable.

5.3 OTHER STATUTES AND PROGRAMS

In preparing this study the question has been raised whether other state and federal statutes place restrictions on the ability of the ARB and the state to offer various types of financial incentives, including market-based pricing measures. This section examines provisions under the federal Constitution, the Intermodal Surface Transportation Efficiency Act, and the California Clean Air Act. Also reviewed are provisions of the International Registration Plan which is a registration reciprocity agreement for the commercial trucking industry.

United States Constitution

California produces and consumes a large number of goods which are shipped via truck and rail to and from other states. Depending on the type and way in which market-based pricing measures are implemented, a California trucking firm, for example, might incur higher shipping costs as opposed to a trucking firm based outside the state. This could result in California trucking firms being penalized and placed at a competitive disadvantage with out-of-state trucking firms that could operate at a lower cost. It could also result in the pricing measure(s) being legally challenged as an impediment to interstate commerce and a violation of the U.S. Constitution which gives Congress the power to regulate commerce among the states.²⁷

Our legal research suggests that the federal courts have attempted to analyze commerce clause objections to state regulations by weighing the strength of state interests against the burdens

²⁷Article I, Section 8(4) of the United States Constitution.

on interstate commerce. However, achieving this balance can sometimes be difficult. Consequently, it is fair to say that should the state adopt a market-based pricing measure that is perceived to infringe on the movement of goods in interstate commerce, it is likely to be challenged in the courts.

While not specifically addressing the commerce clause issue, the ARB in adopting the State Implementation Plan last November appeared to have this issue in mind when it discussed the need for national standards for heavy-duty vehicles. The document said, in part, that:

National standards for on-road heavy-duty diesel vehicles are critical to ensuring the maximum reductions from one of the most significant mobile sources of NO_x. A national standard is essential to ensure reductions from all heavy-duty vehicles operating in California, including those based plated outside the state. A nationwide standard would not only reduce emissions from out-of-state heavy-duty vehicles operating in California, it would prevent a potential increase in the use of vehicles registered out-of-state that could result from a stricter California standard. In addition, the adoption of a national standard would avoid *the interstate commerce and competitiveness problems inherent with a state-only standard* (emphasis added).

While there may be scientific and economic merit in advocating a national standard for heavy-duty vehicles, the adoption of such a standard would eliminate a potential conflict with the commerce clause of the federal Constitution.

Intermodal Surface Transportation Efficiency Act

Adopted in 1991, the Intermodal Surface Transportation Efficiency Act (Public Law 102-240 or ISTEA) established a six year nationwide transportation funding program totaling \$150 billion for construction of new highways and transit systems, for highway maintenance and repair, for providing operating assistance to eligible bus and rail transit systems, and for a number of programs and demonstration projects.

Prior to passage of ISTEA, federal law had prohibited the imposition of tolls on any federal-aid highways, except for those facilities designed and built to serve as toll facilities. However, due to congressional interest in experimenting with market-based pricing measures, the law was rewritten to allow tolls to be imposed under the following exceptions:

for the initial construction of non-Interstate toll highways, tunnels and bridges that receive federal aid;

for the reconstruction, replacement, resurfacing, restoring and rehabilitation of existing federal-aid toll highways, tunnels, and bridges; and

for testing the use of congestion pricing on up to five existing federal-aid highways, of which two can be interstate highways. Under this program, the Federal Highway Administration (FHWA) has approved a proposal from the Metropolitan Transportation Commission to evaluate the use of congestion pricing on the San Francisco-Oakland Bay Bridge.²⁸ In addition, the Southern California Association of Governments has been awarded a \$1 million FHWA grant to prepare a set of regional congestion pricing strategies and preferred alternative plan for the Southern California region.

Under federal law, the implementation of tolls on federal aid-highways is decided by FHWA. However, the ban on tolls on most federal-aid highways will limit the consideration of congestion pricing or other toll-based pricing measures. Due to continuing interest in market-based pricing measures, these restrictions may be relaxed when ISTEA is reauthorized by the congress in 1997.

The 15,000 centerline miles of highways that make up the state highway system are under the jurisdiction of the Legislature and Caltrans. Under existing state law, evidence suggests that the ARB does not possess authority to impose market-based pricing measures for use on the state highway system. Nor does the agency have authority over privately funded toll roads as established by the legislature under AB 680.

California Clean Air Act

In 1988, the California Legislature adopted AB 2995 which became the California Clean Air Act. This bill amended portions of the California Health & Safety Code to significantly strengthen state standards and planning requirements for achieving and maintaining the state's ambient air quality standards.

Under Sections 39002, 39500, and 40000 of the Health & Safety Code, the ARB has the authority to set motor vehicle emission standards. Local air districts, however, may adopt regulations which focus on the use of motor vehicles. This authority derives from the districts' general authority to regulate nonvehicular sources (Health & Safety Code Sections 39002, 40717, and 40702), to adopt indirect source control measures and transportation control measures (Health & Safety Code Sections 40716, 40717, 40910 and 40918-40920), and to establish emission reduction credit banking program systems (Health & Safety Code Sections 40709-40713).

With this in mind, the ARB has adopted guidelines for use by the local air districts in developing and using mobile source emission reduction credit programs.²⁹ The ARB does

²⁸23 U.S.C.A. Section 1012 (a) and (b). Also see initial implementing guidelines prepared by the Associate Administrator for Program Development, FHWA, March 12, 1993.

²⁹*Ibid.*

review the programs to ensure that statutory mandates are met. If the ARB determines that the programs fail to meet state requirements, the agency does have authority to amend a district rule or regulation should it become necessary (Health & Safety Code Sections 39002 and 41504).

In researching the issue with ARB legal staff, attorneys at the agency could not render a definitive opinion as to whether the agency has authority to directly impose market-based pricing or incentive measures. This uncertainty is due in part on legal interpretation of current law. It was suggested that additional research would be needed before making a judgment. Ultimately, the issue may need to be resolved by the courts. However, it should be noted that the ARB has endorsed the concept of market-based and other innovative control measures in adopting last November the State Implementation Plan.³⁰

International Registration Plan

In July 1973, the American Association of Motor Vehicle Administrators adopted what is called the International Registration Plan (IRP) which is discussed in more detail in Chapter 2. The IRP is an agreement authorizing the proportional registration of commercial vehicles and providing for the recognition of such registrations in the participating jurisdictions. Under proportional registration, a carrier registers in a single "base" state or province, declaring the extent (in actual or estimated mileage) of his fleet's operations in all jurisdictions and the weight in each jurisdiction. Fees for the vehicles in the fleet will be calculated for each of the IRP jurisdictions, according to the jurisdiction's unique fee requirements, and then apportioned based on the percentage of total miles declared in that jurisdiction.

For example, if a carrier registering in California declares 75 percent of his operation in California and 25 percent in Nevada, he will pay 75 percent of the California fee and 25 percent of the Nevada fee for each vehicle in his fleet.

An apportionable vehicle is any commercial vehicle used or intended for use in two or more IRP jurisdictions which is:

- A power unit having a gross weight in excess of 26,000 pounds; or
- A power unit having three or more axles, regardless of weight; or
- Is used in combination when the combined gross weight exceeds 26,000 pounds.

Vehicles exempt from registering under the IRP include vehicles under separate reciprocity agreements that are not superseded by the IRP, recreational vehicles, vehicles displaying a registered plate, and charter buses.

³⁰The California State Implementation Plan for Ozone, Volume II, prepared by the California Air Resources Board, adopted November 15, 1994, pg. I-21.

Once registered, the carrier receives, for each vehicle, one license plate bearing the word "apportioned" or "IRP" and one cab card listing each jurisdiction the vehicle is registered in, and the registered weight limit for the vehicle. All IRP members are bound by the agreement to recognize these documents as authorization for a carrier's vehicles to operate in the jurisdictions specified on the cab card.

The base jurisdiction is responsible for calculating, billing, and collecting fees for all IRP jurisdictions through which operation has been declared. It is also responsible for distributing the collected fees to the other jurisdictions, and informing the other jurisdictions of the operations declared. Currently, forty-four states are signatories to the agreement. Under ISTEA all states must become a party to the IRP by September 30, 1996.³¹

Based on discussions with California Department Motor of Vehicle (DMV) staff, the state's IRP program would probably not be affected by the imposition of market-based pricing measures. Under the registration plan, a participating carrier is not exempt from paying fuel taxes, weight fees, or other business-related fees. It would, however, likely increase the workload requirements and cost for DMV's administration of the program.

International Fuel Tax Agreement

The International Fuel Tax Agreement (IFTA) is a multi-state and province agreement to share fuel tax revenues. The basic purpose of this agreement is to provide a system to allocate fuel tax revenues according to where vehicle mileage is accrued rather than where the fuel is purchased. Because fuel taxes are paid at the pump, it is possible for companies and vehicles to purchase fuel and pay taxes in one state, but to accrue all of their mileage in other states. IFTA provides an efficient legal and accounting system for states to reallocate revenues according to where VMT and highways costs are accrued. Carriers are required to submit quarterly apportioned VMT reports which provide information on the total miles traveled by all their trucks in each state. These mileage figures are calculated from detailed trip reports maintained by drivers. States who are not members of IFTA may collect some of the same data to apportion fuel taxes in separate bilateral agreements. California is not a member of IFTA and thus IFTA states are not required to apportion California truck miles. However, since all states are required to join IFTA by 1996, IFTA is important to consider.

³¹ *International Registration Plan*, adopted July 1973, pg. 2. Also see Title IV (Motor Carrier Act of 1991), Section 4008(f) of ISTEA.

5.4 SUMMARY

In regulating emissions from mobile sources, the ARB has adopted a program consisting of regulatory standards, the use of mobile source emission reduction credits, and the use of market-based control measures. One strategy which has not been adopted is the use of market-based pricing measures that would have individuals and companies pay a fee based on vehicle use, peak hour travel, or the type and level of vehicle emissions. Examples of market-based pricing measures include rebates or tax credits for low- or zero-emission vehicles, higher gas taxes, congestion pricing, toll roads, and the use of vehicle registration fees.

A decision by the legislature as to whether a pricing measure is implemented as a "tax" or as a "fee" will determine whether the measure is subject to voter approval under Article XIII A of the California Constitution. Voter approval applies only to local taxes and not state taxes enacted by the legislature. While a fee is not subject to voter approval, it does require that a defensible relationship be established between the individual who pays the fee and the benefits that are derived from the payment.

Provisions under ISTEA support somewhat wider use of federal-aid toll road facilities and experimentation with congestion pricing. Decisions on the application of pricing measures on the state highway system are under the jurisdiction of the State Legislature and Caltrans.

It remains unclear, however, whether the ARB possesses authority under the California Clean Air Act to directly impose market-based pricing measures. This is a question that will require further legal analysis and is beyond the scope of this paper.

Finally, based on discussions with DMV staff, implementation of the IRP for the commercial trucking industry in California could be coordinated with the imposition of market-based pricing measures. Like the other legal issues raised in this paper, the impact of market-based measures on the IRP will require further study.

6 ECONOMIC INCENTIVES TO MITIGATE REGULATORY IMPACTS

With respect to proposed regulations for HDVs, the ARB is interested in pursuing regulations that will reduce HDV emissions while not causing out-migration of trucking firms from the state. As detailed in Chapter 2, the International Registration Plan (IRP) has flexible provisions which allow HDV operators to base their vehicles in any state in which they accumulate miles as long as an appropriate facility is maintained in the state. Because the costs of registering and maintaining a place of business in another state may be considerably less than compliance costs, the development of economic incentives may be necessary for California to reduce emissions while maintaining these business activities. The loss of these truck registrations would hamper state efforts to reduce emissions and the loss of these business activities would have both direct and indirect impacts on the state's economy, including lost jobs and tax revenues (direct impacts) and lost retail and other purchases by these employees (indirect impacts). In some cases, businesses would spend money for duplicative services in another state solely to avoid regulatory costs.

The standard approach to reducing emissions from a source category such as HDVs is to promulgate either a **performance standard** that states how many units of a pollutant may be emitted per unit of activity or a **technological requirement** that describes in some detail what technology must be used to reduce emissions. These two approaches are often grouped together under the label of "command and control" approaches. It should be noted that the ARB does not adopt technology-specific requirements, but rather relies on performance standards when employing a command and control type approach.

The imposition of "command and control" low-emission HDV regulations presents three basic problems for the ARB. First, from an economic point of view such standards have inherent inefficiencies in reducing emissions because they do not allow operators to employ more cost-effective methods to reduce their emissions by taking advantage of the fact that the cost of reducing emissions varies considerably across HDVs of various weights, fuel types, engine sizes, operational characteristics, and miles traveled. All else being equal (quantity of emissions, ability of the source to afford the controls, etc.), economic efficiency is maintained at an optimum by first reducing those emissions that have the lowest control cost. Second, because of the IRP, California does not have adequate authority to "command and control" since carriers may purchase their vehicles outside of California (49 state vehicles) and thus avoid the low-emission requirements. Third, operators may temporarily frustrate efforts to reduce emissions through the introduction of new low-emission vehicles by extending the lives of their current vehicles. This results in increased emissions by extending the lives of the oldest (and highest polluting) vehicles while costing operators money. These problems may be overcome, however, to various degrees by employing economic incentive strategies to supplement or replace the "command and control" regulations.

Many of the economic incentives proposed here have been developed by economists in response to air quality problems. Specifically, the original intent of these incentives was to reduce emissions. However, many of these programs could also reduce the incentive to purchase new vehicles outside of California. Economic incentives, whether employed alone or in conjunction with "command and control" regulations, can help mitigate the negative aspects of the "command and control" approach. By adding incentives, the state relies on enticing rather than commanding operators to purchase low-emission HDVs; therefore, the incentive to purchase and register HDVs outside of the state is diminished. Through the use of strategies that follow the economic principle of making each polluter pay for their respective emissions regardless of their state registration, the incentive to relocate is reduced or eliminated.

This chapter describes 14 different economic incentive concepts that fall into five categories. A summary of these concepts is provided in Exhibit 6-1. The five categories are:

- Rebate measures;
- Tax and fee measures;
- Trading measures;
- Loan measures; and
- Operating cost measures.

Section 6.1 of this chapter reviews some issues relevant to alternative regulatory approaches. Section 6.2 provides detail on each of the 14 strategies and includes a preliminary assessment of what level of government the program would be implemented (e.g., direct ARB implementation, state statute) based on federal and state restrictions discussed in Chapter 5. Finally, Section 6.3 identifies which of these concepts are incorporated into the simulation model developed for this study, which is discussed in Chapter 9. The simulation model examines how hypothetical HDV operators might react to alternative regulatory approaches and how the combined actions of each of the HDV operators will influence the numbers of new low-emission HDVs operating in California.

6.1 ALTERNATIVE REGULATORY APPROACHES

Although economic incentive strategies come in many forms, they all attempt to alter either the supply or demand side of a market transaction. Before discussing specific economic incentive concepts, it is important to provide information on some relevant conceptual issues. With this purpose in mind, this section discusses the basic concepts behind alternative regulatory approaches.

EXHIBIT 6-1
ECONOMIC INCENTIVE CONCEPTS FOR LOW-EMISSION HEAVY-DUTY VEHICLES

REBATE MEASURES

Vehicle Scrappage Program	A program in which HDV owners turn in their old vehicles and receive cash payments or credits toward the purchase of a new low-emission HDV. Non-California based registrants could participate in the credit part of this program.
Clean Vehicle Subsidy	A program in which purchasers of qualifying low emission HDVs receive a cash subsidy.

FEE AND TAX MEASURES

Fee-Bate Through Registration Fees	A program where the registration fee for all vehicles is based, at least in part, on the emissions characteristics of vehicles. This program could be applied through the International Registration Plan such that all HDV operators based outside the state would participate through the IRP.
Fee-Bate Through Sales Taxes	A program where the level of sales tax for a new vehicle is based on emissions characteristics of the vehicle.
State Income Tax Credit	Creation of a tax credit of a specified amount available to individuals or organizations that purchase qualifying low-emission HDVs.
State Income Tax Deduction for Purchase Price	Creation of an income tax deduction for individuals or organizations that purchase qualifying low- emission HDVs equal to the purchase price of the vehicle.
State Income Tax Deduction of Interest on Purchase Loan	Creation of an income tax deduction for individuals or organizations that purchase qualifying low- emission HDV equal to the interest on the loan for the purchase of the vehicle.
Sales Tax Exemption	An incentive program whereby an individual or organization who purchases a qualifying low-emission HDV is exempt from paying state sales tax on that purchase.
Accelerated Depreciation for low-emission HDVs	An incentive program whereby qualifying low-emission HDV purchasers are allowed a more rapid depreciation of HDVs.

LOAN MEASURES

Low Interest Loans Through Banks	A program whereby the state government provides low interest loans through banks for the purchase of qualifying low-emission HDVs.
Government Loan Guarantees for Low Interest Loans	A program whereby the state government provides banks with guaranteed payment upon default of low interest loans for the purchase of a qualifying low-emission HDV.

EXHIBIT 6-1
ECONOMIC INCENTIVE CONCEPTS FOR LOW-EMISSION HEAVY-DUTY VEHICLES

TRADING MEASURES

Emissions Trading Credits for Low-Emission HDVs

A program whereby the fleet purchaser of qualifying low-emission HDVs receives an emission trading credit based on a calculation of the fleet's emissions with and without the low-emission HDVs (where all calculations are conducted within the parameters of the State Implementation Plan). This system could be set up to include carriers that are not based in California. The program would require the creation of an overall emission budget for the state or some form of emissions caps on individual operators that would force them to purchase low-emission HDVs to obtain credits, or to purchase them from operators with excess credits.

OPERATING COST MEASURES

Reduced Overweight Vehicle Fees for Low-Emission HDVs

A program whereby reduced state overweight fees would apply to overweight vehicles or Longer Combination Vehicles that qualify as low-emission vehicles.

The case for government intervention in the free market states that intervention is justified if a positive or negative externality exists such that the optimum amount of a good or service is not provided in the market. In the case of HDVs, the externality of concern for this study is the emissions from engine operation into the atmosphere. These emissions are not naturally bought or sold in any market. In the absence of government intervention, no one has a personal incentive to produce, sell, purchase, or operate engines based on their emissions characteristics.

The ARB is now considering state regulation of HDVs to reduce their contribution to emissions of ozone precursors, particularly oxides of nitrogen (NO_x). Theoretically, the intervention could assume any form, from detailed design specifications of the engines, to performance standards, subsidies, fees (or taxes), or the creation of markets for permits to release the emissions. These options constitute a continuum of interventions from the most inflexible to the most flexible. The only form of intervention that the ARB can directly take is through the adoption of performance standards. While the other forms of intervention could potentially be incorporated into a program designed to reduce emissions from heavy-duty vehicles, the ARB cannot directly implement these measures.

It does not necessarily follow that emission markets or fees for emissions will be the most efficient form of intervention. Improperly designed market or fee systems can often send the wrong price signals to buyers and sellers, thus resulting in inefficient uses of resources. Transaction costs of emission markets can be prohibitively high. Therefore, careful program design is required to reduce emissions without causing a misallocation of resources. In Section 6.2, various approaches will be compared, and their strengths and weaknesses assessed.

6.2 ECONOMIC INCENTIVES VERSUS STANDARD EMISSION CONTROL APPROACHES

Given that the ARB is currently considering the adoption of a performance standard for HDVs, it seems unlikely that market based approaches, or economic incentives, will be adopted in the place of a command and control regulation. Economic incentive programs can be used to help mitigate negative impacts of these traditional regulations. The impact of market incentives will be different depending on whether they are implemented alone or in conjunction with a performance standard. For analytical purposes, as a result, it is important that market incentives are considered both with and without the assumption that the ARB will adopt a performance standard.

Consider the case where a performance standard was adopted for HDVs and a rebate is offered towards the purchase of a new HDV. Some motor carriers may decide to purchase the low-emission vehicle. Others may choose to relocate outside of the state in order to avoid purchasing a new low-emission HDV. Of the motor carriers choosing to purchase the new HDV, some may have chosen to make this purchase in the absence of a rebate program. Others may have otherwise relocated outside of the state and avoided this purchase altogether.

The decision to purchase a new HDV also changes in the absence of a new performance standard. In particular, some motor carriers who would have purchased a new HDV with the incentive program and performance standard in place would forego the rebate if the performance standard were not in place.

In this section, economic incentive measures that could help mitigate the impacts of a performance standard are identified and evaluated (see Exhibit 6-1). This section describes each of these concepts, their strengths and weaknesses, and how they could be implemented. Legal issues related to these concepts are discussed briefly here, and in more detail in Chapter 5.

6.2.1 Rebate Measures

In general, rebate measures are designed such that the state provides a subsidy used to help turn over the vehicle fleet. For HDVs, the goal of these programs would be to reduce the likelihood of relocation while also reducing emissions by enticing consumers to purchase new, cleaner HDVs.

Each of these rebate measures would help mitigate the impacts of low-emission HDV regulations by providing a cash subsidy for HDV operators that participate in these rebate programs. Most of the costs resulting from these programs would be incurred by the state government. Means of financing would need to be obtained before rebate measures could be implemented. A mixed program of fees on some units or activities and subsidies on others can help to balance the books. In choosing funding mechanisms, criteria including efficiency, equity, and administrative convenience should be weighed.

Vehicle Scrappage Program

Under this program, HDV owners would receive a cash payment for their old vehicles. The program would be most effective if targeted at California-based fleets only. In order to affect the relocation decision while also helping to reduce emissions, vehicle scrappage programs would need to be linked with the purchase of a new vehicle. Specifically, the program could provide HDV operators with credits towards the purchase of a low-emission HDV. This program could take the form of a "voucher system" whereby a vehicle operator is issued a voucher, upon turning in the old vehicle, that can be tied to the emission level of the replacement vehicle. The lower the emission level of the replacement vehicle, the greater the amount of the voucher. Creating this link could provide an incentive for California-based fleets to remain in the state in order to obtain this rebate. Such a program would help reduce emissions by replacing so-called "super-emitters," older vehicles with high emission rates as a result of engine design, age and maintenance. Such a program could force a difficult or costly challenge to the state, which would then need to dispose of the scrapped vehicles. While no programs to date have focused on HDVs, vehicle scrappage programs have been adopted for other mobile sources. In particular, two important trials of mobile source emissions trading—the UNOCAL accelerated vehicle retirement demonstration program and

the Delaware Vehicle Retirement Program—have been completed and the results examined.³² In addition, the South Coast Air Quality Management District (SCAQMD), and other jurisdictions, has included mobile source emission trading for NO_x and SO_x in its Regional Clean Air Incentives Market (RECLAIM) program. These three programs are discussed below to provide a description on how a vehicle scrappage program could be implemented.

UNOCAL (the Union Oil Company) conducted a demonstration project in 1990 in which it purchased over 8,000 pre-1971 vehicles in the Los Angeles basin. Requirements of the program were that the cars had been operated in the region for the past six months and they had to be driven to the scrapyards by the registered owner. For each car accepted, UNOCAL paid \$700. The focus of the program was to determine how much regional emissions were reduced by scrapping these cars. There were two sides to this effort. First, UNOCAL had to estimate the emissions the cars would have emitted. They did this through surveys of the driving habits of 800 of the persons turning in their cars and by running the Federal Test Procedure on 74 of the vehicles. Second, UNOCAL estimated the emissions related to the mode of transportation used by the owners after they scrapped their cars. They relied on fleet averages for this. It was estimated that reductions of hydrocarbon emissions, the emission of concern for this program, cost between \$2,200 and \$2,900 per ton.

The Delaware Vehicle Retirement Program was a demonstration program similar to the UNOCAL program. It was designed as an experiment, so certain vehicles thought to have exceptionally high emissions were targeted and follow-up surveys conducted. Since the major concerns of the program were the calculation of regional emission reductions due to the program and its acceptability in providing emission reduction credits, great attention was paid to examining the emissions characteristics of the cars turned in.³³

The accelerated vehicle retirement programs present a more complicated issue in estimating emissions reductions than do most stationary source emission reduction programs. The vehicle retirement program requires estimation of data that can never be observed: the emissions a vehicle would have emitted if it had not been scrapped. In contrast, most stationary source emission trading programs can measure the actual emissions that occur once the controls are in place and compare them to an emission limit that has been placed on the source.

The SCAQMD has included an automobile buy-back program as part of its emission trading systems. Originally used to provide emission reductions in the new source review (NSR) program, it has now become part of the more advanced RECLAIM program.

³²Alberini, Anna; Edelstein, David; Harrington, Winston; and McConnell, Virginia. *Reducing Emissions From Old Cars: The Economics of the Delaware Vehicle Retirement Program*. Resources for the Future, Washington, DC, 1994.

³³*Ibid.*

At this point in time, no thorough review of the applicability of a scrappage type program for HDVs has been conducted. Further research is required to understand how the unique ownership and operational characteristics of such vehicles would be incorporated into an HDV scrappage program.

Clean Vehicle Subsidy

Under this program, purchasers of new HDVs conforming to new performance standards would receive a cash subsidy, or a rebate. If a command and control regulation is adopted, then this subsidy could help reduce the likelihood of relocation by affecting the purchase decision. This rebate would serve as a reduction in the price of a new HDV. For example, if a HDV has a retail price of \$70,000, then a rebate of \$1,000 would lower the new purchase price to \$69,000. Traditionally, rebates have been used by vehicle dealers in order to sell the existing vehicle stock by reducing the vehicles' purchase price. Rebates are often used to sell the old model year vehicles in order to create dealer space for new model year vehicles. Rebates may be obtained after the vehicle is purchased by a consumer through a mail request or can be provided at the time of purchase.

California is currently considering programs that would provide a subsidy towards the purchase of electric vehicles. While clean vehicle subsidy programs have not been implemented for HDVs, such a program could provide an incentive for HDV operators to purchase a new HDV by lowering its purchase price. Rather than postpone this purchase, the operator may instead choose to purchase a new HDV in order to obtain this rebate, if the program was adopted on a limited time basis, as is often true for new vehicle rebates offered by dealers. As a result, the new, cleaner HDVs could be phased in more quickly than would occur in absence of this program, thereby resulting in lower overall HDV emissions.

6.2.2 Tax and Fee Measures

The most classic of economic incentives is a tax (or fee) levied directly on the negative externality and charged to the party that releases it. Several versions of taxes (or fees) have been suggested over the years. The original fee concept developed by economists was levied directly on the emissions and paid by the user of the polluting equipment. In recent years, the idea of using a fee to influence the purchaser's choice of equipment has been proposed.

Fee based systems, if applied through the IRP, would affect all motor carriers that have trucks that accrue mileage in California, regardless of where the truck is based. As a result, the program would not create an incentive for operators to relocate all or part of their operations outside of California, because the operator would face fees even if he decided to relocate or rebase his fleet. A fee-based system can provide a more efficient emissions reduction because the fee can be linked to the actual cost of emission reduction by characteristics of the HDV and its operations.

The original emission fee, as developed in microeconomic theory, was designed to make the marginal cost to the consumer of causing an emission just equal to the marginal damage to society of that emission. It would thereby cause the consumer to make the economically efficient choice of equipment and of the type and amount of use of that equipment. Because a large amount of information is needed in order to set the fee at the correct level for each consumer, a second, albeit less efficient alternative, was developed. Rather than seeking to achieve the optimal amount of pollution, a tax could be used to reduce pollution to a level agreed upon by society. This basic concept can be practically applied to HDVs. For example, the emissions expected per gallon of fuel from each type of engine could be computed, based on certification standards for that engine. A tax per unit of emissions is then set and the driver is charged for his/her expected emissions when filling his/her gas tank. If set high enough, an emission tax on fuels for motor vehicles would reduce the miles driven and could provide incentives for truck dispatchers to make their operations more efficient. In order to improve program efficiency, the fee would need to take into account the differing emissions of the vehicles in the fleet. On the other hand, this may lead to administrative difficulties and higher program costs that would reduce overall program efficiency.

Fee-Bate Through Registration Fees

A fee-bate system based on registration fees could be developed for HDVs. The VMT data needed for such a system could be taken from IRP or International Fuel Tax Agreement (IFTA) data, which provides fleet VMT and fuel purchase estimates within the state. Although these data may not be available when the vehicle is purchased, one option would be for the fees to be developed once the HDV has been registered, and the mileage appropriately apportioned between jurisdictions. The fees could be prorated based on the number of miles driven in California as a percentage of the total HDV miles traveled. The fee-bate would be applied to an annual registration fee. This action, if implemented through the IRP or IFTA, would affect all HDV operators that accrue mileage in California and would put pressure on owners of older vehicles that produce high emissions to replace them with lower emitting vehicles. The level of pressure would vary based on the percentage of mileage and the fee rate in California.

The fee-based approach is similar to the "fee-bate" sales tax system for automobiles proposed in California.³⁴ Under this system, the fees collected on the purchases of automobiles with emissions and fuel efficiency above the target level would be rebated to purchasers of automobiles with lower emissions and higher fuel efficiency. The purpose of the proposed fee-bate system was to encourage purchasers to choose cleaner and more efficient vehicles. A zero emission vehicle such as an electric car would get the largest rebate. The fees and targets could conceptually be set in a way to make the system revenue neutral.

³⁴Deborah Gordon and Leo Levenson, *Drive +: A Proposal for California to Use Consumer Fees and Rebates to Reduce New Motor Vehicle Emissions and Fuel Consumption*, Applied Science Division, Lawrence Berkeley Laboratory, Berkeley, California, July 1989.

The existing HDV registration fee in California consists of three parts: a weight fee, based on the vehicle's weight, a vehicle license fee, based on the value of the vehicle depreciated over an 11 year period, and a fixed registration fee. These fees are shown in Exhibit 6-2. The fee-bate system proposed here would be most effective if it was based on either the weight fee or the vehicle license fee. In other words, owners of clean HDVs would pay lower fees for either or both of these two categories, while owners of dirtier HDVs would pay higher fees. Because total registration fees are based on estimated VMT, the system could use existing VMT data available through the IRP.

As detailed in Chapter 5, a fee is easier to impose than a tax because a fee does not need to be passed by the state legislature. Under Article XIII A (Proposition 13) of the California Constitution, increases in state taxes must be approved by two-thirds of each house of the legislature. Yet because these fees would be imposed through the IRP, this measure would be easier to adopt from a regulatory standpoint than tax measures. For more detail on the legal issues surrounding the adoption of fee based systems, the reader is referred to Chapter 5.

It is also possible to provide a registration fee exemption for operators that purchase a low-emission HDV. However, since the current annual registration fee is only \$29, inclusion of this fee would have very little impact.

Accelerated Depreciation for Low-Emission HDVs

As indicated in Exhibit 6-2, the vehicle license fee depends on the purchase price, depreciated over an 11 year period. One incentive to encourage operators to purchase low-emission HDVs would be to accelerate the depreciation schedule. A different fee schedule could be created for low-emission HDVs that would charge a smaller rate. This program could be applied through the IRP to entice non-California-based motor carriers to purchase low-emission HDVs in order to lower their vehicle licensing fees. Because this measure would cause a change in vehicle fees, it could be implemented by the California Department of Motor Vehicles in conjunction with the ARB.

Fee-Bate Through Sales Taxes

Rather than impose a fee-bate system through registration fees, another option would be to link sales taxes for HDVs with their emission characteristics. High emission HDVs would have higher sales taxes, while clean HDVs could have lower sales taxes, no sales tax or a rebate, equivalent to a negative sales tax. However, there are two main drawbacks to this system. First, it only affects the decision to purchase the equipment, but not its use after purchase. Dirty equipment, once purchased, could be used without further penalty. An annual registration fee-bate system, by contrast, can discourage usage because mileage is factored in using the IRP or IFTA data. Second, fee-bates for low-emission vehicle sales taxes would most likely apply only to the purchase of vehicles. It would take many years for the entire stock of equipment in use to be influenced. These two defects deprive the concept of much of its power.

Exhibit 6-2



SCHEDULE OF CALIFORNIA FEES (Effective 1/1/95)

VEHICLE LICENSE FEE (EQUIVALENT FEE FACTOR TABLE)

- Locate year of purchase. Under current year, fill in subsequent years beginning with the latest.
- In the column to the right locate the corresponding equivalent factor.
- Multiply the equivalent factor by the purchase price. (The purchase price must be rounded to the nearest odd hundred dollars, i.e., \$27,465 rounds to \$27,500.)
- The product derived equals the vehicle license fee for a 12 month period. For periods less than 12 months, multiply the product by the number of months and divide by 12. (See example)

PURCHASE YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Current Year	.0200	x 11	x 10	x 9	x 8	x 7	x 6	x 5	x 4	x 3	x 2	x 1
19____	.0180	12	12	12	12	12	12	12	12	12	12	12
19____	.0160											
19____	.0140	EXAMPLE: Fees due for a 12 month period January to December) Purchase Price: \$27,500 Purchase date: 1994 \$27,500 x .0200 = \$550										
19____	.0120											
19____	.0100	EXAMPLE: Fee due for a 7 month period (June to December) Purchase Price: \$27,500 Purchase date: 1994 \$27,500 x .0200 = \$550 x 7 (June) + 12 = \$321										
19____	.0080											
19____	.0060	NOTE: When computing fees, a fraction of a dollar is disregarded, unless it exceeds forty nine cents (\$.49) in which case it shall be rounded to the next full dollar amount (i.e., \$5.49 = \$5.00 and \$5.50 = \$6.00).										
19____	.0050											
19____	.0040											
19____	.0030											

WEIGHT FEES (Effective 1/1/95)

UNLADEN WEIGHT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
POWER UNITS—TWO AXLES												
Less than 3,000 lbs.	8	7	7	6	5	5	4	3	3	2	1	1
3001-4000	24	22	20	18	16	14	12	10	8	6	4	2
4001-5000	80	73	67	60	53	47	40	33	27	20	13	7
5001-6000	154	141	128	116	103	90	77	64	51	39	26	13
6001-7000	204	187	170	153	136	119	102	85	68	51	34	17
7001-8000	257	236	214	193	171	150	129	107	86	64	43	21
8001-9000	308	282	257	231	205	180	154	128	103	77	51	26
9001-10000	380	330	300	270	240	210	180	150	120	90	60	30
10001-11000	409	375	341	307	273	239	205	170	136	102	68	34
11001-12000	462	424	385	347	308	270	231	193	154	116	77	39
12001-13000	513	470	428	385	342	299	257	214	171	128	86	43
13001-14000	563	516	469	422	375	328	282	235	188	141	94	47
14001 and over	616	565	513	462	411	359	308	257	205	154	103	51
POWER UNITS—THREE OR MORE AXLES AND ANY TRAILER												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0-1999	No Fee											
2000-3000	43	39	36	32	29	25	22	18	14	11	7	4
3001-4000	77	71	64	58	51	45	39	32	26	19	13	6
4001-5000	154	141	128	116	103	90	77	64	51	39	26	13
5001-6000	231	212	193	173	154	135	116	98	77	58	39	19
6001-7000	308	282	257	231	205	180	154	128	103	77	51	26
7001-8000	385	353	321	289	257	225	193	160	128	96	64	32
8001-9000	462	424	385	347	308	270	231	193	154	116	77	39
9001-10000	539	494	449	404	359	314	270	225	180	135	90	45
10001-11000	616	565	513	462	411	359	308	257	205	154	103	51
11001-12000	693	635	578	520	462	404	347	289	231	173	116	58
12001-13000	770	706	642	578	513	449	385	321	257	193	128	64
13001-14000	847	776	706	635	565	494	424	353	282	212	141	71
14001-15000	924	847	770	693	616	539	462	385	308	231	154	77
15001 and over	1016	931	847	762	677	593	508	423	339	254	169	85

REGISTRATION FEE - NOT PRORATED (Effective 1/1/95)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
\$29	\$29	\$29	\$29	\$29	\$29	\$29	\$29	\$29	\$29	\$29	\$29

A sales tax exemption, if granted only to California-based fleets, would provide an incentive for these fleets to purchase low-emission HDVs. From a relocation standpoint, however, this program would not have as large an impact as a fee-based registration system. If the sales tax was reduced on low-emission HDVs in conjunction with a performance standard, an operator may decide to relocate outside of the state as a result of the new standard. Unlike the fee-based registration system, the sales tax fee-bate is not as broad based, and would be less effective in reducing the likelihood of relocation.

Another option would be to completely eliminate the sales tax paid on a new low-emission HDV. This program would diminish state sales tax revenue, which would imply that the state would either need to find other sources of revenue or cut spending in order to account for this lost revenue. Because a sales tax exemption is merely an extension of a sales tax reduction, many of these same problems that are true under the sales tax reduction would apply to this system. The sales tax exemption would need to be passed through state statute, which would hinder the expedient implementation of this measure.

State Income Tax Credits

Tax credits can also be used to encourage the purchase of new, cleaner HDVs. A tax credit is often calculated as a set amount on an annual basis. Tax credits, however, would only benefit motor carriers that report positive net income; carriers that report a loss would not have any tax liability, and thus would not benefit from a tax credit. This program could reduce the likelihood of relocating by providing an incentive for firms to remain in the state. If a motor carrier relocated outside of the state, then this carrier could no longer take advantage of the tax credit and would forego tax savings that it could otherwise obtain if it remained in California.

As an example of a income tax credit, a credit of \$500 for each purchase of a low-emission HDV would reduce a firm's tax burden by \$500 for each HDV purchased. If total estimated taxes for a California-based motor carriers were \$40,000, and the motor carrier bought six low-emission HDVs, then the carrier's state income taxes would be reduced by \$3,000, to \$37,000.

State Income Tax Deduction Measures

Other tax measures could be adopted which would encourage the purchase of low-emission HDVs. These include state income tax deductions for the purchase price and for the interest on a purchase loan. Allowing motor carriers to use their HDV purchases as tax deductions would lower their tax burden. However, these deductions would vary based on the firm's marginal tax rate. The degree to which California state income taxes are progressive would affect deductions as well. The first of these two tax measures would be a one-time deduction (e.g., the year the HDV is purchased) while the second program would allow for a deduction in each year of the loan. Because HDV operators are likely to finance their purchases through loans, motor carriers could benefit from both of these two measures.

Both income tax credit and deduction measures would require changes in the state income tax code. Because businesses may be faced with a command and control regulation before state income tax measures are approved, these businesses may choose to relocate outside of the state. Prompt implementation of these measures may be difficult, and this delay may diminish the beneficial impacts of these measures.

6.2.3 Emission Trading Measures

Emissions trading is a concept developed by economists in the 1970s to more efficiently reduce emissions than the "command and control" approach. Emissions trading would reduce the likelihood of relocating if it was created such that it provided additional credits for being located in California. However, trading could still occur between California and non-California-based fleets. This section discusses the concept of emissions trading, and how it could be implemented in California.

Theoretical Review of Emissions Trading

Emissions trading can take many forms, based on the pollution control objective. It should be noted that the objective of an emission trading program may not be to reduce emissions. For example, the objective may be to hold emissions constant while reducing cost. A trading program that reduces emissions is often referred to as an emission budget approach. Three basic approaches to emissions trading are:

1. ***The Emissions Budget Approach.*** This approach bases emissions trading on the rule that the sum of all emissions released within the jurisdiction shall not exceed a prestated limit. The limit is often referred to as an emissions budget. The emission increase allowed to one party of the trade would equal the emission decrease guaranteed by the other.
2. ***The Ambient Air Quality Approach.*** Here, emissions trading is based on the rule that the ambient air quality after the trade be no worse than it was before the trade. This approach accounts for the pollution impact of each source at each location.³⁵ It assumes that air quality was acceptable before the trade. If it was not, the ambient limit required after the trade may become the limiting criterion for the trade. The criterion for the ambient air quality approach is more complicated to apply than the one for the emissions budget approach because it requires use of some form of air quality modeling.

³⁵Krupnick, Alan J.; Oates, Wallace E.; and Van De Verg, Eric. *On Marketable Air-Pollution Permits: The Case for a System of Pollution Offsets*. Journal of Environmental Economics and Management, 1983, 10(3), pp. 233-247.

3. *The Damages Approach.* This approach requires an additional step beyond the ambient air quality approach. The step is to measure the economic impacts on health, crops, materials, and the environment due to the changed patterns of emission resulting from a trade. The decision rule associated with this approach would state that net damages be zero or that there be no negative impacts. The requirement to measure the economic effects of the trade adds a great deal of complexity to trading.

Obviously, the emission budget approach is the easiest approach to implement, because neither economic nor air quality modelling must be performed in conjunction with the trade. The emissions budget can be based on economic and air quality considerations, and the boundaries of the trading area can be set to assure that the impacts of the emissions involved in the trade are similar. Moreover, most of the emissions trading programs being implemented or proposed follow the emissions budget approach. The rest of the section focuses on the emissions budget approach to emissions trading.

The design of an emission trading system depends on which approaches and emission reduction goals apply. An emission trading system could be set up with either an increasing, constant, or decreasing emission limits, depending on pollution reduction targets. There are three basic emission trading methods, which are:

- *Emission Reduction Credit Trading* is a form of emissions trading in which an emission reduction credit is approved by the regulatory agency based on emission reductions already completed. Before the emission reduction credit is approved the agency has assessed the amount by which the altered control technologies and operating procedures have reduced the level of emissions of a source below its emission limit. Emission reduction credits can then be sold to other emission sources to be used to meet their emission control requirements.
- *Emission Allowance Trading* involves the assignment of a certain number of emission allowances to each source. Sources must install controls or institute programs to meet those limits. If emissions are less than the limit, sources may sell their surplus emission allowances. If emissions are in excess of the limit, sources must obtain additional emission allowances or are deemed to be out of compliance with the limit.
- *Emission Averaging* is a form of emissions trading in which no specific limit is placed on a source's total emissions. Rather, a limit is placed on the emission rate of each piece of equipment. If the emission rate of a given piece of equipment is lowered below its limit, then the rate for another piece of equipment may be increased. The allowable increase in the rate is determined using a weighting system in which the expected rates of utilization for each piece of equipment are used as the weights.

Traditionally, most emission trading programs have been targeted at stationary sources, which are easier to quantify than mobile sources. Output levels are easily monitored for a stationary source, while mobile source emission estimates require vehicle operating data, including usage patterns, the type of engine, the type of fuel being consumed, and vehicle speed. In general, emission trading programs involving mobile sources must meet the same criteria as programs for stationary sources. Emission reduction credits must be quantifiable, enforceable, and permanent within the timeframe specified by the program, and consistent with all other statutory and Federal regulatory requirements.

Transaction Costs

The magnitude of transaction costs is thought to be a primary determinant of the success of a trading system. In the brief history of emissions trading, transaction costs have varied greatly from one trading system to another.³⁶ For example, the market for lead (in gasoline) rights, in effect between 1982 and 1987, is thought to have had relatively low transaction costs. The trading unit and trading universe were well defined, with the trading universe consisting of gasoline refiners who were in the habit of frequent transactions with each other in other markets. Over half of all lead rights were involved in market activity, and half of eligible firms participated. The level of trading activity in the lead market contrasts with that under the U.S. EPA's Emissions Trading Policy Statement (ETPS) program, which was used in less than one percent of possible situations. Further evidence of the negative effect of transaction costs is that most of the ETPS program trades were internal to a firm rather than external, and transaction costs of internal trades are thought to be substantially lower than those of external trades.

Transaction costs may be felt in many ways. They may be experienced as the amount of time the firm's employees spend on effecting a trade rather than on some other task. Also, the elapsed time required for the firm's employees or agency personnel to complete the transaction may cost the firm in terms of lost business opportunities. There is evidence of the magnitude of monetary transaction costs as well. As an example of the magnitude of costs that occur in some trading systems, AER*X, an emissions brokerage firm, has reported that, in Los Angeles, when emission offsets were purchased for new sources, the fixed fee was \$3,000 per trade with \$10,000 to \$25,000 for administrative costs, such as documentation and filing costs.³⁷

³⁶Stavins, Robert N., *Transaction Costs and the Performance of Markets for Pollution Control*. Presented at the American Economics Association Meeting, Boston, MA, January 1994. Stavins reviews several papers that depict the link between transactions costs and the performance of emissions trading systems and then develops a model to illustrate how transactions costs affect the optimal control levels of a pollutant. This paragraph is based on his review.

³⁷Stavins, *Op. Cit.*

Many proposals for the trading of mobile source emissions deal with fleets of vehicles under common ownership. In such cases, the emissions are likely to be easier to quantify and one owner has the ability to reduce larger quantities of emissions by his decisions regarding emission controls, fuel use, maintenance programs, and vehicle miles traveled.

Potential Emissions Trading Systems for California

An emissions trading system could be set up through the IRP in order to involve both California and non-California-based HDV operators to participate in the program. Additionally, the program could be expanded to include other users of heavy-duty diesel engines, such as locomotives. While developing this system is beyond the scope of this study, this section briefly discusses how an emission credit system could be operated.

The ARB could set a per mile pollutant standard that would vary by truck weight. Each trucking firm would then be required to meet that standard for all miles traveled in California. If the firm bought low-emission HDVs they could sell their extra pollution rights, while if they operated higher polluting vehicles they would need to buy extra pollution rights.

Operators would have to meet the standard for their California fleet or buy credits regardless of where they based their trucks. This program would eliminate the incentive to base their vehicles outside of California. By varying the per mile pollutant standard, the ARB could set a total pollution level (budget) for the state.

Alternatively, the credit trading program could include special provisions that benefit California-based operators. Under such a scheme, an incentive would exist not only for operators not to leave the state but also for non-California-based firms to relocate their operations in California. If, for example, each California-based fleet received an annual credit allowance, this allowance could be used towards meeting a pollution standard or could be sold to other fleets that own older vehicles. Out-of-state operators under this scheme may decide to relocate to California because their operating costs would be lower if they took advantage of this preferential treatment.

6.2.4 Loan Measures

Purchases of new vehicles are often financed through loans. Incentives towards the purchase of a new HDV could be developed by the state in an effort to mitigate the impacts of low-emission regulations. If faced with a performance standard, motor carriers may be less likely to move their base operations outside of California if provided with low interest loans. These loan measures work in much the same method as rebates, in that they effectively reduce the purchase price of a new HDV. Two loan measures are discussed in this section.

In the first loan program, the government would provide low interest loans through banks for the purchase of low-emission HDVs. During the past two years, interest rates have increased considerably, which may discourage the purchase of a new HDV. By lowering the loan

interest rate, California would help motor carriers finance their vehicle purchases. In a second program, the government could provide loan guarantees on low interest loans. This program would be targeted at banks, and would encourage them to provide low interest loans to motor carriers towards the purchase of a low-emission HDV.

Both of these programs would require the state to coordinate its efforts with the state financial community. In the case of the second program, sources of financing would need to be located to create a fund that would be used to guarantee payment in the case of a loan default. This fund would need to be adequately funded in order to maintain stability in the financial markets.

6.2.5 Operating Cost Measures

Incentives can also be created which would reduce the operating costs of low-emission HDVs. These costs include tolls, vehicle permits, and overweight vehicle fees. In one program, overweight vehicle fees could be reduced for low-emission HDVs. Currently, operators of vehicles exceeding 80,000 Gross Vehicle Weight Rating are required to purchase either a single trip or an annual permit in order to travel on California roads. Because vehicle weight is an important safety issue, changing these permit fees in order to enhance vehicle emissions may not be advisable from a safety standpoint. These permits fees are designed to discourage the use of the California transportation system by overweight vehicles, and as a result, efforts to encourage the use of this system by overweight low-emission HDVs may be met with resistance from the safety community.

6.3 ECONOMIC INCENTIVE PROGRAMS TO BE USED IN THE SIMULATION MODEL

To analyze the benefits and costs of relocation, a simulation model is developed as part of this study. The model sets key policy variables, such as the operating and capital regulatory costs while the level of incentives is set at desired levels. This section discusses the incentive programs included in the model, as well as some of the efficiency issues associated with these measures, building on the analysis of Section 6.1. Exhibit 6-3 shows the different incentive measures evaluated. As depicted in Exhibit 6-3, these economic incentive programs are modeled with and without the assumption that a performance standard is implemented.

Emission cost reductions vary with the weight, use, and the percent of VMT in California. Maximum economic efficiency, therefore, may not be obtained through a command and control approach. With rebasing as a viable option, moreover, the state may lack the power to effectively command HDV purchases for many HDV operators. Performance standards for new vehicles represent the normal strategy for reducing vehicle emission and therefore serve as the model's base case and an optional addition to each alternative emission reduction strategy.

EXHIBIT 6-3
ECONOMIC INCENTIVE SIMULATION MODEL

Regulation	Without Performance Standard	With Performance Standard
Performance Standard	X	N/A
Rebate	X	X
Tax Reduction	X	X
Emission-Based Registration Fees	X	X

N/A: Not Applicable

A rebate, by reducing the purchase price of low-emission HDVs, uses market forces in encouraging the purchase of low-emission HDVs and the discouragement of relocation, rebasing and extending vehicle life. Two problems exist with a rebate. First, a rebate does not equate marginal cost to the HDV operator with marginal damage to society. In addition, sources of financing would need to be located for a rebate program. Some sort of a cash payment for purchase of lower emission HDVs, however, represents a standard method of incentive which, given the lack of control of the operators, may be necessary to reduce emissions without causing relocation.

Another option, a tax credit, would be even less efficient because firms that are not earning positive net income might not benefit from the credit thus making the impact more uneven and inefficient. It should be taken into account, however, that tax credits can be carried over to another year. Moreover, while many businesses, especially small businesses, tend not to show income to avoid double taxation (both corporate tax and personal income tax by the owners), the tax credit can still be useful for sheltering corporate taxes. The same logic would apply towards income tax deductions. These tax credit options will be included in the model, however, as tax policy is often used in government incentive programs.

Fee-based systems attempt to equilibrate the marginal cost of polluting with the marginal social benefit of eliminating the pollution. As noted earlier, fee-bate based systems could be applied through the IRP to encourage non-California-based carriers to purchase clean HDVs. Since this alternative incentive program has the potential to significantly improve efficiency, it is included in the model.

A market trading system with an emission budget would also be more efficient as it would provide financial incentives for consumers to purchase lower polluting HDVs. A motor carrier that purchases low-emission HDVs would accumulate pollution credits that can be sold to a carrier that owns older and dirtier HDVs. A certain number of credits would be required in

order for a carrier to accrue mileage in California. One difficulty inherent with a market trading system is that transactions costs would exist. These costs could diminish the attractiveness of a market trading system.