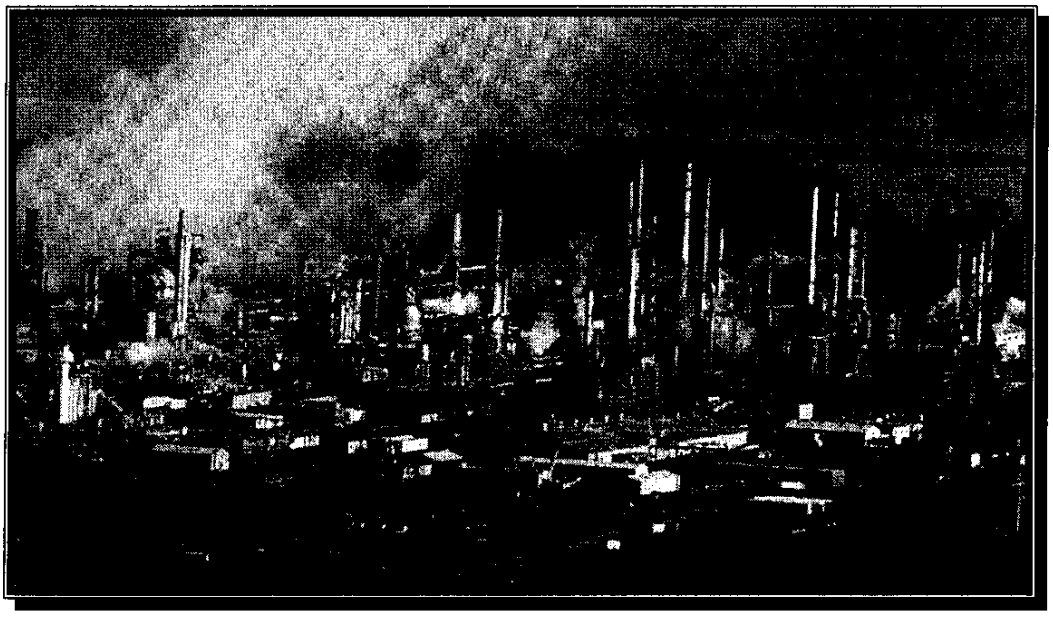
California Environmental Protection Agency
Air Resources Board

Assessment of the Local and Regional Emission Impacts from California Phase 2 Reformulated Gasoline and Related Clean Fuels Refinery Modifications



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State of California
California Environmental Protection Agency
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Principal Authors:

Harold Holmes, Engineering Evaluation Section
Duong Trinh, Engineering Evaluation Section

With Special Thanks to:

Valentine Montoya for Administrative Support

Reviewed by:

Michael H. Scheible, Deputy Executive Officer
Peter D. Venturini, Chief, Stationary Source Division
Dean C. Simeroth, Chief, Criteria Pollutants Branch
Erik C. White, Manager, Engineering Evaluation Section

TABLE OF CONTENTS

I. SUMMARY 1

A. Overall Findings 1
B. Change in Emissions from CaRFG2 Producing Refineries 2
C. Regional Emission Impacts 4

II. INTRODUCTION 7

A. Need for Staff's Assessment of the Emission Impacts Associated with the CaRFG2 Refinery Modifications 7
B. Scope of Staff's Evaluation of the Local and Regional Emission Impacts of the CaRFG2 Refinery Modifications 7

III. CALIFORNIA'S GASOLINE REFINERIES AND GASOLINE REQUIREMENTS 9

A. California Refineries That Produce CaRFG2 9
B. Gasoline Requirements in California 10
1. California Requirements 10
2. Federal Requirements 11

IV. ENVIRONMENTAL REQUIREMENTS FOR CARFG2 PROJECTS 13

A. Overview 13
B. CEQA 13
1. South Coast Air Quality Management District 13
2. Bay Area Air Quality Management District 14
3. San Joaquin Valley Unified Air Pollution Control District 14
C. California's Air Permit Requirements 14
1. NSR Requirements for Emission Control Equipment 15
2. Emission Offset Requirements 16
D. Offset Exemptions 16
1. Federal Clean Air Act Amendments of 1990 (Section 182(e)(2)) 17
2. California State Law 17
3. SCAQMD Rule 1304(e)(4) 17

V. CARFG2 REFINERY MODIFICATIONS 19

A. General Types of CaRFG2 Refinery Modifications 19
B. Specific CaRFG2 Refinery Modifications 21

VI. DATA COLLECTION AND ANALYSIS 23

A. Data Collection 23
B. Data Analysis 24

VII. CARFG2 LOCAL AND REGIONAL EMISSION IMPACTS IN THE SCAQMD 27

A. Change in Emissions From CaRFG2 Producing Refineries 27
1. Changes in Emission Inventory 28
2. Changes in Stationary Source Emissions 28
B. Regional Emission Impacts 29
1. Indirect Source Emissions 30
2. Local and Regional Emission Benefits of Using CaRFG2 31

VIII. CARFG2 LOCAL AND REGIONAL EMISSION IMPACTS IN THE BAAQMD 33

A. Change in Emissions for CaRFG2 Producing Refineries 33
1. Changes in Emissions Inventory 34
2. Changes in Stationary Source Emissions 34
B. Regional Emission Impacts 35
1. Indirect Source Emissions 36
2. Local and Regional Emission Benefits of Using CaRFG2 37

IX. CARFG2 LOCAL AND REGIONAL EMISSION IMPACTS IN THE SJVUAPCD .. 39

A. Change in Emissions for CaRFG2 Producing Refineries 39
1. Changes in Emissions Inventory 40
2. Changes in Stationary Source Emissions 40
B. Regional Emission Impacts 41
1. Indirect Source Emissions 41
2. Local and Regional Emission Benefits of Using CaRFG2 42

REFERENCES 43

Appendices

A. CaRFG2 Refinery Emissions (1990-1999)

B. CEQA Process Flow Chart & Overview of CEQA Process

C. Examples of CaRFG2 CEQA Mitigation Monitoring Plans

D. Examples of CaRFG2 CEQA Mitigations

E. SCAQMD – Letters Requesting District Serve as Lead Agency

F. BAAQMD – Letter Explaining District's Role as Responsible Agency

G. SCAQMD – Detailed CaRFG2 BACT Determinations

H. BAAQMD – Detailed CaRFG2 BACT Determinations

I. Federal Clean Air Act Section 182(e)(2) – Federal Offset Exemption

J. Health and Safety Code Section 42301.2 – California Offset Exemption

K. U.S. EPA and SCAQMD Correspondence – SCAQMD Offset Exemption

L. SCAQMD Rule 1304 (b)(4) – Offset Exemption

M. Summary of Major Types of CaRFG2 Refinery Modifications

N. SCAQMD – Summary of CaRFG2 Refinery Modifications

O. SCAQMD – Detailed Matrix of CaRFG2 Refinery Modifications

P. BAAQMD – Summary of CaRFG2 Refinery Modifications

Q. BAAQMD – Detailed Matrix of CaRFG2 Refinery Modifications

I. SUMMARY

Today's gasoline, known as California Phase 2 Reformulated Gasoline, or CaRFG2, was introduced in 1996. In California, nearly all of the CaRFG2 consumed is produced by refineries in the South Coast Air Quality Management District (SCAQMD), the Bay Area AQMD (BAAQMD), and the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD)[1].

This document is an assessment performed by staff of the Air Resources Board (ARB) on the emission impacts of introducing CaRFG2. This assessment includes a consideration of both the emission benefits of the program and the emission impacts of the associated refinery modifications necessary to produce CaRFG2. There is also included in this report an assessment of emissions from refineries over the period 1990 through 1999 in these three air districts.

An assessment of the emissions associated with current refinery projects to produce California Phase 3 Reformulated Gasoline, or CaRFG3, are not included in this document since these projects are not yet completed.

A. Overall Findings

Since its implementation, the CaRFG2 program has provided very significant reductions in ozone and particulate matter precursor emissions and toxic air pollutants. The emission benefits of this program have been equivalent to the removal of 3.5 million vehicles from California's roads, and are a major component of California's plan for achieving both the federal and state ambient air quality standards. The emission reductions from CaRFG2 represent about one quarter of the emission reductions committed to in the 1996 State Implementation Plan. Table I-1 shows the criteria pollutant emission benefits of the CaRFG2 program in the SCAQMD, BAAQMD, and the SJVUAPCD.

In order to produce CaRFG2, California refineries underwent significant modifications from 1992-1998 spending about 4 billion dollars on capital equipment and improvements. These modifications included retooling of existing equipment and processes, as well as installation of new equipment. In performing these modifications, the permitted emissions from the refineries changed. In some instances, these changes resulted in some increases in permitted emissions. In other cases, the change resulted in a reduction in permitted emissions. In all cases, the change in permitted emissions from refineries as a result of the CaRFG2 modifications was small. In the context of the overall CaRFG2 program, any increases in permitted emissions from refineries (see Appendix A for CaRFG2 refinery emissions) were greatly overshadowed by the emission benefits of the CaRFG2 program.

[1] Within this document, the SCAQMD, BAAQMD and SJVUAPCD will collectively be known as the "districts".

Table I-1:
Emission Benefits and Impacts of the CaRFG2 Program

District	Emission Type	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
SCAQMD	CaRFG2 Benefits	-42	-25	-439	-10	[2]
	Impacts of Implementing CaRFG2[1]	1.2	1.4	0.7	0.6	0.4
BAAQMD	CaRFG2 Benefits	-26	-11	-208	-5	[2]
	Impacts of Implementing CaRFG2[1]	-0.3	0.3	1.4	0.6	0.1
SJVUAPCD	CaRFG2 Benefits	-9	-6	-105	-3	[2]
	Impacts of Implementing CaRFG2[1]	0.1	0.1	0.1	0.1	0

[1] Includes both direct and indirect emission impacts
[2] It was estimated that the CaRFG2 reductions in NO_x and SO_x would significantly reduce the formation of PM_{10}.

Table I-1 shows the changes in emissions within each of the three air districts as a result of implementing the CaRFG2 modifications. The changes in emissions include both changes in permitted emissions from the refineries (known as stationary source emission impacts) and changes in emissions from truck, marine, and employee traffic (known as indirect source emission impacts). As can be seen in Table I-1, when the emission impacts of the CaRFG2 modifications are compared to the emission benefits of the CaRFG2 program in each of the three districts, the CaRFG2 program emission benefits are up to 400 times greater than any emission impacts.

B. Change in Emissions from CaRFG2 Producing Refineries

The changes in emissions of criteria pollutants for CaRFG2 projects from the California Environmental Quality Act (CEQA) are presented in Table I-2 for each of the three air districts. Based on CEQA and air district permitting information, many of the CaRFG2 refinery modifications resulted in a relatively slight increase in permitted emissions from refineries in the SCAQMD and SJVUAPCD. For example, in the SCAQMD while the introduction of CaRFG2 in 1996 increased refinery emissions of ROG by 0.9 tpd, overall ROG refinery emissions still declined by 19 tpd in the period from 1990 to 1999. This is because while modifications were made to existing equipment which generally served to reduce emissions from these units, at some facilities additional new equipment which was not previously in operation was also installed, resulting in relatively slight emission increases from some facilities. However, in the BAAQMD, the permitted emission increases from refineries were limited to CO emissions.

The emission reductions shown in Table I-2 for refineries are a result of increased stringency of local air district rules and regulations applicable at refineries, as well as from the replacement or modifications of older equipment throughout the last decade with newer, cleaner units. In evaluating this trend towards lower emissions for these

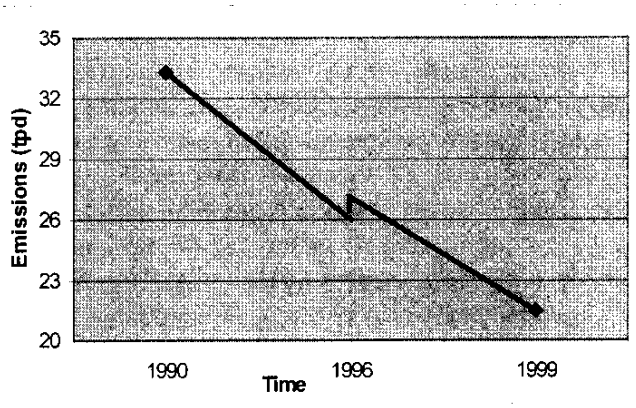
refineries, it is important to note that they occurred during a time of overall growth in gasoline production of 10 percent and an increase in California gasoline consumption of 8 percent.

Because of the increases in emissions from the CaRFG2 projects, refinery emissions as a whole may not have decreased as much as possible had the CaRFG2 projects not occurred. As can be seen in Table I-2, the increases in permitted emissions from the CaRFG2 refinery modifications did not significantly impact the overall emission reduction trends from CaRFG2 producing refineries. However, outside of the BAAQMD, the CaRFG2 projects somewhat reduced the emission reductions achieved over this period. Figure I-1 further illustrates the overall downward emissions trend during the period from 1990-1999. The graph represents the general decrease in nitrogen oxides (NOx) in the South Coast Air Basin, despite the slight increase in emissions attributable to the implementation of the CaRFG2 refinery modifications, as indicated in 1996.

Table I-2:
Change in Emissions from CaRFG2 Producing Refineries (1990-1999)

District	Emission Type	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
SCAQMD	Change in Refinery Emissions from1990-1999	-19	-12	3	6	-3
	Impact of CaRFG2 Refinery Emissions	0.9	0.5	0.4	0.5	0.3
BAAQMD	Change in Refinery Emissions from1990-1999	-6	-10	-3	-8	-0.4
	Impact of CaRFG2 Refinery Emissions	-0.3	-0.1	1.6	-0.1	0
SJVUAPCD	Change in Refinery Emissions from1990-1999	-1	-4	0	-1	1
	Impact of CaRFG2 Refinery Emissions	0.1	0.1	0.1	0.1	0

Figure I-1:
Refinery NO_x Emission Trend in the South Coast Air Basin 1990-1999



C. Regional Emission Impacts

As previously discussed, the use of CaRFG2 in gasoline powered motor vehicles has provided very significant reductions in emissions of precursors for both ozone and particulate matter and emissions of toxic air pollutants. However, the production of CaRFG2 has necessitated changes in the movement of materials and components to produce CaRFG2 at California refineries. Changes in emissions from these sources, known as indirect sources, are generally mobile source related and include changes in marine, rail, truck, and employee traffic. These emission changes also include impacts from offsite stationary sources, such as power plant emissions from increased electrical demand. As shown in Table I-3, generally, there was an increase in the annual daily average emissions from indirect sources associated with the CaRFG2 projects in the three air districts.

Table I-3:
Regional Emission Impacts of CaRFG2
(Annual Daily Average)

District	Emission Type	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
SCAQMD	CaRFG2 Emission Benefits	-42	-25	-439	-10	[1]
	CaRFG2 Indirect Source Impacts	0.3	0.9	0.3	0.1	0.1
BAAQMD	CaRFG2 Emission Benefits	-26	-11	-208	-5	[1]
	CaRFG2 Indirect Source Impacts	0	0.4	-0.2	0.7	0.1
SJVUAPCD	CaRFG2 Emission Benefits	-9	-6	-105	-3	[1]
	CaRFG2 Indirect Source Impacts	0	0	0	0	0

1 It was estimated that the significant CaRFG2 reductions in NO_x and SO_x would significantly reduce the formation of PM_{10}.

Because the CaRFG2 program must comply with the federal requirements, nearly all of the gasoline sold in southern California contains oxygenates. Oxygenates are compounds designed to reduce emissions of carbon monoxide (CO) from motor vehicles. In complying with these federal requirements, most refiners chose to use methyl tertiary butyl ether, or MTBE. With the introduction of CaRFG2, MTBE use in California more than doubled, with much of the MTBE arriving at refineries via marine shipments. Also, in complying with the CaRFG2 requirements, some refiners chose to increase imports of certain gasoline blending components such as alkylates. These imports also arrived into California through the ports.

Because of the federal oxygenate requirements, the SCAQMD had the largest CaRFG2 indirect source emission impacts. The majority of these emission increases occurred in the Long Beach and Los Angeles Harbor areas of the SCAQMD, with marine tanker emissions accounting for most of the emission impacts. As shown in Table I-3 the result of the increased marine activity effected both the SCAQMD and BAAQMD.

Oxides of nitrogen, or NO_x increased by 0.9 tpd on average in the SCAQMD and oxides of sulfur, or SO_x increased by 0.7 tpd on average in the BAAQMD. There were also smaller average daily emission increases of indirect sources of less than half a ton per day of reactive organic gases (ROG), and minimal impacts from CO, and particulate matter (PM) emissions in the SCAQMD. Yet, as previously discussed, while there were emission impacts associated with the implementation of the CaRFG2 program, these impacts are small when compared to the very significant benefits the CaRFG2 program provided.

II. INTRODUCTION

This report is an assessment by the staff of the ARB on the local and regional emission impacts associated with the CaRFG2 refinery modifications and related clean fuels projects. These projects, initiated in the early to mid-1990's, provided a means for California refiners to produce gasoline meeting the federal Phase 1 Reformulated Gasoline (RFG) standards and the more stringent CaRFG2 standards.

A. Need for Staff's Assessment of the Emission Impacts Associated with the CaRFG2 Refinery Modifications

Since the implementation of the CaRFG2 regulations in the spring of 1996, some environmental and citizen groups have expressed concerns that they believed that the implementation of CaRFG2 and the related refinery modifications resulted in local adverse emission impacts. As a result, ARB staff began this past year to compile the information necessary to assess the local and regional emission impacts associated with the implementation of the CaRFG2 regulations.

B. Scope of Staff's Evaluation of the Local and Regional Emission Impacts of the CaRFG2 Refinery Modifications

Staff's assessment includes those CaRFG2 and related clean fuels refinery modifications which were undertaken in the early to mid-1990's (1992-1997), as well as an assessment of the change in emissions from CaRFG2 producing refineries over the period of 1990 through 1999. The refineries that were modified to produce CaRFG2 are located in the SCAQMD, BAAQMD, and SJVUAPCD. Staff has reviewed historical documents to assess how these three air districts and local governments mitigated the emission increases from the CaRFG2 refinery modifications under the then existing emission regulations and CEQA requirements. Also, staff has attempted to gather the information available to assess the emissions impacts associated from indirect sources such as marine and rail traffic and increased truck and employee traffic.

III. CALIFORNIA'S GASOLINE REFINERIES AND GASOLINE REQUIREMENTS

In this chapter, staff provides information on which California refineries produce CaRFG2 and the specifications for gasoline in California.

A. California Refineries That Produce CaRFG2

In California, twelve major refineries and one small refinery made the necessary refinery modifications to produce CaRFG2. Those refineries are shown in Table III-1. The refineries that produce CaRFG2 are located in the:

- SCAQMD – (Los Angeles County)
- BAAQMD – (Contra Costa County and Solano County)
- SJVUAPCD – (Kern County)

Table III-1:
California Refineries that Currently Produce CaRFG2

South Coast Air Quality Management District		
Refinery	Location	History of Ownership
British Petroleum (BP)	Carson	ARCO
ChevronTexaco	El Segundo	No recent changes
Shell	Wilmington	Equilon / Texaco
ExxonMobil	Torrance	Mobil
ConocoPhillips	Wilmington and Carson	Tosco / Unocal
Valero	Wilmington	Ultramar Diamond Shamrock
Bay Area Air Quality Management District		
Refinery	Location	History of Ownership
ChevronTexaco	Richmond	No recent changes
Shell	Martinez	Equilon
ConocoPhillips	Rodeo	Phillips / Tosco / Unocal
Tesoro	Avon (Martinez)	Phillips / Tosco / Ultramar Diamond Shamrock
Valero	Benicia	Exxon
San Joaquin Valley Unified Air Pollution Control District		
Refinery	Location	History of Ownership
Shell	Bakersfield	Equilon / Texaco
Kern Oil	Bakersfield	No recent changes

B. Gasoline Requirements in California

The production of gasoline in California is governed by both state and federal requirements.

1. California Requirements

California has adopted three modifications to our gasoline regulations since 1989 that make-up California's reformulated gasoline regulations. The expected emissions benefits of these three regulations were a reduction of about 400 tpd of hydrocarbons, 129 tpd of NO_x, 34 tpd of SO_x, 1300 tpd of CO, and a 37 percent reduction in toxics. The controls implemented in California's first reformulated gasoline regulation, the Phase I program in 1992 included lowering the Reid vapor pressure (RVP) from 9.0 to 7.8 psi, a requirement for the addition of deposit control additives, and the elimination of leaded gasoline in California.

Shown in Table III-2 are the specifications established in the second modification to California's reformulated gasoline regulations, the CaRFG2 regulations. This modification resulted in a comprehensive set of specifications designed to achieve maximum reductions in criteria and toxic pollutants and in the mass and reactivity (ozone-forming potential) of emissions from gasoline fueled vehicles. These regulations were approved by the ARB in 1991 and were implemented statewide in 1996. The CaRFG2 regulations have different sets of limits depending on how the refinery chooses to comply with the regulations. However, the cap limits may not be exceeded.

Table III-2:
CaRFG2 Specifications

Property Limits	Units	Flat Limits	Averaging Limits	Cap Limits (1)
Reid vapor pressure	psi, max	7.0	---	7.0
Benzene	vol %, max	1.00	0.80	1.20
Sulfur	ppmw, max	40	30	80
Aromatic Hydrocarbons	vol %, max	25	22	30
Olefins	vol %, max	6.0	4.0	10
Oxygen	wt %	1.8 to 2.2	---	1.8 (min)(2) 3.7 (max) (3)
T50	°F, max	210	200	220
T90	°F, max	300	290	330

(1) The "cap limits" apply to all gasoline at any place in the marketing system and are not adjustable.
(2) The 1.8 weight percent minimum applies only during the winter and only in certain areas.
(3) If the gasoline contains more than 3.5 weight percent but nor more than 10 volume percent ethanol, the cap is 3.7 weight percent.

The CaRFG2 regulations have provided very significant reductions in ozone and particulate matter precursor emissions and toxic air pollutants. The emission benefits of the program have been equivalent to removing 3.5 million vehicles from California's roads. The CaRFG2 regulations are also a major component of California's plan for achieving both the federal and state ambient air quality standards.

The California Phase 3 Reformulated Gasoline (CaRFG3) regulations are expected to be fully implemented in 2004 and are intended to eliminate the use of MTBE in California while retaining the emission benefits of CaRFG2 gasoline.

2. Federal Requirements

California gasoline production is also governed by federal regulations. The United States Environmental Protection Agency (U.S. EPA) also has enacted federal RFG regulations. Nationally, about 30 percent of the gasoline produced must meet these requirements. These regulations impose emission performance standards in conjunction with specific requirements for oxygen content (year-round average of 2.0 percent by weight), and limits on benzene content. The federal requirements were implemented in two phases. The first phase began in 1995 and the second phase began in December 1999. In the September 15, 1999 Federal Register, the U.S. EPA made the finding that the emission reduction benefits of California gasoline are at least as great as those from federal Phase II RFG.

For California, the federal RFG regulations were first implemented in 1995 in the South Coast and San Diego and in 1996 in the Sacramento Metropolitan Region. The South Coast, San Diego, and Sacramento areas of the State account for about 70 percent of the gasoline sold in California. Further, the San Joaquin Valley was recently reclassified by U.S. EPA as a "severe" ozone nonattainment area and must comply with federal RFG requirements beginning in December of 2002. With the San Joaquin Valley included in the federal RFG program, approximately 80 percent of the gasoline sold in California must meet both the federal and the more stringent state gasoline requirements.

IV. ENVIRONMENTAL REQUIREMENTS FOR CaRFG2 PROJECTS

In this chapter, the air pollution control requirements that were applied to the CaRFG2 and related clean fuels refinery modifications are discussed. An assessment of the emissions associated with the projects needed to implement the CaRFG3 requirements are not included. These projects are not yet complete.

A. Overview

The refinery modifications for CaRFG2 were subject to requirements to assess both local and regional multimedia environmental impacts (i.e., water, air, waste, toxics, etc.). In regards to emission impacts, the primary environmental requirements were the CEQA reviews, local governmental land use requirements, and local district air permitting requirements. Those requirements of CEQA, relating to emission impacts, and air district permitting requirements are discussed in this chapter.

B. CEQA

CEQA requires state and local agencies to identify significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. Appendix B contains an overview of the CEQA process and a simplified CEQA process flowchart. The impetus for CEQA can be traced to the passage of the first federal environmental protection statute in 1969, the National Environmental Policy Act (NEPA). In response to this federal law, the California State Assembly created the Assembly Select Committee on Environmental Quality to study the possibility of supplementing NEPA through state law. Based on the recommendations of the select committee, the legislature passed, and Governor Reagan signed, the CEQA statute in 1970. Below is a discussion of the key elements of the CEQA process that directly effected the CaRFG2 refinery projects.

1. South Coast Air Quality Management District

The SCAQMD assumed lead agency responsibility for the CEQA review of the six refineries in the district that planned to comply with the CaRFG2 regulations. In the case of the refineries located in the South Coast, each refinery submitted a letter to their respective responsible local governmental agencies requesting that the SCAQMD serve as lead agency. Refineries based their requests on the rationale that the CaRFG2 refinery modifications were largely focused on emission related issues. The affected local government agencies in the South Coast included the cities of Los Angeles, Torrance, El Segundo, and Carson. Each of these local governments agreed with the refineries and sent letters to the SCAQMD asking the air district to assume the lead

agency responsibility for the CaRFG2 refinery projects. Examples of these letters are provided in Appendix E.

As lead agency, the SCAQMD prepared the Notice of Preparation (NOP) and the Initial Studies to determine the need and preparation of an EIR for each of the refineries in the district. After the completion of the NOP, the SCAQMD determined that each of the South Coast refineries would need to prepare EIRs.

2. Bay Area Air Quality Management District

The BAAQMD chose to serve as a cooperating or responsible agency rather than act as the lead agency for CEQA for the CaRFG2 refinery modifications in their jurisdiction. In its role as a responsible agency, the BAAQMD provided ongoing technical assistance to the city and county governments that served as the lead agencies for Bay Area CaRFG2 refinery projects. The City of Richmond served as lead agency for Chevron (Richmond), the City of Benicia served as lead agency for Exxon (now Valero), the City of Hercules served as lead agency for Pacific Refinery (which was later shutdown), and Contra Costa County served as lead agency for Shell, Tosco (now Tesoro), and Unocal (now Phillips). Letters on the BAAQMD's position to serve as a cooperating agency, and an example of a local Bay Area government agency agreeing to be the lead agency and requesting the BAAQMD to be a cooperating agency are provided in Appendix F.

3. San Joaquin Valley Unified Air Pollution Control District

The SJVUAPCD served as lead agency for the Texaco (now Shell) and Kern Oil Refining CaRFG2 refinery projects.

C. California's Air Permit Requirements

California's emission permit programs for new and modified stationary sources are referred to as New Source Review (NSR) programs. NSR programs, adopted by air districts, consist of regulations and requirements that govern the building and expansion of stationary sources. Stationary sources are industrial or commercial facilities which emit air contaminants. Typical stationary sources include oil refineries, power generation plants, automobile manufacturers, food processors, and auto body painters (California Health and Safety Code Sections 42300 et seq provide for district permitting program requirements). Mobile sources, such as trucks and automobiles, are not regulated under NSR programs.

The purpose of NSR is to provide the regulatory mechanism to allow continued industrial growth in nonattainment areas while minimizing the amount of emission increases from this growth. The California Clean Air Act (CCAA) mandates that the

purpose of NSR is to keep emission levels from the permitting of new and modified stationary sources at a constant level; in other words, to allow no increase in emissions.

1. NSR Requirements for Emission Control Equipment

Under the NSR program, districts evaluate the potential emission increases from new and modified stationary sources. Using California NSR, the CaRFG2 Clean fuels projects were subject to district review of their applications for modifications or additions to their facilities. If emission increases are above specified levels, the district requires the source to apply best available control technology (BACT) to control those emissions. While reviewing these applications, the districts determined the use of BACT for the new or modified equipment. Examples of CaRFG2 refinery modifications and their BACT requirements (determinations), at that time, are provided in Table IV-1. Appendices G and H provide detailed descriptions of the SCAQMD and BAAQMD BACT determinations, respectively.

Any remaining emissions after the utilization of BACT would need to be offset. The districts did not issue permits to begin construction until the CEQA process and mitigation requirements had been completed.

Table IV-1:
Examples of CaRFG2 "BACT Determinations"

Refinery Modification	Pollutant	BACT Control
Furnaces	NO_x	Low NO_x Burners with SCR and ammonia injection
Boilers	NO_x	Low NO_x Burners with SCR and ammonia injection
Heaters	NO_x	Low NO_x Burners with SCR and ammonia injection
Storage Tanks	VOC	Fixed roof tanks connected to a vapor recovery system.
Pumps	VOC	Seal-less pumps with dual seals with barrier fluids. Dry running seals vented to a closed system. Double mechanical seals with barrier fluid and vented to a vapor recovery system.
Valves	VOC	Bellows sealed valves for sizes 2" or smaller. Valves 3" or larger utilized API/ANSI design.
Flanges	VOC	Designed in accordance with ANSI B 16.5-1998 pipe fittings and flanged fittings.
Pressure Relief Valves	VOC	Vented to a closed system.

After BACT is applied, the project's remaining emission levels are then compared to another specified level called the offset threshold. Offsets are required to mitigate any emission increases remaining after BACT has been applied. These offset requirements

are usually at a ratio greater than one (e.g., a 100 pound per day emissions increase may have to be offset by 110 pounds of emission reductions).

The existing NSR program has been successful in the sense that emission increases have been minimized through the application of BACT. In addition, the program's offset requirements have been the driving force behind technological advances resulting in more effective emission control equipment and techniques in order to reduce emission increases to levels below the offset threshold.

2. Emission Offset Requirements

Offsets are emission reductions at the project location or at a nearby location used to compensate for the expected increase in emissions from the project. When a source reduces its emissions, beyond what is required under NSR, it can receive credit for those reductions, called emission reduction credits (or ERC's) which can be sold at a future date or used by the facility to offset future projects.

In most scenarios, stationary sources with new or modified projects that have remaining emissions after BACT is applied, generally consider the following options to provide offsets:

- Reduce emissions on-site at other units at the facility either by downsizing or shutting other existing process units at the facility.
- Reduce emissions off-site at the owner's nearby or distant units that are associated with the facility.
- Purchase ERC's from another facility that has emission reductions from previous downsizing or unit shutdowns.

The vast majority of CaRFG2 projects obtained the necessary offsets by downsizing, applying advanced control technology, or by achieving on-site emission reductions at their facilities.

D. Offset Exemptions

The SCAQMD and the SJVUAPCD chose to exempt certain new and modified CaRFG2 stationary source projects from their district offset requirements. The CaRFG2 and related clean fuels projects were provided with offset exemptions when the associated emission increases were the result of complying with federal, state, or local air quality mandates - in this case the state's mandated CaRFG2 regulations. The BAAQMD required emission offsets for CaRFG2 projects in their district.

1. Federal Clean Air Act Amendments of 1990 (Section 182(e)(2))

The Federal Clean Air Act Amendments (CAAA) of 1990 included section 182(e)(2), which provides state and local agencies in extreme ozone nonattainment areas the authority to exempt projects from offset requirements for emission increases resulting from compliance with federal, state, and local air quality mandates. Appendix I contains the complete text of CAAA section 182(e)(2) which states:

> "Offset requirements... shall not be applicable in extreme areas to a modification of an existing source if such modification consists of installation of equipment required to comply with the applicable implementation plan, permit, or this Act."

This section provided specific authority to the SCAQMD, a federal extreme ozone non-attainment area, to exempt CaRFG2 refinery modifications from their offset requirements.

2. California State Law

Subsequent to the approval of the federal CAAA, California law was amended to provide similar offset exemption provisions for compliance with air quality mandates. California Heath and Safety Code (HSC) section 42301.2 provides that:

> "A district shall not require emission offsets for any emission increase at a source that results from the installation, operation, or other implementation of any emission control device or technique used to comply with a district, state, or federal emission control requirement, including, but not limited to, requirements for the use of reasonably available control technology or best available retrofit control technology, unless there is a modification that results in an increase in capacity of the unit being controlled." (Added by Stats. 1996, Chapter 771, Section 5).

The full text of HSC section 42301.2 is provided in Appendix J. Under the California provisions, districts could exempt the CaRFG2 refinery modifications from offset requirements as long as there was no increase in the refinery capacity.

3. SCAQMD Rule 1304(e)(4)

Just prior to refineries submitting CaRFG2 project proposals, the SCAQMD approved Rule 1304(e)(4) which provided an offset exemption for projects which must comply with district, state, or federal air pollution control laws, rules, regulations or orders, as approved by the Executive Officer or his designee, and provided there was no increase

in maximum rating (in the case of refineries, no increases in refinery capacities). A copy of Rule 1304 is provided in Appendix L.

In 1992, California refiners were concerned about their ability to meet the CaRFG2 compliance date of March 1996. In particular, they were concerned about how long CEQA and permitting reviews and approvals would take. In the case of air permitting, refineries in southern California held preliminary discussions with the U.S. EPA and the SCAQMD on an exemption for offsets of emissions resulting directly from CaRFG2 refinery modifications. In initial discussions, U.S. EPA had raised concerns about the SCAQMD's offset exemption provision in Rule 1304(b)(4). Subsequent to these discussions, the SCAQMD issued a letter on October 9, 1992 which underscored the District's position of support for the offset exemption provided under Rule 1304(b)(4), as long as the modifications could be demonstrated to be necessary to comply with the CaRFG2 requirements and did not result in capacity increases. On December 14, 1992, U.S. EPA Region IX issued a letter indicating that after meetings with the SCAQMD, they agreed that the Rule 1304(b)(4) exemption could be used once the SCAQMD modified its Regulation XIII (New Source Review rule) to include an emission tracking system to account for and mitigate the CaRFG2 refinery modifications emissions increases. An emission tracking system is a facility accounting of emission increases and decreases. It allowed credit toward future emission reductions against the remaining CaRFG2 refinery modifications emission increases. Copies of the correspondence between U.S. EPA and the SCAQMD regarding emission offsets for the CaRFG2 projects are contained in Appendix K.

As a result, the SCAQMD approved offset exemptions (under Rule 1304(b)(4)) for unmitigated refinery project emissions that were necessary to directly comply with the CaRFG2 regulations. Some of the CaRFG2 projects also included other modifications (such as refinery expansions) which were not directly related to the CaRFG2 regulations or any other mandates. Emission increases that were related to refinery expansions were subject to the SCAQMD's offset requirements.

V. CaRFG2 REFINERY MODIFICATIONS

In this chapter, staff will discuss the various types of CaRFG2 refinery modifications that were performed during the CaRFG2 modifications.

A. General Types of CaRFG2 Refinery Modifications

To produce CaRFG2 and comply with federal RFG gasoline requirements, California refineries made a number of common refinery modifications.

In performing these modifications, California refineries invested approximately four billion dollars. To produce these fuels, these modifications necessarily increased the complexity and energy consumption of these refineries. A flow diagram of a typical California refinery and the "typical" refinery modifications necessary to produce CaRFG2 is provided in Figure V-1 (The shaded units represent those modifications to produce CaRFG2). Some of the more common refinery modifications designed to meet key CaRFG2 limits were to build or expand:

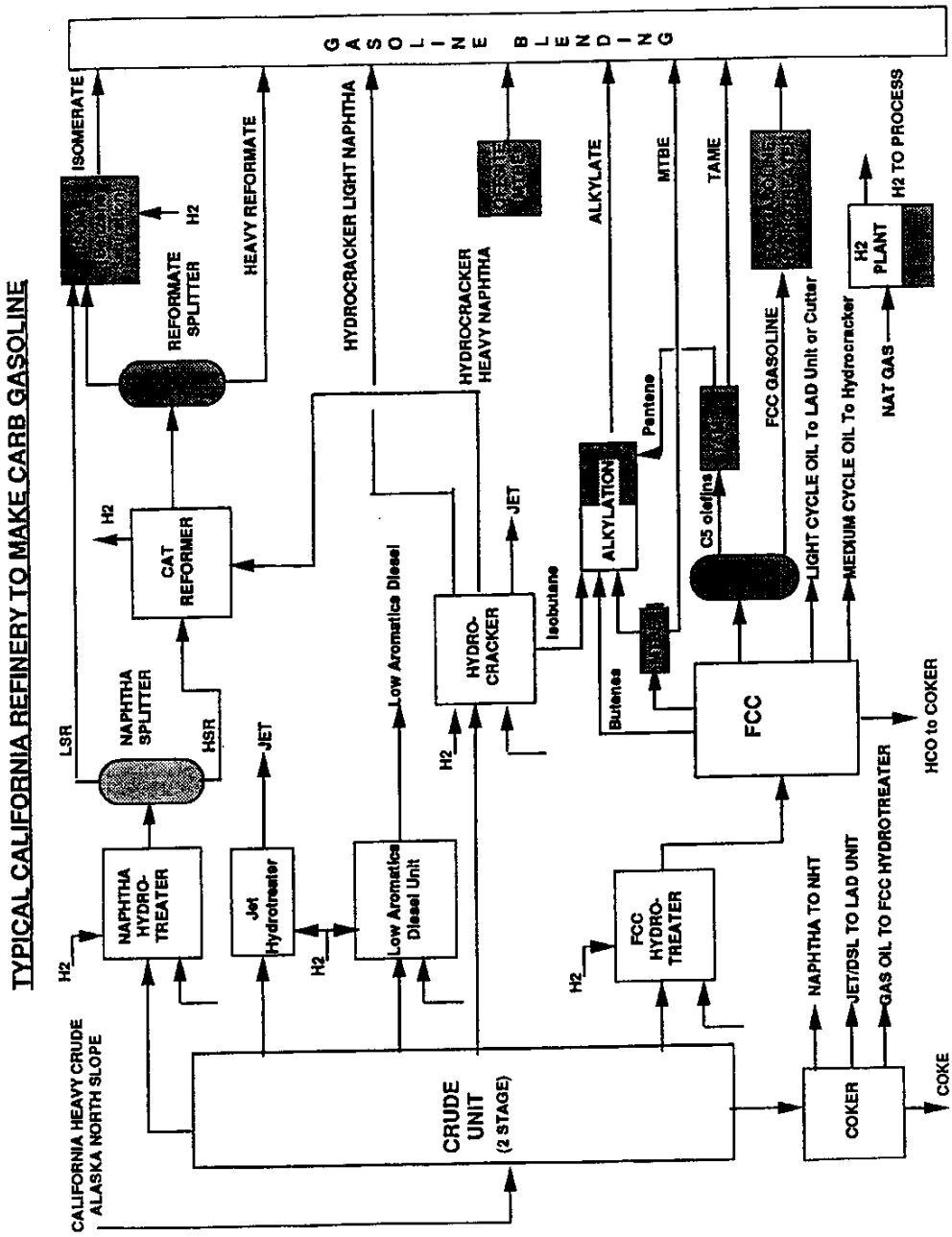
1) improved control of the distillation process to meet the RVP limits,
2) hydrotreaters to meet the sulfur and olefin limits,
3) increased capacity for hydrogen production, and
4) Fluid Catalytic Cracking (FCCU) and Hydrocracking units to provide more gasoline blendstock and produce additional feedstocks for alkylation and oxygenate plants.

Alkylation plants were built or expanded to increase gasoline supply by converting "light ends" (i.e., propane and butane) to alkylate which is a gasoline blendstock. Alkylate is a high octane, low vapor pressure gasoline blending component that essentially contains no olefins, aromatics, or sulfur.

Oxygenate plants to produce MTBE and tertiary amyl methyl ether (TAME), another oxygenate, were built to provide a blending additive that increases the oxygen content of gasoline to comply with both federal and California oxygenate requirements. Some refineries built these units to have on-site production of oxygenates rather than to import oxygenates or to use this on-site production to supplement their oxygenate imports and to comply with the federal oxygenate requirement.

With the large-scale refinery modifications came increased complexity and increased demands for energy (i.e. electricity and steam) in order for California refineries to produce CaRFG2. As a result, some refineries looked on-site or at nearby facilities for their increased energy needs. Some refineries proposed the use of on-site cogeneration facilities to produce additional energy.

FIGURE V-1


TYPICAL CALIFORNIA REFINERY TO MAKE CARB GASOLINE
GASOLINE BLENDING
ISOMERATE
H2
REFORMATE SPLITTER
HEAVY REFORMATE
HYDROCRACKER LIGHT NAPHTHA
HYDROCRACKER HEAVY NAPHTHA
ALKYLATE
MTBE
TAME
H2 PLANT
H2 TO PROCESS
Pentene
FCC GASOLINE
LIGHT CYCLE OIL To LAD Unit or Cutter
MEDIUM CYCLE OIL To Hydrocracker
NAT GAS
H2
CAT REFORMER
JET
ALKYLATION
C5 olefins
Isobutane
Low Aromatics Diesel
HYDRO-CRACKER
Butenes
FCC
HCO to COKER
LSR
NAPHTHA SPLITTER
HSR
JET
H2
NAPHTHA HYDRO-TREATER
Jet Hydrotreater
Low Aromatics Diesel Unit
FCC HYDRO-TREATER
NAPHTHA TO NHT
JET/DSL TO LAD UNIT
GAS OIL TO FCC HYDROTREATER
CRUDE UNIT (2 STAGE)
COKER
COKE
CALIFORNIA HEAVY CRUDE
ALASKA NORTH SLOPE

B. Specific CaRFG2 Refinery Modifications

Each refinery that decided to produce CaRFG2 initiated refinery modifications based on the unique needs of their particular refinery; no two refineries were identical in their CaRFG2 projects. The specific needs of each refinery were based on the types of equipment a particular refinery operated, the type of crude oil it processed, the capacities of the various refinery units, and the make-up of the refinery product slate. As a result, no two refineries needed the same types of modifications to produce CaRFG2.

However, there were a number of modifications that were "common" to many of the refineries which were modified to comply with the CaRFG2 regulations. The major new or modified units many refineries (identified by their names at that time) proposed to produce CaRFG2 are shown in Table V-1. A brief narrative of each of the major types of CaRFG2 refinery modifications is provided in Appendix M.

Appendices N and O, respectively, provide a summary and a detailed matrix of the SCAQMD refineries CaRFG2 and related clean fuels refinery modifications.

Appendices P and Q, respectively, provide a summary and a detailed matrix of the BAAQMD refineries CaRFG2 and related clean fuels refinery modifications.

Table V-1:
Overview of CaRFG2 Refinery Modifications

Refinery	FCCU	Reformer	Hydro-cracker	Hydro-treater	Alkyl-ation	Isomer-ization (C4-C6)	Butamer	Hydro-gen	MTBE or TAME	Storage Tanks	Cogen-eration
South Coast Air Quality Management District											
ARCO	X	X	X		X	X		X		X	
Chevron		X		X	X	X		X	X		X
Mobil	X		X		X			X		X	
Texaco	X	X	X		X	X		X	X	X	
Ultramar	X	X			X	X	X	X	X	X	X
Unocal			X		X		X	X		X	X
Bay Area Air Quality Management District											
Chevron	X				X		X		X	X	
Exxon		X	X		X	X		X	X	X	
Shell		X		X	X	X		X		X	X
Tosco			X		X	X		X	X	X	
Unocal						X		X		X	
San Joaquin Valley Unified Air Pollution Control District											
Texaco			X	X				X	X		
Kern Oil		X								X	

VI. DATA COLLECTION AND ANALYSIS

This chapter provides the methodology staff used in collecting and analyzing the data available for staff's assessment of the local and regional emission impacts from both stationary and indirect sources associated with the CaRFG2 and related clean fuels refinery modifications.

A. Data Collection

Staff's assessment of the local and regional emission impacts of the CaRFG2 and related clean fuels projects was designed to determine the change in local permitted stationary and indirect source emissions associated with these projects, and the types of mitigation, if any, that occurred in conjunction with these projects. Staff's assessment is based on environmental and permitting information from this period, and includes:

- CEQA information;
- Air permit information;
- Authority-to-construct documents;
- Land use permits, and;
- Conversations with air district staff and refinery personnel.

The process to develop this assessment began with ARB staff gathering existing information on CaRFG2 and related clean fuels refinery projects in the Spring of 2001. This information included:

SCAQMD ARB staff worked with district staff to obtain the available letters of notification of "intent to issue authority-to-construct permits" under SCAQMD Rule 212, authority-to-construct permits, and permit-to-operate information related to the CaRFG2 and clean fuels refinery modifications. In addition, SCAQMD district staff provided ARB staff with copies of all the CaRFG2 refinery CEQA documents ARB staff did not already possess.

BAAQMD ARB staff obtained CEQA information from the local governments who served as lead agencies (i.e., City of Richmond, City of Benicia, and Contra Costa County) and authority-to-construct permit information from the BAAQMD regarding the CaRFG2 and clean fuels refinery modifications.

SJVUAPCD ARB staff obtained copies of both the CEQA and authority-to-construct permit information issued for the CaRFG2 refinery modifications at Shell (formerly Equilon and Texaco-Bakersfield) and Kern Oil Refining of Bakersfield.

ARB staff worked very closely with district and local government staff (for CEQA information in the Bay Area) to collect all of this information. District and local government staff also helped compile and evaluate the information collected and provided critical review of staff's findings. District and local government staffs' were also very helpful in providing follow up information and answering any questions. Staff of the ARB sincerely appreciate the resources and efforts provided by the air districts and local governments in the development of this document.

B. Data Analysis

Upon completion of staff's data collection efforts, staff began evaluating the impacts of the CaRFG2 refinery projects by analyzing the DEIRs and FEIRs issued in conjunction with these projects. These documents provided an overview of the CaRFG2 projects planned by each refinery. The EIRs contained baseline emission inventories for the refineries (typically in the 1990-1994 timeframe), proposed refinery modifications, and estimates for stationary, transportation, and other activity emissions. In addition, these documents identified proposed control measures and any mitigation measures that may have been required. Based on the CEQA documentation, ARB staff was able to establish preliminary emission impacts from the CaRFG2 refinery modifications.

ARB staff also reviewed available air district permitting information on the CaRFG2 and related clean fuels projects. This information included authority-to-construct permits and in some cases, operating permits. In addition, staff also evaluated any other available documents to develop emission estimates for permitted stationary sources and indirect sources associated with CaRFG2 and related clean fuels refinery modifications.

Generally, the CaRFG2 and clean fuels projects initially proposed in the DEIRs were larger in scale than the modifications that were actually constructed and operated. In most cases, refinery planning staff developed their initial projects based on conservative estimates of refinery needs to ensure the refinery would be able to comply with the CaRFG2 requirements. However, through the development process, refiners were able to continually optimize their proposed modifications to better meet the needs of their particular refinery. As a result, as the projects approached the permitting and construction phases, they were typically downsized in scale from what had been originally proposed.

Upon completion of staff's initial analysis, staff requested the local air districts and the individual refiners review these emissions estimates. Based on air district and industry

comments, final permitted emission estimates were developed for the CaRFG2 and related clean fuels refinery modifications.

It is important to recognize that the emission impacts identified in staff's analysis are "permitted emissions" and represent potential to emit levels. Permitted emissions are generally higher than the "actual emissions levels" typically reported in refinery and air district emission inventories. Also, the change in permitted emissions does not reflect any emission reductions obtained since these projects were completed, from either refinery projects or increased stringency of air district rules. Staff's evaluation is limited to identifying what emissions were allowed under CEQA and air district permitting requirements.

VII. CaRFG2 LOCAL AND REGIONAL EMISSION IMPACTS IN THE SCAQMD

In this chapter, staff provides an assessment of the overall changes in emissions from CaRFG2 producing refineries since 1990, including the localized emission impacts associated with implementing the CaRFG2 regulations. Staff also provides an estimate of the regional emission benefits of the CaRFG2 program in the SCAQMD, including the impacts of indirect source emissions to produce CaRFG2.

A. Change in Emissions From CaRFG2 Producing Refineries

Emissions from CaRFG2 producing refineries have generally decreased as a result of new air pollution control regulations at refineries, as well as replacement of older, dirtier equipment with newer, less polluting equipment. The decrease in emissions since 1990 has occurred despite the fact that the CaRFG2 modifications resulted in small increases in permitted emissions from these refineries.

Table VII-1 shows the emission reductions from the CaRFG2 producing refineries in the SCAQMD over the period 1990 through 1999 and the associated changes in permitted emissions from the CaRFG2 refinery modifications. It is important to note that the impact from the stationary source's new and modified equipment already reflects emission reductions associated with the application of BACT. Normally under NSR, the remaining emissions would need to be offset by other mitigating factors. However, the SCAQMD allowed these emissions increases without requiring offsets based on application of SCAQMD Rule 1304(b)(4). Under SCAQMD Rule 1304(b)(4), any resulting net emissions, after the application of BACT, due to refinery additions and modifications that were required in order to comply with federal, state, and local mandate were exempt from requiring offsets. As can be seen in Table VII-1, the small emission increases in permitted emissions did not significantly impact the emission decreases from CaRFG2 producing refineries. Overall, if these CaRFG2 refinery modifications in the SCAQMD had not occurred, even greater emission reductions from refineries may have been achieved

Table VII-1:
Change in Emissions from CaRFG2 Producing Refineries in SCAQMD (1990-1999)

Emission Impacts	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
Change in 1990-1999 Inventory	-19.2	-11.8	3.0	5.8	-2.6
CaRFG2 Stationary Source Impacts	0.9	0.5	0.4	0.5	0.3

As shown in Table VII-1, the changes in CaRFG2 producing refinery emissions in the 1990's showed a significant decline of about 19 tons per day of ROG and 12 tons per day of NOx, both ozone forming pollutants. PM10 emissions were reduced by slightly over 2 tons per day. However, according to the ARB Emissions Inventory, there were increases in SOx and CO emissions for CaRFG2 producing refineries. However, the SCAQMD is attainment for SOx and only marginally non-attainment for CO.

This trend towards lower emissions for these refineries has occurred during a time of overall growth in gasoline production and significant increases in statewide gasoline consumption. These reductions are a result of increased stringency of local air district rules and regulations applicable at refineries, as well as from the replacement of older equipment with newer, cleaner units.

1. Changes in Emission Inventory

Staff compiled emission inventory data for CaRFG2 producing refineries for the years 1990 and 1999 to evaluate the changes in refinery emissions over this period. As can be seen in Table VII-2, there were substantial changes in emissions from refineries that are currently producing CaRFG2.

Table VII-2:
CaRFG2 Refinery Emissions in SCAQMD (1990-1999)

Year	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
1990	28.8	33.3	11.3	14.8	6.0
1999	9.6	21.5	14.3	20.6	3.4
Change	**-19.2**	**-11.8**	**3.0**	**5.8**	**-2.6**

2. Changes in Stationary Source Emissions

ARB staff developed an estimate of the localized stationary source emission changes associated with the CaRFG2 refinery modifications based on both the CEQA and air permit emissions estimates, as well as through additional information provided by individual refiners. Staff's estimate also factored into consideration the application of BACT and any mitigation that occurred in conjunction with these projects.

Based on this information, ARB staff estimates that there was a small increase in permitted emissions from stationary sources in the SCAQMD associated with CaRFG2 and related clean fuels projects. These permitted emissions impacts are presented in Table VII-3.

Table VII-3:
Stationary Source Permitted Emissions
Associated with CaRFG2 Refinery Modifications in SCAQMD

Refinery	Former Name	Location	ROG (lbs/day)	NOx (lbs/day)	CO (lbs/day)	SOx (lbs/day)	PM (lbs/day)
BP	ARCO	Carson	326	156	188	16	211
Chevron	N/A	El Segundo	231	310	160	141	174
Shell	Equilon/ Texaco	Wilmington	31	0	0	0	0
ExxonMobil	Mobil	Torrance	297	90	242	41	64
ConocoPhillips	Tosco/ Unocal	Wilmington and Carson	478	187	84	276	13
Valero	Ultramar	Wilmington	410	171	207	587	123
Stationary Source Emissions Impacts			**1,773**	**914**	**881**	**1,061**	**585**
Convert to Tons Per Day (TPD)			**0.9**	**0.5**	**0.4**	**0.5**	**0.3**

Note: SCAQMD District Rule 1304(b)(4) exempted refinery modifications, directly related to complying with the state's mandate for CaRFG2, from offset requirements.

For the South Coast CaRFG2 refinery modifications and related clean fuels projects, permitted emissions increased primarily because the SCAQMD provided an offset exemption under Rule 1304 (see Appendix K). The SCAQMD's offset exemption was limited to modifications necessary to comply with either the federal or state gasoline requirements (i.e., Federal RFG Phase I and CaRFG2), and were not allowed for increases in capacity or those modifications that were not related to the federal or state mandates.

It is important to note that the emission increases shown in Table VII-3 are changes in permitted emissions, and do not necessarily reflect changes in actual emissions. While these projects resulted in local emission increases, even those projects that were exempt from emission offset requirements still had to meet the district's stringent BACT requirements.

B. Regional Emission Impacts

The use of CaRFG2 has provided very significant regional emission reductions in ozone and particulate matter precursor emissions and toxic air pollutants. The SCAQMD emission benefits from CaRFG2 are shown in Table VII-4. However, the production of CaRFG2 has necessitated changes in the movement of materials and components to produce CaRFG2 at California refineries. Changes in emissions from these sources, known as indirect sources, include changes in marine, rail, truck, and employee traffic. As shown in Table VII-4, there was an increase in emissions in the SCAQMD for nearly all pollutants. However, these impacts are very small in comparison to the regional CaRFG2 benefits.

Table VII-4:
Local and Regional Emission Impacts
Associated with CaRFG2 Refinery Modifications in SCAQMD

Emission Impacts	ROG (TPD)	NOx (TPD)	CO (TPD)	SOx (TPD)	PM_{10} (TPD)
CaRFG2 Regional Emission Benefits	-42	-25	-439	-10	*
Indirect Source Emissions from Implementing CaRFG2	0.3	0.9	0.3	0.1	0.1

* No data available
** It was estimated that the significant CaRFG2 reductions in NOx and SOx would significantly reduce the formation of PM_{10}.

1. Indirect Source Emissions

Based upon staff's assessment of the applicable CEQA documentation, staff has determined there were localized emission increases associated with indirect sources.

These localized emission increases were due to a number of factors, including increases in marine and truck traffic as well as increased employee trip emissions. Also, the indirect source emission impacts of the CaRFG2 projects were not just from refineries in the SCAQMD. As is discussed later in Chapter IX, the majority of the indirect source emission increases from refineries in the SJVUAPCD were anticipated to occur within the SCAQMD. Staff has included these emission increases in their evaluation of the SCAQMD indirect source emission impacts. The local estimated indirect emission impacts of the SCAQMD and SJVUAPCD are shown in Table VII-5.

The majority of emission increases identified in Table VII-5 occurred in the Long Beach and Los Angeles Harbor area of the SCAQMD, with marine tanker emissions accounting for most of the indirect source emission increases. These emission increases are attributable to increased imports of MTBE as well as other gasoline blending components such as alkylate. The most significant emission impact from indirect sources is from NO_x (about 1 ton per day). Smaller increases, approximately half a ton per day of ROG, CO, and lesser for SO_x and PM emissions were observed. Significant proportions of the indirect emissions for nitrogen oxides (94%) were due to two main sources, marine traffic and electrical generation. Due to marine traffic being intermittent in nature, the impacts from indirect source emissions were all calculated using an annual daily average in Table VII-5.

Table VII-5:
Regional Emission Impacts from Indirect Source Emissions SCAQMD
(Annual Daily Average)

Refinery	Former Name	Location	ROG (lbs/day)	NOx (lbs/day)	SOx (lbs/day)	CO (lbs/day)	PM (lbs/day)
BP	ARCO	Carson	43	106	339	169	46
Chevron	N/A	El Segundo	-2	-13	-127	-85	-27
Shell	Equilon/ Texaco	Wilmington	24	837	113	174	36
ExxonMobil	Mobil	Torrance	7	119	13	49	7
ConocoPhillips	Tosco/ Unocal	Wilmington and Carson	478	197	84	-276	13
Valero	Ultramar	Wilmington	10	216	53	56	10
Total Indirect Source Emissions (for SCAQMD refineries only)			**560**	**1,462**	**475**	**87**	**85**
Indirect Source Emissions from SJVUAPCD Refineries			17	137	112	44	10
Total Indirect Source Emissions			**577**	**1,599**	**587**	**131**	**95**
Convert to Tons Per Day (TPD)			**0.3**	**0.9**	**0.3**	**0.07**	**0.05**

2. Local and Regional Emission Benefits of Using CaRFG2

Based upon available CEQA documentation, staff has determined that the local emission benefits of CaRFG2 may have substantially mitigated some of the stationary source emission increases associated with the CaRFG2 and related clean fuels refinery modifications. These estimated local emission benefits are shown in Table VII-6, and are the benefits of using CaRFG2 in and around the refineries in the SCAQMD. CaRFG2 also provided very significant regional emission benefits, as shown in Table VII-7. In many cases, these regional emission benefits served as the rationale for the approval of a "statement of overriding considerations" for some of the CaRFG2 refinery modifications and their associated emission increases.

Table VII-6:
CaRFG2 Local Emission Benefits in SCAQMD

ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
-0.5	-0.5	No Data	-0.3	N/A

Source: ARCO DEIR - February 1993 - (Tables 1.1-5 and 4.3-11).

Table VII-7:
CaRFG2 Regional Emission Benefits in SCAQMD

ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
-42	-25	-439	-10	*

Source: ARB, Emissions Benefits Analysis – Phase 2 RFG – January 13, 1993

* No data available. ARB analysis assumed NOx and SOx emissions reductions would provide PM10 emission reductions as well.

VIII. CaRFG2 LOCAL AND REGIONAL EMISSION IMPACTS IN THE BAAQMD

In this chapter, staff provides an assessment of the overall changes in emissions from CaRFG2 producing refineries since 1990, including the localized emission impacts associated with implementing the CaRFG2 regulations. Staff also provides an estimate of the regional emission benefits of the CaRFG2 program in the BAAQMD, including the impacts of indirect source emissions to produce CaRFG2.

A. Change in Emissions for CaRFG2 Producing Refineries

Emissions from CaRFG2 producing refineries have generally decreased as a result of new air pollution control regulations at refineries, as well as replacement of older, dirtier equipment with newer, less polluting equipment. The decrease in emissions since 1990 has occurred despite the fact that the CaRFG2 modifications resulted in small increases in permitted emissions from these refineries.

Table VIII-1 shows the emission reductions from the CaRFG2 producing refineries in the BAAQMD over the period 1990 through 1999 and the associated changes in permitted emissions of the CaRFG2 refinery modifications. As can be seen in Table VIII-1, the increases in permitted emissions did not significantly impact the emission decreases from CaRFG2 producing refineries. The CaRFG2 refinery modifications in the BAAQMD resulted in emission reductions from refineries, except for CO.

Table VIII-1:
Change in Emissions from CaRFG2 Producing Refineries in BAAQMD (1990-1999)

Emission Impacts	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
Change in 1990-1999 Inventory	-5.7	-9.8	-3.1	-8.3	-0.4
CaRFG2 Stationary Source Impacts	-0.3	-0.1	1.6	-0.1	0

As shown in Table VIII-1, the changes in CaRFG2 producing refinery emissions in the 1990's showed a significant decline of about 6 tons per day of ROG and 10 tons per day of NOx, both ozone forming pollutants. Also, SOX emissions declined about 8 tons per day. Carbon monoxide and PM10 emissions were reduced by slightly less than 3 tons and 0.5 ton per day, respectively. However, the decline in refinery emissions was reduced over the 1990's by CO emission increases that occurred from the CaRFG2 refinery modifications.

This trend towards lower emissions for these refineries has occurred during a time of overall growth in gasoline production and significant increases in statewide gasoline consumption. These reductions are a result of increased stringency of local air district rules and regulations applicable at refineries, as well as from the replacement of older equipment with newer, cleaner units.

1. Changes in Emissions Inventory

Staff compiled emission inventory data for CaRFG2 producing refineries for the years 1990 and 1999 to evaluate the changes in refinery emissions over this period. As can be seen in Table VIII-2, there were substantial reductions in emissions from refineries that are currently producing CaRFG2 in the Bay Area.

Table VIII-2:
CaRFG2 Refinery Emissions in BAAQMD (1990-1999)

Year	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
1990	24.5	45.2	9.6	47.3	2.9
1999	18.8	35.4	6.5	39.0	2.5
Change	**-5.7**	**-9.8**	**-3.1**	**-8.3**	**-0.4**

2. Changes in Stationary Source Emissions

ARB staff developed an estimate of the localized stationary source emission changes associated with the CaRFG2 refinery modifications based, on both the CEQA and air permit emissions estimates as well as through additional information by individual refiners. Staff's estimate also factored into consideration the application of BACT and any other mitigation that occurred in conjunction with those projects. Based on this information, ARB staff estimates that there was no localized emission increases for ROG, NOx, and SOx in permitted emissions from stationary sources in the BAAQMD associated with CaRFG2 and related clean fuels projects. CO emissions may have been the exception, as the BAAQMD's NSR rule allowed stationary sources to "model out" of offset requirements for CO if the increases will not result in a violation of the applicable federal or state ambient air quality standard for CO. Changes in stationary source emissions of PM were nearly neutral. These estimated changes in permitted emissions are presented in Table VIII-3.

Table VIII-3:
Stationary Source Permitted Emissions
Associated with CaRFG2 Refinery Modifications in BAAQMD

Refinery	Former Name	Location	ROG (lbs/day)	NO$_x$ (lbs/day)	CO (lbs/day)	SO$_x$ (lbs/day)	PM$_{10}$ (lbs/day)
Chevron	N/A	Richmond	-95	0	0	0	0
Shell	Equilon	Martinez	-328	-155	1,687	-107	3
ConocoPhillips	Tosco/ Unocal	Rodeo	-37	-12	60	0	42
Tesoro	Ultramar	Avon	-83	-55	971	0	0
Valero	Exxon	Benicia	-22	-18	377	0	0
Stationary Source Emissions Impacts			**-565**	**-240**	**3,095**	**-107**	**45**
Convert to Tons Per Day (TPD)			**-0.3**	**-0.1**	**1.6**	**-.05**	**.02**

B. Regional Emission Impacts

The use of CaRFG2 has provided very significant regional emission reductions in ozone and particulate matter precursor emissions and toxic air pollutants. The BAAQMD emission benefits from CaRFG2 are shown in Table VIII-4. However, the production of CaRFG2 has necessitated changes in the movement of materials and components to produce CaRFG2 at California refineries. Changes in emissions from these sources, known as indirect sources, include changes in marine, rail, truck, and employee traffic. As shown in Table VIII-4, there was an increase in emissions in the BAAQMD for nearly all pollutants. However, these impacts are very small in comparison to the regional CaRFG2 benefits.

Table VIII-4:
Local and Regional Emission Impacts
Associated with CaRFG2 Refinery Modifications in BAAQMD

Emission Impacts	ROG (TPD)	NO$_x$ (TPD)	CO (TPD)	SO$_x$ (TPD)	PM$_{10}$ (TPD)
CaRFG2 Regional Emission Benefits	-26	-11	-208	-5	*
Indirect Source Emissions from Implementing CaRFG2	0	0.4	-0.2	0.7	0.1

* No data available

** It was estimated that the significant CaRFG2 reductions in NOx and SOx would significantly reduce the formation of PM$_{10}$.

1. Indirect Source Emissions

Based upon staff's assessment of the applicable CEQA documentation, staff has determined there were small, localized emission increases associated with indirect sources in the Bay Area.

These localized emission increases were due to a number of factors, including increases in marine and truck traffic as well as increased employee trip emissions. The local estimated indirect source emission impacts in the BAAQMD are shown below in Table VIII-5. The majority of the emission increases identified in Table VIII-5 occurred in the harbor areas of the Bay Area refineries (Richmond, Rodeo, Martinez, and Benicia). Marine tanker emissions accounted for most of the indirect source emission increases, though rail traffic had some impacts as well. These emission increases are attributable to increased imports of MTBE as well as other gasoline blending components such as alkylate. The most significant emission impacts are for NO_x (about 0.4 tons per day) and SOx (about 0.7 tons per day). Negligible increases of ROG and PM emissions were observed. Due to intermittent nature of these marine loading events, an annual daily average was calculated.

Table VIII-5:
Regional Emission Impacts from Indirect Source Emissions BAAQMD
(Annual Daily Average)

Refinery	Former Name	Location	ROG (lbs/day)	NOx (lbs/day)	CO (lbs/day)	SOx (lbs/day)	PM (lbs/day)
Chevron	N/A	Richmond	-100	-130	-600	-164	-50
Shell	Equilon	Martinez	50	178	109	26	22
ConocoPhillips	Tosco / Unocal	Rodeo	8	43	6	72	6
Tesoro	Ultramar	Avon	54	**665**	101	**1,406**	106
Valero	Exxon	Benicia	2	4	33	1	7
Total Indirect Source Emissions			**14**	**760**	**-351**	**1,341**	**91**
Convert to Tons Per Day (TPD)			**0**	**0.4**	**-0.2**	**0.7**	**0.05**

2. Local and Regional Emission Benefits of Using CaRFG2

Based upon available CEQA documentation, staff has determined that the local emission benefits of CaRFG2 may have substantially mitigated most of the CO stationary source emission increases associated with the CaRFG2 and related clean fuels refinery modifications. These estimated local emission benefits are shown in Table VIII-6 and are the benefits of using CaRFG2 in and around the refineries in the BAAQMD. CaRFG2 also provided very significant regional emission benefits, as shown in Table VIII-7. In many cases, these regional emission benefits served as the rationale for the approval of a "statement of overriding considerations" for some of the CaRFG2 refinery modifications and their associated emission increases.

Table VIII-6:
CaRFG2 Local Emission Benefits in Contra Costa County and City of Benicia

ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
-3	-2	-29	-1	-1

Table VIII-7:
CaRFG2 Regional Emission Benefits in BAAQMD

ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
-26	-11	-208	-5	*

Source: CARB, Emissions Benefits Analysis – Phase 2 RFG – January 13, 1993.
* No data available. ARB analysis assumed NOx and SOx emissions reductions would provide PM10 emission reductions as well.

IX. CaRFG2 LOCAL AND REGIONAL EMISSION IMPACTS IN THE SJVUAPCD

In this chapter, staff provides an assessment of the overall changes in emissions from CaRFG2 producing refineries since 1990, including the localized emission impacts associated with implementing the CaRFG2 regulations. Staff also provides an estimate of the regional emission benefits of the CaRFG2 program in the SJVUAPCD, including the impacts of indirect source emissions to produce CaRFG2.

A. Change in Emissions for CaRFG2 Producing Refineries

Emissions from CaRFG2 producing refineries have generally decreased as a result of new air pollution control regulations at refineries, as well as replacement of older, dirtier equipment with newer, less polluting equipment. The decrease in emissions since 1990 has occurred despite the fact that the CaRFG2 modifications resulted in small increases in permitted emissions from these refineries.

Table IX-1 shows the emission reductions from the CaRFG2 producing refineries in the SJVUAPCD over the period 1990 through 1999 and the associated changes in permitted emissions from the CaRFG2 refinery modifications. As can be seen, the small increases in permitted emissions did not significantly impact the emission decreases from CaRFG2 producing refineries.

Table IX-1:
Change in Emissions from CaRFG2 Producing Refineries in SJVUAPCD (1990-1999)

Emission Impacts	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
Change in 1990-1999 Inventory	-1	-4	0	-1	1
CaRFG2 Stationary Source Impacts	0.1	0.1	0.1	0.1	0

As shown in Table IX-1, the changes in CaRFG2 producing refinery emissions in the 1990's showed a decline of about 1 ton per day of ROG and 4 tons per day of NOx, both ozone forming pollutants. Also, SOx emissions declined about 1 ton per day while PM10 emissions increased by about 1 ton per day. There was relatively no change in CO emissions over this period.

This trend towards lower emissions for these refineries has occurred during a time of overall growth in gasoline production and significant increases in statewide gasoline

consumption. These reductions are a result of increased stringency of local air district rules and regulations applicable at refineries, as well as from the replacement of older equipment with newer, cleaner units.

1. Changes in Emissions Inventory

Staff compiled emission inventory data for CaRFG2 producing refineries for the years 1990 and 1999 to evaluate the changes in refinery emissions over this period. As can be seen in Table IX-2, there were substantial changes in emissions from refineries that are currently producing CaRFG2.

Table IX-2:
CaRFG2 Refinery Emissions in SJVUAPCD (1990-1999)

CaRFG2 Refineries	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
1990	1.8	5.5	0.8	2.2	0.1
1999	0.9	1.3	0.6	1.2	1.2
Change	**-0.9**	**-4.2**	**-0.2**	**-1.0**	**1.3**

2. Changes in Stationary Source Emissions

ARB staff developed an estimate of the localized stationary source emission changes associated with the CaRFG2 refinery modifications based on both the CEQA and air permit emissions estimates as well as through additional information provided by the SJVUAPCD. Staff's estimate also factored into consideration the application of BACT and any other mitigation that occurred in conjunction with those projects.

Based on this information, ARB staff estimates that there was a very small localized emission increase in permitted emissions from stationary sources in the SJVUAPVD associated with CaRFG2 and related clean fuels projects. These permitted emissions estimates are presented in Table IX-3. The permitted emission increases in the SJVUAPCD were small and below the air district's CEQA and offset thresholds. Therefore, these emissions were not subject to the district's offset requirements.

Table IX-3:
Stationary Source Permitted Emissions
Associated with CaRFG2 Refinery Modifications in SJVUAPCD

Refinery	Former Name	Location	ROG (lb/day)	NO_x (lb/day)	CO (lb/day)	SO_x (lb/day)	PM_{10} (lb/day)
Shell	Equilon/ Texaco	Kern Co.	260	228	215	104	18
Kern Oil	N/A	Kern Co.	7	19	6	0	0
Stationary Source Emissions Impacts			**267**	**247**	**221**	**104**	**18**
Convert to Tons Per Day (TPD)			**0.1**	**0.1**	**0.1**	**0.05**	**0**

B. Regional Emission Impacts

The use of CaRFG2 has provided very significant regional emission reductions in ozone and particulate matter precursor emissions and toxic air pollutants. The SJVUAPCD emission benefits from CaRFG2 are shown in Table IX-4. However, the production of CaRFG2 has necessitated changes in the movement of materials and components to produce CaRFG2 at California refineries. Changes in emissions from these sources, known as indirect sources, include changes in marine, rail, truck, and employee traffic. As shown in Table IX-4, there were minimal or insignificant increases in emissions in the SJVUAPCD for all pollutants.

Table IX-4:
Local and Regional Emission Impacts
Associated with CaRFG2 Refinery Modifications in SJVUAPCD

Emission Impacts	ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
CaRFG2 Regional Emission Benefits	-9	-6	-105	-3	*
Indirect Source Emissions from Implementing CaRFG2	0	0	0	0	0

* No data available
** It was estimated that the significant CaRFG2 reductions in NO_x and SO_x would significantly reduce the formation of PM_{10}.

1. Indirect Source Emissions

Based on staff's assessment of the applicable CEQA documentation, there was essentially no change in indirect source emissions associated with the implementation of the CaRFG2 regulations in the SJVUAPCD, as presented in Table IX-5. Although the CEQA documentation for the Shell (formerly Texaco & Equilon) refinery estimated indirect source emission impacts associated with importing alkylate and MTBE, the EIR

documentation assumed 65 percent of those indirect source emissions would occur within the SCAQMD (primarily Long Beach Harbor) from marine tanker, diesel truck, and rail traffic to transport gasoline blending components to Bakersfield. As previously discussed, these impacts were included in Chapter VII regarding the indirect emissions in the SCAQMD.

Table IX-5:
Regional Emission Impacts from Indirect Source Emissions SJVUAPCD
(Annual Daily Average)

SOURCE	ROG (lbs/day)	NO_x (lbs/day)	CO (lbs/day)	SO_x (lbs/day)	PM (lbs/day)
Marine Avg. Daily Emissions (Avg. Annual Emissions)*	8.8	72.21	4.928	40.456	5.00
Locomotive Emissions in the SJVUAPCD**	2.15	6.67	49.04	3.72	1.07
Diesel Trucks***	12.37	99.13	164.43	5.4	8.14
Electrical (1 MW-HR of energy)	0.01	1.51	0.2	0.12	0.04
TOTAL	**23.33**	**179.52**	**218.60**	**49.70**	**14.25**
Indirect Emissions that Occurred in SCAQMD	15.16	116.69	142.09	32.30	9.26
Net Indirect Emissions in SJVUAPCD	**8.2**	**62.8**	**76.5**	**17.4**	**5.0**
Convert to Tons Per Day (TPD)	**0**	**0.03**	**0.04**	**0**	**0**

Source: Texaco (Bakersfield) Refinery Reformulated Fuels Project Draft EIR, Volume I – January 1995, prepared by Environmental Audit. SCH No. 93082088.

As previously mentioned in Chapter VII, a significant source of the indirect emissions can be attributed to an increase in truck traffic into Bakersfield transporting the marine tanker imports.

2. Local and Regional Emission Benefits of Using CaRFG2

Staff was unable to locate the necessary information to be able to quantify the local CaRFG2 emission benefits around the SJVUAPCD refineries. However, consistent with the SCAQMD and BAAQMD, staff believes that the use of CaRFG2 provided significant emission benefits to the local area. This conclusion is based on the significant regional emission benefits that CaRFG2 provided in the SJVUAPCD, as shown in Table IX-6.

Table IX-6:
CaRFG2 Regional Emission Benefits in SJVUAPCD

ROG (TPD)	NO_x (TPD)	CO (TPD)	SO_x (TPD)	PM_{10} (TPD)
-9	-6	-105	-3	*

* No data available.

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