REVISIONS TO THE STATE IMPLEMENTATION PLAN (SIP) FOR THE CONTROL OF OZONE AIR POLLUTION

POST-1999 RATE-OF-PROGRESS AND ATTAINMENT DEMONSTRATION SIP FOR THE HOUSTON/GALVESTON OZONE NONATTAINMENT AREA

INSPECTION/MAINTENANCE SIP FOR THE HOUSTON/GALVESTON OZONE NONATTAINMENT AREA

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
P.O. BOX 13087
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DECEMBER 6, 2000

RULE LOG NO. 2000-011-SIP-AI

SECTION V: LEGAL AUTHORITY

A. General

The commission has the legal authority to implement, maintain and enforce the national ambient air quality standards.

The first air pollution control act, known as the Clean Air Act of Texas, was passed by the Texas Legislature in 1965. In 1967, the Clean Air Act of Texas was superceded by a more comprehensive statute, the Texas Clean Air Act (TCAA), found in Article 4477-5, Vernon's Texas Civil Statutes). The Legislature amended the TCAA in 1969, 1971, 1973, 1979, 1985, 1987, 1989, 1991, 1993, 1995, 1997 and 1999. In 1989, the TCAA was codified as Chapter 382 of the Texas Health & Safety Code.

Originally, the TCAA stated that the Texas Air Control Board (TACB) is the state air pollution control agency and is principal authority in the state on matters relating to the quality of air resources. In 1991, the Legislature abolished the TACB effective September 1, 1993 and its powers, duties, responsibilities and functions were transferred to the TNRCC. With the creation of the TNRCC, the authority over air quality is found in both parts of the Texas Water Code and the TCAA. Specifically, the authority of the TNRCC is found in Chapters 5 and 7. Chapter 5, Subchapters A - F, and H - J and L, include the general provisions, organization and general powers and duties of the TNRCC, and the responsibilities and authority of the Executive Director. This Chapter also authorizes the TNRCC to implement action when emergency conditions arise, and to conduct hearings. Chapter 7 gives the TNRCC enforcement authority.

The TCAA specifically authorizes the TNRCC to establish the level of quality to be maintained in the state's air and to control the quality of the state's air by preparing and developing a general, comprehensive plan. The TCAA, Subchapters A - D, also authorize the TNRCC to collect information to enable the commission to develop an inventory of emissions; conduct research and investigations; enter property and examine records; to prescribe monitoring requirements; to institute enforcement proceedings; to enter into contracts and execute instruments; to formulate rules; to issue orders taking into consideration factors bearing upon health, welfare, social and economic factors, and practicability and reasonableness; to conduct hearings; to establish air quality control regions; to encourage cooperation with citizens' groups and other agencies and political subdivisions of the state as well as with industries and the Federal Government; to establish and operate a system of permits for construction or modification of facilities.

Local government authority is found in Subchapter E of the TCAA. Local governments have the same power as the TNRCC to enter property and make inspections. They also may make recommendations to the commission concerning any action of the TNRCC that affects their territorial jurisdiction, may bring enforcement actions, and may execute cooperative agreements with the TNRCC or other local governments. In addition, a city or town may enact and enforce ordinances for the control and abatement of air pollution not inconsistent with the provisions of the TCAA, the rules or orders of the commission.

B. Applicable Law

The following statutes and rules provide necessary authority to carry out the SIP. The rules listed below have previously been submitted as part of the SIP.

Statutes

TEXAS HEALTH & SAFETY CODE, Chapter 382	September 1, 1999

TEXAS WATER CODE September 1, 1999

Chapter 5:
Subchapter A: General Provisions
Subchapter B: Organization of the Texas Natural Resource Conservation Commission
Subchapter C: Texas Natural Resource Conservation Commission
Subchapter D: General Powers and Duties of the Commission
Subchapter E: Aministrative Provisions for Commission
Subchapter F: Executive Director
Subchapter H: Delegation of Hearings
Subchapter I: Judicial Review
Subchapter J: Consolidated Permit Processing
Subchapter L: Emergency and Temporary Orders

Chapter 7, Enforcement §§7.002, 7.004, 7.005, 7.032, 7.073, 7.177, 7.179, 7.180 and 7.181.

Rules

All of the following rules are found in Title 30, Texas Administrative Code, as of the following effective dates:

Chapter 35, Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions	December 10, 1998
Chapter 39, Public Notice, §§ 39.201; 39.401; 39.403(a) and (b)(8)-(10); 39.405(f)(1) and (g);39.409; 39.411 (a), (b)(1)-(6) and (8)-(10) and (c)(1)-(6) and (d); 39.413(9), (11), (12) and (14); 39.418(a) and (b)(3) and (4); 39.419(a), (b),(d) and (e); 39.420(a), (b) and (c)(3) and (4); 39.423 (a) and (b); 39.601; 39.602; 39.603; 39.604; and 39.605	September 23, 1999
Chapter 55, Request for Contested Case Hearings; Public Comment, §§ 55.1; 55.21(a) - (d), (e)(2), (3) and (12), (f) and (g); 55.101(a), (b), (c)(6) - (8); 55.103; 55.150; 55.152(a)(1), (2) and (6) and (b); 55.154; 55.156; 55.200; 55.201(a) - (h); 55.203; 55.205; 55.206; 55.209 and 55.211	October 20, 1999
Chapter 101: General Air Quality Rules	September 4, 2000
Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter (formerly known as Regulation I)	June 11, 2000
Chapter 112: Control of Air Pollution from Sulfur Compounds (formerly knows as Regulation II)	July 16, 1997
Chapter 113, §113.120, Subchapter A: Control of Air Pollution from Toxic Materials	July 9, 2000

Chapter 114: Control of Air Pollution from Motor Vehicles (formerly known as Regulation IV)	May 28, 2000
Chapter 115: Control of Air Pollution from Volatile Organic Compounds (formerly known as Regulation V)	July 20, 2000
Chapter 116 (except Subchapters H & I): Permits for New Construction or Modification (formerly known as Regulation VI)	September 14, 2000
Chapter 117: Control of Air Pollution from Nitrogen Compounds (formerly known as Regulation VII)	May 19, 2000
Chapter 118: Control of Air Pollution Episodes (formerly known as Regulation VIII)	March 5, 1972
Chapter 122, § 122.122: Potential to Emit	September 20, 1993

SECTION VI. CONTROL STRATEGY

A. Introduction (Revised)

B. Ozone (Revised)

1. *Dallas/Fort Worth* (No change since April 2000 revision)
   - Chapter 1: General
   - Chapter 2: Emissions Inventory
   - Chapter 3: Photochemical Modeling
   - Chapter 4: Data Analysis
   - Chapter 5: Rate-of-Progress
   - Chapter 6: Required Control Strategy Elements
   - Chapter 7: Future Attainment Plans
2. *Houston/Galveston* **(Revised)**
   - Chapter 1: General **(Revised)**
   - Chapter 2: Emissions Inventory **(Revised)**
   - Chapter 3: Photochemical Modeling **(Revised)**
   - Chapter 4: Data Analysis (No change)
   - Chapter 5: Rate-of-Progress **(Revised)**
   - Chapter 6: Required Control Strategy Elements **(Revised)**
   - Chapter 7: Future Attainment Plans **(Revised)**
3. *Beaumont/Port Arthur* (No change since April 2000 revision)
   - Chapter 1: General
   - Chapter 2: Emissions Inventory
   - Chapter 3: Photochemical Modeling
   - Chapter 4: Data Analysis
   - Chapter 5: Rate-of-Progress
   - Chapter 6: Required Control Strategy Elements
   - Chapter 7: Future Attainment Plans
4. *El Paso* (No change since July 1996 revision)
5. *Regional Strategies* (No change since April 2000 revision)
   - Chapter 1: General
   - Chapter 2: Control Strategy Elements
   - Chapter 3: Photochemical Modeling

C. Particulate Matter (No change.)

D. Carbon Monoxide (No change.)

E. Lead (No change.)

F. Oxides of Nitrogen (No change.)

G. Sulfur Dioxide (No change.)

H. Conformity with the National Ambient Air Quality Standards

I. Site Specific (No change.)

J. Mobile Sources Strategies

1. *Inspection/Maintenance* **(Revised)**
   Chapter 1: General **(Revised)**
   Chapter 2: Applicability **(Revised)**
   Chapter 3: I/M Performance Standards **(Revised)**
   Chapter 4: Network Type and Program Evaluation **(Revised)**
   Chapter 5: Adequate Tools and Resources
   Chapter 6: Test Frequency and Convenience
   Chapter 7: Vehicle Coverage **(Revised)**
   Chapter 8: Test Procedures and Standards and Test Equipment **(Revised)**
   Chapter 9: Quality Control
   Chapter 10: Waivers and Time Extensions
   Chapter 11: Motorist Compliance Enforcement **(Revised)**
   Chapter 12: Motorist Compliance Enforcement Program Oversight
   Chapter 13: Quality Assurance
   Chapter 14: Enforcement Against Contractors, Stations, and Inspectors
   Chapter 15: Data Collection
   Chapter 16: Data Analysis and Reporting
   Chapter 17: Inspector Training and Licensing or Certification
   Chapter 18: Public Information and Consumer Protection
   Chapter 19: Improving Repair Effectiveness
   Chapter 20: Compliance with Recall Notices
   Chapter 21: On-Road Testing **(Revised)**
   Chapter 22: State Implementation Plan Submission **(Revised)**
   Chapter 23: Attachment A - Modeling and Technical Supplement **(Revised)**
2. *Transportation Control Measures* (No change since May 2000 revision)
3. *Vehicle Miles Traveled* (No change since May 2000 revision)
4. *Clean Gasoline* (No change from June 1999 revision)

LIST OF ACRONYMS

ACT - Alternative Control Techniques
AFV - Alternative Fuel Vehicle
AIRS - Aerometric Information Retrieval System
APA - Administrative Procedure Act
ARACT - Alternate Reasonably Available Control Technology
ARPDB - Acid Rain Program Data Base
ASC - Area Source Categories
ASE - Alliance to Save Energy
ASM - Acceleration Simulation Mode
ATA - Airline Transport Association
ATC - Air Traffic Control
BACT - Best Available Control Technology
BEIS - Biogenic Emissions Inventory System
BEIS-2 - Biogenic Emissions Inventory System, version2
BELD - Biogenic Emissions Land Cover Database
BIF - boilers and industrial furnaces
BIOME - Biogenic Model for Emissions
BPA - Beaumont/Port Arthur
Cal LEV - California Low Emission Vehicle
CAM - Compliance Assurance Monitoring
CAMS - Continuous Air Monitoring Station
CAMx - Comprehensive Air Model with Extensions
CARB - California Air Resources Board
CARE - Clean Air Responsibility Enterprise
CB-IV HC - Carbon Bond IV Hydrocarbon
CFR - Code of Federal Regulations
CEMS - Continuous Emissions Monitoring System
CMAQ - Congestion Mitigation and Air Quality
CMSA - Consolidated Metropolitan Statistical Area
CNG - Compressed Natural Gas
CO - Carbon Monoxide
COAST - Coastal Oxidant Assessment for Southeast Texas
CTG - Control Technique Guidelines
DART - Dallas Area Rapid Transit
DERC - Discrete Emission Reduction Credit
DFW - Dallas/Fort Worth
DFWN - Dallas/Fort Worth North
DFWRTM - Dallas/Fort Worth Regional Travel Model
DOW - Day of Week
DPS - Department of Public Safety
DRI - Desert Research Institute
DV - Design Value
EDFW - Extended Dallas/Fort Worth
EGAS - Economic Growth Analysis System
EGF - Electric Generating Facilities

EGR - Exhaust Gas Recirculation
EI - Emissions Inventory
EIQ - Emissions Inventory Questionnaire
ELP - El Paso
EPA - U.S. Environmental Protection Agency
EPN - Emission Point Number
ERC - Emission Reduction Credit
ERG - Eastern Research Group
ETR - Employer Trip Reduction
FAA - Federal Aviation Administration
FACA - Federal Advisory Committee Act
FCAA - Federal Clean Air Act
FMVCP - Federal Motor Vehicle Control Program
FR - Federal Register
FTE - Full Time Equivalent Employee
FTP - File Transfer Protocol
g/hp-hr - Grams Per Horsepower-Hour
GIS - Geographic Information System
GloBEIS - Global Biogenic Emissions Inventory System
g/mi - Grams Per Mile
GSE - Ground Support Equipment
GVWR - Gross Vehicle Weight Rating
HAP - Hazardous Air Pollutant
HAXL - Houston Air Excellence in Leadership
HB - House Bill
HC - Hydrocarbon
HDD - Heavy-duty Diesel
HDDV - Heavy-duty Diesel Vehicle
HDEWG - Heavy Duty Engine Working Group
HDV - Heavy-duty Vehicle
HGA - Houston/Galveston
HGAC - Houston-Galveston Area Council
HON - Hazardous Organic NESHAPS
HOV - High Occupancy Vehicle
hp - Horsepower
HPMS - Highway Performance Monitoring System
HRM - Houston Regional Monitoring
ICI - Industrial, Commercial, and Institutional
IIG - Interim Implementation Guidance
IIP - Interim Implementation Plan
I/M - Inspection and Maintenance
INIT - Initial Condition Tracer
ITWS - Integrated Terminal Weather System
IWW - Industrial Wastewater
KG/HA - Kilograms/hectare
KM - Kilometer
LDT - Light-duty Truck

LED - Low Emission Diesel
LEV - Low Emission Vehicle
LNG - Liquefied Natural Gas
LSG - Low Sulfur Gasoline
m - Meter
MACT - Maximum Achievable Control Technology
MDERC - Mobile Discrete Emission Reduction Credit
MERC - Mobile Emission Reduction Credit
METT - Mass Emissions Transient Testing
MMBtu - Million British Thermal Unit
MPA - Metropolitan Planning Area
MY - Model Year
NAAQS - National Ambient Air Quality Standard
NCDC - National Climatic Data Center
NCTCOG - North Central Texas Council of Governments
NEGU - Non-electric Generating Units
NESHAPS - National Emission Standards for Hazardous Air Pollutants
NEVES - Non-road Engine and Vehicle Emission Study
NHSDA - National Highway System Designation Act
NLEV - National Low Emission Vehicle
NNSR - Nonattainment New Source Review
NO_x - Nitrogen Oxides or Oxides of Nitrogen
NO_y - Nitrogen Species
NSR - New Source Review
NWS - National Weather Service
O_3 - Ozone
OAQPS - Office of Air Quality Planning and Standards
OBD - On-Board Diagnostics
OSAT - Ozone Apportionment Technology
OTAG - Ozone Transport Assessment Group
OTAQ - Office of Transportation and Air Quality
PAMs - Photochemical Assessment Monitoring Sites
PCV - Positive Crankcase Ventilation
PEI - Periodic Emissions Inventory
PM_{10} - Particulate Matter less than 10 microns
ppb - Parts Per Billion
ppm - Parts Per Million
ppmv - Parts Per Million by Volume
PSDB - Point Source Database
PSIA - Pounds per Square Inch Absolute
PSR -
QA/QC - Quality Assurance/Quality Control
RACT - Reasonably Available Control Technology
RAQPC - Regional Air Quality Planning Committee
RAZ - Regional Analysis Zone
RCTSS - Regional Computerized Traffic Signal System
RFG - Reformulated Gasoline

REMI - Regional Economic Modeling, Inc.
RFO - Request for Offer
ROP - Rate-of-Progress
RPM - Revolutions Per Minute
RSD - Remote Sensing Device
RVP - Reid Vapor Pressure
SAE - Society of Automotive Engineers
SAIMM - Systems Applications International Meteorological Model
SB - Senate Bill
SCAQMD - South Coast Air Quality Management District [Los Angeles area]
SCC - Source Classification Code
SCRAM - Support Center for Regulatory Air Models
SETRPC - Southeast Texas Regional Planning Commission
SIC - Standard Industrial Classification
SIP - State Implementation Plan
SITWC - Spark Ignition Three-Way Catalyst
SO_2 - Sulfur Dioxide
SO_x - Sulfur Compounds
SOCMI - Synthetic Organic Chemical Manufacturing Industry
SOS - Southern Oxidants Study
SULEV - Super-Ultra-Low Emission Vehicle
TAC - Texas Administrative Code
TACB - Texas Air Control Board
TAFF - Texas Alternative Fuel Fleet
TCAA - Texas Clean Air Act
TCF - Texas Clean Fleet
TCM - Transportation Control Measure
TIP - Transportation Implementation Plan
TMC - Texas Motorist’s Choice
TMO - Transportation Management Organization
TNMOC - Total nonmethane organic compounds
TNRCC - Texas Natural Resource Conservation Commission (commission)
TPOD - Tons Per Ozone Day
TPY - Tons Per Year
TSP - Total Suspended Particulate
TTI - Texas Transportation Institute
TxDOT - Texas Department of Transportation
UAM - Urban Airshed Model
USDA - United States Department of Agriculture
USGS - United States Geological Survey
UTM - Universal Transverse Mercator
VAVR - Voluntary Accelerated Vehicle Retirement
VERP - Voluntary Emission Reduction Permit
VID - Vehicle Identification Database
VIN - Vehicle Identification Number
VIR - Vehicle Inspection Report
VMAS - Vehicle Mass Analysis System

VMEP - Voluntary Mobile Source Emissions Reduction Program
VMT - Vehicle Miles Traveled
VNR or VNRAT- VOC-NO_x ratios
VOC - Volatile Organic Compound
VRF - Vehicle Repair Form
WOE - Weight of Evidence
ZEV - Zero Emission Vehicle

VI: Ozone Control Strategy

A. INTRODUCTION

This introduction is intended to provide the reader with a broad overview of the SIP revisions that have been submitted to the EPA by the State of Texas. Some sections may be obsolete or superseded by new revisions, but have been retained for the sake of historical completeness. The reader is referred to the body of the SIP for details on the current SIP revision.

Requirements for the SIP specified in 40 CFR Part 51.12 provide that "...in any region where existing (measured or estimated) ambient levels of pollutant exceed the levels specified by an applicable national standard," the plan shall set forth a control strategy which shall provide for the degree of emission reduction necessary for attainment and maintenance of such national standard." Ambient levels of SO_2 and NO_x, as measured from 1975 through 1977, did not exceed the national standards set for these pollutants anywhere in Texas. Therefore, no control strategies for these pollutants were included in revisions to the Texas SIP submitted on April 13, 1979. Control strategies were submitted and approved for inclusion in the SIP for areas in which measured concentrations of ozone, TSP, or CO exceeded an NAAQS during the period from 1975 to 1977. On October 5, 1978, the Administrator of the EPA promulgated a lead ambient air quality standard. The FCAA Amendments of 1977 required that each state submit an implementation plan for the control of any new criteria pollutant. A SIP revision for lead was submitted in March 1981.

The control strategies submitted in 1979 provided, by December 31, 1982, the amount of emission reductions required by EPA policy to demonstrate attainment of the primary NAAQS, except for ozone, in the Harris County nonattainment area. For that area, an extension to December 31, 1987 was requested, as provided for in the FCAA Amendments of 1977.

Supplemental material, including emission inventories for VOCs and TSP submitted with the 1979 SIP revisions, is included in Appendices H and O of the 1979 SIP submittal.

Proposals to revise the Texas SIP to comply with the requirements of the FCAA Amendments of 1977 were submitted to EPA on April 13, November 2, and November 21, 1979. On December 18, 1979 (44 FR 75830-74832), EPA approved the proposed revision to the Texas SIP relating to vehicle inspection and maintenance and extended the deadline for attainment of the NAAQS for ozone in Harris County until December 31, 1987 (see Appendix Q of the 1979 SIP submittal for the full text of the extension request and the approval notice). On March 25, 1980 (45 FR 19231-19245), EPA approved and incorporated into the Texas SIP many of the remaining provisions included in the proposals submitted by the state in April and November 1979. The March 25, 1980 *Federal Register* notice also included conditional approval of a number of the proposed SIP revisions submitted by the state.

Additional proposed SIP revisions were submitted to EPA by the state on July 25, 1980 and July 20, 1981 to comply with the requirements of the March 25, 1980 conditional approvals. By May 31, 1982, all of the proposed revisions to the Texas SIP submitted to EPA in April and November 1979, July 1980, and July 1981, with the exception of provisions relating to the definition of major modification used in NSR and certain portions of the control strategy for TSP in Harris County, had been fully approved or addressed in a *Federal Register* notice proposing final approval. The NSR provisions were approved on August 13, 1984.

The FCAA Amendments of 1977 required SIPs to be revised by December 31, 1982 to provide additional emission reductions for those areas for which EPA approved extensions of the deadline for attainment of the NAAQS for ozone or CO. In 1982 the state submitted a revision to the Texas SIP to comply with the FCAA Amendments of 1977 and EPA rules for 1982 SIP revisions. Supplementary emissions inventory data and supporting documentation for the revision were included in Appendices Q through Z of the 1982 SIP submittal.

The only area in Texas receiving an extension of the attainment deadline to December 31, 1987 was Harris County for ozone. Proposals to revise the Texas SIP for Harris County were submitted to EPA on December 9, 1982. On February 3, 1983, EPA proposed to approve all portions of the plan except for the Vehicle Parameter I/M Program. On April 30, 1983, the EPA Administrator proposed sanctions for failure to submit or implement an approvable I/M program in Harris County. Senate Bill 1205 was passed on May 25, 1983 by the Texas Legislature to provide the Texas Department of Public Safety with the authority to implement enhanced vehicle inspection requirements and enforcement procedures. On August 3, 1984, EPA proposed approval of the Texas SIP pending receipt of revisions incorporating these enhanced inspection procedures and measures ensuring enforceability of the program. These additional proposed SIP revisions were adopted by the state on November 9, 1984. Final approval by EPA was published on June 26, 1985.

Although the control strategies approved by EPA in the 1979 SIP revisions were implemented in accordance with the provisions of the plan, several areas in Texas did not attain the primary NAAQS by December 31, 1982. On February 23, 1983, EPA published a *Federal Register* notice identifying those areas and expressing the intent to impose economic and growth sanctions provided in the FCAA. However, EPA reversed that policy in the November 2, 1983 *Federal Register*, deciding instead to call for supplemental SIP revisions to include sufficient additional control requirements to demonstrate attainment by December 31, 1987.

On February 24, 1984, the EPA Region 6 Administrator notified the Governor of Texas that such supplemental SIP revisions would be required within one year for ozone in Dallas, Tarrant, and El Paso Counties and CO in El Paso County. The TACB requested a 6-month extension of the deadline (to August 31, 1985) on October 19, 1984. EPA approved this request on November 16, 1984.

Proposals to revise the Texas SIP for Dallas, Tarrant, and El Paso Counties were submitted to EPA on September 30, 1985. However, the revisions for Dallas and Tarrant Counties did not provide sufficient reductions to demonstrate attainment of the ozone standard and on July 14, 1987, EPA published intent to invoke sanctions. Public officials in the two counties expressed a strong desire to provide additional control measures sufficient to satisfy requirements for an attainment demonstration.

A program of supplemental controls was taken to public hearings in late October 1987. As a result of testimony received at the hearings, a number of the controls were modified and several were deleted, but sufficient reductions were retained to demonstrate attainment by December 31, 1991. These controls were adopted by the TACB on December 18, 1987 and were submitted to EPA as proposed revisions to the SIP. Supplemental data and supporting documentation are included in Appendices AA through AO of the 1987 SIP submittal.

The FCAA Amendments of 1990 authorized EPA to designate areas failing to meet the NAAQS for ozone as nonattainment and to classify them according to severity. The four areas in Texas and their respective classifications include: HGA (severe), BPA (serious), ELP (serious), and DFW (moderate).

The FCAA Amendments required a SIP revision to be submitted for all ozone nonattainment areas classified as moderate and above by November 15, 1993, which described in part how an area intends to decrease VOC emissions by 15%, net of growth, by November 15, 1996. The amendments also required all nonattainment areas classified as serious and above to submit a revision to the SIP by November 15, 1994, which described how each area would achieve further reductions of VOC and/or NO_x in the amount of 3.0% per year averaged over three years and which includes a demonstration of attainment based on modeling results using the UAM. In addition to the 15% reduction, states were also required to prepare contingency rules that would result in an additional 3.0% reduction of either NO_x or VOC, of which up to 2.7% may be reductions in NO_x. Underlying this substitution provision is the recognition that NO_x controls may effectively reduce ozone in many areas and that the design of strategies is more efficient when the characteristic properties responsible for ozone formation and control are evaluated for each area. The primary condition to use NO_x controls as contingency measures is a demonstration through UAM modeling that these controls will be beneficial toward the reduction of ozone. These VOC and/or NO_x contingency measures would be implemented immediately should any area fall short of the 15% goal.

Texas submitted rules to meet the ROP reduction in two phases. Phase I consisted of a core set of rules comprising a significant portion of the required reductions. This phase was submitted by the original deadline of November 15, 1993. Phase II consisted of any remaining percentage toward the 15% net of growth reductions, as well as additional contingency measures to obtain an additional 3.0% of reductions. Phase II was submitted by May 15, 1994. The complete list of contingency measures was submitted by November 15, 1994. The appropriate compliance date was to be incorporated into each control measure to ensure that the required reductions would be achieved by the November 15, 1996 deadline. A commitment listing the potential rules from which the additional percentages and contingency measures were selected was submitted in conjunction with the Phase I SIP on November 15, 1993. That list of Phase II rules was intended to rank options available to the state and to identify potential rules available to meet 100% of the targeted reductions and contingencies. Only those portions of the Phase II rules needed to provide reasonable assurance of achieving the targeted reduction requirements were adopted by the commission.

The DFW and ELP areas achieved sufficient reductions with the 15% ROP SIP to demonstrate attainment by 1996. Attainment Demonstration SIP Revisions for these two areas were submitted on September 14, 1994.

The FCAA Amendments of 1990 classified the BPA area as a serious nonattainment area. The BPA nonattainment area includes Hardin, Jefferson, and Orange Counties. The BPA nonattainment area has an ozone design value of 0.16 ppm, which places the area in the serious classification.

The FCAA Amendments of 1990 required a Post-96 ROP SIP revision and accompanying rules to be submitted by November 15, 1994. According to the FCAA Amendments, this submittal had to contain an Attainment Demonstration based on UAM. Additionally, the revision had to demonstrate how the HGA and BPA nonattainment areas intended to achieve a 3% per year reduction of VOC and/or NO_x until the year 2007, and additional reductions as needed to demonstrate modeled attainment. The plan was also required to carry an additional 3% of contingency measures to be implemented if the nonattainment area fails to meet a deadline. To use NO_x reductions for all or part of the Post-96 controls or the contingency measures required a demonstration using UAM showing that NO_x controls would be beneficial in reducing ozone.

On November 9, 1994, the state submitted a SIP revision designed to meet the 3% per year ROP requirements for the years 1997-1999. This Post-96 ROP SIP revision detailed how the BPA and HGA nonattainment areas intended to achieve these three years' reductions of VOC (or 9% net-of-growth). Most of this amount was achieved by quantifying additional reductions due to existing rules and reductions due to federally-mandated rules. Rules to achieve the further reductions needed to meet the ROP SIP goal were submitted to EPA on January 11, 1995. This submittal included modeling demonstrating progress toward attainment, using a 1999 future year emissions inventory.

On August 14, 1994, the state submitted preliminary UAM modeling results for the BPA and HGA nonattainment areas that showed the relationship between emission levels of VOC and NO_x, and ozone concentrations. This modeling was conducted with a 1999 future year emissions inventory. Based on the results of this preliminary modeling, which showed that NO_x reductions might increase ozone concentrations, on April 12, 1995 the state received a temporary §182(f) exemption from all NO_x requirements, including RACT, I/M, NO_x NSR, and transportation conformity requirements. Permanent §182(f) exemptions from all NO_x requirements were granted for DFW and ELP, and temporary exemptions until December 31, 1996 for HGA and BPA. The commission subsequently requested that EPA extend this date until December 31, 1997. EPA approved this 1-year extension on May 14, 1997.

On March 2, 1995, Mary Nichols, EPA Assistant Administrator for Air and Radiation, issued a memo which gave states some flexibility to design a phased Attainment Demonstration. It provided for an initial phase which was intended to continue progress in reducing levels of VOC and/or NO_x, while giving states an opportunity to address scientific issues such as modeling and the transport of ozone and its precursor pollutants. The second phase was designed to draw upon the results of the scientific effort and design a plan to bring the area into attainment. To constitute Phase I under this approach, the EPA guidance required that states submit the following SIP elements by December 31, 1995:

- ♦ Control strategies to achieve reductions of ozone precursors in the amount of 3% per year from the 1990 baseline EI for the years 1997, 1998, and 1999.
- ♦ UAM modeling through the year 1999, showing the effect of previously-adopted control strategies which were designed to achieve a 15% reduction in VOCs from 1990 through 1996.
- ♦ A demonstration that the state has met the VOC RACT requirements of the FCAA Amendments.
- ♦ A detailed schedule and plan for the "Phase II" portion of the attainment demonstration which will show how the nonattainment areas can attain the ozone standard by the required dates.
- ♦ An enforceable commitment to:
    - # Participate in a consultative process to address regional transport;
    - # Adopt additional control measures as necessary to attain the ozone NAAQS, meet ROP requirements, and eliminate significant contribution to nonattainment downwind; and
    - # Identify any reductions that are needed from upwind areas to meet the NAAQS.

Texas submitted the first two of these required sections in November 1994. The remaining three, a VOC RACT demonstration, the required commitments, and a Phase II plan and schedule, were submitted on January 10, 1996 to EPA.

ROP SIP modeling was developed for the HGA nonattainment area in two phases using the UAM. The first phase of ROP modeling was the modeling submitted in January 1995, as described above. The second phase of the ROP modeling was conducted using data obtained primarily from the COAST project, an intensive 1993 field study. The COAST modeling for HGA and the associated SIP were projected to be completed by December 1996 for submittal in May of 1997. Control strategies developed in this second phase were planned to be based on a more robust database, providing a higher degree of confidence that the strategies would result in attainment of the ozone NAAQS or target ozone value. A discussion of the schedule for the UAM modeling for the Phase II Attainment Demonstration can be found in Appendix 11-F of the January 10, 1996 submittal.

On January 29, 1996, EPA proposed a limited approval/limited disapproval for the Texas 15% ROP SIP revision. EPA proposed a limited approval because the SIP revision would result in significant emission reductions from the 1990 baseline and would, therefore, improve air quality. Simultaneously, the EPA proposed a limited disapproval because it believed that the plan failed to demonstrate sufficient reductions to meet the 15% ROP requirements. It also proposed a limited approval/disapproval of the contingency plans (designed to achieve an additional 3% of reductions if needed because a milestone is missed) along the same lines as the 15% action. EPA stated that some of the control measures submitted along with the SIP revision did not meet all of the requirements of the FCAA Amendments of 1990 and, therefore, cannot be approved. EPA further stated that it was not making a determination at this time about whether the state had met its requirements regarding RACT, or any other underlying FCAA Amendments of 1990 requirements. Finally, EPA proposed approval of the Alternate Means of Control portion of the November 9, 1994 Post-96 SIP submittal, but did not propose action on any other portion of that submittal.

Additionally, on November 29, 1995, the President signed the National Highway Systems Designation Act, which, among other things, prohibited EPA from discounting the creditable emissions from a decentralized vehicle I/M testing program if an approvable conditional I/M SIP revision was submitted to EPA within 120 days of the bill's signature. EPA's Office of Mobile Sources issued guidance stating that it would accept an interim I/M SIP proposal and Governor's letter 120 days after signature of the bill in lieu of an adopted SIP revision. The SIP proposal and letter was submitted to the EPA prior to the March 27, 1996 deadline to meet the 120-day time frame. The final I/M SIP revision (Rule Log No. 96104-114-AI), commonly referred to as the "Texas Motorist's Choice Program," was adopted by the commission on May 29, 1996 and submitted to the EPA by the state on June 25, 1996. On October 3, 1996, EPA proposed (61 FR 51651-51659) conditional interim approval of the Texas Motorist's Choice Program based upon the state's good faith estimate of emission reductions and the program's compliance with the Clean Air Act.

Part of EPA's determination that the new I/M SIP is approvable depends on the program's ability to achieve sufficient creditable VOC reductions so that the 15% ROP can still be achieved. The commission designed the revised I/M program to fit in with the other elements of the 15% SIP to achieve the full amount of creditable reductions required. The I/M program also achieves creditable reductions for the Post-96 ROP SIP.

Changes to the I/M program have had an impact on the ELP §818 Attainment Demonstration as well. This demonstration was predicated on the assumption that the I/M program would be implemented as adopted for the 15% SIP. An addendum to the §818 Demonstration shows that the basic underlying assumptions of the modeling still pertain despite the revisions to the I/M program.

The ETR program revision to the SIP and ETR rule were adopted in October 1992 by the TACB to meet the mandate established in the FCAA Amendments of 1990 (§182 (d)(1)(B)). This section of the FCAA required states with severe or extreme ozone nonattainment areas to develop and implement ETR programs in those areas. For Texas, the only area affected was the HGA area. The ETR program required large employers (those with 100 or more employees) to implement trip reduction programs that would increase the average passenger occupancy rate of vehicles arriving at the workplace during the peak travel period by 25% above the average for the area.

Congress amended the FCAA in December of 1995 by passing House Rule 325. This amendment allows the state to require an ETR program at its discretion. It also allows a state to “remove such provisions (ETR program) from the implementation plan...if the state notifies the Administrator, in writing, that the state has undertaken, or will undertake, one or more alternative methods that will achieve emission reductions (1.81 tons/day) equivalent to those achieved by the removed...provisions.” As such, large employers will no longer be mandated to implement trip reduction programs. The HGA ozone nonattainment area will, however, through the coordination of the Houston-Galveston Area Council, implement a voluntary regional initiative to reduce vehicle trips.

The 1990 Adjusted Base Year EI was submitted on November 12, 1993. It is the official inventory of all emission sources (point, area, on-road and non-road mobile) in the four nonattainment areas. There have been several changes to the EI due to changes in assumptions for certain area and non-road mobile source categories. Changes to the baseline EI have affected the target calculations and creditable assumptions made in the 15% and 9% SIPs.

In December of 1990, then-Texas Governor William Clements requested that the BPA area be reclassified as a "moderate" ozone nonattainment area in accordance with §181(a)(4) of the FCAA Amendments of 1990. That request was denied on February 13, 1991. A recent review of the original request and supporting documentation has revealed that this denial was made in error. As provided by §110(k)(6) of the Act, the EPA Administrator has the authority to reverse a decision regarding original designation if it is discovered that an error had been made.

Monitoring data from a privately-funded, special purpose monitoring network which was not included in the Aerometric Information Retrieval System database was improperly used to deny this request. Furthermore, subsequent air quality trends demonstrated that BPA is more properly classified as a moderate nonattainment area, and could attain the standard by the required date for moderate areas of November 15, 1996. Therefore, Governor Bush sent a letter and technical support to EPA on July 20, 1995, requesting that the BPA area be reclassified to moderate nonattainment status. BPA planned to demonstrate attainment one of the following ways:

- ♦ Monitored values showing attainment of the standard at state-operated monitors for the years 1994-1996, which is the time line the FCAA Amendments of 1990 specifies for moderate areas.
- ♦ UAM modeling showing attainment of the standard but for transport of ozone and/or precursors.

EPA Region 6 verified the data submitted in support of this request and concurred that it is valid. On June 3, 1996, the reclassification of the BPA area became effective. Because the area was classified as serious, it was following the SIP submittal and permitting requirements of a serious area, which included the requirements for a Post-96 SIP. With the consolidated SIP submittal, the commission removed the BPA area from the Post-96 SIPs, which became applicable to the HGA nonattainment area only.

The State of Texas, in a committal SIP revision submitted to EPA on November 15, 1992, opted out of the Federal Clean Fuel Fleet program in order to implement a fleet emission control program designed by the state. In 1994, Texas submitted the state's opt-out program in a SIP revision to the EPA and adopted rules to implement the TAFF program. In 1995, the 74th Texas Legislature modified the state's alternative fuels program through passage of SB 200. In response to SB 200, the commission adopted regulations modifying the TAFF program to create the TCF program.

Since adoption on July 24, 1996 and subsequent submission to EPA of the TCF SIP revision, the 75th Texas Legislature modified the state's alternative program once again through passage of SB 681. Staff modified the TCF program, now called the TCF Low Emission Vehicle program, to reflect changes mandated by SB 681.

On June 29, 1994, the commission adopted a revision to the SO_2 SIP regarding emissions in Harris County. The SIP revision was required by EPA because of exceedances of the SO_2 NAAQS in 1986, 1988, and 1990. An EPA study conducted by Scientific Applications International Corporation also predicted SO_2 exceedances. On April 22, 1991, the EPA declared that portions of Harris County were potentially in nonattainment of the SO_2 NAAQS. Consequently, the HRM Corporation volunteered to find reductions in SO_2 in order to prevent being redesignated to nonattainment. HRM's efforts resulted in finding voluntary SO_2 reductions. These reductions were adopted in 13 commission Agreed Orders and were included as part of the June 29, 1994 SIP revision. The EPA approved the Harris County SO_2 SIP on March 6, 1995 (60 FR 12125).

On May 14, 1997, the commission adopted an additional revision to the Harris County SO_2 SIP to incorporate modifications to two of the 13 commission Agreed Orders. The remaining sections of the SIP remained the same. While on the scale of "minor technical corrections," the modified orders were submitted as a SIP revision because the new emission rates differ from what EPA had previously approved. The two Agreed Order modifications concerned grandfathered units at Simpson Pasadena Paper Company and Lyondell-Citgo Refining Company, Ltd. The commission approved changes to both Agreed Orders on July 24, 1996.

On May 14, 1997, the commission also adopted a revision to the SIP modifying the vehicle I/M program. This revision removed the test-on-resale component that had been included in the vehicle I/M program, as designed in July of 1996. Test-on-resale required persons selling their vehicles in the I/M core program areas to obtain emissions testing prior to the title transfer of such vehicles. Test-on-resale was not required to meet the FCAA Amendments of 1990 and did not produce additional emissions reduction benefits. The SIP revision also incorporated into the SIP the Memorandum of Understanding between the commission and the Department of Public Safety, adopted by the commission on November 20, 1996.

The FCAA Amendments of 1990 required that, for severe and above ozone nonattainment areas, states develop SIP revisions that include specific enforceable TCMs, as necessary, to offset increases in motor vehicle emissions resulting from growth in VMT or the number of vehicle trips. This SIP revision would also satisfy reductions in motor vehicle emissions consistent with the 15% ROP and the Post-1996 ROP SIPs.

Therefore, the commission developed and submitted to EPA a committal SIP revision for the HGA nonattainment area on November 13, 1992, and VMT Offset SIP revisions on November 12, 1993 and November 6, 1994, to satisfy the requirements of the 15% ROP SIP revision. The former SIP revision laid out a set of TCMs and other mobile source controls which reduced emissions below the modeled ceiling. The 1994 SIP revision did not require additional TCMs.

As a result of changes in the I/M and the ETR programs, it was necessary to do the 1997 VMT Offset SIP revision for the HGA area, which was adopted on August 6, 1997. Additional TCMs were included: high occupancy vehicle lanes, park and ride lots, arterial traffic management systems, computer transportation management systems, and signalization. These TCMs were part of the "Super SIP" submitted to EPA on July 24, 1996.

Using the best technical guidance and engineering judgement available at the time, the State of Texas calculated emissions reductions available from the enhanced monitoring rule that was to be part of the Title V permitting program. The enhanced monitoring rule was later revised and transformed into the CAM Rule. Texas maintained that its calculation methodologies still accurately reflected the amount of creditable reductions available. EPA disagreed with the calculation methodologies used by the state and intends to disapprove the 9% SIP as a result. EPA also indicated that the emission reduction credits claimed for the Texas Clean Fuels Fleet program were not approvable due to a legislative change to the program. The state plans to submit a SIP revision for this program in a separate action, but has removed the credits claimed in the 9% SIP in this action. The State of Texas proposes to submit a revision to the 9% SIP which revises the reductions claimed by the state toward the 9% emissions target.

The State of Texas did not reapply for an extension of the NO_x §182(f) waivers for HGA and BPA as discussed previously. Therefore, on December 31, 1997, the waivers expired. The state is now required to implement several NO_x control programs. Among them is a requirement for all major NO_x sources within the area to implement RACT. The state has adopted a revised compliance date of November 15, 1999 for this program.

The commission, in a committal SIP revision adopted on June 3, 1998, and submitted to EPA on June 23, 1998, agreed to implement OBD checks as part of the I/M program by the federal deadline of January 1, 2001.

On July 29, 1998, the commission adopted regulations and a revision of the TCF SIP to set forth the LEV requirements for mass transit fleets in each of the serious and above nonattainment areas, and for local government and private fleets operated primarily within the serious and above nonattainment areas. These rules satisfy the state requirements to adopt rules to implement SB 681.

The DFW area was classified as a moderate ozone nonattainment area in accordance with the FCAA Amendments of 1990. As a moderate nonattainment area, DFW was to demonstrate, through monitoring, attainment of the 1-hour ozone standard by November 15, 1996, or face being "bumped up" to the serious classification. Air quality data from DFW ambient air quality monitors for the years 1994-96 show that the 1-hour NAAQS for ozone has been exceeded more than one day per year over this three-year period. On February 18, 1998, the EPA issued a final notice in the *Federal Register* that the DFW area was being reclassified to the serious classification for failing to attain the NAAQS for ozone. As a result of this reclassification, the EPA required that a new SIP demonstrating attainment of the ozone standard in DFW be submitted by March 20, 1999. The state submitted a SIP for DFW that included photochemical modeling showing the level of reductions needed to attain the standard by 1999, a 9% ROP target calculation for the years 1997-99, VOC RACT rules in Chapter 115 applicable to sources meeting the 50 tpy major source level, NO_x RACT rules in Chapter 117 applicable to major sources of NO_x, and amendments to Chapter 116 reinstating nonattainment new source review for NO_x. The governor submitted this SIP to EPA on March 16, 1999. Because there was not enough time to implement the rules to achieve necessary reductions of ozone precursor emissions in the DFW area by the required attainment date of November 15, 1999, the state proposed to submit in March 2000 a full attainment demonstration including a complete rule package necessary to attain the 1-hour ozone standard.

On February 24, 1999 the commission adopted a SIP revision for the DFW area which was submitted to EPA on March 16, 1999. This SIP was not only intended to demonstrate how the DFW area would attain the standard through the submission of an updated emissions inventory and photochemical modeling, but to also include a 9% ROP target calculation in order to satisfy EPA's requirement of reasonable further progress in emission reductions for the DFW area for the years 1997-99. The reductions toward ROP were short of the 9% target and the SIP lacked required modeled control strategies; therefore, a follow-up SIP was developed. More information about the follow-up submittal is addressed later in this introduction.

On May 12, 1999 the commission adopted a revision to the SIP for the Northeast Texas region which would make certain local ozone precursor emission reductions federally enforceable. This revision was submitted to EPA on June 4, 1999. Four affected companies (Norit Americas, Inc.; La Gloria Oil and Gas Company; Eastman Chemical Company, Texas Eastman Division; and ARCO Permian) in the Northeast Texas region voluntarily agreed to be subject to the implementation of enforceable emission reduction measures pursuant to Part A, Sections 2-5 of the Northeast Texas Flexible Attainment Region (FAR) Memorandum of Agreement. The FAR approach allows time for the area's control program to work, similar to contingency measures in a post-1990 maintenance agreement, prior to EPA issuing a call for a SIP revision or nonattainment redesignation. The MOA required the immediate implementation of control measures through the use of Agreed Orders, which are included in the SIP revision to make them federally enforceable.

On June 30, 1999 the commission adopted a revision to the SIP in order to incorporate cleaner gasoline rules. The cleaner gasoline is required to have a lower RVP outside the DFW and HGA areas, and a limit on the amount of sulfur in each gallon of gasoline. The RVP required in this SIP revision is 7.8 psi starting May 1, 2000. The RVP limit would be in effect every summer from May 1st through October 1st. A 7.8 psi RVP fuel is expected to reduce evaporative emissions from automobiles, off-highway gasoline powered equipment, and all gasoline storage and transfer operations. Evaporative VOC emissions from automobiles will be reduced by at least 14%. The sulfur cap requirement is 150 ppm per gallon of gasoline, starting January 1, 2004. Low sulfur gasoline is expected to reduce NO_x emissions from today's cars by 8.5% according to the EPA complex model. The rules would further provide for counties or large cities to opt into these regulations earlier than required provided that certain conditions are met. If EPA were to adopt sulfur regulations to require compliance by January 1, 2004, the commission's rules would no longer apply, allowing the federal sulfur rules to take precedence. However, areas that choose to opt-in early would continue to follow the sulfur requirements of their early compliance plan until EPA actually implemented its regulations, unless otherwise specified in the commission order.

On July 28, 1999 the commission adopted a site-specific revision to the SIP which provides for the redesignation to attainment of that portion of Collin County currently designated as nonattainment for the lead NAAQS. The revision also provides a maintenance plan for the area to ensure continued compliance. As part of the maintenance plan, the revision establishes a new contingency plan through an agreed order and replaces Agreed Board Orders 92-09(k) and 93-12 and Board Order 93-10. The revision also provides for a commitment by the commission to keep the existing monitoring network in place until the end of the maintenance period.

On October 15, 1999 the commission adopted a revision to the SIP for the DFW ozone nonattainment area. This SIP was developed in order to address the shortfall in the reductions towards the 9% ROP target and the lack of modeled control strategies from the February 24, 1999 revision. Potential emission reduction credits were reviewed that were not claimed in the February 1999 SIP in order to make up the ROP shortfall. The focus was on VOC reductions because fewer VOC reductions would be needed to make up the shortfall compared to NO_x emission reductions. The ROP lacked about 20% of the VOC reductions needed, which amounted to 5.87 tpd. Making complete the 9% ROP portion of the SIP should allow certain transportation projects to avoid being put on hold. Elements have been identified that were not previously considered that would bring SIP emission reduction credits in order to complete the 9% ROP requirements for the years 1996-99. These technical corrections were included in the October 1999 revised SIP.

In November 1998, the HGA SIP revision submitted to EPA in May 1998 became complete by operation of law. However, EPA stated that it could not approve the SIP until specific control strategies were modeled in the attainment demonstration. EPA specified a submittal date of November 15, 1999 for this modeling. As the HGA modeling protocol evolved, the state eventually selected and modeled seven basic modeling scenarios. As part of this process, a group of HGA stakeholders worked closely with commission staff to identify local control strategies for the modeling. This modeling showed a gap in reductions necessary for attainment of the 1-hour ozone standard. The commission adopted these revisions to the SIP on October 27, 1999.

In January 1997 the commission proposed a program that, for the first time in Texas' air pollution control history, extended beyond the confines of the urbanized areas. The concept of the regional strategy was developed as a result of several major occurrences. These events include the COAST Study, participation in the OTAG process, deployment of intensive aircraft monitoring by Baylor University, and the development of regional photochemical modeling. While Texas was not involved in the OTAG SIP call requiring mandatory statewide NO_x reductions, the commission realized the importance of the role of transported ozone and/or its precursors and the need for a statewide comprehensive plan in order to assist the areas that are struggling to attain the ozone standard. The impact on several states from the smoke and haze episodes from fires in Central America during the summer of 1998 helped reinforce the fact that air pollution is capable of traveling hundreds of miles.

The purpose of the regional strategy was to reduce ozone causing compounds in the eastern half of the state in order to help reduce background levels of ozone in both nonattainment areas as well as those areas close to noncompliance for the new 8-hour ozone standard. Components of the regional strategy included support for the NLEV program, cleaner burning gasoline and stage I vapor recovery, voluntary involvement in the permitting of grandfathered facilities, and reductions from major stationary sources.

On July 16, 1998, EPA issued a guidance memorandum titled "Extension of Attainment Dates for Downwind Transport Areas." The guidance, referred to hereinafter as the "transport guidance," provides a means for EPA to extend the attainment date for an area affected by transported air pollution, without reclassifying ("bumping up") the area to a higher classification. The transport guidance is particularly relevant to BPA, which is downwind of the HGA area and is affected by transport from HGA. If EPA approved such a determination for BPA, the area would have until no later than November 15, 2007, the attainment date for HGA, to attain the 1-hour ozone standard. There is also mounting technical data which suggests that the DFW area is impacted by transport and high regional background levels of ozone. A modeling demonstration has been developed and shows that the air quality in the DFW area is influenced at times from the HGA area. This demonstration, if approved by the EPA, would allow EPA to determine that the area should not be bumped up from serious to severe under the conditions of the July 16, 1998 transport guidance. If approved by the EPA the new attainment date for the DFW area would be no later than November 15, 2007, the attainment date for HGA.

As a result of the transport demonstrations for BPA and DFW, the development of SIPs in Texas will be, for the first time ever, on a coordinated timeline. This coordinated planning effort will include three of the state's four 1-hour ozone nonattainment areas as well as future 8-hour ozone areas. While there is uncertainty with the 8-hour ozone standard due to a pending court case, EPA's original plan calls for designations of 8-hour areas in 2000, SIP submittals by 2003, and attainment of the 8-hour standard by 2007. This statewide comprehensive planning with 2007 as a target date will allow Texas to utilize its resources in the most efficient manner to develop control strategies to reduce air pollution not only in the urbanized areas but regionally as well.

The challenges associated with reducing pollution levels to comply with the federal standards are very great, especially in the state's two largest urban areas - DFW and HGA. Commission staff worked very closely with local entities to develop recommendations that will get the respective areas into attainment. Future attainment relies on not only the development of local and state control measures, but on future federal rules involving new technologies as well. These especially involve cleaner fuels and cleaner engines for both on-road as well as non-road mobile sources. Unfortunately, many of these federal measures will not be available until the 2004 timeframe and then time will be required to provide for turnover before they will become effective at reducing pollution levels. This would make it very difficult for any large urban nonattainment area to comply before the 2007 timeframe. As a result of federal measures, state regulations, and local initiatives it is estimated that emissions in the eastern and central part of the state that contribute to the production of ground level ozone will be reduced by approximately 100 tpd by 2001; approximately 1200 tpd by 2003; approximately 1400 tpd by 2005; and approximately 1500 tpd by 2007. Texas is committed to implementing these strategies as quickly as practicable.

In the April 2000 SIP revision for HGA the state made the following enforceable commitments : 1) to quantify the shortfall of NO_x reductions needed for attainment; 2) to list and quantify potential control measures to meet the shortfall of NO_x reductions needed for attainment; 3) to adopt the majority of the necessary rules for the HGA attainment demonstration by December 31, 2000, and to adopt the rest of the rules as expeditiously as practical, but no later than July 31, 2001; 4) to submit a Post-99 ROP analysis by December 31, 2000; 5) to perform a mid-course review by May 1, 2004; and 6) to perform new mobile source modeling, using MOBILE6, within 24 months of the model's release. In addition, if a transportation conformity analysis is to be performed between 12 months and 24 months after the MOBILE 6 release, transportation conformity will not be determined until Texas submits an MVEB which is developed using MOBILE 6 and which the EPA finds adequate. Finally, if any of the measures adopted in the SIP pertain to motor vehicles, the commission commits to recalculate and resubmit a MVEB by December 31, 2000.

The BPA area is classified as moderate, and therefore was required to attain the 1-hour ozone standard by November 15, 1996. The BPA area did not attain the standard by that date, and also did not attain the standard by November 15, 1999, the attainment date for serious areas. In determining the appropriate attainment date for an area, EPA may consider the effect of transport of ozone or its precursors from an upwind area which interferes with the downwind area's ability to attain. On April 16, 1999, EPA proposed in the *Federal Register* to allow BPA to take advantage of the transport guidance if an approvable attainment demonstration is submitted by November 15, 1999. The SIP revision, adopted by the commission on October 27, 1999 and submitted to EPA by November 15, 1999, contained results of photochemical modeling demonstrating transport from HGA to BPA, and, following EPA's transport guidance, demonstrating that BPA attains the 1-hour ozone standard. In addition, the November 1999 SIP revision contained adopted rules for IWW and batch process sources to ensure that VOC emission limits for these sources meet EPA's guidelines for RACT. Furthermore, the SIP revision included adopted rules establishing NO_x RACT emission limits for gas-fired, lean-burn stationary internal combustion engines. These NO_x rules represented "Phase I" of a two-part revision to the BPA attainment demonstration SIP.

The April 2000 SIP revision represented "Phase II" of the BPA attainment demonstration SIP, and contained adopted rules specifying NO_x emission limits for electric utility boilers, industrial boilers, and industrial process heaters. In accordance with EPA guidance, implementation of these NO_x emission limits represented a reasonable level of control, necessary for an approvable attainment demonstration. Modeling of these Phase II reductions showed that the BPA area attains the 1-hour ozone standard, using WOE analyses.

The DFW area's attainment deadline as a serious ozone nonattainment area was November 15, 1999. In March 1999 the state submitted an attainment demonstration to EPA, however this SIP submittal did not contain the necessary rules to bring the DFW area into attainment by the November 1999 deadline. As a result, EPA issued a letter of findings that the March 1999 submittal was incomplete. This findings triggered an 18-month sanctions clock effective May 13, 1999.

The state now has mounting technical data which suggests that DFW is significantly impacted by transport and regional background levels of ozone. The reductions from the strategies needed for the HGA area and the regional rules discussed are a necessary and integral component in the strategy for DFW's attainment of the 1-hour ozone standard. The April 2000 SIP contained a modeling demonstration which showed that the air quality in the DFW area is influenced at times from the HGA area. This demonstration, if approved by EPA, would allow EPA to determine that the DFW area should not be bumped up to a more severe classification. It would also allow DFW to have until no later than November 15, 2007, the attainment date for HGA, to reach attainment.

In order to develop local control strategy options to augment federal and state programs, the DFW area established a North Texas Clean Air Steering Committee made up of local elected officials and business leaders. Specific control strategies were identified for review by technical subcommittee members. In addition, the NCTCOG hired an environmental consultant to assist with the analysis and evaluation of control strategy options. The consultant was responsible for presenting the findings of the technical subcommittees to the NCTCOG air quality policy and steering committees for final approval prior to being submitted to the state. A WOE argument was developed for DFW which consisted of several elements which, taken together, formed a compelling argument that attainment will be achieved by 2007.

On April 19, 2000 the state adopted a revision to the Northeast Texas FAR SIP. The Flexible Attainment Region Agreement requires that contingency measures be implemented as a result of exceedances of the National Ambient Air Quality Standard for ozone. As outlined in the FAR Action Plan under Part B, Contingent Measures, in the event of a subsequent violation the SIP must be revised to include quantifiable and enforceable control measures. Through the use of Agreed Orders these measures were adopted and included in the Northeast Texas FAR SIP to make them federally enforceable.

On May 3, 2000 the state adopted a revision to the TCM and VMT portions of the SIP. This revision required TCM project-specific descriptions and estimated emissions reductions to be included in the SIP and allowed nonattainment area MPOs to substitute TCMs without a SIP revision if the substitution results in equal or greater emission reductions.

Background on the Current Revision

The development of the current attainment demonstration SIP for the HGA area has proved to be an extremely challenging effort, due to the magnitude of reductions needed for attainment and the shortage of readily available control options. The emission reduction requirements included as part of this SIP revision represent substantial, intensive efforts on the part of stakeholder coalitions in the HGA area, in partnership with the commission. These coalitions, involving local governmental entities, elected officials, environmental groups, industry, consultants, and the public, as well as the commission and EPA, have worked diligently to identify and quantify control strategy measures for the HGA attainment demonstration.

In order for the state to have an approvable attainment demonstration, the EPA has indicated that the state must adopt those strategies modeled in the November 1999 SIP submittal, and then adopt sufficient measures to close the remaining gap in NO_x emissions. The modeling included in this revision indicates an emissions gap such that an additional 91 tpd of NO_x reductions is necessary for an approvable attainment demonstration. The HGA nonattainment area will need to ultimately reduce NO_x by more than 750 tons per day to reach attainment with the 1-hour ozone standard. In addition, a VOC reduction of about 25% will also have to be achieved.

The current SIP revision contains rules and photochemical modeling analyses in support of the HGA ozone attainment demonstration. In addition, this SIP contains post-1999 ROP plans for the milestone years 2002 and 2005, and for the attainment year 2007. The SIP contains transportation conformity MVEBs for NOx and VOC. The SIP also contains enforceable commitments to implement further measures in support of the HGA attainment demonstration, as well as a commitment to perform and submit a mid-course review. Implementation of the rules and other control measures contained in this SIP revision will close the gap and achieve attainment of the 1-hour ozone standard in the HGA area by November 15, 2007, the date required for attainment.

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CHAPTER 1: GENERAL

1.1 BACKGROUND

The HGA ozone nonattainment area is classified as Severe-17 under the FCAA Amendments of 1990 (42 United States Code (USC) §§7401 et seq.), and therefore is required to attain the 1-hour ozone standard of 0.12 ppm by November 15, 2007. The HGA area, defined by Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, has been working to develop a demonstration of attainment in accordance with 42 USC §7410. On January 4, 1995, the state submitted the first of its Post-1996 SIP revisions for HGA.

The January 1995 SIP consisted of UAM modeling for 1988 and 1990 base case episodes, adopted rules to achieve a 9% ROP reduction in VOCs, and a commitment schedule for the remaining ROP and attainment demonstration elements. At the same time, but in a separate action, the State of Texas filed for the temporary NO_x waiver allowed by §182(f) of the FCAA. The January 1995 SIP and the NO_x waiver were based on early base case episodes which marginally exhibited model performance in accordance with EPA modeling performance standards, but which had a limited data set as inputs to the model. In 1993 and 1994, the commission was engaged in an intensive data-gathering exercise known as the COAST study. The state believed that the enhanced EI, expanded ambient air quality and meteorological monitoring, and other elements would provide a more robust data set for modeling and other analysis, which would lead to modeling results that the commission could use to better understand the nature of the ozone air quality problem in the HGA area.

Around the same time as the 1995 submittal, EPA policy regarding SIP elements and time lines went through changes. Two national programs in particular resulted in changing deadlines and requirements. The first of these programs was the OTAG. This group grew out of a March 2, 1995 memo from Mary Nichols, former EPA Assistant Administrator for Air and Radiation, that allowed states to postpone completion of their attainment demonstrations until an assessment of the role of transported ozone and precursors had been completed for the eastern half of the nation, including the eastern portion of Texas. Texas participated in this study, and it has been concluded that Texas does not significantly contribute to ozone exceedances in the Northeastern U.S. The other major national initiative impacting the SIP planning process has been the revisions to the national ozone standard. EPA promulgated a final rule on July 18, 1997 changing the ozone standard to an 8-hour standard of 0.08 ppm. In November 1996, concurrent with the proposal of the standards, EPA proposed an IIP that it believed would help areas like HGA transition from the old to the new standard. In an attempt to avoid a significant delay in planning activities, Texas began to follow this guidance, and readjusted its modeling and SIP development time lines accordingly. When the new standard was published, EPA decided not to publish the IIP, and instead stated that, for areas currently exceeding the 1-hour ozone standard, that standard would continue to apply until the area attained. The FCAA requires that HGA attain the standard by November 15, 2007.

EPA issued revised draft guidance for areas such as HGA that do not attain the 1-hour ozone standard. The commission adopted on May 6, 1998 and submitted to EPA on May 19, 1998 a revision to the HGA SIP which contained the following elements in response to EPA's guidance:

- ♦ UAM modeling based on emissions projected from a 1993 baseline out to the 2007 attainment date;

- An estimate of the level of VOC and NO_x reductions necessary to achieve the 1-hour ozone standard by 2007;
- A list of control strategies that the state could implement to attain the 1-hour ozone standard;

- A schedule for completing the other required elements of the attainment demonstration;

- A revision to the Post-1996 9% ROP SIP that remedied a deficiency that EPA believed made the previous version of that SIP unapprovable; and

- Evidence that all measures and regulations required by Subpart 2 of Title I of the FCAA to control ozone and its precursors have been adopted and implemented, or are on an expeditious schedule to be adopted and implemented.

In November 1998, the SIP revision submitted to EPA in May 1998 became complete by operation of law. However, EPA stated that it could not approve the SIP until specific control strategies were modeled in the attainment demonstration. EPA specified a submittal date of November 15, 1999 for this modeling. In a letter to EPA dated January 5, 1999, the state committed to model two strategies showing attainment.

As the HGA modeling protocol evolved, the state eventually selected and modeled seven basic modeling scenarios. As part of this process, a group of HGA stakeholders worked closely with commission staff to identify local control strategies for the modeling. These local strategies are described in Chapter 3 under Scenarios III and VI. Some of the scenarios for which the stakeholders requested evaluation included options such as California type fuel and vehicle programs as well as an ASM-equivalent I/M program. Other scenarios incorporated the estimated reductions in emissions that were expected to be achieved throughout the modeling domain as a result of the implementation of several voluntary and mandatory statewide programs adopted or planned independently of the SIP. It should be made clear that the commission did not propose that any of these strategies be included in the ultimate control strategy submitted to EPA in 2000. The need for and effectiveness of any controls which may be implemented outside the 8-county area will be evaluated on a county by county basis.

The SIP revision was adopted by the commission on October 27, 1999 and submitted to EPA by November 15, 1999, and contained the following elements:

- Photochemical modeling of potential specific control strategies for attainment of the 1-hour ozone standard in the HGA area by the attainment date of November 15, 2007;

- An analysis of seven specific modeling scenarios reflecting various combinations of federal, state, and local controls in HGA. Additional scenarios H1 and H2 build upon Scenario VIf;

- Identification of the level of reductions of VOC and NO_x necessary to attain the 1-hour ozone standard by 2007;

- A 2007 mobile source budget for transportation conformity;

- Identification of specific source categories which, if controlled, could result in sufficient VOC and/or NO_x reductions to attain the standard;

- A schedule committing to submit by April 2000 an enforceable commitment to conduct a mid-course review; and

- A schedule committing to submit modeling and adopted rules in support of the attainment demonstration by December 2000.

As the result of an agreed settlement between several environmental groups and EPA, in November 1999 EPA informed the state that an additional SIP revision was required in order to quantify additional potential reductions to fill the shortfall or “gap” needed for attainment. This “gap closure” SIP, submitted by the commission in April 2000, contained the following enforceable commitments by the state:

- To quantify the shortfall of NO_x reductions needed for attainment;

- To list and quantify potential control measures to meet the shortfall of NO_x reductions needed for attainment;

- To adopt the majority of the necessary rules for the HGA attainment demonstration by December 31, 2000, and to adopt the rest of the shortfall rules as expeditiously as practical, but no later than July 31, 2001;

- To submit a Post-99 ROP plan by December 31, 2000;

- To perform a mid-course review by May 1, 2004; and

- To perform modeling of mobile source emissions using MOBILE6, to revise the on-road mobile source budget as needed, and to submit the revised budget within 24 months of the model’s release. In addition, if a conformity analysis is to be performed between 12 months and 24 months after the MOBILE6 release, the state will revise the MVEB so that the conformity analysis and the SIP MVEB are calculated on the same basis.

The development of the current attainment demonstration SIP for the HGA area has proved to be an extremely challenging effort, due to the magnitude of reductions needed for attainment and the shortage of readily available control options. The emission reduction requirements included as part of this SIP revision represent substantial, intensive efforts on the part of stakeholder coalitions in the HGA area, in partnership with the commission. These coalitions, involving local governmental entities, elected officials, environmental groups, industry, consultants, and the public, as well as the commission and EPA, have worked diligently to identify and quantify control strategy measures for the HGA attainment demonstration.

In order for the state to have an approvable attainment demonstration, the EPA has indicated that the state must adopt those strategies modeled in the November 1999 SIP submittal, and then adopt sufficient measures to close the remaining gap in NO_x emissions. EPA has not provided guidance to implement Section 185 of the FCAA Amendments of 1990. The commission believes that further coordination with EPA is necessary to assure an acceptable implementation method. The modeling included in this proposal indicates an emissions gap such that an additional 91 tpd of NO_x reductions is necessary for an approvable attainment demonstration. The HGA nonattainment area will need to ultimately reduce NO_x by more than 750 tpd to reach attainment with the 1-hour ozone standard. In addition, a VOC reduction of about 25% will also have to be achieved.

The current SIP revision contains rules and photochemical modeling analyses in support of the HGA ozone attainment demonstration. In addition, this SIP contains post-1999 ROP plans for the milestone years 2002 and 2005, and for the attainment year 2007. The SIP contains transportation conformity MVEBs for NOx and VOC. The SIP also contains enforceable commitments to implement further measures in support of the HGA attainment demonstration, as well as a commitment to perform and submit a mid-course review. Implementation of the rules and other control measures contained in this SIP revision will close the gap and achieve attainment of the 1-hour ozone standard in the HGA area by November 15, 2007, the date required for attainment.

1.2 PUBLIC HEARING INFORMATION

The commission held public hearings at the following times and locations:

CITY	DATE	TIME	LOCATION
Conroe	September 18, 2000	10:00 a.m.	Lone Star Convention Center 9055 Airport Road (FM 1484)
Lake Jackson	September 18, 2000	7:00 p.m.	Lake Jackson Civic Center 333 Highway 332 East
Houston	September 19, 2000	10:00 a.m.	George Brown Convention Center 1001 Avenida De Las Americas
Houston	September 19, 2000	7:00 p.m.	George Brown Convention Center 1001 Avenida De Las Americas
Katy	September 20, 2000	9:00 a.m.	VFW Hall 6202 George Bush Drive
Pasadena	September 20, 2000	6:00 p.m.	East Harris County Community Center 7340 Spencer
Beaumont	September 21, 2000	10:00 a.m.	Southeast Texas Regional Airport Media Room 6000 Airline Drive
Amarillo	September 21, 2000	2:00 p.m.	City Commission Chambers City Hall 509 E. 7th Street
Texas City	September 21, 2000	6:00 p.m.	Charles T. Doyle Convention Center 21st Street at Phoenix Lane
Dayton	September 22, 2000	10:00 a.m.	Dayton High School 2nd Floor Lecture Room 3200 N. Cleveland
El Paso	September 22, 2000	11:00 a.m.	El Paso City Council Chambers 2 Civic Center Plaza, 2nd Floor
Arlington	September 22, 2000	2:00 p.m.	North Central Texas Council of Governments 2nd Floor Board Room 616 Six Flags Drive, Suite 200
Austin	September 25, 2000	10:00 a.m.	TNRCC 12100 N. I-35, Building E, Room 201S
Corpus Christi	September 25, 2000	2:00 p.m.	Natural Resources Center 6300 Ocean Drive Suite 1003

Written comments were also accepted via mail, fax, or e-mail. The public comment period closed on September 25, 2000.

1.3 SOCIAL AND ECONOMIC CONSIDERATIONS
For a detailed explanation of the social and economic issues involved with any proposed strategies, please refer to the preambles that precede each rule package accompanying this SIP.

1.4 FISCAL AND MANPOWER RESOURCES
The state has determined that its fiscal and manpower resources are adequate and will not be adversely affected through implementation of this plan.

CHAPTER 2: EMISSIONS INVENTORY

2.1 OVERVIEW

The 1990 Amendments to the FCAA require that EIs be prepared for ozone nonattainment areas. Because ozone is photochemically produced in the atmosphere when VOCs are mixed with NO_x and CO[1] in the presence of sunlight, it is important that the agency compile information on the important sources of these precursor pollutants. It is the role of the EI to identify the source types present in an area, the amount of each pollutant emitted and the types of processes and control devices employed at each plant or source category. The EI provides data for a variety of air quality planning tasks, including establishing baseline emission levels, calculating reduction targets, control strategy development for achieving the required emission reductions, emission inputs into air quality simulation models, and tracking actual emission reductions against the established emissions growth and control budgets. The total inventory of emissions of VOC, NO_x, and CO for an area is summarized from the estimates developed for five general categories of emissions sources, which are each explained below.

While the November 1999 SIP for HGA was being developed, the commission, HGA stakeholders, and consultants recognized the need to improve and refine certain portions of the EI for the attainment demonstration SIP. In the November 1999 SIP, the commission committed to the following:

- ♦ Identification and examination of the accuracy of some key assumptions used in the inventory development, including spatial and temporal allocations, and

- ♦ Identification and critical review of growth assumptions used to project the inventory to 2007.

As a result, work was completed on a number of intensive EI projects, which are summarized briefly in this section and discussed in more detail in the appendices. Specifically, new EIs for airport GSE, HDD construction equipment, and commercial marine vessels were prepared by HGA stakeholders and submitted to the commission staff, which performed additional photochemical modeling with the revised data. The modeling results were then used to redefine the gap list for the HGA attainment demonstration. Chapter 3, Photochemical Modeling, contains a detailed description of the modeling work performed, using the revised EI data.

2.2 POINT SOURCES

Major point sources are defined for inventory reporting purposes in nonattainment areas as industrial, commercial, or institutional which emit actual levels of criteria pollutants at or above the following amounts: 10 tpy of VOC, 25 tpy of NO_x, or 100 tpy of any of the other criteria pollutants which include CO, SO_x, PM_{10}, or lead. For the attainment areas of the state, any company which emits a minimum of 100 tpy of any criteria pollutant must complete an inventory. Additionally, any source which generates or has the potential to generate at least 10 tpy of any single HAP or 25 tpy of aggregate HAP is also required to report emissions to the commission.

To collect emissions and industrial process operating data for these plants, the commission mails EIQs to all sources identified as having triggered the level of emissions. Companies are asked to report not only

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[1]CO plays a relatively minor role in ozone formation compared with VOC and NO_x.

emissions data for all emissions generating units and emission points, but also the type and, for a representative sample of sources, the amount of materials used in the processes which result in emissions. Information is also requested in the EIQ on process equipment descriptions, operation schedules, emissions control devices currently in use, abatement device control efficiency, and stack parameters such as location, height, and exhaust gas flow rate. All data submitted via the EIQ is then subjected to rigorous quality assurance procedures by the technical staff of the Industrial Emissions Assessment Section and entered into the PSDB by the Data Services Section. Appendix S documents the procedures used for updates to the point source ROP inventories.

2.3 AREA SOURCES

To capture information about sources of emissions that fall below the point source reporting levels and are too numerous or too small to identify individually, calculations have been performed to estimate emissions from these sources on a source category or group basis. Area sources are commercial, small-scale industrial, and residential categories of sources which use materials or operate processes which can generate emissions. Area sources can be divided into two groups characterized by the emission mechanism: hydrocarbon evaporative emissions or fuel combustion emissions. Examples of evaporative losses include: printing, industrial coatings, degreasing solvents, house paints, leaking underground storage tanks, gasoline service station underground tank filling, and vehicle refueling operations. Fuel combustion sources include stationary source fossil fuel combustion at residences and businesses, as well as outdoor burning, structural fires and wildfires. These emissions, with some exceptions, may be calculated by multiplication of an established emission factor (emissions per unit of activity) times the appropriate activity or activity surrogate responsible for generating emissions. Population is the most commonly used activity surrogate for many ASCs, while other activity data include amount of gasoline sold in an area, employment by industry type, and acres of cropland.

The forecasting years' emissions inventories were compiled by using the EPA Economic Growth Analysis System (EGAS) growth factors for each area source category. This is the standard and accepted method for developing future year emissions inventories. The EGAS contains individual growth factors for each category for each forecasting year.

2.4 ON-ROAD MOBILE SOURCES

On-road mobile sources consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways in the nonattainment area. Combustion related-emissions are estimated for vehicle engine exhaust; evaporative hydrocarbon emissions are estimated for the fuel tank and other evaporative leak sources on the vehicle. Emission factors have been developed using the EPA's mobile emissions factor model, MOBILE5a_h. Various inputs are provided to the model to simulate the vehicle fleet driving in each particular nonattainment area. Inputs include such parameters as vehicle speeds by roadway type, vehicle registration by vehicle type and age, percentage of vehicles in cold start mode, percentage of miles traveled by vehicle type, type of I/M program in place, and gasoline vapor pressure. All of these inputs have an impact on the emission factor calculated by the MOBILE model, and every effort is made to input parameters reflecting local conditions. To complete the emissions estimate the emission factors calculated by the MOBILE model must then be multiplied by the level of vehicle activity, VMT. The level of vehicle travel activity is developed from travel demand models run by the Texas Department of Transportation or the local council of governments. The travel demand models have been validated against a large number of ground counts of traffic passing over counters placed in various locations throughout each county. Estimates of VMT are often calibrated to outputs from the federal Highway Performance Monitoring

System, which is a model built from a smaller number of traffic counters. Finally, roadway speeds, which are required for the MOBILE model's input, are calculated by a post-processor to the travel demand model.

Complete documentation of the on-road mobile inventories for ROP is available in Appendices T and U. The complete set of input and output files for the MOBILE5a_h mode are available upon request to the commission's Technical Analysis Division.

2.5 NON-ROAD MOBILE SOURCES

Non-road mobile sources are a subset of the area source category. This subcategory includes aircraft operations, marine vessels, recreational boats, railroad locomotives, and a very broad category of off-highway equipment that includes everything from 600-horsepower engines mounted on construction equipment to 1-horsepower string trimmers. Calculation methods for emissions from non-road engine sources are based on information about equipment population, engine horsepower, load factor, emission factor, and annual usage. Emission estimates for all sources in the non-road category except aircraft, locomotives, commercial marine vessels, diesel construction equipment, and airport support equipment were originally developed by a contractor to EPA's Office of Transportation Air Quality as a 1990 emissions inventory. Emissions were originally projected to later years based on EPA's Economic Growth Analysis System (EGAS) model. Subsequently, several projects using improved methodologies revised the inventory for some categories. The revised 2007 emissions inventory for construction equipment in HGA used by the commission modeling staff was based on updated methodologies, revised equipment populations, and revised activity data (hours per year of operation by equipment type/HP range). The updated methodologies used were an integral part of the EPA NONROAD model, versus the outdated NEVES methodologies. Diesel-powered construction equipment ($\geq$ 50 HP) population data, except cranes, were from the ERG/Starcrest report (see Appendix B). All other population data used were NONROAD model default values. The activity data used were developed by ERG and Starcrest as reported, with the exceptions of diesel powered equipment < 50 HP and all cranes. The activity data used for diesel powered equipment < 50 HP and all cranes were EPA NONROAD model default values. The current SIP has been updated with the more refined and accurate data.

Additionally, recently completed survey work refined the data sets needed to calculate the emissions from the commercial marine activity at the Houston port (see Appendix C). The data were checked against independent data sources to provide corroboration of the activity estimates being made.

Aircraft emissions were estimated from landings and takeoff data for airports used in conjunction with the EDMS aircraft emissions model. Also, emissions from airport GSE (see Appendix A) were estimated with new methods involving the use of local survey data. Locomotive emissions were developed from fuel use and track mileage data obtained from individual railroads. The current adopted SIP reflects these updated, more refined emissions data. More information on non-road is included in Appendix V.

2.6 BIOGENIC SOURCES

Biogenic sources are another subset of area source which includes hydrocarbon emissions from crops, lawn grass, and forests as well as a small amount of NO_x emissions from soils. Plants are sources of VOC such as isoprene, monoterpene, and alpha-pinene. Tools for estimating emissions include satellite imaging for mapping of vegetative types, field biomass surveys, and computer modeling of emissions estimates based on emission factors by plant species (PCBEIS-2). Emissions from biogenic sources are subtracted from the inventory prior to determining any required reductions for a rate of progress plan. However, the biogenic emissions are important in determining the overall emissions profile of an area and therefore are required for regional air quality dispersion modeling.

2.7 EMISSIONS SUMMARY

The September 8, 1993 base case emissions inventory summary for the HGA ozone nonattainment area is shown in Figures 2.7-1 (VOC) and 2.7-2 (NO_x). It is evident from the pie charts that for NO_x, the greatest man-made contribution is from point sources, and for VOC, from biogenic sources. Contributions from biogenic emissions are included in the summary, although the SIP control strategies are limited to the reduction of man-made emissions only. The contributions from VOC sources in the 1993 base case inventory include the following: on-road mobile sources 9%; area and non-road sources 14%; point sources 19%; and biogenic sources 58%. The contributions from NO_x sources in the 1993 base case inventory are as follows: on-road mobile sources 32%; area and non-road sources 12%; point sources 54%; and biogenic sources 1%.

The 2007 future base emission inventory for the HGA area is summarized in Figures 2.7-3 (VOC) and 2.7-4 (NO_x). The 2007 future base emissions inventory is an estimation that is projected forward from the 1993 base case inventory, using specific procedures approved by the EPA. The contribution from VOC sources in the 2007 base case inventory are as follows: on-road mobile source 5%; area and non-road sources 14%; point sources 13%, and biogenic sources 67%. Contribution from NO_x is as follows: on-road mobile sources 19%; area and non-road sources 13%; point sources 66%; and biogenic sources 2%.

Figure 2.7-1 1993 VOC Emissions in HGA

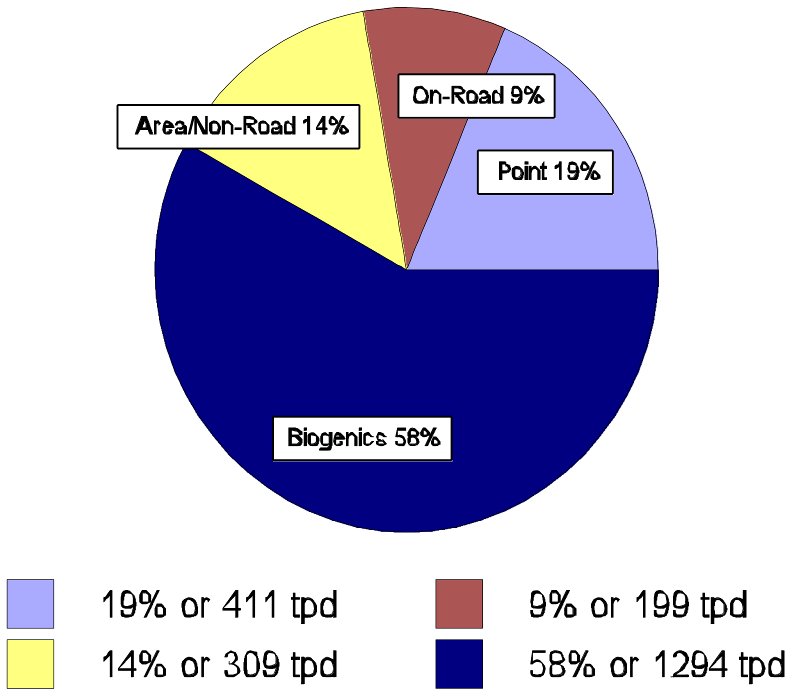


Figure 2.7-2 1993 NOx Emissions in HGA

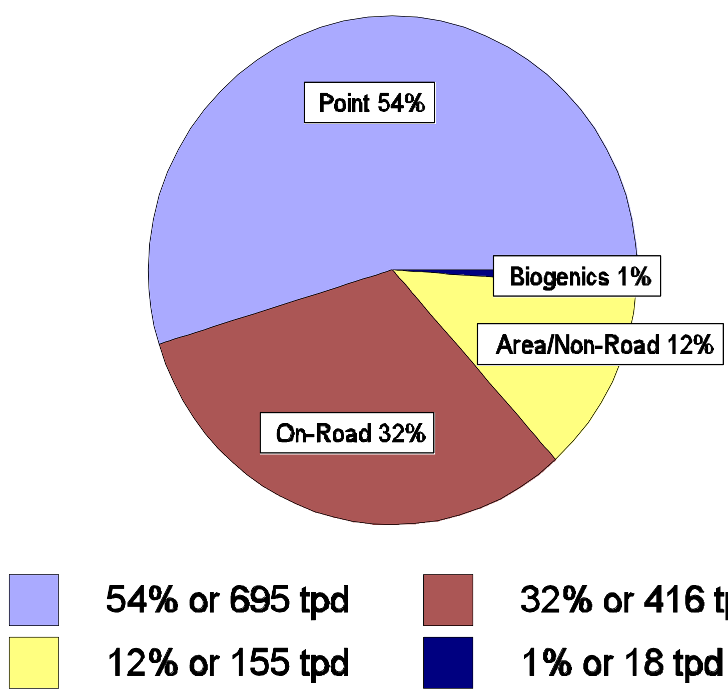


Figure 2.7-3 2007 VOC Emissions in HGA

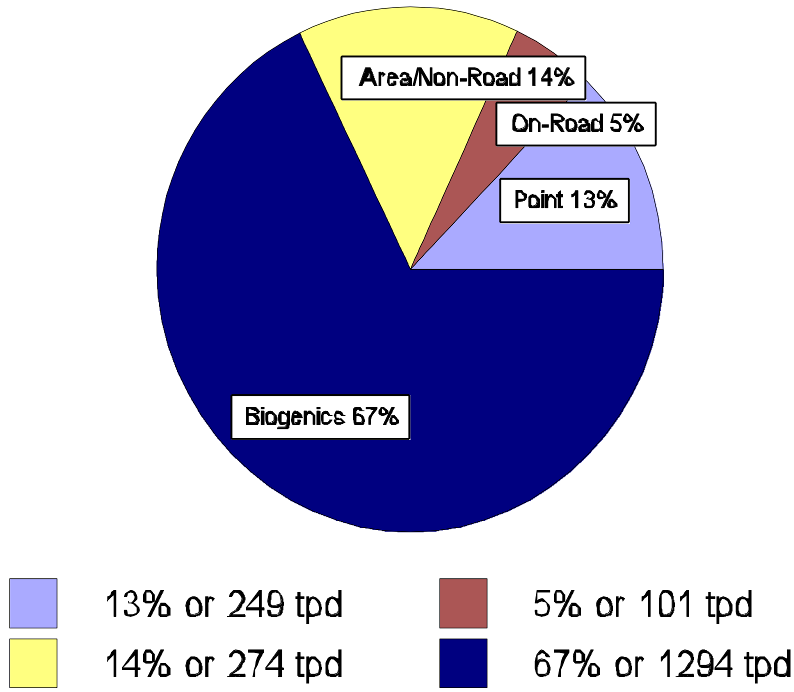
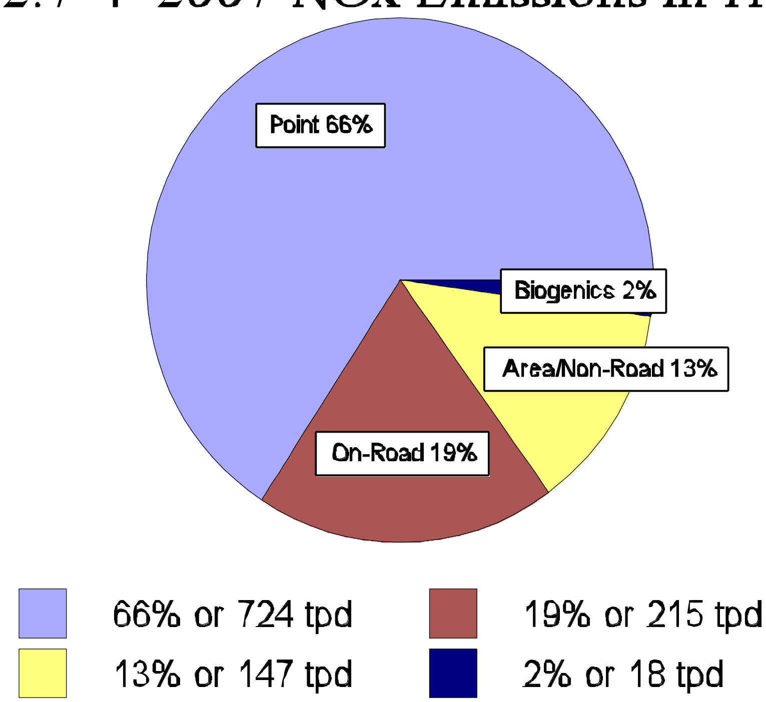


Figure 2.7-4 2007 NOx Emissions in HGA



2.8 TRANSPORTATION CONFORMITY

Transportation conformity is required by §176(c) of the FCAA. The FCAA requires that transportation plans, programs, and projects conform to SIPs in order to receive federal transportation funding and project approvals. Conformity to a SIP means that transportation activities will not cause or contribute to new air quality violations, increase the frequency or severity of existing violations, or delay timely attainment of the NAAQS. EPA's transportation conformity rule (40 CFR Parts 51 and 93) contains criteria and procedures for making conformity determinations for transportation plans, programs, and projects. The Texas transportation conformity rule (30 TAC §114.260) adopts EPA's rule by reference, contains Texas specific consultation procedures and is the enforcement mechanism for transportation conformity requirements in Texas. Currently, the 2022 MTP and the 2000-2002 TIP conform to the May 1998 ROP SIP.

2.9 MOTOR VEHICLE EMISSIONS BUDGETS

EPA requires all ROP and attainment demonstration SIPs to establish motor vehicle emissions budgets for transportation conformity purposes. As described in Chapter 7, the commission will be evaluating new technologies and programs during the next four year mid-course review process. As these technologies or programs develop sufficiently to warrant rules, the commission will also evaluate their impact on the mobile source budget and revise it accordingly. Currently the technologies being studied could reduce the mobile source budget by as much as 38 tpd. Likewise, Chapter 7 describes a number of technical studies underway which are designed to improve the assumptions upon which the modeling is based. As these enhancements are incorporated into the model, the commission will be evaluating the overall control strategy. Again, to the extent these re-evaluations have an impact on the mobile source budget, the commission will revise it accordingly.

A motor vehicle emission budget is the on-road mobile source allocation of the total allowable emissions for each applicable criteria pollutant or precursor, as defined in the SIP. Transportation conformity determinations must be performed using the budget test, once EPA determines the budget(s) adequate for transportation conformity purposes. In order to pass the budget test, areas must demonstrate that the estimated emissions from transportation plans, programs and projects do not exceed the motor vehicle emissions budget(s).

The motor vehicle emissions budgets for the 8-county HGA nonattainment area are listed in the Table 2.9-1 (ROP budgets) and 2.9-2 (attainment budgets). The attainment budgets in Table 2.9-2 represent the 2007 projected on-road mobile source VOC and NO_x emissions that demonstrate attainment.

Table 2.9-1 2002, 2005, and 2007 ROP Motor Vehicle Emission Budgets for HGA

	NO_x (tpd)	VOC (tpd)
2002 ROP budget	260.85	100.07
2005 ROP budget	185.48	68.52
2007 ROP budget	189.17	71.84

Table 2.9-2 2007 Attainment Demonstration Motor Vehicle Emission Budgets for HGA

	NO_x (tpd)	VOC (tpd)
2007 on-road emissions projection (after modeling of base control measures)	164.43	81.46
2007 on-road gap control measures	–12.81	–1.95
2007 budget	151.60	79.51

CHAPTER 3: PHOTOCHEMICAL MODELING

3.1 BACKGROUND

The commission and its predecessor, the TACB, have submitted a number of SIP revisions for the HGA ozone nonattainment area based on photochemical modeling. The first of these SIP revisions was submitted to the EPA in 1994, but was based on limited observational data and used (by current standards) rather primitive modeling tools including the Urban Airshed Model version IV (UAM-IV) and the Colorado State University Meteorological Model. The modeling analysis in that SIP indicated that reducing NO_x emissions by as much as 50% would significantly increase peak ozone in the HGA area (this phenomenon is sometimes called a "NO_x disbenefit"). The TACB asked for, and was granted, a conditional waiver from implementing NO_x RACT rules in HGA under the provisions of §182(f) of the 1990 FCAA Amendments.

In the summer of 1993, TACB, along with several public and private partners, conducted an ambitious field study designed to collect data which would allow ozone formation along the Texas Gulf Coast to be better understood and more accurately simulated. The study was known as the COAST. The TACB, and later the commission, began a second round of photochemical modeling which incorporated the COAST data and utilized the variable-grid version of the UAM called UAM-V and an improved meteorological model known as the Systems Applications International Meteorological Model. The SIP revision submitted in 1998 used this modeling to conclude that VOC reductions alone would be insufficient to bring the HGA area into attainment of the ozone NAAQS, and that NO_x reductions would be necessary, even though the modeling still predicted a moderate NO_x disbenefit until reductions of over 50% were achieved. No specific controls were modeled in that round of modeling, but across-the-board reductions were tested, and it was concluded that NO_x reductions of around 85% would be necessary to reach attainment. The commission received a one-year extension of the conditional §182(f) waiver for HGA, and the waiver expired on December 31, 1997.

On October 27, 1999, the commission adopted another SIP revision in which specific control strategies were evaluated. However, no rules were adopted at that time. This modeling incorporated some revisions to the emissions data, and used CAMx instead of UAM-V. Several combinations of controls were tried, but none were able to demonstrate attainment except under certain assumptions which proved unacceptable to EPA. As a result, the final control strategy (called Strategy H2) still showed modeled peak ozone concentrations substantially above the NAAQS.

Because several other areas were faced with a similar situation, the EPA developed guidance for determining how much additional reduction would be necessary to reach attainment (the "gap"), and for identifying measures to fill the gap. In order for the state to have an approvable attainment demonstration, the EPA has indicated that the state must adopt those strategies modeled in the November 1999 SIP submittal, and then adopt sufficient measures to close the remaining gap in NO_x emissions. The HGA nonattainment area will need to ultimately reduce NO_x by more than 750 tpd to reach attainment with the 1-hour ozone standard. In addition, a VOC reduction of about 25% will also be achieved.

The current modeling application represents the third phase of modeling based on the COAST study, so is henceforth referred to as the "Phase 3 Modeling." The modeling submitted in the 1999 SIP revision will be referred to as "Phase 2 Modeling." Both the 1999 and 2000 HGA SIP revisions can be obtained at http://www.tnrcc.state.tx.us/oprd/sips.html.

3.2 INTRODUCTION

Photochemical modeling was performed for the current SIP revision, primarily to incorporate better inventory data and improved modeling methodology into the process. The modeling described in this document supplants the modeling discussed in the 1999 SIP revision, and will be used to re-calculate the gap described in the April 2000 SIP revision. Because much of the modeling input data and setup were documented in the 1998 and 1999 SIP revisions, this document primarily details those items that have changed since the last round of modeling. Significant changes for the current SIP revision include:

- Use of CAMx-2 (version 2 of CAMx), which incorporates several enhancements to the previous version, as well as providing a number of new features.

- Merging of the regional modeling domain with the COAST domain into a single SuperCOAST domain. This change allows modeling to be conducted in one step instead of two as was done previously.

- Improved biogenic emissions estimates, using the new GloBEIS model.

- Updated emissions from construction equipment, based on activity data collected from extensive surveys.

- Updated emissions from ships, with emissions from stacks treated as elevated point sources.

- Updated emissions from airport GSE.

- New spatial surrogates based on demographic projections provided by the HGAC. These new surrogates allow emissions from certain sources to be allocated more realistically in simulations of the 2007 attainment year.

- Revised attainment year point source emissions based on more current inventory data.

- New growth estimates for area and non-road mobile sources based on HGAC demographic data.

- Updated control factors for control strategy modeling.

Because the Phase 3 modeling builds upon modeling already performed in Phase 2, this SIP will not discuss in detail the portions of the modeling analysis unchanged from the Phase 2 work documented in the 1999 SIP revision. Rather, this document will discuss how the modeling analysis has changed from the Phase 2 analysis, then will describe the control strategy modeling performed to demonstrate attainment of the ozone NAAQS. Specifically, the interested reader should refer to the 1998 and 1999 SIP documentation for detailed discussions of episode selection, meteorology, initial and boundary conditions, and the definition of the modeling domain and subdomains.

The modeling inventory was based on the COAST special study and represents the best available characterization of the specific episode days modeled. Since 1990, many enhancements have been made to the modeling inventory, some of which have increased the emissions while others have decreased it. The 1998 and 1999 SIP revisions, along with this SIP revision detail the evolution of the current modeling inventory. Thus, the emissions modeled in this attainment demonstration differ substantially from the 1990 base inventory, as expected.

3.3 THE 1993 PHASE 3 BASE CASE

This section describes the changes made to the previous base case, and provides a comparison of base-case model performance.

3.3.1 CAMx Version 2

For phase 3 of the HGA modeling, the commission migrated from version 1 to version 2 (release 2.03) of CAMx, noted as CAMx-2 (note: in this document, the term "CAMx" is understood to refer to version 2, unless stated otherwise). CAMx-2 offers several enhancements over the original version. For information on CAMx, the reader is referred to the CAMx web site at http://www.camx.com.

3.3.2 The SuperCOAST Modeling Domain

As described in the 1998 and 1999 SIP revisions, earlier modeling was conducted in two steps. First, a regional model was run, then results of this regional model run were post-processed to develop initial and lateral boundary conditions for the COAST modeling domain. These boundary and initial conditions were then used in subsequent modeling for the HGA area. Because many of the modeling analyses involved relatively minor changes on a regional scale, it was not necessary to re-run the regional model each time the COAST modeling was revised. However, on several occasions it was decided that the regional model needed to be re-run and new boundary conditions developed for COAST. Merging the regional and COAST modeling domains into a single modeling domain removes the need to perform this extra step.

The merged modeling domain, called SuperCOAST, consists of a large 16 km × 16 km coarse grid (same as the regional modeling domain used formerly), with a single nested 4 km × 4 km fine grid which covers the HGA and BPA nonattainment counties (same as the fine grid domain used in the previous COAST domain modeling). Figure 3.3-1 shows the SuperCOAST domain with the nested grid. Shown for reference purposes only is the boundary of the original COAST domain. Appendix D describes how the COAST and regional meteorology and emissions were combined to provide input to the SuperCOAST modeling.

3.3.3 Revised Biogenic Emissions

Since the previous modeling analysis for the HGA area, the commission has adopted the newest model in the BEIS line, called Global BEIS or GloBEIS. This model is based upon recent work by Guenther et al. 1995, 1998, 1999, 2000. GloBEIS represents several advances over the model formerly used, BIOME. In addition, the commission contracted with Environ, Inc. to develop a comprehensive land-use database for Texas and the surrounding states (including northern Mexico). This database incorporates land-use and biomass data collected in several field studies across eastern Texas, and updates data for surrounding areas using the most current information available. Note that the previous modeling for HGA already used the most current land-use and biomass within the HGA and surrounding areas, so the only changes in the HGA (and BPA) areas are due to the use of the GloBEIS model instead of BIOME.

Important features of the revised biogenics estimates include:

- Correction of some errors present in the BEIS2 model (Guenther et al. 1998, 1999);

- Incorporation of recent developments in the biogenic field (Guenther et al. 2000; Lamb et al. 1999) that have occurred since the last revision of BEIS2 in November 1997;

- Use of the most recent land use and vegetation distribution data for Texas (Wiedinmyer et al. 2000; Yarwood et al. 1999), for the surrounding U. S. states (Kinnee et al. 1997), and for northern Mexico (Mendoza-Dominguez et al. 1999);

- More complete VOC speciation than used by either BEIS2 or BIOME (Guenther et al. 2000);

- Estimation of biogenic CO emissions (Guenther et al. 2000).

Table 3.3-1 compares the results of GloBEIS and the biogenic emissions estimates used in the 1998 and 1994 SIP modeling analyses.

Table 3.3-1. Biogenic Emissions for HGA 8-county Nonattainment Area, September 10, 1993

Model used for estimate	NO_x (tpd)	VOC (tpd)
GloBEIS (Phase 3 Modeling)	18	1,308
BIOME (Phase 2 Modeling)	20	1,578
BIOME (Phase 1 Modeling)	20	1,448

The primary reason for the decrease in biogenic VOC emissions compared with Phase 2 is the change to a more accurate simulation of light attenuation within the tree canopy. As a result, the greatest changes in emissions occurred in the most dense stands of forest. While the overall emissions for the 8-county HGA area did not change dramatically, significant local changes were seen. See Appendix E for a more detailed discussion of GloBEIS and the biogenic emissions changes from the previous SIP modeling application.

3.3.4 Revised Diesel Construction Equipment Emissions

The Phase 3 base case introduces additional emissions inventory improvements which represent the culmination of years of effort by commission staff and their contractors. Most importantly, this new base case replaces the emissions for diesel-powered construction equipment with updated emissions developed from an extensive bottom-up activity survey conducted by ERG under contract to the commission. Emissions were updated within the 8-county HGA nonattainment area only.

There are several reasons to believe that the construction equipment NO_x emissions used in previous modeling analyses were significantly overstated, as follows:

- Ambient VOC/NO_x ratios at monitors in the HGA area are significantly larger than inventory-derived VOC/NO_x ratios. Reducing surface-level emissions of NO_x is consistent with reducing the discrepancy between the ambient and inventory-derived ratios.

- Comparing the HGA construction emissions on a per capita basis with the Los Angeles air basin reveals that emissions per person are nearly three times as high in HGA as in the Los Angeles area. Again, reducing construction equipment emissions substantially would lead to closer agreement between the inventories.

- During and following the comment period for the 1998 SIP amendment, several stakeholders expressed their belief that the construction equipment emissions were overstated. The cooperation of a large number of stakeholders was essential in developing the revised emissions estimates used in the current modeling.

The revised emissions were generated using EPA's NONROAD model, but with much of the default inputs replaced with results of the bottom-up survey. Since the survey estimated activity in 1998, it was necessary to back-cast the emissions to 1993. While the NONROAD model could have been used to perform the back-casting, its growth assumptions are very generic and do not account for the strong differential growth experienced among the HGA nonattainment counties. Therefore, the NONROAD model was run for 1993, but using the 1998 activity data. This measure accounts for the effects of any federal measures that were in place in 1998 but not in 1993. Then, county growth factors acquired from HGAC were used to back-cast the emissions to 1993 levels (see Table 3.3-2).

Table 3.3-2 1998 to 1993 Back-casting Factors by County (from HGAC)

County	1998-1993 Back-Casting Factor	County	1998-1993 Back-Casting Factor
Brazoria	0.90397	Harris	0.92063
Chambers	0.89757	Liberty	0.86035
Fort Bend	0.78971	Montgomery	0.77150
Galveston	0.90266	Waller	0.82747

The new base case reduces 1993 construction equipment NO_x emissions from 103.3 tpd to 42.4 tpd, and reduces VOC emissions from 12.7 tpd to 6.0 tpd. Development of this improved inventory is documented in Appendix B.

3.3.5 Revised Commercial Marine Vessel Emissions

A second major change to the Phase 3 base case emissions was the use of updated emissions from commercial vessels. The Port of Houston Authority worked closely with commission emissions inventory staff to perform a bottom-up study which inventoried the types and numbers of vessels traversing the various shipping lanes within the Galveston Bay system and in the segment of Intracoastal Waterway within the HGA nonattainment area. The Port's contractor, Starcrest, Inc. then applied EPA-approved emission factor estimates to the activity data to produce emissions along each segment of the waterway system. Emissions from docked vessels (also called as "dwelling" or "hotelling" emissions) were also calculated. Overall, the commercial vessel NO_x emissions in the HGA nonattainment counties were reduced from 46.4 tpd in the previous modeling to 32.3 tpd in the current application. Commercial vessel emissions outside the HGA nonattainment counties were not changed from Phase 2. Appendix C provides details of the methodology used to develop the revised commercial vessel emissions.

In addition to refining the emissions estimates, commission staff developed an innovative new approach to modeling the emissions. Since ships emit hot exhaust gases from stacks which typically extend several meters above the water, ships would be modeled as elevated point sources if they were stationary. Because many vessels visit the ports in the HGA area, load or unload cargo, then leave the area, it is of course not possible to model vessels individually. However, it is possible to define a set of pseudo-stacks along the course of the shipping lanes and to assign various stack parameters to each stack based on the characteristics of the ships that travel the lanes. Commission staff assigned several pseudo-stacks at each of several locations along the waterways, with each representing a separate class of vessels. Details of methodology developed to elevate the commercial vessel emissions are provided in Appendix F.

3.3.6 Revised Airport Ground Support Equipment Emissions

During the public comment period for the 2000 DFW Attainment Demonstration SIP, the ATA noted that modeled emissions for airport GSE (baggage carts, pushback tractors, etc.) in the DFW area appeared to be unreasonably large. The ATA conducted an inventory of equipment at DFW International Airport (as well as three smaller airports in the DFW area) and developed bottom-up estimates for airport GSE that were significantly lower than the values that had been used in the modeling. Because these revisions were based on sounder methodology than the data used previously, commission staff revised the DFW modeling to use these new emissions data in the DFW attainment demonstration. Subsequently, the ATA also provided updated emissions for the HGA area airports, and these revised inventory values were incorporated into the Phase 3 base case. The older inventory had consisted of 7.9 tpd of NO_x and 1.3 tpd of VOC emissions, while the revised NO_x emissions are now 4.0 tpd of NO_x for Bush Intercontinental, Houston Hobby, and Ellington Field, but the VOC emissions remained unchanged at 1.3 tpd. Details of the development of these revised emissions values are provided in Appendix A.

3.3.7 Revised Industrial Equipment Emissions

One final modification was made to the base inventory when it was discovered that the Phase 2 inventory included 3.7 tpd of NO_x emissions from 2-stroke forklifts, but only 1.5 tpd of VOC emissions from this category. Since 2-stroke equipment typically emits much more VOC than NO_x, (not to mention the scarcity of 2-stroke forklifts to begin with), clearly this type of equipment was incorrectly categorized in the modeling. To remedy this problem, commission staff used the NONROAD model to re-estimate emissions for the Industrial Equipment category. The same process described above for construction equipment was used (including using the same back-casting factors listed in Table 3.3-2), except that default NONROAD activity data were used. Overall, the weekday NO_x emissions for Industrial Equipment increased from 9.5 tpd to 15.3 tpd, and VOC emissions increased from 4.5 tpd to 4.9 tpd. Emissions outside the HGA nonattainment area did not change from Phase 2.

3.3.8 Base Case Emissions Comparison

Table 3.3-3 compares the Phase 3 modeling emissions for a typical weekday (Wednesday, September 8, 1993) with the Phase 2 emissions used in the previous modeling application.

Table 3.3-3: 1993 Base Case Emissions in the HGA 8-County Area for September 8

Category	NO_x (tpd)		VOC (tpd)	
	Phase 2	Phase 3	Phase 2	Phase 3
On-road mobile sources	416	416	199	199
Area/non-road mobile sources	226	155	318	309
Point sources	695	695	411	411
Biogenic sources	19	18	1608	1294
Total	1356	1284	2536	2213

3.3.9 Base Case Model Performance

Table 3.3-4 shows model performance for the Phase 3 base case and compares it with performance for the Phase 2 modeling. Performance is based only on monitors in the 8-county HGA nonattainment area. All model performance statistics for both the Phase 2 and Phase 3 base case meet EPA recommended standards for all four days.

Table 3.3-4. CAMx Phase 3 Base Case Ozone Performance Statistics for September 8-11, 1993 (Statistics for Phase 2 base case are shown in *italics*)

Episode Date	Normalized Bias (±5–15%)		Normalized Gross Error (30–35%)		Unpaired Peak Accuracy (±15–20%)		Domain-wide Peak Ozone (ppb)		
							Simulated		Observed
9/8/93	1.8	*9.2*	22.6	*24.8*	-12.7	*-15.0*	187	*182*	214
9/9/93	2.6	*11.4*	29.1	*28.2*	-10.4	*-7.9*	175	*180*	195
9/10/93	-13.0	*-4.2*	26.1	*24.4*	6.2	*9.7*	172	*178*	162
9/11/93	-2.9	*8.4*	20.4	*23.6*	-3.9	*-1.8*	182	*186*	189

As seen in Table 3.3-4, model performance for the Phase 3 base case is similar to that for the Phase 2 base case, except for a tendency towards more negative bias. Interestingly, the modeled peak on September 8 (187) is higher than was modeled in Phase 2 (182), while the modeled peak on each of the other three primary episode days is smaller than in Phase 2. Figure 3.3-2 shows modeled peak ozone concentrations for the four primary episode days for the entire SuperCOAST domain, and Figure 3.3-3 shows modeled peak ozone concentrations for the HGA/BPA 4 km × 4 km fine grid area.

3.4 THE 2007 FUTURE BASE CASE

Since the Phase 3 base case modeling shows acceptable performance, we now proceed to the next step in the modeling process, which is to construct a future base case for the 2007 attainment year. Like the 1993 base case, the Phase 3 future base modeling incorporates several enhancements from Phase 2. Besides changes incorporated into the new base case, the future case features:

- Updated growth assumptions for most area and non-road sources, based on projections developed by the HGAC.

- New spatial allocation of construction equipment emissions, using projections developed by H-GAC for RAZs.

- Updated point source emissions using the 2007 inventory developed for the 2000 DFW SIP. This inventory incorporates reductions to large point sources expected under the Regional Strategy SIP (adopted in April 2000) and under SB 7.

- Revised emission adjustment factors for several federal measures included in the Phase 2 future base.

3.4.1 2007 Future Base Emissions for Area and Non-road Mobile Sources
Growth for area and most non-road mobile sources was revised to use population growth factors instead of the econometric forecasts used in Phase 2. This approach has several advantages over the previous approach: 1) By the use of population growth factors, growth is based on current forecasts consistent with those used for planning by local governmental bodies; 2) the growth factors are easy to apply, since they affect all categories of area and non-road emissions equally; and 3) the growth factors were provided at no cost to the commission. The disadvantage is that growth among the various emission categories is no longer distinct, and some categories do not necessarily correlate well with population, although these categories tend to be fairly insignificant contributors to the overall emissions inventory.

For area sources (such as architectural coatings, vehicle refueling, and similar stationary non-point source categories), plus locomotives and aircraft operations, the 1993 emissions were grown using growth factors listed in Table 3.4-1. Following the application of growth factors, the emissions for these categories were controlled using the same control factors used in the Phase 2 future base.

Table 3.4-1 1993-2007 Growth Factors by County (from HGAC)

County	1993-2007 Growth Factor	County	1993-2007 Growth Factor
Brazoria	1.25267	Harris	1.19935
Chambers	1.27507	Liberty	1.40621
Fort Bend	1.69792	Montgomery	1.76776
Galveston	1.25782	Waller	1.53489

A slightly different approach was followed with the diesel construction and industrial equipment emissions. For these emission categories, a 2007 inventory was developed by a process similar to that discussed in the last section for developing the 1993 base case emissions. For the future inventory, NONROAD was run for 2007, again using 1998 activity data from the bottom-up survey. Then, these emissions were grown from 1998 to 2007 using HGAC's population projections. The growth factors for these categories are provided in Table 3.4-2. The revised 2007 NO_x emissions from construction equipment are now 32.1 tpd, compared with 101.8 tpd in the Phase 2 future base. Emissions of VOC declined from 11.9 tpd to 5.5 tpd.

Industrial equipment NO_x emissions are now 15 tpd, compared with 8.9 tpd in Phase 2, and VOC emissions are now 4.6 tpd, compared with 3.0 tpd in Phase 2.

Table 3.4-2 1998-2007 Growth Factors by County (from HGAC), Used for Diesel Construction and Industrial Equipment Emissions

County	1998-2007 Growth Factor	County	1998-2007 Growth Factor
Brazoria	1.13237	Harris	1.10416
Chambers	1.14447	Liberty	1.20983
Fort Bend	1.34087	Montgomery	1.36383
Galveston	1.13538	Waller	1.27008

Emissions for airport GSE for 2007 were supplied by the ATA and incorporated directly into the future base. Phase 3 future emissions of NO_x were modeled at 5.35 tpd, and VOC emissions at 1.3 tpd. The equivalent Phase 2 emissions for airport ground-support equipment were 8.3 tpd of NO_x and 1.3 tpd of VOC.

The 2007 commercial shipping emissions were provided by the Port of Houston Authority, so these emissions were used directly in the 2007 future base. As in the base case, emissions were treated as elevated point sources. The same federal/international controls applied in the Phase 2 modeling were also applied here. The revised 2007 commercial shipping NO_x emissions are 41.7 tpd (compared with 49.8 tpd in the Phase 2 future base), and the revised VOC emissions are 0.8 tpd (compared with 6.4 tpd in Phase 2).

Finally, emissions from the remaining non-road sources (lawn and garden, pleasure boats, etc.) were not changed from the Phase 2 modeling. These sources were grown using the default growth assumptions of the NONROAD model.

Area and non-road mobile source emissions for areas outside the 8-county HGA nonattainment area were unchanged from Phase 2, except that Stage I refueling and cleaner gasoline (modeled in Phase 2 as control strategy items) were applied to counties in East and Central Texas, because these measures were adopted by the commission in the spring of 2000.

3.4.2 New Spatial Allocation for Construction Equipment Emissions

In Phase II modeling, non-road and area sources were allocated spatially using a number of gridded spatial surrogates developed by SAI or by commission staff. With a few exceptions, these surrogates were created from USGS digital data which divided the region into Land Use/Land Cover (LULC) categories such as water, industrial, or agriculture. In Phase 2 modeling, construction emissions were allocated to land areas classified as industrial, residential, or commercial.

The approach taken in Phase 2 provides a reasonable allocation scheme in the 1993 base case, but may not accurately reflect the spatial distribution of emissions in the attainment year of 2007, since the urban area has expanded (and is expected to expand further) into areas that were not residential, commercial, or industrial in 1993. Thus, using 1993 surrogates for 2007 emissions may artificially concentrate the emissions into the former urban area, which can in turn affect the model's future ozone forecasts.

Ideally, future surrogates would be built from LULC data analogous to data used in the base case, but unfortunately such data are not available. Instead, the commission acquired population and employment projections for RAZs from HGAC, and used these data to develop a new surrogate for allocating construction activity. The commission modeling staff plans to eventually develop new future surrogates for several additional categories of area and non-road mobile source emissions, but due to time constraints was limited to only developing a surrogate for construction activity at this time.

Because the revised construction equipment emissions were developed for four separate categories of activities (see Appendix B), the commission emissions inventory staff developed a composite surrogate that was used to allocate the aggregate construction emissions. The four categories are as follows: heavy highway, industrial, residential/commercial, and municipal/utility. Industrial activity is primarily defined as emissions associated with refinery turnarounds, and was allocated among 13 specific RAZs identified as containing large industrial areas, including Freeport, Texas City, Bayport, and the Houston Ship Channel. The remaining three categories are primarily associated with providing infrastructure to population and employment centers. In each case, some activity is associated with developing new facilities, while the remainder is associated with maintaining or replacing existing facilities. To allocate activity in these three categories, the modeling and emissions inventory staff devised a procedure to account for both maintenance and growth, and also to account for both residential population and employment.

Population growth was estimated in each RAZ by taking the difference between the 2008 population forecast in that RAZ minus the 2006 forecast. Similarly, employment growth was estimated by subtracting the 2006 employment forecast from the 2008 forecast. Taken together, these growth estimates predict where new growth (both residential and commercial building) will occur in 2007. These growth estimates by RAZ are clearly related to residential/commercial construction, but are also indirectly related to both heavy highway and municipal/utility, since the latter two categories provide the facilities required to serve employment and population centers (roads, water mains, etc.). Additionally, a significant amount of activity is related to total population and employment, since existing facilities must be periodically repaired or replaced.

Because the staff was unable to locate information detailing how much activity relates to new construction versus repair and replacement, nor how much relates to employment versus population, it was assumed that each of the following four factors each accounted for 25% of the activity in each county:

- Population
- Employment
- 2006-2008 change in population
- 2006-2008 change in employment

These four factors were thus equally weighted to develop the allocation scheme for heavy highway, residential/commercial, and municipal/utility construction emissions. The result was then merged with the industrial allocation to provide the final construction equipment allocation. Figure 3.4-1 shows the 2007 construction equipment emissions for September 8, after being processed into a gridded model-ready emissions file.

3.4.3 2007 Future Base Emissions for On-Road Mobile Sources

The basis of the 2007 on-road mobile source emissions inventory used in the Phase 3 modeling was consistent with that used for the Phase 2 modeling. Under contract to the commission in 1998, the TTI developed a link-based gridded mobile source emissions inventory for the 8-county HGA nonattainment area. Development of this inventory is documented in Appendix G of the Phase 2 HGA SIP, dated October 27, 1999. The title of the report is *Development of Gridded Mobile Source Emissions Estimates for the Houston-Galveston Nonattainment Counties FY2007 in Support of the COAST Project, Technical Note, December 1998.* This TTI inventory summarized below in Table 3.3-3 will be referred to as either the "mobile baseline" or simply the "baseline." The manner in which the baseline was adjusted constitutes the differences between Phases 2 and 3 of the photochemical modeling.

Table 3.4-3 On-Road Mobile Source Baseline Emissions for 2007 (tpd) for Wednesday, September 8

County	Baseline NO_x Emissions	Baseline VOC Emissions
Brazoria	17.1	7.4
Chambers	6.0	2.1
Fort Bend	23.1	10.6
Galveston	12.6	6.1
Harris	190.6	79.2
Liberty	5.7	2.3
Montgomery	22.9	9.6
Waller	4.2	1.6
8-County Total	282.3	118.8

This baseline inventory had been modeled by TTI using MOBILE5a_h, yet the analyses for some of the on-road mobile source control strategies under review required the use of the more current MOBILE5b. Consequently, both MOBILE5a_h and MOBILE5b were run with identical inputs to develop factors for adjusting the baseline inventory to become equivalent to MOBILE5b. The net result was a 4.3 tpd reduction of NO_x emissions in the 8-County from 282.3 to 278 tpd. 8-County VOC emissions were reduced by 23.9 tpd from 118.8 to 94.9 tpd. Table 3.4-4 below summarizes the result of applying this adjustment to the modeling inventory. A more complete description of this adjustment can be found in an ERG memo which is included as Appendix G of this SIP.

Table 3.4-4 MOBILE5b Adjustments to On-Road Mobile Source Baseline Inventory for 2007 (tpd) for Wednesday, September 8

Counties	Unadjusted Baseline Inventory		MOBILE5b Adjustments		Registration Adjusted Baseline	
	NO_x	VOC	NO_x	VOC	NO_x	VOC
Harris	190.6	79.2	-3.1	-16.5	187.5	62.6
Brazoria, Fort Bend, Galveston, Montgomery	75.8	33.7	-0.9	-6.3	74.8	27.3
Chambers, Liberty, Waller	15.9	6.0	-0.2	-1.1	15.7	4.9
Total	282.3	118.8	-4.3	-23.9	278.0	94.9

The most significant change to the mobile inventory between Phases 2 and 3 involved the manner in which an I/M program was originally modeled in the baseline inventory for Harris County in 2007. The MOBILE5 input file for Harris County in 2007 had been prepared in accordance with EPA *MOBILE5 Information Sheet #6, Effect of the New National Low Emission Vehicle (NLEV) Standard for Light-Duty Gasoline Fueled Vehicles, EPA 520-F-98-027, July 1998*. Mobile modeling performed in accordance with recommendations from this memo resulted in a significant overestimate of the I/M benefits in Harris County for NLEV vehicles. This overestimate was not known at the time that the Phase 2 modeling was conducted. A recent analysis performed under contract to the commission by ERG determined that this I/M benefit had been overestimated by 22.5 tpd of NO_x and 7.7 tpd of VOC. This analysis is documented in Appendix G of this SIP. Subsequent to the MOBILE5b adjustment discussed above, these I/M benefit changes resulted in an increase in the on-road mobile source baseline inventory for Harris County from 187.5 to 210 tpd of NO_x and from 62.6 to 70.3 tpd of VOC. Since no I/M program was modeled in the seven remaining nonattainment area counties in the original 2007 baseline inventory, similar I/M benefit adjustments do not apply outside of Harris County.

The most recently available vehicle registration distribution data was used when the baseline mobile source inventory was modeled in 1998. Since that time, however, the vehicle registration distribution has changed significantly due to the increased purchase of new vehicles during the last few years, resulting in a relatively "newer" overall fleet. Projection of this newer 1999 vehicle registration distribution data into 2007 results in a newer, cleaner vehicle fleet. By comparing MOBILE5 modeling runs utilizing both the older and newer registration distributions, ERG was able to determine the amount by which the baseline inventory should be adjusted to account for the updated vehicle registration data. These adjustments are summarized in Table 3.4-5 and are detailed further in the aforementioned ERG memo in Appendix G.

Table 3.4-5 Vehicle Registration Distribution Updates to Baseline Inventory for 2007 (tpd)

Counties	MOBILE5 & I/M Adjusted Baseline		Registration Adjustments		Registration Adjusted Baseline	
	NO_x	VOC	NO_x	VOC	NO_x	VOC
Harris	210.0	70.3	-9.8	-1.0	200.2	69.3
Brazoria, Fort Bend, Galveston, Montgomery	74.8	27.3	-1.0	+0.6	73.8	28.0
Chambers, Liberty, Waller	15.7	4.9	-0.5	0.0	15.1	4.9
Total	300.5	102.6	-11.4	-0.4	289.1	102.2

The final step in development of the mobile source base case inventory for 2007 was to account for the benefits which will accrue from penetration of 2004-and-newer Tier 2 vehicles into the on-road fleet. Benefits which will accrue from implementation of the Tier 2 vehicle program were not accounted for in the original baseline inventory, because MOBILE5 does not have the capability to model Tier 2 vehicles. A recent ERG analysis summarized in Table 3.4-6 indicates the amounts by which the mobile inventory should be adjusted to account for these benefits. The Tier 2 benefits in the 8-county area also include an additional 5.92 tpd of VOC, as referenced in a May 30, 2000 letter from EPA to the TNRCC to account for evaporative emission controls on Tier 2 vehicles which will be equivalent to California LEV standards.

Table 3.4-6 Tier 2/Low Sulfur Benefits to On-Road Mobile Source Fleet for 2007 (tpd)

Counties	Registration Adjusted Baseline		Tier 2 Adjustments		Tier 2 Adjusted Baseline	
	NO_x	VOC	NO_x	VOC	NO_x	VOC
Harris	200.2	69.3	-23.1	-7.6	177.1	61.7
Brazoria, Fort Bend, Galveston, Montgomery	73.8	28.0	-7.2	-2.8	66.6	25.2
Chambers, Liberty, Waller	15.1	4.9	-1.3	-0.6	13.8	4.4
Total	289.1	102.2	-31.6	-10.9	257.5	91.3

It should be noted that commission staff performed an in-house analysis of the Tier 2 benefits to be accrued based on the EPA *MOBILE5 Information Sheet #8, Tier 2 Benefits Using MOBILE5, April 2000*. However, commission staff believe that the ERG analysis summarized above is more representative of the Texas vehicle fleet, due to the fact that the EPA method referenced above relies only on national default data. More detail on the ERG analysis is provided in the aforementioned memo contained in Appendix G. The revised base case emission estimates used for modeling purposes are contained in the two right-hand columns of the above table. For the 8-county HGA area, these estimates are 257.5 tpd of NO_x and 91.3 tpd of VOC.

3.4.4 2007 Future Base Emissions for Point Sources

In Phase 2, the 1993 base case point source emissions (based largely on the COAST special inventory) were grown to 2007 using observed emission trends for sources in the COAST domain (except Louisiana and offshore sources). Since the inventory has changed substantially since 1993, both in terms of actual emissions changes (new sources, shutdowns, process changes, controls, etc.) and in terms of improved reporting, the commission decided to use a more current inventory for the basis of the 2007 projections. Also, in the 2000 DFW Attainment Demonstration, the commission used an innovative approach for developing future inventories which involves searching through the Commission permit database to locate planned new sources within 100 miles of the DFW nonattainment area. It was planned to apply this approach to the HGA point sources as well.

In early June of 2000, commission modeling staff began the process of analyzing the permit data to inventory planned sources within 100 miles of HGA. Unlike the DFW area, which has few existing and planned point sources, the Texas Gulf Coast area has many thousands of existing sources and a correspondingly larger number of new permits. Besides identifying planned new sources and major modifications, modeling staff also identified planned shutdowns and performed extensive quality assurance. Despite the assistance of four contract personnel, it was impossible to complete the processing of the permit data in time to include all the newly-permitted sources in the Phase 3 future base. Modeling staff were able to account for those sources in the 100-mile radius which were outside the nonattainment area, but the Phase 3 future base did not include newly-permitted sources in the nonattainment counties. Note that new sources outside the nonattainment area are especially important, since they are not required to offset emission increases with reductions, while new sources in the HGA nonattainment area are subject to an offset requirement of 1.3 to 1. Appendix H provides details of the process used to identify and record the newly-permitted sources, and also provides a list of the sources along with their relevant characteristics.

For the Phase 3 future base, the 2007 inventory developed for the DFW Attainment Demonstration was modified and used in the current modeling. This inventory used emissions data from the Commission's Point Source Data Base for 1996 to develop a 1996 base year inventory for all Texas sources, then projected these emissions to 2007 using growth factors developed by EPA Region VI. Emissions for electric generation facilities were then replaced with average summertime values (specifically average of Acid Rain Program Database emissions for third calendar quarter of 1996-1998). Newly-permitted sources within a 100-mile radius of the DFW nonattainment area were included, along with the sources identified in the HGA area described above. Only elevated point source emissions were replaced with the DFW-based future emissions. Ground-level point sources were the same as in the Phase 2 modeling.

In the DFW modeling analysis, the HGA and BPA point sources were modeled with across-the board reductions, so in adapting this inventory for HGA these reductions were removed. Instead, point sources in HGA and BPA were controlled in accordance with the current requirements of Chapter 117. In BPA, this represents the level of control in the 2000 BPA Attainment Demonstration, but represents only modest reductions in the HGA area (additional reductions will be modeled as a control strategy in the following section). The 2000 DFW and BPA SIP revisions can be obtained at http://www.tnrcc.state.tx.us/oprd/sips.html.

Commission staff plan to complete cataloging the permit data and build a new 2007 inventory based on the 1997 point source inventory before the end of July, 2000. This updated inventory may be included in the finally adopted SIP revision as a result of comments received by the commission during the public comment period.[2]

3.4.5 2007 Future Base Emission Summary

Table 3.4-6 summarizes the 2007 future base emissions for Phase 3, and also provides a comparison with Phase 2. Biogenic emissions are not reported, since they did not change from the base case.

Table 3.4-7: 2007 Future Base Emissions in the HGA 8-County Area for September 8

Category	NO_x (tpd)		VOC (tpd)	
	Phase 2	Phase 3	Phase 2	Phase 3
On-road mobile sources	267	258	103	91
Area/non-road mobile sources	222	147	263	274
Point sources	564	641	243	264
Total anthropogenic emissions	1053	1046	609	629

3.4.6 Future Base Model Results

Table 3.4-8 summarizes modeled peak ozone for the Phase 3 future base, compared with the analogous results from the Phase 2 modeling. Figure 3.4-2 provides isopleth plots of peak modeled ozone for each of the four episode days in the 4 km × 4 km fine grid area.

Table 3.4-8 Future Base Peak Modeled Ozone in the HGA 8-County Area, Phase 2 and Phase 3

Episode Day	Peak Modeled Ozone (ppb)	
	Phase 2	Phase 3
September 8	171.1	170.9
September 9	166.0	159.7
September 10	164.9	153.5
September 11	170.6	160.5

Although peak modeled ozone remained nearly the same as in the base case on September 8, it decreased significantly on the three remaining episode days. Particularly, peak ozone on September 10 decreased by over 11 ppb from Phase 2.

3.5 THE 2007 CONTROL STRATEGY CASE

[2]Prior to adoption of the current SIP revision by the Commission on December 6, 2000, these planned revisions were made and the modeling analysis was conducted once again. Section 3.8 has been added to describe these changes and additional modeling analyses.

This section describes the changes made to the final control strategy described in the Phase 2 SIP, and later used to calculate the "gap" (the remaining amount of NO_x reductions needed to reach attainment). The modification to the 2007 controlled inventory consist of modifications to the rules proposed in Strategy H2 of the Phase 2 modeling, as well as adjustments to several reduction factors based on newer information.

3.5.1 Reductions to Area and Non-road Mobile Sources in the 2007 Control Case

Table 3.5-1 shows the controls modeled in the 2007 control case. Differences between the current control case and Phase 2 Strategy H2 are indicated.

Table 3.5-1 Controls Applied to Area and Non-road Mobile Sources in Phase 3 Control Strategy

Measure	Geographic Area	NO_x Reduction (tpd)	VOC Reduction (tpd)	Compared with Phase 2 Strategy H2
Cleaner Gasoline (15 ppm sulfur)[1]	East and Central Texas	2.3 tons in 8 HGA Counties	-7.1 tons in 8 HGA Counties	California Reformulated Gasoline in 8-county area
Texas Clean Diesel	Statewide	4.3 tons in 8 HGA Counties	2.2 tons in 8 HGA Counties	California Diesel in 8-county area
Delay construction and landscaping activities until after noon	8-county area	0.0	0.0	Construction activity only
VMEP (split 1/3 non-road, 2/3 on-road)	8-county area	8.0[2]	0.0	All VMEP was taken from non-road

[1]The reductions modeled for 15 ppm sulfur gasoline were the same as those used for California RFG in the Phase 2 modeling, since commission staff were unable to quantify the benefits of 15 ppm sulfur gas relative to non-road engines in time to include in the Phase 3 modeling. Commission staff will modify the benefits modeled for low sulfur gasoline when more information becomes available.

[2]VMEP is calculated as 3% of the reduction required to reach attainment (i.e. future base total NO_x emissions minus the attainment target). Although the required reduction in Phase 3 is slightly larger than that from Phase 2, the VMEP was not changed from the 24 tpd used previously.

Note that the regional Texas Clean Gasoline and Stage I refueling rules are now included in the future base. Also, low-NO_x water heaters were listed as a measure in the Phase 2 modeling (although no reductions were assumed at that time). This measure has been moved to the gap list, so was not modeled here.

3.5.2 Reductions to On-road Mobile Sources in the 2007 Control Case

Table 3.5-2 shows the on-road mobile source controls modeled in the 2007 control case. Differences between the current control case and Phase 2 Strategy H2 are indicated. Greater detail on the development of these reductions is documented in an ERG memo contained in Appendix G.

Table 3.5-2 2007 Controls Applied to On-Road Mobile Sources in Phase 3 Control Strategy

Measure	Geographic Area	NO_x Reduction (tpd)	VOC Reduction (tpd)	Compared with Phase 2 Strategy H2
ASM & OBDII I/M Program	8-county area	42.0	16.5	IM240 modeled instead of ASM
Cleaner Gasoline (15 ppm sulfur)	Eastern and central Texas	1.1 tons in 8 HGA Counties	0.1 tons in 8 HGA Counties	California Reformulated Gasoline in 8-county area
Texas Clean Diesel	Statewide	4.1 tons in 8 HGA Counties	0	California Diesel in 8-county area
VMEP (split 1/3 non-road, 2/3 on-road)	8-county area	16.0	0	All VMEP was taken from non-road

3.5.3 Reductions to Point Sources in the 2007 Control Case

Point source NO_x emissions in the HGA 8-county area were assumed to be reduced by 90% from the future uncontrolled base level (i.e. the future base, but without applying the Chapter 117 rules). The commission modeling staff intends to model the specific rules included elsewhere in this SIP revision, but must wait for the 2007 future base point sources to be completed.[3] These regulations will reduce overall point source emissions by about 90%, but the level of control will vary from source to source, depending on its type and current level of control.

Since the point sources used in the modeling described here are preliminary, the modeled ozone concentrations (and resulting gap) must be considered approximate. However, in any case the point sources form a relatively small part of the 2007 controlled NO_x inventory after being reduced by about 90%. Thus, even if the uncontrolled 2007 base point source inventory changes significantly, the effect on the controlled 2007 inventory is likely to be relatively minor. The resulting effects on the peak ozone prediction and gap are therefore expected to be minor as well.

3.5.4 Summary of 2007 Controlled Emissions

Table 3.5-3 below summarizes emissions for the 2007 control case. Phase 2 emissions are also presented for comparison.

[3]Specific Chapter 117 rules were eventually modeled for the electric generating units in the 8-county area. The remaining sources were modeled with across-the-board reductions consistent with the cap-and-trade rules. Details are provided in Section 3.8, which was added subsequent to the original SIP proposal.

Table 3.5-3 2007 Control Case Emissions in the HGA 8-County Area for September 8

Category	NO_x (tpd)		VOC (tpd)	
	Phase 2 (Strategy H2)	Phase 3	Phase 2 (Strategy H2)	Phase 3
On-road mobile sources	195	194	79	75
Area/non-road mobile sources	148	134	257	280
Point sources	64	67	243	264
Total anthropogenic emissions	407	395	579	619

Comparing Table 3.5-3 with Table 3.4-6 shows an overall NO_x reduction of 62% from the 2007 future base, and a VOC reduction of 1.6% from the 2007 future base. Since the future base already includes substantial reductions to NO_x and VOC (NO_x RACT, NLEV, Tier 2/low sulfur, Tier 2/3 non-road diesel standards, etc.) the actual level of reduction from an uncontrolled future base is much greater. Because of the process used to estimate future on- and non-road mobile source emissions, it is difficult to determine the uncontrolled 2007 emission levels. However, the modeling conducted for the 1998 HGA SIP revision used a largely uncontrolled future base. That modeling established that a NO_x reduction of up to 85%, together with a VOC reduction of 25%, would be sufficient to reach attainment. The 1998 modeling future base inventory consisted of 1468 tpd of NO_x emissions and 1052 tpd of VOC emissions. Compared with the 1998 future base, the Phase 3 control case represents a NO_x reduction of 73% and a VOC reduction of 41%.

3.5.5 Future Control Case Model Results

Table 3.5-4 summarizes modeled peak ozone for the Phase 3 control case, compared with the analogous results from the Phase 2 modeling. Figure 3.5-1 provides isopleth plots of peak modeled ozone for each of the four episode days in the 4 km × 4 km fine grid area.

Table 3.5-4 Future Control Case Peak Modeled Ozone in the HGA 8-County Area, Phase 2 and Phase 3

Episode Day	Peak Modeled Ozone (ppb)	
	Phase 2 (Strategy H2)	Phase 3
September 8	152.3	146.4
September 9	141.1	134.7
September 10	146.5	139.9
September 11	140.4	132.6

Comparing the Phase 3 control strategy results with Phase 2 Strategy H2, it is seen that the inventory enhancements result in a significant reduction in peak ozone on every episode day. The Phase 3 control strategy represents a great improvement in air quality over the base and future base cases, but still does not meet the ozone NAAQS of 125 ppb. The next section uses these results to recalculate the gap, in terms of NO_x tpd, which must be filled in order to demonstrate attainment of the NAAQS.

3.6 GAP CALCULATION

In October of 1999, EPA published a draft document titled *Guidance for Improving Weight of Evidence Through Identification of Additional Emission Reductions, Not Modeled.* This document provides two methods for calculating the gap: Method One relates modeled ozone peak values to emission reductions, and Method Two relates the observed design value to emission reductions. Unfortunately, neither method can be successfully applied in the HGA area (as discussed in the April 19, 2000 HGA SIP revision), so an alternative approach is necessary. EPA Region 6 developed a variant on Method One which uses a second-order polynomial, instead of the linear relationship assumed in Method One, to approximate the relationship between peak ozone and reductions of NO_x emissions. The relationship was fitted using three control scenarios modeled in Phase 2, namely Scenarios VI, VIb and VIc. The relation is given below:

$$\%NO_X = -0.010949 \times OC^2 + 2.62 \times OC - 74.62 \qquad (1)$$

where

$\%NO_x$ is the percent reduction of NO_x from the Phase 2 future base total anthropogenic NO_x emissions, and

OC is the peak modeled ozone concentration of any of the episode days.

For a specific control strategy (say H2), the modeled peak ozone concentration and the associated NO_x reduction form an ordered pair (OC, $\%NO_x$) which will not generally lie on the relation described by equation (1). In fact, because Strategy H2 includes the construction time shift (which provides modeled ozone benefits with no associated reduction in emissions), it is expected that this strategy will lie a considerable distance from the relation. The solution is to translate equation (1) so that it passes through (OC, $\%NO_x$) for a particular strategy, then use the translated relation to calculate the remaining NO_x reduction necessary to reach attainment.

For strategy H2, the peak modeled ozone was 152 ppb with a NO_x reduction of 61.3%. Translating equation (1) to include this point yields

$$\%NO_X = -0.010949 \times OC^2 + 2.62 \times OC - 84.12 \qquad (2)$$

Finally, the value of OC which would demonstrate attainment of the NAAQS (124.5 ppb) is inserted into equation (2) to yield a required NO_x reduction of 72.4%. Strategy H2 included a 61.3% reduction, so the gap in terms of % reduction is 11.1%. Since the Phase 2 future base had 1052 tpd of NO_x emissions, the final gap based on Phase 2 modeling is 117 tpd (Region VI used 124 ppb as the attainment target and calculated 118 tpd needed).

The original gap calculation was based on percentages relative to the Phase 2 future base, so it is not directly applicable to the Phase 3 modeling. However, equation (1) can be recalculated in terms of NO_x

tons, which yields a relation that is independent of future base emissions. Table 3.6-1 gives peak modeled ozone and NO_x emissions for the four scenarios used to fit equation (1):

Table 3.6-1 Peak Modeled Ozone and NO_x, by Modeling Scenario

Scenario	Peak Modeled Ozone (ppb)	NO_x Emissions (tpd)
VI	168	456
VIb	155	330
VIc	143	249

Recalculating equation (1) using NO_x emissions (instead of %NO_x) yields:

$$NO_X = 0.11769 \times OC^2 - 28.322 \times OC + 1892.4 \qquad (3)$$

where NO_x now represents the modeled emissions corresponding to peak ozone concentration OC. Now, the Phase 3 control strategy model run predicted a peak ozone value of 146.4 ppb on September 8, with NO_x emissions of 395 tpd. Translating equation (3) to pass through the point (146.4, 395) yields the equation

$$NO_X = 0.11769 \times OC^2 - 28.322 \times OC + 2022.8 \qquad (4)$$

Now, equation (4) is evaluated for OC=124.5, yielding a required NO_x emission level of 321 tpd. The gap is then 78.0 tpd NO_x.

It should be pointed out that the methodology employed in equations (3) and (4) is mathematically equivalent to that employed in equations (1) and (2). To demonstrate, the gap based on Strategy H2 will be recalculated using NO_x emissions rather than % NO_x reduction. Strategy H2 peak ozone was 152 ppb with emissions of 407 tpd. Translating equation (3) to pass through this ordered pair yields

$$NO_X = 0.11769 \times OC^2 - 28.322 \times OC + 1992.8 \qquad (5)$$

Evaluating equation (5) for the ozone target of 124.5 ppb yields 291 tpd. Therefore, the gap calculated from (5) is 407 – 291 = 116 tpd. The one ton difference between this value and the 117 tpd calculated with equation (2) is due to using higher precision in the coefficients of equations (3) and (5) than were used in equations (1) and (2).

3.7 MODELING SUMMARY

The Phase 2 modeling presented in the 1999 HGA SIP revisions has been updated to include better emissions data than were previously available. The CAMx model used was upgraded to a newer version, and the COAST modeling domain was integrated with the regional modeling domain. Base case model performance was similar to that of Phase 2, with slightly higher peak ozone on September 8, but with lower peak ozone on the remaining episode days.

The modeling described here used the 2007 point source emissions developed for the DFW SIP. Commission staff are completing a revised future point source inventory for HGA which will include newly permitted sources in the area.[4] This new inventory is expected to have only a minor impact on the peak ozone (hence the gap), since point sources make up the smallest component of the controlled future inventory.

Several controls were reevaluated and more current reduction factors were used in Phase 3. The Phase 3 control strategy (similar to Phase 2 Strategy H2) was run using the newer modeling formulation, and peak ozone on September 8 was modeled at 145 ppb. The methodology developed by EPA Region 6 to calculate the gap was revised to model tons of NO_x instead of percent reduction. The gap was recalculated to be 78 tpd, compared with 118 tpd calculated from the Phase 2 modeling.

3.8 ADDITIONAL MODELING ANALYSES IN RESPONSE TO COMMENTS

As a result of several public comments received, the commission has conducted additional modeling analyses. The modeling described in the remainder of this chapter was performed to address several issues:

- EPA Region VI commented that the functional relationship used to calculate the NO_x shortfall (the "gap") needs to be redrawn using the inventory improvements described in this document. Three additional modeling analyses were performed to allow this functional relationship to be redrawn.
- EPA Region VI also commented that there was an apparent discrepancy between the reported and modeled emissions. As a result of cooperation between the commission and Region VI the source of this discrepancy was pinpointed and the modeling inventory was modified to correct the double-counting of ship and locomotive emissions in the HGA area. A related correction was made which corrects a problem with point source emissions in Louisiana.
- Point source emissions were revised significantly to provide a baseline consistent with the inventory used to develop the rules in the proposed SIP revision. Additional changes include adding ROP controls, accounting for sources permitted between the base inventory and the adoption of the SIP revision, and modeling more precisely the proposed point source controls.
- Two control strategies were modified slightly and one was withdrawn in response to comments received: The Lawn and Garden equipment usage restrictions were removed for non-commercial activities in five urban counties, and were removed entirely from three rural counties. The construction equipment usage restrictions were also removed from the same three rural counties, and the low sulfur gasoline regulation was removed entirely.
- On-road mobile source emissions were updated, primarily to provide a consistent transportation conformity budget for the region. The revised emissions reflect the latest demographic projections. Several control strategies which formerly were applied as across-the-board reductions have been incorporated directly into the new inventory.
- VMEP credit was re-calculated and redistributed between on-road and non-road mobile sources.

All of these revisions apply to the 2007 future control case, and do not impact the base case. Future base modeling was not conducted again, although future base emissions (projected to 2007 but without applying any of the controls in this SIP revision) were calculated for the purpose of revising the amount of VMEP credit for which the region is eligible.

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[4]These changes were made and are described in Section 3.8, added subsequent to the SIP proposal. Additional changes, made in response to comments, are also included in the final modeling analysis and are also discussed in Section 3.8.

3.8.1 Changes to Point Source Inventory

As mentioned, several improvements and corrections have been made to the point source EI. Additionally, several improvements have been made to the modeling techniques. Table 3.8-1, Point Source Inventory Changes in the HGA 8-county area, lists each of these changes, improvements, or corrections. This subsection addresses each of the changes that have occurred between the SIP proposal and the Revised Control Case, in some detail, in the order provided by the table.

Table 3.8-1 Point Source Inventory Changes in HGA 8-County Area

	HGA Change (tpd)	
Change Description	NO_x	VOC
Update Electric Utility emissions using highest 30-day period of 1997-99, and use 1997 non-Electric Utility emissions	+ 0.5	- 38.6[5]
Modify reductions to non-Electric Utility sources based on modifications to Chapter 117 rules	+9.2	0
Correct inadvertent control of non-Electric Utility emissions in attainment counties	0[6]	0
Apply post-1996 ROP rules, excluding RE Improvements	0	- 30.6[7]
Corrected an error which caused emissions from low-level Louisiana point sources to be omitted.	0[8]	0
Account for ERCs in the bank	+ 2.0[9]	+ 12.2
Account for DERCs expected to be used by 2007	+ 2.7[10]	+ 5.0
Account for newly permitted sources.	+22.8	0[11]
TOTAL (HGA 8 Counties)	+36	- 52

Update electric utility emissions using highest 30-day period of 1997-99, and use 1997 non-electric utility emissions

[5] 1997 emission inventory (EI) includes improved rule effectiveness

[6] No change in HGA or BPA, but increased statewide NO_x emissions ~ 350 tons/day

[7] Additional reductions were made in BPA. RE improvements taken into account during 1997 EI development.

[8] No change in HGA emissions, but represents a significant increase in VOC emissions and a minor increase in NO_x emissions in Louisiana.

[9] Currently in the bank: NO_x ERCs = 7299 tons, VOC ERCs = 4448 tons. Assume a 90% devaluation for NO_x.

[10] Currently in the bank: NO_x DERCs = 38,553 tons, VOC DERCs = 1807 tons. Assume a limit of 10,000 tons used per year; NO_x devalued by 10 to 1 offset.

[11] VOC changes were not counted

This update represents two distinct improvements made to the point source emissions. First, the 30 TAC Chapter 117 rule states that each electric utility system (essentially, owner) is mandated to emit NO_x not to exceed a cap based on the average of the daily heat input (MMBtu) for each electric utility capped for the system highest 30-day period during the third calendar quarters of 1997-99, as reported to the EPA's ARPDB. For the SIP proposal, the commission modeled the HGA 8-county nonattainment area electric utilities as was done for the remainder of the attainment area EGUs in the state (overall average of NO_x emissions over the third calendar quarters of 1996-98). For the Revised Control Case, Table 3.8-2, Modeled Reductions for Reliant and Entergy Electric Generating Facilities, shows the two systems affected by this Chapter 117 rule. This table shows the Chapter 117 NO_x rate (lb/MMBtu) limitation for each boiler/turbine type; each boiler/turbine calculated heat input (MMBtu/day) during its highest 30-day period; the emission limit (tons per day) allowed under this rule; the emission rate modeled by the commission as calculated from the highest 30-day period of the ARPDB for the system; the modeled control factor applied to the modeled emission rate to achieve the commission's 30-day limit for each boiler/turbine (unit); and the effective reduction required by the unit to achieve that limit. The footnotes to the table give additional details.

Secondly, in the SIP proposal modeling, the commission used a 1996 EI for non-electric utility point sources. For this Revised Control Case, the commission produced a modeling EI for the year 1997. Hence, the underlying modeled point source EI (electric utilities plus non-electric utilities) represents 1997. The multi-year averaged electric utility EI derived from the ARPDB (as described in the paragraph above) was modeled such that it superceded any 1997 EI records. Table 3.8-1 reports the overall emissions changes for these two improvements, after controls were applied.

Table 3.8-2 Modeled Reductions for Reliant and Entergy Electric Generating Facilities

Reliant [1] Unit	Ch.117 Limit (lb/MMBtu)	Max 30-day Heat Input [2] (MMBtu/day)	Calculated [3] Ch.117 30-day Limit (tpd)	Modeled NO_x Emissions [4] (tpd)	Control Factor [5] Applied to Reach Limit	Reduction [6]
SRB1	0.01	12,368	0.0618	1.7352	0.0356	96.4%
SRB2	0.01	15,333	0.0767	1.4980	0.0512	94.9%
CBY1	0.01	114,842	0.5742	5.5337	0.1038	89.6%
CBY2	0.01	116,279	0.5814	9.7930	0.0594	94.1%
CBY3	0.01	143,893	0.7195	6.0642	0.1186	88.1%
DWP9	0.01	11,972	0.0599	2.4351	0.0246	97.5%

[1] Reliant Energy (formerly, Houston Lighting and Power)

[2] 30-day average Heat Input from July 7 - August 5, 1998

[3] The product of the two previous columns divided by 2000, to obtain tons per day

[4] Calculated from hourly Acid Rain Program (EPA) data for the highest 30-day period of Heat Input

[5] The quotient of the two previous columns

[6] 1.0 - Control Factor

Reliant [1] Unit	Ch.117 Limit (lb/MMBtu)	Max 30-day Heat Input [2] (MMBtu/day)	Calculated [3] Ch.117 30-day Limit (tpd)	Modeled NO_x Emissions [4] (tpd)	Control Factor [5] Applied to Reach Limit	Reduction [6]
PHR1	0.01	81,757	0.4088	13.7273	0.0298	97.0%
PHR2	0.01	77,576	0.3879	12.9197	0.0300	97.0%
PHR3	0.01	104,974	0.5249	13.2988	0.0395	96.1%
PHR4	0.01	126,144	0.6307	7.4215	0.0850	91.5%
WEB3	0.01	62,092	0.3105	4.4044	0.0705	93.0%
WAP1	0.01	17,746	0.0887	1.9385	0.0458	95.4%
WAP2	0.01	10,457	0.0523	1.9268	0.0271	97.3%
WAP3	0.01	9,163	0.0458	5.2184	0.0088	99.1%
SRB3	0.01	25,656	0.1283	2.7100	0.0473	95.3%
SRB4	0.01	32,922	0.1646	1.6815	0.0979	90.2%
GBY5	0.01	48,075	0.2404	1.9898	0.1208	87.9%
THW2	0.01	33,299	0.1665	2.6002	0.0640	93.6%
WAP4	0.01	86,483	0.4324	7.1682	0.0603	94.0%
WAP5	0.03	184,662	2.7699	25.8121	0.1073	89.3%
WAP6	0.03	177,210	2.6582	31.8479	0.0835	91.7%
WAP7	0.03	156,092	2.3414	10.3179	0.2269	77.3%
WAP8	0.03	135,938	2.0391	21.9222	0.0930	90.7%
SJS1	0.015	21,703	0.1628	0.5021	0.3242	67.6%
SJS2	0.015	21,932	0.1645	0.4374	0.3761	62.4%
THW30-40 TOT	0.015	94,855	0.7114	2.3653	0.3008	69.9%
THW50 TOT	0.015	12,208	0.0916	0.3987	0.2296	77.0%
GBY TOT	0.015	11,370	0.0853	0.3137	0.2718	72.8%
HOC TOT	0.015	1,799	0.0135	0.0440	0.3066	69.3%
Small GT TOT	0.015	859				
Auxiliary Blrs.	0.01					
30-day System Total:		1,949,659	**16.7**	**198.03**		

Entergy [7] Unit (Lewis Creek)	Ch.117 Limit (lb/MMBtu)	Max 30-day Heat Input [8] (MMBtu/day)	Calculated Ch.117 30-day Limit (tpd)	Modeled NO_x Emissions (tpd)	Control Factor Applied to Reach Limit	Reduction
1	0.01	62,860	0.3143	6.2380	0.0504	95.0%
2	0.01	53,207	0.2660	4.6705	0.0570	94.3%
30-day System Total:		116,067	**0.58**	**10.90**		

[7] Entergy (formerly, Entergy Gulf States)

[8] 30-day average Heat Input from July 15 - August 13, 1999

Modify reductions to non-Electric Utility sources based on modifications to Chapter 117 rules

Subsequent to the proposed SIP revision, the rules affecting non-electric utility point sources were modified to place less restrictive controls on several classes of small sources. Since the reductions on non-electric utility sources is modeled as a cap, the adjustment was applied uniformly across all non-utility sources. This adjustment added 9.2 tpd of NO_x emissions to the final control strategy modeled inventory (VOC emissions were not affected).

Correct inadvertent control of non-Electric Utility emissions in attainment counties

For the SIP Proposal, a control scenario was inadvertently applied that was not intended to be applied, resulting in an inappropriate 350 tpd decrease in NO_x emissions, spread statewide, excluding the nonattainment areas of the state. This resulted in a minor effect upon the modeled ozone concentration in the HGA NAA. For the Revised Control Case, these controls were not applied.

Apply Post-1996 ROP rules, excluding RE Improvements

In the SIP proposal, the commission inadvertently neglected to include the remainder (post-1996) of the ROP controls from previous SIPs in the model runs. In attainment demonstrations for HGA SIP revisions prior to the SIP proposal, the commission modelers applied 24% ROP controls to the modeled EI in order to represent those controls that would come into effect between the years 1993 and 1999.

Since the currently-modeled EI is a 1997 EI, it is assumed that all of the controls prior to, and including, 1997 have been included in the 1997 actual emissions reported by the industries to the commission. Subsequently, the 15% ROP controls that accounted for the controls between 1993 and 1996, were removed from the package of controls. This left 9% ROP, 3% for each year between 1996 and 1999. Hence, in the Revised Control Case, only the remainder of the ROP controls (post-1996) were included.

Additionally, RE is now being applied externally from the AIRS extract program, and is being applied directly to the quality-assured 1997 actual EI, via a SAS program that acts as a post-processor to the AFS (AIRS Facility Subsystem) point source records. The RE Improvements, historically applied to the modeling EI as additional controls, are now built into the same SAS program that applies RE to VOC sources. CU (“Catch-Ups”) records have also been removed from the ROP controls, for the Revised Control Case modeling.

Correction of an error which caused emissions from low-level Louisiana point sources to be omitted

In the SIP proposal modeling, the low-level (less than 20-meter effective plume height) Louisiana point sources were inadvertently replaced with a file containing ships and locomotives emissions (also low-level). As the footnote to Table 3.8-1 also states, this did not affect the HGA 8-county NAA emissions totals, since this was an issue in Louisiana only. It was not expected that low-level emissions in the state of Louisiana would affect ozone production in the HGA NAA. In fact, once the Louisiana low-level point source file was correctly modeled in the Revised Control Case, it was determined that this represented only 5.3 tpd of low-level NO_x emissions and 30.5 tpd of low-level VOC emissions. Elevated point sources in Louisiana would be expected to have a larger ozone production impact upon the HGA NAA, because elevated sources are typically transported further distances.

Account for ERCs in the bank

There are currently 7299 tons of NO_x in the bank for the HGA NAA, and 4448 tons of VOC ERCs in the bank for the HGA NAA. If we assume an average of 90% reduction in NO_x valuation (new banking rules) and divide by 365 (days per year), then we arrive at a value of 2.0 tpd of NO_x that could be expected to be added to the controlled EI. At this time, VOC ERCs are not assumed to be devalued; therefore, if we divide the 4448 tons of VOC ERCs in the bank by 365, we arrive at 12.2 tpd of VOC to be added to the controlled EI. These values were applied (added) to the entire point source EI via a "mask" (spread evenly) over the entire HGA 8-county NAA in this Revised Control Case modeling.

Account for DERCs expected to be used by 2007

Similar to the ERCs, DERCs were accounted for in the Revised Control Case modeling. There are currently 38,553 tons of NO_x DERCs in the bank for the HGA NAA, and 1807 tons of VOC DERCs in the bank for the HGA NAA. Assuming a 10:1 usage ratio limitation and a limit of 10,000 per year NO_x limitation (new banking rules), we arrive at a value of 2.7 tpd of NO_x that could be expected to be added to the controlled EI. At this time, VOC DERCs will not have the usage limitations of the NO_x DERCs, so if we divide the 1807 tons of VOC DERCs by 365, we arrive at 5.0 tpd of VOC that could be expected to be added to the controlled EI. As with the ERCs, these DERCs were applied (added) to the entire point source EI via a "mask" (spread evenly) over the entire HGA 8-county NAA in this Revised Control Case modeling.

Account for newly-permitted sources

Appendix H of the SIP proposal described the procedure that the commission and its contractor used to develop the "growth" in point source emissions since 1997 (future base year). For the Revised Control Case, Appendix H has been updated with the addition of Section One, which describes the new procedure used by commission permit engineers. The original version of this appendix is now contained in Section Two of Appendix H. Commission permit engineers reviewed all of the permit files that represented all of the significant changes in permits since 1997 for the HGA NAA. New to this process, since the SIP proposal, was a thorough review of the control percentage difference between BACT/LAER (applied to the sources at permit issuance) and the new Chapter 117 rules. These differences were taken into account to develop the resultant NO_x increase of 23 tpd, which were then included in the model, for the HGA NAA. VOC was not included in this study.

Within the HGA 8-county NAA, the point source growth was entirely represented by the addition of the ERCs, DERCs, and the newly-permitted sources. These changes accounted for the majority of the 36 ton/day increase in NO_x emissions from the draft SIP proposal. Outside of the HGA NAA, the treatment of growth in point sources is unchanged from the SIP proposal, and is still represented by the study that added the new point sources within 100 miles of the HGA NAA.

3.8.2 Changes to On-Road Mobile Source Inventory

Estimation of differences between "old" and "new" inventories

Development of new inventory

As noted in Section 3.4.3, the basis of the on-road mobile source inventory which had been used prior to October of 2000 for both the future base case and attainment demonstration modeling is well documented in Appendix G of the October 27, 1999 HGA SIP. The title of this report is *Development of Gridded Mobile Source Emissions Estimates for the Houston-Galveston Nonattainment Counties FY2007 in Support of the COAST Project, Technical Note, December 1998*. Under contract to the TNRCC in 1998, TTI developed the 2007 gridded inventory based on the most recently available travel demand model output from the HGAC. Typically, TTI couples HGAC's travel demand model output with EPA MOBILE5 emission factor output by vehicle type and speed to obtain total vehicle emissions by roadway link on an hourly basis. The emissions from this link-based inventory are then converted into the 2 km square grid format used by the photochemical model.

Since the time that this baseline inventory was developed in 1998 by TTI, new travel demand model output became available from HGAC. For the 2007 Wednesday September 8th episode day, the former or "old" travel demand model output was 139,467,784 VMT for the entire 24-hour period. The revised or "new" travel demand model output for the Wednesday September 8th episode day is now 129,362,378 VMT for the entire 24-hour period. The VMT difference between these two travel demand model scenarios is 10,105,406 miles. Table 3.8-3 and Table 3.8-4 summarize the differences between the "old" and "new" inventories by both county and vehicle type, respectively.

Table 3.8-3 Changes in VMT by County

County	*"Old" VMT*	*"New" VMT*	*Difference*	*Change*
Brazoria	7,637,145	5,103,877	-2,533,269	-33.2%
Chambers	1,981,012	2,684,528	703,515	35.5%
Fort Bend	9,789,704	8,083,012	-1,706,692	-17.4%
Galveston	5,601,400	5,032,142	-569,258	-10.2%
Harris	101,551,829	94,611,516	-6,940,313	-6.8%
Liberty	2,158,780	2,408,400	249,620	11.6%
Montgomery	9,157,376	9,883,270	725,894	7.9%
Waller	1,590,537	1,555,634	-34,903	-2.2%
Total	***139,467,784***	***129,362,378***	***-10,105,406***	***-7.2%***

Table 3.8-4 Changes in VMT by Vehicle Type

Vehicle Type	*"Old" VMT*	*"New" VMT*	*Difference*	*Change*
LDGV	97,287,739	90,500,059	-6,787,680	-7.0%
LDGT1	21,980,326	21,369,835	-610,491	-2.8%
LDGT2	6,359,457	6,387,345	27,888	0.4%
HDGV	4,408,214	2,879,907	-1,528,308	-34.7%
LDDV	418,403	262,680	-155,724	-37.2%
LDDT	139,468	265,372	125,904	90.3%
HDDV	8,734,709	7,567,818	-1,166,891	-13.4%
MC	139,468	129,362	-10,105	-7.2%
Total	***139,467,784***	***129,362,378***	***-10,105,406***	***-7.2%***

HGAC developed the revised 2007 inventory estimates for VMT as part of their ongoing travel demand modeling work. Provided as Appendix M is a November 14, 2000 HGAC memo which summarizes the reasons for the VMT change between the two inventories. The title of this memo is *Analysis of Difference in Year 2007 Forecasted VMT Between That Developed for Original Attainment SIP and That Developed for Proposed Revised Attainment*.

As detailed in Section 3.4.3 and Appendix G, adjustments were made to the 139.4 million VMT baseline inventory in order to develop appropriate 2007 inventories for both future base case and attainment demonstration modeling. A full discussion of these adjustments is not included here, but a list of the types of adjustments made to develop the base case inventory is provided below:

- MOBILE5a_h to MOBILE5b conversion;
- NLEV I/M benefit overestimate correction;
- Updated vehicle registration distribution data; and
- Tier 2/low sulfur emission standards.

In order to develop the attainment demonstration inventory, additional adjustments were made to account for the following control strategies:

- ASM/OBDII I/M program;
- Low emission diesel fuel;
- 15 ppm sulfur gasoline; and
- On-road VMEP credit (16 tons of NO_x).

One of the problems in making these adjustments to a gridded inventory is that errors are introduced when a single adjustment factor (e.g., a 10% reduction) is uniformly applied to all 2 km grid squares within a given geographical area. Once a link-based gridded inventory is submitted by TTI to the TNRCC, it is impractical to have separate base case inventory adjustment factors applied to each of the 2 km grid squares. For example, the distribution of vehicle types and roadways within each 2 km grid square in Harris County is not uniform, even though the same base case NO_x adjustment factor is applied to each of these grid squares.

When developing the “new” inventory, TTI accounted for the adjustments listed above at the roadway link level in order to minimize the error introduced by grid-level adjustments. The only adjustment listed above which was intentionally excluded from TTI’s “new” link-level analysis is the 16 NO_x tons of VMEP credit, due to the fact that the amount of VMEP credit modeled can periodically change based on revised base case inventory estimates. The TTI report summarizing the development of this “new” inventory is included as Appendix N, and is entitled *Gridded Mobile Source Emissions Estimates for the Houston-Galveston Nonattainment Counties to Support the Attainment Demonstration SIP, December 2000*.

On July 31, 2000, the EPA Administrator signed a rule which will require lower emissions from heavy-duty gasoline vehicles (HDGVs) starting with the 2005 model year. This rule was published in the *Federal Register* on October 6, 2000. Due to the timing of its release, these HDGV benefits were not included in the “old” inventory. However, they are included in the “new” inventory as described in Appendix O, which is an October 20, 2000 Environ memo entitled *Comparison of Current and Revised SIP Highway Emissions Modeling*. This memo details the various inputs for the “new” inventory, in addition to providing a summary of some differences between the “old” and “new” inventories.

Section 3.4.3 details the adjustments that were made to the “old” inventory received from TTI to obtain the attainment inventory which was modeled for the August 9, 2000 proposed SIP. Tables 3.8-5 through 3.8-8 provide a comparison of NO_x and VOC emissions by both county and vehicle type between the “old” inventory (adjusted by TNRCC) and unadjusted “new” inventory received from TTI:

Table 3.8-5 Changes in NO_x Emissions by Vehicle Type (tpd)

Vehicle Type	*"Old" NO_x*	*"New" NO_x*	*Difference*	*Change*
LDGV	94.2	74.8	-19.4	-20.6%
LDGT1	19.2	19.1	-0.1	-0.7%
LDGT2	6.2	6.4	0.3	4.6%
HDGV	22.4	13.1	-9.3	-41.7%
LDDV	0.5	0.2	-0.3	-60.3%
LDDT	0.19	0.21	0.02	12.4%
HDDV	67.4	65.5	-1.9	-2.8%
MC	0.170	0.169	-0.001	-0.6%
Total	***210.2***	***179.5***	***-30.8***	***-14.6%***

Table 3.8-6 Changes in VOC Emissions by Vehicle Type (tpd)

Vehicle Type	*"Old" VOC*	*"New" VOC*	*Difference*	*Change*
LDGV	41.1	44.5	3.4	8.3%
LDGT1	10.3	12.2	1.9	18.5%
LDGT2	2.6	3.5	0.9	35.7%
HDGV	6.4	5.0	-1.4	-22.3%
LDDV	0.13	0.02	-0.11	-87.0%
LDDT	0.06	0.03	-0.03	-50.9%
HDDV	11.7	10.0	-1.7	-14.3%
MC	0.4	0.7	0.2	52.5%
Total	***72.8***	***76.0***	***3.2***	***4.4%***

Table 3.8-7 Changes in NO_x Emissions by County (tpd)

County	*"Old" NO_x*	*"New" NO_x*	*Difference*	*Change*
Brazoria	12.5	7.9	-4.6	-36.8%
Chambers	3.8	5.1	1.3	33.3%
Fort Bend	16.0	11.3	-4.6	-28.9%
Galveston	8.6	7.2	-1.4	-16.1%
Harris	147.3	126.2	-21.1	-14.3%
Liberty	3.6	3.8	0.2	4.6%
Montgomery	15.5	15.2	-0.3	-1.8%
Waller	3.0	2.7	-0.2	-7.9%
Total	***210.2***	***179.5***	***-30.7***	***-14.6%***

Table 3.8-8 Changes in VOC Emissions by County (tpd)

County	*"Old" VOC*	*"New" VOC*	*Difference*	*Change*
Brazoria	3.9	2.7	-1.2	-30.3%
Chambers	0.9	1.4	0.5	54.4%
Fort Bend	5.4	4.6	-0.8	-15.3%
Galveston	3.0	2.9	-0.2	-5.5%
Harris	52.9	56.8	3.9	7.3%
Liberty	1.0	1.4	0.4	39.2%
Montgomery	4.8	5.3	0.5	10.1%
Waller	0.8	0.9	0.1	19.0%
Total	***72.8***	***76.0***	***3.2***	***4.4%***

Several factors account for the changes in NO_x and VOC emissions between the "old" and "new" inventories. In order to determine the precise impact of each of these factors on the change in NO_x and VOC emissions, it would be necessary to redevelop the on-road mobile source inventory while modifying only one input at a time. Such an effort is not practical due to the enormous time and resources that it takes to develop the inventory just once. Nonetheless, an attempt has been made to approximate the impact that each of these factors has on the changes in NO_x and VOC emissions.

Estimate of emissions impact due to change in VMT

The most significant factor accounting for the change in NO_x and VOC emissions is the 10.1 million drop in VMT referenced earlier. In order to approximate the impact of this change, aggregate emission factors (in grams per mile) by vehicle type for the "old" inventory were obtained by dividing VMT from total emissions. These aggregate emission factors were then multiplied by the change in VMT in order to approximate the overall impact of the VMT change on emissions. As shown in Table 3.8-9, the 10.1 million drop in VMT caused the emissions to drop by roughly 23.9 NO_x tpd. A similar analysis was performed for VOC emissions and the overall change was calculated to be roughly 7.0 tpd (Table 3.8-10).

Table 3.8-9 Estimate of Changes in NO_x Emissions Due to Reduction in VMT

Vehicle Type	*"Old" NO_x Emissions (tpd)*	*"Old" VMT (miles)*	*"Old" Emission Factors (gpm)*	*VMT Change (miles)*	*NO_X Emissions Change (tpd)*
LDGV	94.2	97,287,739	0.88	-6,787,680	-6.6
LDGT1	19.2	21,980,326	0.79	-610,491	-0.5
LDGT2	6.2	6,359,457	0.88	27,888	0.03
HDGV	22.4	4,408,214	4.61	-1,528,308	-7.8
LDDV	0.5	418,403	1.12	-155,724	-0.2
LDDT	0.2	139,468	1.24	125,904	0.2
HDDV	67.4	8,734,709	7.00	-1,166,891	-9.0
MC	0.2	139,468	1.11	-10,105	-0.01
Total	***210.2***	***139,467,784***	***1.37***	***-10,105,406***	***-23.9***

Table 3.8-10 Estimate of Changes in VOC Emissions Due to Reduction in VMT

Vehicle Type	*"Old" VOC Emissions (tpd)*	*"Old" VMT (miles)*	*"Old" Emission Factors (gpm)*	*VMT Change (miles)*	*VOC Emissions Change (tpd)*
LDGV	41.1	97,287,739	0.38	-6,787,680	-2.9
LDGT1	10.3	21,980,326	0.43	-610,491	-0.3
LDGT2	2.6	6,359,457	0.37	27,888	0.01
HDGV	6.4	4,408,214	1.33	-1,528,308	-2.2
LDDV	0.1	418,403	0.28	-155,724	-0.05
LDDT	0.1	139,468	0.38	125,904	0.1
HDDV	11.7	8,734,709	1.21	-1,166,891	-1.6
MC	0.4	139,468	2.92	-10,105	-0.03
Total	***72.8***	***139,467,784***	***0.47***	***-10,105,406***	***-7.0***

Estimate of emissions impact due to changes in VMT mix

Another factor contributing to the change in NO_x and VOC emissions between the “old” and “new” inventories is the differing distributions of VMT by vehicle type, which is also referred to as “VMT mix”. As described on page 80 of Appendix G to the October 27, 1999 HGA SIP revision, VMT mix varies by both roadway type and by day of week. However, an aggregate VMT mix can be estimated by determining the contribution of each vehicle type’s VMT to the total VMT for the entire 8-county area. These VMT mix data are presented in Table 3.8-11 for both the “old” and “new” inventories. In order to approximate the impact of the VMT mix change, the “old” emission rates were multiplied by the “old” VMT totals and both the “old” and “new” VMT mix data by vehicle type. The difference between these two inventories was then estimated to be 9.3 tpd of NO_x. A similar analysis was performed for VOC emissions and the impact due to VMT mix changes was estimated to be 1.8 tpd (Table 3.8-12).

Table 3.8-11 Estimate of Changes in NO_x Emissions Due to VMT Mix Differences (tpd)

Vehicle Type	*"Old" VMT Mix*	*"New" VMT Mix*	*"Old" Inventory "Old" VMT Mix*	*"Old" Inventory "New" VMT Mix*	*VMT Mix Change Effects*
LDGV	69.8%	70.0%	94.2	94.5	0.3
LDGT1	15.8%	16.5%	19.2	20.1	0.9
LDGT2	4.6%	4.9%	6.2	6.7	0.5
HDGV	3.2%	2.2%	22.4	15.8	-6.6
LDDV	0.3%	0.2%	0.5	0.4	-0.2
LDDT	0.1%	0.2%	0.2	0.4	0.2
HDDV	6.3%	5.9%	67.4	62.9	-4.4
MC	0.1%	0.1%	0.2	0.2	0.0
Total	***100.0%***	***100.0%***	***210.2***	***200.9***	***-9.3***

Table 3.8-12 Estimate of Changes in VOC Emissions Due to VMT Mix Differences (tpd)

Vehicle Type	*"Old" VMT Mix*	*"New" VMT Mix*	*"Old" Inventory "Old" VMT Mix*	*"Old" Inventory "New" VMT Mix*	*VMT Mix Change Effects*
LDGV	69.8%	70.0%	41.1	41.2	0.1
LDGT1	15.8%	16.5%	10.3	10.8	0.5

LDGT2	4.6%	4.9%	2.6	2.8	0.2
HDGV	3.2%	2.2%	6.4	4.5	-1.9
LDDV	0.3%	0.2%	0.13	0.09	-0.04
LDDT	0.1%	0.2%	0.1	0.1	0.1
HDDV	6.3%	5.9%	11.7	10.9	-0.8
MC	0.1%	0.1%	0.4	0.4	0.0
Total	***100.0%***	***100.0%***	***72.8***	***71.0***	***-1.8***

Estimate of emissions impact due to changes in Tier 2 benefits

Tier 2 vehicle emission standards begin to be phased in starting with the 2004 model year. The Tier 2 emission benefits in calendar year 2007 calculated for the "old" inventory are discussed in Appendix G, which is an Eastern Research Group (ERG) 7-26-00 memo entitled *Revised SIP Modeling Procedures for Houston Ozone Nonattainment Area*. Under contract to the TNRCC, ERG developed revised Tier 2 benefit estimates for the "new" inventory based on the latest available information as outlined in Appendix P, which is an October 12, 2000 memo entitled *Revised Tier 2 Adjustment Factors for COAST SIP Inventory Update*. Contained within this memo are emission factor adjustments (in grams per mile) broken down by both vehicle type and county. Provided in Table 3.8-13 is a summary of the "old" and "new" Tier 2 benefits. Please refer to Appendix P for a more detailed explanation of the reasons for the differences in the total NO_x and VOC Tier 2 benefits.

Table 3.8-13 Summary of "Old" and "New" Tier 2 Benefits by Vehicle Type (tpd)

Vehicle Type	***"Old" NO_x "Old" VMT***	***"New" NO_x "New" VMT***	***NO_x Benefit Difference***	***"Old" VOC "Old" VMT***	***"New" VOC "New" VMT***	***VOC Benefit Difference***
LDGV	20.1	18.3	-1.8	6.1	3.0	-3.1
LDGT1	9.3	4.8	-4.5	3.8	0.8	-3.0
LDGT2	2.2	1.1	-1.1	1.1	0.3	-0.9
HDGV	0.0	0.6	0.6	0.0	0.1	0.1
LDDV	0.0	0.1	0.1	0.0	0.1	0.1
LDDT	0.0	0.1	0.1	0.0	0.1	0.1
HDDV	0.0	0.0	0.0	0.0	0.0	0.0
MC	0.0	0.0	0.0	0.0	0.0	0.0
Total	***31.6***	***25.2***	***-6.5***	***10.9***	***4.2***	***-6.7***

One of the factors contributing to the discrepancy in benefits between the "old" and "new" inventories is the 10.1 million VMT drop. Due to the fact that the VMT reduction impacts have already been estimated above, it would be informative to determine the difference in "old" and "new" Tier 2 benefits in the absence of any change in VMT. This was accomplished by multiplying the "new" emission factors from the October 12, 2000 ERG memo by the VMT figures from the "old" inventory. The results of this approach are presented in Table 3.8-14.

Table 3.8-14 Estimate of "Old" and "New" Tier 2 Benefits With "Old" VMT Data (tpd)

Vehicle Type	***"Old" NO_x "Old" VMT***	***"New" NO_x "Old" VMT***	***NO_x Benefit Difference***	***"Old" VOC "Old" VMT***	***"New" VOC "Old" VMT***	***VOC Benefit Difference***
LDGV	20.1	19.6	-0.5	6.1	3.2	-2.9

LDGT1	9.3	4.9	-4.4	3.8	0.8	-3.0
LDGT2	2.2	1.1	-1.1	1.1	0.3	-0.9
HDGV	0.0	1.0	1.0	0.0	0.1	0.1
LDDV	0.0	0.2	0.2	0.0	0.1	0.1
LDDT	0.0	0.1	0.1	0.0	0.0	0.0
HDDV	0.0	0.0	0.0	0.0	0.0	0.0
MC	0.0	0.0	0.0	0.0	0.0	0.0
Total	***31.6***	***26.9***	***-4.8***	***10.9***	***4.5***	***-6.4***

Estimate of emissions impact due to I/M benefit changes

The benefits to be achieved in the "old" inventory from the ASM/OBD II I/M Program are presented in Appendix G. Under contract to the TNRCC, ERG calculated the I/M benefits to be achieved from the "new" inventory. A comparison of the "old" and "new" I/M benefits is presented in Table 3.8-15.

Table 3.8-15 Summary of "Old" and "New" I/M NO_x and VOC Benefits by Vehicle Type (tpd)

Vehicle Type	*"Old" I/M NO_x Benefit*	*"New" I/M NO_x Benefit*	*NO_x Benefit Difference*	*"Old" I/M VOC Benefit*	*"New" I/M VOC Benefit*	*VOC Benefit Difference*
LDGV	33.7	27.6	-6.1	12.5	13.2	0.7
LDGT1	6.7	6.8	0.1	3.2	3.8	0.6
LDGT2	1.6	1.7	0.2	0.6	0.8	0.3
HDGV	0.1	0.1	-0.1	0.2	0.2	-0.1
LDDV	0.0	0.0	0.0	0.0	0.0	0.0
LDDT	0.0	0.0	0.0	0.0	0.0	0.0
HDDV	0.0	0.0	0.0	0.0	0.0	0.0
MC	0.0	0.0	0.0	0.0	0.0	0.0
Total	***42.1***	***36.2***	***-5.9***	***16.6***	***18.1***	***1.5***

As with the Tier 2 benefits, one of the factors contributing to the discrepancy in the I/M benefits is the 10.1 million VMT drop. Due to the fact that the VMT reduction impacts have already been calculated above, it would be informative to determine the difference between "old" and "new" I/M benefits in the absence of any change in VMT. This was accomplished by dividing the "new" I/M benefits by the "new" VMT in order to obtain gram per mile emission factors which were then multiplied by the "old" VMT. The results of this analysis are presented in Table 3.8-16.

Table 3.8-16 Estimate of "Old" and "New" I/M Benefits With "Old" VMT Data (tpd)

Vehicle Type	*"Old" I/M NO_x Benefit*	*"New" I/M "Old" VMT*	*NO_x Benefit Difference*	*"Old" I/M VOC Benefit*	*"New" I/M "Old" VMT*	*VOC Benefit Difference*
LDGV	33.7	29.7	-4.0	12.5	14.3	1.7
LDGT1	6.7	6.9	0.2	3.2	3.9	0.6
LDGT2	1.6	1.7	0.1	0.6	0.8	0.2
HDGV	0.15	0.11	-0.04	0.25	0.26	0.01
LDDV	0.0	0.0	0.0	0.0	0.0	0.0
LDDT	0.0	0.0	0.0	0.0	0.0	0.0

HDDV	0.0	0.0	0.0	0.0	0.0	0.0
MC	0.0	0.0	0.0	0.0	0.0	0.0
Total	***42.1***	***38.4***	***-3.7***	***16.6***	***19.3***	***2.6***

Estimate of emission impacts due to new HDGV standards

As mentioned previously, the "new" inventory includes recently announced HDGV emission standards which were not included with the "old" inventory. In order to estimate the impacts of this change, TNRCC staff ran MOBILE5b for each of the eight HGA counties both with and without the revised HDGV inputs, which are outlined in the Environ October 20, 2000 memo included as Appendix O. When performing these MOBILE5b runs, TNRCC staff kept all other inputs constant and consistent with those outlined in the Environ memo. For each run, an HDGV emission factor output (in grams per mile) was obtained for the facility-weighted average speeds by county, which were originally provided by TTI and are outlined in the ERG October 12, 2000 memo included as Appendix P. The only change is that the facility-weighted average speed for Chambers County was listed by TTI as 66.6 mph, but 65 mph was used in MOBILE5b because that is the highest speed that can be modeled.

In order to estimate the benefits in 2007 of the new HDGV standards, the difference in emission rates by county were multiplied by the "new" HDGV VMT data. Consideration was not given to what the benefits would be if the "old" VMT data were used, because these revised HDGV standards were never included with the old inventory. Consequently, Table 3.8-17 indicates that the new HDGV emission rates provided roughly an additional 1.26 tpd benefit of NO_x for the 8-county area beyond what would have occurred if these new standards had not been modeled. As shown in Table 3.8-18, the VOC benefits from these revised HDGV standards are quite low at approximately 0.05 tpd of VOC for the entire 8-county area.

Table 3.8-17 Estimate of NO_x Emissions Impact from New HDGV Emission Standards

County	***Weighted Average Speed***	***Former HDGV Emission Rate*** *(gpm)*	***Revised HDGV Emission Rate*** *(gpm)*	***Differential Emission Rate*** *(gpm)*	***"New" HDGV VMT***	***Revised HDGV Benefit*** *(tons per day)*
Brazoria	46.0	5.17	4.88	0.29	123,380	0.04
Chambers	65.0	5.77	5.32	0.45	57,770	0.03
Fort Bend	41.7	5.05	4.90	0.15	191,169	0.03
Galveston	40.4	4.91	4.52	0.39	114,631	0.05
Harris	37.6	4.37	3.96	0.41	2,047,258	0.93
Liberty	53.2	5.53	5.00	0.53	61,055	0.04
Montgomery	48.6	5.09	4.66	0.43	246,169	0.12
Waller	59.4	5.54	4.86	0.68	38,475	0.03
8-County Total					2,879,907	1.26

Table 3.8-18 Estimate of VOC Emissions Impact from New HDGV Emission Standards

County	***Weighted Average Speed***	***Former HDGV Emission Rate*** *(gpm)*	***Revised HDGV Emission Rate*** *(gpm)*	***Differential Emission Rate*** *(gpm)*	***"New" HDGV VMT***	***Revised HDGV Benefit*** *(tons per day)*
Brazoria	46.0	1.69	1.69	0.00	123,380	0.000
Chambers	65.0	1.47	1.46	0.01	57,770	0.001

Fort Bend	41.7	2.12	2.11	0.01	191,169	0.002
Galveston	40.4	2.23	2.22	0.01	114,631	0.001
Harris	37.6	1.51	1.49	0.02	2,047,258	0.045
Liberty	53.2	2.03	2.01	0.02	61,055	0.001
Montgomery	48.6	1.75	1.74	0.01	246,169	0.003
Waller	59.4	1.92	1.91	0.01	38,475	0.0004
8-County Total					2,879,907	0.05

Summary of estimated differences between "old" and "new" inventories

In order to summarize the primary inventory differences discussed above, Table 3.8-19 is provided which contains both the NO_x and VOC impacts for the entire 8-county area. As shown in a previous table, the NO_x emissions from the "new" inventory are roughly 30.8 tons lower than the old inventory, while the VOC emissions are roughly 3.2 tons higher. The primary factor accounting for the drop in NO_x emissions is the 10.1 million drop in VMT, which accounts for approximately 23.9 tpd of NO_x. The factors shown in the table as negative resulted in a decrease in the overall inventory emissions from "old" to "new", while those shown as positive resulted in an increase in the overall inventory emissions. For example, the overall "new" inventory total was increased by 4.8 tons of NO_x due to the fact that the Tier 2 benefit shrunk by this amount. Conversely, the overall "new" inventory would have been 1.3 tons of NO_x higher if the HDGV standards had not been modeled.

Table 3.8-19 8-County Summary of Differences Between "Old" And "New" Inventories

Factor Accounting for Difference in Inventories	***NO_x Emissions*** *(tons per day)*	***VOC Emissions*** *(tons per day)*
10.1 Million VMT Drop	-23.9	-7.0
VMT Mix Changes	-9.3	-1.8
Tier 2 Benefit Changes	4.8	6.4
I/M Program Benefit Changes	3.7	-2.6
Revised HDGV Standards	-1.3	-0.1
Subtotal	-26.0	-5.1
Minor Differences & Error	-4.8	8.3
Total Inventory Difference	***-30.8***	***3.2***

As noted in the previous discussions, an attempt was made to isolate the effects of the VMT change from the effects due to other factors so that double counting would not occur. For example, when calculating the Tier 2 benefits impact shown in the above table, only "old" VMT data were used because the overall effect of the VMT change had already been estimated. To simply take the difference in Tier 2 benefits between the "old" and "new" inventories would have double counted the effect that the drop in VMT had on the Tier 2 benefits.

It is important to reiterate that this approach has only approximated the impacts which each of the factors listed in the table have had on the total emissions levels of the "old" and "new" inventories. A more precise approach would involve an inordinate amount of time and resources because an entirely new link-based inventory would need to be developed for each single change in all of the input factors. In addition, this analysis has only focused on the major differences between the two inventories and has not addressed the minor ones. As discussed further in Chapter 7, the mid-course review process has already begun and will continue, ultimately resulting in a SIP revision by May 1, 2004. There are planned opportunities throughout this process to incorporate the latest information and make decisions which will involve a thorough evaluation of all modeling, inventory data, and other tools and assumptions used to develop the attainment demonstration.

TNRCC processing of new on-road mobile source inventory

Future Base Case and Attainment Strategy Inventory Development

In order to develop the future base case and attainment strategy emissions for the 2007 modeling episode, revisions to the "new" inventory were required. For the future base case, the I/M, low emission diesel, and 15 ppm sulfur gasoline benefits had to be removed from the "new" inventory. In this case, "removing" the benefit is accomplished by adding its total to the unadjusted baseline. Since the time that the "new" inventory was received from TTI in early October, new information became available concerning emission standards on HDDVs. Starting with the 2002 model year, HDDV standards which were originally planned for the 2004 model year will go into effect. This is often referred to as the HDDV "pull-ahead" process. Under contract to the TNRCC, ERG estimated the benefits to be obtained from the HDDV pull-ahead in 2007 to be approximately 5 tons of NO_x emissions. In addition, recently announced tighter HDDV standards will go into effect starting with the 2007 model year. The benefits to be achieved in calendar year 2007 from these new standards were estimated by ERG to be approximately 0.61 tons of NO_x emissions. These HDDV benefits were "added" to the inventory by subtracting them from the unadjusted baseline. Provided in Tables 3.8-20 and 3.8-21 are NO_x and VOC on-road base case emissions summaries for the Wednesday September 8th episode in 2007.

Table 3.8-20 2007 Future Base Case NO_x Emissions for Wednesday September 8th Episode (tpd)

	"New" Unadjusted Inventory From TTI	*Inventory Increases*			*Inventory Reductions*		*Future Base Case Inventory*
		ASM/OBD II I/M Program Benefits	*Low Emission Diesel*	*15 ppm Sulfur Gasoline*	*2002 HDDV Pull-Ahead*	*HDDV 2007 Standards*	
Brazoria	7.9	1.9	0.2	0.04	-0.2	-0.03	9.8
Chambers	5.1	1.3	0.1	0.02	-0.2	-0.02	6.3
Fort Bend	11.3	2.6	0.3	0.06	-0.3	-0.04	13.9
Galveston	7.2	1.8	0.2	0.04	-0.2	-0.03	9.0
Harris	126.2	23.0	2.7	0.65	-3.4	-0.42	148.8
Liberty	3.8	1.1	0.1	0.02	-0.1	-0.01	4.9
Montgomery	15.2	3.7	0.4	0.07	-0.4	-0.05	18.8
Waller	2.7	0.8	0.1	0.01	-0.1	-0.01	3.5
Total	***179.5***	***36.2***	***4.0***	***0.92***	***-5.0***	***-0.61***	***214.9***

Table 3.8-21 2007 Future Base Case VOC Emissions for Wednesday September 8th Episode (tpd)

"New" Unadjusted Inventory	*Inventory Increases*			*Inventory Reductions*		*Future Base Case*
	ASM/OBD II I/M Program	*Low Emission*	*15 ppm Sulfur*	*2002 HDDV*	*HDDV 2007*	

	From TTI	Benefits	Diesel	Gasoline	Pull-Ahead	Standards	Inventory
Brazoria	2.7	1.3	0	0	0	0	4.1
Chambers	1.4	0.8	0	0	0	0	2.3
Fort Bend	4.6	2.1	0	0	0	0	6.6
Galveston	2.9	1.4	0	0	0	0	4.3
Harris	56.8	8.9	0	0	0	0	65.7
Liberty	1.4	0.7	0	0	0	0	2.1
Montgomery	5.3	2.4	0	0	0	0	7.7
Waller	0.9	0.5	0	0	0	0	1.4
Total	***76.0***	***18.0***	***0***	***0***	***0***	***0***	***94.0***

For the attainment demonstration, it was decided to cancel the proposed strategy which would have lowered the sulfur content of gasoline down to 15 ppm. Consequently, this benefit was removed from the inventory. Under the “old” inventory, the 15 ppm sulfur gasoline benefit was estimated to be 1.15 tons of NO_x. Due to the lower VMT in the “new” inventory, this benefit was estimated to be 0.92 tons of NO_x instead. In the “old” inventory, the on-road mobile VMEP benefit was estimated to be 16 tons of NO_x. Based on revised inventory calculations, the total VMEP benefit was recalculated to be 23 tpd, of which 10.4 tpd was applied to on-road mobile sources and 12.6 was applied to non-road mobile sources. The benefits associated with VMEP, 2002 HDDV pull-ahead, and revised 2007 HDDV standards were included in the “new” inventory by subtracting them from the unadjusted baseline. Provided in Tables 3.8-22 and 3.8-23 are NO_x and VOC attainment strategy emissions summaries for the Wednesday September 8th episode in 2007.

Table 3.8-22 2007 Attainment Strategy NO_x Emissions for Wednesday September 8th Episode (tpd)

	"New" Unadjusted Inventory From TTI	Increases: 15 ppm Sulfur Gasoline	Inventory Reductions: On-Road Mobile VMEP	Inventory Reductions: 2002 HDDV Pull-Ahead	Inventory Reductions: HDDV 2007 Standards	Future Attainment Strategy Inventory
Brazoria	7.9	0.04	-0.5	-0.2	-0.03	7.2
Chambers	5.1	0.02	-0.3	-0.2	-0.02	4.6
Fort Bend	11.3	0.06	-0.7	-0.3	-0.04	10.4
Galveston	7.2	0.04	-0.4	-0.2	-0.03	6.6
Harris	126.2	0.65	-7.3	-3.4	-0.42	115.7
Liberty	3.8	0.02	-0.2	-0.1	-0.01	3.5
Montgomery	15.2	0.07	-0.9	-0.4	-0.05	13.9
Waller	2.7	0.01	-0.2	-0.1	-0.01	2.5
Total	***179.5***	***0.92***	***-10.4***	***-5.0***	***-0.61***	***164.4***

Table 3.8-23 2007 Attainment Strategy VOC Emissions for Wednesday September 8th Episode (tpd)

	"New" Unadjusted Inventory From TTI	*Increases: 15 ppm Sulfur Gasoline*	*Inventory Reductions: On-Road Mobile VMEP*	*Inventory Reductions: 2002 HDDV Pull-Ahead*	*Inventory Reductions: HDDV 2007 Standards*	*Future Attainment Strategy Inventory*
Brazoria	2.7	0	0	0	0	2.7
Chambers	1.4	0	0	0	0	1.4
Fort Bend	4.6	0	0	0	0	4.6
Galveston	2.9	0	0	0	0	2.9
Harris	56.8	0	0	0	0	56.8
Liberty	1.4	0	0	0	0	1.4
Montgomery	5.3	0	0	0	0	5.3
Waller	0.9	0	0	0	0	0.9
Total	***76.0***	***0***	***0***	***0***	***0***	***76.0***

TNRCC preprocessing of on-road mobile source inventory

Upon receipt of an on-road mobile source inventory, TNRCC modeling staff must run it through an emissions preprocessing system so that the text data can be converted to binary format for input into the photochemical model. Whenever this process occurs, the NO_x and VOC emission totals are slightly modified, due partly to the manner in which emissions are apportioned whenever a boundary between two or more counties is contained within a single 2 km grid square. The magnitude of modification is enhanced for the VOC emissions due to the fact that the numerous hydrocarbon compounds are speciated into ten different groupings (paraffins, olefins, aldehydes, etc.) based on their carbon bond structure. This process is often referred to as Carbon Bond IV (CB-IV) speciation. Provided in Table 3.8-24 is a summary of the how the emissions preprocessing step performed by TNRCC staff modified the unadjusted “new” inventory which was received from TTI.

Table 3.8-24 Summary of TNRCC Preprocessing on Unadjusted TTI Inventory

	NO_x Emissions *(tpd)*		***VOC Emissions*** *(tpd)*	
	Unadjusted	*Preprocessed*	*Unadjusted*	*Preprocessed*
Harris	126.2	125.9	56.8	60.7
Brazoria	7.9	7.7	2.7	2.9
Fort Bend	11.3	11.1	4.6	4.8
Galveston	7.2	7.1	2.9	3.0
Montgomery	15.2	15.3	5.3	5.7
Urban Total	41.6	41.2	15.5	16.4
Chambers	5.1	5.6	1.4	1.8
Liberty	3.8	4.0	1.4	1.6
Waller	2.7	2.8	0.9	1.0
Rural Total	11.6	12.4	3.8	4.3
8-County Total	179.5	179.5	76.0	81.5

All of the inventory data described above have been specific to the Wednesday September 8th episode in 2007. For the “old” inventory, TTI had prepared separate hourly on-road mobile emission files for each day in the 2007 September 6-11 modeling episode. Due to limited time and resources when preparing the “new” inventory, TTI was only able to provide hourly on-road emission files for the Wednesday September 8th episode. In order to develop the appropriate on-road mobile photochemical model input files for the other days in the episode, TNRCC staff utilized PV-WAVE software to adjust the “new” Wednesday episode data by the ratio of the “old” episode day of interest to the “old” Wednesday inventory. For example, in order to develop the “new” Friday September 10th on-road mobile inventory, the ratio of “old Friday” to “old Wednesday” emissions was multiplied by “new Wednesday” emissions to obtain “new Friday” emissions. This approach was taken for all of the remaining episode days for each hour and for each 2 km grid square within the 8-county HGA modeling domain. Tables 3.8-25 and 3.8-26 summarize the NO_x and VOC emissions for each episode day after completion of both the TNRCC preprocessing on the Wednesday September 8th episode day and the PV-WAVE adjustment to develop the other episode days. TNRCC staff performed quality assurance checks on these “new” figures to ensure that the relative differences in emission totals among the episode days were consistent with the equivalent relative differences from the “old” inventory.

Table 3.8-25 2007 Preprocessed On-Road Mobile Source NO_x Emissions (tpd)

	Monday September 6	*Tuesday September 7*	*Wednesday September 8*	*Thursday September 9*	*Friday September 10*	*Saturday September 11*
Harris	125.6	125.7	125.9	125.2	158.9	106.7
Brazoria	7.7	7.7	7.7	7.7	9.9	8.1
Fort Bend	11.1	11.1	11.1	11.0	14.0	9.5
Galveston	7.1	7.1	7.1	7.1	9.3	8.7
Montgomery	15.2	15.2	15.3	15.2	19.4	14.4
Urban Total	41.1	41.1	41.2	41.0	52.6	40.6
Chambers	5.6	5.6	5.6	5.6	6.8	6.7
Liberty	4.0	4.0	4.0	4.0	5.3	3.9
Waller	2.8	2.8	2.8	2.8	3.5	2.4
Rural Total	12.3	12.4	12.4	12.3	15.6	13.0
8-County Total	***179.0***	***179.1***	***179.5***	***178.5***	***227.1***	***160.4***

Table 3.8-26 2007 Preprocessed On-Road Mobile Source VOC Emissions (tpd)

	Monday September 6	*Tuesday September 7*	*Wednesday September 8*	*Thursday September 9*	*Friday September 10*	*Saturday September 11*
Harris	58.1	59.1	60.7	56.9	73.5	50.0
Brazoria	2.9	2.9	2.9	2.9	3.5	3.1
Fort Bend	4.6	4.7	4.8	4.5	5.7	4.1
Galveston	3.0	3.0	3.0	3.0	3.8	3.8
Montgomery	5.5	5.6	5.7	5.4	6.8	5.4
Urban Total	16.0	16.2	16.4	15.8	19.8	16.3
Chambers	1.7	1.7	1.8	1.7	2.0	2.2
Liberty	1.5	1.5	1.6	1.5	1.9	1.5
Waller	1.0	1.0	1.0	1.0	1.2	0.9
Rural Total	4.2	4.3	4.3	4.2	5.1	4.6
8-County Total	***78.3***	***79.6***	***81.5***	***76.9***	***98.4***	***71.0***

After the preprocessing and PV-WAVE adjustment steps were completed, the “new” 8-county HGA data were merged with on-road mobile source inventory data from Beaumont/Port Arthur and other surrounding counties within the modeling domain. These non-HGA on-road mobile source inventories have not changed from those reported in recent attainment demonstration SIPs for the HGA area.

Development of base case and attainment strategy adjustment factors

Prior to input into the photochemical model, these on-road mobile source inventory data must be adjusted to develop the future base case and attainment strategy inventories. In order to obtain the adjustment factors to accomplish this, the “new” unadjusted inventory is divided from the future base case and attainment strategy inventories by county grouping. The resulting ratios are then applied to the on-road mobile inventory for each episode day prior to input into the photochemical model. This approach ensures that the same relative adjustment is applied uniformly for each episode day. For example, due to increased traffic demand typical of a Friday episode, the September 10th on-road mobile emissions are significantly higher than the Wednesday September 8th emissions. By applying the same base case and attainment strategy adjustment factors to both days, the relative benefits are uniformly applied even though the absolute magnitude of those adjustments differ. Tables 3.8-27 and 3.8-28 summarize how the base case and attainment strategy adjustment factors for NO_x and VOC were developed for the 2007 on-road mobile inventory. In the tables, “Urban Counties” refer to Brazoria, Fort Bend, Galveston, and Montgomery. “Rural Counties” refer to Chambers, Liberty, and Waller.

Table 3.8-27 On-Road Mobile NO_x Emissions Adjustment Summary

	NO_x Inventories (tpd)			***Adjustment Factors***	
County Grouping	*"New" Unadjusted*	*Base Case*	*Attainment Strategy*	*Base Case*	*Attainment Strategy*
Harris	126.2	148.8	112.2	1.179	0.917
Urban Counties	41.6	51.5	36.9	1.238	0.914
Rural Counties	11.6	14.6	10.3	1.260	0.915
Total	179.5	214.9	159.4		

Table 3.8-28 On-Road Mobile VOC Emissions Adjustment Summary

	VOC Inventories (tpd)			***Adjustment Factors***	
County Grouping	*"New" Unadjusted*	*Base Case*	*Attainment Strategy*	*Base Case*	*Attainment Strategy*
Harris	56.8	65.7	56.8	1.157	1.000
Urban Counties	15.5	22.6	15.5	1.463	1.000
Rural Counties	3.8	5.8	3.8	1.524	1.000
Total	76.0	94.0	76.0		

By applying the NO_x and VOC base case adjustment factors to the preprocessed emissions presented above, the following 2007 on-road mobile base case inventories for each episode day were developed (Tables 3.8-29 and 3.8-30).

Table 3.8-29 2007 On-Road Mobile Source Base Case NO_x Emissions (tpd)

	Monday September 6	*Tuesday September 7*	*Wednesday September 8*	*Thursday September 9*	*Friday September 10*	*Saturday September 11*
Harris	148.1	148.2	148.5	147.6	187.3	125.8
Brazoria	9.6	9.6	9.6	9.6	12.3	10.0
Fort Bend	13.7	13.7	13.7	13.6	17.4	11.7
Galveston	8.8	8.8	8.8	8.8	11.6	10.8
Montgomery	18.9	18.9	18.9	18.8	24.0	17.8
Urban Total	50.9	50.9	51.0	50.8	65.2	50.3
Chambers	7.1	7.1	7.1	7.1	8.6	8.5
Liberty	5.0	5.0	5.0	5.0	6.6	4.9
Waller	3.5	3.5	3.5	3.5	4.4	3.0
Rural Total	15.6	15.6	15.6	15.5	19.6	16.4
8-County Total	***214.5***	***214.6***	***215.0***	***213.9***	***272.1***	***192.5***

Table 3.8-30 2007 On-Road Mobile Source Base Case VOC Emissions (tpd)

	Monday September 6	*Tuesday September 7*	*Wednesday September 8*	*Thursday September 9*	*Friday September 10*	*Saturday September 11*
Harris	67.2	68.4	70.2	65.8	85.1	57.9
Brazoria	4.2	4.2	4.2	4.2	5.1	4.5
Fort Bend	6.8	6.9	7.0	6.6	8.4	6.0
Galveston	4.4	4.4	4.4	4.4	5.6	5.6
Montgomery	8.0	8.2	8.4	7.9	9.9	7.9
Urban Total	23.5	23.7	24.1	23.2	28.9	23.9
Chambers	2.7	2.7	2.7	2.7	3.1	3.4
Liberty	2.3	2.3	2.4	2.3	2.9	2.3
Waller	1.5	1.5	1.5	1.5	1.8	1.3
Rural Total	6.5	6.5	6.6	6.4	7.8	7.0
8-County Total	***97.1***	***98.6***	***100.9***	***95.4***	***121.8***	***88.8***

By applying the NO_x and VOC attainment strategy adjustment factors to the preprocessed emissions presented above, the following 2007 on-road mobile attainment strategy inventories for each episode day were developed (Tables 3.8-31 and 3.8-32).

Table 3.8-31 2007 On-Road Mobile Source Attainment Strategy NO_x Emissions (tpd)

	Monday September 6	*Tuesday September 7*	*Wednesday September 8*	*Thursday September 9*	*Friday September 10*	*Saturday September 11*
Harris	115.2	115.2	115.5	114.8	145.7	97.9
Brazoria	7.1	7.1	7.1	7.1	9.1	7.4
Fort Bend	10.1	10.1	10.1	10.1	12.8	8.7
Galveston	6.5	6.5	6.5	6.5	8.5	8.0
Montgomery	13.9	13.9	14.0	13.9	17.7	13.1
Urban Total	37.5	37.6	37.6	37.5	48.1	37.1
Chambers	5.1	5.1	5.1	5.1	6.2	6.2
Liberty	3.6	3.6	3.6	3.6	4.8	3.6
Waller	2.6	2.6	2.6	2.5	3.2	2.2
Rural Total	11.3	11.3	11.3	11.3	14.3	11.9
8-County Total	***164.0***	***164.1***	***164.4***	***163.6***	***208.1***	***146.9***

Table 3.8-32 2007 On-Road Mobile Source Attainment Strategy VOC Emissions (tpd)

	Monday September 6	*Tuesday September 7*	*Wednesday September 8*	*Thursday September 9*	*Friday September 10*	*Saturday September 11*
Harris	58.1	59.1	60.7	56.9	73.5	50.0
Brazoria	2.9	2.9	2.9	2.9	3.5	3.1
Fort Bend	4.6	4.7	4.8	4.5	5.7	4.1
Galveston	3.0	3.0	3.0	3.0	3.8	3.8
Montgomery	5.5	5.6	5.7	5.4	6.8	5.4
Urban Total	16.0	16.2	16.4	15.8	19.8	16.3
Chambers	1.7	1.7	1.8	1.7	2.0	2.2
Liberty	1.5	1.5	1.6	1.5	1.9	1.5
Waller	1.0	1.0	1.0	1.0	1.2	0.9
Rural Total	4.2	4.3	4.3	4.2	5.1	4.6
8-County Total	***78.3***	***79.6***	***81.5***	***76.9***	***98.4***	***71.0***

3.8.3 Changes to Area and Non-Road Mobile Sources

There were three changes that affected area and non-road mobile sources between the SIP Proposal modeling and the Revised Control Case modeling.

<u>The inadvertent double-counting of low-level ship and locomotive emissions</u>

Due to an error in scripting, which is an ordered list of files to be included in a model run, the Texas link-based emissions (ships and locomotives) were included twice in the SIP proposal modeling. Instead of modeling low-level point sources in Louisiana and Texas link-based emissions, the run script for the SIP proposal modeling included two lines for Texas link-based emissions. Hence, as is described in subsection 3.8.1, the Louisiana low-level point sources were not included in the SIP proposal modeling, and the low-level ship and locomotive emissions were actually doubled in the SIP proposal model run. This was corrected by modifying the list of files in the run script to include the low-level point source Louisiana file, and removing the second occurrence of the Texas link-based file. This correction reduced modeled NO_x emissions by 60 tpd and VOC emissions by 4.4 tpd. Modeled peak ozone levels for each day of the simulation (Sept 8-11) were reduced by about 1-4 ppb.

In both the SIP proposal and Revised Control Case modeling, the shipping emissions were modeled as low-level area sources in the area outside the eight-county nonattainment area. Within the eight-county area, the shipping emissions were modeled as elevated point sources in both the SIP proposal and the Revised Control Case. Hence, the eight-county shipping emissions were unaffected by the scripting error.

Change in control strategy of the lawn and garden and construction equipment usage restrictions

The Lawn and Garden equipment usage restrictions were lifted for the non-commercial (residential) activities. For the modeling, this entailed simply removing the shift in the hours of activity (redistributing the emissions to allow morning activity) for the residential portion of this area source category. Also, the commission removed the usage restrictions in three rural counties: Liberty, Waller, and Chambers. No changes in daily total emissions result from these control strategy modifications - only the timing of the emissions is affected.

Change to amount of VMEP benefit applied to non-road mobile sources

In the SIP proposal, a total of 24 NO_x tpd benefit was estimated for VMEP. Of this 24 NO_x tpd, 16 tons were applied to on-road mobile emissions and 8 tons were applied to non-road mobile emissions. Based on revised future base case inventory estimates, a total of 23 NO_x tpd of VMEP benefit has been estimated, as detailed in Table 6.3-5. Of this 23 NO_x tpd, 10.4 tpd has been applied to on-road mobile emissions and 12.6 tons were applied to non-road mobile emissions. This change in VMEP benefit has reduced the total non-road mobile NO_x inventory by 4.6 tons.

3.8.4 Summary of Revised 2007 Control Case Emissions

Table 3.8-33 shows the anthropogenic emissions by category for the revised control case, along with those of the control case modeled in the SIP proposal.

Table 3.8-33 2007 Control Case Emissions in the HGA 8-County Area for September 8

Category	NO_x (tpd)		VOC (tpd)	
	SIP Proposal	Revised Control Case	SIP Proposal	Revised Control Case
On-road mobile sources	194	164	75	81
Area/non-road mobile sources	134	129	280	280
Point sources	67	103	264	212
Total anthropogenic emissions	395	396	619	573

Overall, emissions of NO_x increased marginally, with decreases in area/non-road and on-road mobile source emissions counterbalanced by the increase in point source emissions. Emissions of VOC showed a small decrease, mostly due to the application of the post-96 ROP rules. The most significant change in emissions in the model was the correction of the double-counting of ship and locomotive emissions in the HGA 8-county area, which reduced NO_x emissions by 60 tpd and VOC emissions by 4.4 tpd. The extra emissions due to double counting were in the modeling for the SIP proposal; however, since the extra emissions were not included in the area/non-road mobile source emissions reported for the final control strategy in Table 3.5-3, emissions from this category show no change in Table 3.8-33.

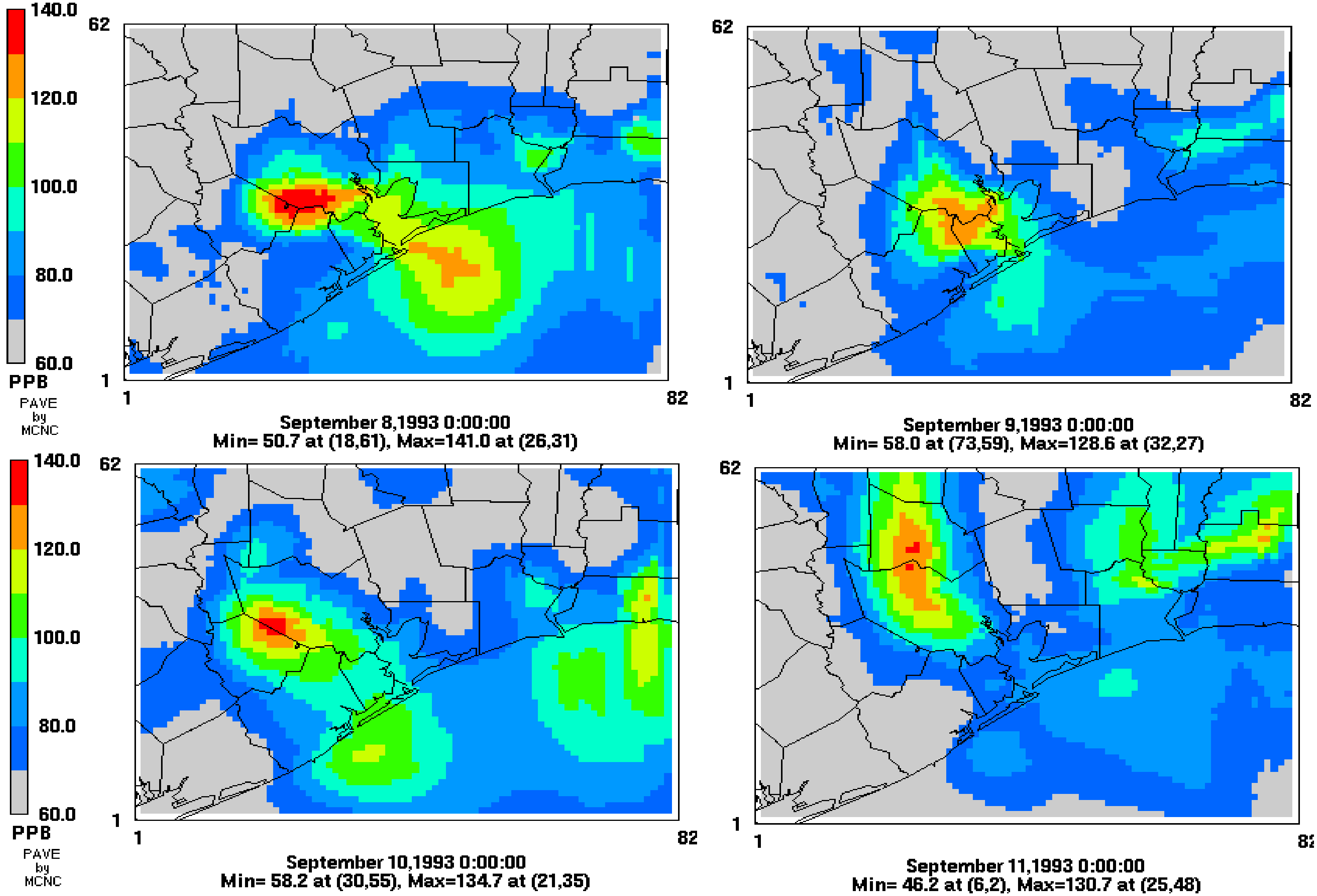
3.8.5 New Modeling Analyses

Once the inventory changes detailed above had been implemented, the future control case was modeled again. As anticipated, the modeled peak ozone values declined significantly from the SIP proposal, due primarily to the correction of the double-counting problem. Table 3.8-34 shows modeled peak ozone for each primary episode day for the revised control case, and also lists the corresponding values from the SIP proposal (Table 3.5-4). Figure 3.8-1 provides isopleth plots of peak modeled ozone for each of the four episode days in the 4 km × 4 km fine grid area.

Table 3.8-34 Future Control Case Peak Modeled Ozone in the HGA 8-County Area

Episode Day	Peak Modeled Ozone (ppb)	
	SIP Proposal	Revised Control Case
September 8	146.4	141.0
September 9	134.7	128.6
September 10	139.9	134.7
September 11	132.6	130.7

The revised control case shows significant reductions in peak modeled ozone on all days when compared with the modeling reported in the SIP proposal, with the largest decrease seen on September 9th, where peak modeled ozone declined by 6.1 ppb. The decrease on September 8th was 5.4 ppb, followed by 5.2 ppb on the 10th and 1.9 ppb on the 11th.


140.0
120.0
100.0
80.0
60.0
PPB
PAVE
by
MCNC
62
1
82
September 8,1993 0:00:00
Min= 50.7 at (18,61), Max=141.0 at (26,31)
September 9,1993 0:00:00
Min= 58.0 at (73,59), Max=128.6 at (32,27)
September 10,1993 0:00:00
Min= 58.2 at (30,55), Max=134.7 at (21,35)
September 11,1993 0:00:00
Min= 46.2 at (6,2), Max=130.7 at (25,48)

3.8.6 Revised Gap Calculation

As was done previously, the results of the control case modeling were used to estimate the shortfall (gap) in NO_x emissions between the revised control case and what is needed to show attainment of the one-hour ozone standard. In the SIP proposal, the shortfall was calculated using a relation between September 8th peak modeled ozone and emissions of NO_x on that day. EPA Region VI developed this relation based on modeling submitted in the 1999 SIP revision.

Since several changes were made to the emissions in the latest SIP proposal, Region VI commented that the relation needs to be re-drawn using modeling which reflects these changes. Since the relation developed by Region VI was quadratic, it required three ordered pairs (Peak modeled ozone concentration, Emissions of NO_x) to fit. The revised control case modeling for September 8th provides one ordered pair, so two additional model runs were conducted to provide sufficient data to redraw the curve. These additional runs were designed so that they, along with the revised control case, would form a set of runs analogous to the three scenarios used by Region VI to develop the original relation. The three cases were Scenario VI, Scenario VIb, and Scenario VIc. Scenario VI was a control strategy which included approximately the same set of rules in the revised control case. Scenario VIb included the same rules as Scenario VI, but reduced the area/non-road NO_x emissions by 50%, and Scenario VIc added the assumption of a 2015 vehicle fleet (which reduced on-road mobile source NO_x about 50%).

One significant inventory change made since the 1999 SIP revision was the revision to construction equipment emissions, which reduced non-road mobile source NO_x emissions significantly. So the revised control case can be thought of as the analogue of Scenario VIb (50% reduction to non-road NO_x). Then a case analogous to Scenario VI can be created by doubling the non-road NO_x emissions from the revised control case in the HGA 8-county area. Similarly, the analogue to Scenario VIc can be created from the revised control case by halving the on-road mobile source NO_x emissions in the HGA area. These two new cases were run along with the revised control case to provide the three ordered pairs required to redraw the relation between modeled peak ozone and NO_x emissions.

Table 3.8-35 lists modeled peak ozone for each primary episode day for the three model runs discussed above.

Table 3.8-35 Peak Modeled Ozone in the HGA 8-County Area for Three Future Control Cases

Case	Peak Modeled Ozone (ppb)			
	Sept 8	Sept 9	Sept 10	Sept 11
Revised Control Case (RCC)	141.0	128.6	134.7	130.7
RCC w/ double non-road mobile source NO_x	151.1	138.8	142.4	139.8
RCC w/ half on-road mobile source NO_x	128.6	120.9	121.7	122.4

The corresponding NO_x emissions for these model runs are listed in Table 3.8-36.

Table 3.8-36 Modeled NO_x Emissions in the HGA 8-County Area for Three Future Control Cases

Case	NO_x Emissions (tons/day)			
	Sept 8	Sept 9	Sept 10	Sept 11
Revised Control Case (RCC)	396.3	395.5	440.0	372.9
RCC w/ double non-road mobile source NO_x	525.3	524.5	569.0	496.4
RCC w/ half on-road mobile source NO_x	314.1	313.3	336.0	299.5

Note that the NO_x emissions vary only slightly between September 8th and 9th, but increase significantly on September 10th due to Friday traffic. Emissions on Saturday, September 11th are lowest, reflecting both reduced traffic and a different mix of non-road sources (e.g. lower construction activity but increased recreational boating).

It is now possible to fit a curve to the ordered pairs (peak ozone, NO_x emissions) for September 8th: (141.0, 396.3), (151.1, 525.3), and (128.6, 314.1). Using the same technique discussed above in Section 3.6 yields the following relation:

$$NOx = .27303 \times OC^2 - 66.981 \times OC + 4412.4 \qquad (6)$$

where, as before, NO_x represents modeled NO_x concentration and OC represents modeled peak ozone concentration in the HGA eight-county area. Evaluating equation (6) for the one-hour standard of 124.5 ppb yields a NO_x target of 305.4 tpd. Since the modeled NO_x emissions on September 8th are 396.3 tpd, the revised gap calculation for September 8th becomes 396.3-305.4 tpd. Note that no translation is needed in this case, since the curve was fit through the revised control case ordered pair.

Interestingly, the gap has increased from that calculated earlier, even though the peak modeled ozone on September 8th has decreased by 5.4 ppb from the modeling in the proposal. The explanation for this seeming anomaly lies in the shape of the ozone/NO_x curve described by equation (6). This curve is much steeper than the previously used relation described by equation (5) in Section 3.6, which means that the change in NO_x per ppb of ozone is greater now than previously. Or, equivalently, more NO_x reductions are now needed to equal a ppb of ozone. So even though the future control case starts out closer to attainment than previously, additional NO_x reductions give relatively less ozone benefit. The net result is a gap which is larger than was seen previously.

Additional gap calculations can be performed on the remaining three primary days, using the data in Tables 3.8-35 and 3.8-36. Since the methodology is the same as was used for September 8th, the details of the calculations for these days are omitted. Table 3.8-37 gives the calculated gap for all four primary episode days.

Table 3.8-37 NO_x Shortfall (Gap) for Four Primary Episode Days

Episode Day	NO_x Shortfall (tons/day)
September 8	90.9
September 9	45.2
September 10	93.7
September 11	58.4

Table 3.8-37 shows that the gap on September 10th is the largest, with September 8th a close second. This contrasts with the analysis performed originally in the SIP proposal, which only considered September 8th. The commission still considers September 8th to be the controlling day for purposes of determining the shortfall for several reasons: First and foremost, Table 3.8-35 shows the control case modeled peak ozone on September 8th, 141 ppb, is much higher than that of any other primary day, exceeding the September 10th peak by over 6 ppb. Secondly, September 8th recorded the highest measured ozone concentrations of the episode, 214 ppb, while the September 10th measured peak was only 162 ppb, well below the 1993 design value of 200 ppb. Finally, the model performance on September 8th, as shown in Table 3.3-4, is overall better than that seen on September 10th, with less bias and smaller gross error. Taken together, these factors make September 8th the preferred choice for determining the final gap (although for practical purposes, the gap values calculated for September 8th and 10th are almost identical).

3.8.7 Additional Analyses Metrics

As noted previously, Table 3.8-34 shows modeled peak ozone for each primary episode day for the revised control case. TNRCC has used additional analyses metrics to evaluate the response of the model to the proposed control scenarios. Table 3.8-38 shows the number of modeled grid cells where the ozone in the base case was above the standard compared to the number of modeled grid cells where the ozone in the revised control case was above the standard. This metric indicates the area where ozone is above the standard for more than one hour during each day. This data shows that the number of grid cells above the standard for the revised control case was decreased by more than 88% on each day modeled, with a reduction on September 10th of nearly 94%.

Also included in Table 3.8-38 are the number of modeled grid cell hours where the ozone in the base case was above the standard compared to the number of modeled grid cell hours where the ozone in the revised control case was above the standard. This metric counts the number of hours each grid cell is above the standard and sums this for each grid cell. This is more robust than the previous metric because it includes the temporal aspect in addition to the spatial aspect. This data shows the number of grid cell hours above the standard for the revised control case was decreased by over 93% on every day modeled, and by over 96% on three of the four primary episode days.

Both of these metrics indicate a very significant improvement after the revised control case is implemented.

Table 3.8-38. Additional Metrics in HGA Nonattainment Area

Case	09/06/1993	09/07/1993	09/08/1993	09/09/1993	09/10/1993	09/11/1993
Number of Grid Cells for Ozone Concentration > 124 ppb:						
Base Case	86	81	410	261	405	319
Revised Control Case	0	0	46	26	26	35
Reduction	100%	100%	88.8%	90.0%	93.6%	89.0%
Total Grid Cell Hours for Ozone Concentration > 124 ppb:						
Base Case	212	184	1598	1016	1275	1146
Revised Control Case	0	0	103	38	41	41
Reduction	100%	100%	93.6%	96.3%	96.8%	96.4%

CHAPTER 4: DATA ANALYSIS

One of the commission's guiding principles is to ensure that regulations and decisions are based on good science. The analysis of air quality data is an integral part of the decision making process in the commission. As a result of some of the responses received during the public comment period, this chapter is being expanded to include updated aircraft monitoring information, a study of ozone spikes in the HGA nonattainment area, and an analysis of NO_x and VOC in the HGA area.

4.1 An Analysis of NO_x- and VOC-limitation in the HGA Area using MAPPER and its Relationship to Ozone Control Strategies

<u>Background</u>

The program MAPPER (Measurement-based Analysis of Preferences in Planned Emissions Reductions) was developed as a tool for determining the effectiveness of ozone control strategies. MAPPER differs from grid-based photochemical air quality models in that it solely uses ambient data as a way of determining whether reductions in emissions of VOCs or NO_x would be effective in lowering ambient ozone concentrations.

MAPPER uses the smog production algorithm (SP) to predict where and when peak ozone concentrations are limited by the availability of VOC radicals or nitrogen oxides. Because the SP algorithm uses ambient data, the accuracy of its predictions depend greatly on the accuracy of the ambient measurements, which include the concentrations of ozone, nitric oxide (NO), and either NO_x (NO2 + NO) or NOy (NO2 + NO + nitrate radicals and other oxidized products). The SP algorithm calculates the extent of reaction, a number which ranges from 0.0 to 1.0, and categorizes an area as being either VOC-limited (0.0 to 0.6), transitional (0.6 to 0.9), or NO_x-limited (0.9 to 1.0).

Local VOC/NO_x ratios, as well as a variety of other factors, can determine the effectiveness of NO_x or VOC emissions reductions. When an area has a low VOC/NO_x ratio it is classified as being "VOC or hydrocarbon limited". In a VOC-limited area, reductions in VOC emissions lead to reductions in local ambient ozone concentrations while reductions in NO_x emissions lead to increases in local ozone concentrations. An area with a high VOC/NO_x ratio is said to be "NO_x-limited". NO_x-limited areas benefit from NO_x emissions reductions (local ozone concentrations are reduced) and have a neutral response to VOC reductions.

<u>Methodology</u>

Days from August and September 1998 were studied to get an idea of representative VOC/NO_x ratios in the Houston area. The days were divided into three groups of six days each, depending on daily peak ozone levels. The groups included: days which HGA area monitors measured low one-hour peak ozone concentrations (20 - 50 ppb), days which monitors measured moderate one-hour peak ozone concentrations (40 - 90 ppb), and days when at least one monitor in the HGA area exceeded the one hour federal ozone standard (greater than 125 ppb). The Houston/Galveston/Brazoria data set (hgb98.dat) was loaded into MAPPER (data sets for metropolitan areas in Texas, from 1994 to July 1999, were prepared by Charlie Blanchard). Monitors with available data included: Northwest Harris, Aldine, Bayland Park, Mae Drive, Deer Park, and Galveston.

MAPPER computes the extent of reaction based on either NOy or NO_x ambient data. TNRCC doesn't have NOy data from 1998 so NO_x data was used. It is crucial to note, though, that the data are not true

NO_x measurements. TNRCC NO_x data also includes unknown concentrations of nitrogen oxide products. Because of this, the NO_x version of the SP algorithm underestimates the "true" extent of reaction (skews the results towards VOC-limitation) and the NOy version overestimates the "true" extent of reaction (skews the results towards NO_x-limitation). The extent of reaction based on NO_x represents the lower boundary of the "true" extent of reaction and based on NOy represents the upper boundary of the extent of reaction. The mean of the two boundaries is then the most accurate representation of the "true" extent.

Results:

Low ozone days
MAPPER showed extensive "VOC-limitation" at all monitors. One small exception stood out. The SP algorithm calculated a higher extent of reaction at the Aldine monitor on two days, making those peak ozone hours more transitional than the surrounding monitors.

Moderate ozone days
On moderate ozone days, there was greater variation in VOC/NO_x ratios between monitors and between dates. Area wide, MAPPER showed transitional conditions on most days but the inner urban monitors showed a tendency towards "VOC-limitation". The VOC/NO_x ratios at the suburban and downwind monitors showed a tendency towards "NO_x-limitation" on several days as well.

Exceedance ozone days
Mostly transitional conditions were observed on high ozone days. The monitors with the highest ozone concentrations in the area tended to be more "NO_x-limited" during the peak ozone concentration hours.

Implications
The results from the August and September 1998 data show that in the HGA area, VOC/NO_x ratios change both temporally and spatially. This suggests that both NO_x and VOC emissions reductions are needed in order to obtain reductions in ambient ozone concentrations.

Notes
It is important to note that the SP algorithm is based on smog chamber and environmental chamber experiments. Also, the SP algorithm relates the chemistry of the area at an instantaneous moment so it would be unwise to classify an area as being either VOC-limited or NO_x-limited without the use of another sophisticated tool.

References
Blanchard, C.L., Roberts, P.T., Chinkin, L.R., and P.M. Roth. "Application of smog production (SP) algorithms to the TNRCC COAST data". Air &Waste Management Association 88th Annual Meeting & Exhibition, San Antonio, Texas, June 18 -23, 1995. Paper number 95-TP15P.04.

Blanchard, C.L., Lurmann, F.W., Roth, P.M., Jeffries, H.E., and M. Korc. 1999. "The use of ambient data to corroborate analyses of ozone control strategies". Atmospheric Environment (33), pp.369-381.

Blanchard, C.L., Tanenbaum, S., Ladner, D., and P.T. Roberts. 1999. "Enhancement of Measurement-Based Analysis of Preferences in Planned Emissions Reductions (Ozone M.A.P.P.E.R.) and Application to Data From the Beaumont-Port Arthur, Dallas-Fort Worth, El Paso, and Houston Metropolitan Areas, 1994-1999. Prepared for the Texas Natural Resource Conservation Commission.

Blanchard, C.L. "Ozone process insights from field experiments - part III: extent of reaction and ozone formation".

Supporting materials showing analysis results can be found in Appendix Q.

4.2 Airborne Sampling Data

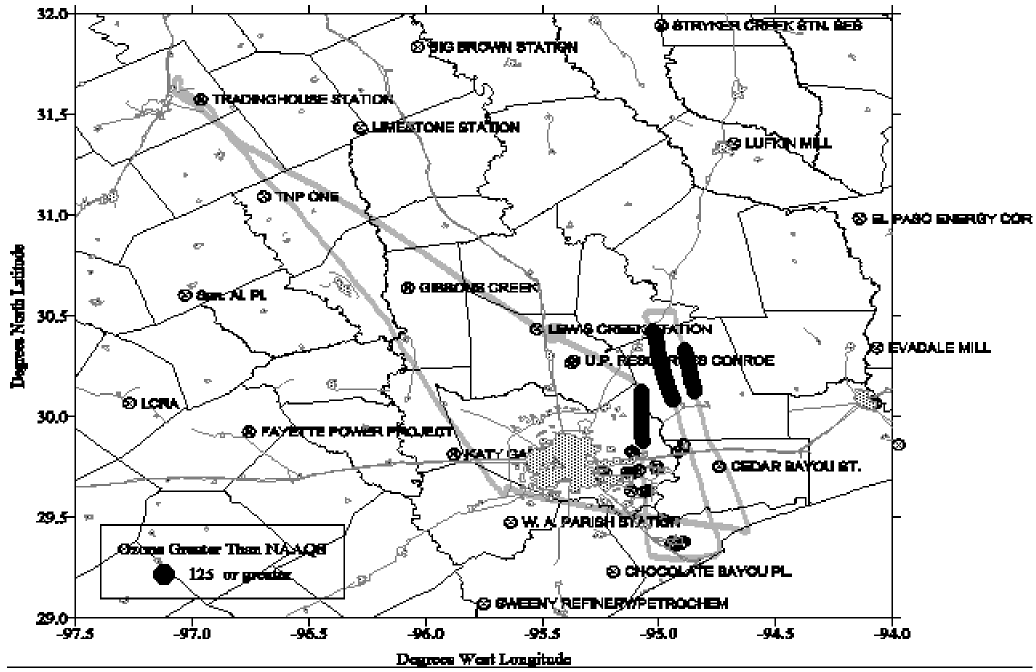
Since 1997, the TNRCC (with the assistance of CENSARA and EPA) has funded an airborne sampling program operated by Baylor University. This program has investigated ozone and other air pollution problems in the Houston/Galveston/Brazoria area as well as many other areas of Texas.

A number of these flights have investigated air quality in counties surrounding Harris County. These flights have found that ozone levels above the NAAQS can often be measured in these surrounding counties. Airborne sampling made these high measurements in almost any compass direction except West. The following table summarizes a set of flights demonstrating the various directions in which high ozone values can be found.

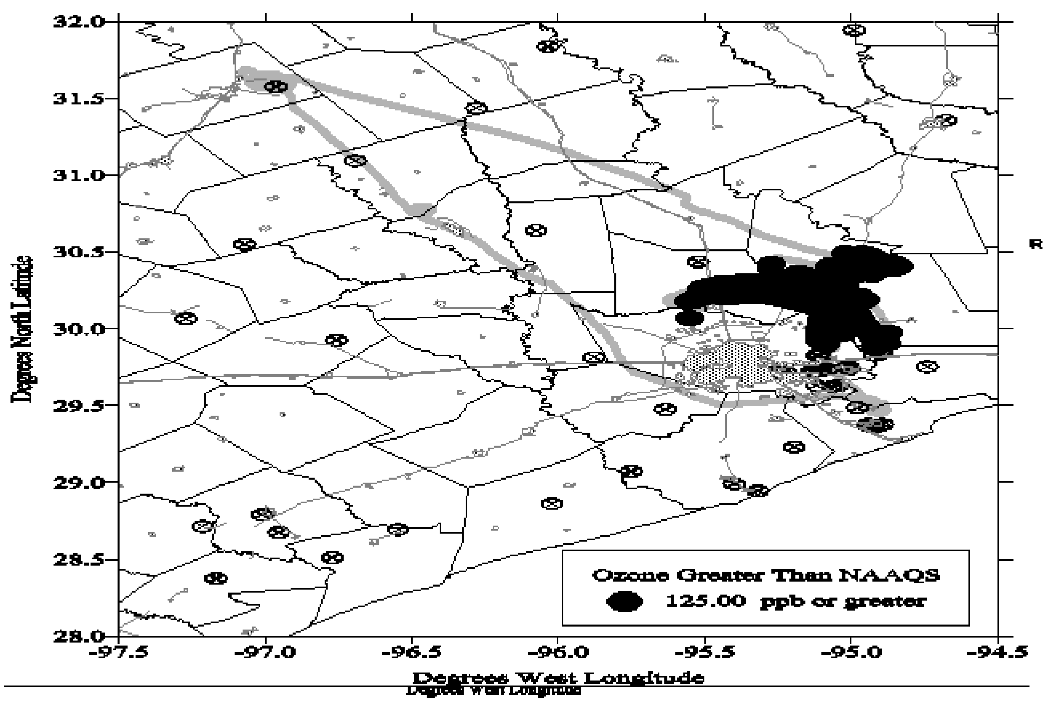
Table 4.2-1 Summary of Flights

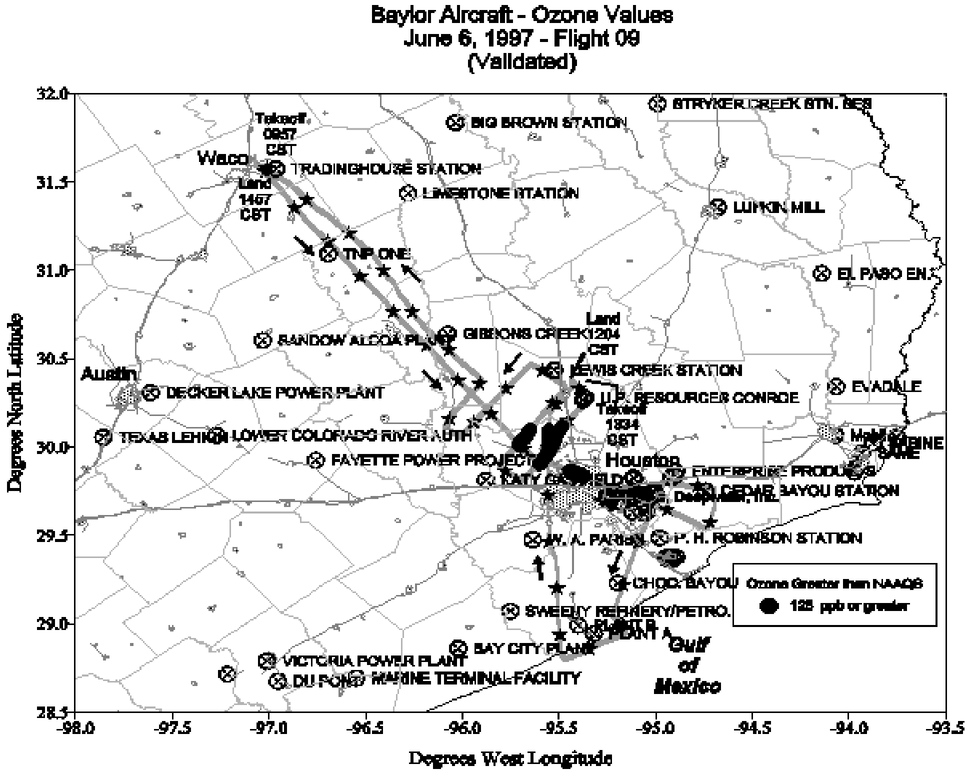
Flight	Date	Compass Direction From Houston/Harris County	Maximum Ozone
Flight 9	June 8, 1997	Northwest	170.6 ppb
Flight 48	May 17, 1998	East, Northeast	185.1 ppb
Flight 54	May 28, 1998	North, Northeast	210.9 ppb
Flight 70	August 26, 1998	Northwest	148.1 ppb
Flight 148	September 5, 2000	South	254.4 ppb

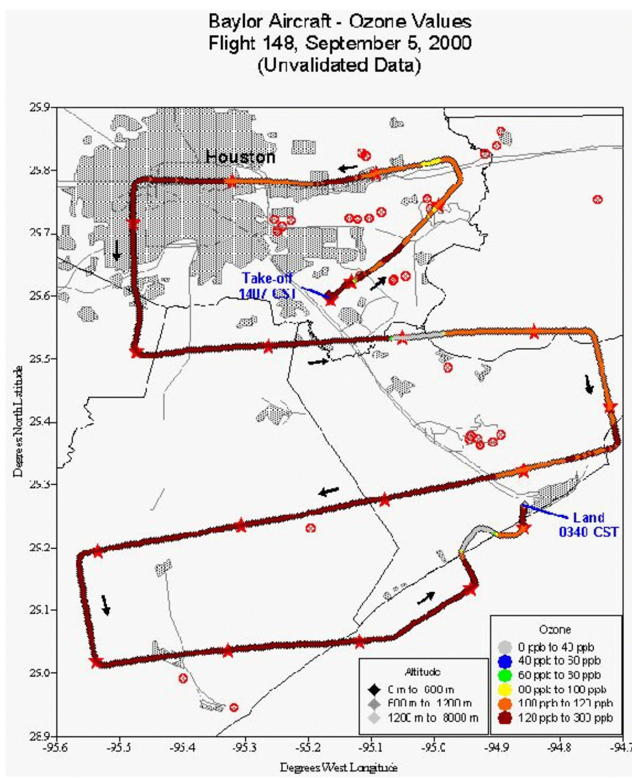
Baylor Aircraft -- Ozone Values
May 17, 1998 -- Flight 48
(Validated)



Baylor Aircraft -- Ozone Values
May 28, 1998 -- Flight 54
(Validated)




Baylor Aircraft - Ozone Values
June 6, 1997 - Flight 09
(Validated)
Degrees North Latitude
Degrees West Longitude
Takeoff 0957 CST
Waco
Land 1457 CST
TRADINGHOUSE STATION
BIG BROWN STATION
LIMESTONE STATION
LUFKIN MILL
TNP ONE
EL PASO EN.
SANDOW ALCOA PLANT
GIBBONS CREEK
Land 1204 CST
LEWIS CREEK STATION
Austin
DECKER LAKE POWER PLANT
EVADALE
TEXAS LEHIGH
LOWER COLORADO RIVER AUTH
Takeoff 1334 CST
FAYETTE POWER PROJECT
Houston
ENTERPRISE PRODUCTS
CEDAR BAYOU STATION
W. A. PARISH
P. H. ROBINSON STATION
CHOC. BAYOU
SWEENY REFINERY/PETRO.
PLANT B
PLANT A
BAY CITY PLANT
VICTORIA POWER PLANT
DU PONT
MARINE TERMINAL FACILITY
Gulf of Mexico
Ozone Greater than NAAQS
125 ppb or greater


Baylor Aircraft - Ozone Values
Flight 148, September 5, 2000
(Unvalidated Data)
Degrees North Latitude
Degrees West Longitude
Houston
Take-off 1407 CST
Land 0340 CST
Altitude
0 m to 600 m
600 m to 1200 m
1200 m to 8000 m
Ozone
0 ppb to 40 ppb
40 ppb to 60 ppb
60 ppb to 80 ppb
80 ppb to 100 ppb
100 ppb to 120 ppb
120 ppb to 300 ppb

4.3 Analysis of Ozone Spikes in Houston

4.3.1 Introduction

It is well known that high concentrations of ozone are commonly measured in the Houston metropolitan area. Perhaps less well known are the dramatic increases in measured ozone over short time periods, ranging from several minutes to an hour, which are also characteristic of this region. These ozone "spikes" are a very important piece of the Houston ozone "puzzle." Depending on what level of ozone increase one defines as a spike, they can be rather common.

These spikes present formidable difficulties to atmospheric modelers attempting to simulate ozone concentrations in the area. They appear to be associated at times with small-scale meteorological events, such as the flow reversals caused by competing land, sea, and bay breezes in the Houston area. At other times, their cause appears to be strictly related to emissions. While the evidence strongly suggests that ozone spikes are associated with point source emissions in the area, it has not been determined whether routine emissions releases alone are capable of producing these spikes, or whether one or more types of unusual emissions—such as those from facility start-up, shut-down, maintenance, or upset releases—are necessary to produce them.

4.3.2 Analysis of 1995-1999 High Ozone Days

The logical first step in assessing Houston spikes is to look at existing analyses. In summer 2000, the TNRCC Data Analysis team undertook a study of these ozone spikes. The team looked at all area monitors in a 5-year study period, 1995-1999, which had recorded one-hour ozone levels of at least 100 ppb in a day. Two new metrics were defined in this analysis: "delta-max" signified the greatest hourly ozone increase at a monitor on a day, and "delta-min" was the greatest hourly decrease following the delta-max. This method assigns a daily spike to each monitor that records high ozone, regardless of whether an observer would have said that a spike occurred on that day or not.

This study found the average delta-max to be 34.9 ppb. An identical analysis was conducted for all monitors in the DFW area, which found that area's average delta-max to be 24.5 ppb (see Table 4.3-1). A comparison of Figures 4.3-1 and 4.3-2 reveals several striking facts which show how much more prevalent spikes are in Houston than in DFW. First, Houston's mean delta-max is greater than the 90^{th} percentile of DFW delta-max values; that is, less than 10% of DFW spikes, according to this study's criteria, are even as great as the average Houston spike. DFW's largest spike is 48 ppb; Houston recorded 230 spikes greater than this value during the same study period. DFW's distribution of spikes appears to be normally distributed around a median delta-max of 24 ppb. Houston, on the other hand, has an asymmetric distribution, with a median of 32 ppb, and a maximum of 114 ppb.

Table 4.3-1: Delta-Max Statistics in HGA and DFW

	N	Mean (ppb)	Median (ppb)	Maximum (ppb)
HGA	1570	34.9	32	114
DFW	569	24.5	24	48

This study also determined that there is considerable variation in "spikiness" across the Houston area. Figures 4.3-3 and 4.3-4 are scatter-plots of delta-max vs. delta-min at two different monitors, Deer Park

CAMS 35 and Northwest Harris County CAMS 26. The x-axis is delta-min, with zero on the right rather than the left (delta-min values are always zero or less; a value of -60, for example, indicates twice as steep a drop than does a value of -30). The y-axis is delta-max. The clustering of values in the lower-right corner of Figure 4.3-4 show how many of the spikes at Northwest Harris, a suburban/rural monitor, are relatively low. Figure 4.3-3 (Deer Park, an urban/industrial monitor), by contrast, shows more values on the left and upper parts of the plot. In other words, this monitor has more spikes of greater magnitude.

By comparing Houston's ozone spikes to those from DFW, it can be determined that Houston's spikiness is largely attributable to the emissions from its vast industrial sector. These two areas have relatively similar populations (see Table 4.3-2), and mobile and area source emissions in the two areas are roughly similar. It is in emissions from industrial point sources that the two areas are totally different. The 1996 TNRCC Emission Inventory shows that point source VOC emissions were over 10 times greater, and point source NO_x emissions were 14 times greater, in Houston than in DFW. It takes highly reactive air masses to generate such tremendous ozone increases. These sorts of air masses generally do not occur in areas lacking large amounts of point source emissions. In Houston, monitors located near the Houston Ship Channel, the area of greatest concentration of industry in the area, often record the highest ozone spikes.

Table 4.3-2: Population and Emission Inventory in HGA and DFW

		1996 Emission Inventory (tpy)					
		Area		Mobile		Point	
Metro Area	**1996 Population**	**VOC**	**NO_x**	**VOC**	**NO_x**	**VOC**	**NO_x**
HGA	4,237,207	58,919	7,961	102,884	187,297	69,027	222,208
DFW	4,030,213	50,938	10,027	107,820	161,009	6,642	15,817

It is also true that Houston has different meteorology than DFW, and this may play a role in the disparity of ozone spikes in the two areas. Most notably, as mentioned earlier, Houston often experiences a phenomenon during the ozone season whereby the prevailing wind is from the land in the morning (i.e., predominantly from the north and/or west), and then switches to a bay or sea breeze (from the south and/or east) in the afternoon. This pattern contributes to high ozone levels in the area. It appears that the ozone precursors are collected by the land breeze in the morning, "cook" while over the bays and Gulf, and then return with the sea/bay breeze in the afternoon, collect additional precursors, and form high concentrations of ozone as well as high spikes. Dallas experiences no such pattern. However, Dallas has experienced situations where weak fronts stall in the area, creating stagnation, which also allows ozone precursors to "cook," yet Dallas never recorded a delta-max even as high as 50 ppb in a 5-year period. This suggests that its comparative lack of point source industrial emissions keeps it from experiencing significant spikes.

4.3.3 Variation in Length of Spike

In addition to delta-max and delta-min, another important variable in analyzing the extent and impact of ozone spikes is the length of time that the spike lasted. Figure 4.3-5, which shows diurnal ozone on two different days at Deer Park CAMS 35, illustrates this. On September 20, 1999, there was a sharp morning ozone spike which started at about 8:30 a.m. (see "Upset Emissions and Ozone Spikes" below). This resulted in a one-hour ozone increase of 98 ppb (which happened to be the monitor's delta-max for the day). By 10 a.m., the one-hour ozone average was back down to 81 ppb. This sort of steep, short-lived spike indicates a relatively small, very reactive air mass passing across a monitor. The ozone formation potential of this kind of air mass is probably limited by the amount of the reactive VOC(s) that are in it. This is the kind of air mass which may be affected by some sort of unusual emissions release.

There are also spikes which last a comparatively long time. An example of this can be seen in the diurnal ozone profile at Deer Park on August 28, 1999 (also in Figure 4.3-5). On this day, it took two hours for ozone to climb 90 ppb (the beginning of the spike). Once there, the spike lasted approximately seven hours. This indicates a relatively large, more homogenous air mass. It also suggests a NO_x-limited environment. This is because the ozone stops increasing, even though meteorological factors that day (sun, temperature) favored additional ozone production.

4.3.4 Analysis of Sept. 8-11, 1993, Episode

In early September 1993, an ozone episode occurred in Houston which has been modeled extensively by TNRCC staff. This episode exhibited some change of wind direction, but not the classic flow reversal pattern mentioned above.

Following the protocol used in the above analysis, this September 1993 episode was evaluated for its "spikiness." Delta-max and delta-min values were calculated for each monitor equaling or exceeding 100 ppb peak one-hour ozone in a day. There were a total of 19 such "hits" in the four-day period.

This evaluation showed that delta-max ranged from 27 to 99 during this episode, with a median of 39, and a mean of 46.2 (see Figure 4.3-6). According to this evaluation, the September 1993 episode was slightly "spikier" than the long-term Houston average.

4.3.5 Upset Emissions and Ozone Spikes

As mentioned in the introduction, the relationship between non-routine emissions—including upset releases, and emissions from facility start-up, shutdown, and maintenance—and ozone spikes is not well understood.

There are cases where non-routine emissions appear to have affected the magnitude of ozone spikes. One example would be what occurred on September 20, 1999. On that day, there was a dramatic morning ozone spike recorded at the Deer Park CAMS 35 monitor. Some 25 minutes before the spike was recorded, an upset release of a highly reactive hydrocarbon — 1,3-butadiene—was reported from a plant upwind of the monitor. This spike was unusual not only for how early in the day it occurred, about 9:25 a.m. local time, but for its severity: ozone increased 144 ppb in just 25 minutes at Deer Park. There were no meteorological features that morning which might have caused this. The reported release was only 50 pounds, a small amount. But estimates of non-routine emissions are commonly inexact, and this amount may have been underestimated.

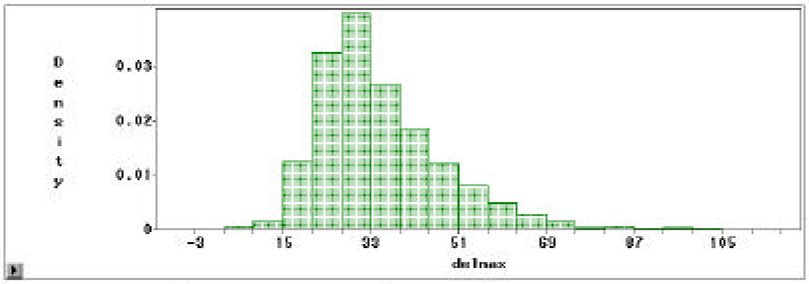
However, it is also possible that the routine emissions produced by area industry can, in the absence of non-routine releases, account for the kinds of spikes seen in Houston. As mentioned before, ozone precursors can react in air masses over area bays or the Gulf of Mexico, and then cause spikes to be recorded at the first monitors in the path of the returning air mass, such as at the Galveston or Texas City monitors. There is no evidence that upset releases are needed to cause these spikes. A massive research effort, the Texas Air Quality Study 2000, was conducted in Houston between mid-August and mid-

September 2000. Its researchers studied many aspects of Houston air quality, including factors which directly influence spikes, such as rates of photochemical reactivity in the ship channel emissions, and the levels of free radicals such as OH and HO_2 which play roles in ozone formation. As research findings are published, much more will be revealed about the capacity of Houston routine, and non-routine, emissions to generate ozone spikes.

4.3.6 Summary

It is apparent that for Houston to observe large, steep ozone spikes— up to and exceeding 100 ppb increases in one hour—there must be an air mass capable of very fast photochemistry. The dense concentration of industry in the Houston area is capable of emitting, and does emit, the hydrocarbons necessary to create such a volatile air mass. For the purpose of controlling Houston's ozone, it is essential to understand more about the photochemistry in and around Houston's industrial areas, most importantly the Houston Ship Channel. There is great promise that the Texas Air Quality Study 2000 will reveal much about this, when its findings are published. Ultimately, however, it seems clear that researchers will need to know much more about the emissions from these industrial sources than is known presently, if these spikes are to be significantly reduced.

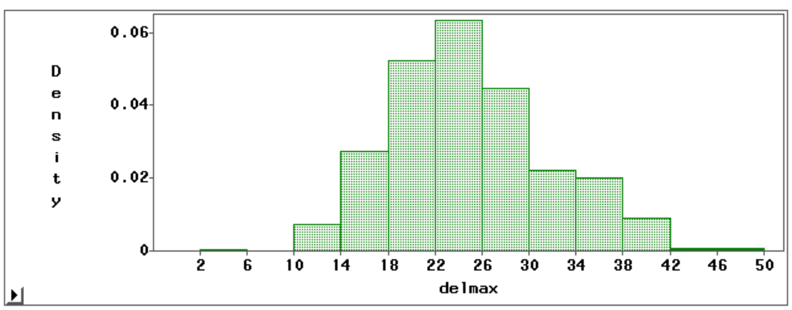
What is needed is highly speciated VOC data, with good temporal resolution. TNRCC's annual point source emissions inventory is supposed to contain highly speciated VOC data for these companies, but too often, the VOCs are left unspeciated. Upset emissions may be playing a large role in these spikes, and need to be understood much more completely. But there are serious questions about the accuracy of the existing upset emissions data, as companies may not have an incentive to come up with accurate estimates. There is also a great need to make the upset data easily available to researchers. This has not been done in the past, but there is hope that TNRCC's new upset emissions database will help.



Moments			
N	1570.0000	Sum Wgts	1570.0000
Mean	34.9293	Sum	54839.0000
Std Dev	14.0656	Variance	197.8414
Skewness	1.4258	Kurtosis	3.3234
USS	2225901.00	CSS	310413.152
CV	40.2688	Std Mean	0.3550

Quantiles			
100% Max	114.0000	99.0%	85.0000
75% Q3	41.0000	97.5%	70.0000
50% Med	32.0000	95.0%	61.0000
25% Q1	26.0000	90.0%	53.0000
0% Min	2.0000	10.0%	21.0000
Range	112.0000	5.0%	18.0000
Q3-Q1	15.0000	2.5%	16.0000
Mode	28.0000	1.0%	13.0000

Figure 4.3-1 – Distribution of Delta-Max Values in the 8-County HGA Nonattainment Area



Moments			
N	569.0000	Sum Wgts	569.0000
Mean	24.4622	Sum	13919.0000
Std Dev	6.8425	Variance	46.8194
Skewness	0.4524	Kurtosis	0.0178
USS	367083.000	CSS	26593.4376
CV	27.9716	Std Mean	0.2869

Quantiles			
100% Max	48.0000	99.0%	41.0000
75% Q3	28.0000	97.5%	39.0000
50% Med	24.0000	95.0%	37.0000
25% Q1	19.0000	90.0%	34.0000
0% Min	4.0000	10.0%	16.0000
Range	44.0000	5.0%	14.0000
Q3-Q1	9.0000	2.5%	13.0000
Mode	22.0000	1.0%	11.0000

Figure 4.3-2 – Distribution of Delta-Max Values in DFW, 1995-1999

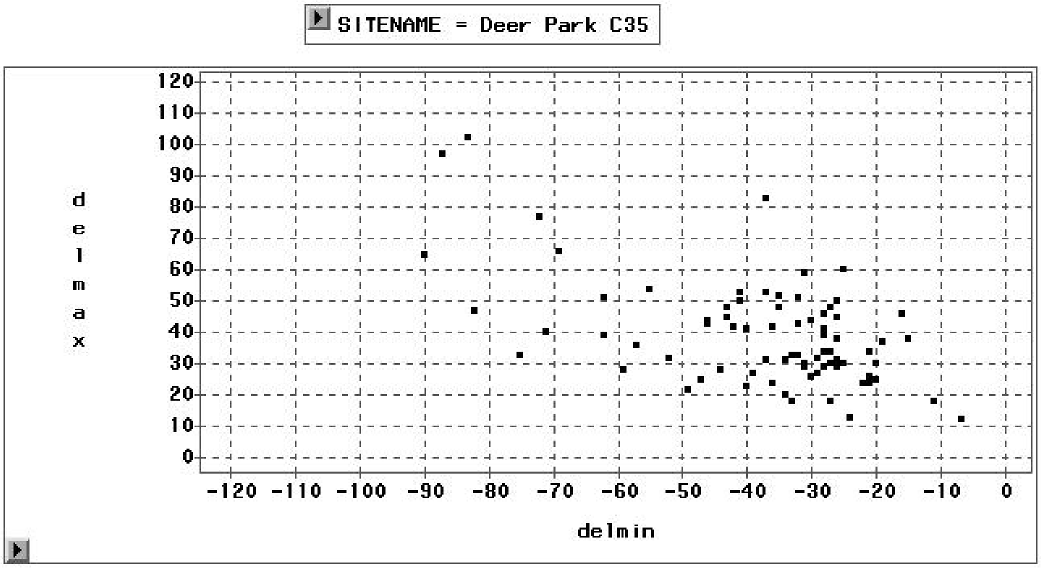


Figure 4.3-3 – Delta-Max vs Delta-Min at Deer Park CAMS 35

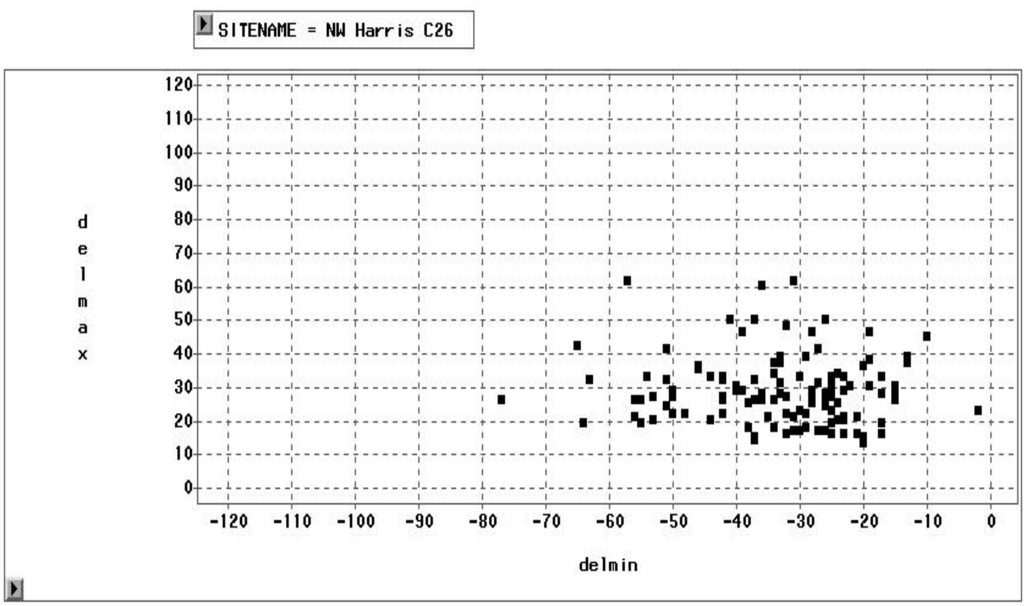


Figure 4.3-4 – Delta-Max vs Delta-Min at Northwest Harris CAMS 26

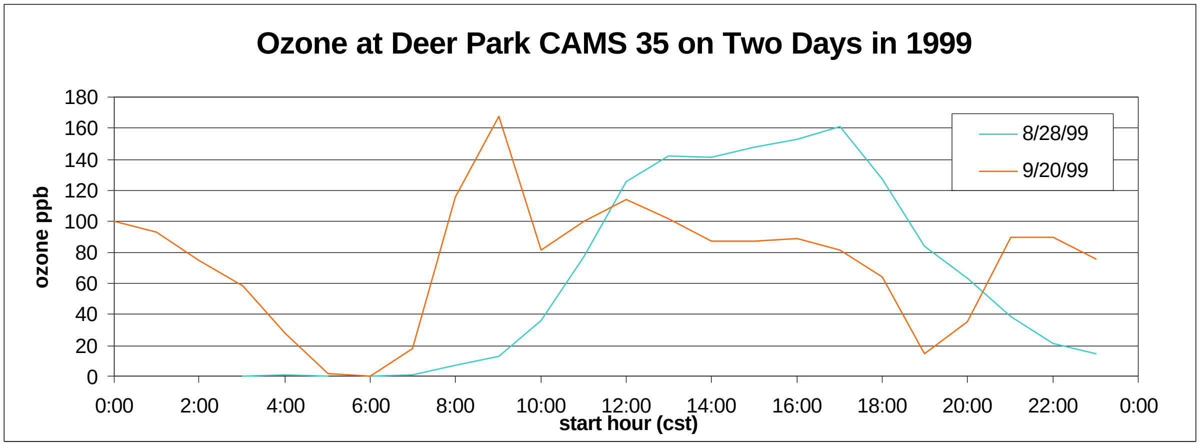
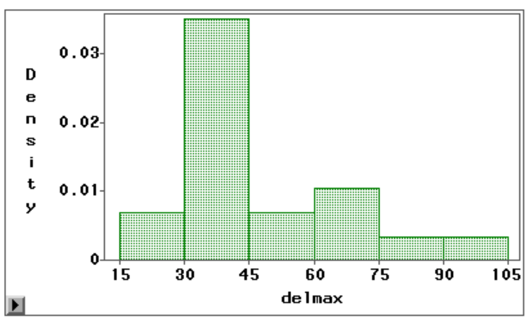


Figure 4.3-5 – Variation in Spike Pattern at Deer Park CAMS 35



Moments			
N	19.0000	Sum Wgts	19.0000
Mean	46.2105	Sum	878.0000
Std Dev	18.9607	Variance	359.5088
Skewness	1.4972	Kurtosis	2.0989
USS	47044.0000	CSS	6471.1579
CV	41.0312	Std Mean	4.3499

Quantiles			
100% Max	99.0000	99.0%	99.0000
75% Q3	61.0000	97.5%	99.0000
50% Med	39.0000	95.0%	99.0000
25% Q1	32.0000	90.0%	78.0000
0% Min	27.0000	10.0%	29.0000
Range	72.0000	5.0%	27.0000
Q3-Q1	29.0000	2.5%	27.0000
Mode	32.0000	1.0%	27.0000

Figure 4.3-6 -- Distribution of Delta-Max Values for Houston for Sept. 8-11, 1993, Episode

4.4 CONCLUSIONS

The analysis of NO_x and VOC limitations in the HGA nonattainment area indicates some areas are NO_x limited and some are VOC limited. This supports the need for continuing to evaluate NO_x and VOC control strategies that could reasonably be implemented in the area.

A review of the aircraft monitoring data indicates that high levels of ozone have been observed in many of the more rural areas in the HGA nonattainment area. The review also supports the need for rules in the eastern half of Texas to address air quality issues in the eastern half of the state. The analysis indicates there may be elevated level of ozone in areas that do not have monitors.

The study of ozone spikes in the HGA nonattainment area indicates that ozone formation in the area may occur very rapidly and be over very quickly. This was observed several times during the Texas 2000 Air Quality Study. The results of this study were not conclusive in the cause of these sudden spikes; however, the spikes are quite different from the urban area formation of ozone seen in the DFW nonattainment area. The TAQS may help determine the cause of these spikes which may be related to upsets, maintenance, batch processing, or other activities.

CHAPTER 5: RATE OF PROGRESS

The FCAA Amendments of 1990 require that areas classified moderate or above with respect to the ozone NAAQS submit ROP plans demonstrating continued progress toward achieving the standard. The ROP plan must demonstrate that specific reductions of emissions of VOC and/or NO_x from the 1990 baseline have been achieved, accounting for growth that occurred after 1990, accompanied by rules to implement these reductions. In addition, 3% contingency measures must be adopted, to be implemented in the event that milestone reductions fail to occur.

The first of these plans, the 15% ROP, was submitted by the state in November 1993 (Phase I) and May 1994 (Phase II). The 15% ROP documented 15% VOC reductions, net of growth, from 1990 to 1996, along with adopted rules and other measures. The next plan, the post-1996 ROP, was submitted by the state in November 1994 and revised in July 1996 and May 1998. The post-1996 ROP demonstrated an additional 3% reduction per year, or 9% net of growth, from 1996 to 1999, accompanied by adopted rules and other measures. Since the FCAA allows NO_x reductions to be substituted for VOC reductions only for the post-1996 ROP plans, in its May 1998 SIP revision the state documented reductions of 6% for VOC and 3% for NO_x. The VOC and NO_x reductions are calculated from these pollutants' respective emissions inventories. Of the 3% required contingency measures, 2% (or two-thirds of the total) was met by VOC reductions, and 1% (or one-third of the total) was met by NO_x reductions.

The current SIP revision contains post-1999 ROP plans for the milestone years 2002 and 2005, and for the attainment year 2007. The 2002 ROP documents 3% per year, or 5% NO_x and 4% VOC reductions occurring from 1999 to 2002; the 2005 ROP documents 3% per year, or 9% NO_x reductions occurring from 2002 to 2005; and the 2007 ROP documents 3% per year, or 6% NO_x reductions occurring from 2005 to 2007 (attainment year). Each of these post-1999 ROP plans also contains adopted regulations and other measures needed to achieve the Post-1999 ROP requirements up to the attainment date and to attain the 1-hour ozone standard.

Tables 5.1-1 through 5.1-12 contain the 2002, 2005, and 2007 ROP calculations and the emission reduction estimates. Each of the above-referenced plans demonstrates compliance with the ROP requirements, and in fact goes beyond the 3% per year reduction requirement of the FCAA. The 2002 plan relies on a combination of NO_x and VOC reductions, whereas the 2005 and 2007 ROP plans rely on NO_x reductions alone. VOC reduction tables are included for all three milestone years, since the 2002, 2005, and 2007 ROP VOC budgets (and for 2007, the generally more restrictive attainment budget) are important for transportation conformity determinations.

Table 5.1-1
2002 ROP Required NO_x Emissions Target Calculations
Houston Ozone Nonattainment Area
Ozone Season NO_x Tons Per Day
November 29, 2000

Step	Emissions Basis	Stationary		Mobile		Total
		Point	Area	On-road	Non-road	
1	1990 ROP Nonattainment Area Base Year EI	794.85	14.37	337.03	198.08	1344.33
2	Adjusted Base Year EI Relative to 1999	794.85	14.37	262.23	198.08	1269.53
3	Adjusted Base Year EI Relative to 2002	794.85	14.37	234.80	198.08	1242.10
4	5% of Adjusted Base Year EI Relative to 1999					62.11
5	RVP and Fleet turnover correction [steps (2-3)]		0.00	27.43		27.43
6	1999 Target Level					1191.77
7	2002 Target Level [steps (6-5-4)]					1102.24
8	2002 Emissions Forecast (Grown)	712.78	14.94	346.14	173.07	1246.93
9	Inventory Adjustment (see note 4)				72.69	72.69
10	2002 Emissions Forecast with Adjustment (8 + 9)	712.78	14.94	346.14	245.76	1319.62
11	Total Reductions Required by 2002 with growth [steps (10-7)]					217.39
12	Creditable Reductions to date (include 199 6&1999 ROP)	95.00	0.00	36.49	0.00	131.49
13	***NOx Reduction Required for 2002 ROP***					85.90

Notes:
1. Base year on-road mobile emissions calculated with MOBILE5 for an ozone season weekday.
2. Adjusted base year on road mobile emissions and 1999 forecast on-road mobile emissions calculated with MOBILE5A for an ozone season weekday.
3. 1990 base year point source emissions of 481.95 tpd are adjusted by addition of 1.33 tpd from pulp and paper mills table in Appendix 11c-K of the July 1996 SIP.
4. Non-road emission inventories are calculated using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NOROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

Table 5.1-2
NOx ESTIMATES TOWARDS 2002 9% ROP SIP - HOUSTON/GALVESTON
5% of 2002 ROP Reductions from NO_x
November 29, 2000

Base Year and Baseline Inventories

Emissions Inventory Source Category	1990 Adjusted Base Year	Percent	Growth 1990 to 2002	2002 Baseline	Percent
Area Sources	14.37	1.2%	4.0%	14.94	1.1%
Point Sources	794.85	64.0%	-10.3%	712.78	54.0%
On-road Mobile Sources	234.80	18.9%	47.4%	346.14	26.2%
Non-road Mobile Sources	198.08	15.9%	24.1%	245.76	18.6%
Total	**1242.10**		6.2%	**1319.62**	

Estimated NO_x Reductions for 2002 ROP and 2003 Contingency

	Baseline	Total Reduction 1990 to 2002	Cumulative Total Reductions from Previous ROPs	2002 ROP Reduction	Percent of Requirement
	TPD	TPD	TPD	TPD	
Federally Mandated Controls					
NO_x RACT		95.00	95.00	0.00	0.00%
Tier I/II, I/M, RFG, NLEV, HDDV	346.14	85.29	36.49	48.80	122.71%
Gasoline utility engine rule, marine recreational & HDDV standards (non-road)	245.76	23.57	0.00	23.57	59.27%
Federal Controls Subtotal				72.37	181.97%
State and Local Controls					
NO_x Point Source	712.78	0.00	0.00	0.00	0.00%
State and Local Controls Subtotal				0.00	
Total 2002 Control Strategy Reductions				**72.37**	
Contingency Strategy					
2003 Tier I/II, I/M, RFG, NLEV, HDDV				0.00	0.00%

Target Assessment

NOx Reduction Required for 2002 ROP	39.77
Creditable Reductions	72.37
Excess (Shortfall)	**32.60**
Required Contingency	12.42
Required Target + Contingency	52.19
Total Reductions	72.37
Excess (Shortfall)	**20.18**

Notes:

1. NO_x reductions will comprise 1/3 of the required contingency measure amounts of 3% of the adjusted base year EI. VOC reductions will comprise 2/3 of the required contingency measure amounts of 3% of the adjusted base year EI.

2. The value for the required NO_x reduction (target) is calculated based upon EPA guidance, takes into account the effects of growth and non-creditable reductions, and is calculated on a separate spreadsheet. If the target value from the separate spreadsheet calculation is less than zero, the value is set to zero in the target assessment section of this spreadsheet.

3. Non-road emission reduction calculations are done using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NONROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

Table 5.1-3
2002 ROP Required VOC Emissions Target Calculations
Houston Ozone Nonattainment Area
Ozone Season VOC Tons Per Day
November 29, 2000

Step	Emissions Basis	Stationary		Mobile		Total
		Point	Area	On-road	Non-road	
1	1990 ROP Nonattainment Area Base Year EI	483.28	200.07	251.52	129.98	1064.85
2	Adjusted Base Year EI Relative to 1999	483.28	200.07	153.01	129.98	966.34
3	Adjusted Base Year EI Relative to 2002	483.28	200.07	134.02	129.98	947.35
4	4% of Adjusted Base Year EI Relative to 1999					37.89
5	RVP and Fleet turnover correction [steps (2-3)]		0.00	18.99		18.99
6	1999 Target Level					772.08
7	2002 Target Level [steps (6-5-4)]					715.20
8	2002 Emissions Forecast (Grown)	518.85	184.65	179.95	154.87	1038.32
9	Inventory Adjustment (see note 4)				4.65	4.65
10	2002 Emissions Forecast with Adjustment (8 +9)	518.85	184.65	179.95	159.52	1042.97
11	Total Reductions Required by 2002 with growth [steps (10-7)]					327.77
12	Creditable Reductions to date (include 1996 &1999 ROP)	176.85	45.21	59.86	21.11	303.03
13	***Required VOC reductions for 2002 ROP***					24.74

Notes:
1. Base year on-road mobile emissions calculated with MOBILE5 for an ozone season weekday.
2. Adjusted base year on road mobile emissions and 1999 forecast on-road mobile emissions calculated with MOBILE5A for an ozone season weekday.
3. 1990 base year point source emissions of 481.95 tpd are adjusted by addition of 1.33 tpd from pulp and paper mills table in Appendix 11c-K of the July 1996 SIP.
4. Non-road emission inventories are calculated using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NOROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP and 1999 ROP inventories.

Table 5.1-4
VOC ESTIMATES TOWARDS 2002 9% ROP SIP - HOUSTON/GALVESTON
4% of 2002 ROP Reductions from VOC
November 29, 2000

Base Year and Baseline Inventories

Emissions Inventory Source Category	1990 Adjusted Base Year	Percent	Growth 1990 to 2002	2002 Baseline	Percent
Area Sources	200.07	21.1%	-7.7%	184.65	17.8%
Point Sources	483.28	51.0%	7.4%	518.85	50.0%
On-road Mobile Sources	134.02	14.1%	34.3%	179.95	17.3%
Non-road Mobile Sources	129.98	13.7%	19.1%	154.87	14.9%
Total	**947.35**		9.6%	**1038.32**	

Estimated VOC Reductions for 2002 ROP and 2003 Contingency

	Baseline TPD	Total Reduction 1990 to 2002 TPD	Cumulative Total Reductions from Previous ROPs TPD	2002 ROP Reduction TPD	Percent of Requirement
Federally Mandated Controls					
HON		0.47	0.47	0.00	0.00%
Pulp & Paper, RFG - Tanks & RFG - Loading Racks		14.53	8.41	6.12	24.43%
RE Floating Tanks		26.96	26.86	0.10	0.40%
Gasoline utility engine rule, Marine recreational & HDDV standards	154.87	50.69	14.84	35.85	143.11%
Tier I/II, I/M, RFG, NLEV, HDDV	179.95	79.88	59.00	20.88	83.35%
Federal Controls Subtotal				62.95	251.30%
Total 2002 Control Strategy Reductions				**62.95**	
Contingency Strategy					
2003 Tier I/II, I/M, RFG, NLEV, HDDV				0.00	0.00%

Target Assessment

VOC Reduction Required for 2002 ROP(target)	25.05
Creditable Reductions	62.95
Excess (Shortfall)	**37.90**
Required Contingency	18.95
Required Target + Contingency	44.00
Total Reductions	62.95
Excess (Shortfall)	**18.95**

Notes:

1. NO_x reductions will comprise 1/3 of the required contingency measure amounts of 3% of the adjusted base year EI. VOC reductions will comprise 2/3 of the required contingency measure amounts of 3% of the adjusted base year EI.

2. The value for the required VOC reduction (target) is calculated based upon EPA guidance, takes into account the effects of growth and non-creditable reductions, and is calculated on a separate spreadsheet. If the target value from the separate spreadsheet calculation is less than zero, the value is set to zero in the target assessment section of this spreadsheet.

3. Non-road emission reduction calculations are done using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NONROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

Table 5.1-5
2005 ROP Required NO_x Emissions Target Calculations
Houston Ozone Nonattainment Area
Ozone Season NO_x Tons Per Day
November 29, 2000

Step	Emissions Basis	Stationary		Mobile		Total
		Point	Area	On-road	Non-road	
1	1990 ROP Nonattainment Area Base Year EI	794.85	14.37	337.03	198.08	1344.33
2	Adjusted Base Year EI Relative to 2002	794.85	14.37	234.80	198.08	1242.10
3	Adjusted Base Year EI Relative to 2005	794.85	14.37	230.49	198.08	1237.79
4	9% of Adjusted Base Year EI Relative to 2005					111.40
5	RVP and Fleet turnover correction [steps (2-3)]		0.00	4.31		4.31
6	2002 Target Level					1119.01
7	2005 Target Level [steps (6-5-4)]					1003.30
8	2005 Emissions Forecast (Grown)	713.12	14.70	321.20	185.69	1234.71
9	Inventory Adjustment(see note 4)				77.99	77.99
10	2005 Emissions Forecast with Adjustment (8 + 9)	713.12	14.70	321.20	263.68	1312.70
11	Total Reductions Required by 2002 with growth [steps (10-7)]					309.40
12	Creditable Reductions to date (include 1996,1999, & 2002)	95.00	0.00	85.29	23.57	203.86
13	***NOx Reduction Required for 2005 ROP***					105.54

Notes:
1. Base year on-road mobile emissions calculated with MOBILE5 for an ozone season weekday.
2. Adjusted base year on road mobile emissions and 1999 forecast on-road mobile emissions calculated with MOBILE5A for an ozone season weekday.
3. 1990 base year point source emissions of 481.95 tpd are adjusted by addition of 1.33 tpd from pulp and paper mills table in Appendix 11c-K of the July 1996 SIP.
4. Non-road emission inventories are calculated using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NOROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP and 1999 ROP inventories.

Table 5.1-6
NOx ESTIMATES TOWARDS 2005 9% ROP SIP - HOUSTON/GALVESTON
9% of 2005 ROP Reductions from NOx
November 29, 2000

Base Year and Baseline Inventories

Emissions Inventory Source Category	1990 Adjusted Base Year	Percent	Growth 1990 to 2005	2005 Baseline	Percent
Area Sources	14.37	1.2%	2.3%	14.70	1.1%
Point Sources	794.85	64.2%	-10.3%	713.12	54.3%
On-road Mobile Sources	230.49	18.6%	39.4%	321.20	24.5%
Non-road Mobile Sources	198.08	16.0%	33.1%	263.68	20.1%
Total	**1237.79**		6.1%	**1312.70**	

Estimated NO_x Reductions for 2005 ROP and 2006 Contingency

	Baseline TPD	Total Reduction 1990 to 2005 TPD	Cumulative Total Reductions from Previous ROPs TPD	2005 ROP Reduction TPD	Percent of Requirement
Federally Mandated Controls					
NO_x RACT		95.00	95.00	0.00	0.00%
Tier I/II, I/M, RFG, NLEV, HDDV	321.20	135.72	85.29	50.43	38.63%
Gasoline utility engine rule, Marine recreational & HDDV standards (non-road)	263.68	48.56	23.57	24.99	19.15%
Federal Controls Subtotal				75.42	
State and Local Controls					
NO_x Point Source	713.12	599.00	0.00	599.00	458.90%
State and Local Controls Subtotal				599.00	
Total 2005 Control Strategy Reductions				**674.42**	
Contingency Strategy					
2006 Tier I/II, I/M, RFG, NLEV, HDDV				0.00	0.00%

Target Assessment

NO_x Reduction Required for 2005 ROP(target)	130.53
Creditable Reductions	674.42
Excess (Shortfall)	**543.89**
Required Contingency	37.13
Required Target + Contingency	167.66
Total Reductions	674.42
Excess (Shortfall)	**506.76**

Notes:

1. NO_x reductions will comprise all of the required contingency measure amounts of 3% of the adjusted base year EI. None of the contingency requirement will be taken from VOC reductions.

2. The value for the required NOx reduction (target) is calculated based upon EPA guidance, takes into account the effects of growth and non-creditable reductions, and is calculated on a separate spreadsheet. If the target value from the separate spreadsheet calculation is less than zero, the value is set to zero in the target assessment section of this spreadsheet.

3. Non-road emission reduction calculations are done using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NONROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

Table 5.1-7
2005 ROP Required VOC Emissions Target Calculations
Houston Ozone Nonattainment Area
Ozone Season VOC Tons Per Day
November 29, 2000

Step	Emissions Basis	Stationary		Mobile		Total
		Point	Area	On-road	Non-road	
1	1990 ROP Nonattainment Area Base Year EI	483.28	200.07	251.52	129.98	1064.85
2	Adjusted Base Year EI Relative to 2002	483.28	200.07	134.02	129.98	947.35
3	Adjusted Base Year EI Relative to 2005	483.28	200.07	132.58	129.98	945.91
4	0% of Adjusted Base Year EI Relative to 2005					0.00
5	RVP and Fleet turnover correction [steps (2-3)]		0.00	1.44		1.44
6	2002 Target Level					726.48
7	2005 Target Level [steps (6-5-4)]					725.04
8	2005 Emissions Forecast (Grown)	519.04	187.51	163.52	164.78	1034.85
9	Inventory Adjustment(see note 4)				4.94	4.94
10	2005 Emissions Forecast with Adjustment (8 + 9)	519.04	187.51	163.52	169.72	1039.79
11	Total Reductions Required by 2002 with growth [steps (10-7)]					314.75
12	Creditable Reductions to date (include 1996,1999, & 2002 ROP)	183.07	45.21	80.74	56.96	314.75
13	***VOC Reduction Required for 2005 ROP***					-51.23

Notes:
1. Base year on-road mobile emissions calculated with MOBILE5 for an ozone season weekday.
2. Adjusted base year on road mobile emissions and 1999 forecast on-road mobile emissions calculated with MOBILE5A for an ozone season weekday.
3. 1990 base year point source emissions of 481.95 tpd are adjusted by addition of 1.33 tpd from pulp and paper mills table in Appendix 11c-K of the July 1996 SIP.
4. Non-road emission inventories are calculated using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NOROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP and 1999 ROP inventories.

Table 5.1-8

VOC ESTIMATES TOWARDS 2005 9% ROP SIP - HOUSTON/GALVESTON
0% of 2005 ROP Reductions from VOC
November 29, 2000

Base Year and Baseline Inventories

Emissions Inventory Source Category	1990 Adjusted Base Year	Percent	Growth 1990 to 2005	2005 Baseline	Percent
Area Sources	200.07	21.2%	-6.3%	187.51	18.0%
Point Sources	483.28	51.1%	7.4%	519.04	49.9%
On-road Mobile Sources	132.58	14.0%	23.3%	163.52	15.7%
Non-road Mobile Sources	129.98	13.7%	30.6%	169.72	16.3%
Total	**945.91**		9.9%	**1039.79**	

Estimated VOC Reductions for 2005 ROP and 2006 Contingency

	Baseline TPD	Total Reduction 1990 to 2005 TPD	Cumulative Total Reductions from Previous ROPs TPD	2005 ROP Reduction TPD	Percent of Requirement
Federally Mandated Controls					
HON		0.47	0.47	0.00	0.00%
Pulp & Paper, RFG - Tanks & RFG - Loading Racks		14.53	14.53	0.00	0.00%
RE Floating Tanks		26.97	26.96	0.01	
Gasoline utility engine rule, Marine recreational & HDDV standards	169.72	77.17	50.69	26.48	
Tier I/II, I/M, RFG, NLEV, HDDV	163.52	95.00	79.88	15.12	
Federal Controls Subtotal				41.61	
Total 2005 Control Strategy Reductions				**41.61**	
Contingency Strategy					
2006 Tier I/II, I/M, RFG, NLEV, HDDV				0.00	0.00%

Target Assessment	
VOC Reduction Required for 2005 ROP(target)	0.00
Creditable Reductions	41.61
Excess (Shortfall)	**41.61**
Required Contingency	0.00
Required Target + Contingency	0.00
Total Reductions	41.61
Excess (Shortfall)	**41.61**

Notes:

1. NO_x reductions will comprise 1/3 of the required contingency measure amounts of 3% of the adjusted base year EI. VOC reductions will comprise 2/3 of the required contingency measure amounts of 3% of the adjusted base year EI.

2. The value for the required VOC reduction (target) is calculated based upon EPA guidance, takes into account the effects of growth and non-creditable reductions, and is calculated on a separate spreadsheet. If the target value from the separate spreadsheet calculation is less than zero, the value is set to zero in the target assessment section of this spreadsheet.

3. Non-road emission reduction calculations are done using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NONROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

Table 5.1-9
2007 ROP Required NOx Emissions Target Calculations
Houston Ozone Nonattainment Area
Ozone Season NOx Tons Per Day
November 29, 2000

Step	Emissions Basis	Stationary		Mobile		Total
		Point	Area	On-road	Non-road	
1	1990 ROP Nonattainment Area Base Year EI	794.85	14.37	337.03	198.08	1344.33
2	Adjusted Base Year EI Relative to 2005	794.85	14.37	230.49	198.08	1237.79
3	Adjusted Base Year EI Relative to 2007	794.85	14.37	228.97	198.08	1236.27
4	6% of Adjusted Base Year EI Relative to 2007					74.18
5	RVP and Fleet turnover correction [steps (2-3)]		0.00	1.52		1.52
6	2005 Target Level					1001.64
7	2007 Target Level [steps (6-5-4)]					925.94
8	2007 Emissions Forecast (Grown)	713.46	14.58	371.17	194.08	1293.29
9	Inventory Adjustment (see note 4)				81.51	81.51
10	2005 Emissions Forecast with Adjustment(8 + 9)	713.46	14.58	371.17	275.59	1374.80
11	Total Reductions Required by 2002 with growth [steps (10-7)]					448.86
12	Creditable Reductions to date (include 1996, 1999, 2002, & 2005 ROP)	688.00	0.00	135.72	48.56	872.28
13	***NOx Reduction Required for 2007 ROP***					-423.42

Notes:

1. Base year on-road mobile emissions calculated with MOBILE5 for an ozone season weekday.
2. Adjusted base year on road mobile emissions and 1999 forecast on-road mobile emissions calculated with MOBILE5A for an ozone season weekday.

3. 1990 base year point source emissions of 481.95 tpd are adjusted by addition of 1.33 tpd from pulp and paper mills table in Appendix 11c-K of the July 1996 SIP.
4. Non-road emission inventories are calculated using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NOROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP and 1999 ROP inventories.

Table 5.1-10
NOx ESTIMATES TOWARDS 2007 6% ROP SIP - HOUSTON/GALVESTON
6% of 2007 ROP Reductions from NOx
November 29, 2000

Base Year and Baseline Inventories

Emissions Inventory Source Category	1990 Adjusted Base Year	Percent	Growth 1990 to 2007	2007 Baseline	Percent
Area Sources	14.37	1.2%	1.5%	14.58	1.1%
Point Sources	794.85	64.3%	-10.2%	713.46	51.9%
On-road Mobile Sources	228.97	18.5%	62.1%	371.17	27.0%
Non-road Mobile Sources	198.08	16.0%	39.1%	275.59	20.0%
Total	**1236.27**		11.2%	**1374.80**	

Estimated NO_x Reductions for 2007 ROP and 2008 Contingency

	Baseline TPD	Total Reduction 1990 to 2007 TPD	Cumulative Total Reductions from Previous ROPs TPD	2007 ROP Reduction TPD	Percent of Requirement
Federally Mandated Controls					
NOx RACT		95.00	95.00	0.00	
Tier I/II, I/M, RFG, NLEV, HDDV	371.17	182.00	135.72	46.28	
Gasoline utility engine rule, Marine recreational & HDDV standards (non-road)	275.48	65.76	48.56	17.20	
Federal Controls Subtotal				63.48	
State and Local Controls					
NO_x Point Source	713.46	593.00	593.00	0.00	0.00%
State and Local Controls Subtotal				0.00	
Total 2007 Control Strategy Reductions				**63.48**	
Contingency Strategy					
2008 Tier I/II, I/M, RFG, NLEV, HDDV				0.00	0.00%

Target Assessment

NOx Reduction Required for 2007 ROP(target)	0.00
Creditable Reductions	63.48
Excess (Shortfall)	**63.48**
Required Contingency	24.73
Required Target + Contingency	25.07
Total Reductions	63.48

Excess (Shortfall)	**38.75**

Notes:

1. NO_x reductions will comprise all of the required contingency measure amounts of 3% of the adjusted base year EI. None of the contingency requirement will be taken from VOC reductions.

2. The value for the required NO_x reduction (target) is calculated based upon EPA guidance, takes into account the effects of growth and non-creditable reductions, and is calculated on a separate spreadsheet. If the target value from the separate spreadsheet calculation is less than zero, the value is set to zero in the target assessment section of this spreadsheet.

3. Non-road emission reduction calculations are done using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NONROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

Table 5.1-11
2007 ROP Required VOC Emissions Target Calculations
Houston Ozone Nonattainment Area
Ozone Season VOC Tons Per Day
November 29, 2000

Step	Emissions Basis	Stationary		Mobile		Total
		Point	Area	On-road	Non-road	
1	1990 ROP Nonattainment Area Base Year EI	483.28	200.07	251.52	129.98	1064.85
2	Adjusted Base Year EI Relative to 2005	483.28	200.07	132.58	129.98	945.91
3	Adjusted Base Year EI Relative to 2007	483.28	200.07	131.61	129.98	944.94
4	0% of Adjusted Base Year EI Relative to 2007					0.00
5	RVP and Fleet turnover correction [steps (2-3)]		0.00	0.97		0.97
6	2005 Target Level					722.66
7	2007 Target Level [steps (6-5-4)]					721.69
8	2007 Emissions Forecast (Grown)	519.23	191.29	190.10	171.89	1072.51
9	Inventory Adjustment(see note 4)				5.16	5.16
10	2007 Emissions Forecast with Adjustment (8 + 9)	519.23	191.29	190.10	177.05	1077.67
11	Total Reductions Required by 2002 with growth [steps (10-7)]					355.98
12	Creditable Reductions to date (include 1996,1999, 2002, & 2005 ROP)	183.07	45.21	95.86	83.44	407.58
13	***VOC Reduction Required for 2007 ROP***					-51.60

Notes:
1. Base year on-road mobile emissions calculated with MOBILE5 for an ozone season weekday.
2. Adjusted base year on road mobile emissions and 1999 forecast on-road mobile emissions calculated with MOBILE5A for an ozone season weekday.
3. 1990 base year point source emissions of 481.95 tpd are adjusted by addition of 1.33 tpd from pulp and paper mills table in Appendix 11c-K of the July 1996 SIP.
4. Non-road emission inventories are calculated using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NOROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP and 1999 ROP inventories.

Table 5.1-12
VOC ESTIMATES TOWARDS 2007 9% ROP SIP - HOUSTON/GALVESTON
0% of 2007 ROP Reductions from VOC
November 29, 2000

Base Year and Baseline Inventories

Emissions Inventory Source Category	1990 Adjusted Base Year	Percent	Growth 1990 to 2007	2007 Baseline	Percent
Area Sources	200.07	21.2%	-4.4%	191.29	17.8%
Point Sources	483.28	51.1%	7.4%	519.23	48.2%
On-road Mobile Sources	131.61	13.9%	44.4%	190.10	17.6%
Non-road Mobile Sources	129.98	13.8%	36.2%	177.05	16.4%
Total	**944.94**		14.0%	**1077.67**	

Estimated VOC Reductions for 2007 ROP and 2008 Contingency

	Baseline TPD	Total Reduction 1990 to 2007 TPD	Cumulative Total Reductions from Previous ROPs TPD	2007 ROP Reduction TPD	Percent of Requirement
Federally Mandated Controls					
HON		0.47	0.47	0.00	0.00%
Pulp & Paper, RFG - Tanks & RFG - Loading Racks		14.54	14.53	0.01	
RE Floating Tanks		27.47	26.97	0.50	
Gasoline utility engine rule, Marine recreational & HDDV standards	177.05	94.32	77.17	17.15	
Tier I/II, I/M, RFG, NLEV, HDDV	190.10	118.26	95.00	23.26	
Federal Controls Subtotal				40.92	
Total 2007 Control Strategy Reductions				**40.92**	
Contingency Strategy					
2006 Tier I/II, I/M, RFG, NLEV, HDDV				0.00	0.00%

Target Assessment

VOC Reduction Required for 2007 ROP(target)	0.00
Creditable Reductions	40.92
Excess (Shortfall)	**40.92**
Required Contingency	0.00
Required Target + Contingency	0.00
Total Reductions	40.92
Excess (Shortfall)	**40.92**

Notes:

1. NO_x reductions will comprise 1/3 of the required contingency measure amounts of 3% of the adjusted base year EI. VOC reductions will comprise 2/3 of the required contingency measure amounts of 3% of the adjusted base year EI.

2. The value for the required VOC reduction (target) is calculated based upon EPA guidance, takes into account the effects of growth and non-creditable reductions, and is calculated on a separate spreadsheet. If the target value from the separate spreadsheet calculation is less than zero, the value is set to zero in the target assessment section of this spreadsheet.

3. Non-road emission reduction calculations are done using a baseline inventory calculated with the NONROAD model adjusted using a methodology ratio. The methodology ratio corrects the NONROAD values for differences in the NEVES and NONROAD methodologies using 1999 grown NEVES and 1999 NONROAD inventories to determine the ratio. This correction is done in order to maintain consistency with the 1990 base year, 1996 ROP, and 1999 ROP inventories.

CHAPTER 6: REQUIRED CONTROL STRATEGY ELEMENTS

Table 6-1.1 HGA NO_x Reduction Estimates[1]

September 8, 1993 Base Case Emissions Inventory	1993 Base Case (tpd)	Percent of 1993 Total	2007 Future Base	2007 Controlled (tpd)	Percent of 2007 Total
On-road mobile sources	416	32%	215	164	40%
Area and non-road mobile sources	155	12%	147	129	31%
Point sources[1]	695	54%	721	103	25%
Biogenic sources	18	1%	18	18	4%
TOTALS	**1284**	**100%**	**1101**	**414**	**100%**

[1]Totals may not equal 100% due to round-off.
[2]Point source inventory subject to revision. See Chapter 3, Section 3.5.3 for explanation.

6.1 OVERVIEW

The development of the attainment demonstration SIP for the HGA area has proved to be an extremely challenging effort, due to the magnitude of reductions needed for attainment and the shortage of readily available control options. Several leading-edge, innovative control technologies are now approaching an advanced state of development due to the role played by Texas stakeholders and others in aggressively pursuing new ozone control technologies. As promising as these new technologies may be, however, they alone are not yet adequate to bring the HGA area into attainment. There are test programs already initiated evaluating all of these new technologies which will provide the commission with the necessary information to base decisions on during the full continuum of the mid-course review (see Chapter 7). Ideally, this attainment demonstration would rely upon technical solutions that provided the cleanest possible automobiles and trucks, ships, locomotives, aircraft, construction equipment, etc., within a few years' time. Unfortunately, the current state of technology, coupled with the inevitable lag time to achieve significant equipment turnover, prevents a purely technical solution from being a reality by 2007, the attainment year. For this reason, the commission must implement measures that rely on behavioral changes, in addition to technological controls.

The HGA nonattainment area will need to ultimately reduce NO_x by more than 750 tons per day to reach attainment with the 1-hour ozone standard. In addition, a VOC reduction of about 25% will also have to be achieved. Implementation of the rules and other control measures contained in this SIP revision will close the gap and achieve attainment of the 1-hour ozone standard in the HGA area by November 15, 2007, the date required for attainment. Table 6.1-2 provides a summary of the NO_x control strategies and reductions for the HGA attainment demonstration.

Table 6.1-2: Summary of Control Strategies and NO_x/VOC Estimated 2007 Reductions for the HGA Attainment Demonstration

Type of Measure	Description	NO_x	VOC
EXISTING FEDERAL MEASURES			
Federal on-road	- These reduction estimates reflect the difference of 1993 vs. 2007 on-road emissions, which consider the effect of federal controls and growth	201	98
Federal area/non-road	- These reduction estimates reflect the difference of 1993 vs. 2007 area and non-road emissions, which consider the effect of federal controls and growth	8	35
ADDITIONAL FEDERAL MEASURES			
Heavy-Duty Engine Consent Decree	- Additional fleet turnover of cleaner heavy-diesel trucks subject to federal standards embodied in the consent decree	5	0
	Federal Measures Total	214	133
STATE			
A. Base Measures (November 1999 SIP) **1. State Rules**			
Point Source NO_x	- Requires a wide variety of minor and major stationary sources to meet new emission specifications and other requirements in order to reduce NO_x emissions - Requires overall NO_x reductions of 89% from these sources from the 1997 baseline (85% reduction with new, post-1997 facilities) - Requires sources with a design capacity to emit 10 tpy or more to participate in the proposed mass emission cap and trade program	595 tpd	--

Emissions Banking and Trading Program	- Creates an overall NO_x Mass Emission Cap and Trade Program for the HGA area. - Creates a partial bridge between the existing Emissions Banking and Trading Programs and the Mass Emission Cap and Trade Program to provide maximum flexibility in meeting the SIP requirements - Revises current open market rules currently located in 101.29 to: 1) consolidate banking and trading rules into one location (101, Subchapter H) 2) require registration of emission reduction credits within 180 days of the actual reduction 3) provide an improved mechanism for mobile sources to generate credits 4) guarantee that actual emission reduction are not double counted, ie, shown as a reduction in the SIP and banked for future use.	--	--
Inspection/ Maintenance	- Requires ASM or equivalent testing as well as OBD testing - Begins May 1, 2002 for Harris County - Begins May 1, 2003 for Brazoria, Fort Bend, Galveston, and Montgomery Counties - Begins May 1, 2004 for Chambers, Liberty, and Waller Counties - Provides Chambers, Liberty and Waller Counties flexibility to submit a resolution by May 1, 2002 that is approved by the commission and EPA and provides an alternative air pollution control strategy which assures equivalent emission reductions	36.20 tpd	18.05
Construction Equipment Operating Restrictions	- Establishes a restriction on the use of HDD construction equipment from 6:00 a.m. - noon starting in April 2005 - Only applies from April 1 - October 31 each year - Applies in Harris, Fort Bend, Brazoria, Galveston, and Montgomery Counties - Exempts wet concrete operations and emergency operations - Provides an exemption from the rule if an alternative plan is submitted assuring equivalent emission reductions	7.8 tpd NO_x shifted 6.7 tpd equivalent	---

Cleaner Diesel Fuel	- By May 1, 2002, the fuel will have improved aromatics and cetane for all on-road sales statewide and for all on- and non-road sales in East/Central Texas - By June 1, 2006, sulfur will be reduced to 15 ppm in East/Central Texas for on- and non-road fuel	3.98 tpd on-road 2.69 tpd non-road	--
Small, Spark-Ignition Engine Operating Restrictions	- Restricts the use of handheld and non-handheld spark-ignition equipment, for commercial use only, rated at 25 hp and below between the hours of 6:00 a.m. - noon starting in 2005 - Only applies April 1 through October 31 each year - Applies in Harris, Fort Bend, Brazoria, Galveston, and Montgomery Counties - Commercial operators are exempted from the rule in the case of certain emergencies, or if they can develop a plan to lower emissions which receives the approval of the commission and the EPA	.23 tpd NO_x shifted 12.4 tpd VOC shifted 4.6 tpd NO_x equivalent	--
VOC RACT	- Implements RACT requirements for batch processes, bakeries, and offset lithographic printers	--	--
2. Local Measures			
VMEP	- SIP control strategy (no rule required) - Numerous projects have been identified by the HGAC for inclusion in the SIP such as telecommuting, bus fare promotions, alternative fuel programs, and ozone action days	23	--
	Base Measures Total	**672.17**	**18.05**
B. Gap Measures **1. Federal Measures**			
Energy Efficiencies	- These reductions estimates reflect the minimum standards of energy efficiency for many major appliances as established by the U.S. Congress in the National Appliance Energy Conservation Act of 1987.	3.57	--
2. State Rules			

Accelerated Purchase of Tier 2/Tier 3 Diesel Equipment	- Requires the early retirement of older equipment and purchase of newer, cleaner non-road diesel equipment - Phased-in implementation beginning in December 2004 - Provides an exemption from the rule if an alternative plan is submitted assuring equivalent emission reductions	12.20 tpd	1.86
Speed Limit Reduction	- The speed limit on all roadways with a current maximum speed limit above 55 mph would be reduced to 55 mph in the 8-county area - Starts May 1, 2002	12.33 tpd	1.76
Airport GSE	- The rule was withdrawn, however, agreements were reached with Continental Airlines, Southwest Airlines, and the City of Houston to make certain local reductions of NO_x from sources at Houston area airports. These federally enforceable agreements are equivalent to the NO_x reductions proposed in the rulemaking package being withdrawn	5.09 tpd	--
California Spark-Ignition Engines	- Requires manufacturers to ensure that all affected large spark ignition engines are certified to California LSI standards - Exempts agriculture and construction equipment less than 175 hp, recreational equipment, stationary engines, marine vessels, and equipment on tracks - Statewide rule	2.80 tpd	7.58
Vehicle Idling Restrictions	- Limits idling for all vehicles over 14,000 pounds to five consecutive minutes - Begins April 1, 2001 - Only applies from April 1 through October 31 each year	0.48 tpd	0.19
Gas-fired Water Heaters, Small Boilers, And Process Heaters	- Rule already adopted for statewide sales of water heaters, small boilers, and process heaters	0.50 tpd	--
2. Local Measures			
TCMs	- SIP control strategy (no rules required). - Numerous projects have been identified by H-GAC for inclusion in the SIP, such as traffic signalization and bicycle/pedestrian projects.	1.06 tpd	2.13

Gap Measures Total	38.03	13.52
Equivalent NO_x reduced as a result of VOC reductions	1.14	
Gap	90.9	
Remaining gap to fill	51.73	

6.2 VOC RULE CHANGES

6.2.1 VOC RACT Fix-ups

The revisions to Chapter 115 implement RACT requirements for batch processes, bakeries, and offset lithographic printers in the HGA ozone nonattainment area. The revisions will ensure that RACT is in place for all major VOC sources in HGA.

6.3 NO_x RULE CHANGES

6.3.1 Point Source NO_x

The revisions to Chapter 117 require a wide variety of stationary sources of NO_x emissions in the HGA ozone nonattainment area to meet new emission specifications and other requirements in order to reduce NO_x emissions and ozone air pollution. The affected equipment types and processes include electric utility boilers and gas turbines, ICI boilers and gas turbines, duct burners used in turbine exhaust ducts, process heaters and furnaces, stationary internal combustion engines, fluid catalytic cracking units (including catalyst regenerators and associated CO boilers and furnaces), pulping liquor recovery furnaces, lime kilns, lightweight aggregate kilns, heat treating and reheat furnaces, magnesium chloride fluidized bed dryers, incinerators (including fume abaters), hazardous waste-fired BIFs at major sources in HGA, and stationary internal combustion engines and ICI boilers and process heaters at minor sources in HGA. Demonstrated control technology is available to achieve these NO_x reductions. The rules will result in an estimated 85% reduction in NO_x emissions from the 1997 baseline or 595 tpd, from major sources of NO_x in HGA.

6.3.2 Emissions Banking and Trading Program

The emissions banking and trading program has been designed to offer maximum flexibility to air emission requirements by allowing the generation and use of ERCs, MERCs, DERCs, and MDERCs. Flexibility has been built into the proposed rule to create incentives for the early or permanent retirement of VOC, NO_x and other criteria pollutants. The intent of this rule is to streamline the emissions banking and trading program by combining the rules relating to stationary emission credits and mobile emission credits to achieve continuity within the two programs. Also, a NO_x mass emission cap and trade program is being established which creates a cap for facilities which have NO_x emissions in the HGA nonattainment area that are both subject to Chapter 117 emission requirements and have a design capacity of 10 or more tons per year. The allowance allocation schedule is follows:

- For investor owned utilities
  46% reduction by 3-31-03
  92% reduction by 3-31-04
  all required reduction by 3-31-07

- For all other sources

44% reduction by 3-31-04
89% reduction by 3-31-05
all required reduction by 3-31-07

6.3.3 Inspection/Maintenance

The HGA area is expanding and revising the vehicle emissions I/M program as an additional control strategy option. The adopted amendments to the I/M program require that all vehicles registered and primarily operated in Harris County will continue to utilize the current two-speed idle test until April 30, 2002. Beginning May 1, 2002, all vehicles registered and primarily operated in Harris County will transition to an emissions test utilizing OBD for model year vehicles 1996 and newer, and ASM-2 or a vehicle emissions testing program that meets SIP emissions reduction requirements and is approved by EPA for model year vehicles 1995 and older.

Beginning May 1, 2003, all vehicles registered and primarily operated in Brazoria, Fort Bend, Galveston, and Montgomery Counties will implement OBD testing for model year vehicles 1996 and newer, and ASM-2 or a vehicle emissions testing program that meets SIP emissions reduction requirements and is approved by EPA for model year vehicles 1995 and older. Beginning May 1, 2004, all vehicles registered and primarily operated in Chambers, Liberty, and Waller Counties will implement OBD testing for model year vehicles 1996 and newer, and ASM-2 or a vehicle emissions testing program that meets SIP emissions reduction requirements and is approved by EPA for model year vehicles 1995 and older. Program expansion is essential for reduction of NO_x emissions to be able to demonstrate attainment with the NAAQS for ozone. Additionally, in its effort to ensure that the SIP strategies impose no more burden than necessary to protect health and welfare, the commission decided to provide Chambers, Liberty and Waller Counties and their respective largest municipality the flexibility to submit by May 1, 2002, individually or collectively, a resolution that is approved by the commission and EPA as an alternative air pollution control strategy. The commission staff estimates that NO_x reductions in 2007 will be 36.20 tpd.

6.3.4 Construction Equipment Operating Restrictions

This strategy implements operating restrictions for HDD construction and industrial equipment rated 50 hp and greater, between the hours of 6:00 a.m. to noon from April 1 through October 31 each year starting April 1, 2005. This strategy covers Harris, Fort Bend, Brazoria, Galveston, and Montgomery Counties.

The commission developed these operating restrictions in the HGA area in order to limit ozone production, and to enable the counties in the HGA ozone nonattainment area to attain compliance with the NAAQS for ozone.

Commission staff has estimated that the construction and industrial equipment operating restrictions will shift 7.8 tpd of NO_x to the afternoon. By shifting the hours of operation for HDD construction equipment until after noon during the effective time period, the NO_x emissions will not mix in the atmosphere with other ozone-causing compounds until later in the day. Ozone is formed through chemical reactions between natural and man-made VOC and NO_x emissions in the presence of sunlight. The critical time for the mixing (chemical reactions) of NO_x and VOC is early in the day, and thus, higher ozone levels occur most frequently on hot summer afternoons. By delaying the hours of operation of construction and industrial equipment, and delaying the release of NO_x emissions until after noon during the time period between April 1 though October 31 in the HGA nonattainment area, the NO_x emissions are less likely to mix in the atmosphere with other ozone-forming compounds until after the critical mixing time has passed. Therefore, production of ozone will be stalled until later in the day when optimum ozone formation conditions no longer exist, ultimately minimizing the peak level of ozone produced.

Exemptions allow for the operation of any heavy-duty diesel construction and industrial equipment used exclusively for emergency operations to protect public health and the environment. In addition, HDD construction and industrial equipment used in the mixing, transporting, pouring, or processing of wet concrete is exempted. Also, operators that submit an emissions reduction plan by May 31, 2002, which the executive director and the EPA approve by May 31, 2003, will be exempt from this rule and will be permitted to operate during the restricted time period. The emission reduction plan must describe in detail how the operator will modify his behavior or fleet of equipment to reduce NO_x emissions by the implementation date in 2005 by a target amount equal to the total equivalent NO_x reductions achieved by implementation of the rule from which the operator is applying for exemption. Owners or operators may submit plans to apply for exemption from either the Construction Equipment Operating Restrictions rule or the Accelerated Purchase of Non-road Heavy-duty Diesel Equipment rule, or from both rules.

Construction Industry Reduction Goal

The construction industries in the HGA contribute to the overall air quality challenges faced by the HGA area. They also will contribute, in substantial part, to the solution. It is possible to determine how much emissions come from non-road diesel construction equipment and then apply the emission reduction goals of the various programs to this inventory to arrive at an estimated overall goal for non-road diesel powered construction equipment in the 8-county HGA area. The commission has estimated this number to be 18.77 tons of NO_x per day. A photochemical model run was used to estimate the equivalent NO_x reductions achieved by a shift in the construction work day. This was determined to be equivalent to removing 6.7 tpd of NO_x from the inventory. The accelerated purchase of Tier 2/Tier 3 equipment as applied to the construction inventory was determined to be 10.62 tpd of NO_x. LED fuel again applied to just non-road construction equipment was estimated at 1.45 tpd NO_x. Adding these measures together arrives at the 18.77 tpd estimated above.

Port Estimated Emission Reductions

There are a number of sea ports located in the HGA area. These ports contribute to the economy of the HGA area. They also contribute, in some part, to the air quality challenges the HGA area faces and will play a significant role in the air quality improvement plan. There are several measures, all of which may be quantified, which apply to the port industries. These measures can be added together to arrive at an emissions reduction target for the HGA area port industries. The port industries contribute 7% of the overall industrial and construction non-road emissions in the HGA area. This fraction of the emissions inventory can be used to calculate the reduction amount from each proposed measure for which the port is responsible. The measures that apply to the port are: the construction equipment operating restriction, accelerated purchase of Tier 2/ Tier 3 diesel equipment, and low emission diesel fuel. Applying the emission reductions to the percentage of contribution of the port, the total number of reductions which are estimated to be the port's responsibility is 1.41 tpd of NO_x. See the following methodology:

HGA Ports Estimated Emissions Contributions	
Port Equipment Inventory	2.7 (based on TNRCC Non-road run and Port inventory data)
Total industrial Diesel Inventory	6.65
Total construction Diesel Inventory	31.60
Total industrial + construction inventory	38.25
Port Fraction	0.07

HGA Ports Estimated Emission Reduction Goal from Non-road Cargo Handling Equipment		
	Updated NO_x Reduction (tpd)	Proportional Maritime Share NO_x
Construction Equipment Operating Restriction	6.7	0.47
Accelerated Purchase of Tier 2/Tier 3 Equipment	11.48	0.81
LED Fuel	1.85	0.13
Total		**1.41**

6.3.5 Cleaner Diesel Fuel

This strategy implements a state LED fuel program requiring diesel fuel producers and importers, beginning May 1, 2002, to ensure that all diesel fuel used statewide for on-road use does not exceed 500 ppm sulfur, contains less than 10.0% by volume of aromatic hydrocarbons, and has a minimum cetane number of 48. Alternative diesel fuel formulations that achieve equivalent emission reductions may also be used. In addition, these same requirements must be met for all diesel fuel used for non-road use in the HGA, BPA and DFW ozone nonattainment areas and in an additional 95 East and Central Texas counties. The state LED fuel program also requires that, beginning June 1, 2006, the sulfur content be reduced to 15 ppm sulfur in both on-road and non-road diesel fuel in the HGA, BPA, and DFW ozone nonattainment areas, and in an additional 95 East and Central Texas counties. The fuel required by the state LED fuel program will have a lower aromatic hydrocarbon content and a higher cetane number in each gallon of diesel than required by current federal regulations for on-road diesel.

The state LED fuel program will lower NO_x emissions from diesel fueled compression-ignition engines in the affected areas. Because NO_x emissions are precursors to ground-level ozone formation, reduced emissions of NO_x will result in ground-level ozone reductions. By 2007, the state LED fuel program will reduce NO_x emissions from on-road vehicles and non-road equipment statewide by 30 tpd, of which 6.67 tpd of reductions will be achieved in the HGA ozone nonattainment area.

The state LED fuel program will require LED fuel statewide for on-road use. In addition, the state LED fuel program will require LED fuel for both on-road and non-road use in the eight counties in the HGA ozone nonattainment area, which comprise Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties; the three counties of the BPA ozone nonattainment area, which comprise Hardin, Jefferson, and Orange Counties; the four counties of the DFW ozone nonattainment area, which comprise Collin, Dallas, Denton, and Tarrant Counties; and 95 additional East and Central Texas counties comprising Anderson, Angelina, Aransas, Atascosa, Austin, Bastrop, Bee, Bell, Bexar, Bosque, Bowie, Brazos, Burleson, Caldwell, Calhoun, Camp, Cass, Cherokee, Colorado, Comal, Cooke, Coryell, De Witt, Delta, Ellis, Falls, Fannin, Fayette, Franklin, Freestone, Goliad, Gonzales, Grayson, Gregg, Grimes, Guadalupe, Harrison, Hays, Henderson, Hill, Hood, Hopkins, Houston, Hunt, Jackson, Jasper, Johnson, Karnes, Kaufman, Lamar, Lavaca, Lee, Leon, Limestone, Live Oak, Madison, Marion, Matagorda, McLennan, Milam, Morris, Nacogdoches, Navarro, Newton, Nueces, Panola, Parker, Polk, Rains, Red River, Refugio, Robertson, Rockwall, Rusk, Sabine, San Jacinto, San Patricio, San Augustine, Shelby, Smith, Somervell, Titus, Travis, Trinity, Tyler, Upshur, Van Zandt, Victoria, Walker, Washington, Wharton, Williamson, Wilson, Wise, and Wood counties.

The state LED fuel program will require diesel fuel producers and importers that provide fuel to the affected area to register with the commission. In addition, the state LED fuel program will require diesel fuel producers and importers to test fuel samples for compliance and keep records of the test results. Diesel fuel producers and importers will also be required to submit a report to the commission for compliance on each blend batch and a quarterly summary report of the results from the fuel testing. All parties in the fuel distribution system (producers, importers, pipelines, rail carriers, terminals, truckers, and retailers, except those acting as a common carrier) will be required to keep records of product transfer documents for two years. Retail fuel dispensing outlets will be exempt from all of the state LED fuel program's testing and recordkeeping requirements except for the keeping of product transfer documents.

SECTION 211(C)(4)(C) WAIVER REQUEST

Section 211(c)(4)(A) of the FCAA prohibits states from prescribing or attempting to enforce any “control or prohibition” of a “characteristic or component of a fuel or fuel additive” if the EPA has promulgated a control or prohibition applicable to such characteristic or component under section 211(c)(1). EPA regulates diesel fuel used in on-road applications in Title 40 CFR Section 80.29. Section 211(c)(4)(C) provides an exception to this prohibition for a nonidentical state standard contained in a SIP where the standard is “necessary to achieve” the primary or secondary NAAQS that the SIP implements. EPA can approve a SIP provision as necessary if the Administrator finds that “no other measures exist and are technically possible to implement, but are unreasonable or impracticable.” Therefore, Texas is submitting this revision to the SIP as adequate justification and is requesting from EPA a waiver from Section 211(c)(4)(A) of the FCAA to implement a state LED fuel program in the areas defined in this SIP revision. Texas is requesting this waiver for the state regulation of on-road diesel fuel only, since EPA does not regulate diesel fuel used in non-road applications and as such, no waiver is required.

Waiver Requirements for Alternative Fuel Specifications

Under Section 211 (c)(4)(C) of the FCAA, EPA may approve a non-identical state fuel control as a SIP provision, if the state demonstrates that the measure is necessary to achieve the national primary or secondary NAAQS that the plan implements. EPA can approve a state fuel requirement as necessary only if no other measure exists that would bring about timely attainment, or if other measures exist but are unreasonable or impracticable.

If a state decides to pursue a state fuel requirement, the state must submit a SIP revision adopting the state fuel control and apply for a waiver from federal preemption. The state must include in its petition specific information showing the measure is necessary to meet the ozone NAAQS, based on the statutory requirements for showing necessity. The waiver request must:

Identify the quantity of reductions needed to reach attainment of the NAAQS;

- Identify possible other control measures and the quantity of reductions each would achieve;
- Explain in detail, with adequate factual support, which of those identified control measures are considered unreasonable or impracticable; and
- Show that even with the implementation of all reasonable and practicable measures, the state would need additional emissions reductions for timely attainment, and the state fuel measure would supply some or all of such additional reductions.

Determining Whether Other Measures are Unreasonable or Impracticable

In determining whether ozone control measures are unreasonable or impracticable, reasonableness and practicability are determined in comparison to the state-specific fuel control program.

While the basis for finding unreasonableness or impracticability is in part comparative, the state still must provide solid reasons why the other measures are unreasonable or impracticable and must demonstrate these reasons with adequate factual support. Reasons why a measure might be unreasonable or impracticable for a particular area include, but are not limited to, the following:

- Length of time to implement the measure;
- Length of time to achieve ozone reduction benefits;
- Degree of disruption entailed by implementation;
- Other implementation concerns, such as supply issues;
- Costs to industry, consumers, or the state;
- Cost-effectiveness; and
- Reliance on commercially unavailable technology.

A strong justification for finding a measure unreasonable or impracticable might rely upon the combination of several of these reasons.

THE NEED FOR THE STATE LOW EMISSION DIESEL PROGRAM

The commission has developed a NO_x control strategy consisting of a state LED fuel program that it believes is an essential element in the control strategy package needed for the HGA ozone nonattainment area to be able to demonstrate attainment of the ozone NAAQS. The fuel that is required by the state LED fuel program is a low aromatic hydrocarbon/high cetane diesel fuel which will be required statewide for use by on-road diesel fueled compression-ignition engines and for both on-road and non-road diesel fueled compression-ignition engines in the HGA, BPA, and DFW ozone nonattainment areas and in an additional 95 East and Central Texas counties. The state LED fuel program was originally developed as a NO_x control strategy for the DFW ozone nonattainment area, and state regulations were adopted to implement this strategy in the DFW area. The state LED fuel program developed for this SIP revision is an expansion of the DFW program, but with additional requirements.

The commission's current understanding, based upon national studies as well as the commission's own studies, is that ozone must be controlled at two levels: the regional level and the urban level. Historically, the FCAA has limited states to addressing the ozone problem at the local level. Recently, however, this has begun to change. The EPA has started to incorporate the findings of the OTAG, the SOS, and the advice of stakeholders (e.g., the FACA Subcommittee on Ozone, Particulate Matter, and Regional Haze Implementation) into recent policy guidance, encouraging states to factor regional reductions into their control plans.

On a national level, the OTAG study and its findings are particularly noteworthy. OTAG was established by the EPA to work with states in the eastern portion of the country to develop strategies to address the regional ozone problem. Among the group's determinations were that ozone is pervasive; ozone and the compounds that form it are transported both at lower levels of the atmosphere and aloft from one day to the next; and reductions of ozone precursors over a large area are beneficial in lowering regional background levels of ozone.

The commission's own studies have provided evidence that there is regional transport of ozone and ozone precursors in Texas, and that regional reductions of ozone precursors are beneficial. The commission's own modeling studies have shown that pollutant sources across Texas contribute to regional background levels of ozone, and that regional reductions of ozone precursors will lower the regional ozone background levels. These studies and upper air monitoring have found that regional air pollution should be considered when studying air quality in Texas' ozone nonattainment areas. This work is supported by the OTAG study which is the most comprehensive attempt ever undertaken to understand and quantify the transport of ozone. Both the commission and OTAG study results point to the need to take a regional approach, such as that described in the regional control strategy adopted by the commission, to control air pollutants.

Lowering regional background ozone through a regional strategy will serve three purposes. It will give existing nonattainment areas the flexibility to design optimal local control strategies to help them attain the 1-hour and 8-hour ozone standards. It will help areas which are currently close to violating the standards to avoid actually violating. And, over the longer term, it will help keep the developing areas of the state from ever violating the standards.

The regional aspect of the state LED fuel program was developed to provide LED fuel for use in areas of the state that could potentially have a negative air quality impact on current ozone nonattainment areas, near nonattainment areas, and future areas of concern. For example: the HGA ozone nonattainment area currently needs every possible emission reduction to demonstrate attainment; the BPA nonattainment area's attainment goals are heavily influenced by transport from HGA; the DFW ozone nonattainment area is also impacted by transport and has little leeway to handle additional emissions based on their current attainment demonstration modeling; and several near-nonattainment areas for the new 8-hour standard are seeking immediate reductions to preclude a nonattainment area designation. All of these areas will benefit from the reductions attributed to the regional aspect of the state LED fuel program.

The main attractiveness of the fuel-based strategy is that it has a more immediate impact than other controls. Once the fuel is in the marketplace, it begins having an immediate air quality impact as both old and new vehicles and non-road equipment begin using the new fuel.

The fuel required by the state LED fuel program was chosen based upon the following reasons:

- Emissions performance;
- Effect on advanced technology vehicles and engines;
- Impacts on non-road emissions;
- Modeling;
- Distribution;
- Transport; and
- Length of time needed to achieve benefits.

Emissions Performance

State and federal modeling has shown that reductions in NO_x continue to contribute to reductions in ozone. The use of LED fuel will reduce emissions of NO_x from diesel fueled compression-ignition engines in the eight county HGA ozone nonattainment area. The statewide implementation of LED fuel for on-road use will help reduce emissions in the HGA ozone nonattainment area from on-road vehicles that are transiting the area but fueling outside of the nonattainment area counties. The LED fuel is also beneficial in that NO_x emission reductions will be seen in all diesel fueled compression-ignition engines in the HGA ozone nonattainment area - both old and new and from on-road and non-road applications.

Effect on Advanced Technology Vehicles and Engines

Through the NLEV program and agreements between the heavy-duty engine manufacturers and EPA, vehicle and engine manufacturers have made a commitment to introduce cleaner vehicles and engines to the nation earlier than what would have been required by the FCAA. The NO_x reductions from this federal action will not be enough to get Texas where it needs to be in relation to overall air quality. Improvements in diesel fuel quality alone will not be enough. However, an improvement in diesel fuel quality as the result of a state LED fuel program, combined with the advanced vehicle and engine technology, will bring Texas closer to achieving its overall air quality goals. In addition, the state LED fuel program will benefit engine retrofit efforts in the HGA, BPA, and DFW ozone nonattainment areas by providing lower sulfur diesel fuel to these areas beginning June 2006.

Impacts on Emissions from On-road Vehicles and Non-road Engines

By 2007, the state LED fuel program will reduce NO_x emissions from on-road vehicles and non-road equipment statewide by 30 tpd, of which 6.67 tpd of reductions will be achieved in the HGA ozone nonattainment area.

Modeling

The commission contracted with ERG to estimate the on-road and non-road NO_x emissions benefits associated with adopting the LED rule for the HGA, BPA, and DFW areas, the affected 95 East and Central Texas counties, as well as the state as a whole, for a typical ozone summer day in 2007. The modeling performed by ERG for this SIP revision assumed that state LED fuel will be similar to California diesel fuel (CA diesel) in terms of the specifications (sulfur content, aromatic content, and cetane). Thus the emission benefits for the state LED fuel (compared to CA diesel) are based upon the switch from current Federal diesel (industry standard) to CA diesel.

Modeling Methodology for the HGA and DFW Ozone Nonattainment Areas

CA diesel fuel benefits were evaluated relative to industry average on-road diesel fuel, as provided in EPA's HDEWG report. ERG compared the regression equations generated under the HDEWG study with those from the European Auto Oil study. Given similar inputs, these models tend to agree in their NO_x predictions, with less than a 2.0% difference. Selecting the HDEWG model, NO_x reductions are predicted to be 5.7% for on-road engines with electronic controls (i.e., 1990 and later models for the most part). Note that the European Auto Oil equations estimated a 4.1% NO_x reduction for the same engines.

Also note that pre-1990 engine benefits were estimated using CARB test data from 1988. While this data set is thin, it is the only data available for estimating aromatics effects in pre-electronic control engines (estimated at 7% for NO_x). Therefore, ERG relied on this estimate for the older portion of the on-road fleet as well as the entire non-road diesel fleet.

On-Road Modeling Methodology for Statewide and for the 95-county Region plus the BPA Ozone Nonattainment Area

ERG developed baseline emission estimates for heavy-duty diesel vehicles using MOBILE5b, and county-specific inputs as well as projected vehicle miles traveled estimates for these vehicles. Resulting emissions were adjusted by the LED benefit estimate developed for the Dallas nonattainment area rulemaking. The following summarizes ERG's methodology and assumptions used to estimate ton per day NO_x reductions for this measure.

ERG developed individual MOBILE5b input files for the 95 counties in order to develop baseline NO_x emission inventories for each area. ERG used existing data sources to develop the baseline emission inventories. Table 6.3-1 summarizes the data sources used for each of the key input parameters.

Table 6.3-1. Data Sources for Statewide and 95-county Region Inventory Development

Input Parameter	Source
Vehicle registration distributions	1997 TxDOT records, by county
Average vehicle speed (excluding Travis, Hays, Williamson, and Bexar counties)	By county, from TTI COAST Modeling Project
Travis and Williamson County speeds	1996 TTI Conformity Modeling
Bexar County speed	1995 TTI Conformity Modeling
Hays County speed	Assumed equal to Comal County (due to I-35 location and proximity to major urban areas)
VMT per day (2007)	By county from E.H. Pechan Tier 2 Study for EPA, projected from HPMS data
HDD VMT fraction	By county from E.H. Pechan Tier 2 Study for EPA, projected from HPMS data

With the exception of the county-specific registration and speed inputs, ERG used default MOBILE5b settings, with the introduction of the new HDD emission standards in 2004. Once HDD gram per mile emission factors were estimated for each county, these were combined with HDD VMT estimates to determine total NO_x tpd emissions for the region as a whole (116 tpd).

County-specific data for the remaining counties in the western part of the state are quite limited, due to the lack of conformity and related modeling efforts for this region. Therefore, ERG developed an alternative approach for estimating NO_x inventories for these counties. The three counties in the BPA ozone nonattainment area (Hardin, Jefferson, and Orange) have also been included in this analysis.

ERG used the MOBILE5b input files from E.H. Pechan's National Tier 2 analysis for this effort. These input files contained detailed registration distributions for each region. Pechan grouped together counties with similar roadway, vehicle, and speed profiles for their analysis. Table 6.3-2 summarizes the county groupings used by Pechan to generate representative NO_x emission factors.

Table 6.3-2. Pechan's County Groupings for MOBILE5b Inputs

Representative County	Counties Represented
El Paso	El Paso only
Hardin	Hardin only
Jefferson	Jefferson only
Orange	Orange only
Anderson	All other "western" counties

ERG obtained the representative input files from Pechan in order to develop appropriate emission factors. However, these files were developed for use in post-processing with roadway specific speed data not currently available to ERG. Therefore, ERG ran each of the Pechan input files at 33.1 and 54.0 mph, the respective low and high speeds seen in the 95-county region data set, to "bracket" the likely emission factors for these counties. Table 6.3-3 summarizes the emission factors associated with the low- and high-end speeds, for each county grouping.

Table 6.3-3. Grams per Mile as a Function of Low/High Speed Assumption, by County Group

Representative County	Low Speed g/mi	High Speed g/mi
El Paso	7.13	9.53
Hardin	6.98	9.32
Jefferson	6.76	9.03
Orange	7.50	10.02
Anderson	6.70	8.95

As with the previous analysis, the Pechan input files accounted for the effect of the 2004 HDD engine standards.

Once obtained, the g/mi values were combined with Pechan's 2007 VMT estimates for each county to generate tpd values for NO_x from HDD vehicles. The resulting value for all 147 counties was 89.35 tpd.

Using a previous analysis, ERG estimated the NO_x reductions expected from adopting the California diesel fuel specifications in various Texas nonattainment areas. The specifications for Texas LED are essentially identical to the CARB specifications for the purposes of NO_x estimation. Therefore, ERG used the previous estimate of a 5.7% NO_x reduction to determine expected tpd benefits for the different regions. It was noted that pre-1990 mechanically-controlled engines were estimated to achieve a 7.0% reduction. However, given the small amount of total heavy diesel VMT attributable to these engines in 2007, ERG did not differentiate the benefit estimate by model year, but simply applied the 5.7% reduction uniformly across the entire inventory.

It is important to note that these benefit estimates are independent of the fuel sulfur level. Sulfur level only has an impact on NO_x emissions when catalysts are in place. At this time, EPA and automakers do not believe that advanced NO_x catalysts will be required to meet the upcoming 2004 emission standards. Therefore, fuel sulfur level was not considered in this modeling analysis.

Non-road Modeling Methodology for the BPA Ozone Nonattainment Area and Additional 95-County Region

ERG developed baseline emission estimates for HDD engines using EPA's draft Non-road model for each county. Resulting emissions were adjusted by the LED benefit estimate developed for the Dallas nonattainment area rulemaking. The following summarizes ERG's methodology and assumptions used to estimate ton per day NO_x reductions for this measure.

The current non-road emission inventories for the HGA and DFW nonattainment areas are based on EPA's NEVES study from 1991 (with the exception of construction, commercial marine, and airport GSE, which were recently revised using bottom-up survey data.). However, the NEVES study did not provide emissions estimates for attainment areas. Therefore, ERG relied upon EPA's draft Non-road model to generate NO_x inventories for non-road diesel engines operating in the 95-county area. Non-road has the ability to allocate statewide equipment population estimates to the county level.

The following Non-road equipment categories were evaluated for diesel engines in each county:

- Construction
- Agricultural
- Commercial
- Industrial
- Lawn and Garden
- Logging

The following categories were excluded from the non-road analysis because their aggregate NO_x emissions from diesel engines in the 95-county area were estimated by Non-road to be substantially less than 1 tpd: recreational marine, airport GSE, and recreational vehicles.

ERG's recent survey of construction equipment in the HGA area found a significant overestimation of equipment population estimates in the default Non-road files. Equipment populations were overestimated by a factor of 2 to 3, depending upon engine type. A similar overestimation was subsequently found for the DFW area. Similar overestimations of construction equipment population estimates for the 95 counties were also anticipated to occur using the non-road model. Therefore, ERG scaled the default statewide construction equipment population file downward to match the HGA survey totals when allocated back to the 8-county HGA area. ERG then used this adjusted statewide file to estimate a baseline emission inventory for diesel construction equipment in each of the 95 counties.

There is no bottom-up engine population survey available for many of the other equipment categories, such as agricultural and commercial. The level of uncertainty associated with Non-road's default population estimates for these categories is unknown. Since the Non-road population estimates were developed using the same database as was used for the construction sector, it is anticipated that default populations for these sectors are also overestimated. Therefore, ERG chose to estimate emissions inventories for these other categories using both the Non-road default populations as well as population files scaled downward in accordance with the HGA construction survey findings. For this later estimate, ERG used the ratio of total diesel construction equipment from the HGA survey and the default Non-road population estimates for the same area - 58%. In this way, ERG obtained a range for NO_x emissions in the 95-county area for these other equipment categories.

Table 6.3-4 summarizes the results of the non-road emissions inventory calculation for the 95-county area.

Table 6.3-4. 2007 Non-road NO_x Emission Inventory for 95-County Region

Equipment Category	NO_x Estimate, tpd*
Construction	51.4
Agricultural	43.1 – 74.2
Commercial	4.2 – 7.2
Industrial	8.9 – 15.4
Lawn and Garden	4.2 – 7.2
Logging	1.7 – 2.9
Total	**113.5 – 158.4**

* Low estimate based on 42% reduction from non-road default

Using a previous analysis, ERG estimated the NO_x reductions expected from adopting the California diesel fuel specifications in various Texas nonattainment areas. The specifications for Texas LED are essentially identical to the CARB specifications for the purposes of NO_x estimation. Therefore, ERG used the previous estimate of a 7% NO_x reduction to determine expected tpd benefits for the 95-county region. It was noted that advanced electronically-controlled engines are estimated to achieve a 5.7% reduction with Texas LED. However, given the small amount of electronically-controlled engines likely to be in the fleet in 2007, ERG did not differentiate the benefit estimate by model year, but simply applied the 7% reduction uniformly across the entire inventory.

It is important to note that these benefit estimates are independent of the fuel sulfur level. Sulfur level only has an impact on NO_x emissions when catalysts are in place. At this time, EPA and engine manufacturers do not believe that advanced NO_x catalysts will be required to meet the upcoming Tier 2 and Tier 3 emission standards for non-road engines. Therefore, fuel sulfur level was not considered in this modeling analysis. However, diesel fuel sulfur level could have a significant impact on aftermarket NO_x reduction systems, which are often fouled by exposure to higher sulfur levels.

As described in this section, modeling has indicated that by 2007, the state LED fuel program will reduce NO_x emissions from on-road vehicles and non-road equipment statewide by 30 tpd, of which 6.67 tpd of reductions will be achieved in the HGA ozone nonattainment area. These reductions are necessary for the HGA area to demonstrate attainment with the ozone NAAQS within the time frame prescribed by the EPA.

<u>Distribution</u>

A statewide LED fuel requirement facilitates distribution. The statewide coverage area for on-road use will create a large enough market to ease the costs of distribution. Supplies can be co-mingled in the pipeline, trading can take place, and tracking compliance will be simplified. Since the DFW and HGA ozone nonattainment areas already distribute a federal RFG, and the state's low-RVP Gasoline is already distributed to the 95 East and Central Texas county regional area, diesel producers and importers will be able to use the current distribution system to distribute state LED fuel to the affected areas beginning in 2006 when the sulfur in LED is limited to 15 ppm for the HGA, BPA, and DFW ozone nonattainment areas and 95 East and Central Texas counties.

A statewide LED fuel requirement also reduces non-compliant fuel usage within the nonattainment areas from out-of-area refueling by pass-through truck traffic. According to data shown on a 1997 truck traffic flow map published by TxDOT, over 10,000 trucks per day traverse the HGA nonattainment area. In addition, according to a Texas Department of Transportation report, “Effect of the North American Free

Trade Agreement on the Texas Highway System, December 1998," the volume of truck traffic through the HGA nonattainment area directly associated with NAFTA commerce ranges between 1001 and 2500 trucks per day. Therefore, statewide coverage for on-road use of LED will ensure that higher volumes of pass-through truck traffic will be refueling with LED within the state and will be using this fuel when traveling within the state's nonattainment areas.

Transport

Air pollution knows no boundaries. Federal and state studies have shown that pollution from one area can affect ozone levels in another area. Regional air pollution should be considered when studying air quality in Texas' ozone nonattainment areas. This work is supported by the findings of the OTAG study, which is the most comprehensive attempt ever undertaken to understand and quantify the transport of ozone. Both the commission and the OTAG study results point to the need to take a regional approach to control air pollutants, such as that prescribed in the state LED fuel program.

The regional implementation of LED fuel will result in reductions of NO_x emissions in the surrounding counties and help reduce the amount of NO_x being transported into the HGA, BPA, and DFW ozone nonattainment areas. As modeling has shown that HGA ozone and ozone precursor transport has the potential to impact areas as far away as DFW, the benefits from reduced HGA peak ozone concentrations have the potential to positively impact other nonattainment and near-nonattainment areas.

In addition to the current 1-hour ozone nonattainment counties, Texas also has several areas that are facing potential nonattainment status under the new 8-hour ozone standard. These areas will benefit not only from reduced ozone and ozone precursor transport, but also from the immediate reduction of NO_x emissions in their local area from the use of LED fuel.

Length of Time Needed to Achieve Benefits

The most important aspect of using the state LED fuel program is that the benefits are seen immediately. Once the state LED fuel program begins, emission reductions begin for both old and new vehicles, as well as from non-road engines that use the fuel. The statewide coverage area required by the state LED fuel program ensures NO_x emission reductions significant enough to have an immediate impact on the air quality in the HGA ozone nonattainment area.

EMISSION REDUCTIONS NEEDED FOR ATTAINMENT OF THE NAAQS

The HGA ozone nonattainment area will need to ultimately reduce NO_x by more than 750 tpd to reach attainment with the 1-hour ozone NAAQS. In addition, a VOC reduction of about 25% will have to be achieved. The state LED fuel program will contribute to attainment and maintenance of the 1-hour ozone NAAQS in the HGA area. The state LED fuel program also may contribute to a successful demonstration of transportation conformity in the HGA area. Assessment of emissions inventory data has also shown that over 20% of the NO_x emissions in the HGA area come from mobile sources. As such, the control strategy package for the HGA ozone nonattainment area needs to include strategies that have an immediate impact on mobile sources. The state LED fuel program will have an immediate impact. In order for HGA to demonstrate attainment in 2007, monitored ozone concentrations in the HGA area must show compliance with the ozone NAAQS for the three-year period 2005–2007. By 2007, the state LED fuel program will reduce NO_x emissions from on-road vehicles and non-road equipment statewide by 30 tpd, of which 6.67 tpd of reductions will be achieved in the HGA ozone nonattainment area.

EVALUATION OF OTHER CONTROL MEASURES

The commission has analyzed other control measures for reasonableness and practicability of implementation to meet the attainment deadline. This included evaluating on-road mobile sources, non-road mobile sources, area, and point sources. A complete listing of these control strategy measures is provided in Section 6.1. A listing of 202 potential control strategy measures, identifying why certain measures were considered unreasonable or impracticable, is provided in Appendix L.

The commission determined that all but 17 of the 202 control measures evaluated were either already done in Texas or were unreasonable or impracticable to demonstrate attainment by the 2007 deadline. The state LED fuel program was among the 17 control measures determined by the commission to be reasonable, practicable, and capable of being implemented in time to demonstrate attainment. A complete listing of the control measures determined by the commission to be essential to demonstrate attainment by the 2007 deadline is provided in Table 6.1-2.

CONCLUSIONS
By 2007, the state LED fuel program will reduce NO_x emissions from on-road vehicles and non-road equipment statewide by 30 tpd, of which 6.67 tpd of reductions will be achieved in the HGA ozone nonattainment area, and is a vital component of the overall NO_x emissions reduction strategy for the HGA ozone nonattainment area. Modeling has shown that without the emission reductions achieved by the state LED fuel program, it will not be possible for the HGA ozone nonattainment area to demonstrate attainment with the NAAQS within the time frame prescribed by EPA. Therefore, the commission finds that the state LED fuel program is essential to the timely attainment of the 1-hour ozone NAAQS in the HGA ozone nonattainment area.

6.3.6 Low Sulfur Gasoline

The commission has withdrawn the proposal to adopt a regional low sulfur gasoline. This decision was based on comments received and the federal implementation of a low sulfur gasoline in 2004. Issues addressed in the comments included the excessive costs associated with producing the low sulfur gasoline as compared to the small estimated emission reductions benefit, the difficulties associated with producing a boutique fuel, anticipated distribution problems, and the short engineering and construction time lines that conflict with the producers on-going efforts to comply with federal low sulfur gasoline requirements.

6.3.7 Small, Spark-Ignition Engine Operating Restrictions

These revisions implement an operating-use restriction program requiring that handheld and non-handheld spark-ignition equipment, rated at 25 hp and below, be restricted from use by commercial operators between the hours of 6:00 a.m. through 12:00 p.m., April 1 through October 31 of each year. Commercial operators are exempted from the rule in the case of certain emergencies, or if they can develop a plan to lower emissions which receives the approval of the commission and the EPA. The affected handheld equipment includes, but is not limited to, trimmers, edgers, chainsaws, leaf blowers/vacuums, and shredders. Non-handheld equipment includes such devices as walk-behind lawnmowers, lawn tractors, tillers, and small generators. The affected area includes Harris, Fort Bend, Brazoria, Montgomery, and Galveston Counties. The effective date is April 1, 2005. The commission staff estimates that implementation of this rule results in a shift in NO_x emissions of 0.23 tpd. Because of accompanying VOC reductions resulting from this rule, the modeled ozone concentration is projected to improve by 1.1 ppb, which has the impact of reducing NO_x by 4.6 tpd.

6.3.8 Voluntary Mobile Emissions Reduction Program

The FCAA Amendments of 1990 increased the responsibility of states to demonstrate progress toward attainment of the NAAQS. Voluntary mobile source measures have the potential to contribute, in a cost effective manner, emission reductions needed for progress toward attainment and maintenance of the NAAQS.

Historically, mobile source control strategies have focused on reducing emissions per mile through vehicle and fuel technology improvements. Tremendous strides have been made resulting in new light-duty vehicle emission rates that are 70-90% less than for the 1970 model year. However, transportation emissions continue to be a significant cause of air pollution due to increases in VMT.

With the increasing cost of technological improvements to produce incrementally smaller reductions in grams per mile emissions in the entire fleet of vehicles, and the time it takes for technological improvements to penetrate the existing fleets, it becomes clear that supplemental or alternative approaches for reducing mobile source air pollution are necessary. Mobile source strategies that attempt to complement existing regulatory programs through voluntary, nonregulatory changes in local transportation sector activity levels or changes in in-use vehicle and engine fleet composition are being explored and developed.

A number of such voluntary mobile source and transportation programs have already been initiated at the state and local level in response to increasing interest by the public and business sectors in creating alternatives to traditional emission reduction strategies. Some examples include emission reduction programs implemented on a demonstration basis to test new technologies, and policies requiring the purchase of clean vehicles and equipment. These programs attempt to gain additional emissions reductions beyond mandatory Clean Air Act programs by engaging the public to make changes in activities that will result in reducing mobile source emissions.

Current EPA regulations have set a limit on the amount of emission reductions allowed for VMEPs in a SIP. The limit is set at 3% of the total future year emissions reductions required to attain the appropriate NAAQS. Specifically in the Houston-Galveston nonattainment area, the TNRCC estimates that 3% of the region's projected emissions are to be 23 tpd. HGAC has committed to reducing 23 tpd through its VMEP initiative.

Programs and control strategies under VMEP, many of which fall within the purview of existing air quality programs, that may contribute to this 23 tpd target include the following: commute solution initiatives; a scrappage program; a smoking vehicle program; pricing measures; and various other on and non-road mobile source emission reduction initiatives.

HGAC's air quality programming demonstrates a commitment to integrating environmental concerns into its organizational culture. HGAC's programs advance air quality issues, innovative technologies and policy-making towards creative solutions for the region's air quality problems. HGAC seeks to implement voluntary measures which present a common sense approach. The voluntary emission reduction measures will be administered through existing HGAC programs.

Programs and control strategies, many of which fall within the purview of existing air quality programs, that will contribute to this 23 tpd target are summarized in Table 6.3-5.

Table 6.3-5 Summary of VMEP Measures Identified for the HGA SIP

VMEP Measure Name	**NOx Emissions Reductions (8-County tpd)**
On-road	
1. Scrappage Program	0.39
2. Smoking Vehicle Program	0.04
3. Public Fleet Measures (Clean Cities)	1.02
4. Highway Demonstration Projects	0.84
5. Private Fleet Measures (Clean Air Action)	0.0 - 3.21
Subtotal	**2.29 - 5.50**
Non-road	
6. Non-road Demonstration Projects	0.5 - 2.5
7. Other Locomotive Controls	2.0
8. Marine Measure	4.8
Subtotal	**7.30 - 9.3**
Planning	
9. Commute Solutions	1.8
10. TRANSTAR Expansion	0.0
11. Clean Air Action/Cool Cities/Other Planning	0.03
12. Signal Light timing (RCTSS)	0.0 - 0.5
13. Smart Growth	0.3
Subtotal	**2.13 - 2.63**
Other	
14. Local/County Emissions Reduction Plan	1.5
15. AERCO Pilot Project	6.0
Subtotal	**7.5**
TOTAL	***23 tpd***

The programs listed above can achieve as much as 24.93 tpd NO_x. H-GAC will make a best faith effort to achieve 23 tpd NO_x. Details of the HGA area's VMEP initiatives are described in Appendix K.

6.3.9 Accelerated Purchase of Tier 2/Tier 3 Diesel Equipment

This strategy affects state and local governments, businesses, and private entities in the HGA area that own or operate non-road equipment powered by compression-ignition engines rated 50 hp and above.

The rules require the owners or operators to meet the following requirements: for the portion of the fleet with equipment powered by non-road engines in the range from 50 hp to 100 hp, the owner or operator must ensure that 100% of such equipment will meet Tier 2 standards by the end of the calendar year 2007. For the portion of the fleet in the 100 hp to 750 hp range, the owner or operator must ensure that at least 50% of such equipment meets Tier 3 standards, and that the remaining equipment meets Tier 2 standards. Finally, for the portion of the fleet greater than 750 hp, the owner or operator must ensure that 100% of such equipment meets Tier 2 standards by the end of calendar year 2007. The rules exempt non-road engines used in locomotives, underground mining equipment, marine applications, aircraft, airport ground support equipment, equipment used solely for agricultural and/or logging purposes, emergency equipment, and freezing weather equipment. This rule results in a 12.20 tpd reduction in NO_x.

Owners or operators can be exempted from this rule if they submit an emission reduction plan by May 31, 2002, that the commission approves by May 31, 2003. The plan must describe in detail how the owner or operator will reduce NO_x emissions by June 1, 2005 by an amount equivalent to the total reductions achieved by implementation of this rule. Owners or operators may submit plans to apply for exemption from either the Accelerated Purchase of Non-road Heavy-duty Diesel Equipment rule or the Construction Equipment Operating Restrictions rule, or from both rules. The plans must contain emission reductions equivalent to the total NO_x reductions achieved by the rule or rules from which they are applying for exemption. Preliminary estimates indicate that implementation of both this rule and the Construction Equipment Operating Restrictions rule will result in a NO_x reduction of approximately 18.90 tpd.

Construction Industry Reduction Goal

The construction industries in the HGA contribute to the overall air quality challenges faced by the HGA area. They also will contribute, in substantial part, to the solution. It is possible to determine how much emissions come from non-road diesel construction equipment and then apply the emission reduction goals of the various programs to this inventory to arrive at an estimated overall goal for non-road diesel powered construction equipment in the 8-county HGA area. The commission has estimated this number to be 18.77 tons of NO_x per day. A photochemical model run was used to estimate the equivalent NO_x reductions achieved by a shift in the construction work day. This was determined to be equivalent to removing 6.7 tpd of NO_x from the inventory. The accelerated purchase of Tier 2/Tier 3 equipment as applied to the construction inventory was determined to be 10.62 tpd of NO_x. LED fuel again applied to just non-road construction equipment was estimated at 1.45 tpd NO_x. Adding these measures together arrives at the 18.77 tpd estimated above.

Port Estimated Emission Reductions

There are a number of sea ports located in the HGA area. These ports contribute to the economy of the HGA area. They also contribute, in some part, to the air quality challenges the HGA area faces and will play a significant role in the air quality improvement plan. There are several measures, all of which may be quantified, which apply to the port industries. These measures can be added together to arrive at an emissions reduction target for the HGA area port industries. The port industries contribute 7% of the overall industrial and construction non-road emissions in the HGA area. This fraction of the emissions inventory can be used to calculate the reduction amount from each proposed measure for which the port is responsible. The measures that apply to the port are: the construction equipment operating restriction, accelerated purchase of Tier 2/ Tier 3 diesel equipment, diesel emulsions, and low emission diesel fuel. Applying the emission reductions to the percentage of contribution of the port, the total number of reductions which are estimated to be the port's responsibility is 1.41 tpd of NO_x. See the following methodology:

HGA Ports Estimated Emissions Contributions	
Port Equipment Inventory	2.7 (based on TNRCC Non-road run and Port inventory data)
Total industrial Diesel Inventory	6.65
Total construction Diesel Inventory	31.60
Total industrial + construction inventory	38.25
Port Fraction	0.07

HGA Ports Estimated Emission Reduction Goal from Non-road Cargo Handling Equipment		
	Updated NO_x Reduction (tpd)	Proportional Maritime Share NO_x
Construction Equipment Operating Restriction	6.7	0.47
Accelerated Purchase of Tier 2/Tier 3 Equipment	11.48	0.81
LED Fuel	1.85	0.13
Total		**1.41**

6.3.10 Residential and Commercial Air Conditioners

The commission evaluated the comments received on this proposal. Comments received were both in support of and in opposition to this proposal. Comments supporting the proposal were generally regarding support of any additional controls that will improve air quality in the Houston area. Comments opposing the proposal related to reliance on an unproven and untested product, a lack of efficiency, high costs, and other legal and toxicity issues.

The commission's decision to withdraw this proposal is based on the decision to add this control measure to the HGA Post-1999 ROP/Attainment Demonstration SIP as a future commitment, in order to promote further study on this measure.

6.3.11 NO_x Reduction Systems

The commission evaluated the comments received on the proposal to implement a NO_x reduction systems program in the HGA area requiring owners or operators of both on-road and non-road vehicles or equipment manufactured prior to model year 1997 having a heavy-duty engine and fueled by gasoline, diesel, diesel emulsion fuel, or any alternate fuel to use exhaust systems that will achieve an 80% reduction in NO_x emissions. The commission received comments both in support of and in opposition to the proposal. Comments supporting the proposal generally supported additional controls to address air quality concerns. The proposed NO_x reduction systems rules met with strong objection from railroad, trucking, and marine operators.

The commission's decision to withdraw this proposal is based on the decision to add this control measure to the HGA Post-1999 ROP/Attainment Demonstration SIP as a future commitment in order to promote further study of this measure.

6.3.12 Speed Limit Reduction

Substantial emissions reductions can be achieved by implementing 55 mph maximum speed limits on all roadways with current posted speeds above 55 mph in the 8-county HGA area. These reduced speed limits will be implemented by May 1, 2002. This measure will reduce emissions in the 8-county area by 12.33 tpd NO_x and 1.76 tpd VOC in 2007.

A detailed analysis of the speed limit reduction impacts for the 8-county HGA area was performed by TTI. This analysis used an 8-county HGA VMT figure of 129,362,378, as opposed to the 139,467,784 VMT figure used in the previous analysis for the proposal. In order to ascertain the pollution reduction benefits from the 55 mph speed limit measure, TTI developed on-road mobile source inventories for scenarios based on both the current speed limits and the 55 mph speed limit. By taking the difference in NOx and VOC emissions between these two scenarios, the 55 mph speed limit reduction benefits were obtained. The following table summarizes the benefits, by county, for NO_x and VOC:

Table 6.3-6 VOC and NO_x Benefits from 55 mph Speed Limit

County	55 mph Speed Limit Benefits (tpd)	
	NO_x	VOC
Harris	8.06	1.16
Montgomery	1.44	0.18
Fort Bend	0.81	0.11
Brazoria	0.64	0.08
Galveston	0.53	0.07
Chambers	0.51	0.08
Liberty	0.41	0.07
Waller	0.28	0.05
8-county Total	12.68	1.80

Speed limit signs will have to be changed in order to implement this measure. TxDOT estimates costs of $300.00 for small sign replacement and $600.00 for large sign replacement. In addition to emission reductions, other benefits may be realized from the speed limit reduction such as fuel savings and a reduction in the severity of traffic accidents.

TxDOT adopted revisions to the Texas Transportation Code on May 25, 2000 which established procedures allowing speed limits to be changed for emissions reduction purposes. TNRCC will coordinate with TxDOT to define the roadway specific speed limits, which will be implemented according to the procedures established in the Texas Transportation Code. The commission will work with other state and local agencies to ensure adequate enforcement of this measure.

6.3.13 Diesel Emulsion

The commission evaluated the comments received on the proposal to implement a diesel emulsion fuel program in the HGA area requiring the use of a low-emission diesel fuel formulation, diesel emulsion, for both on-road and non-road vehicles. The commission received comments both in support of and in opposition to the proposal. Comments supporting the proposal generally supported additional controls to address air quality concerns. The proposed diesel emulsion rules met with strong objection from railroad, trucking, and marine operators.

The commission's decision to withdraw this proposal is based on the decision to add this control measure to the HGA Post-1999 ROP/Attainment Demonstration SIP as a future commitment, in order to promote further study of this measure.

6.3.14 Airport Ground Support Equipment

The commission has withdrawn the airport ground support equipment proposal. The commission approved an Agreed Order with Continental Airlines on October 18, 2000; an Agreed Order with Southwest Airlines on December 6, 2000; and a Memorandum of Agreement with the City of Houston on October 18, 2000. These agreed orders and MOA (found in Appendix R) make federally enforceable certain local ozone precursor emission reductions of NO_x from sources at George Bush Intercontinental Airport, William Hobby Airport, and the Houston Airport System. The sum of these agreed NO_x emission reductions are equivalent to the NO_x reductions proposed in the rulemaking package being withdrawn (5.09 tpd), therefore, the NO_x reductions claimed in the HGA Post-1999 ROP/Attainment Demonstration SIP as a result of this rulemaking will be achieved through an alternate but equivalent federally enforceable mechanism.

6.3.15 California Spark-Ignition Engines

This rule implements the control requirements for non-road, large spark-ignition engines statewide. The rule is necessary to attain the ozone NAAQS, and to establish a single standard for the state. A single statewide standard would help to prevent the incompatibility and expense that may arise from the distribution of equipment with different emission standards. These amendments are adopted in order to control ground-level ozone in the state by requiring model year 2004 and subsequent non-road, large spark-ignition (LSI) engines 25 hp and larger to be certified under Title 13, California Code of Regulations, Chapter 9, concerning Off-Road Vehicles and Engines Pollution Control Devices. The rule incorporates the California non-road, LSI engine rules by reference. For the HGA area, emission reductions will be approximately 2.80 tpd. The program is estimated to cost about $500 per ton of NO_x reduced.

6.3.16 Vehicle Idling Restrictions

This strategy implements motor vehicle engine idling restrictions in the HGA ozone nonattainment area that, beginning April 1, 2001, limit the engine idling time of motor vehicles with a gross vehicle weight rating of greater than 14,000 pounds to five consecutive minutes while the vehicle is operating in the affected area.

The idling restrictions lower NO_x emissions from both gasoline-powered and diesel-powered motor vehicles in the affected areas. Because NO_x emissions are precursors to ground-level ozone formation, reduced emissions of NO_x will result in ground-level ozone reductions. By 2007, the idling restrictions will reduce

NO_x emissions in the affected areas by 0.48 tpd. In addition, the idling restrictions will also reduce VOC (by 0.19 tpd) and PM emissions from motor vehicles with a gross vehicle weight rating of greater than 14,000 pounds.

These rules provide exemptions for motor vehicles with a gross vehicle weight rating of 14,000 pounds or less; that are forced to remain motionless because of traffic conditions over which the operator has no control; are being used as an emergency or law enforcement vehicle; when the engine is being operated to provide power necessary for a mechanical operation other than propulsion, passenger compartment heating or air conditioning; when the engine is being operated for maintenance or diagnostic purposes; or when the engine is being operated solely to defrost a windshield.

6.3.17 Gas-fired Water Heaters, Small Boilers, And Process Heaters

This statewide rule, which was adopted April 19, 2000, reduces NO_x emissions from new natural gas-fired water heaters, small boilers, and process heaters sold and installed in Texas beginning in 2002. The rule applies to each new water heater, boiler, or process heater with a maximum rated capacity of up to 2.0 MMBtu/hr. The rule is based upon those of California's Bay Area Air Quality Management District Regulation 9, Rule 6 and SCAQMD Rules 1121 and 1146.1. The estimated reductions in HGA resulting from this rule are 0.5 tpd NO_x.

6.3.18 Transportation Control Measures

TCMs are transportation projects and related activities that are designed to achieve on-road mobile source emission reductions and are included as control measures in the SIP. Allowable types of TCMs are listed in §7408 (Air Quality Criteria and Control Techniques) of the FCAA, 42 USC, 1970, as amended, and defined in the federal transportation conformity rule found in Title 40 CFR (40 CFR), Part 93 (Determining Conformity of Federal Actions to State or Federal Implementation Plans). In general, a TCM is a transportation-related project that attempts to reduce vehicle use, change traffic flow, or reduce congestion conditions. A project that adds single-occupancy vehicle roadway capacity or is based on improvements in vehicle technology or fuels is not eligible as a TCM.

The HGAC has identified numerous TCMs that have been, or will be, implemented in the 8-county HGA area. By 2007, these TCMs will reduce NO_x emissions in the nonattainment area by at least 0.80 tpd and VOC emissions by at least 1.92 tpd. One additional potential TCM, the Downtown to Astrodome light rail project, would reduce 2007 emissions by 0.26 tpd NO_x and 0.20 tpd VOC, resulting in total 2007 TCM emissions reductions of 1.06 tpd NO_x and 2.13 tpd VOC. All TCM emission reductions were calculated using EPA's MOBILE5a model 2007 emission factors. Specific calculation methodologies for the different types of TCMs are documented in Appendix I. Table 6.3-6 summarizes total 2007 emissions reductions by type of TCM. Appendix I contains a project specific list of the TCMs, including TCM location, project limits, implementation date, and emission reductions.

Table 6.3-7 Total 2007 Emission Reductions by Type of TCM

TCM Type	July 2007 NO_x Benefits (lbs/day)	July 2007 VOC Benefits (lbs/day)
Computerized Traffic Mgmt. System (CTMS)	685.96	2331.73
Arterial Traffic Mgmt. System (ATMS)	21.33	90.49
Bicycle/Pedestrian Projects	23.18	14.15
Intersection Improvements	13.52	49.07
High Capacity Transitway Project	448.80	1215.00
Park and Ride Lots	282.81	129.87
Port Projects	124.79	26.73
Subtotal: (lbs/day) **(tons/day)**	**1600.39** **0.80**	**3857.04** **1.93**
Additional TCM Downtown to Astrodome Light Rail Project: (lbs/day) (tons/day)	 520.60 0.26	 406.90 .20
Total: (lbs/day) **(tons/day)**	**2120.99** **1.06**	**4263.94** **2.13**

Many TCMs that have already been implemented in accordance with HGA 1996 and 1999 SIP commitments will still reduce VOC and NO_x emissions in 2007. Emission benefits of these projects have been included in this SIP.

The HGA region is also adding one new TCM commitment, the Downtown to Astrodome light rail project, in this SIP. The rail project is currently in preliminary engineering, and the current schedule calls for revenue service to begin in 2004. METRO's estimated capital cost for the rail project is $300 million. Emissions evaluations of this project are included in Appendix I.

In addition to emission reduction benefits, the TCMs will also reduce congestion, which will produce time savings for drivers in the HGA nonattainment area. Many TCMs, such as rail projects and bicycle/pedestrian facilities, will also encourage mixed use and sustainable development, which may reduce urban sprawl in the area.

The TCMs, including the Downtown to Astrodome light rail project, have been included in the HGAC long-range transportation plan and/or TIP, which constitutes evidence that the TCMs were properly adopted and have funding and appropriate approval. Inclusion of the TCMs in the HGAC transportation plan and TIP also constitutes evidence of a specific schedule to plan, implement and enforce the measures. The HGAC is required by 30 TAC §114.260 to submit an annual TCM status report to the commission. The report must include the TCM's implementation date and emissions reduction status. The status report and supporting activities serve as the TCM monitoring program.

Enforcement and implementation of TCMs is also addressed in the Texas transportation conformity rule (30 TAC §114.260) and the Federal transportation conformity rule (40 CFR §93.113), which indicate that the HGAC is responsible for ensuring that TCMs are implemented on schedule. According to 30 TAC §114.260 and 40 CFR §93.113, failure to implement TCMs according to schedule can be grounds for the denial of an area's transportation conformity determination. Additional TCMs may be necessary as the budget is revised during the mid-course review process.

6.3.19 Energy Efficiencies

Minimum standards of energy efficiency for many major appliances were established by the U.S. Congress in the National Appliance Energy Conservation Act of 1987 which amended the earlier Energy Policy Act of 1975. Its key element was the setting of initial federal energy conservation standards for consumer products.

Next came the creation of the National Appliance Energy Conservation Amendments of 1988 and the Energy Policy Act of 1992 which amended the National Appliance Energy Conservation Act of 1987. The Energy Policy Act of 1992 expanded coverage of commercial equipment and provided for voluntary testing and consumer information programs. The residential appliance and commercial equipment area carries out activities that are considered necessary to successfully complete legislative requirements contained in the statutes.

Appliance manufacturers must produce products that either meet the minimum level of energy efficiency, or consume no more than the amount of energy that the legal standard for each type of appliance allows. These rules do not affect the marketing of products manufactured before the standards went into effect, and any products that were already manufactured and in stock can be sold. These new standards are and have been intended to create energy savings as well as reduce fossil fuel usage and air pollution emissions.

DOE is responsible for developing the test procedures for the Appliance Standards Program which are published in the CFR (10 CFR Chapter II, Part 430). DOE periodically issues new standards for certain appliances which are published in the *Federal Register*. Any amended or new standard must achieve the maximum improvement in energy efficiency that is determined by the Department of Energy to be technologically feasible and economically justified.

Table 6.3-8 NO_x Reduction Benefits from Appliance Energy Efficiency Upgrades

Houston/Galveston/Brazoria NO_x emission rate 0.26 lbs/MWH Reliant HG8 average after 90% controls			
	NO_x Reduction		
Appliance	Replace.	New Growth	Total
	NO_x Reductions tpd		
Refrigerators	1.18	0.34	1.52
Clothes Washers	0.23	0.07	0.30
Lighting			0.39
Dishwashers	0.09	0.03	0.12
Room Air Conditioners	0.28	0.06	0.34
Central Air Conditioning	0.75	0.16	0.90
Total	**2.53**	**0.65**	**3.57**

6.3.20 Equivalent NO_x Reduced as a Result of VOC Reductions

EPA indicated that they would be willing to consider quantifying VOC measures as part of the reductions necessary to demonstrate attainment in the HGA area. Therefore, the commission developed the following ratios from the modeling in order to determine what the equivalent NO_x reductions would be.

For on-road mobile sources, a 50 tpd VOC reduction yields a reduction in the gap of 4.7 tpd NO_x. Thus, for on-road mobile the ratio is 50/4.7 = 10.6 or about 10 to 1. For low-level point sources and area/non-road sources, a 50 tpd VOC reduction reduces the gap by 3.8 tpd NO_x, so the ratio for these sources is 50/3.8 = 13.2 or about 13 to 1.

The VOC reductions from the on-road gap measures (see Table 6.1-2) equal 4.08 tpd. The VOC reductions from non-road measures equal 9.44 tpd for a total of 13.52 tpd. Using the 10 to 1 ratio, the NO_x equivalents are .41 for on-road sources (4.08/10) and .73 for non-road (9.44/13) for a total of 1.14 tpd.

CHAPTER 7: FUTURE ATTAINMENT PLANS

The development of the attainment demonstration SIP for the HGA area has proved to be an extremely challenging effort, due to the large magnitude of reductions needed for attainment and the shortage of readily available control options. Several leading-edge, innovative control technologies are now approaching an advanced state of development due to the role played by Texas stakeholders and others in aggressively pursuing new ozone control technologies. As promising as these new technologies may be, however, they alone are not yet adequate to bring the HGA area into attainment. Ideally, this attainment demonstration would rely upon technical solutions that provided the cleanest possible automobiles and trucks, ships, locomotives, aircraft, construction equipment, etc., within a few years' time. Unfortunately, the current state of technology, coupled with the inevitable lag time to achieve significant equipment turnover, prevents a purely technical solution from being a reality by 2007, the attainment year. For this reason, the commission must implement measures that rely on behavioral changes, in addition to technological controls.

In order to ensure that the HGA area is in attainment by 2007 and that the controls to get there are the most cost effective technology-based solutions possible, the commission has committed to performing a mid course review. The mid-course review process has already begun and will continue, ultimately resulting in a SIP revision by May 1, 2004. There are planned opportunities throughout the process, as described in the following pages, to incorporate the latest information and make decisions. This effort will involve a thorough evaluation of all modeling, inventory data, and other tools and assumptions used to develop the attainment demonstration. It will also include the ongoing assessment of new technologies and innovative ideas to incorporate into the plan. Furthermore, the commission asserts that the science today supports that the reductions embodied in this plan to occur by 2005 are a necessary step towards attaining the standard. Beyond that, the commission believes it must perform the full mid-course review analysis to determine the extent to which additional reductions must occur. The commission commits to adopting any additional measures necessary to achieve these reductions no later than May 2004.

This chapter includes a detailed overview of the entire mid-course review process. It begins with an analysis of all reasonably available control measures for both VOC and NO_x. It then discusses what we expect are potential actions over the next ten months. Next, the anticipated results from the Texas 2000 study as well as other improvements and enhancements to the science that we expect are described, including the schedule to incorporate them during two phases: one ending in 2002, and the other by mid-2004. Finally there is a discussion of the technologies which have been developed and are undergoing testing to quantify their reduction potential followed by a discussion of new and innovative ideas that are contemplated.

As discussed in Chapter 6, the current modeling results in a 141 ppb peak ozone level. This correlates to a gap calculation of 91 tpd NO_x equivalent. The control measures adopted result in a NO_x reduction of 39 tpd, which leaves a 52 tpd shortfall to be addressed during the mid-course review process outlined here. As shown in Table 7.1-1 the commission has identified 123 tpd of potential NO_x reductions from new technologies and programs which the commission commits to evaluating and adopting as they become more certain and available.

Table 7.1-1 Potential NO_x Reductions to Fill the Shortfall

NO_x Gap	91 tpd
Gap Measures	- 39 tpd
Gap Shortfall	= 52 tpd
Innovative Technology Measures	68 tpd
Innovative Ideas	+ 55 tpd
Total tons identified through innovative programs	**123**

The commission believes that this plan in its totality, including the adopted measures identified in Chapter 6 plus the process described in this chapter, will achieve the 1-hour ozone standard in the HGA area by 2007.

7.1 ENFORCEABLE COMMITMENTS

Because of the magnitude of reductions required for attainment, and the extremely challenging process of identifying, quantifying, and implementing the control strategies, the commission believes that additional enforceable commitments are necessary to achieve the full extent of reductions to demonstrate attainment. EPA has approved the use of enforceable commitments as a mechanism for identifying potential control strategies and associated anticipated reductions under limited circumstances with certain restrictions.

In its review of the 1994 SCAQMD attainment demonstration SIP (62 FR 1155-57, 117-82), EPA stated:

> "The CAA requires that SIPs include enforceable control measures sufficient to meet rate-of-progress milestones and provide the reductions needed for attainment by the applicable CAA deadline. Where it is infeasible for a state to accomplish the necessary regulatory adoption in the short term, we have recognized that this requirement can be satisfied, to some extent, by enforceable commitments to adopt regulations in the future, since these commitments can be enforced in court by EPA or citizens.
>
> In view of the magnitude of reductions required in the South Coast and the fact that SCAQMD and CARB have already adopted in regulatory form more stringent measures than are included in most other SIPs, we approved the 1994 Ozone SIP despite its heavy reliance on commitments to adopt regulations."

While we are not relying heavily on these commitments, EPA has stated its support for enforceable commitments in the December 16, 1999 proposed conditional approval and disapproval of the attainment demonstration SIP for the HGA ozone nonattainment area. "EPA has recognized that in some limited circumstances, it may be appropriate to issue a full approval for a submission that consists, in part, of an enforceable commitment. Unlike the commitment for conditional approval, such an enforceable commitment can be enforced in court by EPA or citizens. In addition, this type of commitment may extend beyond one year following EPA's approval action. Thus, EPA may accept such an enforceable commitment where it is infeasible for the state to accomplish the necessary action in the short term." 64 FR 70548, 70550 (1999).

The commission began to pursue its enforceable commitment options by doing the following: 1) conducting a VOC analysis to determine if there were additional VOC controls that could be put in place to achieve an equivalent of the necessary NO_x reductions; 2) conducting a NO_x analysis to determine if there were additional NO_x controls that the commission had not already considered; and 3) evaluating those strategies that could be developed through rulemaking within the next six months, such as measures already being considered in other states. The following sections outline the commission's analysis of these areas.

7.1.1 VOC Point and Area Source Analysis

EPA's comment letter indicated that they would be willing to consider quantifying additional VOC measures as part of the reductions necessary to demonstrate attainment in the HGA area. Therefore the commission conducted additional technical analysis to determine what the VOC to NO_x ratio would be in order to evaluate the feasibility of pursuing additional VOC regulations.

Calculation of Model Response to VOC Reductions

While the control strategy described in the current SIP revision is primarily NO_x-based, previously-conducted sensitivity analyses have shown that peak ozone also responds to reductions of emissions of VOC. Some rules designed to reduce NO_x emissions also reduce VOC emissions, but some such rules may increase VOC emissions. Thus VOC changes need to be accounted for when evaluating NO_x reduction strategies. Additionally, rules which reduce VOC emissions alone may be used to supplement or replace NO_x rules in some cases. When the rules are modeled directly, the VOC reductions are accounted for and the response of the model to these rules is reflected in the model output. In cases where the VOC rules are not modeled, such as gap measures, it is useful to determine *a priori* what response would be expected from a given level of VOC emission reduction.

To test the model's response to reductions of VOC, a series of three sensitivity analyses were conducted. These analyses were designed as variations of the revised control strategy reported in Section 3.8 of the SIP revision.[9] The three sensitivity analyses were developed by removing 50 tpd of VOC emissions from, respectively, low-level point, area/non-road mobile, and on-road mobile sources. The change in peak ozone from the control strategy with no additional VOC reductions then provides a measure of the model's response to VOC reductions in a controlled, future case. Table 7.1-2 shows peak modeled ozone on each of the four primary episode days for the control case and the three sensitivities.

[9]After these analyses were completed, the modeled control strategy was modified so that the control strategy reported here differs slightly from that reported in Section 3.8. Specifically, the control strategy reported here reduced non-EGF point sources by 90% instead of the 88% reported in Section 3.8. Also, here the 23 tons/day of VMEP reductions were distributed as 2/3 on-road and 1/3 non-road instead of using the revised distribution described in Section 3.8. Because these changes were very minor, the analyses described here were not re-run with the final revised control strategy.

Table 7.1-2 Peak Modeled Ozone for Future Control Case[1] and Three VOC Reduction Scenarios

Case	Peak Modeled Ozone (parts/billion)			
	Sept. 8th	Sept. 9th	Sept 10th	Sept. 11th
Future Control Case[1]	140.4	128.3	134.3	129.8
Future Control Case[1] minus 50 tpd on-road mobile source VOC	139.9	127.9	133.1	129.3
Future Control Case[1] minus 50 tpd area/non-road mobile source VOC	140.0	127.9	133.6	129.3
Future Control Case[1] minus 50 tpd low-level point source VOC	140.0	128.0	134.1	128.8

In Table 7.1-2 it is seen that on the 8th, 9th, and 10th, on-road mobile source VOC reductions are the most effective in reducing peak ozone (on the 9th, on-road reductions tied with area/non-road reductions), while on the 11th, the low-level point source VOC reductions proved to be the most effective (probably because the 11th was a Saturday with overall less traffic). Area/non-road reductions tend to lie between on-road and point source reductions in effectiveness.

Table 7.1-3 shows the calculated gap (in tpd of NO_x) for each of the above model runs, using the relation derived in Section 3.8.

Table 7.1-3: Calculated Shortfall for Future Control Case[9] and Three VOC Reduction Scenarios

Case	Shortfall (gap) in tons/day of NO_x			
	Sept.8th	Sept. 9th	Sept 10th	Sept. 11th
Future Control Case[9]	88.8	38.3	88.5	53.3
Future Control Case[9] minus 50 tpd on-road mobile source VOC	84.1	34.1	73.7	47.8
Future Control Case[9] minus 50 tpd area/non-road mobile source VOC	85.0	34.1	79.7	47.8
Future Control Case[9] minus 50 tpd low-level point source VOC	85.0	35.1	85.9	42.4

From Table 7.1-3 it is easy to see that reducing on-road mobile source VOC emissions by 50 tpd results in a reduction in the gap of 4.7 tpd on September 8th. Similarly, on this day reducing 50 tpd of either low-level point source or area/non-road mobile source VOC emissions reduces the gap by 3.8 tpd. So for this day, 50/4.7 = 10.6 tpd of on-road mobile source VOC reduction will reduce the gap by one tpd of NO_x, and 50/3.8 = 13.2 tpd of either area/non-road mobile source or low-level point source VOC reduction will reduce the gap by one tpd of NO_x. Table 7.1-4 lists the tons of VOC reduction required to reduce the gap by one tpd of NO_x for each of the three scenarios for all four primary episode days.

Table 7.1-4: Tpd of VOC Required to Reduce Shortfall by One tpd of NO_x

Case	TPD of VOC Required to Reduce Shortfall by One TPD of NO_x			
	Sept.8th	Sept. 9th	Sept 10th	Sept. 11th
Future Control Case[9] minus 50 tpd on-road mobile source VOC	10.6	11.9	3.4	9.1
Future Control Case[9] minus 50 tpd area/non-road mobile source VOC	13.2	11.9	5.6	9.1
Future Control Case[9] minus 50 tpd low-level point source VOC	13.2	15.6	19.2	4.6

Because September 8th is considered to be the controlling day in this SIP revision, the values calculated for this day will be used when considering VOC/NO_x equivalences. Note, however, that on September 10th both on-road mobile and area/non-road mobile source VOC reductions are much more effective in reducing the gap than they were on any of the other days, while on the 11th, low-level point source VOC reductions are much more effective in reducing the gap than on any of the other three days.

Due to the magnitude of reductions required to demonstrate attainment, commission staff established a threshold such that any VOC measure that could provide at least one ton of equivalent NO_x would be worthy of pursuit. This threshold was initially recommended by EPA staff. Commission staff agreed that it was a reasonable recommendation based on the fact that the analysis showed that any additional measures would likely require an intensive and costly effort for many of the potentially affected sources in light of the level of technology available today. In addition, these measures would not advance the attainment date for the HGA area. Figures 7.1-1 and 7.1-2 show the VOC emissions breakdowns that the commission used in its analysis.

Figure 7.1-1 - 8-County HGA Area and Non-Road Source Emissions
2007 Future Base Case for Wednesday, September 8th
(Expressed in tons per day, tpd)

VOC Total: 283.4 tons per day

The largest area source categories are:

Consumer/Commercial Solvents 24.1

Architectural Coatings 21.4

Gasoline Refueling and Transport 14.2

Graphic Arts 12.6

Oil and Gas Operations 10.7 tpd

Auto Refinishing 10.0

Municipal Landfills 7.4

Dry Cleaning 4.9

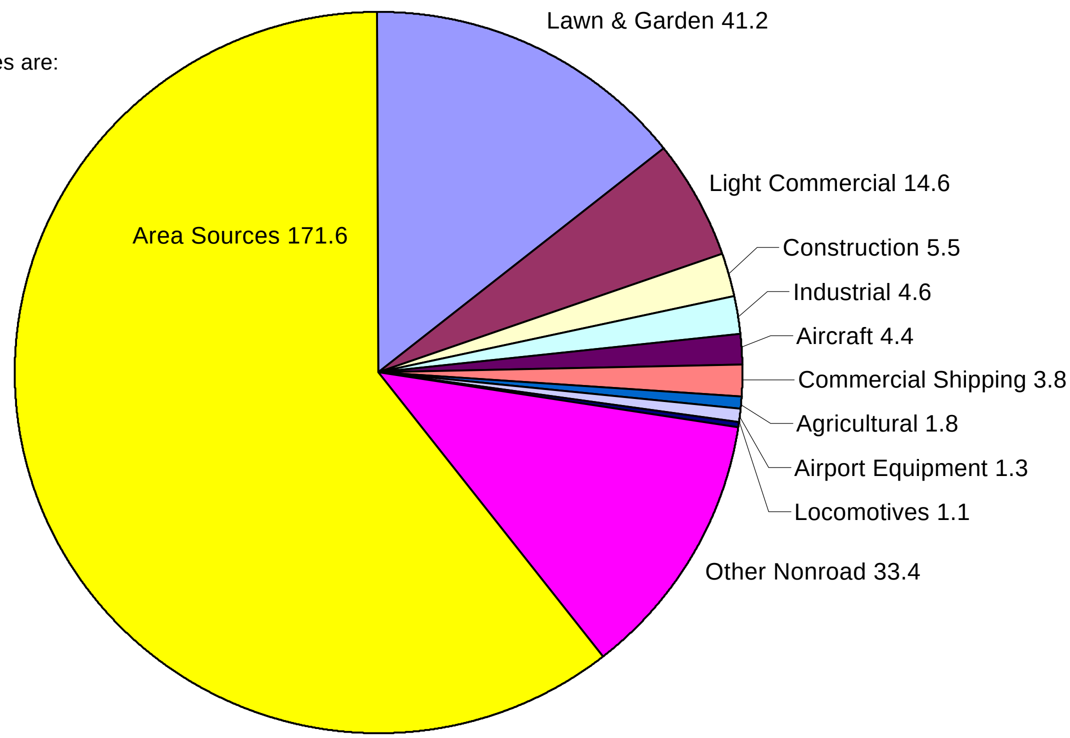
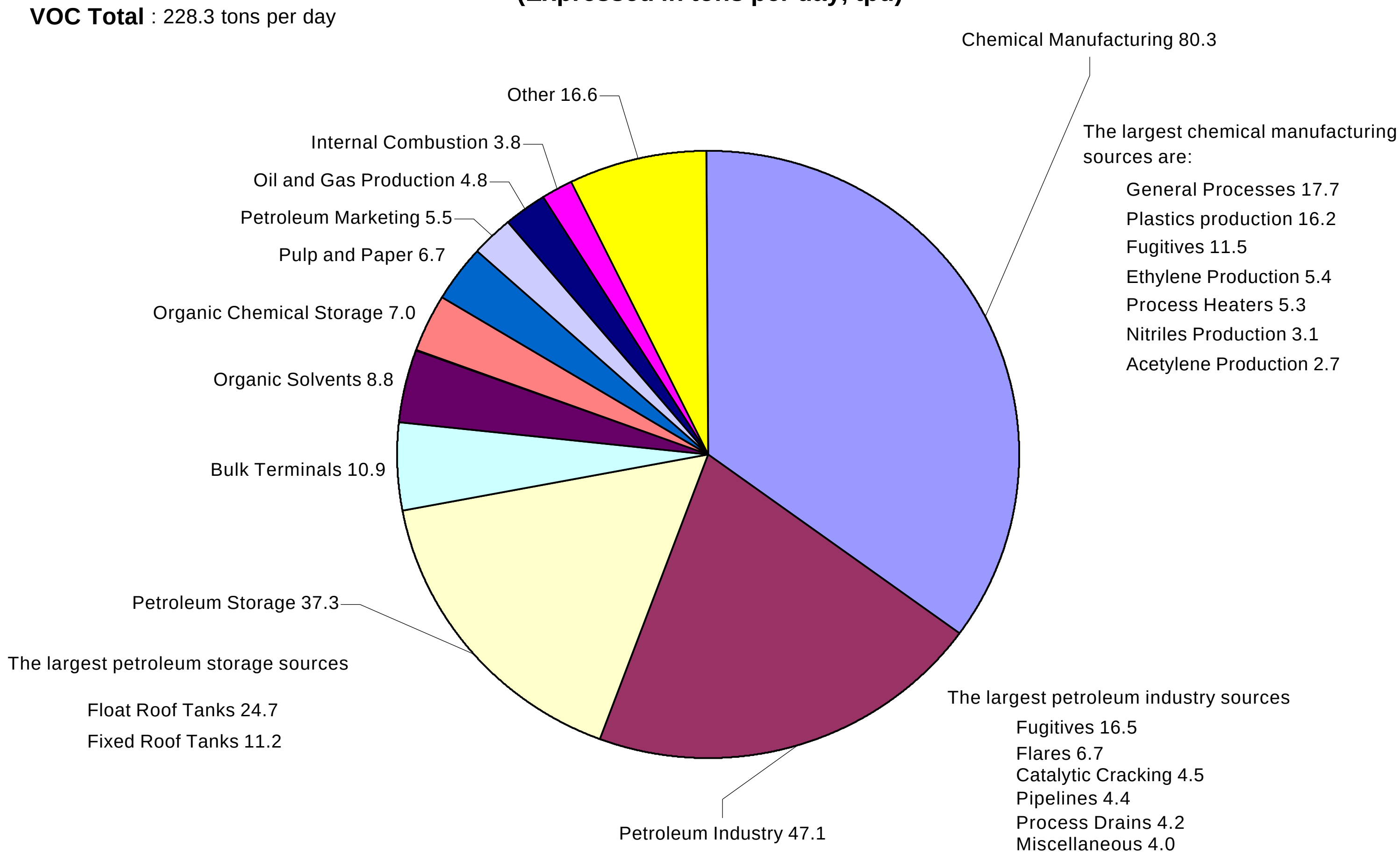


Figure 7.1-2 - 1997 8-County HGA Point Source VOC Emissions by SIC (Expressed in tons per day, tpd)



Point Sources
The commission staff sorted the VOC point source emissions in HGA by SCC. Analysis of this data revealed that the vast majority of VOC point source emissions in HGA are associated with chemical manufacturing (80.3 tpd), petroleum refining (47.1 tpd), and VOC storage (37.3 tpd). The remaining source categories have VOC emissions of less than 11 tpd and were not analyzed further because each category represents far less than 1 tpd of NO_x equivalent reductions.

Within the chemical manufacturing category, subcategories include general processes (SCC 301800xx, 301820xx, and 301830xx) and plastics production (SCC 301018xx). The emissions in these SCCs are already subject to the Chapter 115 general vent gas and SOCMI vent gas rules (§§115.120-115.129), the industrial wastewater rules (§§115.140-115.149), the fugitive emissions monitoring rules (§§115.352-115.359), as well as the new SOCMI batch process rules (§§115.160-115.169) which were adopted as part of the HGA Attainment Demonstration SIP in December 2000. The remaining subcategories within the chemical manufacturing category have VOC emissions of less than 6 tpd and were not analyzed further because each category represents far less than 1 tpd of NO_x equivalent reductions.

Within the petroleum refining category, the largest subcategory, fugitive emissions (SCC 306888xx), has VOC emissions of 16.5 tpd. The emissions in this SCC are already subject to the Chapter 115 fugitive emissions monitoring rules (§§115.352-115.359). The next largest subcategory within the petroleum refining category, flares, are VOC emission control devices and represent 6.7 tpd of VOC emissions. The remaining subcategories within the petroleum refining category have VOC emissions of less than 5 tpd and were not analyzed further because each category represents far less than 1 tpd of NO_x equivalent.

The VOC storage category represents 37.3 tpd of VOC emissions. The commission staff conducted a detailed RACT analysis of this category in 1995. For storage tanks, the commission staff evaluated the effect of making the following changes (identified in EPA's 1994 storage tank ACT document) to the commission's Chapter 115 storage tank rules (§§115.112-115.119):

(1) lowering the vapor pressure exemption level to 0.5 psia;
(2) upgrading at tank turnaround of vapor-mounted primary seals on internal floating roof tanks;
(3) installation at tank turnaround of secondary seals on external floating roof tanks which previously had been exempt from secondary seal requirements;
(4) 95% control efficiency for add-on control devices; and
(5) installation of gasketed seals.

The analysis showed that up to the following emission reductions (in tons per year) could be achieved in HGA for each of these five controls:

(1) 272.41
(2) 177.12
(3) 192.99 (mechanical primary seals) + 22.89 (liquid-mounted primary seals) + 144.82 (vapor-mounted primary seals) = 360.70
(4) 4.88
(5) N/A (Information on deck fitting gaskets not available without conducting a very time-intensive study of the paper copies of each individual emission inventory (EI) in the files. Based upon best professional judgement and existing technology it was assumed that these losses are insignificant.)

TOTAL: 272.41 + 177.12 + 360.70 + 4.88 = 815.11 tpy, or approximately 815.11/365 = 2.2 tpd.

Although the analysis was based on the EI data available in 1995, storage tank emissions have remained relatively constant. Also, the commission staff analyzed the worst-case scenario (i.e., conservative assumptions), so 2.2 tpd is the maximum that could possibly be achieved. Based upon best professional judgement and existing technology it is likely that the actual reductions would be up to perhaps half that, or around 1.1 tpd.

In summary, the vast majority of HGA point source VOC emissions are already subject to Chapter 115 rules. While additional emission reductions could be achieved in the various categories, these would not be significant VOC reductions, and when converted to the equivalent NO_x reductions due to the 16-to-1 conversion ratio would have an insignificant impact on air quality. Therefore, the commission does not believe it is appropriate to pursue these reductions at this time. However, in the future the commission may pursue additional emission reductions of certain highly reactive VOCs, particularly as episodic releases from HGA point sources, if those reductions are determined to be necessary to reach attainment with the ozone NAAQS. Also, any VOC reductions that occur as a result of implementing new NO_x technologies or programs will be quantified and credited towards the SIP.

Area/Non-road Sources
The commission staff sorted the VOC area source emissions in HGA by source category. Analysis of this data revealed that the primary VOC area/non-road source emission categories in HGA are consumer and commercial products (24.1 tpd), architectural coatings (21.4 tpd), vehicle refueling (14.2 tpd), graphic arts (12.6 tpd), oil and gas (10.7 tpd), and vehicle refinishing (10 tpd). The remaining source categories have VOC emissions of less than 2 tpd and were not analyzed further because each category represents far less than 1 tpd of NO_x equivalent reductions.

Consumer and commercial products are subject to a national rule which had a final compliance date of December 10, 1998 for most products and December 10, 1999 for FIFRA products. Similarly, architectural coatings are subject to a national rule which had a final compliance date of September 11, 1999. Vehicle refueling is subject to the Chapter 115 Stage II vapor recovery rules (§§115.240-115.249). Graphic arts sources are subject to the Chapter 115 flexographic and rotogravure printing rules (§§115.432-115.439) as well as the offset printing rules (§§115.440-115.449) which were implemented as part of the HGA Attainment Demonstration SIP in December 2000. The oil and gas category is already subject to the Chapter 115 storage tank rules (§§115.112-115.119), the general vent gas rules (§§115.120-115.129), the industrial wastewater rules (§§115.140-115.149), the VOC transfer rules (§§115.211-115.219), and the fugitive emissions monitoring rules (§§115.352-115.359). The vehicle refinishing category is subject to the Chapter 115 vehicle refinishing rules (§§115.421-115.429).

In summary, the vast majority of HGA area source VOC emissions are already subject to Chapter 115 rules and/or national rules. While additional emission reductions could be achieved in the various categories, these would not be significant VOC reductions based on existing technology, and when converted to the equivalent NO_x reductions due to the 13-to-1 conversion ratio would have an insignificant impact on air quality. Therefore, the commission does not believe it is appropriate to pursue these reductions at this time. However, in the future the commission may pursue additional emission reductions of certain highly reactive VOCs from HGA area sources if those reductions are determined to be necessary to reach attainment with the ozone NAAQS. Also, any VOC reductions that occur as a result of implementing new NO_x technologies or programs will be quantified and credited towards the SIP.

7.1.2 NO_x Point Source Analysis

EPA provided the commission with a copy of approved NO_x reasonably available control measures for evaluation and requested that the commission analyze the list to determine that there are no additional NO_x controls that the commission had not already considered. Table 7.1-5 contains the NO_x strategies that were contained in EPA's list. The commission reviewed the list and determined that all sources on the list are either 1) already complying with the existing state or federal regulations or are impacted by the strategies that are part of this SIP revision, 2) nonexistent or not significant enough to be included in the emissions inventory in the 8-county HGA area, 3) contributing an amount of NO_x emissions which is so small that additional regulations would be essentially of no benefit to the attainment demonstration based on existing technology, or 4) candidate for a short term measure. Staff has added a numerical notation in the last column of the table to indicate which of these scenarios applies to each source.

Based upon this review the commission has determined that one category of sources warrants additional control to meet the Reasonable Available Control Measure threshold. This category, identified as 409 & 410 on the following table, is the Internal Combustion Engine - Oil category. Potential control strategies to reduce emissions from these stationary diesel engines include a prohibition of operation except for when failure of the electric grid is imminent, and for maintenance. Shifting hours of operation for maintenance testing out of the 6:00 a.m. - 12:00 noon time period could have benefits similar to the off-road equipment construction shift. The construction shift was estimated to produce a modeling benefit equivalent to a 21% reduction in actual emissions. The estimated reduction is about 1 tpd.

Table 7.1-5 EPA's List of NO_x Reasonably Available Control Measures - Area/Point Sources

The commission reviewed the list and determined that all sources on the list are either 1) already complying with the existing state or federal regulations or are impacted by the strategies that are part of this SIP revision, 2) nonexistent or not significant enough to be included in the emissions inventory in the 8-county HGA area, 3) contributing an amount of NO_x emissions which is so small that additional regulations would be essentially of no benefit to the attainment demonstration based on existing technology, or 4) candidate for a short term measure.

	SOURCE CATEGORY	CONTROL TECHNOLOGY	
282	Boilers and Process Heaters in Petroleum Refineries	NO_x emission limit + Approved Alternative Emission Control Plan + Continuous NO_x stack monitoring	1
283	Cement Kilns	Continuous monitoring and recording of NO_x emissions + NO_x emission limit	2
284	Electric Power Generating Systems	Selective Catalytic Reduction	1
285	Glass Melting Furnaces	NO_x emission limit + Continuous NO_x monitoring from unit + Alternative Emission Control Plan	3
286	Industrial, Institutional and Commercial Boilers, Steam Generators, and Process Heaters	NO_x emission limit, methods to meet the limit is not specified	1
287	Large Water Heaters and Small Boilers	NO_x emission limit + Compliance Certification Program for equipment manufacturers + Retrofit Compliance Certification Program	1
288	Natural-Gas-Fired, Fan-Type Central Furnaces	NO_x emission limit	3
289	Nitric Acid Units	NO_x emission limit	1
290	Refinery Flares	Adoption of a Flare Monitoring and Recording Plan	3
291	Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	NO_x emission limit, methods to meet the limit is not specified	1
292	Stationary Gas Turbines	Continuous in-stack NO_x and oxygen monitoring system + Selective Catalytic Reduction	1
293	Stationary Internal Combustion Engines	NO_x emission limit	1
294	Adipic Acid Manufacturing	Thermal Reduction	2
295	Adipic Acid Manufacturing	Extended Absorption	2
296	Agricultural Burning	Seasonal Ban (Ozone Season)	3
297	Ammonia - Natural Gas-Fired Reformers	Low NO_x Burners + Flue Gas Recirculation	2
298	Ammonia - Natural Gas-Fired Reformers	Oxygen Trim + Water Injection	2
299	Ammonia - Natural Gas-Fired Reformers	Low NO_x Burners	2
300	Ammonia - Natural Gas-Fired Reformers	Selective Catalytic Reduction	2

301	Ammonia - Natural Gas-Fired Reformers	Selective Non-Catalytic Reduction	2
302	Ammonia Production; Feedstock Desulfurization	Low NO_x Burners + Flue Gas Recirculation	2
303	Asphaltic Concrete; Rotary Dryer; Conversion Plant	Low NO_x Burners	3
304	By-Product Coke Manufacturing; Oven Underfiring	Selective Non-Catalytic Reduction	3
305	Cement Manufacturing - Dry	Selective Non-Catalytic Reduction - NH3 Based	2
306	Cement Manufacturing - Dry	Mid-Kiln Firing	2
307	Cement Manufacturing - Dry	Low NO_x Burners	2
308	Cement Manufacturing - Dry	Selective Non-Catalytic Reduction - Urea Based	2
309	Cement Manufacturing - Dry	Selective Catalytic Reduction	2
310	Cement Manufacturing - Wet	Selective Catalytic Reduction	2
311	Cement Manufacturing - Wet	Low NO_x Burners	2
312	Cement Manufacturing - Wet	Mid-Kiln Firing	2
313	Ceramic Clay Manufacturing; Drying	Low NO_x Burners	2
314	Coal Cleaning-Thermal Dryer; Fluidized Bed	Low NO_x Burners	2
315	Commercial, lnstitutional Incinerators	Selective Non-Catalytic Reduction	1
316	Conv. Coating of Product; Acid Cleaning Bath	Low NO_x Burners	3
317	Fiberglass Manufacturing; Textile-Type Fiber; Recup Furnaces	Low NO_x Burners	2
318	Fluid Catalytic Cracking Units; Cracking Unit	Low NO_x Burners + Flue Gas Recirculation	1
319	Fuel Fired Equipment; Furnaces; Natural Gas	Low NO_x Burners	1
320	Fuel Fired Equipment; Process Heaters, Propane Gas	Low NO_x Burners + Flue Gas Recirculation	1
321	Gas Turbines - Jet Fuel	Selective Catalytic Reduction + Water Injection	2
322	Gas Turbines - Jet Fuel	Water Injection	2
323	Gas Turbines - Natural Gas	Steam Injection	1
324	Gas Turbines - Natural Gas	Selective Catalytic Reduction + Low NO_x Burners	1
325	Gas Turbines - Natural Gas	Selective Catalytic Reduction + Steam Injection	1
326	Gas Turbines - Natural Gas	Selective Catalytic Reduction + Water Injection	1
327	Gas Turbines - Natural Gas	Low NO_x Burners	1
328	Gas Turbines - Natural Gas	Water Injection	1
329	Gas Turbines - Oil	Selective Catalytic Reduction + Water Injection	2

330	Gas Turbines - Oil	Water Injection	2
331	Glass Manufacturing - Container	Cullet Preheat	3
332	Glass Manufacturing - Container	Low NO_x Burners	3
333	Glass Manufacturing - Container	Selective Catalytic Reduction	3
334	Glass Manufacturing - Container	Oxygen-Firing	3
335	Glass Manufacturing - Container	Electric Boost	3
336	Glass Manufacturing - Container	Selective Non-Catalytic Reduction	3
337	Glass Manufacturing - Fiat	Low NO_x Burners	2
338	Glass Manufacturing - Fiat	Oxygen-Firing	2
339	Glass Manufacturing - Fiat	Selective Non-Catalytic Reduction	2
340	Glass Manufacturing - Fiat	Electric Boost	2
341	Glass Manufacturing - Fiat	Selective Catalytic Reduction	2
342	Glass Manufacturing - Pressed	Oxygen-Firing	2
343	Glass Manufacturing - Pressed	Selective Catalytic Reduction	2
344	Glass Manufacturing - Pressed	Cullet Preheat	2
345	Glass Manufacturing - Pressed	Electric Boost	2
346	Glass Manufacturing - Pressed	Selective Non-Catalytic Reduction	2
347	Glass Manufacturing - Pressed	Low NO_x Burners	2
348	IC Engines - Gas, Diesel, LPG	Selective Catalytic Reduction	1
349	IC Engines - Gas, Diesel, LPG	Ignition Retard	1
350	ICI Boilers - Coal/Cyclone	Selective Catalytic Reduction	2
351	ICI Boilers - Coal/Cyclone	Natural Gas Reburn	2
352	ICI Boilers - Coal/Cyclone	Coal Reburn	2
353	ICI Boilers - Coal/Cyclone	Selective Non-Catalytic Reduction	2
354	ICI Boilers - Coal/FBC	Selective Non-Catalytic Reduction - Urea	2
355	ICI Boilers - Coal/Stoker	Selective Non-Catalytic Reduction	2
356	ICI Boilers - Coal/Wall	Selective Non-Catalytic Reduction	1
357	ICI Boilers - Coal/Wall	Selective Catalytic Reduction	1
358	ICI Boilers - Coal/Wall	Low NO_x Burners	1
359	ICI Boilers - Coke	Selective Catalytic Reduction	1
360	ICI Boilers - Coke	Low NO_x Burners	1
361	ICI Boilers - Coke	Selective Non-Catalytic Reduction	1

362	ICI Boilers - Distillate Oil	Low NO_x Burners + Flue Gas Recirculation	1
363	ICI Boilers - Distillate Oil	Low NO_x Burners	1
364	ICI Boilers - Distillate Oil	Selective Catalytic Reduction	1
365	ICI Boilers - Distillate Oil	Selective Non-Catalytic Reduction	1
366	ICI Boilers - Liquid Waste	Low NO_x Burners	1
367	ICI Boilers - Liquid Waste	Selective Catalytic Reduction	1
368	ICI Boilers - Liquid Waste	Selective Non-Catalytic Reduction	1
369	ICI Boilers - Liquid Waste	Low NO_x Burners + Flue Gas Recirculation	1
370	ICI Boilers - LPG	Low NO_x Burners + Flue Gas Recirculation	2
371	ICI Boilers - LPG	Low NO_x Burners	2
372	ICI Boilers - LPG	Selective Non-Catalytic Reduction	2
373	ICI Boilers - LPG	Selective Catalytic Reduction	2
374	ICI Boilers - MSW/Stoker	Selective Non-Catalytic Reduction - Urea	2
375	ICI Boilers - Natural Gas	Selective Catalytic Reduction	1
376	ICI Boilers - Natural Gas	Oxygen Trim + Water Injection	1
377	ICI Boilers - Natural Gas	Low NO_x Burners + Flue Gas Recirculation	1
378	ICI Boilers - Natural Gas	Selective Non-Catalytic Reduction	1
379	ICI Boilers - Natural Gas	Low NO_x Burners	1
380	ICI Boilers - Process Gas	Oxygen Trim + Water Injection	1
381	ICI Boilers - Process Gas	Selective Catalytic Reduction	1
382	ICI Boilers - Process Gas	Low NO_x Burners + Flue Gas Recirculation	1
383	ICI Boilers - Process Gas	Low NO_x Burners	1
384	ICI Boilers - Residual Oil	Low NO_x Burners + Flue Gas Recirculation	1
385	ICI Boilers - Residual Oil	Selective Non-Catalytic Reduction	1
386	ICI Boilers - Residual Oil	Low NO_x Burners	1
387	ICI Boilers - Residual Oil	Selective Catalytic Reduction	1
388	ICI Boilers- Wood/Bark/Stoker	Selective Non-Catalytic Reduction - Urea	1
389	Industrial Coal Combustion	RACT to 50 tpy (Low NO_x Burners)	2
390	Industrial Coal Combustion	RACT to 25 tidy (Low NO_x Burners)	2
391	Industrial Incinerators	Selective Non-Catalytic Reduction	1
392	Industrial Natural Gas Combustion	RACT to 25 tpy (Low NO_x Burners)	1
393	Industrial Natural Gas Combustion	RACT to 50 tpy (Low NO_x Burners)	1

394	Industrial Oil Combustion	RACT to 25 tpy (Low NO_x Burners)	1
395	Industrial Oil Combustion	RACT to 50 tpy (Low NO_x Burners)	1
396	In-Process Fuel Use; Bituminous Coal; General	Selective Non-Catalytic Reduction	2
397	In-Process Fuel Use; Natural Gas; General	Low NO_x Burners	3
398	In-Process Fuel Use; Residual Oil; General	Low NO_x Burners	3
399	In-Process; Bituminous Coal; Cement Kiln	Selective Non-Catalytic Reduction - Urea	2
400	In-Process; Bituminous Coal; Lime Kiln	Selective Non-Catalytic Reduction - Urea	1
401	In-Process; Process Gas; Coke Oven Gas	Low NO_x Burners	1
402	In-Process; Process Gas; Coke Oven/Blast Furnaces	Low NO_x Burners + Flue Gas Recirculation	2
403	Internal Combustion Engines - Gas	Ignition Retard	1
404	Internal Combustion Engines - Gas	Air-to-Fuel Ratio	1
405	Internal Combustion Engines - Gas	Air-to-Fuel Ratio + Ignition Retard	1
406	Internal Combustion Engines - Gas	L-E (Medium Speed)	1
407	Internal Combustion Engines - Gas	L-E (Low Speed)	1
408	Internal Combustion Engines - Gas	Selective Catalytic Reduction	1
409	Internal Combustion Engines - Oil	Selective Catalytic Reduction	4
410	Internal Combustion Engines - Oil	Ignition Retard	4
411	Iron & Steel Mills - Annealing	Low NO_x Burners + Selective Catalytic Reduction	1
412	Iron & Steel Mills - Annealing	Selective Catalytic Reduction	1
413	Iron & Steel Mills - Annealing	Low NO_x Burners	1
414	Iron & Steel Mills - Annealing	Low NO_x Burners + Selective Non-Catalytic Reduction	1
415	Iron & Steel Mills - Annealing	Selective Non-Catalytic Reduction	1
416	Iron & Steel Mills - Annealing	Low NO_x Burners + Flue Gas Recirculation	1
417	Iron & Steel Mills - Galvanizing	Low NO_x Burners + Flue Gas Recirculation	2
418	Iron & Steel Mills - Galvanizing	Low NO_x Burners	2
419	Iron & Steel Mills - Reheating	Low NO_x Burners + Flue Gas Recirculation	1
420	Iron & Steel Mills - Reheating	Low NO_x Burners	1
421	Iron & Steel Mills - Reheating	LEA	1
422	Iron Production; Blast Furnace; Blast Heating Stoves	Low NO_x Burners + Flue Gas Recirculation	2
423	Lime Kilns	Selective Catalytic Reduction	1

424	Lime Kilns	Low NO_x Burners	1
425	Lime Kilns	Selective Non-Catalytic Reduction - Urea Based	1
426	Lime Kilns	Selective Non-Catalytic Reduction - NH 3 Based	1
427	Lime Kilns	Mid-Kiln Firing	1
428	Medical Waste Incinerators	Selective Non-Catalytic Reduction	1
429	Municipal Waste Combustors	Selective Non-Catalytic Reduction	2
430	Natural Gas Production; Compressors	Selective Catalytic Reduction	1
431	Nitric Acid Manufacturing	Selective Catalytic Reduction	1
432	Nitric Acid Manufacturing	Extended Absorption	1
433	Nitric Acid Manufacturing	Selective Non-Catalytic Reduction	1
434	Open Burning	Episodic Ban (Daily Only)	3
435	Plastics Products; Specific; (ABS) Resin	Low NO_x Burners + Flue Gas Recirculation	1
436	Primary Copper Smelters; Reverb Smelting Furnace	Low NO_x Burners + Flue Gas Recirculation	2
437	Process Heaters - Distillate Oil	Low NO_x Burners + Selective Catalytic Reduction	1
438	Process Heaters - Distillate Oil	Low NO_x Burners + Selective Non-Catalytic Reduction	1
439	Process Heaters - Distillate Oil	Low NO_x Burners	1
440	Process Heaters - Distillate Oil	Ultra Low NO_x Burners	1
441	Process Heaters - Distillate Oil	Selective Catalytic Reduction	1
442	Process Heaters - Distillate Oil	Selective Non-Catalytic Reduction	1
443	Process Heaters - Distillate Oil	Low NO_x Burners + Flue Gas Recirculation	1
444	Process Heaters - LPG	Low NO_x Burners	1
445	Process Heaters - LPG	Ultra Low NO_x Burners	1
446	Process Heaters - LPG	Selective Catalytic Reduction	1
447	Process Heaters - LPG	Low NO_x Burners + Selective Catalytic Reduction	1
448	Process Heaters - LPG	Selective Non-Catalytic Reduction	1
449	Process Heaters - LPG	Low NO_x Burners + Flue Gas Recirculation	1
450	Process Heaters - LPG	Low NO_x Burners + Selective Non-Catalytic Reduction	1
451	Process Heaters - Natural Gas	Selective Non-Catalytic Reduction	1
452	Process Heaters - Natural Gas	Ultra Low NO_x Burners	1
453	Process Heaters - Natural Gas	Selective Catalytic Reduction	1
454	Process Heaters - Natural Gas	Low NO_x Burners + Selective Non-Catalytic Reduction	1

455	Process Heaters - Natural Gas	Low NO_x Burners	1
456	Process Heaters - Natural Gas	Low NO_x Burners + Flue Gas Recirculation	1
457	Process Heaters - Natural Gas	Low NO_x Burners + Selective Catalytic Reduction	1
458	Process Heaters - Other Fuel	Low NO_x Burners + Flue Gas Recirculation	1
459	Process Heaters - Other Fuel	Low NO_x Burners	1
460	Process Heaters - Other Fuel	Selective Non-Catalytic Reduction	1
461	Process Heaters - Other Fuel	Ultra Low NO_x Burners	1
462	Process Heaters - Other Fuel	Low NO_x Burners + Selective Non-Catalytic Reduction	1
463	Process Heaters - Other Fuel	Selective Catalytic Reduction	1
464	Process Heaters - Other Fuel	Low NO_x Burners + Selective Catalytic Reduction	1
465	Process Heaters - Process Gas	Low NO_x Burners + Selective Catalytic Reduction	1
466	Process Heaters - Process Gas	Low NO_x Burners + Selective Non-Catalytic Reduction	1
467	Process Heaters - Process Gas	Low NO_x Burners + Flue Gas Recirculation	1
468	Process Heaters - Process Gas	Low NO_x Burners	1
469	Process Heaters - Process Gas	Selective Non-Catalytic Reduction	1
470	Process Heaters - Process Gas	Ultra Low NO_x Burners	1
471	Process Heaters - Process Gas	Selective Catalytic Reduction	1
472	Process Heaters - Residual Oil	Low NO_x Burners + Flue Gas Recirculation	1
473	Process Heaters - Residual Oil	Selective Non-Catalytic Reduction	1
474	Process Heaters - Residual Oil	Low NO_x Burners + Selective Non-Catalytic Reduction	1
475	Process Heaters - Residual Oil	Ultra Low NO_x Burners	1
476	Process Heaters - Residual Oil	Low NO_x Burners + Selective Catalytic Reduction	1
477	Process Heaters - Residual Oil	Low NO_x Burners	1
478	Process Heaters - Residual Oil	Selective Catalytic Reduction	1
479	Sand/Gravel; Dryer	Low NO_x Burners + Flue Gas Recirculation	2
480	Secondary Aluminum Production; Smelting Furnaces/Reverb	Low NO_x Burners	2
481	Solid Waste Disposal; Government; Other Incinerator; Sludge	Selective Non-Catalytic Reduction	1
482	Space Heaters - Distillate Oil	Low NO_x Burners + Flue Gas Recirculation	3
483	Space Heaters - Distillate Oil	Selective Catalytic Reduction	3
484	Space Heaters - Distillate Oil	Selective Non-Catalytic Reduction	3

485	Space Heaters - Distillate Oil	Low NO_x Burners	3
486	Space Heaters - Natural Gas	Low NO_x Burners	3
487	Space Heaters - Natural Gas	Low NO_x Burners + Flue Gas Recirculation	3
488	Space Heaters - Natural Gas	Selective Non-Catalytic Reduction	3
489	Space Heaters - Natural Gas	Selective Catalytic Reduction	3
490	Space Heaters - Natural Gas	Oxygen Trim + Water Injection	3
491	Starch Manufacturing; Combined Operations	Low NO_x Burners + Flue Gas Recirculation	2
492	Steel Foundries; Heat Treating Furnaces	Low NO_x Burners	1
493	Steel Production; Soaking Pits	Low NO_x Burners + Flue Gas Recirculation	2
494	Sulfate Pulping - Recovery Furnaces	Low NO_x Burners + Flue Gas Recirculation	1
495	Sulfate Pulping - Recovery Furnaces	Selective Non-Catalytic Reduction	1
496	Sulfate Pulping - Recovery Furnaces	Selective Catalytic Reduction	1
497	Sulfate Pulping - Recovery Furnaces	Oxygen Trim + Water Injection	1
498	Sulfate Pulping - Recovery Furnaces	Low NO_x Burners	1
499	Surface Coating Operation; Coating Oven Heater;Natural Gas	Low NO_x Burners Measure	2
500	Utility Boilers	Selective Catalytic Reduction	1
501	Ammonia Plants	Controls based on those for process heaters and industrial boilers	2
502	Cement Kilns	Require combustion controls and post-combustion controls (SNCR) to achieve reductions of up to 70 percent on certain processes	2
503	Gas Turbines	Limits for turbines burning natural gas at 25-42 ppm and as low as 9-15 ppm.+ limits for turbines burning distillate oil at 65 ppm or below, and as low as 25-42 ppm..	1
504	Glass Furnaces	Combustion modifications, process changes and post-combustion controls (SNCR) + RACT limits of 5.3-5.5 lbs NO_x/ton of glass removed with limits as low as 4.0 lb NO_x/ton of glass removed + coordinate installation of controls with routine furnace rebuilds	3
505	Industrial and Commercial Boilers	Limits for boilers larger than 100 mmBtu/hr at levels of 0.t 5 lb/mmBtu or below for coal and 0.05 lb/mmBtu for oil and gas + limits for mid-size boilers between 50-100 mmBtu/hr at 0.10 lb/mmBtu for gas, 0.12 lb/mmBtu for distillate oil and 0.30 lb/mmBtu for residual oil, 0.38 lb/mmBtu for coal + boilers smaller than 50 mmBtu/hr make annual "tune-ups" to minimize excess air	1

506	Iron and Steel Mills	Low NO_x burners and FGR for reheat furnaces + SCR and low NO_x burners for annealing furnaces + low NO_x burners and FGR for galvanizing furnaces	1
507	Kraft Pulp Mills	Industrial boilers regulated same as Industrial and Commercial Boilers + SNCR for recovery boilers + lime kilns regulated same as Cement Kilns	1
508	Medical Waste Incinerators	Controls similar to those for municipal waste combustors	1
509	Municipal Waste Combustors	EPA's regulation for large, existing MWCs emitting more than 250 tons/day + more stringent limits (e.g., 30-50 ppmv) or shorter averaging periods (e.g., 8-hr average).	2
510	Nitric and Adipic Acid Plants	Consider a standard of 2.0 lbs NO_x/ton of nitric acid produced, representing approximately 95% control. Even lower standards are achievable using SCR. The nation's four adipic acid plants are already regulated at over 80% efficiency.	1
511	Open Burning	Restrict open burning on days when ozone exceedances are expected + reduce the amount of refuse burned by recycling municipal waste or mulching agricultural and landscaping waste	3
512	Organic Chemical Plants	Controls on industrial boilers and process heaters for these sources	1
513	Petroleum Refineries	Regulate refinery boilers and process heaters like other industries + regulate fluid catalytic cracking units by controlling CO boilers + SNCR or low NO_x burners on tail gas incinerators	1
514	Process Heaters	Limits of 0.036 lb/mmBtu for gas and 0.05 lb/mmBtu for other liquid fuels+ limits same as mid-sized industrial boilers for gas, distillate oil and residual oil-fired units 515 Reciprocating Internal Combustion Engines Limits for rich-burn gas-fired engines between 0.4-0.8 g/bhp-hr, for lean-burn engines as low as 0.5-0.6 g/bhp-hr and for diesel engines at 0.5-1.1 g/bhp-hr.	1
515	Reciprocating Internal Combustion Engines	Limits for rich-burn gas-fired engines between 0.4-0.8 g/bhp-hr, for lean-burn engines as low as 0.5-0.6 g/bhp-hr and for diesel engines at 0.5-1.1 g/bhp-hr.	1
516	Residential Space and Water Heaters	Set limit on new sources of 0.09 lbs//mmBtu of heat output + incentives to replace older space and water heaters	1, 3
517	Utility Boilers	T-fired and wall-fired coal units emissions of 0.15 lb/mmBtu or below + oil and gas units emissions of 0.05 lb/mmBtu + emission rates based on energy output	1
518	NO_x RACT Rules	States' NO_x RACT rules	1
519	Nitric/adipic acids	Nitric acid - 2.3 lb/ton extended adsorption; Adipic acid - 7.4 lb/ton extended adsorption	1

520	Availability/Extent of NO_x Controls		1
521	IC Engines	Lean burn - LEC 2 gm/bhp-hr & Rich Burn - SNCR 2 gm/bhp-hr & Diesel - SCR 2 gm/bhp-hr	1
522	NESCAUM Utility Report		1
523	Gas Turbines	Turbines >25 MW: Wet injection + SCR - 9 ppm (0.04 lb/mm Btu & 8-25 MW: Low NO_x combustion - 42 ppm	1
524	Process heaters (revised)	NG - ULNB 0.05 lb/mm Btu / Oil - ULNB 0.14 lb/mm Btu	1
525	Cement	Production procedures + SCR	2
526	Non-utility boilers	Natural gas - LNB + FGR 0.10 lb/mmBtu & Residual oil - LNB + FGR 0.15 lb/mmBtu & Stoker coal - SNCR 0.22 lb/mmBtu	1
527	Utility boilers	Gas / oil - SCR 0.08 lb/mmBtu	1
528	Glass	Pressed / blown - LNB 13 lb/ton & Container - LNB 6 lb/ton & Flat - SNCR 9.5 lb.ton	3
529	Iron and Steel	Reheat furnace - LNB + FGR 0.2 lb/mmBtu & Annealing furnace - LNB 0.5 lb/mmBtu & Galvanizing furnace - LNB + FGR 0.5 lb/mmBtu	1
530	Phase II MARAMA/NESCAUM Utility Boiler		1
531	Utility Boilers	Natural Gas - 0.2lb/mmBtu; Liquid Fossil Fuel - 0.3 lb/mmBtu; Subituminous Coal - 0.5 lb/mmBtu; Lignite - 0.8 lb/mmBtu; Bituminous Coal - 0.6 lb/mmBtu	1
532	Nonutility Boilers	Natural Gas and Distillate Oil - Low heat release rate - 0.10 lb/mmBtu; High heat -0.20 lb/mmBtu Residual Oil - Low heat release rate - 0.3 lb/mmBtu; High heat release rate - 0.4 lb/mmBtu Coal - Mass Feed Stoker - 0.5 lb/mmBtu; Spreader Stoker and FBC - 0.6 lb/mmBtu; Pulverized Coal - 0.7 lb/mmBtu; Lignite - 0.6 lb/mmBtu	1
533	Municipal Waste Combustors (Began operationbetween 12/20/89 and 9/20/94)	180 ppm at 7% oxygen	2
534	Municipal Waste Combustors (After 9/20/94)	180 ppm at 7% oxygen; after first year of operation - 150 ppm at 7% oxygen	2
535	Medical Waste Incinerators	250 ppmv	1
536	Nitric Acid Plants	3.0 lb/ton of acid produced	1
537	Gas Turbines	Detailed equations 40 CFR 60.332	1

7.1.3 VOC and NO_x Mobile Source Analysis

EPA also provided the commission with a copy of approved VOC and NO_x reasonably available mobile source control measures for evaluation. The commission also reviewed this list to determine whether there were additional mobile source controls that the commission had not already considered. Table 7.1-6 contains the mobile source strategies that were contained in EPA's list. The commission reviewed the list and determined that all strategies on the list are either 1) already in place or will be in place as a result of this SIP revision, or 2) not being considered because the amount of associated emissions is so small based upon existing technology that additional regulations would be infeasible and essentially of little benefit. Staff has added a numerical notation in the last column of the table to indicate which of these scenarios applies to each strategy.

Table 7.1-6 EPA's List of VOC & NO_x Reasonably Available Control Measures - Mobile Sources

565	Highway Vehicles - Gasoline	Transportation Control Package	1
566	Highway Vehicles - Gasoline	Federal Reformulated Gasoline	1
567	Highway Vehicles - LD Gas Trucks	Tier 2 Standards	1
568	Highway Vehicles - LD Gasoline	High Enhanced I/M	1
569	Highway Vehicles - LD Gasoline	Fleet ILEV	2
570	Non-road Gasoline Engines	Federal Reformulated Gasoline	1
571	Accelerated Vehicle Retirement	Implement an accelerated vehicle retirement, or "scrappage" program in conjunction with an I/M program	1
572	California Low-Emission Vehicles	Adopt the California LEV program	2
573	Clean-Fuel Fleets	Adopt a CFFV program, if one is not already required. Where a CFFV program is required, increase its reduction potential by purchasing more CFFVs than called for in any year, purchasing vehicles that meet stricter emission standards than those required, or purchasing vehicles in advance, before requirements take effect. Areas encourage non-covered fleets to participate and/or require the purchase of ILEVs where fleet requirements from the Energy Policy Act are applicable.	1
574	Employee Commute Options	In areas not already required to implement an ECO program, evaluate the potential emission reductions to be achieved by implementing such a program and consider its implementation to achieve additional reductions and stabilize mobile source emissions.	1
575	Motor Vehicle Inspection and Maintenance	Implementation of IM240 in areas not required to adopt such a program, in that IM240 tests for NO_x and inspection and requires repairs accordingly. Augmenting the program by expanding geographic coverage, increasing maintenance of model year and vehicle class coverage and pre-1981 stringency rate, conducting inspections annually and/or setting tighter cutpoints.	1
576	Non-road Vehicles and Engines	In addition to EPA's regulations on 50-hp and above non-road diesel engines, explore scrappage programs. among others, for near-term reductions and to increase turnover of these sources, particularly for construction equipment.	1

577	Reformulated Gasoline and Diesel Fuel	Opt into the federal program or utilize Section 211 (c)(4) authority to adopt a state program, including the California RFG program or one focused on fuel properties (e.g., reducing sulfur content of fuel). Adopt reformulated diesel fuel requirements, including the California reformulated diesel program, to achieve additional reductions from diesel engines.	1
578	Transportation Control Measures	Evaluate the potential effectiveness of TCMs based upon the particular needs and circumstances of a given area, emphasizing pricing strategies, such as parking management, traffic flow improvements and road pricing.	1
601	Accelerated Vehicle Retirement	Accelerated vehicle retirement, or "scrappage," program in conjunction with an I/M program.	1
602	Accelerated Vehicle Retirement	Consider implementing an accelerated vehicle retirement, or "scrappage" program in conjunction with an I/M program.	1
603	California Low-Emission Vehicles	Adopt the California low-emission vehicle program	2
604	Clean-Fuel Fleets	Adopt a clean-fuel fleet vehicle (CFFV) program and increase its reduction potential by expanding the use and performance of CFFVs	1
605	Motor Vehicle Inspection and Maintenance	Augment basic or enhanced Inspection and Maintenance (I/M) programs by expanding vehicle coverage	1
606	Non-road Vehicles and Engines	In addition to EPA's regulations on 50-hp and above non-road diesel engines, explore scrappage programs. among others, for near-term reductions and to increase turnover of these sources, particularly for construction equipment.	1
607	Non-Road Vehicles and Engines	Achieve reductions from lawn and garden equipment and recreational vessels	1
608	Reformulated Gasoline	Opt into the federal reformulated gasoline program	1
609	Transportation Control Measures Employee Commute Options	Employee Commute Options program	1
611	Conversion to Alternative Fueled Vehicles Program	Tax credits or deductions to for conversion to or purchase of alternative fueled vehicles and alternative fuel stations Arizona DEQ	1

7.1.4 Short Term Commitments (12/00 – 10/01)
Short term measures consist of ideas which surfaced as a part of the analysis of all of the comments and which staff identified during the review of all reasonably available control measures. These include ideas that other states, including California, are pursuing. They are considered short term because they are strategies that can be adopted by the commission by the late summer 2001 timeframe and submitted to EPA prior to its scheduled proposed approval of the SIP in October 2001. This timeframe will also allow the commission to respond to any legislative action. The commission is analyzing several ideas which could be implemented in the short term, which are grouped in the categories noted below.

1) California Not to Exceed Standards
The California Air Resources Board has proposed supplemental emissions certification tests for heavy-duty diesel engines during model years 2005 and 2006. These test requirements are designed to fill a gap in the federal certification requirements, between 2004, when the current heavy-duty engine manufacturer Consent Decree expires, and 2007, when the next round of national HDD standards go into effect.

The commission submitted a letter of support to California on their proposal and as allowed under FCAA Section 177, plans to adopt the same requirements for the HGA area in order to help encourage engine manufacturers to adopt a single engine design for the entire country.

2) *NO_x controls*
Potential control strategies to reduce emissions from stationary diesel engines used for electricity generation include a prohibition of operation except for when failure of the electric grid is imminent, and for maintenance. Shifting hours of operation for maintenance testing out of the 6:00 a.m. - 12:00 noon time period could have benefits similar to the off-road equipment construction shift. The construction shift was estimated to produce a modeling benefit equivalent to a 21% reduction in actual emissions. The estimated reduction is about 1 tpd.

3) *Legislative Direction*
The commission anticipates that the Texas Legislature will take an active role in providing additional tools that are not currently available for the state to use in achieving the goal of clean air. Some of these tools may be incorporated through relatively simple rulemaking that can occur in the short term. Other initiatives may warrant more elaborate analysis and rulemaking that would occur in the next phase of this process.

Aspects of the following measures have been identified as requiring legislative authorization before implementation by the TNRCC: energy efficient building codes; vehicle scrappage; telecommute and other commute-reducing programs; incentive programs for cleaner cars including feebates, tax incentives, and free parking; cleaner fleets; VMT reduction programs involving tax incentives and e-commerce.

4) *Energy Efficiencies*
These are measures which may become rules or other types of enforceable measures in the future to complete the attainment demonstration. Measures under consideration include: agreements with the air conditioner manufacturers to increase SEER ratings in lieu of the catalyst rule, SB 7 energy efficiency requirements, federal energy efficiency requirements for appliances including new or enhanced SEER requirements, smart growth or other similar initiatives, heat island effects, and emergency electricity generation. Emission reductions expected from these measures are 0-20 tpd.

The commission commits to developing any of the measures that can be done this summer, taking them through the public comment process along with the enforceable commitments and adopting and submitting them to EPA in advance of EPA's final decision.

7.2 BUILDING THE SCIENCE (12/00 - 5/04)

The combination of unique meteorological conditions and the large industrial complex along the upper Texas Gulf coast has presented challenges in modeling ozone episodes in the area. The rapid formation of ozone at a limited number of monitors has been particularly difficult to duplicate in the existing photochemical models. This phenomena was observed several times during the Texas 2000 Air Quality Study (TexAQS). It is anticipated that TexAQS, the most comprehensive and successful air quality study conducted to date in the U.S. with over 40 research organizations and over 250 scientists, will provide the scientific basis for reassessing the ozone problem in the HGA ozone nonattainment area. The commission has a long history of supporting enhancements to the models and associated tools and input data, and has made improving the science and tools supporting SIP development for Texas areas a top priority in the coming years. The commission is committed to working in cooperation with affected parties to ensure the modeling used to develop effective control strategies for the area will use the most current scientific information to replicate high ozone episodes in the area. Table 7.2-1 provides a description of specific tasks from the study that will be incorporated into the photochemical model for Texas.

Subsequent subsections describe the building of the science for the two planned phases of the mid-course review. Schedules for the technical work involved in the two phases are included. The schedules outlined in Sections 7.3 and 7.4 specify dates by which the commission is confident that sufficient new information will be available to conduct a reassessment. However, the work evaluating all the pieces is a continual process. To the extent that a new piece of information or technology is available sooner than the anticipated schedule, and has a potential to impact the strategy in a significant manner, the commission will make whatever adjustments are necessary.

Table 7.2-1 Potential Contributions from the Texas 2000 Air Quality Study toward Building the Science

Topic	Description	Enhancements Having Potential Benefit for Mid-Course Review
Enhancements to the State-of-the-Science in Photochemical Modeling		
Role of Chlorine in Ozone Formation	Analyses of the reaction products of chlorine and certain hydrocarbons have been carried out by the University of Miami to determine the importance of chlorine in the atmospheric chemistry affecting the site on each day of the study. Preliminary results from in situ smog chamber tests, conducted during the study at the La Porte airport, show the potential effect of chlorine in accelerating ozone formation in the Texas Gulf Coast area.	The University of Miami is conducting additional analyses to calculate the contribution of chlorine to ozone impacting the La Porte airport site. (Available March 2001) The chemical mechanism of the photochemical model being used by the commission is being modified by a commission contractor to account for the role of chlorine emissions in enhancing ozone formation in the coastal area. (Available November 2001)
Aged Air Mass Chemistry	As an air mass ages, reactions that are not accounted for in the current chemical mechanisms may become important. Land/sea breeze regimes, typical of the Texas Gulf Coast area, can bring emissions transported out of the area in the early morning back into the area in the afternoon as aged compounds that mix with fresh emissions. Fixed site measurements at La Porte and the Williams Tower, and from three airborne laboratory aircraft, show evidence of aged air masses in the Houston area.	Chemical analysis and data validation are continuing. An extensive data set will result. NOAA and DOE scientists will evaluate the data to determine whether the products of photochemical reactions are adequately represented in the research grade models they use. Evaluation of the adequacy of current regulatory models to predict and handle aged air mass reactions will need to be arranged (responsibility currently undetermined; available March 2002). The regulatory photochemical models' chemical mechanisms may then need to be modified to account for the effect of aged air mass components on ozone formation (Responsibility currently undetermined. If task is necessary, available August 2002).

Topic	Description	Enhancements Having Potential Benefit for Mid-Course Review
Rapid Ozone Formation Due to Large Amounts of Reactive Hydrocarbons	The research level sites at the La Porte airport and the Williams Tower, as well as the NOAA, DOE, and TNRCC aircraft measured exceptional rates of ozone formation in the Houston and Gulf Coast area, and indicated the presence of large amounts of emissions of reactive hydrocarbon species from industrial sources.	Research grade chemical reaction mechanisms will be exercised to determine if the measured species account for the rapid formation of ozone. SOS, NOAA, and DOE scientists will run the research-grade models. If the measured species account for the rapid ozone formation, the mechanisms in the regulatory models will be tested to determine if they adequately represent the process (responsibility currently undetermined; available February 2002). If the mechanisms in the regulatory models are not adequate, they will need to be modified or replaced. (Responsibility currently undetermined. If necessary, available August 2002).
Enhancements to the State-of-the-Science in Meteorological Modeling		
MM5	Extensive data from radar profilers, acoustic sounders, weather balloon sites, surface networks, and the NOAA and DOE aircraft are available from the intensive study period for checking the performance of MM5 in generating meteorological fields for photochemical modeling.	Check MM5 performance when it is run in retrospective mode for the entire Texas 2000 Air Quality Study period (available February 2002) (responsibility current undetermined) As a result of the MM5 testing, enhancements may be made to MM5, the input data to MM5, or both. (Responsibility is currently undetermined; available August 2002).

Topic	Description	Enhancements Having Potential Benefit for Mid-Course Review
Heat Island Effect	During the study, a thermal mapping project of Houston was conducted using specially instrumented NASA aircraft. In addition, NOAA collected ground-based data to "ground truth" the NASA data.	The ground-based data are being analyzed by NOAA. It is not yet determined who will analyze the NASA aircraft data. The data will be compared with the initial results from MM5 for the period of the thermal mapping in order to determine whether the meteorological model produced the correct heat island signature. Work will be performed under the first part of the MM5 item immediately above. (Responsibility is currently undetermined; available February 2002). Results of the heat island task may lead to the need for further enhancements to MM5. (Responsibility is currently undetermined. If necessary, available August 2002).
Emissions Inventory Improvements		
Hourly Point Source Emissions for Selected Episodes	For episodes selected from the period of the Texas 2000 Air Quality Study, the largest emitting sources in portions of the modeling domain will be asked by the commission to supply detailed, speciated hourly emissions inventory data.	The hourly emissions will be compiled by the TNRCC emissions inventory staff. These emissions will be important for the photochemical modeling due to the dependence of ozone formation on the timing of emissions. (Hourly inventory available September 2001)

Topic	Description	Enhancements Having Potential Benefit for Mid-Course Review
Unscheduled, Nonuniform, and Unquantified Emissions	VOC data were obtained at the La Porte airport, from the Williams Tower, and from NOAA, DOE, and TNRCC aircraft.	One of the study's tasks will be to investigate the potential extent of unscheduled, nonuniform, and unquantified emissions through a comparison of the surface, tall building, and aircraft data with the hourly point source emissions inventory data described above. NOAA and DOE will carry out analyses to determine whether the measured VOCs in the air are accounted for in the hourly emissions inventory. Results of these analyses may indicate that there are missing sources in the inventory that need to be determined, or sources which need to be better refined chemically, spatially or temporally. (Responsibility is currently undetermined; first results available September 2002)
Mobile Source Tunnel Study	A study was conducted in the Washburn Tunnel to obtain data for pollutants including speciated volatile organic compounds and nitrogen oxides, along with vehicle mix data.	The results of the tunnel study will help validate mobile source emissions data for the area. Default mobile source emission profiles may need to be modified. The University of Texas at Austin will conduct some of the work. (Additional resources may need to be determined; available August 2001). Compare results of the tunnel study to MOBILE 6 emission estimates (available February 2002)
Large Amounts of Reactive Hydrocarbons	Measurements obtained by NOAA and DOE show that the Houston and Gulf Coast area are characterized by large amounts of emissions of reactive hydrocarbon species from industrial sources. Data are available from VOC analysis at the La Porte airport, the Williams Tower, and the NOAA, DOE, and TNRCC flying laboratories.	NOAA and DOE will make comparisons of the ambient data with the ozone season emission inventories currently available, as well as the hour-specific inventories that will be available from the study. The results of the comparison will help determine whether the emissions inventory from industrial sources fully account for all the reactive hydrocarbons actually present. If not, substantial additional work may be required to resolve the discrepancies and improve the emissions inventory inputs to the photochemical model (Responsibility is currently undetermined. First results available September 2002).

7.3 PHASE I - INCORPORATING THE SCIENCE (12/00 - 5/02): EPISODE IMPROVEMENT - SEPTEMBER 1993 EPISODE

As part of this phase, the commission will conduct remodeling of the September 1993 ozone episode using available enhancements to the state-of-the-science with updated data and assumptions. Projected tasks and schedules for the remodeling of this episode are summarized in Table 7.3-1.

Table 7.3-1 Schedule for First Phase of the Mid-Course Review Process - Remodeling of the September 1993 Episode

Task	Start Date	Completion Date
Enhancements to photochemical model		
Upgrade to model's chemical mechanism to account for chlorine chemistry (from results of Texas 2000 Air Quality Study)	January 1, 2001	November 30, 2001
Plume-in-Grid evaluation	January 1, 2001	November 30, 2001
Incorporation of Process Analysis	Ongoing	January 1, 2001
Enhancements to base case emissions inventory		
Updated non-road mobile source inventory	December 1, 2000	November 30, 2001
MOBILE6 released		January 31, 2001
Biogenics updates	January 1, 2001	November 30, 2001
Updated area source inventory	January 1, 2001	November 30, 2001
Software revised by TTI (to couple MOBILE6 with travel demand model)	February 1, 2001	July 31, 2001
Updated mobile source inventory based on MOBILE6	August 1, 2001	November 30, 2001
Enhancements to future case inventory	January 1, 2001	November 30, 2001
Enhancements to meteorological modeling	January 1, 2001	November 30, 2001
Photochemical modeling		
Base case modeling	December 1, 2001	March 31, 2002
Future base case modeling	April 1, 2002	April 30, 2002
Future case modeling of control scenarios	May 1, 2002	May 31, 2002
Rule development of any new technologies, direct substitutions, changes due to scientific advances or additional legislative direction	May 1, 2002	November 30, 2002

7.3.1 Enhancements to the State-of-the-Science of Photochemical Modeling

One of the major enhancements to the state-of-the-science in photochemical modeling that the commission believes can be made in time for the remodeling of the September 1993 episode is an upgrade to the photochemical model's chemical mechanism to account for chlorine chemistry. This enhancement will occur largely from results of the Texas 2000 Air Quality Study. The role of chlorine in ozone formation, as well as the upgrade to the model's chemistry, are discussed in more detail in Table 7.2-1.
Other enhancements which may be available in time for the remodeling of the September 1993 episode include the following:

- Modification of the "plume-in-grid" algorithm in the photochemical model:

  The plume-in-grid algorithm allows "staged mixing" of point source plumes in the model in an attempt to realistically simulate plume mixing. This algorithm is already in CAMx, the photochemical model the commission is currently using, but should be evaluated to determine whether it needs to be modified for application specifically to the Texas Gulf Coast.

- Incorporation of "process analysis" into the photochemical model:

  Process analysis is a detailed accounting of all physical and chemical processes that contribute to the predicted concentration of ozone or other species in the photochemical modeling domain. Process analysis identifies the emission categories and source regions contributing to the modeled ozone concentration in each grid cell of the model. It also provides a detailed analysis of specific chemical processes simulated in the model application. As such, process analysis can contribute greatly to our understanding of how ozone is formed and transported. Process analysis is currently being incorporated into CAMx, the model being used by the commission.

7.3.2 Enhanced Base Case Inventory

The base case inventory for the September 1993 episode will be updated. The emissions updates will be made using new or revised emissions models, emissions and activity data for specific sources or types of sources, and other updated information and procedures. The commission anticipates that, considering the overall schedule for remodeling the 1993 episode, updates will be made primarily to area, mobile, and offshore sources.

<u>Area and Mobile Sources</u>

Enhancements expected to be made to the area and mobile source components of the emissions inventory should result in emissions estimates more reflective of local conditions and better spatial allocation of emissions. Enhancements to the emissions will be accomplished with the use of newly released EPA computer models for providing estimates and projections of emissions, more local emissions source activity data developed from Emissions Inventory Improvement Program (EIIP) prescribed survey methods, special studies, and better use of Geographic Information System tools for estimation and allocation of emissions on a location specific basis. The following are several of the planned emissions inventory improvement projects that should benefit the remodeling of the September 1993 episode.

- Implementation of the EPA's new on-road mobile source emission factor model, MOBILE6:

  The latest version of the EPA' s MOBILE model is expected to be released in January, 2001. A contract is in place with the Texas Transportation Institute (TTI) to develop the computer software tools to allow this model to be run in conjunction with the local travel demand models used in urban areas for transportation planning. This will allow the development of travel link based running emissions and trip start and stop based emissions to be located at the trip beginnings and ends.

- Implementation of EPA's new non-road mobile source emissions model, NONROAD:

  This model provides an improved technique for analysis of local non-road equipment emissions activity. While the draft version of this model has been initially used in conjunction with the analysis of construction equipment emissions, broader use of the model with other local equipment activity and load factors (based on local survey data) is expected.

- Incorporation of EIIP-recommended survey methods for significant area source categories:

  While many of the current area source category emissions are based on EPA's top-down method of allocating national data to States based on surrogates such as employment, the use of EIIP local survey methods can significantly improve emissions data. The commission will be working with expert contractors to identify categories most likely to benefit from local surveys and, based on survey findings, will update emissions data accordingly. If time allows, identification of source categories upon which to focus improvements will also consider information developed from the Texas 2000 Air Quality Study in cases where significant discrepancies are revealed between the existing emissions inventory data and ambient samples taken during the study. The commission expects to conduct surveys for at least two area source categories by the fall of 2001.

- Enhancements to biogenics inventory:

  Although considerable enhancements have been made to the Texas biogenics emissions inventory through field and other studies, additional work needs to be conducted to further enhance this inventory. A task which is projected to be completed in time to benefit the update to the 1993 base case episode is the improvement of solar radiation data needed as input to biogenics models.

Offshore Sources

Offshore emissions are created by point and area sources such as shipping, oil and gas operations, recreational boating, and the transfer of liquids from one vessel to another. The commission plans to investigate ways for enhancing the offshore inventory. Available enhancements will be incorporated into the inventory for the remodeling of the September 1993 episode.

7.3.3 Enhanced Future Case Inventory

An updated future base case inventory for 2007 will be developed for the September 1993 episode. The future point source inventory will incorporate the latest available EPA emission factors and Point Source Data Base emissions, coupled with the most current growth assumptions in point sources. Mobile source emissions will be estimated using MOBILE6 and travel demand modeling results for the future year. Wherever possible, local municipal planning data will be used to estimate the magnitude and spatial extent of future emissions from area and non-road sources. For use with area and non-road source emissions projections, the EPA is expected to release by the end of 2000 an updated version of the Emissions Growth Analysis System (EGAS), which will incorporate a more recent and robust set of economic forecast data for application to emission source activity data.

7.3.4 Enhancements to the State-of-the-Science in Meteorological Modeling

The commission plans to use the Fifth-Generation National Center for Atmospheric Research/Penn State Mesoscale Model (MM5) to develop meteorological fields for the remodeling of the September 1993 episode. This meteorological model incorporates state-of-the-science enhancements over previously used meteorological models.

The commission is currently working to evaluate the performance of MM5 in the Texas Gulf Coast area and to make enhancements to MM5. One such enhancement involves "hydrological-meteorological coupling", whereby a hydrological model will be coupled with MM5 to allow the model to simulate the effect rainfall and runoff have on temperature and wind fields.

7.3.5 Rule Development

New Technologies

As new technologies are demonstrated to be proven and certified by EPA, if necessary, the commission will adopt them as necessary to cover any shortfall that may exist.

Direct Substitutions

The commission prefers technology-based solutions to activity-based or life style changing regulations. As new technologies are proven and certified by EPA, if necessary, the commission will consider substituting these strategies provided there are still significant potential reductions from new technologies to cover any shortfall that may exist.

Changes due to Scientific Advances

As improvements are made to the modeling efforts of the September 1993 episode the commission is willing to consider revisions to any control strategies that new science indicates are warranted.

Additional Legislative Direction

The Texas legislature may initiate substantial new programs that cannot be incorporated into the short term process. These will also be addressed in this phase I timeframe.

Aspects of the following measures have been identified as requiring legislative authorization before implementation by the TNRCC: energy efficient building codes; vehicle scrappage; telecommute and other commute-reducing programs; incentive programs for cleaner cars including feebates, tax incentives, and free parking; cleaner fleets; VMT reduction programs involving tax incentives and e-commerce.

7.4 PHASE II - INCORPORATING THE SCIENCE (12/00 - 5/04): NEW EPISODE(S)

The commission believes that for the ultimate mid-course review submittal, additional episodes will need to be modeled to ensure attainment. The combination of unique meteorological conditions and the large industrial complex along the upper Texas Gulf coast has presented challenges in modeling ozone episodes in the area. The rapid formation of ozone at a limited number of monitors has been particularly difficult to duplicate in the existing photochemical models. This phenomena was observed several times during the Texas 2000 Air Quality Study (TexAQS). The commission has a long history of supporting enhancements to the models and associated tools and input data, and has made improving the science and tools supporting SIP development for Texas areas a top priority in the coming years. The commission is committed to working in cooperation with affected parties to ensure the modeling used to develop effective control strategies for the area will use the most current scientific information to replicate high ozone episodes in the area.

There are two main categories of new high ozone episodes that the commission will be considering. First, a classic, well defined "flow reversal" or land/sea breeze case needs to be selected and modeled, as this type of episode is most commonly associated with high ozone in the Texas Gulf Coast area. While the September 1993 episode was characterized by highly elevated ozone, and by some days having an early land breeze and subsequently a sea breeze, the afternoon sea breeze was somewhat weak and did not penetrate very far inland. Thus, the episode was not considered a classic flow reversal case. Regarding the second ozone episode category, an episode needs to be modeled from a period during which enhanced emissions, air quality, and meteorological data are available, such as the period during the intensive Texas 2000 Air Quality Study. Episodes from the study period will be analyzed to determine whether they meet both the classic flow reversal criteria and the enhanced data criteria. If so, modeling of one additional episode may suffice. Otherwise, the commission may need to select one episode from the period of the intensive study, and choose another recent episode from a period exhibiting the classic flow reversal regime. Selected episodes should have concentrations that are close to the design value at each monitoring site to help insure that controls are effective in attaining the ozone standard. It should be noted that, in actuality, several episodes may need to be modeled initially, since it is not at all unusual for there to be model performance difficulties with selected episodes.

The modeling of the additional episode or episodes will incorporate enhancements to the state-of-the-science. The commission expects that there will be enhancements available for the modeling of the new episode or episodes during phase II that will not be available for the remodeling of the September 1993 episode during phase I. These additional enhancements will be discussed in subsequent subsections.

Projected tasks and schedules for the modeling of a new episode or episodes are summarized in Table 7.4-1.

Table 7.4-1. Schedule for Second Phase of the Mid-Course Review Process - Modeling of New Episodes

Task	Start Date	Completion Date
Enhancements to photochemical model		
Upgrade to model's chemical mechanism to account for aged air mass chemistry (from results of Texas 2000 Air Quality Study)	March 1, 2002	August 31, 2002
Upgrade to model's chemical mechanism to account for rapid ozone formation due to large amounts of reactive hydrocarbons	March 1, 2002	August 31, 2002
Development of base case emissions inventory, **including any enhancements**		
Point source inventory	January 1, 2001	December 31, 2001
Non-road mobile source inventory	June 1, 2002	December 31, 2002
Area source inventory	June 1, 2002	December 31, 2002
Tunnel study analysis	January 1, 2001	February 28, 2002
Mobile source inventory	June 1, 2002	December 31, 2002
Biogenics updates	June 1, 2002	December 31, 2002
Development of future case inventory for 2007	January 1, 2003	April 30, 2003
Development of meteorological modeling, including enhancements	June 1, 2002	December 31, 2002
Photochemical modeling		
Base case modeling	January 1, 2003	April 30, 2003
Future base case modeling	May 1, 2003	May 31, 2003
Future case modeling of control scenarios	June 1, 2003	June 30, 2003
Rule development of any new technologies, direct substitutions, changes due to scientific advances or additional legislative direction	July 1, 2003	November 30, 2003

7.4.1 Enhancements to the State-of-the-Science of Photochemical Modeling

For the new episodes, enhancements are planned for the photochemical modeling in addition to those previously discussed for the remodeling of the September 1993 episode. These additional enhancements, which will occur as a result of the Texas 2000 Air Quality Study, involve potential upgrades to the model's chemical mechanism to account for aged air mass chemistry, and upgrades to account for rapid ozone formation due to large amounts of reactive hydrocarbons. These enhancements are discussed in more detail in Table 7.2-1.

7.4.2 Enhanced Base Case Inventory

Base case inventories incorporating the latest in the state-of-the science will be developed for the new episodes. Emissions updates will be made using new or revised emissions models, emission factors, emissions and activity data for specific sources or types of sources, and other updated information and procedures. The following are some anticipated additional enhancements that are not expected to be available for the first phase of the mid-course review.

Point Sources

As described in detail in Table 7.2-1, there will be several enhancements made to the point source inventory based on results from the Texas 2000 Air Quality Study. These enhancements involve the development of hourly emissions for the selected episodes; unscheduled, nonuniform, and unquantified emissions; and modification of emissions inventories to account for large amounts of reactive hydrocarbons. Other tasks or activities that will be involved in the updating of point source emissions are as follows:

- Update of emission factors:

  Emission factors continue to be updated by the EPA. As these factors are updated, the commission requires industry to use the latest factors in updating their emissions inventories. Staff reviews the calculations and ensures the latest and consistent factors are used.

- Point Source Database (PSDB) tasks:
  Comparisons will be made between the Point Source Database (PSDB) and the Toxic Release Inventory to locate under-reporting of hazardous air pollutants and to correct the data. Comparisons will also be made between the PSDB and other databases such as the EPA's acid rain database to detect possible discrepancies. The acid rain database will also provide day-specific emissions.

Mobile and Area Sources

- Use of tunnel study data to help validate mobile source inventory:

  In addition to the enhancements discussed previously for the September 1993 episode, the mobile source inventory may be upgraded based on the results of a tunnel study conducted during the Texas 2000 Air Quality Study. The tunnel study and its use in enhancing the mobile source inventory are described in Table 7.2-1.

- Enhancements to biogenics inventory

  As noted in the discussion of the September 1993 episode, considerable enhancements have been made to the Texas biogenics emissions inventory through field and other studies. However, more work needs to be conducted to further enhance this inventory. A potentially very important biogenics task which may be conducted in time to benefit the new episode modeling is an evaluation of the response of plant species emissions to very high temperatures during the ozone season.

7.4.3 Revised Future Case Inventory

Future case inventories for 2007 will be developed for the additional episode or episodes. The future case inventories will be developed using the same procedures described for the modeling of the September 1993 episode.

7.4.4 Enhancements to the State-of-the-Science in Meteorological Modeling

As in the case of the September 1993 episode, the commission plans to use MM5 to develop meteorological fields for the modeling of additional episodes.

For the new episode modeling, enhancements to MM5 may be made in addition to those discussed previously. The Texas 2000 Air Quality Study provided extensive meteorological data which can be used for evaluating MM5 performance for the period of the study. Also during the Texas 2000 study, a heat island study was performed for the Houston area. Results from the heat island study will be used for further evaluating MM5 performance. Depending on the results of the MM5 performance testing using the above described data, enhancements may be made to this model.

7.4.5 Rule Development

New Technologies

As new technologies are demonstrated to be proven and certified by EPA, the commission will adopt them as necessary to cover any shortfall that may exist.

Direct Substitutions

The commission prefers technology-based solutions to activity-based or life style changing regulations. As new technologies are proven and certified by EPA, if necessary, the commission will consider substituting these strategies provided there are still significant potential reductions from new technologies to cover any shortfall that may exist.

Changes due to Scientific Advances

As improvements are made to the modeling, the commission is willing to consider revisions to any control strategies that new science indicates are warranted.

National Regulatory Changes

As federal regulations are promulgated, either on sources of emissions or other standards, the commission will evaluate their impact on the control strategy and incorporate changes as appropriate.

7.5 MID-COURSE REVIEW

The development of the attainment demonstration SIP for the HGA area has proved to be an extremely challenging effort, due to the large magnitude of reductions needed for attainment and the shortage of readily available control options. The emission reduction requirements included as part of this SIP revision represent substantial, intensive efforts on the part of stakeholder coalitions in the HGA area, in partnership with the commission. These coalitions, involving local governmental entities, elected officials, environmental groups, industry, consultants, and the public, as well as the commission and EPA, have worked diligently to identify and quantify control strategy measures for the HGA attainment demonstration.

In preparing this attainment demonstration, the commission has drawn upon resources, both within the state and across the nation, to attempt to identify control measures that are effective and reasonable. Several leading-edge, innovative control technologies are now approaching an advanced state of development due to the role played by Texas stakeholders and others in aggressively pursuing new ozone control technologies. The nonattainment areas in our state, as well as nonattainment areas in other parts of the country, will be the direct beneficiaries of this proactive approach in Texas.

As promising as these new technologies may be, however, they alone are not yet fully developed to bring the HGA area into attainment. There are test programs already initiated evaluating all of these new technologies which will provide the commission with the necessary information to base decisions on during the full continuum of the mid-course review. Ideally, this attainment demonstration would rely upon technical solutions that provided the cleanest possible automobiles and trucks, ships, locomotives, aircraft, construction equipment, etc., within a few years' time. Unfortunately, the current state of technology, coupled with the inevitable lag time to achieve significant equipment turnover, prevents a purely technical solution from being a reality by 2007, the attainment year.

For this reason, the commission must implement measures that rely on behavioral changes, in addition to technological controls. The task of attaining the federal ozone standard within the schedule mandated by the FCAA leaves little choice but to leave no stone unturned in the search for additional reductions. The commission is willing to consider any and all alternatives to the proposed attainment demonstration rules, as long as the reductions are achieved in the necessary quantity and within the proper time frame to guarantee attainment.

A problem with identifying alternative control strategies is federal preemption, prescribed by the FCAA, in controlling on-road and non-road vehicles, ships, locomotives, and aircraft, among other sources. As a result of these preemption requirements, Texas is prohibited from effectively addressing all of the sources of air pollution that must be reduced if attainment is to be achieved. This situation conflicts with the FCAA's presumed intention of having federal controls act in cooperation with state and local measures to reach attainment of air quality standards. For this reason, the state emphatically calls on EPA to accelerate its activities, which also happen to be mandated by the FCAA, in promulgating emission controls for these sources.

In order to ensure that the HGA area is in attainment by 2007 and that the controls to get there are the most cost effective technology based solutions possible, the commission has committed to performing a mid course review. The mid-course review process has already begun and will continue, ultimately resulting in a SIP revision by May 1, 2004.

This effort will involve a thorough evaluation of all modeling, inventory data, and other tools and assumptions used to develop the attainment demonstration. It will also include the ongoing assessment of new technologies and innovative ideas to incorporate into the plan.

The commission commits to continue working with EPA and the HGA regional stakeholders in an open, public consultative process to ensure that the mid-course review is a comprehensive and thorough evaluation.

Furthermore, the commission asserts that the science today supports that the reductions embodied in this plan to occur by 2005 are a necessary step towards attaining the standard. Beyond that the commission believes it must complete the full mid-course review analysis to determine the extent to which additional reductions must occur. The commission commits to adopting any additional measures necessary to achieve these reductions no later than May 2004.

The commission believes it has identified sufficient potential reductions from new technology and programs in excess of those necessary to reach attainment. These excess reductions represent sufficient backstop measures should some technologies prove to be not as effective as anticipated.

The commission also believes EPA has sufficient authority under the FCAA to ensure the state follows through with its commitments and that the identification of additional backstop measures is unnecessary.

Future Economic Growth: The commission is committed to developing an approvable attainment demonstration that achieves the significant reductions necessary to ensure attainment of the ozone standard in the HGA by 2007 and yet still maintains a robust economic growth. As a part of the ongoing review between 12/00 and 5/04, the commission will continue to evaluate the ability to modify the SIP to incorporate additional reductions from Federal programs and new technologies beyond 2007. These changes will lead to necessary revisions to the control strategies, particularly with regards to the allocations issued under the Cap and Trade program, to allow for growth in all economic sectors.

Federal Responsibilities: In order to accomplish everything necessary for a successful mid-course review, EPA will play a significant role, particularly with regards to three areas.

- **Certification -** There are a number of new technologies which EPA needs to certify. EPA's certification process has historically been cumbersome and time consuming. EPA needs to streamline this process such that the technologies that are being developed and proven can be ready for regulatory development prior to the mid-course review. EPA must complete this process prior to May 1, 2004 for as many technologies as possible. EPA must work hand in hand with the TNRCC and stakeholders to expedite the certification and verification processes. Additionally, EPA has to certify the reduction potential from all certified technologies. This too is a time consuming process that needs to be refined and streamlined.

- **National Regulatory Changes -** EPA is contemplating a number of regulatory changes. However, historically EPA has not operated with the same constraints states must face in developing approvable attainment demonstrations. In order for the commission to have a sound technology-based SIP by 2004, EPA must move expeditiously with their programs and ensure reductions are occurring prior to the 2007 attainment date. EPA needs to work with other Federal agencies (DOE, FAA, FERC, DOAg...) To ensure the programs are comprehensive and address all sources of emissions controlled by the federal government.

- **New Technological Advances -** Currently states are being placed in a position of fostering the development of new technologies for use in attainment demonstration SIPs. EPA must put resources towards the development of new technologies at the national level if states stand a chance of developing technology-based solutions to the attainment issues in their cities.

Future Commitments - Innovative Technology
Emission reductions expected from the following measures are 0-68 tpd.

Enforceable Commitments for Emission Reductions - Technology Ideas

These are commitments to adopt measures and the commitments will be submitted with the December 2000 SIP. They may ultimately become rules in the future and will complete the attainment demonstration for the HGA area.

Table 7.5-1 Estimated Reductions from Technology Ideas

Measure	**Estimated Reductions**
Commercial and Residential A. C. units	0 to 13 tpd
Diesel Emulsion	0 to 10 tpd
NO_x reduction systems	0 to 15 tpd
Diesel I/M	0 to 5 tpd
Gas additives	5 to 20 tpd
Fuel cells	0 to 5 tpd
Total	**0 to 68 tpd**

1) Air Conditioning

One of the control strategies proposed by the commission on August 9, 2000 was a requirement for ozone reducing technology in residential and commercial air conditioning units, supplied or installed after January 1, 2002. This new technology involves applying a paint-like coating to the surface of a heat exchanger (i.e., the outdoor coils and fins of an air conditioning condenser) to convert ozone-laden air, which passes across the coated surface, to oxygen.

Throughout the comment period the commission received indications that further analysis of this technology was necessary before a regulation was put into place. The commission has conducted a study at a test site in Houston, which was financed by the catalyst manufacturer, to determine the ozone reduction efficiency of this technology.

The commission is of the understanding that the catalyst manufacturer will work with the air conditioning manufacturers to conduct additional studies throughout the summer of 2001 and could be in a position of determining the efficacy of this technology early in 2002.

2) Diesel emulsion

Diesel emulsion fuel is an emergent fuel technology that relies on a water-in-fuel mixture to lower NO_x emissions. The water content lowers flame temperature by absorbing latent heat in the combustion chamber, using the same principle of thermodynamics as injecting water into a turbine. There are three components to diesel emulsion fuels: 1) diesel fuel; 2) water, usually 10% to 20% by volume; and 3) a diesel emulsion additive which suspends the fuel and water together. The diesel emulsion fuel can be blended by the diesel emulsion fuel distributor or blended on site using a fuel metering system.

Lubrizol Corporation and Clean Diesel Technologies are two companies that are currently developing a diesel emulsion fuel. Lubrizol is working with the City of Houston and the Port of Houston on a variety of testing applications. Lubrizol is also currently involved in the EPA certification process. Tier 1 health effects documentation has already been submitted to EPA by Lubrizol. The Tier 2 laboratory testing information has not yet been submitted to EPA. Until all testing information has been submitted, approved by EPA, and has been through EPA's emission reduction verification process, Lubrizol is pre-empted from introducing their product into commerce.

Lubrizol's initial indications are that diesel emulsion could reduce NO_x by up to 30%. Clean Diesel Technologies has estimated the NO_x reduction to be at least 20% with emulsion alone and up to 65% when the emulsion is combined with an after treatment device.

EPA OTAQ staff has indicated that this process should be complete within two to three years. Therefore, the commission feels it is reasonable to plan for the adoption of a diesel emulsion strategy for the HGA area by 2004.

3) Diesel NO_x Reduction Systems

This strategy would require owners or operators of on-road or non-road vehicles or equipment manufactured prior to model year 1997 having a heavy-duty on-road or non-road engine and fueled by gasoline, diesel, diesel emulsion fuel or any alternate fuel to use exhaust systems that will achieve an 80% reduction in NO_x emissions from what the engine would emit without the exhaust system. Examples of exhaust systems that could be used include NO_x adsorbers, methane catalysts, diesel oxidation catalysts, selective catalyst reduction, lean NO_x catalysts, and other exhaust after-treatment systems. Numerous other studies are also being conducted on various reduction systems. Some examples of such studies are described below.

The City of Houston is currently planning a diesel fuels and retrofit field demonstration. Baseline emissions testing is currently being completed on the 29 vehicles and equipment that constitute the City's diesel field demonstration.

Emissions testing of the retrofitted equipment will be conducted as soon as possible after the initial round of baseline emissions testing is completed. It is likely that most pieces of equipment will have used the retrofit and/or fuel options for several weeks prior to the retrofit emissions tests being conducted. At the time of the retrofit emissions tests, a determination will be made whether another baseline emissions test will be needed. If another baseline emissions test is required due to concerns about changes in engine performance or degradation, another retrofit emission test will be conducted to include data from points in the engine and exhaust cycles that sample from both pre- and post-retrofit devices. Thus, data will be available to determine if there are any significant variations in engine out pre-retrofit device emission, as well as the results of the emissions post-retrofit device. If warranted, the retrofit devices will be removed and another baseline test will be conducted. Any comparable issues with non-typical fuels will be handled similarly. This process will assure accurate, reliable results.

Given that the retrofit emission tests will be done as soon as possible after installation, there will only be a limited number of post-retrofit emissions tests which will be conducted after the 25% useful life requirement of the proposed EPA draft in-use testing protocol. Another round of selected post-retrofit emissions tests will be conducted toward the end of the field demonstration (May or June 2001) to obtain additional information on emissions for those devices with the highest usage or the most promising emission reductions.

Another study involves the Port of Houston. The Port will soon install SCR emission control devices from two different makers on gantries. These tests are being done to evaluate reliability and emissions. The Port will share their results once they are available, which they anticipate to be no later than early 2001.

Other studies and/or tests are also being conducted on other types of NO_x reduction systems by companies such as Daimler/Chrysler and Cummins Diesel. Contingent upon EPA expeditiously certifying the creditable reduction potential from this technology, the commission feels it is reasonable to plan for the adoption of a NO_x reduction system strategy for the HGA area by 2004.

Therefore, the commission feels it is reasonable to plan for the adoption of a NO_x reduction system strategy for the HGA area by 2004.

4) Gasoline Additives

Fuel and engine performance have long been supplemented through a variety of additives. One of the first additives blended into gasoline at the pump as long ago as the 1920's was tetraethyl lead which resulted in a fuel commonly called leaded gas. The purpose of the lead was to 1) protect against very rapid wear of valve seats, and 2) reduce knock. Due to toxicity and because it will damage catalytic convertors, lead in gasoline has been prohibited in the U.S. for many years. Presently, cars designed for lead-free gas are built with hardened valve seats for more durability.

Currently, gasoline contains additives to reduce knock, inhibit corrosion and rust as well as improve performance. Further, performance additives include detergents, dispersants, anti-icers, combustion enhancers/modifiers, fluidizer oils and flow improvers.

As of January 1, 1995 all gasoline marketed in the United States must contain an EPA approved additive package with a detergent. Detergent in gasoline is critical to keep the fuel nozzles of injectors clear of varnish, gums and other deposits that can clog them. A clogged injector will result in incomplete combustion and then higher tail pipe emissions of raw hydrocarbons and so more pollution. In addition, detergents will minimize carbon deposits on valves, pistons and piston rings so the engine will operate more closely to its design capability and thereby emit fewer pollutants, and derive more potential energy from the gasoline consumed.

Research and development of gasoline additives is ongoing. The Infineum USA L.P. has developed a product called Vektron 6913 which, based on available evidence, seems to have a significant effect on NO_x emissions from gasoline powered vehicles. Vektron 6913 is registered with EPA as a gasoline additive containing a detergent. Historically gasoline additives blended in the fuel at the refinery have been used as anti-freeze and to enhance performance through reduction of carbon deposits and other harmful residues on fuel injectors, rings, pistons and valves.

Fleet tests with a variety of car and light truck models of various ages have indicated a 10% reduction in NO_x emissions as compared to results from use of RFG Phase 2 base gasoline as a control. A report entitled “Vektron 6913 Gasoline Additive NO_x Evaluation Fleet Test Program” prepared by the Southwest Research Institute of San Antonio details the research design and methods utilized for the study of Vektron 6913. Therefore, the commission feels it is reasonable to plan for the adoption of a gasoline additive strategy for the HGA area by 2004.

5) Diesel I/M

The commission hired a consultant to review the possible benefits of a heavy-duty diesel I/M program for the HGA area. The consultant reviewed in-use data from the National Renewable Energy Lab's alternative fuel vehicle database, from Southwest Research Institute, from the Colorado School of Mines, and from Parsons Engineering Science in Sydney, Australia. They also reviewed previous reports on the viability of HDD I/M, such as Radian's report to CARB done in 1989, and EF&EE's report to EPA done in 1998. From those sources the consultant developed the following conclusions.

Older vehicles with no NO_x control (model years 1989 and older) will not benefit significantly from I/M. They emit NO_x at inherently lower levels than their certification cutpoints. High NO_x emitters will undoubtedly occur in that technology group, but those will likely be few and far between. By 2007 vehicles in this age group have relatively low mileage accumulations and generate less than 10% of total HDDV NO_x emissions. Therefore, even if a benefit were feasible from these engines, absolute tpd reductions would be quite low due to ever decreasing activity.

For 1990-1998 model years, the data are highly influenced by the NO_x defeat devices. With that in mind the consultant assumed that a high-emitting vehicle in this age group would have emissions about the same level as the uncontrolled engines. The consultant believes that they would actually fail at higher NO_x levels than the uncontrolled engines, but this cannot be proven due to the defeat devices. Therefore, the in-use data show that repairing the high emitters to a cutpoint of 1.5 times the certification level would give approximately 8% reduction in fleet average emissions.

For 1999-2001 model years there is no in-use data to use at this time, so the same assumptions were applied as those in the 1990-1998 model year category.

For 2002-2007 model years (i.e. engines meeting the 2004 standards) the consultant referred to a recent report by Chris Weaver for EPA. Mr. Weaver estimated that all vehicles in this range would have EGR as the main NO_x reduction strategy. He also estimated that about 20% of those vehicles would have an EGR system failure during their lifetime. Since the EGR systems will be a relatively new technology, and because engines will accumulate close to 40% of their lifetime mileage by age 6 (according to MOBILE5), a 10% aggregate fail rate through 2007 was assumed. As EGR will typically reduce engine-out NO_x by 50% in diesels, an I/M repair benefit of 50% per vehicle was assumed.

A by-model-year output from MOBILE5b was used for Harris County to estimate the gram per mile emission factors and the relative contribution of the different model year groups for this calculation. VMT was taken from TTI's latest estimates. Once benefits were estimated in tpd for Harris County, the benefits were extrapolated to the remaining counties using VMT ratios.

In addition, in-use testing of HDDVs will become especially important as the 2007 engines are introduced, due to their reliance on after-treatment devices. This will not impact I/M benefit estimates for the 2007 year, however.

Therefore, the commission feels it is reasonable to plan for the adoption of a Diesel I/M strategy for the HGA area by 2004.

6) Fuel Cells - based on NO_x analysis
A fuel cell can use hydrogen in either a liquid or compressed form and will yield zero toxic emissions with water as the by-product of generation. Hydrogen is abundant from any number or sources, many of which

are regarded as renewable. Any fuel containing hydrogen is suitable with the use of a reformer to extract hydrogen from gasoline or methane, for example. Some emissions are produced, but are lower than from an internal combustion engine.

In addition to providing an alternative power for automobiles, fuel technology also has applications as a large stationary power source. The Port of Houston is in collaboration with the Houston Advanced Research Center, Reliant Energy and Texaco Oil to conduct a fuel cell demonstration project. The pilot project will cost about $1.5 million.

Initially, one ship from the Carnival Cruise Lines will receive some electricity from a fuel cell as an alternative to running its diesel generators while docked. The fuel cell generator is on land and will provide 250 kilowatts of power, or about 1/25 of the five megawatts a cruise ship at port requires.

Pipeline natural gas is the fuel source and CO2 and water result from the generation of electricity. Full scale application is anticipated to begin in the third quarter of 2001 and initial results are expected late 2001. Measurement of electrical output, general performance and emissions to be conducted. Excess electrical production can be sold back to the local utility.

Therefore, the commission feels it is reasonable to plan for the adoption of a fuel cell strategy for the HGA area by 2004.

7.5.1 Future Commitments - Innovative Ideas

These are measures which may become rules or other types of enforceable measures in the future to complete the attainment demonstration. The commission commits to evaluating and making a decision on these and other measures no later than May 2004.

Energy Efficiencies

Emission reductions expected from these measures are 0-20 tpd.

Energy efficiencies are a critical part of the agency's plan for clean air. Energy efficiency measures not only decrease NO_x emissions but also can have a significant reductions in other pollutants such as oxides of sulfur, VOCs, air toxics, and CO_2. These various efficiency measures when combined have the potential to add up to significant energy savings and emission reductions thereby contributing to the overall goal of clean air for Texas.

Energy efficiencies benefit air quality by decreasing the demand for electricity, and, thereby, decreasing the amount of power plant emissions. One of the challenges comes in quantifying and identifying, on a geographic basis, the amount and location of the emissions reductions. However, since Texas' electricity needs are primarily served by an isolated grid system controlled by Energy Reliability Council of Texas (ERCOT), the issues are confined to the state and may lend themselves to a regional intrastate approach. ERCOT power generation dispatch models, based on the economics of power generation, could be employed in these efforts.

TNRCC will work with EPA, the utilities, and other stakeholders to ensure that reductions in power generation as a result of energy efficiency measures result in actual decreases in emissions.

Table 7.5-2 outlines several ideas for energy savings. These are broken down into suggestions and ideas that could be or are being contemplated for implementation at the local, regulatory state agency, legislative, and federal levels.

Table 7.5-2 Initial Energy Efficiency Summary

Entity	**Measure**	**Estimated Reductions**	**Timing**
Ideas from the City of Houston Plan - Could be expanded to a broader area	Lighting Transformers Electric motors Split AC systems Programable thermostats New Appliances Duct Leakage improvements Improved Insulation Reduce Outside Air Needs Improved Certification for Inspectors	6.80 tpd 0.55 tpd 0.35 tpd 2.30 tpd 2.40 tpd 0.14 tpd 3.22 tpd 0.93 tpd 5.00 tpd 0.25 tpd	Starting Summer 2001
State Legislature adopted legislation	Senate Bill 7 Energy Efficiency Requirements - for HGA area - for DFW area	 0.05 tpd 0.09 tpd	Starting January 1, 2004
TNRCC	Evaluate Allowance Credits for Energy Efficiency Goals Evaluate a SEER Change for AC units	0-5 tpd 2.9 - 6.1 tpd	Evaluation starting 2001 Evaluation starting 2001
Federal Level Energy Efficiency Goals These measures consider replacement appliances to meet DOE's Energy STAR standards	Refrigerators Clothes Washers Lighting Dishwashers Room AC units Central AC units	0.17 tpd 0.33 tpd 0.39 tpd 0.16 tpd 0.22 tpd 0.65 tpd	Evaluation starting 2001

A. Local: City of Houston Initiatives

The City of Houston has completed an analysis of the potential of energy savings.   The following information was supplied by the City of Houston and includes the estimated reduction to be achieved through each activity. The concepts would apply to the entire eight counties. Application on a broader scale would result in even more emission reductions.

1. All new and replacement ballast to be electronic high efficiency types.

2. All lamps sold and used in the city limits are high efficiency types.

Lighting Examples:

Require the sale of 55 watt incandescent instead of 60 watt bulbs
Require the sale of 95 watt incandescent instead of 100 watt bulbs
Fluorescent F34T12 instead of F40T12
Encourage use of T-8 flourescent lamps and compact flourescent for replacement
Require use of T-8 and electronic ballasts for new construction and new fixtures

0.25 watts per square foot
1,000,000,000 square feet
10 hrs per day = 2,500,000 kilowatts per day
@363.64 MW/Ton = 6.875 tons NO_x per day (based upon an approximate reduction of 80%)

3. All new and replacement indoor dry transformers to have a minimum impedance of 4% or less.

Examples:

Typical transformers have an impedance of 5% or more. Four percent impedance transformers are readily available. Restricting the sale and installation of these transformers to the more efficient transformers could save 0.55 tpd NO_x.

4. All new and replacement electric motors to be E rated motors.

Examples:

The efficiency of electric motors varies with size. High efficiency motors are 5 to 15% more efficient and are readily available in 1/2 HP and larger sizes. In buildings, these motors are used for air conditioning and ventilation. In manufacturing, these power various types of equipment. This measure could save 0.35 tpd of NO_x.

5. All new or replacement package and split system AC units to be a minimum of 12 SEER.

The Texas legislature has passed laws to save water in the past as exemplified by the Water Conservation Plumbing Fixtures Legislation. If a similar law could be passed requiring a SEER change to 12 SEER, the City of Houston estimates as savings of 2.318 tpd of NO_x.

Note: This measure may require federal agency (DOE) or local building code changes.

6. All thermostats for all buildings to be programmable with proposed guidelines for operation. The guidelines would provide information that would increase the effectiveness of this measure.

Example:

Programmable thermostats properly operated will save at least 5% of the energy used for heating and air conditioning. Recognizing that not all will be operated properly, it is assumed this item will save 2% of the energy used and result in a reduction of 2.38 tpd NO_x.

7. All new major household appliances to be high efficiency type.

Example:

Pass legislation that all new major household appliances such as refrigerators, ice makers, through-the-wall AC units, washers, dryers, electric hot water heaters, etc. sold throughout the eight county area are the high efficiency type. Estimated emission reductions are 0.138 tpd NO_x.

Note: Requires legislative action, but proposed by City of Houston.

8. Impose strict duct leakage standards on all mechanical systems.

Example:

Revise the city mechanical code to impose strict duct air leakage standards on all new mechanical systems. Prohibit the use of flexible ducts in inaccessible areas. Estimated reductions are 3.22 tpd NO_x.

9. Specify minimum levels of insulation for residential and commercial buildings.

Example:

Specify minimum levels of insulation for residential and commercial buildings including duct insulation in unconditioned space:

Commercial:	
Roofs	R-19
Walls	R-13
Ductwork	R-6
Residential	
Roofs	R-30
Walls	R-15
Vaulted Ceilings	R-22
Ductwork	R-6

Savings: 0.928 tpd NO_x

10. Reduce the outside air requirements in the existing building code, and retroactively allow existing facilities to change to the new reduced air quantities.

Reduce outside air requirements in the existing city building code. Also, retroactively allow existing facilities to change to the new reduced air quantities. This will require prohibition of smoking in business places except for bars and restaurants. Reduction potential is 5 tpd NO_x.

11. The City of Houston could also begin licensing building operators, and require them to attend continuing education classes on energy efficient operating of building systems.

Upgrading Houston's existing Stationary Engineer license to require a facility operators license for larger buildings, emission reductions: 0.253 tpd NO_x

Total potential from City of Houston energy efficiency ideas: 21.46 tpd NO_x

B. State: Legislative Mandates

SB 7, 76th Texas Legislature

The Texas legislature, through passage of SB 7, during the 76th Texas Legislature, has made a commitment to improving air quality through an energy efficiency mandate to offset future growth in the demand of energy production. This environmental commitment is expected to reduce NO_x emission by about 0.05 tpd (41 MW) in the DFW area and by about 0.09 tons per day (22.6 MW) in the Houston/Galveston area. Since SB 7 applies to electric generating facilities across the state, additional analysis is being conducted to determine the extent of these expected reductions, as well. The legislation specifically requires a 10% reduction in growth of energy demand through energy efficiency requirements for utilities. The details of this plan are set out in Chapter 25 of the Public Utility Commission of Texas' rules.

Other Legislation

A number of state and local officials, as well as environmental and business groups, have expressed an interest in pursuing energy efficiency as a preferred option to additional controls on electric generating facilities. It is anticipated that the Texas Legislature may explore these ideas as well as the potential for energy efficient building code requirements and provide the commission with additional guidance or legislative direction.

C. State: State Regulatory Ideas

1. Increasing Efficiency of AC Units

The TNRCC is exploring options for working with industry as well as the federal government, local governments, and the Texas Legislature to increase the minimum efficiency standards for new air conditioning units. The current minimum standard for energy efficiency is 10 SEER. This is expected to increase to 12 or 13 SEER in the near future. There have been analyses completed by TNRCC and others on the impact of an increased minimum SEER standard.

TNRCC analysis:

The TNRCC analysis estimates a savings of 2.9 tpd of NO_x in the HGA area by 2007. This analysis assumes a 10 year life for AC units in Texas, and a minimum 10 SEER standard taking place at the national level in 1992. The analysis also takes into consideration the overall 93% reduction in power plant NO_x expected in the HGA area by 2007. The assumptions further include a 2% annual growth in new AC units, and that about 60% of the old 10 SEER and below units are replaced with higher efficiency units between 2002 and 2007.

Assuming a lesser overall minimum energy efficiency such as 9 SEER will increase the expected benefits of moving to a minimum 12 SEER unit. In addition, if the federal government acts in the next few years to make the minimum 12 SEER, and Texas is successful in requiring federal minimum SEER+2, the overall reductions would increase further.

Goodman Manufacturing analysis performed by Henwood Energy Services, Inc.:

An analysis was performed by Henwood Energy Services, Inc. under contract with Goodman Manufacturing and supplied to TNRCC. This analysis, using a power generation dispatch model adapted to predict NO_x emissions, covers the ERCOT region. The region includes most of Texas except for some areas in far west Texas and some of southeast and northeast Texas. The analysis considered the energy saved from the expected normal replacement of central air conditioners in only the eight county HGA area with higher efficiency (12 SEER) central air conditioner units over the currently mandated minimum efficiency rating (10 SEER). Emissions reductions through these energy savings were calculated on a monthly basis using a load curve to predict air conditioner demand. The calculations yield a range of emissions reductions from 0.3 tpd NO_x in the cooler months to 18.1 tpd NO_x in the warmer months. If the energy savings are distributed evenly over the hours in the day and days in a month the emissions are tempered with a peak reduction of 6.1 tpd. The emissions reductions are predicted to occur in various regions of the state with benefit directly to the HGA non-attainment area as well as other non-attainment and near non-attainment areas of the state.

D. Federal: Increased Efficiency for Appliances

During the 1970s and 1980s, many states began to recognize the potential for saving energy by setting minimum standards for appliances. The Energy Policy and Conservation Act (EPCA) of 1975 established an energy conservation program for major household appliances. This Act required that certain types of new appliances bear a label to help consumers compare the energy efficiency among similar products. In 1980 the Federal Trade Commission's Appliance Labeling Rule became effective requiring certain appliances to bear labels identifying energy consumption characteristics of household appliances.

Minimum standards of energy efficiency for many major appliances were established by the U.S. Congress in the National Appliance Energy Conservation Act of 1987 which amended the earlier Energy Policy Act of 1975. Its key element was the setting of initial federal energy conservation standards for consumer products.

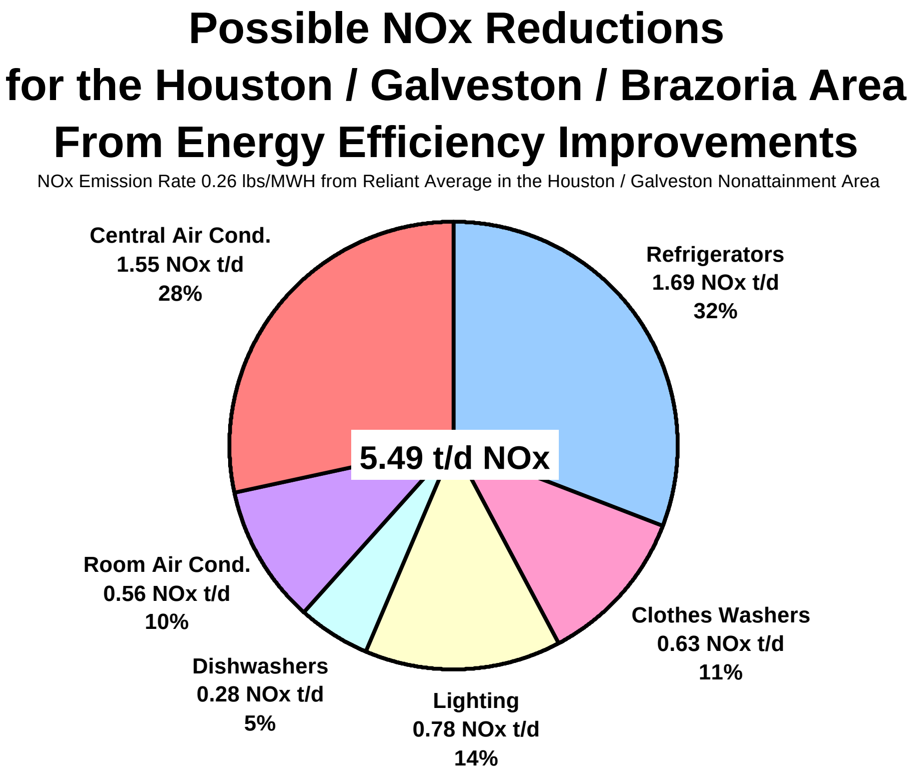
Next came the creation of the National Appliance Energy Conservation Amendments of 1988 and the Energy Policy Act of 1992 which amended the National Appliance Energy Conservation Act of 1987. The Energy Policy Act of 1992 expanded coverage of commercial equipment and provided for voluntary testing and consumer information programs. The residential appliance and commercial equipment area carries out activities that are considered necessary to successfully complete legislative requirements contained in the statutes.

Appliance manufacturers must produce products that either meet the minimum level of energy efficiency, or consume no more than the amount of energy that the legal standard for each type of appliance allows. These rules do not affect the marketing of products manufactured before the standards went into effect, and any products that were already manufactured and in stock can be sold. These new standards are and have been intended to create energy savings as well as reduce fossil fuel usage and air pollution emissions.

DOE is responsible for developing the test procedures for the Appliance Standards Program which are published in the CFR (10 CFR Chapter II, Part 430). DOE periodically issues new standards for certain appliances which are published in the *Federal Register*. Any amended or new standard must achieve the maximum improvement in energy efficiency that is determined by DOE to be technologically feasible and economically justified.

Through the search for energy efficiency a program called Energy Star was created. It is a voluntary partnership between DOE, EPA, product manufacturers, local communities, and retailers. Partners help promote efficient products by labeling them with Energy Star logos, and educating consumers about energy efficiency. Energy Star provides for voluntary partnerships to promote energy efficiency, reduce air pollution, and save money for residential home owners and commercial businesses alike.

There are also local pilot programs which provide incentives for acceleration of the purchase of more efficient household appliances, which include ideas such as buy-back programs or tax rebates.



Emission Reduction Potential Assumptions:
The following estimates are based upon the weighted average NO_x emission rate of generators operated by Reliant Energy inside the 8-county HGA nonattainment area, after 93% NO_x controls have been applied. Use of different emission rates or assumptions would change the results.

Most energy efficiency standards are taken from the web pages (DOE), although some are from the City of Houston, the Association of Home Appliance Manufacturers (AHAM) and the Appliance Recycling Centers of America (ARCA).

While efficiency standards data is readily available, current efficiency, equipment population, and usage data are scarce and have been approximated.

Results:
The pie chart shows the potential NO_x reductions from energy efficiency improvements, which is the product of current energy consumption, percent gains in efficiency, the number of units, frequency and duration of use.

The largest categories are the combination of central air conditioners and room air conditioners. While there is some question about the split between central and room air conditioners, the sum of all air conditioners is in close agreement with previous estimates.

Refrigerators are the second largest category, largely because their very long lifetimes allow inefficient units to remain in service for many years. While lighting and clothes washers are modest, together they add up to 25% of all power use.

Table 7.5-3 NO_x Reduction Benefits from Appliance Energy Efficiency Upgrades

Houston/Galveston/Brazoria NO_x emission rate 0.26 lbs/MWH Reliant HG8 average after 90% controls									
	Standards			**NO_x Reduction**					
Appliance	Current Usage	New	Star	Replace .	New Growth	Total	Replace	Star Growth	Total
	KHW/d/unit or % of Current			NO_x Reductions tpd			NO_x Reductions tpd		
Refrigerators	8.6	2.3	1.6	1.18	0.34	1.52	1.31	0.38	1.69
Clothes Washers	3.5	2.3	0.9	0.23	0.07	0.30	0.49	0.14	0.63
Lighting	100%	90%	80%			0.39			0.78
Dishwashers	2.4	1.9	1.2	0.09	0.03	0.12	0.22	0.06	0.28
Room Air Conditioners	30.0	24.0	20.0	0.28	0.06	0.34	0.47	0.10	0.56
Central Air Conditioning	72.0	60.0	51.4	0.75	0.16	0.90	1.28	0.27	1.55
Total	**118**	**91**	**76**	**2.53**	**0.65**	**3.57**	**3.76**	**0.95**	**5.49**

Additional measures under consideration, to the extent that they are not already included in the other programs include: Economic incentives, fleet controls, marine loading emissions, episodic controls, reductions in VMT associated with commuting, pricing policies to encourage reductions in VMT, incentives for cleaner vehicles and/or vehicle fleets, funding for transit programs, reductions at ports and air ports, and use of new technology and the internet to help further reduce emissions. These measures could lead to emission reductions in the range of 0 to 35 tpd.

Economic Incentives

Local stakeholders in the HGA area and other entities have expressed an interest in the creation of programs designed to provide incentives for the achievement of earlier and/or greater reductions than anticipated from currently proposed control measures. Such incentive programs could be effective technology-forcing tools to obtain substantial innovation and ozone reductions, in the most cost-efficient manner possible.

Such programs may require legislative authority. Interested stakeholders have been working with legislative staff, exploring possible legislation to create various incentive programs. Possible components of one such program could be the competitive provision of funds to entities operating both on- and non-road

NO_x sources to assist in the incremental costs of cleaner equipment (which could encourage earlier implementation of new technologies, cleaner engines, and fuels). Other incentive programs could focus on tax incentives, subsidies, research and development technological assistance, etc.

Fleet Controls
This type of control may require legislative action and could include a requirement for government fleets or any large commercial fleets, including taxis, to purchase low emitting vehicles.

Dockside Emissions
Based on analysis of applicable statutes and regulations, the commission's Environmental Law Division has determined that dockside vessel emissions should be included in federal permit applicability determinations and are subject to full state NSR permit review.

The commission's Air Permits Division has developed a plan to address this issue. For federal permit applicability (Prevention of Significant Deterioration, Nonattainment, and Title V), their proposal is no different than current EPA guidance and regulations concerning vessel emissions. The plan would simply clarify those requirements. However, for state NSR, the plan significantly changes the current practice. Current practice is to evaluate dockside vessel emissions only for impacts review when onshore facilities are new or modified. A complete state NSR permit review will subject dockside vessel emissions to best available control technology review, maximum allowable emission limitations, monitoring, testing, and recordkeeping requirements, in addition to impacts review.

As a result of this plan, reductions in VOC emissions in all gulf coast counties should be expected.

Episodic Releases
Some portion of the emissions in the HGA area can be attributed to upset and maintenance activities. The extent of those emissions and any potential measures that can be put in place to help control those emissions is of great interest to the commission. The commission is currently conducting outreach workshops with the regulated community throughout Texas to help facilities start their own in-house program to reduce emissions from process upset and maintenance activities. This includes an explanation of the rules that were adopted by the commission in June 2000. These rules covered emission reporting, permit implications, and enforcement actions. The workshops also include discussions on the difference between upset emissions and emissions associated with maintenance activities.

As these regulations are implemented, and recordkeeping and reporting requirements become effective, the commission will begin to get a better understanding of the extent of the emissions and how we could begin to account for those emissions.

VMT Reduction Strategies
Examples of these measures include: 1) telecommuting; 2) creating satellite offices; 3) college and university traffic reduction strategies; 4) establishing a regional transit authority; and 5) requiring rental cars to be cleaner vehicles.

Pricing Policies to Encourage VMT Reductions
Examples of this type of policy includes: 1) an insurance pay-as-you-drive program in which the insurance rate is tied to the number of miles the vehicle is driven; 2) pay at the pump insurance which places a surcharge on each gallon of gasoline calculated to be equal to the current average cost of liability

insurance; 3) location-efficient mortgages and tax incentives that reward homebuyers for locating in areas that minimize travel requirements; 4) parking cash-outs where employers can "cash out" the value of the free parking benefits they provide their employees so that employees who choose not to drive their own vehicles have more take home pay; 5) tax breaks for businesses locating near mass transit; and 6) placing taxes on parking spaces.

Incentives for Cleaner Vehicles and/or Vehicle Fleets
Examples of this type of incentive include: 1) allowing alternatively fueled vehicles to use HOV lanes even if there is only one occupant; 2) tying annual auto registration fees to pollution levels so that individuals with cleaner vehicles would payer lower fees; 3) adjusting the sales tax on vehicles to a sharply graduated tax with a lower percentage tax charged to cleaner vehicles and a higher percentage on dirtier vehicles; and 4) waiving parking meter payments for low emitting vehicles.

Funding for Transit Programs
Any of the increased fees or taxes associated with the measures previously mentioned could also be used to help fund transit programs.

Reductions at Airports
Additional measures that could be implemented at airports include: 1) reducing idling on runways; and 2) imposing a fee on takeoffs during the busiest travel hours to decrease the congestion at these times.

Use of Technology to Help Reduce Emissions
There are many opportunities for increased use of the internet for transacting services that have previously required action in person, such as paying property taxes. Use of the internet could reduce commuting and provides the public with new conveniences.