

APPENDIX P

October 12, 2000 ERG Memo,
Revised Tier 2 Adjustment Factors for COAST SIP Inventory Update

Houston/Galveston Attainment Demonstration and
Post-1999 Rate-of-Progress SIP

December 2000



MEMORANDUM

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Date: October 12, 2000
To: Mary McGarry-Barber (TNRCC)
From: Rick Baker (ERG)
cc: Sandeep Kishan (ERG), Chris Lindhjem (ENVIRON)
Re: **Revised Tier 2 Adjustment Factors for COAST SIP Inventory Update – Work Assignment 34730-02**

INTRODUCTION AND SUMMARY

This memo summarizes the methodology used by ERG to estimate the NO_x and VOC emission benefits associated with the adoption of the upcoming federal Tier 2 vehicle and fuel standards, in 2007. TNRCC contracted with ERG to develop Tier 2 adjustment factors as part of a larger effort to update the on-road SIP inventory for the Houston area using the most recent data available. Adjustments were calculated by vehicle type for each of the 8 counties, and presented to the Texas Transportation Institute (TTI) for link-based inventory development.

The method used to develop the adjustments primarily followed ERG's previous Tier 2 benefit assessment.¹ This method is more accurate than relying on EPA's Tier 2 guidance in MOBILE5 Information Sheet #8, since it accounts for fleet-specific characteristics such as age distribution.² The resulting benefit estimates differed from previous estimates for a number of reasons, most importantly because I/M effects were included in the latest baseline, while these effects were applied after Tier 2 benefits in the previous analysis. Other significant differences include the use of new vehicle registration data, vehicle speeds, trip lengths, and new HDGV BERs. The net effect was to lower the Tier 2 benefit estimates relative to the previous analysis. (Again, these adjustments should not be compared directly, however, due to differences in baselines.)

The absolute grams per mile reductions for VOCs and NO_x are summarized below. These numbers can be applied directly to MOBILE5 outputs in the same manner as the default figures provided in the MOBILE5 Information Sheet. Note that no benefits are expected for motorcycles or heavy-duty diesel engines under this rule.

¹ "Analysis of Tier 2 and Cal LEV Emissions Benefits for the Houston-Galveston and Dallas-Ft. Worth Ozone Non-Attainment Areas", ERG report to the TNRCC, January 28, 2000.

² MOBILE5 Information Sheet #8 – Tier 2 Benefits Using MOBILE5, EPA420-F-00-001, April 2000.

**Table 1 – Summary of Tier 2 Benefits for the 8 County Houston Region
gpm Reductions -- NOx**

County	LDGV	LDGT1	LDGT2	HDGV*	LDDV^	LDDT*	HDDV	MC
Harris	0.18	0.20	0.16	0.20	0.44	0.49	0.00	0.00
Brazoria	0.18	0.21	0.15	0.20	0.43	0.49	0.00	0.00
Fort Bend	0.17	0.19	0.14	0.20	0.44	0.49	0.00	0.00
Galveston	0.18	0.21	0.15	0.20	0.44	0.49	0.00	0.00
Montgomery	0.18	0.20	0.15	0.20	0.44	0.49	0.00	0.00
Liberty	0.23	0.25	0.16	0.20	0.44	0.49	0.00	0.00
Chambers	0.28	0.34	0.23	0.20	0.41	0.49	0.00	0.00
Waller	0.27	0.29	0.19	0.20	0.45	0.49	0.00	0.00

gpm Reductions – VOC (Exhaust + Evap)

County	LDGV	LDGT1	LDGT2	HDGV*	LDDV^	LDDT*	HDDV	MC
Harris	0.03	0.03	0.04	0.03	0.22	0.28	0.00	0.00
Brazoria	0.03	0.04	0.03	0.03	0.22	0.28	0.00	0.00
Fort Bend	0.02	0.04	0.03	0.03	0.15	0.28	0.00	0.00
Galveston	0.04	0.04	0.04	0.03	0.23	0.28	0.00	0.00
Montgomery	0.03	0.04	0.03	0.03	0.23	0.28	0.00	0.00
Liberty	0.02	0.04	0.03	0.03	0.16	0.28	0.00	0.00
Chambers	0.03	0.05	0.04	0.03	0.18	0.28	0.00	0.00
Waller	0.04	0.04	0.03	0.03	0.31	0.28	0.00	0.00

* From MOBILE5 Information Sheet #8 -- Tier 2 Benefits Using MOBILE5 (benefits for Final I/M programs with RFG). HDGV benefits from fuel effects only

^ Scaled from LDDT corrections and LDGV/LDGT1 ratios -- no values provided in EPA Information Sheet

METHODOLOGY AND DOCUMENTATION

With the assistance of TNRCC, ERG obtained the latest MOBILE5b input files used by TTI in preparation of the link-based emissions inventory. Files were obtained for each county in the area, and included updates to the following:

- Vehicle registration;
- Trip lengths;
- Inspection and Maintenance; and,
- HDGV BERs (to reflect 2005 and later standards).

The vehicle registration data were taken from Texas DOT records for January 24, 2000. Trip length distributions were taken from the latest H-GAC Conformity Submittal, dated March 23, 2000. Inspection and Maintenance record descriptions were provided by TNRCC staff, reflecting minor modifications to previous analyses in terms of program start dates and program type. Finally, ENVIRON provided Basic Emission Rate (BER) inputs to reflect the impact of the 2005 HDGV standards, as well as the Medium-Duty Passenger Vehicle component under the Tier 2 Rule. The alternate BER records themselves were provided by EPA. The actual MOBILE5b input files are provided as an attachment to this memo.

Next ERG obtained average speeds by county, weighted across all facility types and vehicle classes, from TTI. These speeds were used in the MOBILE5b input files to estimate baseline (i.e., pre-Tier 2) gram per mile emission factors for each vehicle type, for each county. Table 2 summarizes these speeds, by county. These speeds are somewhat lower than those used in the previous analysis. The actual MOBILE5b gram per mile outputs are available from ERG upon request.

Table 2 – Facility-Weighted Average Speeds, by County (mph)

Brazoria	Chambers	Fort Bend	Galveston	Harris	Liberty	Montgomery	Waller
46.0	66.6	41.7	40.4	37.6	53.2	48.6	59.4

In order estimate the combined effect of the Tier 2 program for light-duty gasoline cars and trucks, ERG used the methodology previously developed in conjunction with the TNRCC, US EPA, and representatives of the auto manufacturers (see reference #1 above). This approach uses outputs from EPA’s Tier 2 spreadsheet model for “I/M areas with RFG”, in combination default MOBILE5b outputs to develop an adjustment factor reflecting the benefits of the Tier 2 program. The ratio of the Tier 2 model output and the default MOBILE5b outputs is applied to the site-specific MOBILE5b outputs to develop final Tier 2 emission factors for each of the 8 counties.

ERG also estimated the evaporative VOC benefits of the Tier 2 program by modifying the MOBILE5b code, and scaling baseline emission rates by the ratio of the evaporative standards. In this case we assumed that the auto manufacturers would meet the California LEV evaporative standards (more stringent than the Tier 2 standards), as per EPA recommendation.³ ERG can provide the modified version of the MOBILE5b model upon request.

EPA staff indicated that there was no readily available way to update the Tier 2 spreadsheet model to provide emission factors for light-duty diesel cars and trucks.⁴ Therefore ERG relied upon EPA’s MOBILE5b Tier 2 Information Sheet guidance to obtain an absolute gpm adjustment for LDDTs (assuming I/M). Since this adjustment did not incorporate site-specific fleet characteristics it is necessarily less accurate than the adjustments developed for the light-duty

³ Personal communication, Gary Dolce, USEPA OTAQ, October 3, 2000.

⁴ Personal communication, John Koupal, USEPA OTAQ, October 3, 2000.

gasoline vehicles. (Consequently, the adjustments are constant over all 8 counties for these vehicles.) However, given the very small contribution of these vehicles to total VMT in the area (typically < 0.5%), the resulting error in tons per day should be negligible.

According to the EPA's MOBILE5 Information Sheet #8, LDDVs are not expected to contribute significant benefits under the Tier 2 rule (in terms of total tons per day). Therefore no adjustment factors were provided for these vehicles. ERG multiplied the LDDT adjustments by the ratio of the baseline emission factors for LDDVs and LDDTs for Harris county to obtain an estimate of the gpm adjustment for these vehicles. Again, the very low VMT totals for these vehicles minimize the ultimate impact of these assumptions.

Finally, with the addition of the alternative BERs for HDGVs in the MOBILE input files, the effect of the Tier 2 exhaust emission standards have already been incorporated in the MOBILE outputs for this vehicle class. ERG simply used the default adjustment provided in the MOBILE Information Sheet to account for fuel effects, as per our discussion with EPA (see reference #4 above).

ERG developed adjustment factor tables for TTI's use, providing both absolute gpm and factor adjustments. The gpm adjustments are provided above in Table 1. Table 3 provides the factor adjustments, defined as the percentage reduction in emission rates relative to the baseline. VOC estimates include both exhaust and evaporative benefits.

Table 3 – Tier 2 Benefits (%)

County	Percentage Reductions -- NOx							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Harris	23.9%	21.9%	17.4%	5.1%	46.1%	47.3%	0.0%	0.0%
Brazoria	23.9%	21.9%	17.4%	4.1%	40.9%	42.4%	0.0%	0.0%
Fort Bend	23.9%	21.9%	17.4%	4.1%	44.6%	45.6%	0.0%	0.0%
Galveston	23.9%	21.9%	17.4%	4.5%	44.8%	46.0%	0.0%	0.0%
Montgomery	23.9%	21.9%	17.4%	4.3%	39.9%	40.7%	0.0%	0.0%
Liberty	23.9%	21.9%	17.4%	4.0%	35.4%	35.9%	0.0%	0.0%
Chambers	23.9%	21.9%	17.4%	3.8%	21.4%	23.5%	0.0%	0.0%
Waller	23.9%	21.9%	17.4%	4.2%	28.9%	29.6%	0.0%	0.0%

County	Percentage Reductions -- VOC							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Harris	12%	12%	11%	2.3%	78.1%	72.1%	0.0%	0.0%
Brazoria	17%	16%	11%	2.0%	89.9%	82.6%	0.0%	0.0%
Fort Bend	12%	16%	11%	1.6%	59.4%	78.1%	0.0%	0.0%
Galveston	17%	16%	11%	1.7%	81.0%	75.9%	0.0%	0.0%
Montgomery	18%	17%	11%	2.0%	95.4%	87.8%	0.0%	0.0%
Liberty	12%	16%	11%	1.7%	71.0%	90.6%	0.0%	0.0%
Chambers	12%	15%	11%	2.3%	77.6%	90.6%	0.0%	0.0%
Waller	16%	12%	11%	1.8%	133.1%	93.7%	0.0%	0.0%

Note that the benefit estimates vary significantly for LDDTs, and especially for LDDVs, due to the use of the default gpm adjustment factors from the MOBILE5 Information Sheet. In fact, the LDDV VOC adjustment for Waller county was actually greater than the baseline emissions, resulting in a percentage adjustment > 100%. TTI ultimately set the adjustment equal to that for Montgomery County to address this issue.

Also note that the light-duty gasoline cars and truck NO_x benefits are constant across counties – a result of the methodology described above. However, rounding errors in MOBILE5b provided different estimates for percentage evaporative benefits, resulting in the variation shown above. Based on our approach the VOC benefits should be the same across counties as well, but additional significant digits would be required in the MOBILE5b outputs to determine the precise value.