APPENDIX A

DOCUMENTATION AND ASSUMPTIONS FOR POTENTIAL MEASURES TO MEET HGA ATTAINMENT SHORTFALL

HOUSTON/GALVESTON ATTAINMENT DEMONSTRATION

Area Sources

1. Energy conservation for buildings

   This measure includes implementation of energy-efficient building codes and energy efficiency programs.

2. NO_x limits for water heaters, small boilers, and small process heaters

   This strategy would reduce NO_x emissions from new natural gas-fired water heaters, small boilers, and process heaters sold and installed in Texas beginning in 2002. The strategy would apply to each new water heater, boiler, or process heater with a maximum rated capacity of up to 2.0 MMBtu/hr. Rules of California's Bay Area Management District Regulation 9, Rule 6 and SCAQMD Rules 1121 and 1146.1 could be used as prototypes.

Non-road Mobile Sources

3. Accelerated purchase of Tier III non-road heavy-duty diesel equipment

   The benefit of the accelerated purchase of Tier II/Tier III non-road equipment was calculated using EPA's NONROAD model. The input files to the NONROAD model were adjusted to simulate the quick turnover and the reduced average age of the equipment in use. The fractional benefit for each equipment source classification was then applied to the NEVES emissions inventory to determine the total emission reduction.

4. NO_x catalyst retrofits for equipment > 175 hp

   This calculation was based primarily on data reported by Siemens for their SiNOx SCR system, currently operating in several demonstration projects across the country. Incremental emission controls of 80% were assumed; reported values are 60 to 80% for mobile sources. The upper end of the control potential range may be achieved with the use of clean diesel formulations, as assumed in this analysis. Siemens reported that their system is designed for diesel engines approximately 175 hp and greater. Given that the SiNOx system has been successfully retrofitted in very different applications (e.g., on-road diesel trucks, commercial marine engines, locomotives, and construction equipment), some of which have highly transient operation cycles, this analysis assumed that an aggressive retrofit program could be applied to up to 80% of diesel engines > 175 hp, in the construction, agriculture, commercial, and industrial equipment sectors. All calculations assume that accelerated Tier 3 standards, California diesel, and diesel emulsions are in place before retrofit.

5. Emulsion fuel for diesel equipment

   This calculation was based on preliminary test results of Lubrizol Corporation's LubriNOx diesel/water emulsion product, which has obtained up to 20% NOx reductions relative to the base diesel fuel. This percentage is claimed to be independent of baseline fuel properties. Given that use of the PuriNOx product requires no modifications of existing diesel engines or fuel tanks, this analysis assumed a very aggressive penetration rate of 95% of the construction, industrial,

commercial, and agricultural equipment in the 8-county HGA area. If widely available, this fuel's chief limitation is power loss— it is assumed that approximately 5% of the existing fleet applications could not tolerate the loss of power, and could not modify fuel intake to adequately compensate for the loss. All calculations are incremental to the accelerated Tier 3 program, as well as the California diesel program.

6. Electrify airport ground service equipment

   This strategy would affect owners or operators of ground support equipment at airports in the HGA area. The strategy would require owners or operators of the affected ground support equipment to ensure that their ground support equipment fleet be electric-powered by the end of 2007. The listed reduction was quantified by zeroing out the 2007 modeling emissions inventory for this category.

7. California spark ignition standard

   The benefit of the California non-road large spark ignition requirement for engines > 25 hp was calculated using EPA's NONROAD model. The input files to the NONROAD model were adjusted to simulate the introduction of lower emission engines in the area. The fractional benefit for each equipment source classification was then applied to the NEVES emissions inventory to determine the total emission reduction.

8. Ship hotelling (estimate of improved inventory)

   According to the 1993 COAST Study, ship hotelling emissions in 2007 would be 4.88 tons per day NO_x. This estimate is believed to be inflated due to the assumptions made in determining the inventory. The development of a new estimate of ship hotelling emissions has been contracted to a consulting company, and a new inventory will soon be available. According to the consulting company, the new ship hotelling emissions inventory will be approximately 50% less than the 1993 COAST estimate.

9. Economic incentives for construction equipment

10. Low-emission fuel incentives for commercial marine sources

11. Diesel fuel additives (cetane)

12. Regulate activity levels of tug/tow vessels

13. Combustion controls on existing equipment (rich to lean ratio)

14. Preventive maintenance for heavy-duty diesel vehicles

15. Light-duty diesel construction equipment standards

16. Generator standards

17. Restrict start-up/shutdown of ship engines

18. Bunker fuel improvements for commercial marine sources

19. Preventive maintenance for airport equipment

20. Diesel-powered tugs only

21. Low NO_x fuel for local locomotives

22. Restrict landscaping activities (ban from 6–10 a.m.)

23. On-ground airport operational measures

    Implementation of such measures as single engine taxiing to and from airport takeoffs , aircraft towing, minimization of reverse thrust, reduced idling, reduced thrust takeoffs

24. In-air operational measures

    Implementation of such measures as reduced landing flap, optimum flap retraction.

25. Scrappage program for nonroad diesel engines

26. Provide electric power to construction sites

    Install temporary power lines at construction sites, thus reducing use of diesel and gasoline generators.

27. Replacement with electric-powered lawn and garden equipment

28. Commercial fishing engine standards

Onroad Mobile Sources

29. 25% time/area driving restrictions

30. Reduce speed limit to 55 mph

    This calculation utilized link-based data projected for 2007, from H-GAC. The data files contained estimated average speed and total VMT by road classification, for a.m. peak, midday, p.m. peak, and overnight time periods for the 8-county HGA area. To estimate the benefit of this measure, only links with average speeds above 55 mph were considered, regardless of roadway class. For each of these links, a NOx emission factor was estimated in grams per mile, based on the outputs currently being used in the conformity modeling for Houston. For speeds greater than 65 mph (the limit of MOBILE5 outputs), linear extrapolations were used based on the 64 to 65 mph increment. Incremental gram per mile values were then estimated assuming a 55 mph average speed for each of these links, which were in turn multiplied by VMT for the link and summed

across all links to obtain a per-day value. This process was repeated for all four time periods to obtain a value of 15.23 tpd. This amount was further adjusted to reflect a 25% decrease in VMT, resulting in the final 11.42 figure. Note that this approach does not account for the interaction between changing VMT, traffic volumes, and resulting speeds. It is likely that the reductions would be somewhat more than 11.42 tpd, since average link speeds are likely to be higher than those given in the link-based projections, assuming 25% less volume. However, detailed traffic modeling would be needed to account for this interaction.

31. NO_x catalyst retrofits for locally registered heavy-duty diesel trucks

This calculation assumed the use of the Siemens SiNOx SCR technology for on-road heavy diesel applications. As with non-road applications, this system is estimated to obtain 80% NOx reduction levels. Assuming this measure would be mandated through local fleet rules, only those vehicles registered in the 8-county HGA region could be retrofitted. H-GAC staff estimated that approximately 50% of the total HDDV VMT in the region was attributable to locally registered fleets. Therefore, a 50% penetration rate of this technology was assumed. However, this scenario is optimistic since it assumes that drivers and HDDV owners will be able to maintain an adequate supply of reductant on board at all times, although a distribution infrastructure is not currently in place. Note that all estimates are incremental to the adoption of California diesel fuel in the area.

32. 15 ppm sulfur limit in fuel

This calculation utilized California's Predictive Emissions Model (Beta Version 2) to estimate the incremental benefit of moving from 30 to 15 ppm sulfur in gasoline for pre-LEV vehicles, holding all other parameters constant (equal to the default values provided in the model). Such a fuel program follows the proposed modifications to California RFG II, in the wake of the MTBE ban in that state. The benefit for LEV and later vehicles was estimated using EPA's fuel sulfur effect equations, as developed for the upcoming MOBILE6 model. The overall, fleet-average percentage reduction is projected at 3.41%, incremental to California RFG II, with Cal LEV in place starting in 2004.

33. Gasoline detergent additives

This is a conservative estimate of reductions obtainable from gasoline detergent additives. The base fuel is assumed to be California RFG Phase II. In a protocol testing of the product for New Hampshire, the original claimed reduction was 2.31 ton NO_x/million gallons gasoline burned. This figure was reduced to 0.17 ton NO_x/million gallons gasoline by New Hampshire, and is the basis for the placeholder figure included in this current SIP list.

34. California LEV automobile standards

Section 177 of the Federal Clean Air Act allows states to adopt California motor vehicles emission standards, which are more stringent than federal motor vehicle emission standards. This scenario assumes the adoption of the California LEV II program commencing in 2004. Incremental emissions estimates assumed California RFG II, with an NLEV/Tier 2 baseline. Applying the ratio of the certification standards, and accounting for both the Tier 2 and Cal LEV II phase-in schedules, a fleet-average benefit of 1.73% was assumed, resulting in the 2.41 tpd listed.

35. VMT reductions (1%)

36. Light rail

37. Vehicle scrappage

This analysis assumed that 13,000 20-year-old (or older) vehicles, tested as “high-NOx” emitters under ASM, would be scrapped per year, from 2005 through 2007. It was also assumed that these vehicles would be replaced by 8-year-old vehicles with “normal-NOx” emission levels. Estimation of high and normal NOx emission rates as a function of vehicle age were taken from the Tier 2/low-sulfur spreadsheet by model-year analysis section. The analysis also used the MOBILE5 default VMT rates for 20-year-old vehicles were used to estimate total tpd values. Note that 13,000 vehicles per year is approximately twice the rate proposed in the initial H-GAC Scrap Demonstration Proposal from 1997. A detailed economic and financial assessment should be undertaken to refine the estimate of likely market potential for this measure.

38. Signalization (RCTSS, light rail)

39. Episodic controls

Houston Metro estimated that episodic controls would result in 5,000,000 fewer VMT.

40. Ozone Action Days

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41. Bus fare reductions

Houston Metro used a consultant to evaluate a 50% reduction in bus fares. Given the elasticity of ridership vs. fare, an increase in daily ridership of 22,113 was estimated. This resulted in a net reduction of NOx of 0.08 tons per day.

42. Fleet idling restrictions

This measure assumes extreme minimization of idling from diesel trucks in the area, as per the NCTCOG proposal for DFW. The idling emission factor for HDDVs from MOBILE5 was used, combined with an estimated 25% idle hours for these vehicles. Using the weighted average speed of 46 mph for the area, and total VMT estimates for these vehicles, benefits were estimated assuming < 1% idle time under the potential rule.

43. Local fleet rules for light-duty commercial vehicles

This measure assumes that all light-duty commercial vehicles registered in the 8-county HGA area will meet SULEV or better standards by 2007. Numerous simplifications were made to arrive at this estimate. First, all 50,152 vehicles currently registered with the State under the Texas Clean Fleet program (excluding emergency vehicles) were assumed to be passenger cars or light-trucks 1.

Next, all vehicles were assumed to be four years old or less, and evenly distributed in age from one to four. Next, all vehicles were assumed to accumulate 15,000 miles per year, and to be driven 6 days per week. All benefits were estimated relative to the proposed Cal LEV II phase-in schedule. In-use baseline gpm emissions levels were estimated from the Tier 2 spreadsheet and multiplied by the ratio of the certification standards for each model year between 2004 and 2007. Note that this estimate is probably conservative, since LDT2s and HDVs are likely to achieve significantly greater reductions under such a program.

44. Emulsion fuels for heavy-duty diesel trucks

    This measure assumed the use of the Lubrizol PuriNOx emulsion, similar to that for non-road sources. It was assumed that only the locally-registered fleet could be expected to use this fuel (50%). A 15% reduction was applied to the post-retrofit emission levels.

45. Expand bikeway network

46. Expand transit service area

47. New or expanded bus service

48. Colorado snap test for expanded heavy-duty diesel truck I/M

49. School carpooling programs

50. Expanded RideShare program for transit

51. Flex-time (school)

52. Truck stop idling restrictions

53. New or expanded carpools/vanpools

54. Transit fare incentives on Ozone Action Days

55. Telecommuting

56. Hybrid buses

57. Flex-time (work)

58. TRANSTAR exansion

59. Drive-through restrictions

60. Local fleet rules for heavy-duty commercial vehicles

61. Transit-oriented development

62. Market-based value (congestion) pricing

Congestion pricing, also called time-of-use pricing, is designed to discourage driving during peak times by charging a higher price to use the road. The idea is to eliminate or delay low-priority vehicle trips until off-peak hours. The approach is analogous to the pricing of long-distance telephone service, which is higher during weekday business hours.

63. Cetane enhancers in fuels

64. Shuttle for hire (clean-fueled)

65. Emission-based registration fees

66. New sidewalks/crosswalks

67. New or expanded park-and-rides

68. New technology (guided busways)

69. Gas tax increases

70. Parking restrictions/pricing

71. Driving cycle/traffic calming

72. Conserve air conditioning use

73. Vehicle deterioration rate

74. Higher registration fees for ownership of multiple vehicles

75. Higher registration fees for vehicles with more annual VMT

76. Higher registration fees for older vehicles

77. Sustainable development, pedestrian-oriented development

78. Alternative fuels (LNG)

79. Alternative fuels (CNG)

80. Employer on-road vehicle emission reduction program (SCAQMD Rule 2202)

81. Accelerated fleet turnover

82. Operation-based vehicle insurance premiums

This program would set vehicle insurance premiums based on the parameters of when, where, and for how long policyholders operate their vehicles. This innovation is made possible by installing a sensor in the car that logs the referenced parameters in real time. The less time that a policyholder drives, especially during peak commute times, the lower the insurance premium.

83. Pay-at-the-pump liability insurance

A surcharge on gasoline would be instituted as a way to pay for the minimum, state-required liability coverage. under this approach, the total cost of driving (fuel plus liability insurance) for the average driver is unchanged. However, this program would provide a incentive to drive less miles than average because it results in net reduced costs, while driving more miles than average results in a net increased cost. Drivers would still have the option of paying for additional coverage through their own insurance company. This system could be implemented to be revenue-neutral.

84. Vehicle registration fee rebates

Rebates on the annual vehicle registration fee would provide an incentive to purchase low-emitting vehicles and reduce the annual VMT. Under such a system, owners of low-mileage, low-emission vehicles would qualify for a rebate in the form of discounted registration fees, while owners of high-mileage, high-emission vehicles would be subject to a fee or surcharges. This system could be implemented to be revenue-neutral.

85. Parking cash-out

86. Intermodal freight efficiency for heavy-duty diesel vehicles

This strategy encompasses a number of programs for more efficient shipping, including dedicated truck lanes, maintenenace of proper tire pressure and other maintenance measures to promote fuel efficiency, and shortening of truck stop stays.

87. Improved airport access options

88. Intelligent vehicle highway systems

89. Location-efficient mortgages

90. Truck stop electrification for in-truck services

91. Proximate commute programs

92. Station cars

93. Database sharing/traffic management

94. Remote sensing to identify high-emitting vehicles

95. Repair assistance (I/M)

96. Use of alternate fuels or electric power by airport buses

97. Toll reductions for high-occupancy vehicles

98. Car rental service for single tasks

99. Expand I/M beyond 8-county area

100. Suburb to suburb transit service (could include high capacity transit)

101. "Unbundling" of parking from commercial leases (level the playing field for SOV alternatives)

102. Ban on trucks from certain areas

103. Performance standards in contracts

104. Incubator for development of privatization of transit (to grow opportunities for transit in undeserved areas)

105. Removal of speed humps (public and private streets)

106. Improved coordination of off-duty police officers at parking garages/lots to minimize congestion