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Re: Informal suggestions for additional control strategy concepts

Dear Ashley and Donna,

On behalf of Environmental Defense Fund, Galveston Houston Association for Smog Prevention, and Industry Professionals for Clean Air, thank you for the opportunity to offer informal suggestions on possible control strategies for the next Houston/Galveston/Brazoria SIP. Our suggestions are organized by stationary and mobile sources.

We also wish to generally encourage the TCEQ to consider the co-benefits of possible SIP controls and to give additional weight to measures that reduce emissions of air toxics, PM2.5, greenhouse gases, as well as provide congestion relief or consumer savings. Moreover, the TCEQ should account for EPA's recent adoption of a more protective ozone standard in its current planning efforts.

I. Stationary sources

a) NOx emissions. Additional NOx controls from point sources should be re-evaluated. A set-aside in the NOx cap should be established to provide additional incentive for energy efficiency projects.

b) VOC emissions.

Adopt Current Best Controls and Management Practices

Better performing facilities nationwide are implementing technologies and best practices that could be used to minimize VOC emissions in the Houston area. Many of these technologies have been required for years in other jurisdictions or have been required by EPA to resolve enforcement actions.

Table 6, *Harris County Industrial Emissions by Unit*, lists the largest sources of industrial emissions of benzene and 1,3-butadiene, according to state data.[i] Because emission reporting is notoriously inaccurate, however, there may be additional sources of VOC emissions that warrant improved controls.

TABLE 6. HARRIS COUNTY INDUSTRIAL EMISSIONS BY UNIT (2004)

Units	1,3-Butadiene Emissions (tons/yr)	Percent Total Butadiene	Benzene Emissions (tons/yr)	Percent Total Benzene
Tanks	31.82	8%	209.95	38%
Fugitives	168.08	42%	155.74	28%
Flares	135.18	34%	51.18	9%
Wastewater	9.28	2%	24.42	4%
Cooling Towers	3.03	1%	45.37	8%
TOTALS	394	98%	520	95%

There are technologies and practices that can be implemented *today* that will reduce emissions from tanks, fugitives, flares, wastewater systems, cokers,[ii] and cooling towers. Some of these technologies and best practices are explained in this section.

Fugitives: According to TCEQ's 2004 Point Source Emission Inventory for Harris County, 42 percent of butadiene emissions, and 28 percent of benzene emissions, were fugitive emissions. And, fugitive emissions are likely underestimated. In 1999, EPA's National Enforcement Investigation Center found refinery leaks were on average 10 times greater than reported.[iii] Although there have been some improvements since 1999, facility audits still show "significantly elevated leak rates," particularly at chemical plants.[iv]

Recommendations: Houston-area industries should implement enhanced leak detection and repair programs that include the following:

- ***A well-managed LDAR program:*** a written LDAR program covering all units in VOC service should include a facility-wide leak goal with compliance established on a unit-by-unit basis, training for LDAR employees, contractor accountability and LDAR audits, including annual independent audits. Components on the delay-of-repair list should be included in leak rates.

- ***Lower leak definitions:*** for all equipment in VOC service, facilities should use lower leak definitions, 100 ppm for valves, connectors and other equipment and 500 ppm for pumps, compressors and pressure relief valves. These leak definitions are currently in place in the Bay Area Air Quality Management District (BAAQMD) and are more stringent than the levels required in Texas. See Table 7, *Leak Definitions*.

TABLE 7. LEAK DEFINITIONS (PPM)

Equipment	TCEQ Highly Reactive VOCs[83]	TCEQ All Other VOCs[84]	BAAQMD All VOCs[85]
Pumps and compressors	500 ppm	10,000 ppm	500 ppm
Pressure relief valves	500 ppm	500 ppm	500 ppm
Valves, connectors and other equipment	500 ppm	500 ppm	100 ppm

83 30 Tex. Admin. Code § 115.780. Applies in the Houston area to equipment at refineries and chemical plants in which highly reactive VOCs are a raw material, intermediate, or final, product, or in a waste stream. HRVOCs are VOCs that TCEQ has determined contribute significantly to rapid ozone formation. They are 1,3-butadiene, butanes, ethylene and propylene.
84 30 Tex. Admin. Code §115.352. Applies in Houston and other areas to equipment at refineries and chemical plants not in HRVOC service.
85 BAAQMD Rule 8-18-301 through 8-18-305.

- ***Tighter repair timelines:*** For equipment in VOC service, any leaks should be minimized within 24 hours of identification. Repairs should be made within seven days. These timelines are more stringent than currently required by Texas and are consistent with those required by the BAAQMD and SCAQMD. See Table 8, *Repair Timelines.*

TABLE 8. REPAIR TIMELINES

Actions	SCAQMD[86]	BAAQMD[87]	TCEQ (HRVOC)[88]	TCEQ (Non HRVOC)[89]
Minimization		24 hours		
First Attempt Repair			1 day for leaks greater than 10,000 ppm. 5 days for all other leaks.	5 days
Repair	1-7 days based on component and size of leak[90]	7 days[91]	7 days for leaks greater than 10,000 ppm 15 days for all other leaks.[93]	15 days[92]

86 SCAQMD Rule 1173(g). Applies to chemical plants and refineries.
87 BAAQMD Rule 8-18-301 through 8-18-305.
88 30 Tex.Admin. Code §115.782. Applies in the Houston area to equipment at refineries and chemical plants in which a HRVOC is a raw material, intermediate, final product or in a waste stream.
89 30 Tex. Admin. Code §115.352. Applies to equipment not in HRVOC service at refineries and chemical plants in Houston and other areas.
90 The rules allow a 3-7 day extension for certain leaks.
91 The BAAQMD allows delay of repair for "non-repairable" equipment. Delay is limited to 45-days unless the leak is less than 15 lbs/day. Equipment on the non-repairable list is limited to 0.30% valves, 1.0% pressure relief devices and 1.0% pumps and compressors.
92 The rule allows a delay of repair until the next process shutdown if repairs require shutdown and the shutdown would create more emissions than the repair would eliminate and certain conditions are met.
93 The rule allows a delay of repair until the next process shutdown if repairs require shutdown and the shutdown would create more emissions than the repair would eliminate and certain conditions are met.

- ***Repairs using best available technologies:*** When repairs are made, they should be made using the best available technologies for minimizing leaks, including low leak valve packing. If a component in VOC service requires more than five repair actions in any 12-month period for leaks greater than 10,000 ppm, it should be replaced using the best available technology, or permanently routed to recovery or controls. Pressure relief devices should be routed to recovery or controls following: (1) any release involving more than 2,000 pounds VOC in any 24-hour period, or (2) a second release of 500 pounds or more VOC in any 24-hour period within a five year period. The SCAQMD currently has similar requirements.[v]

  To the extent consistent with good engineering practice, all leaking components should be replaced with leakless components, such as bellows or diaphragm valves. Similarly pumps should be replaced with seal-less pumps such as diaphragm or magnetic drive pumps. Flanged connections should be replaced with welded connections.

- ***Passive Optical Gas Imaging:*** Facilities should use Passive Optical Gas Imaging devices at least quarterly to detect leaks. These are portable, video camera-like devices that can visually identify plumes of leaking emissions. While Gas Imaging is wonderful for identifying previously unknown sources of leaks and for monitoring "difficult-to-monitor" or "unsafe-to-monitor" components, it is not reliable for leaks below 500 ppm or for all chemicals.[vi] It should, therefore, be used to supplement rather than replace traditional LDAR monitoring. Any equipment found to be leaking with Passive Optical Gas Imaging, which does not qualify as difficult or unsafe-to-monitor, should be added to the list of monitored LDAR components and made subject to traditional LDAR monitoring.

Flares: Because flares are significant sources of VOC emissions, they should be strictly limited. Their sole purpose should be treating large volumes of gases that are released as a result of emergency facility failures and cannot be recovered. Unfortunately, instead of using flares for emergencies, companies often use flares as a part of routine operations. In some cases, TCEQ has even permitted facilities to flare emissions during routine operation.

California's South Coast Air Quality Management District found that between 1999 and 2003, only 4 percent of flaring events could be attributed to emergencies.[vii] Similarly, EPA investigations found that flaring "frequently occurs in routine, non-emergency situations or is used to bypass pollution control equipment. This results in unacceptably high releases of sulfur dioxide and other noxious pollutants …"[viii]

Recommendations: Houston-area refineries and petrochemical plants should install flare gas recovery systems, develop flare minimization plans, conduct root cause analyses of flaring events, and improve flare monitoring.

- ***Flare Gas Recovery:*** Petrochemical facilities have alternatives to flaring. Flare gas recovery systems allow plants to recover gases, which are valuable product, rather than simply burning them. Federal regulators acknowledge the benefits of flare gas recovery, and state that routine flaring is not good air pollution control practice.[ix] Several state and local air pollution control districts have adopted rules prohibiting all routine flaring.[x]

Flare gas recovery systems reduce emissions. California's Bay Area Air Quality Management District prohibits flaring in non-emergencies unless the flaring is consistent with a facility's flare minimization plan, which must include all feasible flaring prevention measures.[xi] The district found that adding compressor capacity and instituting better flare management practices resulted in an 85 percent reduction in VOC emissions between 2002 and 2005.[xii]

California's South Coast Air Quality Management District flaring rule requires: (1) improved monitoring, (2) flaring only as a result of emergency, shutdown, startup, turnaround, or essential operational need, and (3) minimization of flare emissions during such events.[xiii] The district estimates that by 2010 its rule will reduce flare emissions, including VOC emissions, by more than 50 percent from 2003 levels.[xiv]

Many Houston-area refineries have signed consent decrees to settle enforcement actions by the EPA. Some of these agreements call for enhancements to flare gas recovery systems. Valero touts recent investments in flare-gas recovery systems at some of its facilities, and notes that the company is considering the "feasibility of applying this emission-reducing technology at others."[xv]

All petrochemical facilities should install sufficient flare gas recovery capacity to handle all gases from: (1) routine operations, (2) planned startup, shutdown and maintenance, and (3) small upsets. Elimination of flaring, except during true emergencies, will be the proof of whether facilities have installed adequate flare gas recovery capacity.

- ***Flare minimization plans.*** In addition to flare gas recovery, petrochemical facilities should develop detailed flare minimization plans to eliminate routine flaring and reduce flaring during emergency events. The plans are currently required by two air districts in California and have been proposed by EPA for refineries subject to New Source Performance Standards.[xvi] Such plans should include all feasible flare reduction measures, including operational procedures such as slower vessel depressurization, as well as training and awareness programs to focus plant personnel on flare reduction.

Reducing Flaring Saved Dow Chemical Company $2.5 Million

From 2001 to 2003, Dow Chemical Company, in Freeport, Texas, reported a 54 percent reduction in emissions from startup, shutdown and off-spececi-fication incidents. The project optimized the use of equipment to re-circulate off-spec hydrocarbons to the front of the plant to be reprocessed. In doing so, Dow documented savings of $2.5 million.

— Steven Krietenstein, Dow Chemical Co., *Flare Minimization Strategy During Plant Upsets: Freeport* (April 12, 2005).

Flare Gas Recovery Virtually Eliminated Flaring at Lion Oil's El Dorado Refinery

Lion Oil Company's El Dorado Refinery, in Arkansas, installed 2 flare gas recovery systems, which "reduced flaring to near-zero levels, thereby achieving the refin-ery's emission-reduction objectives and conserving facility resources."

— Hydrocarbon Processing, *Minimize Flaring with Flare Gas Recovery* (June 2002), pp. 83–85.

- ***Root cause analysis.*** California's South Coast and Bay Area Air Quality Management Districts require refineries to conduct root cause analyses of flaring events.[xvii] EPA has required investigations, reporting, and corrective action for refinery hydrocarbon flaring events in some of its enforcement actions against Houston area refineries.[xviii]

  While Texas requires facilities to report on the likely cause of, and any actions taken to minimize, an exceedance of authorized pollution limits and the actions taken to minimize emissions, these reports do not include root cause analyses. All refining and petrochemical facilities in the Houston area should conduct root cause analyses for flaring events resulting in 100 pounds or more of VOCs.[xix] The analysis should include a detailed determination of the root cause and all contributing causes to the flaring event, an analysis of all means available to reduce the likelihood of another similar flaring event (including design, operation and maintenance changes), and a schedule for implementation of corrective measures.

- ***Flare monitoring****:* Flare emissions are difficult to measure due to high temperatures and radiant heat, the irregular nature of flare flames due to winds and turbulence, the undefined dilution of the plume with ambient air, and flare heights.[xx] Without proper monitoring, however, it is impossible to know whether flares are performing adequately or whether flare emissions are presenting health risks to the surrounding community.

  Flares in the Houston-Galveston area in HRVOC service are currently required to conduct enhanced monitoring of the gas stream going to the flare, including: continuous flow monitoring, temperature and pressure monitoring, and HRVOC content monitoring by on-line analyzer capable of determining VOC content, molecular weight and net heating value at least every 15 minutes.[xxi]

  All petrochemical facilities in the Houston area should conduct enhanced flare monitoring to include:

- continuous volumetric vent gas flow,
- hourly exit velocity calculations,
- speciated composition for benzene and any other toxics for which the area exceeds an ESL,
- net heating value,
- steam flow rate,
- water seal integrity, and
- video monitoring.

Tanks: Studies by TCEQ as well as other studies using LIDAR have found tank emissions to be underreported by factors of 10 or more.[xxii]

Recommendations: Facilities should reduce emissions from storage tanks by improving inspections for and repairs of leaks, and by using closed vent systems for tanks with excessive toxic emissions.

- ***Inspections and Passive Optical Gas Imaging:*** All floating roof tanks and seals should be visually inspected twice per year. Passive Optical Gas Imaging should be used to search for

leaks in all fixed and floating roof tanks quarterly and after any repairs. Results should be documented. If leaks are found, inspections should be conducted to determine their source and repairs made.

- ***Leak Minimization and Repair:*** Leaks from tanks storing VOC-emitting materials should be minimized to the extent possible within 24 hours. Repairs or replacement of any piping, valves, vents, seals, gaskets, or covers of roof openings with defects or visible gaps should be completed before filling an emptied and degassed tank, or within 7-days of discovery of defect. The South Coast Air Quality Management District requires such repairs within 72 hours of detection.[xxiii] Repairs should be made using the best available technologies, including the best seal systems.

- ***Gas Recovery:*** Companies should increase the number of tanks routed to vapor recovery or control devices.[xxiv] Vapor recovery systems are relatively inexpensive and their costs can often be recovered through the sale or reuse of the captured vapors.

EPA Touts Benefits of Vapor Recovery for Crude Oil Storage Tanks

"VRUs (Vapor Recovery Units) are relatively simple systems that can capture about 95% of the Btu-rich vapors for sale or for use onsite as fuel. Currently between 8,000 and 10,000 VRUs are installed in the oil production sector, with an average of four tanks connected to each VRU. Natural Gas STAR partners have generated significant savings from recovering and marketing these vapors while at the same time substantially reducing methane and HAP emissions. Partners have found that when the volume of vapors is sufficient, installing a VRU on one or multiple crude oil storage tanks can save up to $260,060 per year and payback in as little as three months."

— U.S. EPA, *Lessons Learned: Installing Vapor Recovery Units on Crude Oil Storage Tanks*, (Oct. 2003). www/epa.gov/gasstar/pdf/lessons/11_final_vap.pdf

At a minimum, the following tanks should be routed to recovery or controls: (1) all tanks with a maximum capacity of 10,000 gallons or greater and a maximum organic vapor pressure of 11 psi or greater, (2) all tanks with a maximum capacity of 40,000 gallons or greater and a maximum organic vapor pressure of 4.0 psi or greater, and (3) all tanks that are found to be chronic leakers. Control devices should have a minimum 95 percent efficiency.

Texas currently requires controls for tanks with a maximum organic vapor pressure of 11 psi or greater if: (1) those tanks store crude oil and condensate and have a maximum capacity of 40,000 gallons or greater or (2) the tanks store other liquids and have a 25,000 gallon maximum capacity.[xxv] As shown in Table 9, *Tanks Required to Route to Controls*, more stringent requirements are currently required by the Bay Area Air Quality Management District and federal regulations.

TABLE 9. TANKS REQUIRED TO ROUTE TO CONTROLS

Rule	Tank Max. Capacity (gallons)	Tank Maximum Organic Vapor Pressure (psi)	Controls
BAAQMD 8-5-301	≥ 265	≥ 11.1	Requires pressure tank or control system
40 CFR Part 61, Sub FF (61.343)	≥ 20,000 ≥ 40,000	≥ 11.1 ≥ 4	Exemption from requirement for fixed roof and closed vent systems only for tanks below these limits.
40 CFR Part 60, Sub KB (60.112(b))	≥ 20,000	≥ 11	Requires closed vent system or the equivalent.
40 CFR Part 63, Sub G (63.119(a)(2))	≥ 10,000 & ≤ 40,000 ≥ 40,000	≥ 1.9 (maximum vapor pressure of total organic HAP) ≥ 0.1 (maximum vapor pressure of total organic HAP)	Requires control, routing to fuel gas or process, or vapor balance

Wastewater: The EPA has determined that wastewater systems are the third largest source of VOC emissions at refineries nationwide.[xxvi] The City of Houston found that wastewater systems were responsible for 10 percent of benzene emissions in the ten-county Houston region.[xxvii]

Recommendations: To reduce VOC emissions from wastewater systems, facilities should:

- ***Expand control requirements:*** Current control requirements for wastewater systems should be expanded to cover additional sources as follows:
    - Any wastewater system with total annual benzene quantity from facility waste equal to or greater than 5 megagrams per year (Mg/yr) should comply with the federal Benzene Waste NESHAP. This would lower the current threshold of 10 Mg/yr.[xxviii]
    - Refineries and chemical plants in Houston should comply with TCEQ's wastewater rules without utilizing the exemptions for: (1) plants with annual VOC loading less than or equal to 10 Mg,[xxix] or (2) affected VOC waste streams for which the sum of annual VOC loading is less than or equal to 10 Mg.[xxx] In addition, sources should achieve at least a 95 percent VOC reduction when utilizing biotreatment or the alternative "90 percent overall control option."[xxxi]

- ***Improve Monitoring:*** Companies should inspect all wastewater collection and treatment facilities with Passive Optical Gas Imaging quarterly. Routine visual inspection of pea traps to ensure they are not dry should be increased to twice per week. Facilities in the Houston area in HRVOC service are currently required to inspect water seals weekly, with monitoring increased to daily if three or more inspections are failed in a 12-month period.[xxxii]

- ***Add Wastewater Components to LDAR List:*** Facilities' list of LDAR monitored components for wastewater streams should include: sewer hubs, junction boxes, hatches, and any wastewater components found to be leaking during Passive Optical Gas Imaging.

Cooling Towers: Cooling towers emit large quantities of toxics that have historically been largely unreported.[xxxiii] Investigations by TCEQ in 2002 measured VOCs from nine cooling towers totaling 2.3 million pounds per year, almost half of the 4.9 million *total* pounds per year that these facilities reported from *all* of their emission sources.[xxxiv] TCEQ has since adopted rules requiring monitoring of highly reactive VOCs in cooling towers. These rules, together with increased enforcement, appear to have been successful at reducing emissions from cooling towers and should be expanded.[xxxv]

Recommendations: To reduce VOC emissions from cooling towers, companies should expand TCEQ's current cooling tower rules to include the following.

- ***Improve Monitoring:*** Cooling tower monitoring should include speciation for all VOC

- ***Set Repair Deadlines:*** Repair of any exchanger leaks on same timeframe as HRVOC.

- ***Use of Best Available Technologies*****:** Houston facilities should use best available technologies and management practices for reducing leaks into cooling water, including installation of redundant heat exchanger capacity, where feasible, to allow for rerouting of hot process gases when a leak occurs.

Delayed Cokers: Delayed cokers are significant sources of toxic emissions that are not included in emission inventories. The Alberta DIAL Study found that the delayed cokers are the single largest source of refinery benzene emissions.[xxxvi] Yet U.S. refineries do not report fugitive emissions of VOC or benzene from the delayed coking process.[xxxvii]

Recommendations: Houston petrochemical facilities should, at a minimum, take the following steps to reduce toxic emissions from cokers:

- ***Improved Monitoring:*** Coker emissions, including VOC and benzene emissions, should be monitored during drilling. Drilling is part of the coking process during which pressure water jets are used to fracture the coke bed in a drum and allow it to fall into the receiving area.

- ***Best Available Technologies and Practices:*** All new or modified coke drum unheading areas and coke handling areas should be enclosed and vented to a blowdown system. Conoco has installed an enclosed blowdown and coke handling system for a Billings, Montana refinery and

has designed totally enclosed systems for California and German refineries, including the Tesoro Refinery in Martinez, California.[xxxviii]

For existing systems, gases, including gases from blowdown systems, should be routed to fuel gas recovery systems. Facilities should develop coker operational plans for minimizing the accumulation of gases in the coke drum, and cokers should be de-pressured, via a blowdown system, to 2 psig before venting. Depressurization to 2 psig before venting is currently required at a California refinery and has been recommended by SCAQMD for inclusion in the Refinery NSPS.[xxxix]

Increase Monitoring and Verify the Accuracy of Emission Estimates

Continuing to rely on inaccurate and outdated emission factors in order to estimate emissions is unacceptable. Where continuous monitoring of actual emissions is possible, industry should use such monitoring. Where it is not, companies should verify the accuracy of emission calculations at least every two years, using ambient monitoring technologies that permit site-specific emission estimates. Several such technologies are available, including:

- **Differential Absorption Light Detection and Ranging (DIAL) –** These systems are used extensively in Europe and are being used in Canada. The systems use ultraviolet and infrared lasers to measure pollutants, including criteria pollutant, light aromatics, methane and total hydrocarbons. The DIAL system has been validated in European studies for hydrocarbon emissions and its results, while generally found to be conservative, have proven more accurate than prior estimates based on emission factors.

- **Solar Occultation Flux (SOF) –** These systems can quantify pollutants, much like the DIAL system, and are used in Sweden to monitor whole plant emissions. SOF systems are less expensive than DIAL, but they are dependent on high sun and steady winds.

If monitoring results based on technologies like DIAL and SOF differ from emission calculations, companies should work with TCEQ to determine why, and should amend past emission reports to reflect accurate emission levels.

II. Mobile Sources:

Port of Houston

The TCEQ should support the development of a Port of Houston Clean Air Action Plan that seeks to minimize emissions from ships, cargo handling equipment, on-road drayage trucks, and port-related rail.

Clean contracting

The TCEQ should work with local governments to adopt policies and programs to increase the number of clean construction machines used on public works projects.

Incentives to Encourage Less Single Occupant Driving

The TCEQ should work with local governments in the HGB area, in concert with the Houston Galveston Area Council, to consider a series of innovative measures to improve mobility, reduce congestion and curb air emissions. These recommendations offer choices and incentives to drivers – they are not mandates. Most of these incentive-based approaches could result in substantial shifts in travel behavior and pollution reductions in the span of a year or two with concerted marketing, promotions, demonstrations, and adequate incentives for their rapid adoption. HGAC commissioned a review of some of these strategies which showed the potential to significantly reduce smog-forming emissions in the region. A summary from HGAC's contractor UrbanTrans is attached (Attachment 6).

Simply asking people to drive less because it's the right thing has not proved to be a viable approach to reducing either air pollution or traffic congestion. On the other hand, there is substantial empirical evidence that people are likely to change their driving habits if there is a financial stake. We believe there are a number of tangible ways to give drivers incentives that will measurably affect their travel choices.

Because these strategies can be implemented quickly, they can begin to have measurable effects on regional congestion and mobility sooner than building new or expanding existing roads. Substantial shifts in travel behavior and pollution reductions in the span of a year or two are achievable with concerted marketing, promotions, demonstrations, and incentives for rapid adoption of our incentive-based approaches. This contrasts sharply with the much longer time horizon for the development of conventional road projects. Our incentive-based strategies also reduce emissions of carbon dioxide at no additional cost.

Pay-As-You-Drive Insurance. The TCEQ and the Department of Insurance should adopt rules and.or identify any necessary legislation to create and implement a pay-as-you-drive system that includes pay-as-you-drive insurance. When automobile insurance premiums are converted to mileage-based charges, instead of the standard term-based system, motorists can save money by combining trips and driving less. Studies have estimated that mileage-based car insurance could, at no cost to the public sector, produce substantial consumer cost-savings and reduce air pollution and traffic congestion by 10 percent or more. The 2001 Texas legislature authorized insurers to offers this innovative pricing option but none did so. The NCTCOG is completing a multi-year pilot with Progressive Insurance.

Pre-Tax Transit Benefits. The City of Houston and other local governments should offer all of its own employees the ability to set aside some of their income, before taxes, to pay for mass transit passes. Specifically, as authorized under federal tax law, employees should be allowed to exchange up to the maximum amount of $1,200 per year ($100 per month) in taxable compensation for a tax-free transit pass or vanpool voucher. Because this pre-tax deduction is treated as a benefit and not as taxable salary, employers pay no federal payroll taxes or other payroll-related costs on the deduction. Public and private employers would save federal income and payroll taxes on the benefit amount since the pre-tax deduction is no longer treated or reported as taxable salary (savings of more than $300

annually at the 28% tax bracket). Experience at other places indicated that as many as 3% of the daily commute trips taken by all the employees at a workplace offering this benefit may be eliminated.

Parking Cash-Out. Under a parking cash-out program, an employer gives employees a choice to keep a free or partially subsidized parking space at work, or to accept a cash payment and give up the parking space. Given the option to take cash instead of the parking space, many employees will take the cash and choose to carpool, take transit, or walk or bike to work. Experience of firms show that when they have implemented parking cash-out programs 1 out of 8 take the cash and find another way to get to work. The City of Houston and other local governments could begin facilitating implementation of parking cash-out by requiring parking costs to be unbundled from commercial and office building leases. For example, the City of Bellevue, Washington, requires the owner of any new downtown office building greater than 50,000 square feet to identify parking costs as a separate line item and charge a minimum rate for monthly long-term parking. Tenants are still free to lease parking and give it away to their employees for free, but if they want to cash out parking, their lease won't stand in the way. Local governments should use parking cash out where appropriate with its own employees.

Location-Efficient Mortgages. The City of Houston and other local governments should encourage lending institutions to offer "Location-Efficient Mortgages" that reward homebuyers for locating in areas that minimize travel requirements. Location efficient mortgages, by adjusting the qualifying standards to reflect the actual savings from commuting shorter distances, provide another incentive to reduce VMT and related pollution without any additional costs.

Incentives for Businesses Locating Near Mass Transit. Although the increased use of mass transit can reduce vehicle miles traveled and pollution, it is not commonly used by many in the state. One reason why mass transit is used infrequently in Texas is that it is not a convenient option for commuting to work. The City of Houston and other local governments could offer property tax breaks and other financial incentives to businesses that locate close to mass transit stations. Such transit oriented development can also help solve the "chicken or the egg" problem from which mass transit in Texas suffers (people will only ride mass transit if it is convenient, but it is hard to justify the cost of a comprehensive transit infrastructure, without a large number of regular transit riders).

Congestion Pricing. Another promising option for curbing traffic and emissions growth while enhancing mobility is variable time-of-day tolls, commonly called congestion pricing. Congestion pricing gives a discount for toll payers who avoid rush hours and charges a premium in the time of most concentrated demand, just like movie theaters and cell phone service. This helps reduce congestion by moving some of the peak traffic to other times of day. New electronic toll technology means motorists don't need to slow down to pay tolls. Toll revenues support better transit and regional transportation infrastructure and services. The NJ Turnpike, NY Thruway Authority, and other tolling agencies have implemented time-of-day tolls to manage traffic.

High Occupancy Toll (HOT) lanes. A companion strategy to congestion pricing is High Occupancy Toll (HOT) lanes, which allow solo drivers to pay to use High Occupancy Vehicle (HOV) lanes, while giving a free ride to buses, vans, and sometimes carpools. These can put to work unused capacity in HOV lanes and help pay for expanded transit and shared ride services. A network of HOT lanes on existing highways is likely to provide more effective congestion relief than building new roads. New

outer beltway toll roads are likely to bring more sprawl and put more jobs out of reach for those without cars, hurting the poor and the environment. Why not instead give time-stressed travelers a way to buy relief from growing congestion delays in existing freeway corridors and finance better transit?

Smart Growth. This catch-all term means transit-oriented (not just transit proximate) development that is attractive for walking and cycling, includes a vibrant mix of land uses for various income groups, and highly attractive non-automobile access to other parts of the metropolitan area. It includes pricing policies and incentives that favor transit, walking, bicycling, and alternatives to driving while curbing subsidies for driving. Smart Growth transportation pricing and urban design incentives, such as Commuter Choice programs where employers pay for transit benefits and offer cash-in-lieu-of-parking benefits can produce substantial shifts in travel behavior and pollution reductions in the span of a year or two, with concerted marketing, promotions, demonstrations, and incentives for rapid adoption of Smart Growth changes.

We appreciate the opportunity to provide these comments and look forward to working with the TCEQ on the development of the next SIP. If you have any questions about these comments, please contact Ramón Alvarez at 512-691-3408.

Sincerely,

//s//

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i Data from TCEQ's 2004 Point Source Emission Inventory. Industry reports emissions to the inventory and describes the units responsible for such emissions. There is not, however, a uniform classification system for describing emissions units. For example, one facility may describe emissions from a wastewater pond as wastewater system emissions, while another facility may describe them as fugitives.

ii EPA has identified cokers as one of the largest sources of refinery benzene emissions, pursuant to LIDAR studies. Coker toxic emissions are not, however, reflected in the state data. U.S. EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from Petroleum Refining Industry* (July 27, 2007), p. 4-5.

iii EPA Enforcement Alert, *Proper Monitoring Essential to Reducing 'Fugitive Emissions' Under Leak Detection and Repair Programs* (Oct. 1999).

iv http://www.epa.gov//compliance/resources/publications/assistance/ldarguide.pdf.

v SCAQMD Rule 1173(g)(2) requires replacement with best available controls or best available retrofit technology, or venting to a control device, for any component that has been subject to five repair actions within 12-months for: (1) a light liquid leak greater than three drops per minute, (2) a leak greater than 10,000 ppm, or (3) a leak greater than 200 ppm for an atmospheric pressure relief device. SCAQMD Rule 1173(h)(6) applies to refineries with a throughput greater than 20,000 barrels per day and requires the routing of pressure relief devices to controls under the conditions listed.

vi EPA, VOC Fugitive Loses: *New Monitors, Emission Losses, and Potential Policy Gaps* (2006 International Workshop, Oct 25-27, 2006), pp. 19-22.

vii SCAQMD, *Evaluation Report on Emissions from Flaring Operations at Refineries* (Sept. 3, 2004) p. 2, Table 1.

viii EPA *Enforcement Alert*, Volume 3, Number 9 (October 2000).

ix 72 Fed.Reg. 27178, 27195 (May 14, 2007)(noting flare gas recovery can eliminate all routine flaring). EPA Enforcement Alert, Frequent, *Routine Flaring May Cause Excessive, Uncontrolled Sulfur Dioxide Releases* (October 2000).

x BAAQMD Regulation 12, Rule 12; SCAQMD Rule 1118; MARAMA Model Rule for Petroleum Refinery Flares, Env-A xxx.03(a)(3).

xi BAAQMD Rule 12-12-301 and 12-12-401.

xii BAAQMD, *Staff Report, Proposed Regulation, Regulation 12, Miscellaneous Standards of Performance, Rule 12, Flares at Petroleum Refineries* (July 8, 2005) p. 1.

xiii SCAQMD Rule 1118.

xiv SCAQMD, *Final Environmental Assessment for Proposed Amended Rule 1118* (Oct. 2005), Table 1-3.

xv http://www.valero.com/Environment/EnvironmentalStewardship.htm.

xvi SCAQMD Rule 1118(c)(2); BAAQMD Rule 12-12-401; and 72 Fed.Reg. 27178, 27182 (May 14, 2007)(proposing flare minimization plans for startup, shutdown, malfunction events).

xvii SCAQMD Rule 1118(c)(1)(D) and (e); BAAQMD Rule 12-12-406.

xviii See, for example, *U.S. v. ExxonMobil Corporation*, Consent Decree p. 80. *See also*, U.S. EPA, *EPA Enforcement: National Petroleum Refinery Initiative* (EPA-HQ-OAR-2007-0011-0112).

xix SCAQMD requires root cause analyses for events, other than planned shutdowns, startups or turnarounds, resulting in 100 pounds or more of VOCs or for any event resulting in more than 5,000 standard cubic feet of vent gas combusted. SCAQMD Rule 1178(c)(1)(D) & (E).

xx Marc McDaniel, EPA-600/2-83/052, Flare Efficiency Study. Engineering Science, Inc. (July 1983), p. 1.

xxi 30 Tex. Admin. Code §115.725(d).

xxii According to the Alberta LIDAR study, VOC emissions from tanks were 30 times higher, and benzene emissions were 100 times higher, than the reported emissions calculated using emission factors. U.S. EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from Petroleum Refining Industry* (July 27, 2007) at 5-6.

xxiii SCAQMD Rule 1178(g).

xxiv For external floating roof tanks, this would require first installing a domed roof on the tank or otherwise converting it to an internal floating roof tank. See, SCAQMD Rule 1178 requiring domed roofs.

xxv 30 Tex. Admin. Code 115.112 Tables I(a) and II(a).

xxvi EPA, *Memorandum: Review of VOC Emissions Sources at Refineries* at 2, Table 1 (Dec. 14, 2005) (EPA-HQ-OAR-2007-0011-0043).

xxvii City of Houston, *Houston Regional Benzene Air Pollution Reduction: A Voluntary Plan for Major Sources* (Feb. 2007), p. 4.

xxviii 40 CFR §61.342(a).

xxix 30 Tex. Admin. Code §115.142(3) & 115.143(b).

xxx These exemptions are included at 30 Tex. Admin. Code §115.147(1) & (2).

xxxi Ninety-five percent efficiency is required by the Miscellaneous Organic NESHAP, 40 CFR Part 63, Sub FFFF, as well as by other state's rules, such as SCAQMD 1176(e)(6)(A).

xxxii 30 Tex. Admin. Code §115.781.

xxxiii U.S. EPA, *Technical Memorandum: Potential Low Bias of Reported VOC Emissions from Petroleum Refining Industry* (July 27, 2007) at 4.

xxxiv Galveston-Houston Ass'n for Smog Prevention, *Smoke in the Water* (Feb. 2004), p. 1.

xxxv Galveston-Houston Ass'n for Smog Prevention, *Cooling Off: State Investigations Show Reductions in Cooling Tower Emissions*, (Jan. 2007).

xxxvi Environment Canada, *Refinery Demonstration off Optical Technologies for Measurement of Fugitive Emissions and for Leak Detection*, (Nov. 1, 2006), p. 13.

xxxvii EPA, "Memorandum: Review of VOC Emissions Sources at Refineries" at 2, Table 1 (Dec. 14, 2005) (EPA-HQ-OAR-2007-0011-0043), at 4-5.

xxxviii Ehrhardt, Franz, *Delayed Coking, an Attractive Alternative*. www.casaconsulting.com/events/speeches/MOGC.doc.

xxxix Letter from Mohsen Nazemi, SCAQMD, *Subject: proposed New Source Performance Standard for Petroleum Refineries in 40 CFR part 60, Subpart Ja [Docket ID No. EPA-HQ-OAR-2007-0011]* (Aug. 24, 2007).

Transportation Mobility Measures
Summary of Findings

November 2003

This technical memorandum identifies the Transportation Mobility Measures (TMMs) that were examined by UrbanTrans Consultants, EarthMatters, Wilbur Smith Associates, and Environ throughout the course of 2003 for a working group facilitated by the Houston - Galveston Area Council. Each of the TMMs are detailed more substantially within their own TMM reports.

1. Mileage-based Vehicle Insurance Programs 1
2. Mileage-based Vehicle Registration Fees 2
3. Emissions-based Vehicle Registration Fees 3
4. Bus Service and Park-and-Ride Increases 4
5. Tax Incentives for VMT Reduction 6
6. Congestion Pricing and Toll Options 7
7. Parking Cash Out 9

1. Mileage-based Vehicle Insurance Programs

Description:

Mileage-based vehicle insurance programs permit drivers to pay their comprehensive coverage premiums on a variable scale, dependent upon how much they drive each vehicle. Tied directly to vehicle miles traveled, a mileage-based vehicle insurance program can be flat (per mile), include an initial lump sum (generally to cover administrative costs) plus the flat per-mile fee, or feature a dynamic element that rewards low-VMT users over high-VMT users.

Purpose:

Mileage-based vehicle insurance programs may serve to accomplish two objectives: 1) the reduction in overall vehicular use, and 2) greater cost-balance on a per trip basis with other modes of travel. Traditional vehicle insurance premiums are established as an upfront, fixed cost. Whether the insured drives one mile or one thousand miles in any given month, he or she will pay the same amount of insurance. With a mileage-based insurance program, insured drivers will have a cost-based incentive to reduce unnecessary vehicular travel because their insurance cost will be lowered if they drive less. This will have the effect of reducing VMT, which in turn, yields positive air quality and safety benefits. This is likely to produce net positive equity benefits for low and moderate income individuals.

Estimate of Benefits:

In the short term, VMT could be reduced by a factor of 7.9 to 9.7 percent, if 100 percent of drivers participated in the program. This would result in a maximum of 4.18 tons per day of NOx and 4.91 tons per day of VOC (at the 9.7 percent VMT reduction). In the longer term, twice these reductions could be achieved, as individuals' response to price changes generally become more pronounced the longer the change is in effect. The high estimate is based on VMT changes occurring as a result of cents per mile charges developed by Harvey and Deakin (1997) and updated by Littman (2001). The lower estimate is based on a hypothetical scenario using a price elasticity of 0.3. Interestingly, the methods yielded nearly identical results for an elasticity of 0.4.

Estimated VMT, NOx and VOC Reductions Possible For A Range of Participation Rates Using a "Cent-per-Mile" charge approach (2007)

Participation (percent of drivers)	VMT Reduction	NOx Reduction (tons per day)	VOC Reduction (tons per day)
10	792,282	0.42	0.49
25	1,980,705	1.04	1.23
50	3,961,410	2.09	2.45
100	7,922,820	4.18	4.91

2. Mileage-based Vehicle Registration Fees

Description:

Similar to mileage-based insurance programs, mileage based registration fees permit drivers to pay their vehicle registration fees on a variable scale, dependent upon how much they drive each vehicle. Using odometer readings, state and local authorities price the annual vehicle registration fee according to the miles driven or predicted to be driven in the coming year. Mileage based registration fees can be assessed to new or existing registrations, or, can be used to award low-mileage users. More complex programs could establish different mileage fees based upon time of day (higher during congested periods). Finally, mileage based vehicle registration programs can be either revenue-neutral or revenue-generating in nature.

Purpose:

Mileage-based vehicle registration programs may serve to accomplish two objectives: 1) the reduction in overall vehicular use, and 2) create greater cost-balance with other modes of travel. As with other price-based programs, there is an inherent incentive to avoid unnecessary travel, which reduces overall VMT. A typical mileage-based registration program would only charge per mile based upon an occasional audit of the vehicle's mileage, foregoing any of the more complicated measures involving time-of-day. These audits can be carried out through a

variety of means, including official reporting as a part of vehicle servicing. Overall, reducing VMT through such a program would yield positive air quality benefits.

Estimate of Benefits:

According to the Texas Department of Transportation Schedule of Texas Registration Fees, fees range from $40.80 (for 1997 and older vehicles) to $58.80 (for vehicles 2001 and later). This yields a per mile fee of less than one cent per mile. The lowest per mile fee that has been documented is 1 cent per mile (Harvey and Deakin, 1997 as quoted by Littman, 2003). Such a fee is estimated to result in a 1.8 percent reduction in VMT. This estimate was based upon transportation modeling in California and is not directly applicable to Texas because California per mile registration charges are much higher than those in Texas and therefore mileage or emission based programs in Texas should not be expected to have benefits of the same magnitude. For the purpose of evaluating a rough approximation for Texas, a ½ cent per mile charge would result in half the benefit as modeled by Harvey and Deakin. This indicates a maximum 0.9 percent reduction in VMT from light duty vehicles could be achieved by the program, assuming the fee structure of ½ cent per mile roughly approximates the current fee structure for registration. If Houston area residents and voters approved a fee structure that was larger (such that the average registration fee rose to 0.75 cents per mile), then an approximate 1.35 percent VMT reduction would be realized.

Rough Approximation of Emission Reductions for a Hypothetical Mileage-Based Registration Fee Program

Average Emission Fee	VMT Reduction	VOC Reduction (tons per day)	NOx Reduction (tons per day)
0.5 cents per mile	735,107	0.46	0.42
0.75	1,102,661	0.69	0.63

3. Emissions-based Vehicle Registration Fees

Description:

Emissions-based vehicle registration fees provide a cost incentive for owning low-polluting vehicles. Existing vehicle registration fees are based primarily upon age of automobile – the older the vehicle, the less the fee. Under an emissions-based fee program, vehicles with greater pollutant emissions will be subject to higher proportional fees than vehicles with lower emissions rates. Emissions-based fees can be applied differently, based upon vehicle class, typical use, or geographic location.

The most common form of this measure that has been evaluated is to apply fees based upon the average emission factor for a particular model year, vehicle type and technology. The other form of the measure would involve actual on-board measurement of emissions which is technically more difficult and far more costly but would result in lowering the amount of driving by the most grossly emitting vehicles.

Purpose:

The purpose of an emissions-based registration fee program is to create a cost-based incentive for purchasing more emission-efficient vehicles as opposed to less efficient vehicles. Greater emission efficiency would have the effect of reducing overall air-based pollutants, independent of change in VMT. Incidentally, Inherently Low Emitting Vehicles (ILEV), Zero Emission Vehicles (ZEV) and Ultra Low Emitting Vehicles (ULEV) traditionally have access to other special incentives, including admission to certain HOV lanes, as permitted by Federal code. This provides yet another incentive to compound upon the cost incentives.

According to EPA (EPA, 1997), emission fees can trigger a change in vehicle ownership if the fees caused a significant increase in the costs of vehicle ownership. However the fees are expected to have their primary effect on vehicle mix. Households would be expected to either replace high emitting vehicles with cleaner ones and/or shift use within multi vehicle households to lower emitting vehicles.

Estimate of Benefits:

The methodology for calculating the benefits of emissions-based registration fees are identical to the methodology utilized for the mileage-based program, described above. For the sake of brevity, the assumptions and method for calculating benefits are not repeated here.

Rough Approximation of Emission Reductions for a Hypothetical Emission-Based Registration Fee Program

Average Emission Fee	VMT Reduction	VOC Reduction (tons per day)	NOx Reduction (tons per day)
0.5 cents per mile	735,107	0.46	0.42
0.75	1,102,661	0.69	0.63

4. Bus Service and Park-and-Ride Increases

Description:

Increasing the level of bus service and park-and-rides in select corridors can help encourage greater use of transit for trip making needs. Additional buses can help access alternative areas of the Houston metropolitan area, thereby reducing the necessary number of transfers for trip origin / destination pairs. Furthermore, additional buses can increase the frequency of service, even to the point of being “schedule-less” service from the perspective of the consumer. Park and ride lots enable drivers to make a choice regarding their trips – park at work or park at the station.

Purpose:

Transportation Mobility Measures

Summary of Findings

The Houston METRO comprehensive regional systems planning effort provided a vision of the desired level of bus service and park and rides to be constructed in the metropolitan area. The purpose of this TMM strategy is to assess the incremental impact of additional investments in regional public transportation infrastructure and services. Greater access to alternative route pairs, increased frequency of service, and improved parking alternatives all can contribute to reduced total vehicular trips in the metropolitan area, particularly peak period trips, which altogether improves air quality.

Estimate of Benefits:

The following chart presents a summary of the cumulative investment costs of the growth plan, versus a "no-build" scenario, and the forecast ridership impacts of these investments. This analysis is conducted only for the purpose of this comparative analysis of multiple TMMs, and is not suited for, or intended as, an in-depth analysis of regional transit programs.

Regional Transit Growth Plan Costs and Forecast Ridership Impacts

YEAR	DAILY LINKED TRANSIT TRIPS		ANNUAL LINKED TRANSIT TRIPS	
	No Build	Growth Plan	No Build	Growth Plan
2002	252,634	252,634	69,474,350	69,474,350
↓	↓	↓	↓	↓
2025	342,800	466,900	94,270,000	128,397,500
2002 - 2025 Totals	**7,145,208**	**8,634,408**	**1,964,932,200**	**2,374,462,200**
Cumulative New Riders (linked trips)		1,489,200		409,530,000

GROWTH PLAN TOTALS (2002 - 2025)	
New Rider Linked Transit Trips	409,530,000
Growth Plan Cost	$ 3,779,000,000
Cost Per New Linked Transit Trip	$ 9.23

The assessment above presents averaged totals over the entire 24-year span of the transit growth plan, both in terms of investment costs and forecast ridership impacts. This analysis does not take into account a variety of complex factors which influence transit ridership on a year-to-year basis. Nonetheless, the analysis does allow for a useful assessment of the potential impact of incremental increases in regional transit infrastructure and service levels. Using the basic factors developed through existing regional transit growth plan, the following table presents the potential annual impact of EACH ADDITIONAL $10 MILLION invested in regional transit infrastructure and services. These factors allow for application of varying investment dollar values.

ANNUAL IMPACTS OF ADDITIONAL REGIONAL TRANSIT ENHANCEMENTS

PER ANNUAL ADDITIONAL INVESTMENT OF:	$10 Million
New Rider Linked Trips Per Year	1,085,000
New Rider Linked Trips Per Day	4,000
Houston Average Trip Length (miles)	13.3
Daily VMT Reduction	52,000
VOC Reduced (tons per day)	0.030
Nox Reduced (tons per day)	0.075
CO Reduced (tons per day)	0.482

5. Tax Incentives for VMT Reduction

Description:

These measures utilize tailored tax policies to create financial incentives for individuals and private-sector entities to pursue actions which reduce vehicle miles traveled. The types of tax incentives employed can vary based on the prevailing tax environment and the intended outcome. Examples of available options include: exempting specific items or groups from tax liability, tailoring tax rates for specific items or specific groups, allowing specific expenses to be deducted from overall tax liability, and providing tax credits for certain actions. Tax policies would be designed to stimulate employer subsidization of employee transit use, employer adoption of telework, land use development in transit corridors, and incentives for residing near one's place of employment.

Purpose:

The purpose of implementing one or more of these tax incentives is to stimulate individuals and private-sector entities to pursue actions which reduce vehicle miles traveled. Tailored tax policies adjust market dynamics to improve the financial benefits of pursuing a specific course of action. In some cases, tax incentives are designed to compensate for additional expenses which may be incurred through a specific action (i.e., tax incentives designed to off-set the higher cost of alternative fuel vehicle programs). The four tax incentive programs outlined above are designed to increase transit use among commuters, eliminate trips through telework programs, and reduce the overall demand for travel by altering the location of trip origins and destinations. Each of these programs is designed to reduce vehicle miles traveled, which reduces emissions and positively impacts air quality.

Estimate of Benefits:

In order to estimate the benefits of a program such as tax incentives, it would be necessary to quantify several variables, most of which were not a component of this analysis. In addition, a tax incentive program does not and would not operate in isolation from other programs used to implement Commute Solutions. However, for the sake of determining the type of benefit that might be possible, a hypothetical analysis was conducted that assumed that a tax incentive

program were implemented such that an additional one percent of employees began using alternative modes on a regular basis as a result of the program. Key assumptions included using the 2007 employment base, with 66% of employees working at companies of over 100 employees, and that one percent of these employees participated in alternative modes once per week. These assumptions yielded the following results.

Program	VMT Reduction	VOC Reduction (tons per day)	NOx Reduction (tons per day)
1% increase in alt mode use	167,140	0.104	0.096

6. Congestion Pricing and Toll Options

Transportation planners and economists have identified the ability to use tolls as a means of managing the demand for public facilities relative to that of their capacities. This concept, known as “congestion pricing” or ”value pricing”, offers substantial variation in terms of implementation, however the concept remains the same - using tolls to manage demand.

For the purpose of this analysis for the Houston area, two specific applications of congestion pricing were examined. These are:

1. Variable pricing on existing and new toll roads
2. Managed lane / High Occupancy Toll (HOT) policies on highway system

Variable Pricing

Description:

On variable priced toll roads, toll rates are structured such that higher prices are assessed based either upon time of day concurrent with typical periods of congestion (a “Fixed Variable Rate Schedule”) or upon actual levels of congestion (a “Dynamically Priced Schedule”). Despite the nature of the program, tollway users will experience higher charges during the peak periods and lesser charges during off-peak or shoulder periods.

Purpose:

The effect of variable pricing on the toll facilities is to: 1) help divert some traffic from the peak period to the shoulders of the peak period, and, 2) provide a cost-based encouragement for the use of transportation options (such as transit and ridesharing). Shifts to either off-peak periods or other transportation options will likely reduce the overall congestion on the facility, and, reduce the need for additional capacity on the toll facilities. Both elements have positive air quality benefits.

Estimate of Benefits:

The purpose of this analysis was to identify the "best case" scenario for offering discount use of toll facilities to multi-occupant vehicles (HOV2+), whereby HOV2+ vehicles receive free use of the facility. The intent was to assess whether the financial incentive could cause either a reduction in VMT through more efficient routing and/or a modal shift from single occupant vehicles (SOV) to HOV2+. Using the regional transportation model, the following benefits were estimated:

Changes in Travel Activity and Emissions for the HOV 2-Plus Scenario

Category	Change (reduction)
Vehicle Miles Traveled (per day)	366,952
Vehicle Hours of Travel (per day)	8,799
VOC (tons per day)	0.212
NOx (tons per day)	0.525
CO (tons per day)	3.38

Managed Lanes

Description:

Managed Lanes (also known as High Occupancy / Toll lanes) policies use price controls as a means of maximizing the available existing capacity in a corridor. The policies permit the use of a facility for vehicles that either meet a predetermined vehicle classification (such as a three-person carpool or vanpool) or agree to pay a toll. A typical Managed Lane facility will charge lower-occupancy vehicles a toll, while allowing higher-occupancy vehicles to pass without paying a toll or at a discounted rate. Managed Lanes policies can be applied to either existing lanes or new lanes of capacity, and, can use either a Fixed Rate Variable Schedule or a Dynamically Priced Schedule.

More recently, managed lanes are discussed side-by-side with the implementation of Bus Rapid Transit (BRT). Altogether, the terms "managed lanes", "HOT lanes", and "BRT-supporting facilities" will be used interchangeably to imply any exclusive facility that provides a travel time incentive to those who use multi-occupant vehicles and/or pricing of lower occupancy vehicles. Additionally, these terms will assume that the highest-occupancy vehicle also has the highest priority for use of the facility. This prioritization cascades from buses, to vanpools, multi-person carpools, two-person carpools, single-occupant alternative fuel vehicles, and single-occupant vehicles (in that order).

Purpose:

Typically, toll policies are applied to High Occupancy Vehicle (HOV) lanes as a means of better utilizing excess, unused capacity during peak periods. In this example, a single-occupant vehicle may be charged a fee for use, however a three-person carpool would continue to use the facility for free. The actual toll rate should be set such that the level of service for buses and higher-occupancy vehicles does not degrade on the facility.

Managed Lanes toll policies need not only be applied to existing and planned HOV lanes. Other lanes of traffic can also feature a managed approach, including truck lanes, express lanes, and frontage roads. Each application is unique to the intended corridor, and as such, the benefits of Managed Lanes policies may differ. Finally, the use of revenues is a key consideration. On many HOT facilities, a small amount of excess revenue is generated from the use of toll policies. These revenues can be used to augment the corridor's existing rideshare or transit service, thereby enhancing the availability of transportation options at no additional cost to local government. Examples of these service enhancements include vanpools, buses, transit-based facility improvements (such as BRT stations, connecting facilities on arterials, and bike/ped accessibility), and carpool incentives. Air quality benefits stem from 1) reduced hot-spot and stalled-traffic emissions, and, 2) greater availability and encouragement of ridesharing and transit.

Estimate of Benefits:

Three corridors with existing HOV 2+ facilities were identified in Section Two as providing a "medium" level of candidacy for conversion to managed lanes – I-45 North, I-45 South, and US 59 South. Managed lanes on these facilities, as examined, provide additional capacity for carpoolers that would otherwise be excluded from the facility due to overcrowding by HOV-2 vehicles. Two additional facilities, I-10 West and U.S. 290 already feature managed lanes, known as "QuickRide". The air quality benefits from managed lanes, specifically on U.S. 290, for regional application, is currently being modeled by H-GAC and unavailable at the time of this writing.

7. Parking Cash Out

Description:

Parking Cash Out is an employee transportation benefit that offers workers the option of giving up their employer provided parking space in exchange for its equivalent monetary value. Parking Cash Out gives employees the choice to take home the equivalent of their hidden parking subsidy in cash; to use the cash out to pay for commuting by alternate methods such as public transportation or vanpools; or to continue to commute in a single occupancy vehicle while assuming the responsibility for parking options.

Purpose:

Parking management is a powerful demand management tool in influencing mode choice. Free parking at the workplace is a significant factor in encouraging drive alone commuting. Few employers allow employees to apply the monthly value of the parking space to another alternative or to simply keep the cash equivalent. This concept, parking cash out, offers a win-win opportunity in minimizing the financial impact to the employer while giving employees more options in selecting their preferred travel option – and thus, assign the employer investment toward that desired travel mode. Parking cash out alone can increase alternative mode use by more than 10 percent where convenient travel options are available. A related concept,

transportation allowance, moves beyond flexing paid parking to simply providing employees a flat fee each month for transportation. If the employee wants a parking space, they need to use the allowance to pay for it or they can use the allowance on a transit pass, vanpool seat or walking shoes if they want to walk to work. Widespread adoption of parking cash out can be greatly facilitated by introduction of a parking impact fee or excise tax on employer-provided free parking, with a waiver of the fee or tax for employers who offer an allowance or cash-in-lieu-of-parking benefit of equivalent value to the "free" parking

Estimate of Benefits:

The barriers towards implementing a parking cash out program regionally are substantial, and difficult to quantify. These barriers include:

- Bundling of parking in lease agreements is common practice
- Parking is free in most areas excluding downtown, Galleria, Texas Medical Center and a few other locations
- Parking supply is over 3 spaces per 1,000 square feet in all areas other than downtown and most forms of zoning do not exist as a tool to control aspects of new development
- Transit services are limited due to the expansive, moderate to low density development patterns throughout the region. Additionally, few areas outside of Harris County have extensive transit services available.

Influencing one of these barriers may affect a variety of travel options, thereby making the isolation of benefits accruing to parking cash out difficult. Furthermore, it is likely that many individuals will continue to drive to work, but will park elsewhere. Understanding the percentage of such cannot be accomplished using existing models.

In order to quantify benefits for parking cash out, the project team used a similar approach and methodology from the tax incentives TMM. Key assumptions included using the 2007 employment base, with 66% of employees working at companies of over 100 employees, and that one percent of these employees participated in parking cash out on an ongoing basis (every working day per week) and converted to alternative modes. These assumptions yielded the following results.

Program	VMT Reduction	VOC Reduction (tons per day)	NOx Reduction (tons per day)
1% use of parking cash out	835,700	0.520	0.480